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E-Mobility Boundaries and Re-Organizing Supply Networks in the Automobile Industry

Introduction

The trend towards electric mobility (E-mobility) is an ongoing trend, which offers the potential to reshape the future of mobility within the urban-ecosystem. In essence, to make mobility or transport more sustainably focused and protective of delicate "human" and "natural ecological" sub-systems (i.e. green spaces, wildlife). It forms a vital component of emerging sustainability blueprints on "blue" and "green" infrastructural initiatives. For instance, one of the few benefits of the Covid-19 crisis is the improvement in air quality being reported in urban areas. As lockdown initiatives have led to much lower emissions. Indeed, numerous commentators and sustainable development agencies such as the UN one could argue are likely to push governments to speed up their transition to electric vehicles. With the promotion of "low" rather than "high" emission route to economic growth. Given the social and ecological benefits we are currently observing with wildlife, and ironically, the associated improvements in children's and adult's health being experienced with respiratory conditions such as Asthma.

In this paper, electric mobility is considered as a central strategic objective of the smart city. Therefore, when we discuss the very broad concept of the smart city, we are particularly focused on this one element. Electric mobility, according to the definition of the German government and the National Development Plan for Electric Mobility (NEP) comprises: *"*... all street vehicles that are powered by an electric motor and primarily get their energy from the power grid – in other words: can be recharged externally" (Fraunhofer, 2020, p. 1). This includes purely electric vehicles, vehicles with a combination of electric motor and a small combustion engine (range extended electric vehicles – REEV) and hybrid vehicles that can be recharge via the power grid (plug-in hybrid electric vehicles – PHEV).

This research focuses on smart city (electric) mobility rather than transportation. The focus of the study is on "mobility" rather than "transportation"- an ontology of "access" as opposed to "physical movement". Whilst transportation scholars focus on the physical movement of objects including people and goods to get from A to B. Mobility is a broader social concept focused on access. Mobility is having transportation options that you can count on to get you where you need to go.

Without mobility, transportation becomes meaningless. The COVID-19 crisis is bringing to the fore not only issues of accessibility around cities but also threatening issues of safety and the risks of infection. Arteries of the city such as the tube, trams, buses, shred car services, taxis, Uber and rail services in major cities such as London, Manchester, Cardiff etc are potentially major threats to the spread of the disease. As you have problems with social distancing and hight population density in confined spaces.

This is providing city authorities with unique problems of managing a highly complex mobility operation, involving several phases of operational planning, probably spread over several months with a focus no longer on cost and customer satisfaction, but now a need to prioritise the protection of the safety, health and wellbeing of passengers and also of their workforce.

Furthermore, it is putting even more pressure on private automobile and vehicle manufacturers to transform themselves into digital service organizations. To assist with city planning and strategically providing data sharing services and working to reduce the threat of disease spread. Through modelling how safer movement and interaction can take place within the city boundaries. Such services could include providing data where none currently exists and the enablement of focussed safety management by transport providers, councils and automobile businesses through the encouragement and planning of risk averse strategies.

One possible solution being proposed by parliamentary agencies such as POST (the Parliamentary Office of Science and Technology) is the collaborative development of "digital city twins" to simulate the flow of people around cities to work out interactions and movements. A digital twin is a digital replica of a living or non-living physical entity. Digital twin refers to a digital replica of potential and actual physical assets, processes, people, places, systems and devices that can be used for various purposes (Mehomood et al., 2017). Real-time information would then be made available to passengers to enable them to move around the city as safely as possible. These would be decentralised and operate on a city basis.

According to the Fraunhofer research institute, the National Development Plan for Electric Mobility in Germany, does not just look at specific vehicles but at the overall system. Aside from electric cars, this so-called systemic approach also includes the energy supply side as well as the charging and traffic infrastructure in its definition of electric mobility. Since those

components are interconnected and together, they can theoretically lead to sustainable mobility. Such a plan is being replicated in many other countries, both developed and emerging (Fraunhofer, 2020). One thing that all definitions have in common is the narrow interpretation of the term electric vehicles, which is based on the idea of electricity as "fuel" (Bohnsack et al., 2014). With electricity offering efficiency advantages and – as long as it comes from renewable sources – a significant reduction of CO2-emissions (Robinson et al., 2014). It is suggested that electric mobility will replace conventional driving technologies and thereby have a disruptive impact on the automobile industry market and the private consumer (Casals et al., 2016). Electric mobility is also a central policy of "smart cities".

The smart city notion started appearing from the 1990s, initially as a supply-side-driven practice-orientated agenda, but it soon caught the interest of scholars working in various fields of research, including, but not limited to, engineering, computer science, public policy and administration and human geography. The mainstream smart city narrative has been, and still is, dominated by: "... a distinct focus on technology as the enabler for cities to become more instrumented, interconnected and intelligent through capturing and collecting, sharing and distributing and analysing and implementing data" (Harrison and Thiel, 2017, p. 165). However, links to "urban development" goals such as economic regeneration and "city-social*"* and "ecological" challenges such as sustainability, still remain obscure and indirect.

By its transformational character, the electric mobility trend it is suggested is blurring existing "power relations", "governance" and "co-ordination" in the supply network (Graham et al., 2019). Hence, the trend has brought in completely new industry participants, some "left of field" suppliers such as the computing and software companies with no legacy of working in the automobile sector. Within this transformational environment, the existing automobile manufacturers are under huge "social" and "economic" pressure (Di Maggio and Powell, 1983) to rethink and redefine their business model, innovation intention and supply network strategy.

This paper is a first step in our research to understand the impact of the e-mobility trend on the porous nature (i.e. "closed", "open") and type of boundary (i.e. "economic", "power", "competence" and "identity"). This study interrogates the theoretical proposition that the smart city can influence the design of network relationships both horizontally, between the smart city planners and the organization and vertically, between the organization and its suppliers. It asks at a horizontal level, what is the role of smart cities in creating new "organizational forms" and

"innovative" business models designed (for sustainability) at the boundary (between state, citizen and organization). Are automobile product manufacturers evolving towards a new form of mobility boundary organization? What is the vertical relationship between the organization and its supplier network? Is the "make" or "buy" boundary changing? If so, how is management of that boundary different to what went before. Finally, we are interested in investigating how the smart city authority is influencing future R and D, innovation strategy within the automobile organization?

We focus on developing a research framework, through a critical synthesis and interrogation of the supporting literature. We provide both a critique and then guidance on how we intend to advance and test it. Furthermore, the importance of the research for organization studies scholars is outlined together with an indication of the intended contribution of the work, to boundary management theory (Santos and Eisenhardt, 2005). In the conclusion, several research questions are proposed to guide the on-going empirical phase of the investigation.

Theoretical underpinnings and the Research Framework

The management of boundaries involves making decisions on "how" to define partner activities that integrate and interface a firm with the external environment. This approach implies the involvement of several subjects with strategic autonomy and generally affects business processes that cannot be considered fully internal nor fully external. Such management should design and manage business processes, that are "boundary spanning". Inter-boundary processes therefore are based on a broader perspective to identify new integration and coordination opportunities among firms' value chains and those of external "partners" (Boddy et al., 2000; Pil and Holweg, 2006; Porter, 1987). Santos and Eisenhardt (2005) note that: "the study of organizational boundaries offers a unique lens on how environments operate and relate to organizations" (p. 505).

Boundary management

Santos and Eisenhardt (ibid., p. 491) define the organizational boundary simply as: "the demarcation between the organization and its environment". This definition sets aside implicit assumptions that the central organizational boundary decision is the locus of a transaction, the primary logic for these decisions is exchange efficiency, and that the essence of an organization

through its boundary management is to "incentive alignment, property and decision rights, and superior monitoring" (Williamson, 1981, p. 548).

Santos and Eisenhardt (2005) propose four distinct conceptions of boundaries: "efficiency"; "power"; "competence"; and "identity". Each conception deals with a fundamental organizational issue—i.e. cost (efficiency), autonomy (power), growth (competence), and coherence (identity). Although all four conceptions make predictions for both horizontal boundaries (defined by the scope of product/markets addressed in the organizational network) and vertical boundaries (defined by the scope of activities undertaken in the industry supply network), each also provides a unique view of boundaries. These are a locus of transactions (efficiency), sphere of influence (power), resource portfolio (competence), and mind-set (identity). Thus, the conceptions are not only lenses to view the demarcation of the organization from the environment, but are also distinct reflections of the essence of internal organization.

Boundaries of efficiency

Focusing on minimizing governance costs, the efficiency conception asks whether a transaction should be governed by a market or organization. This conception is grounded in a legal understanding of organizations as governance mechanisms distinct from markets. Boundary management is best understood as an accumulation of discrete decisions based on the criterion of governance cost minimization

Organizations are assumed to have specific decision and property rights that enable the use of fiat, alignment of incentives, and monitoring of managerial actions to efficiently govern transactions (Masten, 1993). Thus, for particular transaction attributes, the costs of governing activities through markets are different from the costs of governing these activities in organizations. The central argument is that boundaries should be set at the point that minimizes the cost of governing activities (Coase, 1993). A boundary decision is, therefore, the choice of whether to conduct a particular transaction inside the organization or outside through a market exchange.

Boundaries of Power

Focusing on how organizational members control the broader set of exchange relations in which their organization is directly or indirectly involved, the power conception asks what is the appropriate sphere of organizational influence. Organizations are conceptualized as

institutions that attempt to reduce uncertainty and exercise power in order to improve performance (Thompson, 1967; Pfeffer and Salancik, 1978). The central argument is that organizational boundaries should be set at the point that maximizes strategic control over crucial external forces (Porter, 1987; Davis and Powell, 1992). Thus, with the boundaries of power the firm's strategic logic is of setting boundaries at point of maximum control over critical dependencies.

Boundaries of Competence

Focusing on how organizational members gather, exploit, and renew firm-specific, resource-based advantages (Penrose, 1959; Chandler, 1977), the competence conception asks what resources the organization should possess. The organization is conceptualized as a unique bundle of resources. Its boundary, is dynamically determined by matching organizational resources with environmental opportunities that are both attractive and amenable to the organization's using its resources. The strategic logic of setting boundaries is to maximize opportunity value of resource portfolio. A boundary decision is, thus, a choice of resources for the organizational portfolio.

Boundaries of Identity

This approach focuses on how organizational members define the organization holistically, the identity conception asks who the organization is. Organizations are conceptualized as social contexts for sensemaking (Weick, 1995). The central argument is that organizational boundaries should be set to achieve coherence between the identity of the organization and its activities. Thus, a boundary decision is a choice of "who we are". This conception of boundaries draws from two theoretical strains. One is managerial cognition, which focuses on the cognitive frames used by managers to shape their actions and interpretations of the world (Prahalad and Bettis, 1986; Walsh, 1995; Weick 1995). The other is organizational identity, which discusses the origins and role of the shared values and norms that constitute its central and distinctive character (Elsbach and Kramer, 1996). Boundary management is therefore best understood as a process of resolving inconsistencies between identity and organizational activities and markets.

In this paper, we are theoretically investigating how the nature, types and positions of boundaries are evolving and changing with the e-mobility trend. Specifically, if the types are mutually exclusive or are there combination effects on nature and position.

Research Framework

The research framework which guides this study is presented in Figure 1. The model highlights the interplay between smart city authorities and the city product supplier. There are seven elements in the model that dynamically interact together over time. Through a process of improvisation, iteration and re-iteration (i.e. t, t^1…. t^n) the organization would move from being a product supplier to a mobility service provider.

Although in the framework we introduce seven elements we focus on the three elements in the organization, the element of mobility innovation and boundary management. The concept of the smart city is extremely broad and we wanted to specifically focus on the e-mobility trend. The other elements have an influence on this trend but due to access constraints in the city organization and the direct impact their ACES policy was having on the automobile and related organizations it was evident this was the most important element to research. The elements marked in red in the framework (governance, infrastructure) are therefore not directly researched in this projected but we acknowledge they support the ability of the city authority to introduce electric mobility solutions.

City Suppliers – the Network Approach

As Ping Li (1995) reminds us: "… despite its increasing importance to the research and practice of organizational management, there is no consensus on how to describe, explain and prescribe network as an organizational form" (p. 995). As such as a type of organizational form, it has been variously described in terms of a pattern of social exchange (Burt, 1997), patterns of inter or intra firm cooperation (Miles and Snow, 1994); a special pattern of inter-firm alliance (Uzzi, 1997). Others explain it as a hybrid between market and hierarchy (Williamson, 1991), or it is explained as a unique form which reflects a paradigm shift (Ilinitch et al., 1996).

This study adopts a network approach, as we are exploring both internal and external organizational connections across two (horizontal and vertical) boundary points. For instance, at the vertical boundary point we are investigating changes in outsourcing decisions which

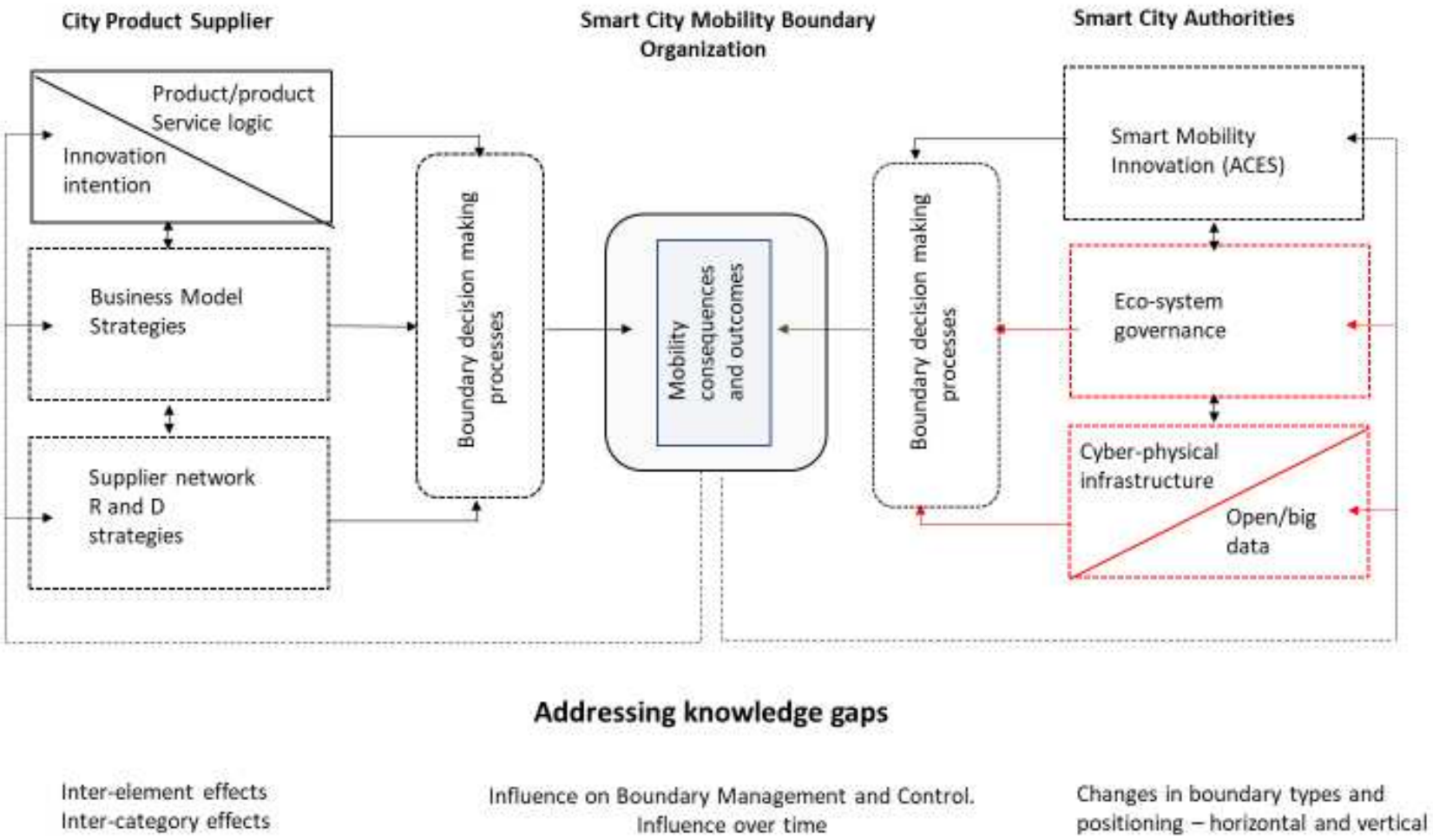

Figure 1: Research Framework

involves working with an external network, often of new supplier entrants to make the electric vehicle. Therefore, critical issues become network design and the management of supplier relationships.

Innovation Intention/Service Dominant Logic

An intentional, specific innovation intent helps people see how innovation connects to what they do and how they do it. For some, innovation may result from incremental process improvements. For others, it may involve designing the next generation of products and services. Traditionally, innovation was viewed as a "closed" activity internal to the firm.

New theories are now emerging to radically challenge this assumption. Chesbrough (2006) introduced the notion of "open innovation" as a model of innovation in which firms, rather than relying on internal ideas to advance business, look outside their boundaries in order to leverage internal and external sources of ideas. Therefore, open innovation is: "the creation of something of economic value based on new jointly generated ideas that emerge from the sharing of information and knowledge" (Miles & Snow, 2007, p. 460). Therefore, in the framework, innovation intention in the smart city is geared to more "open" and porous rather than "closed" forms of innovation.

Service dominant logic is a new approach of looking everything as a process of serving. The name "Service Dominant Logic" does not relate or is not meant to give more importance to service business. Also, it does not separate services from goods. What Vargo and Lush (2004) define as Service dominant logic implies: *"...* that all businesses are service businesses and covers all the economic and also social activities. They also emphasise that the service is exchanged for service. It is mainly the process of using resources for the benefit of the other parties" (p. 1).

The service dominant logic differentiates itself from goods dominant logic mainly by looking from the perspective of customers. Companies do not sell products to customers but sell the service to satisfy their needs and wants. Thus, goods are the channel of distribution for services. Service dominant logic does not have to associate with service business in its traditional perspective (Vargo and Lusch, 2008). The value has not been created by the business, neither is it created only by customers. However, it has been a "co-creative" activity with the

involvement of resource integrators who are suppliers, producers, competitors, customers, and customer's network of resources, other social and economic stakeholders (Vargo et al., 2008).

Business Models

Afuah and Tucci define a business model as a: "system that is made up of components, linkages between components, and dynamics" (2003, p. 4). As Amit and Zott present their view on business models, it can be assumed that the dual focus of value creation and value capture is at the heart of the definition of business models (Amit & Zott, 2001; Zott & Amit, 2013). The concept of business models has been popularised in the past decades with the advent of the Internet as a modification of traditional view of an operational model of a firm. In the past two decades, research on business models has made several advancements
(Schiavone et al., 2019).

Hamel (2002) proposes that to thrive in the "age of revolution" companies must develop new business models— in which both value creation and value capture occur in a value network— which can include suppliers, partners, distribution channels, and coalitions that extend the company's resources.

The concept of a business model captures the fact that for a firm to be successful, it needs to combine several elements into a coherent mix. At a minimum, these elements include: (i) the value proposition; (ii) the configuration of value creation, which includes the way in which the firm links to suppliers and customers; and (iii) the revenue model, that is, how costs and benefits are divided over economic actors in the system (Boons and Leudeke-Freund, 2013).

Business models were related to sustainable innovation and sustainable development in two different ways in the late 1990s. First, as Boons and Leudeke-Freund (2013) suggest at a conceptual and foundational level the need to change existing business models was related to the concept of natural capitalism (Hawken et al., 1999) and to the mechanism of creative destruction of existing industries for sustainability (Hart and Milstein, 1999). Second, alternative business models were key to the so-called product to service switch that employs leasing and hiring as useful service concepts for dematerialization and energy services thinking (Okkonen and Suhonen, 2010).

Business models that help in managing the boundary areas can be used to create and reconfigure activities within the supply network, both "upstream" and "downstream", thus either creating new markets for involved parties or finding a supplier to provide a unique solution for an existing need (Gambardella & McGahan, 2010). These business models can be responsible to drive innovation activities that utilize resources and knowledge to cause significant positive changes in the industry structures (Gambardella & McGahan, 2010).

Supplier Networks: R and D Strategies

The vertical boundary point of our investigation is the traditional one between the organization and its supplier network. Most of the literature is either focused on TCE or the RBV approach in explaining the "make" or "buy" boundary decision, on whether to outsource production through the development of an external supplier network. Hamel and Prahalad (1994) have evolved RBV to the core competence concept, with the distinction between core and non-core business that has become very influential in outsourcing practice.

Consequently, organizations may access complementary capabilities from third-party firms where no advantage can be gained from performing these activities internally (McIvor, 2009, p. 47). Giving activities which do not constitute a core competence of the organization to other firms, and who can provide these at lower costs is the basis for the "make" or "buy" decision which is also defined as transaction costs.

Whilst the TCE approach is based on the assumption, that the transaction is the basic unit of analysis (Williamson, 1981, pp. 549-556). Its primary purpose is to explain why certain industrial arrangements operate with different efficiency degrees. Transactions are thereby defined as actions, in which goods or services are transferred across a technologically separate interface (ibid., p. 552). Transaction costs can be defined as costs which occur due to misunderstandings, and conflicts, which lead to delays, damages or malfunctions. After having assessed the internal and external transaction costs, the efficient boundaries of the firm can be defined.

Based on this assessment, the procurement decision between the two alternatives of make (produce the product internally) and buy (purchase it from an autonomous supplier are made (Williamson, 2008, p. 5)). According to Williamson (1975), only those products and

services should be produced internally, for which the internal transaction costs are less than the transaction costs of purchasing these at an open market. The strict focus on these two options only imply that mixed models like joint ventures or franchising are not considered (Williamson, 1981, pp 549, 556).

The analysis of the two approaches has showed that both offer a solid understanding and basis for an organization's outsourcing decision and therefore the nature and form of its supply network boundary. Yet none of the two approaches alone can and should be used in an outsourcing decision case at an organization. Although the two approaches seem to be completely different, there is a complementary nature between both theoretical standpoint, which is based on the characteristic of being difficult to trade or imitate that applies for both distinctive capabilities and specific assets (Peteraf and Barney, 2003). In some cases, the recommendations given from each approach can even be complementary.

Therefore, what is governing the boundary position in the supply network, what type of vertical boundary is emerging with the e-mobility trend? Is the outsourcing boundary expanding beyond traditional supply categories and business units (i.e. electronics, auto-lighting, powertrains, cockpits, thermal-devices, entertainment, security, mobile/satellite communication)? If so, what does this mean for risks, value, competencies and capabilities? Basically, is it more "buy" than "make"? Is the supply base changing in terms of its composition and the technologies, products and services, capabilities etc and is the sourcing strategy changing from products to services, knowledge, innovation etc?

Smart City Authorities

The city authorities manage the governance of the smart city eco-system. To enable them to govern they need to have the legitimacy, authority and the democratic trust of local citizens, institutions, pressure groups and other stakeholders. There are three elements in the framework linked to smart cities: i. e-mobility innovation trends, ii. eco-system governance and iii. the cyber-physical infrastructure and open/big data.

Smart City Mobility Innovation

There are four major e-mobility trends which are collectively brought together in the ACES (i.e. Autonomous, Connected, Electric and Shared vehicles) acronym (Adler et al., 2019). Connected vehicle technologies allow vehicles to talk to each other and the broader world.

Navigation systems have evolved into full-fledged infotainment systems and personal assistants that proactively help drivers reach their destination, entertain them and assist them with accomplishing tasks along the way. Adler et al. (2019) notes that: *"...* autonomous vehicles are gaining traction and, while they are not expected to be deployed en masse for years, they are an increasing priority for automakers seeking to stay relevant in the future and public agencies striving to improve safety and efficiency of transportation" (p. 19).

Electric vehicles have been driving on our roads for much longer than both connected and autonomous vehicles and have experienced surges in popularity given changing gas prices and environmental concerns. Dijk et al., (2016) suggests that: *"t*oday, global warming is a growing concern and electric vehicles are viewed as essential for increasing transportation efficiency and reducing emissions of carbon dioxide. Furthermore, range anxiety (fear that a vehicle *won't have enough store power to reach a destination) has greatly decreased given the quality* of in-vehicle meter readers, driver alerts and availability of charging stations" (p. 77).

Lastly, Adler et al., (2019) points out that on-demand and shared vehicles are increasing in popularity not only for the convenience they offer, but because they are significantly reducing the cost of mobility. For instance, Lyft, Inc. is an American ridesharing company based in San Francisco, California and operating in 644 cities in the United States and 12 cities in Canada. With the Covid-19 pandemic questions have been raised about the future of sharing systems such as Lyft, DriveNow and Uber. On the 2nd of March 2020 Lyft cut back nearly 20% of its workforce (Nasdaq, 2020).

Smart City Governance

Smart cities require new coordination processes which fit the changing societal perceptions about the role of public and private actors and citizens in public policymaking, implementation and service delivery (Klijn and Koppenjan, 2012). It has been argued that rendering policy issues governable (i.e. possible to govern) in this context requires a shift towards more reflexive forms of governance where decision-making is a temporally evolving set of repeating interactions and negotiations among relevant actors over the long-run.

This entails the reorientation of the role of state (public-sector bodies) towards steering and managing collective and joint decision-making processes and decisions emerging from networks of collaboration. The usefulness of digital technologies therefore may be evaluated

according to their potential to aid this change by complementing (or replacing) parallel organisational change processes aimed at reducing fragmentation by way of integration and improving interoperability in public service delivery (Dunleavy et al., 2006).
What follows from this is the importance of (social and political) trust between the government and the governed when it comes to building an acceptance of the risks and costs of public-private forms innovation (Newton, 2001). Trust between the "governing" and the "governed" has been defined as the result of the evaluation of whether the normative expectations of the governed (citizens) are perceived as met by the governing (authorities and institutions (Tolbert and Mossberger, 2006)). There is often resistance to the market and private entities entering the supply of public and socially driven services such as mobility services, as it is often perceived to enhance rather than reduce deeply engrained class divisions, social and racial inequality.

Trust-building mechanisms may also contribute to enhancing accountability, legitimacy, authority and democratic quality in public policymaking, implementation and service delivery. For example, specific options available to build trust may involve the (at least partial) transfer of costs, responsibilities and accountability to others (experts, professionals or the citizens themselves) through engagement in joint ventures, partnerships and participative decision-making.

Cyber-technical Infrastructure/Big Data

There is a growing body of literature reviewing the physical/technological infrastructural barriers and enablers for e-mobility adoption and exploitation. As we have mentioned the smart city is basically a collection of cyber-physical systems (CPSs) that include new software platforms and strict requirements for mobility, security, safety, privacy, and the processing of massive amounts of information (Mehmood et. al., 2017).

We suggest that sustainable models of mobility will be best achieved through a combined effort involving government, industry associations, and businesses. Long sustained periods of austerity and government spending cuts have led to local city authorities dramatically reducing their infrastructural budgets since 2010. They clearly understand their local problems with mobility, access, sustainability etc but lack the resources, say to introduce green or blue infrastructural projects, to meet sustainability goals and smart city targets.

So, we suggest that if they provision technical services, provide regulatory and legislative framework and governance, then entrepreneurial capital, innovation, risk-taking, scaling business opportunities, innovative business models and radical solutions could come from the private sector. Furthermore, the demand for electric vehicles requires manufacturing scale and capabilities that can only be provided by the private sector, likewise the need for energy companies to provide the charging infrastructure.

Mehmood et al. (2017) document how cyber-physical infrastructural services (involving the industrial internet of things (IIOT) and big data), can be leveraged to create more sustainable transport solutions based on "shared vehicle capacity" to meet aggregated "demand peaks", at different times of the day, week and month etc, in Boston. For instance, they enable more shared vehicle usage, less congestion and more efficient journey times (i.e. less delayed journeys). The demand comes from school journeys, travel to work, tourism, leisure, sporting events, medical, university students and freight (i.e. parcels, food, drink and retail stock). User demographics, demands, preferences, and behaviours can be precisely quantified using big data analytics, so that more shared services can be designed. Infrastructure must therefore be rendered fast, secure, and reliable enough for companies to depend on it for near real-time data.

At the heart of smart cities are big data (data analytics and fusion) and cloud-based sensor intelligence (McClaren and Agyeman, 2015). This includes data collected from: "citizens" (Castelnovo, 2016), "devices", and "assets", that are processed and analysed to monitor and manage traffic and transportation systems, power plants, water supply networks, waste management, law enforcement, information systems, schools, libraries, hospitals, and other community services.

The economic paradigm focus of the smart city is in the long run and "value in use". This encompasses the economic and social value that infrastructure provides for local citizens, organizations and city visitors (i.e. tourists) over the life-cycles of its usage, rather than a cross-sectional market exchange value (at one point of time). For instance, with a library or community centre the real value in use would be calculated in the form of it as a resource that makes an important social, health and economic contribution to the education, health and well-being of a community. This is opposed to a real estate asset value which an investor would be prepared to buy the property for, on the open market and comparable say to a hotel purchase.

Boundary Management and Control

This boundary management and control category of the model focuses on the interplay between city authority and product supplier. Further, it interrelates together the six elements of the model. Although Santos and Eisenhardt (2005) focus on defining the types of organizational boundary they do not take a dynamic or evolutionary perspective, which explores the implementation or operationalising of the boundary concept. Nor do they explore how the boundary position, nature, type etc between two or several agents can influence different elements of an organization (i.e. innovation intention, business models strategy, supply network design, supplier relationships). Although Santos and Eisenhardt focus solely on the horizontal position we will focus on both horizontal and vertical boundaries and their interplay.

At a vertical level, we aim to expand the conceptualisation of Santos and Eisenhardt by exploring how negotiations say for more sustainable city solutions are penetrating deep into the organization down at a functional level. For instance, how is the negotiation for clean air solutions and e-mobility influencing R and D and innovation strategy within the organization (and between organizations), future business models and supply network strategies? Is it changing the make or buy and sourcing strategy? Are they evaluating suppliers on non-profit dimensions? Are new suppliers entering into the automobile network?

This part of the framework is where new knowledge can be advanced, as we will be exploring the process of integration between the two different categories and the six sub-elements together. We will advance boundary theory by taking a dynamic perspective investigating how boundary management influences decisions within the organization. Furthermore, we will explore how the product (manufacturing) organization through improvisation, iteration and re-iteration is being integrated into a boundary form of service organization. As this evolves over time we aim to show the opportunities and challenges for more sustainable boundary forms of organization.

Framework limitations and critique

There are three main limitations that we have identified in the framework: i. integration is not always desirable or possible in practice and may ultimately lead to monopoly situations; ii.

the knowledge base on how boundary spanning and management (performed by digital technologies) can support the delivery of city-level outcomes is still largely underdeveloped, and the understanding of cross-agent coordination is lacking and; iii. it cannot be assumed that current "public-private" structures, governance and processes are designed to deal with "wicked" and "complex" sustainability problems. To facilitate the generation of cross-cutting innovation which serves the city and more importantly its citizens.

The authors refer to the boundary spanning process of "integration" as an organisational restructuration. Therefore, interoperability can be understood as the ability of organisations, units or individuals to work together and this signifies a temporal process (institutional) change of developing roles, rules and practices which act as guidelines for collaborative working (Maheshwari and Janssen, 2014).

Integration is not always desirable or possible in practice and may ultimately lead to monopoly situations. Counteracting silo-ends by improving interoperability represents another option to improve coordination by making (organisational or institutional) boundaries sufficiently permeable. An example of this is the joining up of various processes of all different types of city mobility service delivery, so that they are not locked into sectoral silos (Kimble et al., 2010).

There are various strands of existing literature concerned with different options for performing boundary spanning and management – for example, collaborative or networked governance, data sharing or intermediaries. Intermediaries may be specific organisations tasked with boundary management (Kivimaa et al., 2019), as well as "objects".

It is at this point where the potential offered by digital technologies becomes clear: various digital solutions combining digital data collection, management, analysis and automated decision-making started to appear as intermediaries in interaction processes among social and technological system elements in various contexts. Objects that perform intermediary functions appear in existing literature as "boundary objects" (Taylor et al., 2014). The knowledge base on how boundary spanning and management performed by digital technologies can support the delivery of city-level outcomes is still underdeveloped, and coordination is lacking.

Innovation arising in an undirected way through boundary spanning may contribute to the appearance and quick spread of controversial developments, as is well illustrated in cases such as Uber and Airbnb where legislation and regulation have been playing catchup with real-world progress with considerable delay (Stone, 2017). Thus, innovation on the fringes, enabled by boundary spanning, represents both an opportunity in terms of its potential "radicalness" and a risk – for example, in relation to contributing to widening inequality of access to services in cities. For instance, will access be available for deprived communities.

This point leads back to the responsibility of (local, but also regional and national) governments and the need for developing structures and processes which can better deal with complex mobility problems, in order to facilitate cross-cutting innovation which serves the city and its citizens. Viitanen and Kingston (2014, p. 804) argue that: "… [t]echnology can be a powerful *tool for analyzing risks or engaging the public in debates …, but … "smart" technologies offer no guarantee about the quality of decisions made in cities'. Thus, the 'input'* of urban governance – that is, the ways in which decisions affecting citizens are made – must also become integral part of any investigation seeking to understand the impact of digital technologies in cities*"*.

Discussion and Conclusions

This study interrogates the theoretical proposition of the smart city as influencing the design of network relationships from being "*profit*" to "*sustainably-driven*", both horizontally, between smart city partners, citizens and the organization and vertically, between the organization and its suppliers. We have developed a dynamic framework which will guide our future investigation into the organization evolution of an automobile product supplier that is transaction-focused into a sustainably driven mobility service organization. With the outbreak of the COVID-19 virus, a new challenge of safeguarding the health and personal safety for passengers and workers of the city transport providers is a major challenge for mobility service planners.

Therefore, in moving forward there is a need for automobile organizations to operate as service organizations and suppliers of data and even in some cases, even participate in the development of "*digital city twins*" simulations to model safe human interactions and movements.

In advancing the framework we have proposed three research questions which directly relate to the framework categories and their interrelationships.

RQ1: At a horizontal level, what is the role of smart cities in creating new "organizational forms" and "innovative" business models at the boundary (between state, citizen and organization)?

RQ2: Is the vertical "*make"* or "buy" boundary changing? If so, how is management of that boundary different to what went before.

RQ3: How is the smart city authority influencing future R and D, innovation strategy within the automobile organization?

In the context of smart cities, the management of the boundary areas provides both a challenge and an opportunity as there are several different interacting agents negotiating in this space (Abbate et al., 2019). The "firm-city" boundary provides an emerging organizational territory to support the development of "integrated" business models. These models are "co-designed" (with consumers, the state, etc) and have a "collaborative" and "relational" (i.e. social) rather than "transactional" (i.e. profit maximization) working philosophy (Lee, Hancock, & Hu, 2014; Ryan & O'Malley, 2016). For instance, the "Inzell" initiative which is a collaboration between BMW and the city of Munich has been a successful project that brought together different stakeholders to solve traffic problems in the smart city context (Kesselring & Tschoerner, 2016).

The next phase of the research will test and advance the framework through six longitudinal case studies drawn from across Europe.

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References

Abbate, T., Cesaroni, F., Cinici, M. C., & Villari, M. (2019). Business models for developing smart cities. A fuzzy set qualitative comparative analysis of an IoT platform. Technological Forecasting and Social Change, 142, 183-193.
Adler, M.W., Peer, S. and Sinozic, T. (2019). Autonomous, connected, electric shared vehicles (ACES) and public finance: An explorative analysis. Transportation Research Interdisciplinary Perspectives, 2.
Afuah, A., & Tucci, C. L. (2003). Internet business models and strategies: text and cases (2nd ed. ed.): McGraw-Hill.
Amit, R., & Zott, C. (2001). Value creation in e-business. Strategic Management Journal, 22(6-7), 493-520.
Boddy, D., Macbeth, D. and Wagner, B. (2000). Implementing collaboration between organizations: an empirical study of supply chain partnering. Journal of Management studies, 37(7), 1003-1018.
Bohnsack, R., Pinkse, J. and Kolk, A. (2014). Business models for sustainable technologies: Exploring business model evolution in the case of electric vehicles. Research Policy, 43(2), 284-300.
Boons, F., Montalvo, C., Quist, J. and Wagner, M. (2013). Sustainable innovation, business models and economic performance: an overview. Journal of Cleaner Production, 45, 1-8.
Burt, R.S. (1997). A note on social capital and network content. Social Networks, 19(4), 355-373.
Casals, L.C., Martinez-Laserna, E., García, B.A. and Nieto, N. (2016). Sustainability analysis of the electric vehicle use in Europe for CO2 emissions reduction. Journal of Cleaner Production, 127, 425-437.
Castelnovo, W. (2016). Citizens as sensors/information providers in the co-production of smart city services. Proceedings of the 12th ITAIS, 51-62.
Chandler, A. D. (1977). The visible hand: The managerial revolution in American business. Belknap Press.
Chesbrough, H., Vanhaverbeke, W., & West, J. (2006). Open innovation: Researching a new paradigm: Oxford University Press on Demand.
Coase, R.H. (1993). The nature of the firm: Origins, evolution, and development. Oxford University Press.
Davis, G.F. and Powell, W.W. (1992). Organization-environment relations. Handbook of Industrial and Organizational Psychology, 3, 315-375.
DiMaggio, P.J. and Powell, W.W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review, 147-160.
Dunleavy, P., Margetts, H., Bastow, S. and Tinkler, J. (2006). New public management is dead—long live digital-era governance. Journal of Public Administration Research and Theory, 16(3), 467-494.
Fine, B. and Leopold, E. (1993). The world of consumption, Routledge.
Fraunhofer. (2020). Electric mobility. https://www.isi.fraunhofer.de/en/themen/elektromobilitaet.html.
Gambardella, A., & McGahan, A. M. (2010). Business-model innovation: General purpose technologies and their implications for industry structure. Long Range Planning, 43(2), 262-271.
Graham G, Burns L, Hennelly P, Meriton R. 2019. Electric sports cars and their impact on the component sourcing process. Business Process Management Journal. 25(3), 438-455.

Hamel, G. (2002). Leading the revolution : how to thrive in turbulent times by making innovation a way of life, Harvard Business School Press.
Hamel, G. and Prahalad, C.K. (1994). Competing for the future. Harvard Business Review, 72(4), 122-128.
Harrison, G. and Thiel, C., 2017. An exploratory policy analysis of electric vehicle sales competition and sensitivity to infrastructure in Europe. Technological Forecasting and Social Change, 114, 165-178.
Hart, S.L. and Milstein, M.B., (1999). Global sustainability and the creative destruction of industries. MIT Sloan Management Review, 41(1), 23.
Ilinitch, A.Y., D'Aveni, R.A. and Lewin, A.Y., 1996. New organizational forms and strategies for managing in hypercompetitive environments. Organization Science, 7(3), 211-220.
Kesselring, S., & Tschoerner, C. (2016). The deliberative practice of Vision Mobility 2050: Vision-making for sustainable mobility in the region of Munich? Transportation Research Procedia, 19, 380-391.
Kimble, C., Grenier, C. and Goglio-Primard, K. (2010). Innovation and knowledge sharing across professional boundaries: Political interplay between boundary objects and brokers. International Journal of Information Management, 30(5), 437-444.
Kivimaa, P., Boon, W., Hyysalo, S. and Klerkx, L. (2019). Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. Research Policy, 48(4),.1062-1075.
Klijn, E.H. and Koppenjan, J. (2012). Governance network theory: past, present and future. Policy & Politics, 40(4),.587-606.
Lee, J. H., Hancock, M. G., & Hu, M.-C. (2014). Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco. Technological Forecasting and Social Change, 89, 80-99.
Li, P.F. (2014). Global temporary networks of clusters: structures and dynamics of trade fairs in Asian economies. Journal of Economic Geography, 14(5), 995-1021.
Maheshwari, D. and Janssen, M.(2014). Reconceptualizing measuring, benchmarking for improving interoperability in smart ecosystems: The effect of ubiquitous data and crowdsourcing. Government Information Quarterly, 31, S84-S92.
Masten, S.E. (1993). Transaction costs, mistakes, and performance: Assessing the importance of governance. Managerial and Decision Economics, 14(2), 119-129.
McIvor, R.(2009). How the transaction cost and resource-based theories of the firm inform outsourcing evaluation. Journal of Operations Management, 27(1), 45-63.
McLaren, D. and Agyeman, J. (2015). Sharing cities: a case for truly smart and sustainable cities. MIT press.
Mehmood R, Meriton R, Graham G, Hennelly P, Kumar M. (2017). Exploring the Influence of Big Data on City Transport Operations: a Markovian Approach. International Journal of Operations and Production Management. 37(1), 75-104
Miles, R. K. & Snow, C. C. (1994). Fit, Failure and the Hall of Fame, The Free Press.
Miles, R.E. and Snow, C.C. (2007). Organization theory and supply chain management: An evolving research perspective. Journal of Operations Management, 25(2), 459-463.
Nasdaq. (2020). Lyft to cut 20% of its workforce. https://www.nasdaq.com/articles/lyft-to-cut-nearly-20-of-workforce-2020-04-30.
Newton, K. (2001). Trust, social capital, civil society, and democracy. International Political Science Review, 22(2), 201-214.
Okkonen, L. and Suhonen, N. (2010). Business models of heat entrepreneurship in Finland. Energy Policy, 38(7), 3443-3452.
Penrose, E.(1959). The theory of the growth of the firm, Blackwell.

Peteraf, M. A., & Barney, J. B. (2003). Unraveling the resource-based tangle. Managerial and decision economics, 24(4), 309-323.
Pfeffer, J., & Salancik, G. R. (1978). The external control of organizations: A resource dependence perspective: Stanford University Press.
Pil, F.K. and Holweg, M., 2006. Evolving from value chain to value grid. MIT Sloan Management Review, 47(4), 72.
Porter, M.E., 1987. Corporate strategy: the state of strategic thinking. The Economist, 23(May), 21-22.
Prahalad, C. K., R. A. Bettis. 1986. The dominant logic: A new linkage between diversity and performance. Strategic Management J. 7, 485–501.
Robinson, J., Brase, G., Griswold, W., Jackson, C. and Erickson, L., 2014. Business models for solar powered charging stations to develop infrastructure for electric vehicles. Sustainability, 6(10), 7358-7387.
Ryan, A., & O'Malley, L. (2016). The role of the boundary spanner in bringing about innovation in cross-sector partnerships. Scandinavian Journal of Management, 32(1), 1-9. doi:10.1016/j.scaman.2015.09.002
Santos, F.M. and Eisenhardt, K.M., 2005. Organizational boundaries and theories of organization. Organization Science, 16(5), .491-508.
Schiavone, F., Paolone, F., & Mancini, D. (2019). Business model innovation for urban smartization. Technological Forecasting and Social Change, 142, 210-219.
Stone, B., (2017). The upstarts: How Uber, Airbnb and the killer companies of the new Silicon Valley are changing the world. Random House.
Taylor, M., Bailey, J., Cowie, B., Abbiss, J., Emerson, L., Kilpin, K., Feekery, A., Sullivan, R., Siteine, A., McPhail, G. and Charteris, J. (2014). Metaphors as boundary objects in preservice primary teacher mathematics education. Journal Issue, (3).
Thompson, J. D. (1967). Organizations in Action. McGraw Hill.
Tolbert, C.J. and Mossberger, K. (2006). The effects of e-government on trust and confidence in government. Public Administration Review, 66(3), 354-369.
Uzzi, B., 1997. Social structure and competition in interfirm networks: The paradox of embeddedness. Administrative Science Quarterly, 35-67.
Vargo, S. L., and Lusch, R. F. (2004). Evolving to a new dominant logic for marketing', Journal of Marketing, 68(1), 1-17.
Vargo, S. L., and Lusch, R. F. (2008). Service-dominant logic: continuing the evolution. Journal of the Academy of Marketing Science, 36(1), 1-10.
Viitanen, J. and Kingston, R., 2014. Smart cities and green growth: outsourcing democratic and environmental resilience to the global technology sector. Environment and Planning A, 46(4), 803-819.
Weick, K. (1995). Sensemaking in organizations. Sage Publications.
Williamson, O.E. (1975). Markets and hierarchies: A study in the economics of internal organization. The Free Press.
Williamson, O.E. (1981). The modern corporation: origins, evolution, attributes. Journal of Economic Literature, 19(4), 1537-1568.
Williamson, O.E. (1991). Comparative economic organization: The analysis of discrete structural alternatives. Administrative Science Quarterly, pp.269-296.
Williamson, O.E.(2008). Outsourcing: Transaction cost economics and supply chain management. Journal of Supply Chain Management, 44(2), 5-16.
Zott, C., & Amit, R. (2013). The business model: A theoretically anchored robust construct for strategic analysis. Strategic Organization, 11(4), 403-411.