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A dynamic capability evaluation of emerging business models for new mobility

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ABSTRACT

The 'new mobility' is claimed to promise improved transport services with reduced socioeconomic and environmental impacts whilst at the same time creating high-value business opportunities. The present article contributes to understanding the latter part of this promise through analysing the sources of value creation in the new mobility industry. It makes a novel application of a business model concepts - the Dynamic Capabilities approach - to transport research. Drawing on findings from expert interviews with professionals in innovation clusters, the findings reveal that new mobility companies benefit from an inherent dynamism and a continuous learning culture. The participation in networks and alliances let companies reach broader market solutions through cross-regional collaboration. These ecosystems are well equipped to address wider mobility needs founded on managing data. For managers in the new mobility, key conclusions are that establishing a concise value proposition and expanding key resources such as staff skills or data management procedures are crucial for business sustainability.

1. Introduction

The efficiency of operations, as well as the reduction of greenhouse emissions and air pollution, are key claims of future transportation (Milakis, Thomopoulos, & van Wee, 2020; Nikitas, Thomopoulos, & Milakis, 2021; Parkhurst & Seedhouse, 2019). To the extent that these outcomes can be achieved, they can mitigate the projected growth in passenger and freight demand, which was forecasted pre-COVID-19 to be 30% and 55% respectively by 2050 (JRC, 2019). In parallel, the adoption of low carbon, autonomous, connected and shared transport services has been referred to as a potential step-change in mobility (Nikitas et al., 2021; Parkhurst & Clayton, 2022; Turienzo, Cabanelas, & Lampón, 2022). This transition, even if at an early stage, has been referred to as 'the new mobility' (Lygnerud & Nilsson, 2021; Van den Heuvel, Kao, & Matyas, 2020).

Yet, the technological innovation associated with new mobility is not innocuous, since it is leading to intrinsic modifications in business models and service offers. Some tangible examples are the combination of products and services, the increasing personalisation of services (Ahmed, Adnan, Janssens, & Wets, 2020; Athanasopoulou, de Reuver, Nikou, & Bouwman, 2019), and subscription-based models for transport services, often referred to as Mobility-as-a-Service (MaaS) (Jittrapirom, Marchau, van der Heijden, & Meurs, 2018). Despite forecasting economic activities based on new technologies being highly uncertain, the value of the global market for just one of these technologies in 2030, namely Autonomous Vehicles, has been estimated at US$173bn (Frost and Sullivan, 2018). Hence, in addition to the potential environmental benefits, important claims are also made about very substantial business opportunities.

Currently, the mobility industry and its regulators are at a crossroads about how to deploy these new mobility modes, which foster radical change in terms of energy efficiency and low-emission urban accessibility, whilst at the same time generating business value (Athanasopoulou et al., 2019; Rode, Floater, Thomopoulos, Docherty, et al., 2017; Sarasini & Linder, 2018). Business managers in particular may thus seek to understand the new 'ecosystems' associated with these new technologies, aiming at unlocking revenue-generating opportunities, and addressing customer requirements in market contexts no longer solely

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controlled by traditional actors (Pütz, Murphy, Mullins, & O'Malley, 2019).

Following these developments, scholars have started to shift their attention towards analysing business claims which are merging the sustainability objectives of cleaner mobility, lower carbon emissions and more efficient use of resources within business models that remain viable (Lagadic, Verloes, & Louvet, 2019; Thomopoulos & Nikitas, 2019). Interesting insights have been provided by Van den Heuvel et al. (2020) on business model innovations for mobility sector start-ups and by Calvert, Ward, Shergold, Parkhurst, and Jain (2019) on shared-ride on-demand services, but with limited value for an audience seeking managerial implications. Despite the increasing corporate interest, as the present article identifies, there has been little focus in the literature to date on which business models are relevant or likely to be viable in the long-run (Berg, Rakoff, Shaw, & Smith, 2020; Parkhurst, Cabanelas, Paddeu, Raslavičius, & Thomopoulos, 2021; Riggs & Beiker, 2019).

Hence, this article aims to understand the evolving business models (BM) associated with new mobility, studying the sources of value creation and the capabilities required for managing such a turbulent environment, before suggesting a classification of business models for the new mobility market niche. To this end, the article draws on the perspective of Dynamic Capabilities to provide a novel application of this theoretical approach to transport research, and BM Generation (Osterwalder & Pigneur, 2010) to comprehend how value is created, delivered, and captured. The article reports on a qualitative exploratory approach, based on a series of in-depth interviews with experts. Given the complexity of the dynamics of the adoption of new mobility, which not only features multiple trends but also interactions between them (Parkhurst & Seedhouse, 2019), a grounded theory (Johnson, 2015) perspective is adopted for the analysis of the interview transcripts. The analysis intends to provide a critical assessment of the transport and managerial practices related to the adoption of autonomous, connected and shared mobility solutions.

The remainder of the article is organized as follows: the next section presents the theoretical framework for analysing the BM of 'new mobility'. It is followed by a section outlining the method used in the empirical study, including details about the data collection within collaborative clusters of 'new mobility' businesses. Then, the main results are presented, followed by a final discussion and a conclusion section which considers the theoretical contributions of the article and its implications for business managers.

2. Theoretical framework

A Dynamic Capability (DC) is a *"firm's ability to integrate, build and reconfigure internal and external competences, in order to address rapidly changing environments"* (Teece, Pisano, & Shuen, 1997: 516). It is a systematic and intentional effort to change the capabilities and resource base of firms through micro-processes emphasising the value of intangible assets via sensing, seizing and shifting (Ambrosini & Bowman, 2009). The result of this orchestration process of value creation is the development of new market propositions (Cabanelas, Omil, & Vázquez, 2013; Pitelis & Teece, 2010). DCs are founded on core competencies of the firm which enable it to modify short-term competitive positions, and which in turn can establish long-term advantages (Teece, 2020).

The DC approach has its roots in the evolutionary theory of firms (Nelson & Winter, 1982) and in the Resource Based View (RBV) (Grant, 1991). It is therefore well-suited for evaluating the emergence of niche business opportunities, particularly regarding sense-making to adapt firms to new realities (Wang & Hsu, 2018). Furthermore, the DC approach emphasises alliance and acquisition routines as an essential resource, introducing new strategic assets from external resources (Preikschas, Cabanelas, Rüdiger, & Lampon, 2017; Teece, 2020) to compete in the contemporary marketplace (Sluyts, Matthyssens, Martens, & Streukens, 2011).

The mobility industry is characterised by the continuous adoption of innovative technologies which foster social and organisational changes and provoke a re-configuration of the value chain (Santos, Spector, & Van der Heyden, 2009; Sarasini & Linder, 2018). The present article therefore argues that the dynamic perspective is particularly important in the analysis of the evolution of its business models and their impacts on firms' capabilities. The DC approach is thus appropriate as it allows the identification of how firms alter their resource configuration to seize opportunities and shift organisational transformation to address changes in the business environment (Eisenhardt & Martin, 2000; Teece, 2020; Teece et al., 1997). It provides an approach to analyse the dynamism of markets and the evolution of customer demands (Ferigotti, da Cunha, & dos Santos, 2020; Preikschas et al., 2017).

In order to analyse new business models and their associated DC, it is necessary to identify how value is created, delivered and captured. On the one hand, it is necessary to consider different actors throughout the newly-transformed value chain to gain broader understanding across multiple levels (Cabanelas et al., 2013). On the other hand, the analysis should integrate key elements of the BM approach: *"a business model is a conceptual tool that contains a set of elements and their relationships and allows expressing a company's logic of earning money"* (Osterwalder, 2004: 15). A range of BM approaches have been used to study evolving managerial practice (Joyce & Paquin, 2016; Medina, Mazaira, & Alén, 2022; Palos-Sánchez, Saura, Velicia-Martín, & Cepeda-Carrión, 2021), but the approach followed in this article is an adaptation of that proposed by Osterwalder and Pigneur (2010) because it is straightforward and well-known by both academics and practitioners. Additionally, it represents the central elements of value creation, delivery, and capture (Cabanelas et al., 2013). The basic assumption of the approach is that a firm builds its BM by making various choices to generate revenues encompassing a range of elements such as infrastructure, business offer, customer base and finance structure. The infrastructure (internal and external organisation, i.e., value chain and network) generates costs, but makes it possible to create a value proposition (i.e., an offer) for customers as well.

Five key conceptual axes arise from this BM approach:

1. The understanding of how strategy shapes the new *value propositions* which organisations intend to offer to the market (Lasmar Jr., Gandia, Sugano, de Souza, & Rodriguez, 2019; Wirtz, Pistoia, Ullrich, & Göttel, 2015).
2. It is essential to consider *key resources*, namely, how business operations and activities are re-configured from the perspectives of social, technological, and organisational changes (Santos et al., 2009).
3. It is important to realise how the actor-value *network* is designed *and* how *alliances* are woven to gain a broader scope and reach the market (Lagadic et al., 2019).
4. As businesses need revenue streams to sustain their activities, it is worth analysing how they reach the market and what mechanisms are used to *generate income* (Bohnsack, Pinkse, & Kolk, 2014).
5. As a proxy of the undertaken activity's potential, it is necessary to analyse the *funding* received by each entrepreneurial initiative to develop and commercialise their market solutions, hence evaluating their attractiveness for investors (Zott & Amit, 2008).

These five axes provide a spectrum wide enough to understand (Table 1):

i. where the value creation lies
ii. which are the key activities and resources to generate future value
iii. the network partners for this journey,
iv. how the new channels contribute to generating revenue, and
v. the availability of funding sources e.g., for investment.

Although funding sources are rarely included in conventional BM analyses, they are a core element in new mobility initiatives since they

Table 1
Overview of the main business model axes.

Concept	Scope	Authors
Value proposition	Value proposals addressing new market needs shaped by strategy	Wirtz et al. (2015) Lasmar Jr. et al. (2019)
Key resources	*Re*-configuration of organisational resources and adaptation to changes to address new value propositions: technology, teams, data management	Santos et al. (2009)
Networks and alliances	Sets of actors providing solutions to new market needs	Lagadic et al. (2019)
Income generation	Proposals to generate income from new mobility-related solutions	Bohnsack et al. (2014)
Funding	Perceived support for the activity in terms of subsides (public) or investments (private)	Zott and Amit (2008)

are perceived as a proxy for 'business potential' by future investors.

In addition to analysing the key elements of BM, a classification of the typology of these new BM can be proposed. Despite a handful of attempts in the academic literature to address this (Lagadic et al., 2019; Sarasini & Linder, 2018; Stocker & Shaheen, 2017), existing classifications do not integrate all new mobility issues. The literature is still partially focused on the car industry (Athanasopoulou et al., 2019; Lasmar Jr. et al., 2019), without considering a wider range of services and value propositions integrating other modes of transport such as public transport, ride-sharing or micro-mobility. That said, personalised journey services such as MaaS are gaining interest (Hogan et al., 2019), and a valuable classification focused on shared mobility has been provided by Antonialli, Cavazza, Gandia, Sugano, et al. (2018), which is founded on a previous one developed by Tukker (2004).

The model provided by Tukker (2004) differentiates three categories within BM depending on what value is added for mobility customers. A first category is BM based on the pure product where the value lies in the product content, that is, the possession of a tangible element per se is worthy for the customer, e.g., owning or renting a scooter. A second category is of those focused on pure services, where the content of the service is the basis of the value creation; an example is the provision of motor insurance or repairs undertaken to a car. And a third category is of those based on the function, known as the Product Service System (PSS), itself including three typologies. Applied to the transport system, these PSS categories are:

(a) Product-oriented system, in which the user owns the product, but the seller adds some additional value through advice on efficient use (perhaps via training courses) or maintenance services. The client is responsible for its maintenance and end-of-life management;

(b) Use-oriented system, through which the client makes use of a service, e.g., a bus trip where the provider is responsible for the quality of the result (e.g., selecting the route, driver or vehicle type);

(c) Result-oriented system, within which the client pays for the mobility service, but it is the service-providing company which determines the best transport option (e.g., route plan) and the best infrastructure option (e.g., road vehicle).

3. Method

3.1. Rationale and research method

The research adopted an exploratory qualitative approach aimed at interpreting key contemporary DC for creating value in evolving BM (Preikschas et al., 2017). Given the interwoven relationships between technological management and social changes, which cannot be easily revealed through quantitative analysis (Eisenhardt & Graebner, 2007), the choice of a qualitative approach for this study was pertinent. Specifically, a grounded theory approach was adopted (Glaser, 2002). Whilst quantitative approaches may primarily focus on *'how often'* or *'how many'* type questions (Eisenhardt & Graebner, 2007), qualitative data collection facilitates a direct and extensive narrative from the participant's perspective (Bansal & Corley, 2012). The inductive tradition enables effective understanding of the influence of individual behaviours and thinking on activities (Woodside & Wilson, 2003), allowing insightful answers to *'why'* and *'how'* questions, in this case, focussed on the emergence of new BM.

The main source of data for the analysis was twenty in-depth interviews with key actors within the new mobility value chain. Interviewees were selected based on a sampling frame which sought to include different types of actors found at different nodes of the new mobility value chain. In addition, understanding of the research context was enhanced by the direct involvement of the authors in national and international new mobility communities across Europe, benefitting from their engagement in ongoing research projects (e.g., including trials of transport-sector automation, and evaluation of new mobility services), which offer a cross-section of the whole new mobility value chain (Canitez, Thomopoulos, & Cantafio, 2018). These engagements provided a special opportunity to gain key insights about this rapidly evolving industry, which would not have been possible without having previously built a sufficient level of trust with the various actors (Yin, 2017). This is important, as the novelty of the topic studied requires first-hand exposure to understand and interpret the associated processes for such a diverse group of actors (Preikschas et al., 2017). As a result, content analysis has been the main tool for extracting valuable insights. It has enabled the transformation of common themes and ideas into grounded theory categories, whilst also revealing detail about justifications for business decisions and future opportunities, thus offering in-depth comprehension of the emerging business environment within the new mobility sector.

3.2. Sampling and data collection

Companies and actors participating in the new mobility value chain (i.e., autonomous, connected and shared vehicle services) were considered for this research. A purposive non-probabilistic sampling procedure was used to obtain data from interviewees located in the UK, Spain and Portugal, in regions of those countries with historic links with transportation OEMs (either automotive or aerospace industries). Interviewees were initially identified through the authors' professional networks via a snowball sampling approach, through a range of new mobility initiatives and trials which had been taking place or were in the planning phase. Following a screening stage (conducted by e-mail or telephone) to confirm their relevance, eligibility and willingness to join the study, 20 semi-structured in-depth interviews lasting 30–60 min each took place in-person between November 2019 and March 2020. The sample size is within the range suggested by Creswell (1998) and is comparable with other studies in the business studies literature. The interviews were conducted by at least two team members, which was essential to facilitate any translation challenges, but more importantly to ensure full coverage of both mobility and management topics. The interviewees were experienced managers holding positions of responsibility within their organisations (e.g., owners, technology/product managers, area managers). Hence, they were able to offer detailed knowledge from a strategic perspective about BM (Table 2).

The content of the questionnaire used in the semi-structured interview was informed by the literature review and the responses formed the main data source for the analysis (Bansal & Corley, 2012; Eisenhardt, 1989). It was delivered using a thematic topic guide including fixed questions and prompts (see the Appendix for further details) aiming to cover:

- the main social and technological trends seen as relevant by the interviewee,
- the impact of the trends on existing and new BM,
- the core competencies and capabilities involved,

Table 2
Interviewee overview and interview characteristics.

#	Country	Position	Organisation type	Duration (minutes)	Expertise
1	Portugal	Manager	Business association	60	Transportation, cooperation, new technologies and formation
2	UK	General Manager	Local Authority	50	Economic development and planning
3	UK	Project Manager	Software Company	40	Data management capabilities
4	UK	CEO	OEM – SME	40	Autonomous driving vehicles
5	UK	Project Manager	Consultancy	50	Real-time traffic simulation company - modelling software
6	Spain	CEO	Logistics company	30	Inland transportation
7	UK	CEO	High-tech company	50	Sensors for autonomous driving
8	Spain	Researcher	University	40	Telco and aerospace specialisation
9	UK	CMO	Start up on R&D	50	Route planner and new mobility projects
10	UK	Product Manager	AV start-up: Camera based software	50	Smart cameras for decision taking during autonomous or automated driving
11	Spain	CEO	Start-up on security	60	Connectivity in case of accident
12	Spain	Business developer	Spin-off on satellites	50	Business on solutions with nano-satellites
13	Spain	CEO and Product Manager	R&D on electric mobility	60	Provider of electric mobility options (R&D and renting)
14	Portugal	CEO	Start-up on sharing mobility	50	Electric mobility sharing
15	Portugal	Manager and Mobility Manager	R&D Public-private consortium	45	R&D project development on mobility and ICTs
16	Portugal	Researcher	Research institute	50	Longevity specialisation
17	Portugal	CEO	Start-up on carbon emission measurement	60	Mobility platform
18	Spain	Business Developer	Start-up on Connected Transport	55	Connectivity on security through neural networks
19	UK	Senior Associate	Law firm	40	Specialisation in new mobility, autonomous and connected
20	Spain	Representative	Taxi company	50	Traditional mobility company (with a platform for users)

- market issues,
- business alliances,
- revenue streams and funding sources, and the
- typology of new BM,

as well as the contextualisation of each organisation and its perspective on new mobility.

Each interview was audio-recorded and transcribed verbatim following standard research ethics and data management procedures, hence involving the anonymisation of interviewees' contributions, so as to ensure that a wealth of insights could be captured without compromising identities or commercial confidentiality. Annotations and data processing were done within 24 h of the interview to minimise any errors due to memory loss regarding relevant details, which could have affected subsequent analysis.

3.3. Data analysis

The interview transcripts were subjected to an iterative, sequential coding process to identify new perspectives on value creation and the DC required for new mobility BM. The process encompassed three main activities as suggested by Creswell (2014): open, axial, and selective coding. Following the suggestions made by Glaser on the application of Grounded Theory to novel situations with an *'open mind'*, the coding process was manual (Johnson, 2015). The data were subjected to an open coding, with the intention of reducing the information towards its essentials in terms of the impact of managerial decisions on BM and value creation activities. Later, those open codes were related through axial coding. This process enabled a series of connections and data patterns among BM concepts associated to new mobility features; that is, the impact of those concepts on BM and the DC required to attend the challenges associated. Finally, selective coding was used to identify relationships among the elements identified in axial coding, to develop a potential classification of BM in new mobility. Following this approach, each concept identified in the BM axes (Table 1) has been firstly identified and explained in the findings section (open-coding, Table 3), and later linked to new mobility features that shape the competitive environment (axial-coding) summarized in Table 5.

Triangulation techniques were also applied to improve the reliability of the results (Lindgreen, Di Benedetto, Thornton, & Geersbro, 2021), including comparison with reports, white papers, news on the topic, and the discussions of findings among different researchers (Guenzi & Storbacka, 2015). Indeed, three team members participated in the definition of clusters or segments of text phrases that were considered to offer valuable insights about the objectives of the study, and multiple iterations were developed to reach valid and reliable explanations (Eisenhardt, 1989).

4. Findings

An overarching finding from the research was that the environment associated with the current mobility services industry has been highly dynamic and volatile even prior to any impact introduced by the COVID-19 pandemic, and therefore it is very challenging and difficult for actors to predict the direction and nature of change. However, alongside this general notion, many ideas emerged from the interviews about how to deal with this uncertain environment, where the configuration of new business models may yield high rewards. The incorporation of a wide range of actors from different nodes of the mobility value chain was found to contribute to understanding the management of underlying capabilities and resources to adapt actors' businesses in what sometimes seemed to them to be a process of never-ending change. The key themes and concepts are highlighted in the current section. Table 3 includes selected quotations from interviews, referred to as quotation (Q) and its number (#n).

4.1. Value propositions for new mobility

Although the interviewees had different backgrounds, nationalities, and positions in the value chain, each had a clear definition of how they created and delivered value in the new mobility market, albeit from different perspectives. In this regard, it is important to observe social and political changes related to sustainability, efficiency or safety as key emerging topics for creating value (Q#1). Interviewees positioned their organisational contributions to mobility among these three topics, emphasising in doing so their very specific *vision* and interpretation of reality, whilst integrating different perspectives such as data analytics, connectivity, hardware, and software.

A challenge that interviewees identified was the connection of contemporary market gaps with existing or emerging technical capabilities. Thus, managers need to not only identify unmet needs, but also to possess or develop the technological capabilities to address these

Table 3
Selected quotes from interviews.

Q#	Interviewee input	Sub-section
1	Safety: *"Provide the best system for AVs, focusing on public transport (…) is where we see the customer demand due to the size of that market. Currently we aim at demonstrating that our system works on both large and small vehicles."* Environmental sustainability: "*In some cities, collective mobility is a niche market, while in others it has a broad market. (…) Large operators normally work in large cities, which opens up space for smaller operators in smaller cities."* Economic efficiency: *"local authorities' budgets have gone down (…) in some local authorities we're able to find very significant savings [for them]."*	4.1
2	*"We provide a tool to integrate municipal transport policy with a decarbonisation approach (public-policy instrument). The objective is to reduce the rate of public space occupied by vehicles in the municipalities, and quantify this saving in energy and pollution terms, allowing an integration between modes of transport in a single application, with a clear value proposition: Sustainability as a Service."*	4.1
3	*"Our market focus is demand driven. For smaller companies this approach makes more sense since we cannot compete in every area with large OEMs."* *"Initially large OEMs started working individually. Now we all understood that collaboration is key with OEMs, Tier 1 suppliers* etc.*"*	4.1
4	*"We are pioneers in this niche, and we are setting the norm (…) our small size means we are flexible, and we are researching more (…) furthermore we know what we do and how to demonstrate it."*	
5	*"(…) the capacity to create value lies in the ability to recruit a cross- and inter-disciplinary group that can provide complete solutions".* *"Projects that meet demands from industrial partners. In order to contribute with ideas of greater innovation, the key is a multi-disciplinary team of diverse human resources, including sociologists, designers, engineers (computing, materials). They seek to solve business problems."*	4.2
6	*"(…) communications are more important than discussed. There are problems in the hierarchy of information from different sources (cameras, radar, Lidar,* etc.*), so communications become fundamental."*	4.2
7	*"Data is an asset. The challenge is what you keep and what you discard. Some organisations struggle with the amount of data. So, what is the point of storing everything? Data should be valuable information. What is the point for us keeping everything?"*	4.2
8	*"The role of data management will be essential, but it is necessary to invest in transparency. That is, transparency and clear policies must be improved,* e.g.*, through clear, unified and reversible data protection, with a single profile per citizen."*	4.2
9	*"The future of electric mobility is only neglected by those with other interests. But a series of support lines is required to proactively improve the charging infrastructure and the potency of charge."*	4.2
10	*"Definitely SMEs, micro-SMEs (5 to 20 employees), at the same time as large companies (100 and 500 employees) (…) small companies have different points of view than big companies, different skills and capabilities. When you merge them, you have something magical! Private sector, public sector and the academia; it's all, that's the point."* *"It is important to generate an adequate ecosystem of public transport in which municipal entities are committed. Must include all mobility agents."*	4.3
11	*"Technology provides relatively easy solutions. Legal and regulatory aspects are key elements. Autonomous mobility goes step by step, it should start with highways. But the political dimension is unknown. Socio-political aspects are more doubtful than technological."*	4.3
12	*"A key problem for the sector is getting data. Cities may have some data, but not interconnected to offer meaningful analysis (…) the only solution is to partner up with a big city."* *"(…) business is in the data, and the relationship between the vehicle and the infrastructure, through the application of technology that already exists on the road (…) certain telecoms company intends to enter in the field of driving data analytic; there are many interests behind the connected vehicle."*	4.3
13	*"We offer a niche market product/service. We hope to evolve from public transport to automotive service provider."* *"Ours is a very specific software, so we are niche. However, its potential application is broad. We have some other small trials* e.g.*, an indoor product with a major aerospace OEM."*	4.4
14	*"We are a diversified company, where technological development and data management will be key for other areas/industries (…) in scalable business models, the marginal profitability of an incremental innovation or a small improvement in the product is very impressive."* *"It is also necessary to ensure that the system learns from the captured data, so that the cartography is updated in real time. Data management will be key in the future, in such a way that in a few years these vision systems will become a commodity."*	4.4
15	*"This project is actually a spin-out company from the matrix, it identifies how to solve specific problems and might then create solutions for that or depending on how that- those solutions have been derived then".*	4.4
16	*"Vehicles and software are our main source of income, but consulting is the most profitable area, as always. We do a lot of consulting for people who tell us 'we have to do this, and you can tell us about it'…"*	4.4
17	*"Large companies are collecting data to predict behaviour, but we are not at that point."*	4.4
18	*"We use Venture Capital funding since we have no recurring revenue so far. Most firms [in this business] do not have a recurring revenue stream."* *"The closer we get to full deployment; the more private funding will be available in AVs."*	4.5
19	*"(…) financially… Americans are investing billions in accelerating this technology. That is very important to accelerate technology. UK is fine, they have invested millions in it, but you cannot compare with billions. It is a shame because in Europe a lot could be developed. In China they are doing some things, but I think in the USA they are very strategically focused on AVs."*	4.5
20	*"Our proposition is a low-cost ADAS system to facilitate the connectivity of older fleet cars to reduce accidents, also in industrial environments".* *"We are working on shared corporate mobility; the employees can share a vehicle reducing the fleet required by the company".*	4.6
21	*"The new mobility tends to not use cars for short trips to share the road with other vehicles. Vehicle ownership patterns are expected to change."*	4.6
22	*"…different start times, fewer people going to more destinations, we are particularly good at is 'many-to-few', so lots-and-lots of people going to a few destinations and we are thinking on how combine those destinations (…), it is an evolution that appears on the road map.*	4.6

needs through specific value propositions. The understanding of the updated value chain associated with new mobility and the contemporary requirements by users and policymakers was fostering *identification* as a DC which connected the assessment of environmental evolution with a company's strengths (Q#2).

As discussed in the introduction, pressing concerns about the future opportunities and environmental impacts of the transportation sector are driving mobility stakeholders to cooperate with customers, public authorities or other partners. The development of on-demand solutions in direct collaboration with clients favours *co-creation,* which can become a differential capability for firms; that is, the intersection between socio-political trends, technical capabilities and understanding of underlying needs. It was argued that managers must have an open mind and capacity to collaborate with other organisations of diverse size on a flexible basis in order to foster their agility regarding market changes and upcoming needs, but also to explore cross-fertilisation of such developments in other areas, hence diversifying their innovation plans (Q#3).

Managers may balance their understanding of social changes with the particular technological foundations of their businesses, while interpreting the demand and supply characteristics introduced by end users and public authorities, in order to clearly define their contribution to market and society. But the demonstration of their often-advanced technology-based capabilities through a *visualisation* of their value propositions is core to attracting potential partners or customers. As one interviewee stressed, it is necessary to offer good reasons to use AV

devices as AVs will co-exist with conventional vehicles. The deployment of trials and multimedia case-study content explaining how AVs can provide specific solutions to the transport market have been identified as core for this visualisation-related DC (Q#4).

4.2. Key resources

The foremost issue on resourcing was the increasing importance of teams and the convergence of workforce skills with talent. Initiative, open mindedness and an ability to work in multi-disciplinary teams were identified as core staff attributes for these new mobility-related businesses. Being able to be flexible and *agile*, to the extent that small company size could be identified as a virtue, provides a competitive advantage to these organisations in addressing unsatisfied market needs. Indeed, the interviewees highlighted the value of recruiting interdisciplinary workers into their organisations (Q#5).

Although different interviewees signalled that the challenge is more social than technological, when they were asked about which they saw as the 'main' technologies underpinning their activities they outlined a wide array of ideas, summarized in Table 4.

The summary in Table 4 amount to a series of high-profile, emerging technologies, potentially being subject to 'hype' and with unclear future evolutionary paths of exploitation (Nikitas, Njoya, & Dani, 2019). What was clear was that sensors and ICT represented a 'spearhead' due to the primary need of collecting both close-proximity and wider-context situational data about the immediate vehicle environment and the road network. These primary technologies were expected to feed secondary in-house evaluation technologies which would be able to manage and process data (Artificial Intelligence and Machine Learning) and propose alternatives in specific situations in terms of security (cyber and physical), efficiency (routes, travel planning and shared transport) and sustainability (emissions and battery charge monitoring), as well as user comfort, once AVs are deployed. However, a key challenge that remained was the need for these organisations to manage their often-limited resources due to their SME or start-up nature and to prioritise their use among projects and countries aiming at the best possible *technology integration* to meet customer needs through innovative fusions of data sources (Q#6).

As an example, data management and latency were thus seen as core to improving the vehicle as a system, whether at SAE (2018) automation level 3, 4 or 5, but also for MaaS systems. Data management was seen as offering the option to create undisputable advantages in terms of security, minimising in-vehicle time, promoting sharing options, and enhancing comfort, but also in terms of the identification of suitable travel mode options or alternative routes. Nevertheless, it was argued that data should only be retained at manageable levels, because information storage requirements are otherwise expected to increase exponentially, increasing cost and data protection risks respectively. Therefore, it was seen as important for a manager to learn which data are important and which not, so as to avoid undesired and unnecessary exposure of the data managing organisation to breaches (Q#7).

In this context, some interviewees advocated for transparent data management, both for users and customers, along with the development of ethics principles and guidelines which will create a high level of protection. An innovative alternative which has been considered is for each mobility product/service user or citizen to have a unique data profile containing their raw mobility data, in the form of a mobility access card, for example (Q#8).

Hence it is clear, and many interviewees agreed, that data have become the basis for new service development, which is well aligned with the observation that companies with at least half of their revenues based on digital ecosystems offer higher revenues and profit margins than the industry average (Weill & Woerner, 2015). The core challenge is identifying the important information from the diverse data types and extracting value for each project and organisation both in the short and long term. Managing data volume and defining a series of *data management principles* about how corporations use data for value creation is crucial given that data management transparency may be a competitive mobility service selection criterion for users.

Finally, another area connected to the main trends is the electrification of mobility. The development of these capabilities was seen as cross-cutting, particularly due to the emergence of more available products in a context of rising concern about global policy targets related to emissions and pollution reduction (Q#9).

Table 4
Technologies suggested by interviewees *(listed by frequency of appearance)*.

1. IoT	2. 5G	3. ICT Platform
4. Artificial Intelligence	5. Big Data	6. Cyber Security
7. Emission Control System	8. Emission Control System	9. Data Fusion
10. ADAS	11. Lidar	12. Machine Learning
13. Quantum Computing	14. Blockchain	15. Neural Networks

4.3. Networks and alliances

Interestingly, responses relevant to this topic area emerged spontaneously during the interviews, before the interviewer arriving at the planned question in the guide. Many interviewees emphasised the necessity of developing an ecosystem of actors from different fields to create an 'innovation incubator' as a core resource. This 'constellation' of actors was seen as required throughout the value chain. Research centres and universities were perceived as situated at the early steps of the value chain, offering R&D insight but also enhancing a highly-skilled workforce. It was highlighted that, for integrated solutions to arise, it is vital to forge collaborations between diverse stakeholders with essential skills, organisational size and experience within the product and service development process, e.g., between OEMs, automotive suppliers, transport operators, safety testers and telecommunication providers. The latter would allow a holistic system overview of training needs accelerating validation and adoption of innovative solutions. This activity was thought to foster ties among partners, enhancing a close and mutually beneficial process (Q#10). Moreover, public authorities were seen as a fundamental component of such multi-disciplinary project teams alongside customers (e.g., OEMs, end users, transport operators), particularly regarding the deployment and validation steps, but extending to cooperation with standardisation and regulatory bodies. Hence, being able to work in a *collaborative ecosystem* also emerged as a DC.

Public authorities, in particular, were seen as a special case, because they may, depending on legal competencies, be able to regulate and either foster or limit the introduction of technological advancements, but even where regulations are determined centrally, their facilitating and motivating functions can be critical. That is, they can invest in appropriate infrastructure, promote networking and collaboration between and within industries and adopt policy stances which promote the concept of embracing new technologies as a local economic or transport network priority, and in these ways, they can contribute decisively to supporting the creation of the mobility ecosystem (Q#11).

Particularly important were those partners engaged in data processing: suppliers, managers, and developers. Interviewees mentioned the importance of data, but also identified certain shortcomings in extracting the maximum value from data analysis. Ideas around these shortcomings ranged from the risk of lower-than-initially-anticipated value being realised, to the fear of an 'ICT firms bubble' forming, as one interviewee suggested. Along the same lines, data management and integration featured as the new 'currency' or, as another interviewee mentioned, the next indispensable 'fuel' (i.e., equivalent to oil in an earlier mobility revolution). Undoubtedly, this was one of the most significant challenges the participants were dealing with, as most interviews emphasised the difficulty of managing data and realising the

extraction of value from data. Particularly, SMEs and start-ups were advised to form *alliances, acquiring and sharing data* with selected partners, while being realistic about the potential risks and shortcomings (Q#12).

4.4. Income generation

According to RBV, organisations are profitable when they achieve a superiority in the market. In the new mobility sector, revenue derives from at least three sources. One of these sources is selling physical products, such as sensors, cameras, or related hardware with embedded software, delivering targeted technological solutions to potential customers. In this case, the product itself (i.e., hardware) provides value to the user, either as an additional device or through integration with existing devices in a mobility ecosystem. Although some interviewees recognised that these kinds of solutions are currently technologically 'advanced', they may not remain so, suggesting their eventual commoditisation, bearing a reduced price with reduced profits in the medium-to-long-term. Nonetheless, first-mover advantage was identified as crucial for managers in such instances. Indeed, most interviewees considered their products and services as competing in a niche, but with promising possibilities to also compete in broader markets (Q#13).

It is particularly important to explore the diversification of the product for different user types in a continuously-evolving business, i.e., *reconfiguring market competencies*. If a company has made important investments in R&D, it should achieve the maximum profit possible for this commitment to continue to evolve in a virtuous circle based on both short- and long-term management plans (Q#14).

A second broad category of revenue acquisition concerned the data relating to the reality of mobility supply and demand, including products related to on-demand services and the co-creation of mobility solutions for potential customers seeking to target specific traveller groups. These may be 'mode agnostic' in terms of how the service is provided, since the key challenge is to reach the destination, never mind how, with a range of alternative solutions considered real-time to identify the 'best' option against user-defined criteria; a type of dynamic *personalised* travel planning service for users (e.g., MaaS). Revenue increases for all business ecosystem members were expected in the case that transit agencies were to share their data facilitating new mobility innovation, which in turn was expected to lead to increased service performance and user satisfaction (Q#15).

Finally, the last category of revenue sources relates to the *development of special offerings*, ranging from software and licencing, such as companies providing licenses to other companies for information analysis and management to other types of mobility data software. This category naturally includes consultancy about product maintenance or service updates, but also about how to improve the performance of hardware and software on offer. This revenue stream was thought to often rely on remotely-sourced data and to be delivered in tandem with a deep understanding of a new mobility product or service (Q#16). Thus, it is important to highlight the rise of software as an upcoming selling proposition in contrast to the hardware-based solutions which have been dominating the transport sector for decades.

Along the same lines, an associated business area was identified to be raw data retailing, but also consultancy associated with the aggregate profiling of users. The key challenge to overcome was the identification of behavioural patterns that help predict future travel and purchasing behaviours; a kind of Decision Support System for firms based on data analysis. But it was recognised that there is still a long way to go in this field (Q#17).

4.5. Funding

The evolving mobility sector had considerable capacity to raise funding until the COVID-19 outbreak. The sector is particularly attractive for public investment for three reasons. First, it is a 'trending topic' on the public agenda due to its effects on the competitiveness of countries and regions. Second, it is also an attractive sector for investment due to its potential influence on meeting national and international climate targets through reduced energy consumption and greenhouse gas emissions. Third, new mobility products and services promise new levels of customer satisfaction in a marketplace in which consumers' daily experiences often fail to live up to the idealised visions of efficient, 'seamless' mobility, particularly in dense urban areas. Nevertheless, it is not only public funds which were vying to fund mobility innovations, but also venture capital and private investors who have been active in investing in such projects (Q#18).

Some firms were growing substantially based on their individual revenue streams, while others were negotiating investments by private funds in order to grow. Indeed, in some cases, a spin-off company had emerged to offer specific solutions to demands identified through the initial market offering but not directly satisfied by it. Such an approach implies constant diversification based on a co-creation process including the business ecosystem stakeholders. A mix of private and public funding appears to foster such initiatives, particularly during times of high uncertainty, suggesting a DC in this business area, namely *attractiveness*.

However, interviewees had two main concerns when attempting to attract funding. The first was related to uncertainty about future mobility trends; an example of the perennial uncertainties associated with processes of profound change, which have been exacerbated during the COVID-19 restrictions imposed in most countries. The second was linked with private funding. Although Europe is strongly involved in the global development of new mobility services, with strong OEMs and component firms in the automotive sector, funding sources have traditionally been more abundant in the US rather than in Europe (#Q19). Different interviewees suggested that private funds in Europe were more conservative by nature than those in the US, which were more open to investing, for example, in AVs. The interviewees, based in Europe, envied the investment capacity of the US, identifying it as a competitive advantage, and contrasted European with US initiatives, particularly regarding ICTs and AVs. In contrast, most interviewees had very little or no detailed understanding about developments in Asia and particularly in China.

Table 5 summarises the findings linking concepts and the contextual evolution, the impact on BM, and the DC required.

4.6. Classification of the new business model typology

Based on insights from the interviews and adapted from Tukker (2004) PSS categorisation in combination with the SAE (2018) capabilities definition, a classification of BM is presented (Table 6). Each column includes a series of BM, some of them new and others traditional ones which are evolving, with a common value proposition that is explained subsequently. Table 6 also includes (using rows with different colours) the aggregation of the technological capabilities (autonomous, connected and shared) through an evolutionary approach, and other related attributes, such as the perceived personal autonomy of users during transport, the number of actors involved, the coordination capabilities required, the fleet availability and the fixed costs faced by the user; issues further explained below.

The value proposition in the category 'pure product' is very close to the traditional concept of mobility, where owning a vehicle is central (column on the left). In this group, an OEM or a component provider offers their technological products and after-sales services. The customer can access vehicles to travel with a high-technology option, keeping its full ownership and individual use. The last column modifies the suggestion of Tukker (2004) and is renamed as 'additional services' (column on the right), including data management and personalised services, and entertainment, among others. It becomes an evolution of the PSS categorisation, as the servitization of mobility is growing, and new services are expected to emerge. In many cases, those concepts will be integrated in the service offered, for example, long journeys and leisure travel in

Table 5
Linking Business Models with Dynamic Capabilities.

Concept	New mobility feature	Impact on business models	Dynamic Capability required
Value propositions	Social and political changes related to sustainability, efficiency and safety	Interpretation of the reality, integrating different perspectives such as data analytics, connectivity, hardware, and software	Vision
	New requirements about mobility by citizens and policymakers	To recognise unsatisfied customers' needs: connection of the environmental assessment with the company's strengths	Identification
	Speed of change	Flexible collaboration with stakeholders (and customers) to gain agility to attend market changes and new needs, and potential diversification (cross-fertilisation) of innovation outcomes	Co-creation
	Availability of new technological solutions	Deployment of case studies and multimedia contents to explain how the company can provide specific solutions to market to attract potential partners and customers	Visualisation
Key resources	Broader skills and knowledge (e.g., sociology, engineering, computing, urban planning)	Staff attributes to provide flexibility and agility able to address unsatisfied customer needs: Initiative, open mindedness and ability to work in interdisciplinary teams	Interdisciplinary team skills
	Multiple systems and platforms sharing and exchanging information	Integration of different interfaces and information systems to operate	(Systems) Integration
	Relevance of data communication among actors	To ensure manageability and transparency (through ethical statement) during data storage and use to increase user confidence	Data management and privacy principles
Networks and alliances	Ecosystem continuous innovation	Intensification of ties among partners, enhancing a close and mutually beneficial processes. External coordination and integration through collaboration	Collaborative ecosystem
	Diversity of data sources and providers	To obtain quality data from different potential providers	Alliance and resources acquisition (data)
Income generation	Presence of cross-cutting products and technologies	Market diversification to extend current market niches	Reconfiguration (market competencies)
	User diversity and specific needs	Adaptation of products to diverse user profiles or other industries	Personalisation
	Performance analysis based on raw data	To offer additional services linking to the products such as consulting or maintenance	Development of specialised offerings
Funding	High investment dynamism	External resource acquisition: public and private funders	Attractiveness

AVs would create a new or expanded market for entertainment or urban nightlife services (Cohen & Hopkins, 2019; Thomopoulos, Cohen, Hopkins, Siegel, & Kimber, 2021).

Within the part of Table 6 referring to PSS (the three central columns), the left-hand column includes BM related to the product-oriented system but providing solutions for some of the new transport challenges. This domain is characterised by the main user benefits continuing to arise from the ownership of the vehicle and within this domain the user retains significant freedom of choice about personal mobility but includes openness to ridesharing or vehicle-sharing in exchange for a monetary reward, losing in the process some degree of control over the mobility asset. The owner (main user) assumes responsibility for all fixed and sunk costs (e.g., depreciation, repair, maintenance, insurance) but is interested in sharing those fixed costs with other travellers, transferring some costs by participating in the 'sharing economy' via platforms or apps. Ultimately the BM suggest new types of services, such as insurance or platforms. The value proposition is more complex than in the case of the pure product, because ICT applications allow a contact between users and user-providers which creates new sources of income by improving efficiency (Q#20).

In the central PSS column, the use-oriented system applies a different mental model, as users are seeking different kinds of new mobility solutions. There is a lower level of traveller autonomy, but also fixed costs decrease. On-demand mobility comes into play, with more conventional models based on fleet management and database management (leasing or renting), but others built on real-time platforms and geolocation that allow more 'real-time' decisions for users (and more knowledge about the basis of demand by providers). Both the instantaneous information management and the marketplace combining offer and demand are centralised, so the coordination efforts increase. AVs may provide additional value as they promise to offer more flexibility in terms of human resource management, but only in the long-term. Meanwhile, autonomous or automated driving solutions, as in the case of pure products, are expected to provide greater safety during travel. ICT, platforms, geo-location systems, fleet management, environmental information, and e-marketplaces are all clearly important in this category in providing solutions to travellers. Thus, connectivity will become core to securing the use of a preferred (generally routinely-used) mode of transport. (Q#21).

In the right-hand PSS column, service-oriented (instead of Tukkers' result-oriented system) BM are found, in which the core transport service and destination have not already been specified but the mobility provider offers additional services (e.g., routing, ticketing, reservation of parking) adding value by enhancing the journey experience. The user is open to use different transport means depending on the criteria given in a certain moment. The value arises from moving a person at the time desired, drawing from a range of alternative services; the user takes an outcome-oriented evaluative perspective on the journey. The fleet 'belongs' to, or access is secured by, the service provider, with agility and efficiency, as the operator can resort to other (partner-)operators, increasing the coordination efforts and the number of actors participating. Fleet management software and coordination among units are therefore critical issues, and so e-marketplaces, data management software and connected vehicles are key resources. This category represents the ultimate version of the MaaS concept, where the user may not have major concerns about how the destination is reached, but simply follows the suggestions of the mobility service provider(s) (Q#22).

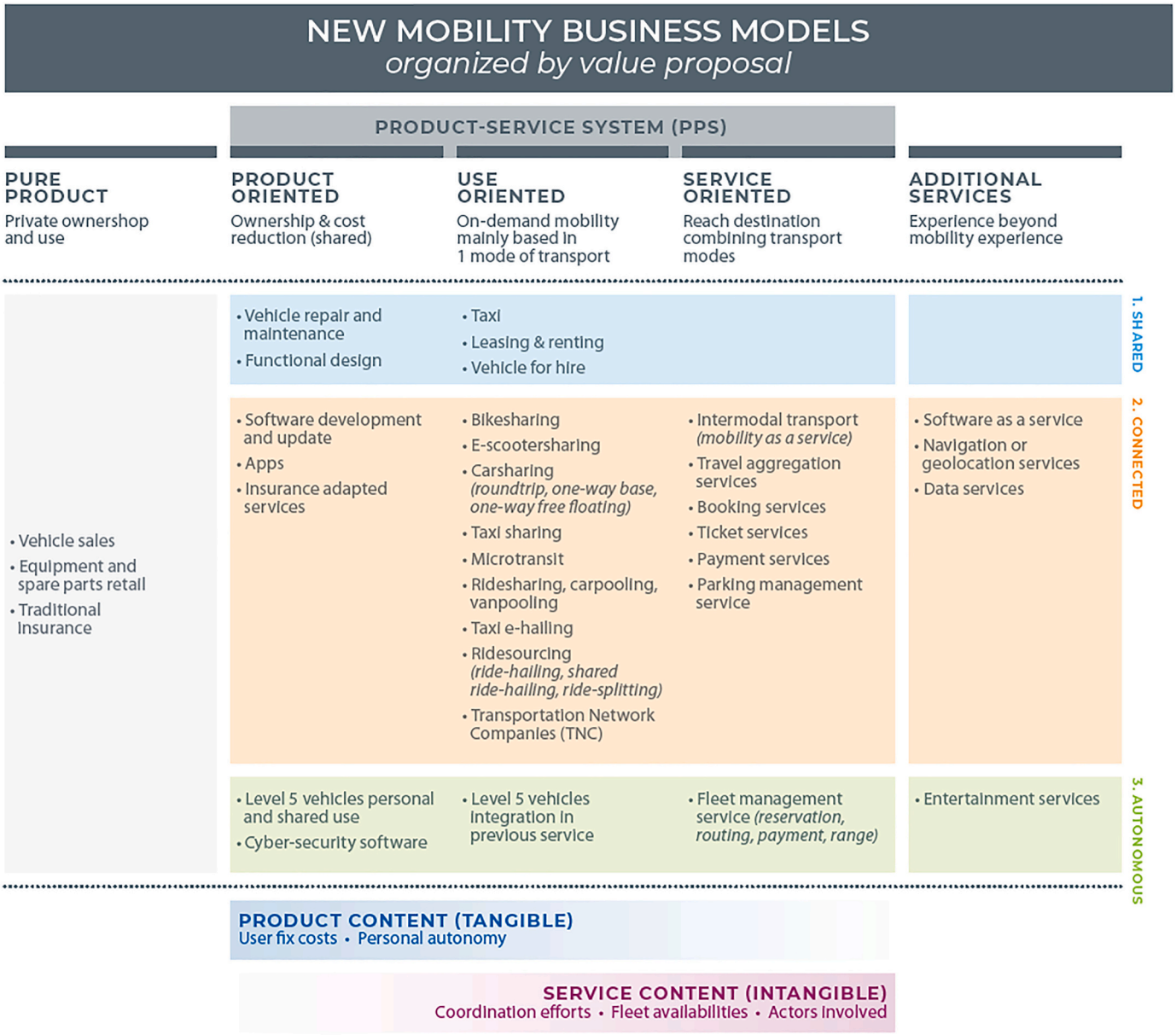
5. Discussion

5.1. Theoretical implications

This article has proposed a theoretical approach to analyse new BM and their associated DC in the new mobility value chain. This analysis includes all actors within the newly transformed value chain, therefore broadening its scope. It also integrates the BM approach (Osterwalder & Pigneur, 2010) and the DC to understand managerial practices from an evolving perspective (Preikschas et al., 2017). This approach allowed the identification of the main features of the value propositions with respect to new customer demands, the key internal and external resources to provide and support income generation solutions as well as the DC involved for firms in the new mobility value chain.

Following this theoretical approach, the findings that emerged reflect a common belief that mobility will be increasingly shared, sustainable, and multi-modal (Nikitas et al., 2021), despite significant, but in principle surmountable, challenges, such as the complete

Table 6
New mobility business models organized by value proposal.



decarbonisation of the transport system, provision of a new electric power infrastructure, overcoming the reticence of many travellers to share unstaffed vehicles with strangers, and the integration of different levels of automated driving capability alongside human-powered road users (Parkhurst & Seedhouse, 2019). In this context, the interviewees intend to identify and deploy business models which seek revenues associated with the rise of more autonomous, connected and sustainable mobility. This is linked with the development of a series of DCs in firms, related with the value propositions adjusted to new market needs, the resource base, and a broad range of managerial skills. In other words, for many firms targeting short-term profits, it does not matter if and when SAE Level 5 is achieved; there is a short- and medium-term market for their specific products and services, for example, in developing an interim level of driver assistance.

Given the nature of the organisations represented by interviewees in this study sample, the discussions tended to focus on BM development related to AVs. Nonetheless, shared mobility also emerged as an interrelated phenomenon in several interviews. Shared transport also underpins many of the ideas on optimisation and connectivity through this holistic perspective, involving users interconnected via online platforms. However, it is necessary to better understand the capabilities-based types of BM which are arising not only from technological, but especially from social and user-behavioural changes in mobility patterns within a socio-technical transitions framework.

5.2. Managerial implications

Since the research reported in this article was of an applied nature, different managerial implications arise, particularly regarding the classification of the DC identified as key requirements in the value propositions such as vision, identification, co-creation, and visualisation. Managers must interpret the new reality, integrating different perspectives such as data analytics, connectivity, or software. They should be able to recognise unsatisfied customer needs and deploy specific services

addressing such customer needs through co-creation. Hence the manager can explain how the company responds to market changes (Matschoss, Pietilä, Rask, & Suni, 2020). Moreover, the new mobility context is defined by the presence of cross-cutting products, technologies, user diversity, and their specific needs, as has been established through the interviews. In this context, revenue is generated from the diversification of markets and from the adaptation of current products to other user profiles and market segments. Such revenues are founded on the manager's capacity to reconfigure the firm's market competencies and, to a lesser extent, by the capacity to personalise offerings and additional services linked to products, such as consultancy and product or service maintenance.

However, the DCs in new mobility go beyond those related with value propositions and their adaptation to market needs. The findings highlight the special relevance of capabilities associated with internal and external resources. Regarding internal resources, the broader skills and knowledge (e.g., sociology, computing) of company staff are required to offer new mobility solutions, whereas managers' initiative and ability to manage interdisciplinary teams are at the core. In terms of data as a resource, new mobility is characterised by the relevance of communication and the use of multiple systems and platforms sharing and exchanging information among actors. Managers may analyse and promote the (technical) integration of different interfaces and information systems, whilst also ensuring data management remains 'manageable' and ensuring transparency during data storage and use, so aiming to increase user confidence with data sharing, which is a fundamental need in such business ecosystems. Data management is the source for new service development, and will be important in the

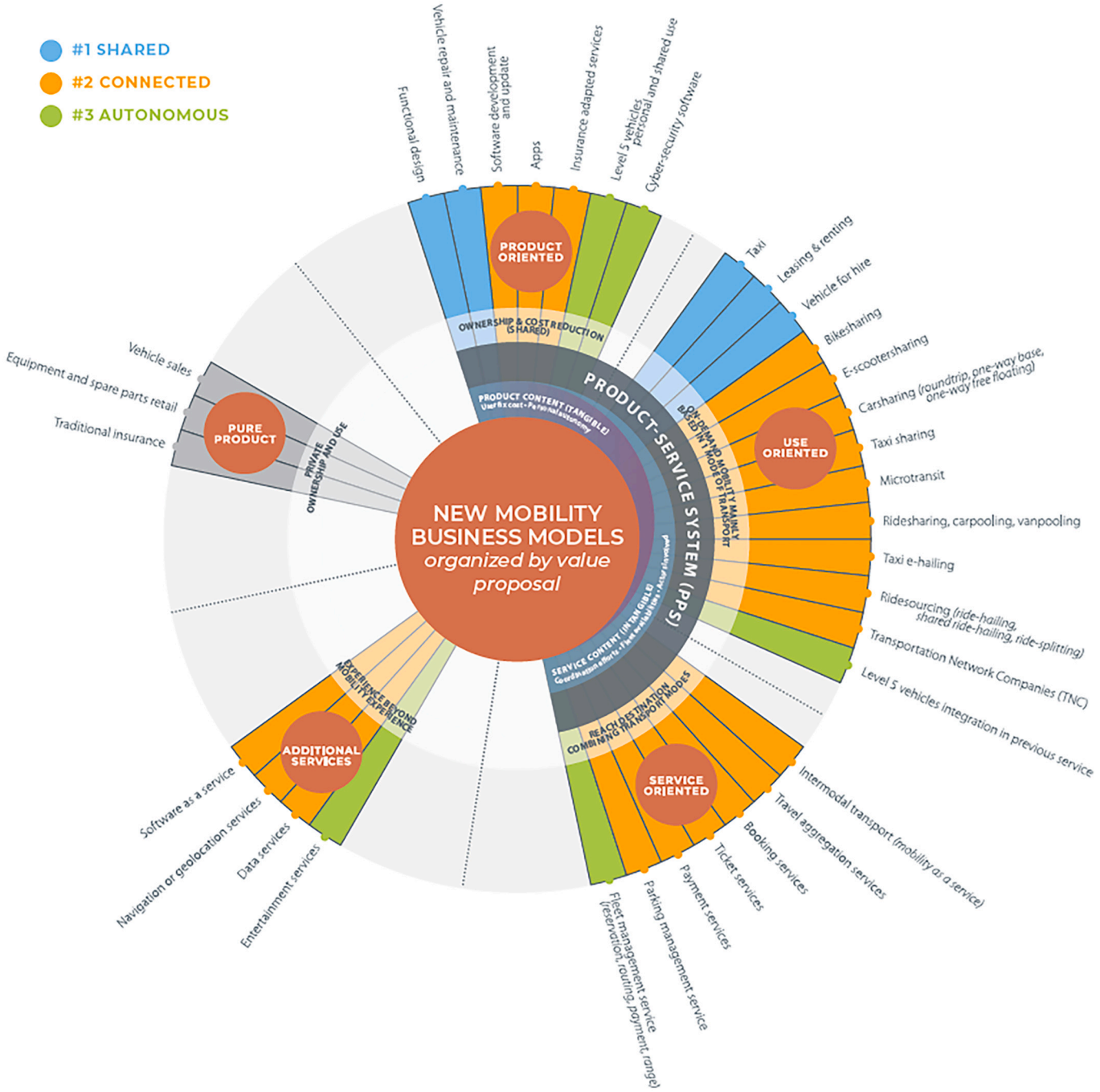


Fig. 1. New Mobility Business Model Innovation as a slice diagram.

rigorous evaluation of how to extract value from them.

Regarding external resources, new mobility needs a continuous innovation process which can only be deployed through a high level of dynamism based on capital investments. Managers may intensify the ties among partners, enhancing a close and mutually beneficial process (Oskam, Bossink, & de Man, 2021). The creation of a collaborative ecosystem and the capacity for external coordination and integration of innovations through collaboration on one hand, and the capacity to attract investments (public and private) on the other, are two issues managers should be engaged with. Whilst recovery from the COVID-19 pandemic unfolded across all industries and sectors of economic activity, it is important to stress the need for increased collaboration and support for niche testing and development, offering space for innovation, fostering business ecosystems as well as cross-regional collaboration.

Finally, a classification of business models and the importance of different forms of income generation associated with these different model typologies was developed. Fig. 1 reflects them as a slice diagram to emphasize the evolutionary approach and the importance of interrelationships. The application of this classification based on the PSS categorisation was useful in detecting the main areas of value creation for existing firms or start-ups developing new mobility services or products. This classification allows managers to identify the required efforts and provide a suitable offering to the market through new BM. The clearer the understanding of emerging BM through relevant visualisations, the easier it will be to find value propositions for the market according to their individual strategic and technical strengths. Those managers who want to successfully manage the changes in the business environment need to leave their 'comfort zones', venturing instead towards more multi-disciplinary and holistic BM, which will certainly be based on a more collaborative ecosystem.

6. Conclusions

The 'new mobility' industry has been high on the business and policy agenda since the beginning of the 21st century. It continues to be identified as a subject of continuous evolution, following ongoing technological innovation and building on grand aspirations to address economic, environmental and social objectives in an integrated way. In contrast with the increasing number of pilot trials taking place worldwide, relatively little attention has been paid to date in successfully testing viable BM. Therefore, this article has contributed towards bridging this gap by focusing on a value creation perspective on new mobility innovation.

The findings suggest that there are several cross-cutting themes (Table 5) which any firm in such a business ecosystem would need to consider, irrespective of their geographic location or the transport mode on which their service or product focuses. Establishing a concise value proposition and expanding key resources such as staff skills or data management procedures are crucial. Additionally, working collaboratively, either in clusters of the same business ecosystem or across regions, is an avenue leading not only to increased revenue streams, but also to increased attractiveness for external funding, which is essential in the early evolutionary steps of such firms.

At the same time, it is essential to also acknowledge the article's limitations and make suggestions for future research. First, although the data collection was concluded prior to the extensive lock-down measures implemented across Europe, mobility service provision has been significantly affected during the COVID-19 pandemic with uncertain long-term implications. Therefore, whilst the normative conceptual contributions of the article are robust, the empirical data relating to specific BMs should be perceived – even more so than typically is the case – as linked to a specific context. It is beyond the scope of this article to seek to judge whether the pre- or post-COVID-19 lens is more appropriate in seeking a long-term perspective regarding the historical emergence of new mobility innovation. Yet, it is reasonable to suppose that some niches will not evolve further, whereas new ones, perhaps linked to higher public health confidence or facilitating remote rather than face-to-face activities, may emerge.

Another limitation is the qualitative, transactional and cross-sectional nature of the research, given the dynamic nature of this market and the fact that a lot of new businesses have been appearing as well as disappearing. The exploratory approach adopted here could be further enhanced with a quantitative as well as a longitudinal study to help understand the evolution of business activities through time, as well as to comprehend how uncertainty was managed and how the evolution has unfolded since the series of DCs were identified. For example, one of the SMEs included in the analysis of this article has been acquired by a large multinational corporation opening up new opportunities, while forcing it to review its capabilities within its new business eco-system.

Considering future research, the wide scope of the research undertaken is particularly suitable for achieving a broad understanding of the business dynamics. However, a deeper understanding of particular issues within new mobility could be enhanced to study specific BM e.g., through AV trials and their evolution at the micro-level, within predefined mobility sub-sectors. Equally, the geographic scope could be expanded, since it would be interesting to conduct similar research aligned with the AV Readiness Index (KPMG, 2020) both within different regions across Europe, as well as outside Europe, notably the US and China.

CRediT authorship contribution statement

Pablo Cabanelas: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Graham Parkhurst:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization, Funding acquisition. **Nikolas Thomopoulos:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Supervision, Funding acquisition. **Jesús F. Lampón:** Writing – review & editing, Validation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Full questionnaire

1. How would you describe the current business focus and activities of your firm?
2. Where does the value creation lie within those activities?
3. And what about the future? How will your company respond to the evolution of market needs and opportunities?
4. What would you see as the key competencies or advantages of your firm in the future business environment?
5. And what technologies will be central for your business model?

6. And what would be the role of data management? How important do you think it will be? How is your firm adapting to this emerging situation?
7. Which are your main partners in developing your business? Why? How?
8. How would you characterise the marketplace you are offering your products/services into? Is it a niche or a broad sector?
9. Which of your activities are generating the highest revenue?
10. In terms of investing and financing, do you find you are operating in an attractive area regarding raising funds?
11. How important is geographical location to you? Why is your business located where it is? Where are the most advantageous locations for firms seeking to benefit from the changing mobility sector potentials?

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