

# Business Model Design in an Ecosystem Context

**Claire Weiller and Andy Neely**

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## Why this paper might be of interest to Alliance Partners:

Companies increasingly have to adapt and design new business models to retain a competitive advantage in highly networked, dynamic environments. This paper presents innovative business models that are being developed in four countries to support the commercialisation of electric vehicles (EV). Findings emphasise the importance of inter-industry partnerships in new value-chain configurations and an ecosystem view of value creation and capture.

This research has several implications for business model design for firms in early-stage innovation ecosystems. First, the case studies in the EV industry illustrate how firms create business models by taking an ecosystem perspective on the outcomes they wish to create for users, and the configuration of the value network they envision. Second, this research shows that the co-existence of competing business models is possible in early ecosystems, but initial business model plans may result in completely different applications than expected.

The framework presented in this paper could be useful for companies to take an ecosystem perspective on their business models. It includes criteria that are essential to the EV sector, but also general criteria, such as business model flexibility and enabling of technological innovation. The four “quadrants” in the framework, that distinguish customer vs business and financial vs strategic advantages, can be applied in the context of other industries as well.

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# Business Model Design in an Ecosystem Context

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## Abstract

Companies increasingly have to adapt and design new business models to retain a competitive advantage in highly networked, dynamic environments. This paper presents innovative business models that are being developed in four countries to support the commercialisation of electric vehicles (EV). Using an original business model framework and interviews with EV company founders and directors, we analyse competing business models for charging networks (US, Japan) and for mobility services (France, Norway). Findings emphasise the importance of inter-industry partnerships in new value-chain configurations and an ecosystem view of value creation and capture. The results provide practical insights for EV companies with which to evaluate their innovative business models. The contribution to theory is a process framework for business model design in the context of early ecosystems.

## 1. Literature Review

### 1.1 Business model innovation

Interest in the concept of “business models” can be traced back to the dot.com boom of 2000–1, a time when a bewildering array of new businesses were being launched based on Internet and telecommunications technologies (Afuah & Tucci, 2000). Though consensus has yet to be reached in the management literature on a common definition of a business model (Zott et al., 2011), one early definition that has been widely influential stems from Amit & Zott (2001): “A business model depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities.” Business models have been presented as a new unit of analysis, which integrate various theoretical perspectives on value creation (Amit & Zott, 2001). Six major functionalities (Chesbrough & Rosenbloom, 2002; Osterwalder et al., 2006) of business models are:

- the value proposition;
- the customer market segment;
- the value chain;
- the cost and profit structure;
- the strategic position of the firm in a value network;
- the formulation of a competitive strategy.

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More detailed frameworks for the design and classification of business models have been developed (Zott & Amit, 2007; McNamara et al., 2011) since the early publications on the topic. However, beyond semantic issues, the opportunity for future research on the theme of business models appears to be related to the challenges of innovating and implementing new ones in practice (e.g. Chesbrough, 2010; McNamara et al., 2011; Visjnic & Neely, 2011). The ability to experiment, through progressive introductions of new products or services and systematic data collection on usage and performance, is important in early stage development of business models (Chesbrough, 2010). Google, for example, experimented with several versions of a new service called “Froogle”, or “Google Fridge”, before developing the now common “Google Checkout” (McNeill, 2012). McNamara et al. (2011) discuss the need for competing companies to “know what kinds of business model configurations are possible within an industry” and to know how and whether it is possible for firms to change between models. This study feeds the literature debate with an empirical case study investigation of business models and examples of what the concept might mean in practice.

## **1.2 Ecosystems**

Existing business model templates and frameworks (Osterwalder et al. 2006, Sinfield et al., 2012) are adequate to examine the challenges faced by single existing organisations (Johnson et al., 2008), but less suited to analysing the interdependent nature of the growth and success of companies that are evolving in the same innovation “ecosystem”. A business “ecosystem” refers to the network comprising a focal firm, its suppliers, its complementor firms, and customers (Adner & Kapoor, 2010). Business ecosystem theory originated in the work of Moore (1993). Some key features of business ecosystems are the interconnectedness of companies’ fates and the processes of competition and cooperation (Peltoniemi, 2005; Iansiti & Levien, 2004). However, few tools exist for the analysis of firm strategies in ecosystems. Ecosystem mapping (e.g. Couzineau et al., 2012) has been used as a visual tool to understand the relationships and interdependencies between firms in an ecosystem. This paper seeks to step forward from a static ontology of business models to a dynamic process of business model design within the context of an ecosystem. The case studies in this paper illustrate the interdependencies that are not represented in Osterwalder’s framework elements (channels with suppliers, partners and customers). Indeed, it is suggested through the case studies in this paper that a deeper link exists between a company and its ecosystem players, which should take the form of an iterative process of business model design.

## **1.3 Aims**

Therefore, the aims set out for this paper are to:

- 1) Understand how new business models are designed in the context of an entire ecosystem that is not yet mature, and how the ecosystem view can guide business model design.
- 2) Develop a methodology to evaluate and compare alternative business model designs in an emerging ecosystem.

## 2. Methods and Research Context

To explore the diversity of configurations of value appropriation that are available for companies undertaking business model innovation, we use the case study methodology (Eisenhardt & Graebner, 2007; Yin, 1994). The case study research method is well adapted to answer the “how” types of question (Yin, 1994) with substantial evidence on processes in early innovation strategies. The primary data for the in-depth case studies are collected from interviews with senior managers, company founders and CEOs in EV ecosystems.

We identify the electric vehicle (EV) industry as a pertinent setting to study business models in the context of an emerging business ecosystem. The EV industry is at an early stage of development, where business model innovation is necessary to promote product adoption, an efficient configuration of the value network, and a strategy for value creation and capture. The EV industry is emerging as an innovative ecosystem that provides a naturally occurring experiment of diverse business model designs.

The value chain for electric vehicles can be broadly divided into the following functions (Figure 1) (Kley et al., 2011; San Román et al., 2009; Anderson et al., 2009):

- vehicle manufacturing;
- battery manufacturing;
- charging infrastructure developers;
- electricity supply services and distribution grid management;
- information technology services (telematics and grid integration);
- customers (EV users).



**Figure 1. A basic representation of the EV value chain**

### 2.1 Ecosystem case selection

Using ecosystems as the unit of sampling and business models as the unit of analysis, we choose four cases of emerging EV ecosystems that have been identified through a review of the academic literature (e.g. Anderson et al., 2011), published case studies, and specialised industry news sources such as *cars21.com* and *EV Update* (Table 1).

These four case studies were selected on the basis of their strongly innovative and contrasting approaches to EV business models. The first two case studies, SwapCo in the United States and FC-Co in Japan, are companies developing systems for electric vehicle charging, including infrastructure and/or services. ServCo 1 (Norway) and ServCo 2 (France) represent a new type of mobility-as-a-service company. These cases are comparable in pairs due to their position in the EV value chain: charging infrastructure and end-user services.

The focal companies were founded in different countries: the US, Japan, Norway and France. The diversity of international contexts allows for the verification of findings validity beyond institutional and political boundaries. The findings are expected to be generalisable and robust across contexts, allowing the cases to contribute to business model and strategic management theory.

**Table 1. Case studies: Business models in EV ecosystems**

Case no.	Focal company	Origin	Ecosystem function	Business model strategy	Market presence
1	Swapping company (SwapCo)	California	Charging infrastructure and services	Battery-swapping; platform leadership	Regional
2	Fast-charging (FC-Co)	Japan	Electricity supply and charging services	Fast-charging; technology leadership for fast-charging	National
3	EV sharing 1 (ServCo 1)	Norway	Mobility-as-a-service	B2B car sharing; partnerships	Metropolitan area
4	EV sharing 2 (ServCo 2)	France	Mobility-as-a-service	Public car sharing; vertical integration	Metropolitan area

## 2.2 Interviews

In each ecosystem, we interview the focal company in addition to sample companies at all the different levels of the value chain (Figure 1), to gain a comprehensive understanding of how companies design business models and envision their position in the EV ecosystem. At this stage of the research, approximately forty interviews have been conducted with company founders, CEOs, CTOs, and senior managers of EV units within companies that are active in the value chain. The interview data to date is summarised in Table 2.

**Table 2. Completed interviews (02/2013)**

Ecosystem	Number of respondents	(Total)	Interview reference code
No. 1: California	1 OEM, 1 battery manufacturer, 1 utility, 1 wholesale electricity supplier, 4 charging infrastructure providers, 1 mobility-as-a-service start-up, 1 energy management/software provider, 1 environmental consultancy, 1 environmental public agency, 1 research institute	13	A11, B11, U11, EN12, C11-C14, I11, MS11, EM11, O11, P11, R11
No. 2: Japan	4 OEMs, 1 OEM start-up, 2 utilities, 2 battery manufacturers, 2 energy equipment and services provider, 3 industry experts, 2 academics, 2 energy management/software providers, 1 mobility-as-a-service provider, 1 management consultancy, 1 governmental ministry, 1 research institute, 1 engineering design company	21	A21- A24, A25, D21, U21, U22, B21, B22, EQ21, EQ22, EXP21-EXP23, AC21, AC22, EM 21, MS21, MA21, GOV 21, R21
No. 3: Norway	1 oil & gas company, 1 wholesale electricity generation company, 1 property developer, 1 rail company, 1 transmission network operator, 1 mobility-as-a-service provider	6	OG31, EN31, P31, R31, N31, MS31
No. 4: France	1 mobility-as-a-service provider, 1 governance. Upcoming: 1 energy management systems provider.	2	MS41, GOV 41



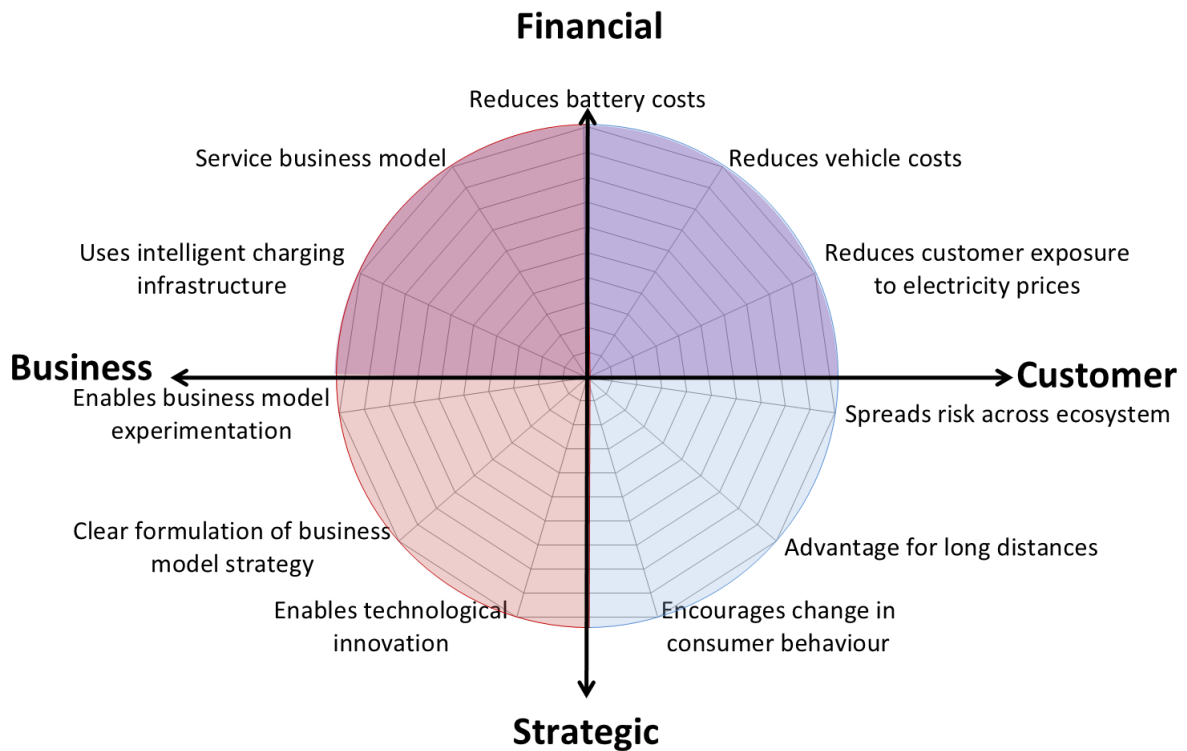
The interviews listed in Table 2 are also supplemented with interviews conducted in the UK with an OEM, a charging infrastructure company and with an international research organisation (interview reference code: Rx). Interviews were recorded, transcribed and coded in NVivo 10 to analyse content systematically in the comparative case analysis.

### **2.3 Framework**

In order to compare and to provide grounds for evaluation of the diverse business models, we identified evaluation criteria from the pilot case studies and in the literature on electric vehicles and strategic management. The resulting research framework allows comparison of EV business models according to 11 criteria that were compiled from the academic literature on technology adoption, innovation, energy policy, as well as industry and consulting reports. This framework is designed to include the main elements that companies should consider when innovating their business model in EV ecosystems. Each business model can be ranked on six scales of change from the consumer perspective and five scales relating to the supply side. The dimensions are presented in four quadrants that reflect the type of competitive advantage: business-oriented vs customer-oriented, and financial vs strategic advantages. A short description, main implications, and scoring scales of each dimension are presented in Table 3.

The framework (Figure 2) has the advantage over existing frameworks that it is not limited to one company and can be applied to an ecosystem of companies in the EV sector. It is therefore useful in this study, where the “business model” rather than a specific company is the unit of analysis.

The first three dimensions (Table 3) evaluate how the business model addresses financial considerations for customers. The three cost sources for EV customers are the battery, the vehicle (without the battery), and the price of electricity as a fuel (Andersen et al., 2009). As for customer exposure to electricity prices, a business model obtains a high score if the customer is protected from the variability of market prices. The scoring for this dimension was chosen for the cost advantage provided to customers in the short term. In the longer term, cost-based electricity pricing ensures an advantage for customers. This is because a competitive efficient market for retail electricity services can only develop – for maximum social benefit – in the context of market-determined prices, that is, if EV charging is done at market rather than at regulated prices. Previous research has shown that the cost of electricity is about a quarter of the price of gasoline for an equivalent distance driven (Yang, 2009; Yeh, 2009).



**Figure 2. Business model framework for electric vehicle commercialisation**

Next, two qualitative dimensions focus on two major barriers to customer adoption that are commonly cited by industry experts (e.g. AC21): EV limitation for long-distance travel, and required change in customer behaviour. Some business models find solutions for long-distance trips, whereas others are limited to local markets. There is also a scale of change and adaptation required in consumer behaviour, from least change in customer driving habits to a significant shift in attitudes towards private transport.

The business-oriented, qualitative dimensions of the framework are the ability to shape an innovative/competitive technological ecosystem (Adner & Kapoor, 2010; Adner, 2006; Geroski, 1990), the explicit or implicit formulation of business model innovation (McNamara et al., 2011; Chesbrough, 2010), and the openness of innovation in the business model (Chesbrough, 2007; Christensen et al., 2005).

Finally, financial value for the focal companies may be amplified as a result of service-oriented business models (Visjnic & Neely, 2008; Tukker, 2004). The co-integration of smart communications in the vehicle and in electric power system infrastructure is a source of complex value creation. Smart ICT enables optimised and controlled vehicle charging. Intelligent vehicle charging technology also has the potential to generate additional external value through the renewable energy storage and secondary energy market services. The last financial dimension of EV business models is that of risks. Higher scores indicate that a firm takes on or reduces risk from other stakeholders in the ecosystem, just as ServCo 2 or SwapCo do for their customers. The nature of risks in the EV sector is multiple. The uncertainty of battery technology costs, lifetime, and development schedule

are examples of technical risks. The failure of the EV market to take off is a market risk, as is the concurrent development of alternative transportation markets (e.g. fuel cells, liquefied natural gas, and hybrid vehicles). Systemic changes, such as macro-economic, environmental, and energy policy environments, may change the investment priorities at a global level and affect the EV ecosystem as a consequence.

Table 3. a) Business model innovation around barriers to consumer adoption

Scale	Description	Implications	Low score (0)	High score (10)
<b>Reduces battery ownership costs</b> (Andersen et al., 2011)	Who owns the battery?	- Technological risk associated with battery degradation and improvements - Capital costs	Customer fully owns the battery	Company fully owns the battery
<b>Reduces vehicle ownership costs</b> (Andersen et al., 2011)	Who owns the vehicle in the BM?	- Vehicle cost risk - Market risk associated with industry evolution	Customer fully owns the vehicle (- battery). Business-as-usual	Company fully owns the vehicle
<b>Reduces customer exposure to electricity prices</b> (Gomez et al., 2011)	Does the BM include the price of recharging, or do customers pay a fixed rate, or market prices?	- Fuel price risk - Elasticity of demand for electricity - Incentives for “smart” charging choices - Pay-back time of initial costs	Customers pay for electricity at market prices. Highest elasticity of demand and price risk.	The cost of electric recharge is fully included/covered by the supplier.
<b>Spreads risk across ecosystem</b> (Visnjic & Neely, 2011)	Who bears the risks in this BM – technical, market, financial, infrastructural?	- The distribution of risks influences EV adoption and entry strategies	All risks of adoption accrue to consumers. Business-as-usual	Risks are distributed over different agents
<b>Advantage for long distances</b> (Andersen et al., 2011)	Does this BM resolve the issue of range limitation?	- Solution to a major barrier to EV adoption	The BM does not address the problem	The BM explicitly offers a solution for long-distance recharging
<b>Encourages change in consumer behaviour</b> (Turrentine et al., 2007)	Does the BM change the way people drive and attitudes?	- Market research and modelling: cannot treat driving behaviour as exogenous	No changes in consumer behaviour	Full range of changes: driving habits, attitudes towards personal vehicles and mobility

### b) Enablers of EV ecosystem development

Scale	Description	Implications	Low score (0)	High score (10)
<b>Enables technological innovation</b> (Adner & Kapoor, 2010)	Does the BM allow for innovations in vehicle design, in battery technology, in charging networks?	Technology-based competition drives industry growth	The BM does not require or facilitate technological change	The BM requires significant technological change
<b>Clear formulation of business model strategy</b> (Chesbrough & Rosenbloom, 2003)	Does the company explicitly define its strategy as BM innovation?	Emphasis of entry strategy on technical vs marketing aspects may be a determinant of success	The BM and its innovative component are not addressed explicitly.	Explicit focus of the company on BMI
<b>Enables business model experimentation</b> (Chesbrough, 2010)	Is the BM flexible? Can it be adapted to new technological and market conditions?	BM flexibility improves firm resilience in a changing market	The BM requires irreversible actions	The BM can be implemented gradually and adapt to market needs
<b>Uses intelligent charging infrastructure</b> (Andersen et al., 2009)	Does the BM require smart charging and grid communication technologies to be implemented?	Arguably, ICT allows the full value creation and capture from innovations in the EV sector	The BM uses a “dumb” charging infrastructure	The BM requires smart controls for charging
<b>Servitized business model</b> (Tukker, 2004)	Is EV transportation viewed as a private good, a private service, or a public service?	Changes the value proposition	Vehicles as a product. Business-as-usual	Mobility as a service with maximum efficiency and optimisation



### 3. Case Studies

#### Case 1: California – Battery-swapping

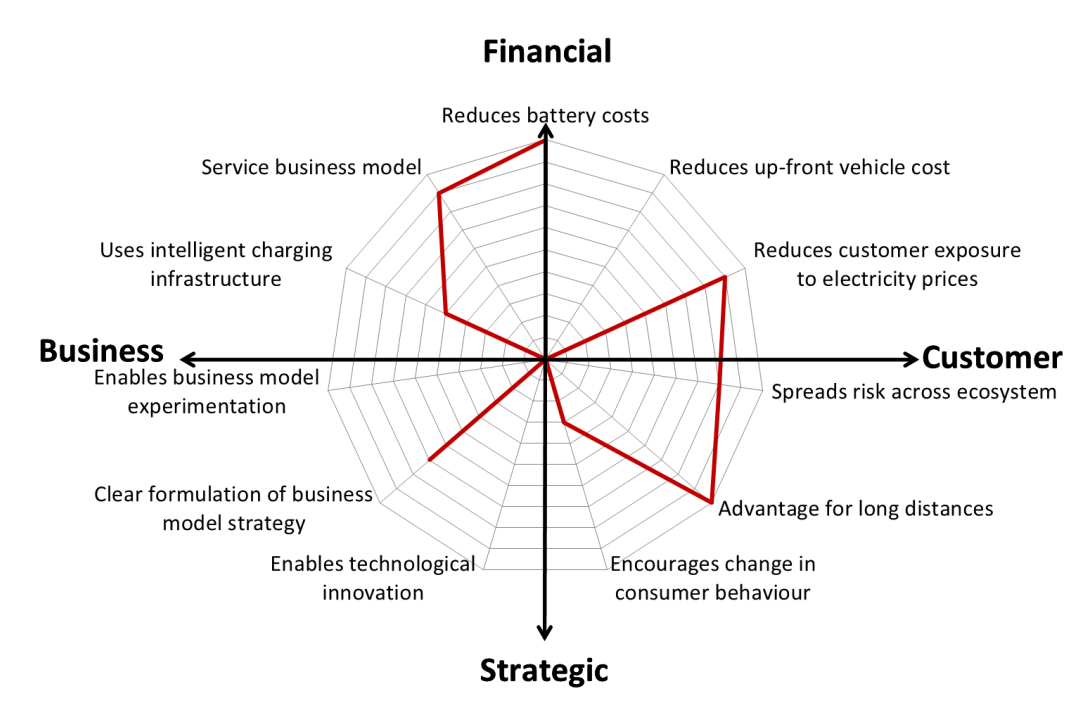
The battery-swapping business model is based on two main concepts: the separation of ownership of battery and vehicle, and users' subscriptions to a service network for "refuelling". According to this model, EV buyers purchase a car and lease a battery, and pay monthly for access to a network of battery-swapping stations, where their car batteries, once empty, are replaced with full new ones in approximately five minutes.<sup>2</sup> The innovation in the subscription contract is that the fee is charged "per mile", thus offering a service similar to a cellular network subscription for driving (Andersen et al., 2009).

Against the research framework, this business model performs very well on the dimensions of reducing battery costs for consumers, as well as reducing customer exposure to electricity prices, since battery recharging is included in the monthly subscription fee. The model shifts much of the risk in the EV purchase from consumers to the company. It offers a strong solution for long-distance travel, by alleviating the barrier of long recharging times. In terms of encouraging change in consumer behaviour, the model does not receive a high score as it tries to fit within current user habits by providing a solution around a strong barrier to adoption, rather than to deeply shift the expectations of the customer to different performance criteria, as a truly disruptive business model would (Adner, 2002). A major weakness of the business model is that in order for the battery exchange to be quick and automatic, it requires a high level of standardisation of batteries and vehicle design (A11). "Swap-Co", the company that conceived the battery-swapping business model, consciously designed a business model that would lock in partners and customers and position them as a "platform" company (Andersen et al., 2011). This strategy could lead to a natural monopoly in the charging network business, which suggests this business model would reduce rather than stimulate technological innovation in the ecosystem. The high capital costs and space requirements of battery-swapping stations make it difficult to experiment with the business model. The role of smart energy demand management in the battery-swapping business model is not emphasised and ICT serves more to enhance the driver's value proposition, for example, through location and identification services, than to optimise battery charging. However, the availability of large storage parks of batteries for the swapping system could be an avenue to secondary usage of EV batteries for electricity storage (EQ21).

Despite a clear vision of the ecosystem and its position therein, as well as an amount of starting venture capital funding and investment close to \$1 billion (C11), SwapCo did not manage to convince the rest of the ecosystem (particularly automakers) to subscribe to its vision. The company signed memorandums of agreement with governments in Israel and Denmark, small countries with strong political interest in diverting from fossil fuel resources. SwapCo's limited implementation of its business model in practice, despite its ambitions and influence on EV business model innovation since its founding in 2007, means that it has not become a central player in the California EV ecosystem.

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<sup>2</sup> *New York Times* (31/07/2011) Plug-and-Play Batteries: Trying Out a Quick-Swap Station for E.V.'s: <http://www.nytimes.com/2011/07/31/automobiles/a-plug-and-play-plan-for-ev-batteries.html>



**Figure 3. Framework analysis: the battery-swapping business model (SwapCo)**

### **Case 2: Japan – Fast-charging**

The fast-charging business model is another solution to the barriers of electric vehicle use for long-distance travel, namely, the fear of running out of battery power and the inconvenience of long recharging times with electric vehicles. Fast-charging at 50 kW allows a full charge in less than 10 minutes. FC-Co is an electric utility in Japan that relied on a collaborative R&D consortium and strategic alliance formation<sup>3</sup> to achieve technological leadership and convert its technological standard into a “dominant design” (Suarez & Utterback, 1995).

This business model focuses solely on charging infrastructure and services and does not deal with the customer financial barriers to EV adoption (Figure 4). The technology development and market risks are shared between companies in the alliance, but customers still bear the full risks associated with buying an EV. This system adapts to consumer refuelling habits with little incentive to facilitate significant behavioural changes (drivers would recharge their car similarly to making a stop at a gas station). The business model encourages technological innovation in the value network. FC-Co is a utility with highly influential power (AC21), which made it possible to engage a wide network of international automakers, equipment manufacturers and ICT companies. The various elements of the business model are not explicitly formulated, which may prove to be a weakness in terms of FC-Co achieving dominance in the international market, where alternative standards for fast-charging are being commercialised (SAE

<sup>3</sup> ChaDeMo (2010) Annual report: [www.chademo.com/pdf/ar2010.pdf](http://www.chademo.com/pdf/ar2010.pdf)

J1772). Given the partnership strategy, the business model appears highly flexible and adaptable to information input from various ecosystem participants as the EV industry evolves. Fast-charging poses a huge challenge for grid management due to the demand spikes it would cause. Due to these risks, the business model enforces the necessity of optimising EV charging and managing the load with smart grid technologies.

Finally, the business model is agnostic as to servitization in the EV value chain. It may be compatible with service business models in various areas such as the charging network or end-user mobility services but does not include this in its remit.

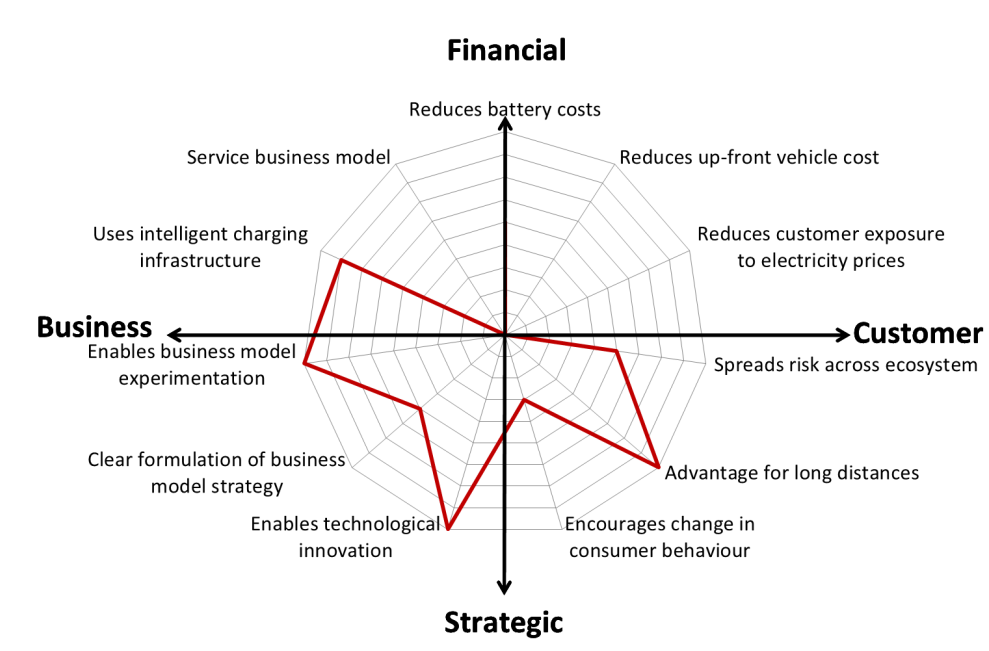
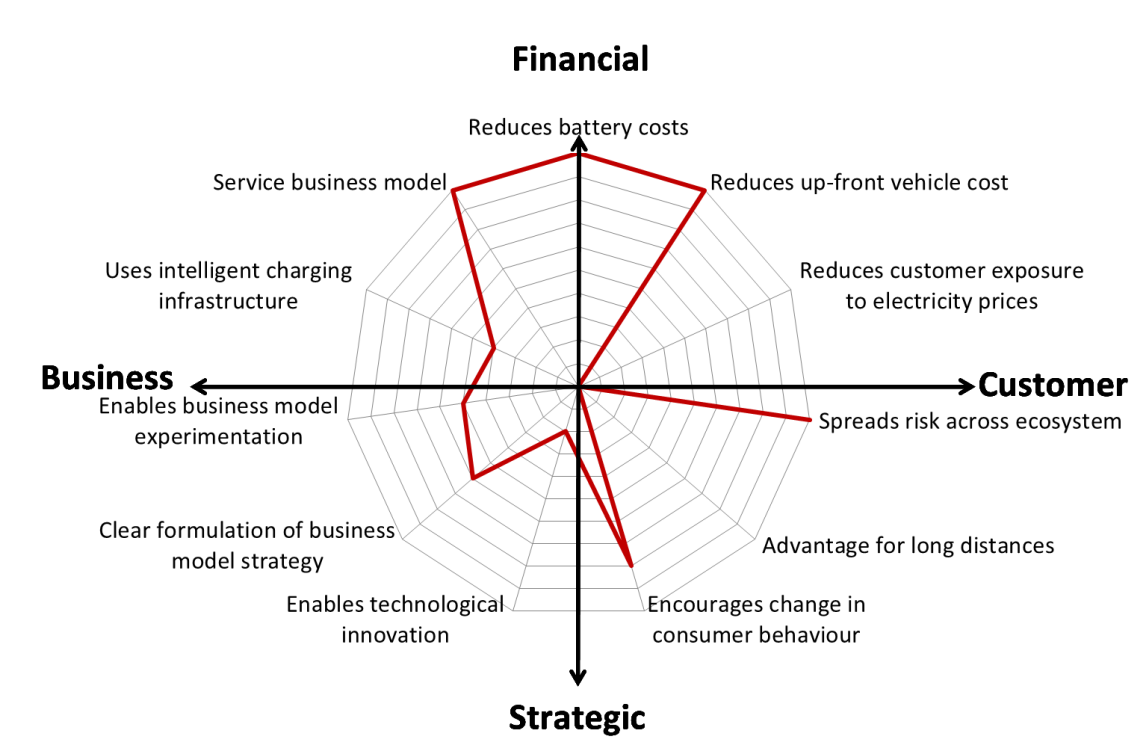


Figure 4. Framework analysis: the fast-charging business model

### Case 3: Norway – Mobility-as-a-service 1

The case of *ServCo 1*, a company founded as a spin-off from Norwegian company Th!nk in 2007, illustrates one of the earliest initiatives to sell the service of mobility with electric vehicles. The business model is a regular car-leasing model that innovates by offering environmentally sustainable products: electric vehicles. The company has been focusing on the corporate fleet customer segment and provides an integrated service for EVs, including repairs and maintenance, online booking system, and charging demand management. Customers pay a monthly subscription and usage time fee, which shields them from vehicle and battery costs and the risks associated with buying an EV. ServCo have contracts with major local companies like Statkraft, the Norwegian utility, property developer ENTRA, as well as with the university in Oslo. The cost of electricity is billed to and paid for by the customers directly. The company procures its EVs from many of the current manufacturers (Mitsubishi, Nissan, etc.) (MS31). The business model spreads the risk across the ecosystem, by separating the functions of vehicle manufacturing, electricity supply, and even charging infrastructure construction, since corporate customers are responsible for the capital costs of their charging stations. The model of car-sharing or car-leasing is restricted to local areas, usually urban areas where sufficient use can be made of

such a system. ServCo 1 therefore plans its expansion from city to city, rather than radially growing around a centre of activity (MS31). E-mobility services require a radical shift in customer mindset from “vehicle” to “mobility”, as well as from “gasoline” to “electric”. The model does not have any implications for technological innovation in the EV sector. ServCo 1 is very clear about its business model’s strengths (MS31), without wishing to overcome some of its limitations. The model allows for limited experimentation given the single focus on the combination of car leasing with electric vehicles. While ServCo wants to use ICT to improve customer experience and optimise the dispatch and charging of its vehicle fleet – particularly because their business model allows provision of EVs that are not 100 per cent recharged, depending on the distance a customer wants to drive – there is no vision to use ICT for new value creation and capture in this EV ecosystem.



**Figure 5. Framework analysis: private EV leasing service by the Norwegian start-up ServCo 1**

**Case 4: France – ServCo 2**

The second mobility-as-a-service business model is the case of the government-commissioned introduction of EVs as a new sustainable mode of urban transport. The service is a public EV-sharing service governed by a public-private partnership between ServCo 2 and local municipal authorities. ServCo is a family-run French industrial conglomerate, which integrates the service by providing its own battery technology, developed over the last 10 years based on its experience in super-capacitors (MS41), electric vehicles, charging stations, operations, maintenance and repair services, electric recharging and energy management through a subsidiary, as well as all customer-facing services. Local authorities are partners and provide land and up to €50,000 per charging station in initial investment. Since its launch in Paris in December 2011, around 53,000

users have subscribed, of which 20,000 are annual subscriptions. For a fixed fee and a usage fee of around €5/30 min, customers gain access to a dense network of approximately 2,000 EVs in 750 parking stations around the city of Paris (MS41).

The business model reduces up-front costs for EVs (batteries included) and the cost of electricity is included in the use-based fee.<sup>4</sup> Customers do not have to own a vehicle to drive one, and the risks associated with ownership are shifted to the public-private partnership in charge. However, the fully integrated structure of the service suggests that risks are not spread across players in the ecosystem and the market is monopolistic. A single battery failure would signal the end of the whole 12-year project. This business model, similarly to ServCo 1, is limited to metropolitan areas and is therefore not suited to long-distance travel. While the service is promoted as a complement to other modes of transport, rather than a substitute (MS41), its explicit goal is to encourage a shift towards “mobility-as-a-service” (MS41). It therefore receives high scores on two criteria of the framework: “change in customer behaviour”, and “service business model”.

Strategically, the explicit long-term objective of ServCo 2 is to pioneer city EV-sharing services, to stimulate market demand for EVs (ServCo 2 also leases its EV model for private users), and to pioneer energy storage technology through the development of high-performance batteries (MS41). ServCo 2 could be approached by vehicle manufacturers to license its battery technology. The business model enables ServCo 2’s future opportunities in these sectors, but does not have many implications for technological innovation in the surrounding ecosystem of firms.

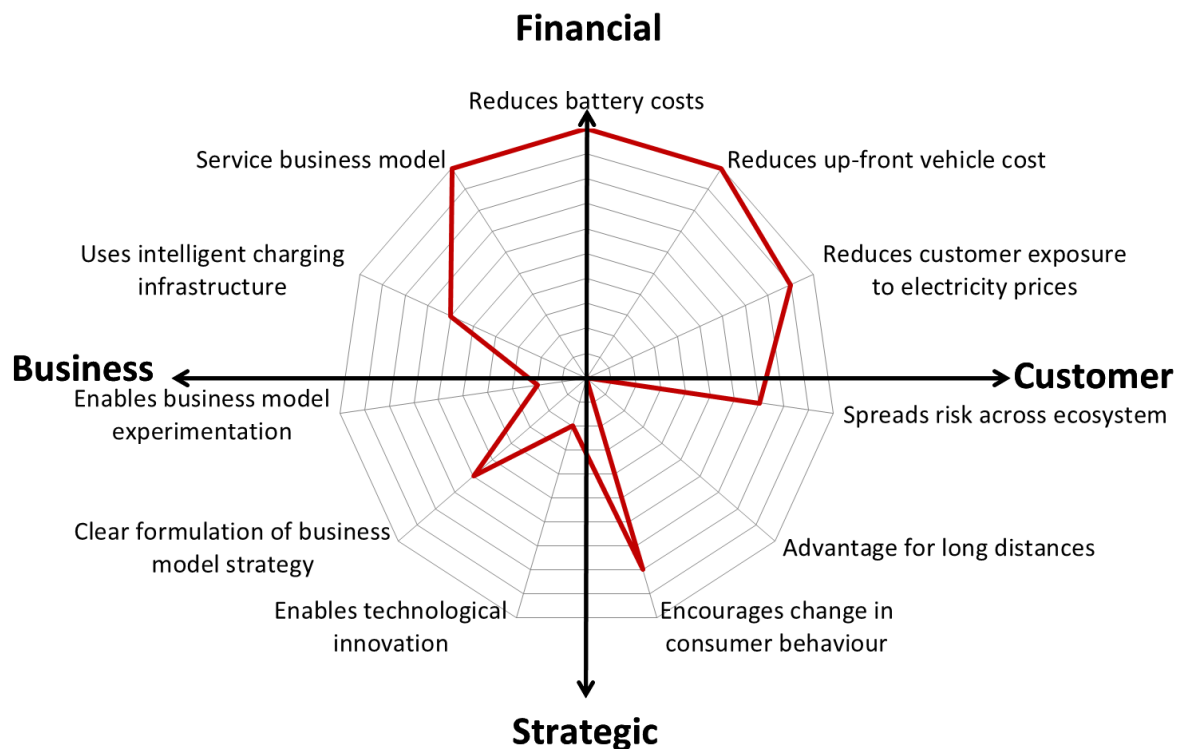
The business model allows limited experimentation and deviation from the plan given the fixed targets set by the governing syndicate (MS41) and logistical limitations in the city. However, pricing has been simplified over time and new services have been offered, such as the availability of ServCo 2’s charging stations to charge private EVs for a subscription of €180/year.<sup>4</sup>

In this business model, ICT and smart energy systems are developed by ServCo in partnership with the local distribution network ErDF. ICT are used to optimise the fleet dispatch and charging as well as for end-user information in the vehicle. There is a 24/7 call centre that can be reached from the vehicle provided by a ServCo 2 subsidiary. The use of ICT in this business model, however, is to improve operations rather than to pioneer any new value-creation opportunities.

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<sup>4</sup> [www.Autolib.eu/faq](http://www.Autolib.eu/faq)





**Figure 6. Framework analysis: public integrated service of EV sharing (ServCo 2)**

#### 4. Discussion

This section extends the case study analysis from the framework results into themes towards theory generation. The three main themes that are drawn for this discussion from the results are:

- Ecosystem positioning;
- The shift towards “service” business models;
- The debate on co-existence vs competition of business models.

##### 4.1 Ecosystem positioning

A business “ecosystem” is the wider network of firms that influences how a focal firm creates and captures value (Cambridge Service Alliance, 2011). Firms designing a business model with a perspective on the developing ecosystem of companies around them have to make a conscious decision regarding the position in the value chain – or their “function” in the ecosystem – that they want to serve in the delivery of EV to the customer. While this concept of strategic “positioning” is not new in business model theory (Rosenbloom & Chesbrough, 2002), EVs as a complex value proposition present new specific challenges in restructuring the value network. In EN11’s words: “What’s happening is that market participants are looking at the entire value chain because now this is not about selling a car, it’s about integrating a vehicle in the energy system.” An interesting vertical movement of OEMs down the supply chain into energy services, for example, has been seen in the California ecosystem, where an OEM has started to provide free solar-powered

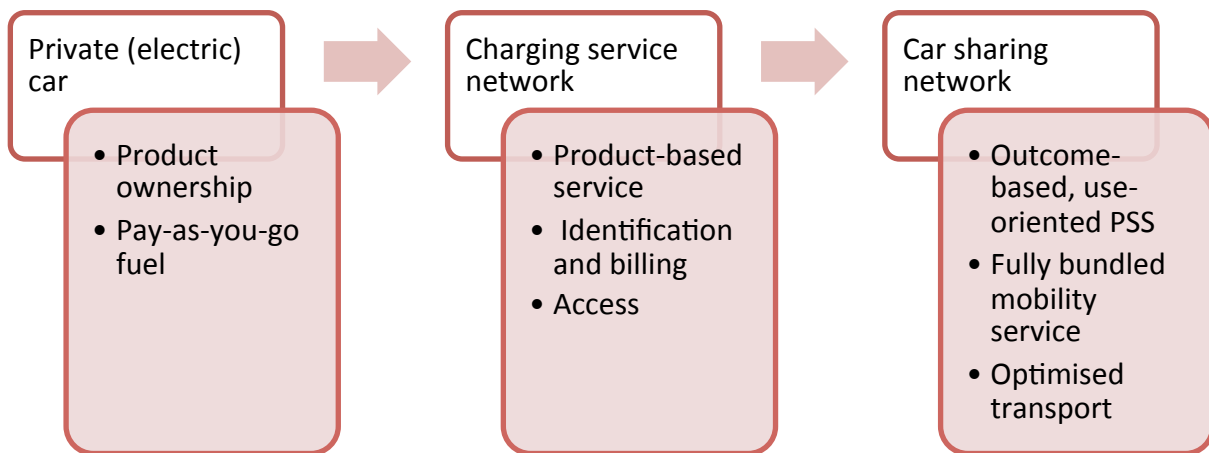
electricity at fast-charging stations for the drivers of one of its EV models (*Businessweek*, 2012). OEMs are also increasingly considering the user outcome of their products and beginning to design mobility services (A11, MS31, MS41). The emerging EV ecosystem may be blurring the boundaries between previously completely distinct industries: automotive and electricity. As one interviewee said: “EVs force OEMs and utilities to start talking to each other, which has been unseen in the past and is a challenge” (EN11).

The importance of partnerships and collaboration in shaping the early EV ecosystem has also been apparent from these cases. SwapCo, despite its visionary business model that scored highly on many dimensions of the framework (Figure 3), did not manage to engage a sufficient number of OEMs in its system to succeed in implementing it. Beyond the question of the technical feasibility of the automated swapping system, there was perhaps a lack of humility in SwapCo’s platform strategy that prevented the company from seeing the barriers to widespread adoption of its business model. Indeed, neither OEMs nor customers want to “lock in” to a particular charging system, which confirms the importance of interoperability and open standards in an early ecosystem strategy (e.g. Chesbrough, 2007; Cecagnoli et al., 2012). Charging infrastructure companies have also collaborated to change policy (C11). Therefore, an implication of this research is that a company seeking to shape the configuration of the EV ecosystem according to its business model “vision” should consult with its suppliers, customers and potential partners to understand their needs and work at co-developing the ecosystem. As interviewees from C11, A11 and MS31 said, the industry is at a pre-competition stage, where every new entrant is welcome and every new EV or charging station sold or installed, regardless of the provider, is positive for all players. This echoes the view that “the business model perspective requires the focal firm to create value for all stakeholder groups and capture value for itself” (Sosna et al., 2010).

This research on business model design in ecosystem contexts also emphasises the importance of **cross-industry** relationships and partnerships. Companies entering a complex service industry like electric vehicles should consider building alliances with companies with which they do not traditionally do business. This was the case for FC-Co in Japan, which invited companies from various industries, including electrical equipment, OEMs, charging infrastructure, and business solutions into the consortium it formed for fast-charging. While FC-Co’s objective was the same as SwapCo’s, namely, to design the dominant standard for charging stations, the approach was radically different in signing up partners and collaborators at a very early stage, rather than focusing on signing up investors and venture capitalists. FC-Co also benefited from government support, as a state-owned utility, as opposed to SwapCo, which, in the California ecosystem, was competing on an independent basis. The level of local and national government involvement is an important issue in the development of the EV industry but is left for a separate discussion. A major OEM in the California EV ecosystem also stated that it was keeping updated on all the new entrants in EV-related industries, as the many innovative start-ups in smart grid solutions or smart phone applications were likely to affect the competitive landscape in the car industry (A11).

## 4.2 Service business models

From these cases, a conceptual representation of the different levels of servitization of business models for EVs has emerged (Figure 7). Typically, automobile manufacturers sell cars as simple products, which provides them and vehicle dealers with one-time sales revenues. Even when purchased on credit or when leased, thus generating “service-like” monthly revenues, the value proposition of cars remains predominantly product ownership. By-products, such as insurance, fuel, repairs and maintenance, may be provided later as services by other companies.



**Figure 7. Conceptual representation of degrees of servitization in electric vehicle ecosystems**

The introduction of EVs is leading to a re-evaluation of this simple product-based model. Figure 7 shows the possible levels in the value chain that can be transformed into services: in the charging network level, or at the end-user service level. A partially servitized business model for electric transportation would imply that customers buy and own their vehicles and batteries, but gain access to a network of charging stations with a specific provider. The network service company would supply customer identification for billing and network access, communication services between vehicles, smart phones, and an online energy management account. Charging network services would supply a host of information services that would allow customers to make “smart” decisions about where and when to charge their vehicle. The type of information would include energy prices, proximity and real-time availability of charging stations and parking places, and control devices. A charging network operator could provide a uniform charging service for customers across all possible locations: at home, at work, or in public. Utilities are developing monthly tariff schemes for EV charging that include public charger access (EN12).

One of the main reasons for this transition towards service business models with EVs is consideration of the various risks for consumers. The business models developed by ServCo 1 and 2 and by SwapCo shift more of the risks associated with barriers to EV adoption towards the company, namely risk of battery degradation, infrastructure risk, and limited driving range.

A second reason is the evolution of the value proposition to focus more on the customer's final use of a car and the outcome he/she desires. A number of factors discovered in the interviews are pushing customers towards seeking mobility rather than a car:

- Shift of status symbol from cars to other objects (mostly high-tech, such as smart phones, tablets...) (OG31).
- The "communication interruption" effect: driving is a "disconnected" moment that requires focus and concentration and diverts time away from Internet browsing, calling, and text-messaging. A survey of Japanese youth suggested they would rather be driven than be drivers to avoid this temporary "disconnection" (OG31). However, cars are increasingly integrating the features of smart-phones in their in-built systems (BBC, 2013).
- Changes in personal lives, which mean that people do not need or cannot afford to buy a car, such as living with parents until a later age, living in cities, or earning income only at a later age.
- Changes in professional lives, such as increasingly working from home (R11).

The two service business models and Swap-Co's business model all reshape the relationship between vehicle, battery, charging infrastructure, and energy supply for the end-user. ServCo 2 includes vehicle and battery manufacturing in its functions, whereas ServCo 1 leases EVs from automotive suppliers. ServCo 2 includes electricity recharging within its retail tariffs, whereas ServCo 1 does not. Both companies provide booking services and include customer services of repairs and maintenance and insurance.

The case studies show a promising future for mobility-as-a-service in the forms of car-sharing or leasing programmes, but only up to a certain point: the market size is limited. Many companies interviewed thought of mobility-as-a-service as a niche market that would never appeal to all customers. Paradoxically, while being the most cost-effective, efficient and optimised business model for transport, mobility-as-a-service is also the most difficult for customers to adapt to with its high requirements for change in behaviour and attitudes. While industry supporters cited consumer surveys that suggested an ongoing change towards the servitization of mobility, the emotional dimension of a car purchase will remain a high barrier to EV adoption in places where consumers are generally not early adopters or risk takers. California, which has one of the highest penetration rates of electric vehicle technology, was cited as a place where consumers tend to embrace behavioural changes induced by technological innovations (A11, EN11, C11, C21). The lessons from that EV ecosystem may not apply in other contexts.

This conceptual representation can be compared with Kley et al.'s (2011) structured approach to assessing business models for EV on a product-service scale. The scale ranges from fully product-oriented to fully service-oriented business models (Tukker, 2004). Classic business models tend to be product-oriented (Kley et al., 2011). Among the new business models in electric transportation, car sharing and fleet concepts are suggested to be intermediary, use-oriented service models (Kley et al., 2011). "Transport services" such as taxis are examples of fully service-oriented business models (Kley et al., 2011). Within each of these, the various possible agents responsible for different aspects of the value chain are configured into different business models. The "holistic mapping" shows these

business model designs along a continuum of required technical and organisational change (Kley et al., 2011).

### 4.3 Competing vs co-existing business models

EVs compete with existing vehicles using conventional fuels (gasoline/diesel), with other alternative fuel vehicles such as biofuels and liquefied or compressed natural gas vehicles, and with other modes of transport such as rail and buses (R31, MS31). The examination of the competitive advantage of electric vehicles relative to each of these alternative modes of transportation is beyond the scope of this study, although the interviews did provide some data on the subject. One interesting finding was that the EV industry was at such an early phase of development, with a 0.2 per cent market share of new vehicles sold in 2012 in the largest market by share – the US – that all entrants were supporting the success of even their direct competitors. According to CTO and co-founder of C11 in California, companies have “a dual role of creating the industry and competing within it” (C11).

However, within the EV innovation ecosystem, cases 1 and 2 have shown the emergence of competing business models in charging infrastructure systems. Can fast-charging and battery-swapping coexist, or must one standard eventually out-compete the other? Will service network business models for recharging coexist with pure hardware/infrastructure companies?

The Osterwalder framework allows one to distinguish between different customer segments, which are critical factors in business model co-existence. China offers one example of the co-implementation of fast-charging stations for private EV drivers and of battery-swapping stations for taxi and vehicle fleets (Rx). One interviewee suggested that co-existence would be possible. However, high capital costs for using both systems suggest that the economically efficient outcome might be chosen in the long run.

One OEM (A11) suggested that an option to lift sales of EVs was to offer EV buyers conventional vehicles for when they need to drive longer distances on exceptional occasions, such as weekend or holiday trips. EVs would be the main car for daily purposes, but users would have the convenience of a priority rental car for long-distance journeys. The complementarity of this dual offering may become more common when the market for EVs develops. Respondents suggested that the commercialisation of EVs would be a progressive rather than a radical displacement of conventional vehicles (R11, C11, C12), which implies that both vehicle technologies would have to coexist for the next years and maybe decades.

Economies of scale in the charging business mean that for concepts such as battery-swapping and fast-charging to be economically viable, a significant penetration of EVs is necessary (Madina et al., 2012). Furthermore, all the value creation applications that are currently being researched in the electricity industry for secondary uses of EV batteries (storage, ancillary grid services, regulation energy, secondary life storage, renewable generation management, smart energy demand management) would only be feasible with a large share of EVs in the automobile market.



## 5. Conclusion

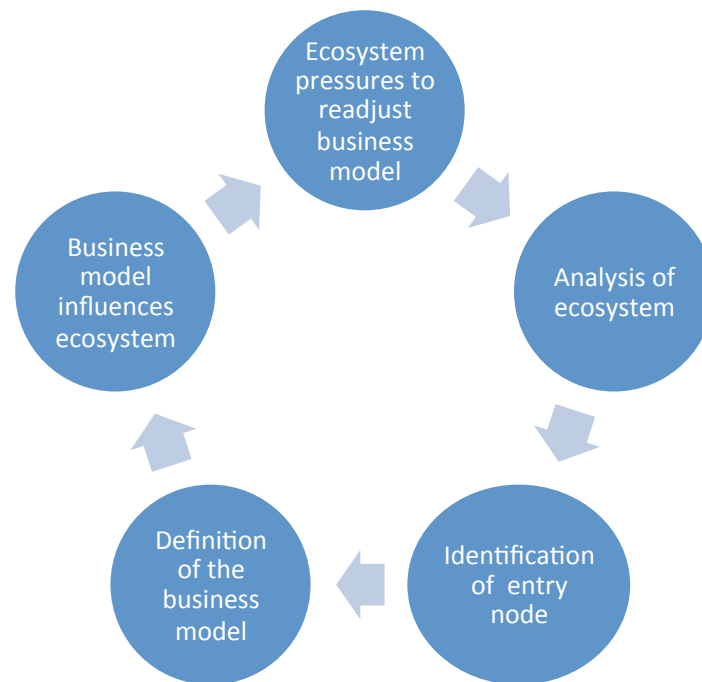
This research has several implications for business model design for firms in early-stage innovation ecosystems. First, the case studies in the EV industry illustrate how firms create business models by taking an ecosystem perspective on the outcomes they wish to create for users, and the configuration of the value network they envision. Companies benefit from envisioning their business models in the context of firms that can influence the way they create and capture value, that is, the business ecosystem. In the delivery of a complex service such as electric vehicles, firms should be prepared to consider relationships with firms from different industries that may not be the ones with which they usually collaborate or work.

Second, this research shows that the co-existence of competing business models is possible in early ecosystems, but initial business model plans may result in completely different applications than expected, such as the case of SwapCo, whose battery-swapping system is currently in use in China by commercial vehicle fleets (taxis) in urban areas. The industrial evolution literature suggests that shakeouts have resulted in similar examples of competition for platform technologies (e.g. VHS vs BetaMax, Apple vs HTC, Gmail vs MSN Hotmail...).

Finally, the innovation of electric vehicles will result in partial or full servitization of the value delivery, either at the charging infrastructure level or by transforming the end-user outcome to mobility rather than a vehicle.

A common ontology is necessary to generalise findings from the EV industry to sustainable technologies in general, which brings us back to the semantics discussion in the literature review. The framework presented in this paper could be useful for companies to take an ecosystem perspective on their business models. It includes criteria that are essential to the EV sector, such as ICT capabilities and the smart grid, but also general criteria, such as business model flexibility and enabling of technological innovation. The four “quadrants” of advantage on the framework, namely, customer – business and strategic – and financial, can be applied in the context of other industries as well.

A dynamic theory of business model design in emerging ecosystems is developed as a result of this work (Figure 8) and will be explored in future work.



**Figure 8. Dynamic theory of business model design in an ecosystem context**

## References

- Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal*, 31(3), 306–333.
- Adner, R. (2006). Match your Innovation Strategy to your Innovation Ecosystem. *Harvard Business Review*, 98–107.
- Afuah, A. & Tucci, C. (2000). *Internet Business Models and Strategies*. Irwin McGraw-Hill, USA.
- Amit, R., & Zott, C. (2001). Value creation in E-business. *Strategic Management Journal*, 22, 493–520.
- Andersen, P. H., Mathews, J. a., & Rask, M. (2009). Integrating private transport into renewable energy policy: The strategy of creating intelligent recharging grids for electric vehicles. *Energy Policy*, 37(7), 2481–2486.
- Businessweek*, Tesla Fires Up Solar-Powered Charging Stations, by [Ashlee Vance](#) on 25 September 2012. Retrieved on 26/02/13 at <http://www.businessweek.com/articles/2012-09-25/tesla-fires-up-solar-powered-charging-stations>.
- Ceccagnoli, M., Forman, C., & Huang, P. (2012). Co-creation of value in a platform ecosystem: The case of enterprise software. *MIS Quarterly*, 36(1), 263–290.
- Chesbrough, H. W. (2010). Business Model Innovation: Opportunities and Barriers. *Long Range Planning*, 43(2–3), 354–363.

- Chesbrough, H. W. (2007). Have Open Business Models. *MIT Sloan Management Review*, 48(2), 22–28.
- Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spin-off companies. *Industrial and Corporate Change*, 11(3), 529–555.
- Couzineau-Zegwaard, E., Meier, O. & Barabel, M., 2012. Business ecosystem model applied to the electric vehicle market. In *Electric Vehicle Symposium 26*. Los Angeles, CA, pp. 1–8.
- Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *The Academy of Management Journal ARCHIVE*, 50(1), 25–32. Academy of Management.
- Geroski, P. A. (1990). Innovation, technological opportunity, and market structure. *Oxford economic papers*, 42(3), 586–602.
- Iansiti, M. & Levien, R., (2004). Strategy as ecology. *Harvard Business Review*, 82(3), pp.68–78.
- Johnson, M.W., Christensen, C.M. & Kagermann, H., 2008. Reinventing your business model. *Harvard Business Review*, (December), pp.50–60.
- Kley, F., Lerch, C., & Dallinger, D. (2011). New business models for electric cars – A holistic approach. *Energy Policy*, 39(6), 3392–3403.
- Madina, C., Coppola, G., Schumann, D., Hartung, P., & Zabala, E. (2012). Business and services models for electric vehicles. *European Electric Vehicle Congress* (pp. 1–12).
- McNamara, P., Peck, S. I., & Sasson, A. (2011). Competing Business Models, Value Creation and Appropriation in English Football. *Long Range Planning*.
- Moore, J.F., (1993). Predators and prey: a new ecology of competition. *Harvard business review*, 71, pp.75–75.
- Osterwalder, A., Parent, C. & Pigneur, Y., (2004). Setting up an ontology of business models. In *Proceedings of 16th International Conference on Advanced Information Systems Engineering (CAiSE03) Workshops* (3). pp. 319–324.
- Peltoniemi, M., (2006). Preliminary theoretical framework for the study of business ecosystems. , 8(1), pp.10–19.
- San Román, T. G., Momber, I., Abbad, M. R., & Sánchez Miralles, Á. (2011). Regulatory framework and business models for charging plug-in electric vehicles: Infrastructure, agents, and commercial relationships. *Energy Policy*, 39, 6360–6375.
- Shankar, B. (2009). *Business Model Innovation by Better Place: A Green Ecosystem for the Mass Adoption of Electric Cars* (pp. 1–23). Case Study: Indian Center for Management Research.
- Sinfield, J. V et al., (2012). How to Identify New Business Models. *MIT Sloan Management Review*, 53(2), pp.84–90

Sosna, M., Trevinyo-Rodríguez, R. N., & Velamuri, S. R. (2010). Business Model Innovation through Trial-and-Error Learning. *Long Range Planning*, 43(2–3), 383–407.

Suarez, F. F., & Utterback, J. M. (1995). Dominant designs and the survival of firms. *Strategic Management Journal*, 16(6), 415–430.

Tukker, A. (2004). Eight types of product–service system: Eight ways to sustainability? Experiences from SusProNet. *Business Strategy and the Environment*, 13(4), 246–260.

Turrentine, T., Kurani, K., & Heffner, R. (2007). Fuel Economy: What Drives Consumer Choice? *Access*, 31, 14–19.

Visnjic, I. and Neely, A.D. (2011) "From Processes to Promise: How Complex Service Providers Use Business Model Innovation to Deliver Sustainable Growth", Cambridge Service Alliance, Cambridge.

Yin, R. (1994). *Case study research: Design and methods* (2nd ed.). Beverly Hills, CA: Sage Publishing.

Zhenpo, W., Peng, L., Tao, X., & Wei, C. (2010). Risk Analysis for EV Charging and Gasoline Filling Integrated Station. *IEEE*, 267–270.

Zott, C., Amit, R., & Massa, L. (2011). The Business Model: Recent Developments and Future Research. *Journal of Management*, 37(4), 1019–1042.