

The role of value constellation innovation to develop sustainable service systems

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Abstract

Purpose – The present article first introduces sustainable service system as an new innovative business approach to solve human needs in a much more sustainable ways. In order to better understand the deployment of a system innovation and the correlated value constellation innovation, this paper analyses the ongoing development of the Auto-Lib car sharing system in Paris by Bolloré. Autolib is a new mobility service system that will offer 3,000 electric vehicles that can be picked up and dropped off at various locations around Paris.

Design/Methodology/approach – The research design is based on a longitudinal in-depth case study. This first paper aims to document the current stage of development of the Autolib and has an exploratory character.

Findings – The key components of the Autolib system - network of actors, infrastructure, products and services - are detailed and fully explained.

Implications – Implications of this research are numerous. Theoretically, it introduces the concept of sustainable service system and it relates it to system innovation, product-service systems, value constellation, service-dominant logic and related streams of research. Practically, it helps to better understand the conditions and the challenges to develop sustainable service systems. Socially, it tries to analyze much more sustainable new ways of meeting human needs.

Originality/Value – this article contributes to bridge the research/practice gap and integrates sustainable development in the research agenda of system innovation.

Keywords – sustainable service system, system innovation, value constellation

Category – Case study analysis

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Introduction

The world is at crossroads of ecological, social, economic, public health and geopolitical crises. Some says the juxtaposition of these crises is no more than a global system in crisis (Kotz 2009). And our future is under pressure, the future course of the world depending on the humanity's ability to provide a high quality of life for a prospective nine billions people without exhausting the Earth's resources or irreparably damaging its climate and its natural systems (Tukker and al. 2008, p.2). In this context, we urgently need to invent a new way of doing business, a way of creating both wealth and well-being for humans, environment and all their ecosystems. This is not new. In 1997, the Club of Rome published a vibrant call to reach the "factor 4" objective i.e. doubling wealth by halving natural resource use (von Weizsäcker et al. 1997). The "factor 4" is now largely supported by the IPCC¹ and by a number of governments. But yet, some argue that factor four is not enough and that a factor 10, 20 or higher improvement in material and energy efficiency will be needed by 2025 (Mont and Emtairah 2008).

A promising way to reach these levels of improvement is presented by the development of sustainable service systems (Tukker and al. 2008). They are based on an evolving adaptive process where a potential disruptive offer and its corresponding more sustainable demand emerges out of a iterative co-creation process in articulation with its ecosystems. Sustainable service systems looks for the service (Vargo & Lusch, 2004) that is rendered to a user; it is sustainable because resource use reduction is a normative guideline during the whole life-cycle of the offering; and systemic because such a reconfiguration is not possible at the level of a sole actor, it necessarily includes a network of actors integrated and coordinated into a new constellation of value.

The goals of this article are numerous. First, it aims to introduce and explain what sustainable service systems are and how they are related to system innovation, product-service systems and value constellation. Then, it aims to present a first exploratory analysis of a novel mobility service system under development: Autolib in the Paris City and its suburb. While the ultimate goal of this research is to model the innovation system and its value constellation and to explore the interactions in a multi-stakeholders approach, the current development

¹ Intergovernmental Panel on Climate Change.

stage of the Autolib system will allow us to document this development process, to explore the key components of the systems and the numerous related challenges. It aims also to differentiate different level of maturity of systems development, by differentiating system optimization, system redesign and system innovation.

This article is the first one of a series that will be written on the basis of a longitudinal analysis of the Autolib case at key moments: the preparation and pre launched stage (now), the test stage, the deployment stage, the launch of the service and its scale up.

Sustainable service systems

Sustainable service systems (3S) may be defined as the conjunction of an innovation strategy developed by an organization interacting with other organizations and the institutional environment to:

- shift the business focus from designing and selling goods to delivering integrated solutions that provide a use function or a global need-fulfillment solution to customers
- that in turn induce more sustainable consumption practices (in B2C, B2B or procurement contracts) and new relationships linking the act of producing and consuming.

3S may be theoretically related to system innovation (Tukker and al. 2008), product-service systems (Mont 2002, Tukker and Tischner 2004) and value constellation (Normann and Ramirez 1993, 2000). Moreover, they show a particularly good fit with service-dominant logic (Vargo and Lusch 2004, Lusch and Vargo 2006) and related streams of research.

The classical value chain (Porter 1985) based on the assembly line is too narrow to grasp the complexity of the current business world. Today, the value creation is not structured anymore on a linear and sequential process, but rather co-created by a constellation of actors - suppliers, business partners, customers, etc. These value-creation systems reconfigure the roles and relationships among the constellation of actors in order to create value in new forms and by new players (Normann and Ramirez 1993, 2000). The quest for sustainable development reinforces this need for a systemic approach. Tukker and Tischner (2004) have for example suggested that selling products is old-fashioned business. Companies should switch their focus on selling need fulfillment systems, satisfaction or experiences, or in other terms sell integrated solutions calling for a systemic approach. In the same way, many authors

argue that reaching the Factor 10, 20 or higher improvement in material and energy efficiency is needed by 2025 (Mont and Emtairah 2008). Cleaner production projects and eco-efficiency initiatives (e.g. eco-designing of products or processes) have demonstrated the economic feasibility to reach the factor 2 improvement. Lately, researchers have explored the potential benefits for more systemic changes, mostly at the function innovation level (e.g. systems of shared use, pay-per-use offers and functional sales) (Mont and Emtairah 2008). These may be summarized as product-service systems (PSS). PSS are defined as a system of products, services, networks of actors and supporting infrastructure that continuously strives to be competitive, satisfy customer needs and have a lower environmental impact than traditional business models (Mont 2004). Eco-performance is thus here a normative guideline, the systems being designed so that environmental benefits could be generated. Most of the time, it integrates eco-efficiency and circular economy in its roots.

At this level, factor 2-3 improvements have been reported on several business cases (copiers' rental (Kerr and Ryan 2001), car sharing (Meijkamp 2000) or integrated pest management systems (Goedkoop and al. 1999; Hockerts 1999) for example). Summing up eco-efficiency, cleaner production and product-service systems environmental gains allow reaching factor 6-7, while some proponents argue that higher levels of environmental performance can be found at the so-called system level which includes demand-side strategies and initiatives towards sustainable consumption (Mont and Emtairah 2008).

The systemic approach conceives indeed innovation as an evolving adaptive process where a potential disruptive offer and its corresponding demand emerges out of an iterative co-creation process between both and their ecosystems. It means first that products, services and production systems are optimized and new ways of needs satisfaction are found within existing institutional frameworks and infrastructures. Product-service systems generally illustrated such system redesign. But the most elaborated form of system innovation calls also for new infrastructures, spatial planning and incentive systems that are developed and implemented to promote more sustainable lifestyles (Mont and Emtairah 2008).

As a source of offer innovation, product-services systems (PSS) appear therefore as a first component of such sustainable systems. Rather than selling goods, PSS aims to deliver integrated solutions based either on use-oriented services or result-oriented services (Bourg and Buclet 2005; Manzini and Vezzoli 2003; Mont 2002, 2004; Sempels and Vandercammen, 2009):

- Use-oriented services: the product is made available in a different form to the customer, is sometimes shared by a number of users, but stays in the ownership of the

provider. It is the usage of the product (so a service) rather than the product itself that is invoiced, without transfer of ownership. Classical examples are the car-sharing system, the communal washing centers in Sweden or the Xerox's leasing scheme (the latest being described here after).

- **Result-oriented services:** the seller no longer sells a product to the customer but sells the desired result rendered by the product. The pest management service is an illustration of such offering. Rather than selling pesticide for example, a company may decide to sell what really interests the farmers, that is a maximum acceptable loss on the crops, based on contractually defined service-level agreement. The value proposition is not driven anymore by the product but by its result. Moreover, the pest used to reach the service-level agreement now becomes and cost rather than the revenue driver, that should be minimized to optimize the systems. Financial objectives may not fit with environmental ones (Felix, Hoffmann and Sempels, 2010).

In PSS, the core value proposition is a service (use or result-oriented service). It is perfectly consistent with the first foundational premise in the S-D logic framework that states that the basis of exchange is, by nature, a service. To make this service available, PSS are generally structured around four elements (see fig.1)

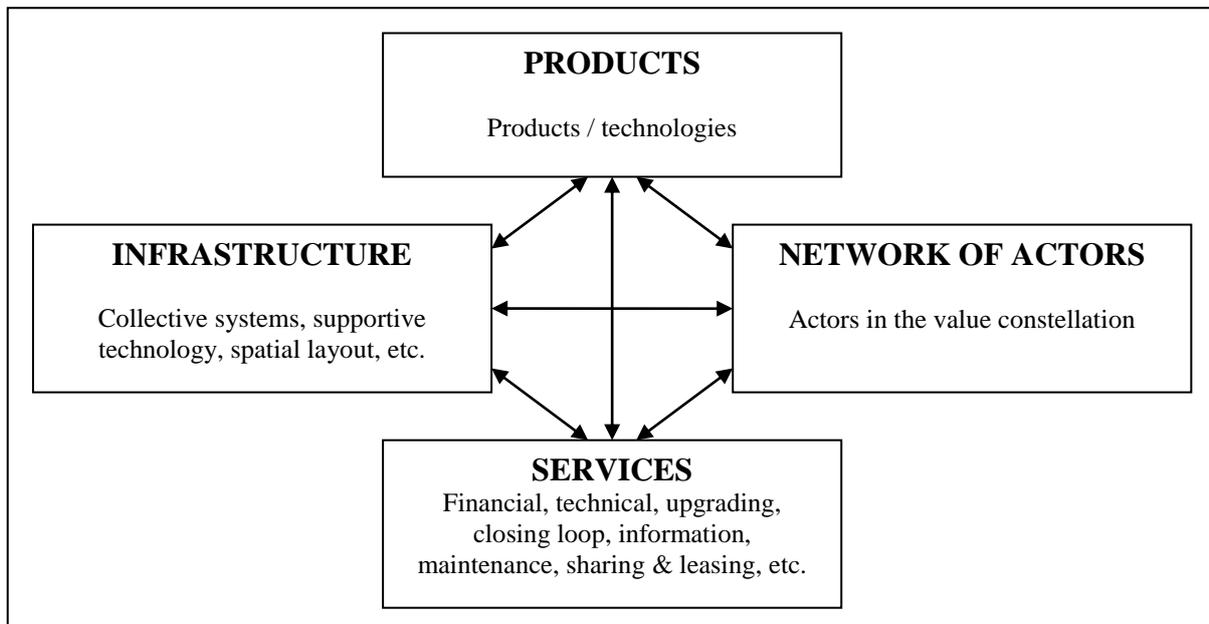


Fig1. Elements of a product-service system (adapted from Mont, 2004)

Products

The products that integrate the system are the first element of a PSS. Consistent with service-dominant logic (Vargo and Lusch 2004, 2008), products are not considered here as the key driver of value. They are integrated into the system only for the service they render, their value being related to their usage. They are therefore only a distribution mechanism to achieve needs fulfillment.

In an attempt to optimize the system, and eco-performance being a normative guideline, these products should be redesigned to be eco-efficient. According to the World Business Council for Sustainable Development, eco-efficiency refers to the delivery of "competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing environmental impacts of goods and resource intensity throughout the entire life-cycle to a level at least in line with the Earth's estimated carrying capacity" (Schmidheiny 1992). The critical dimensions of eco-efficiency are the followings (Klostermann and Tukker 2010):

- A reduction in the material and the energy intensity of goods or services;
- A reduced dispersion of toxic materials;
- An improvement in recyclability;
- A maximum use of renewable resources;
- A greater durability of products and their ability to be maintained and repaired more easily;
- An increased service intensity of goods and services

Services

This element refers to all services that make the product or its result available to the customers in a convenient and attractive way (marketing, payment facilities, after-sales services, sharing or leasing scheme, etc.) (Mont 2004). Moreover, because of the quest for environmental performance, additional services based on the optimization of the products use and their management at the end of life are integrated (maintenance and repair, upgrading, take back, close loop and recycling, etc.). Close loops - also referred as circular economy - are structured around the 3 R's environmental management hierarchy (reduce, reuse, recycle) (Grove et al. 1996; Mont et al. 2006). The first "reduce" step refers to eco-efficiency. As mentioned above, it calls for minimizing the use of natural resources and energy in

developing products, services and processes, for the same service rendered. Reuse aims to maximize the lifetime of the product either by an extension of their life or by judicious replacement of some components only, so that a maximum material can be preserved as long as possible. Finally, recycling plans to redirect a maximum of materials contained in products at the end of life into new productive cycles rather than transforming them into unvaluable wastes. The Xerox leasing scheme is a perfect illustration of the 3 R's hierarchy (Sempels and Vandercammen 2009). By retaining the ownership of their machines through a leasing scheme, Xerox has implemented a close-loop system of their copiers. This system encouraged Xerox to extend the longevity of their machine and to "eco-redesign" them. Copiers have been redesigned in order to be more easily and more effectively disassembled, the parts being recovered, recycled and remanufactured into new generations of machines. Thanks to these eco-redesign stages, 70% to 90% of parts of old-generation machines are now recovered and reused in new generation equipment. This sole operation has entailed a financial gain of \$2 billion for Xerox in less than 10 years, coupled with enormous environmental benefits (see King and al. 2006 for the full case explanation).

Infrastructure and network of actors

Infrastructure refers to all public or private physical systems (e.g. roads, parking space, communication lines, waste collection systems, recycling facilities, ...) integrated into the PSS to make the service possible and available (Mont 2004). In the iterative approach between the offer and the demand (see above), it is important to note that the infrastructure may impact consumption patterns and may lock the customers in unsustainable practices (Cooper 1999 in Mont 2004). Jackson (2004) reported that studies of recycling, for example, have shown higher levels of recycling behaviors amongst higher-income white households than amongst lower-income black or asian families (RRF 2002, 2004). And to conclude that information campaigns targeted specifically at lower income families should be deployed. But a deeper analysis showed that the poor recycling behaviors were not so much a problem of lack of awareness than a problem of lack of infrastructure. More black and asian families live indeed in areas of high density housing with poor recycling facilities and often no kerbside service. This classical error is known as the fundamental attribution error (Cowley 2002).

In addition to the infrastructure, result-oriented or usage-oriented services involve a network of actors in the design of an efficient system (Mont 2002). Basically, any product manufactured or service delivered is the result of a myriad of actors conducting activities, economic transactions and institutional arrangements (Normann and Ramirez 1993). But the

systemic approach goes much beyond the actors needed to design the components of the system. The interconnection of these components and the management of the system's operation also call for the implication of actors and the integration of their resources. And the difference of PSS networks from chain actors is that they may include actors traditionally outside the product chain (Mont 2004). For example, in order to develop a car sharing system that would provide mobility solutions, an operator needs a specific infrastructure that may be negotiated with the authorities, parking space negotiated with private and public parking operators, cooperation with car rental companies, and so on. The operator of the car sharing system, therefore, has to integrate all these social and economic actors to design its value proposition through collaborative value co-creation, not only involving the provider and the beneficiary but all parties in the value constellation (Michel et al. 2008).

And the larger the system is the more additional actors should be associated to the co-creation process. A global mobility system in a city should integrate different modes of public transportation generally managed by different operators, some being public, other being private. It should integrate public authorities (local and national ones), parking operators, infrastructure operators (e.g. the urban or highway tolls), car-sharing operators, information management capabilities to organize the system, telecommunication facilities to provide efficient information to the users, and so on. Innovation in value constellation therefore identifies economic and social actors and links them together in new patterns which allow the creation of new business that did not exist previously or that change the way value is created. As stated by Normann (2001, in Michel, Vargo and Lusch 2008, p.154), it is not about a simple reallocation of existing activities between a set of actors, but of constructing a new, coordinated set of activities resulting in a new kind of output. The design and the operations management of the system do not only therefore require the integration of operand resources of each actors, but also, and notably more important, their operant resources. On particular, both explicit and tacit knowledge seems to play an important role in the construction and the optimization of the system (Felix, Hoffmann and Sempels, 2010).

Developing a sustainable mobility system: the Autolib case

In order to better understand the deployment of a system innovation and the correlated value constellation innovation, we study the ongoing development of a major sustainable service system through the implementation of a longitudinal study: the Auto-Lib car sharing system in the city of Paris by Bolloré Inc. The focus is therefore here on a use-oriented sustainable service system.

While most studies about value constellation focus in the level of the industry value chain (e.g. Moingeon and Lehmann-Ortega 2010), it is our aim to broaden this scope by studying interactions in a multi-party stakeholder complex context.

The choice of this case is motivated by numerous elements. First, the mobility is at the crossroads of key environmental and social issues. The global environmental impact of transport is noticeable and represents 13% of greenhouse gas emissions, while the vehicle manufacturing has the highest total environmental impact among all activity sectors (UNEP, 2010). Moreover, the social impact of mobility is great in domains such as quality of life, urban versus rural living and their related challenges in terms of moving and related cost in a time of pressure on crude oil price, impact of associated pollution of public health, etc.

This case is also particularly rich to analyze due to the scale of the project and the associated challenges: the importance of the network of actors (48 municipalities managed by various political parties, an operator from the private sector, many industrial partners, an energy supplier, many experts, city planners, etc.) and the nature of the contract (a public service delegation contract operated by a private company), a technological challenge (e.g. development of a dedicated electric car), logistic (e.g. management of a 3000 cars fleet and its distribution in 1120 stations), infrastructure (e.g. development of the charging stations and the parking facilities), behavioral (e.g. client education and client service), among others. Moreover, pricing policy is not under the control of the operator, since exploitation prices are pre-determined by the authorities; break-even conditions look especially hard to be attained: 200.000 subscribers out of a population of 11.8 million inhabitants (Parisian agglomeration).

The ultimate goal of this research is to model the innovation system and its value constellation and to explore the interactions in a multi-stakeholders approach on the basis of a longitudinal in-depth case study (Yin 1994). This first paper aims to document the current stage of development of the Autolib and has an exploratory character. The longitudinal follow-up of the Autolib case on its test stage, deployment stage, launch and scale up will allow us to reach the ultimate goal.

At this stage, the data collection involves:

- in-depth interviews with the project manager at the city of Paris (who was the former project manager of the Velib project, a 24/7 self-service bicycle scheme);
- a desk research of press coverage for the period 2009 to early 2011 coupled with extensive information available on the web, and especially but not exclusively on the Autolib official website (<http://www.autolib-paris.fr/>);
- an analysis of internal reports on users' acceptance and perceptions.

What is Autolib ? The genese of an innovative system

Autolib - a contraction of *automobile* (car) and *liberté* (freedom) in French - is a new mobility service system that will offer 3,000 electric vehicles that can be picked up and dropped off at various locations around Paris. Cars will be available 24 hours a day to residents and tourists willing to drive in the dense heart of the Paris region and broader.

Autolib has been modelled after the city's successful Velib 24/7 self-service bicycle scheme. Launched on July 15, 2007, Velib offers thousands of bikes in hundreds of stations spread every 300 metres in Paris. The principle is that a customer may take a bike from any station and put it back in any other station all across Paris. Based on the rapid success of the Velib project, Bertrand Delanoë, Mayor of Paris, launched the idea to replicate the system with electric cars. The Autolib project was born.

The components of the Autolib mobility system

Based on the near-decomposability of complex systems into subsystems (Simon 1977), the PSS framework (product, services, infrastructure and network of actors) is valuable to structure the presentation of the Autolib mobility system.

The network of actors

As explained, the idea of the Autolib system comes from Bertrand Delanoë, the Mayor of the city of Paris. To get an idea, the city of Paris has an estimated population of 2.193.031², but the Paris metropolitan area has a population of 11,836,970.

So that the inhabitants of the city could benefit from a reliable system of self-service cars, the city of Paris has offered to 81 municipalities in the dense heart of the city and in the neighborhood to participate in the project. 26 **municipalities** have first decided to join the project in September the 24th, 2009. Together, they have constituted the “***Syndicat mixte Autolib***” which is the administrative structure set up by the municipalities to launch and manage the Autolib public service delegation. 20 other municipalities have now joined the *syndicat*, to form a group of 46 involved municipalities managed by different political parties. The *syndicat* has decided to organize the Autolib system through a public service delegation contract. In France, a public service delegation (abbreviated DSP) is a set of contracts under which a public authority (city, country, region or national government) delegates the

²<http://www.recensement.insee.fr/chiffresCles.action?codeMessage=5&zoneSearchField=PARIS&codeZone=75056-COM&idTheme=3&rechercher=Rechercher> - 2007

management of a public service to a public, non profit or private organization whose remuneration is substantially related to operating income of the service. It is a concept under French law. The *syndicat* is responsible for the whole project, including a) the coordination and the management of the call for tenders to select the partner that will operate the DSP contract, b) the layout of the service, in particular the negotiation of dedicated public or private space for the stations and c) the control of the operations achieved by the operator.

The call of tenders has been launched on December, the 21th, 2009, on a two round steps: first, the selection of potential candidates that would be allowed to develop a full proposition, and then, exclusive negotiation with the selected candidates to choose the operator. Four candidates were selected in March, the 18th, 2009: Ada, Veolia Transport, the SNCF-RATP-Avis-Vinci³ consortium and Bolloré Inc. It is worthwhile to mention that the core business of the three first ones is transport of persons, while Bolloré is a diversified group in freight forwarding and international logistic, fuel distribution with dedicated terminals and systems, plastic films, batteries and super capacitors, communication and media. On December, the 16th, 2010, **Bolloré** was selected as the private company to operate the public service through a DSP contract of twelve years. The choice was motivated by many factors, one being a financial guarantee of €60 millions given by Bolloré for the contract period. That means that Bolloré is committed to cover at least €60 millions of the project cost even in case of poor operating results. If exceeded, financial loss will be shared by Bolloré and the *Syndicat*. An other motive was based on the high intensity of employees present in the Bolloré solution – 800 employees will be hired - to support the customers and to provide them with a high level of service.

As operator, Bolloré has to support all the costs of the project: investments in terms of infrastructure (note that a public subvention is allocated to Bolloré to partially support the infrastructure cost. The **Ile-de-France Region** – one of the twenty-six administrative regions of France composed mostly of the Paris metropolitan area - subsidizes for example €4 millions), development of the cars and their equipments, dedicated staffs, management of the operations on a daily basis, financial risk due to potential vandalism, etc. Their revenue will only be generated by the activities. But break-even conditions look especially hard to be attained, as pricing policy is not under the control of the operator, exploitation prices being pre-determined by the syndicat.

³ SNCF is the French public train operator (and related service); RATP is the bus, metro and RER operator; Avis and ADA are car rental companies; Vinci is a big private parking/infrastructure operator.

Bolloré is not a car manufacturer. As explained below, it was the only candidate not to rely on an existing car in its solution (the motivation being to be able to equip the dedicated car with its new battery technology, batteries design being one key strategic business unit of the group). It has therefore signed an agreement with the Italian car manufacturer **Pininfarina** to produce 4 000 electric cars, all being devoted to the Autolib project. Under the terms of the contract, Pininfarina will lease a plant and will provide staff from **Cecomp Italian group** specializing in the design of automobile prototypes, to produce 4,000 electric cars for Bolloré. Pininfarina will receive 14 million euros for a three years contract period.

An important component of the system is the charging station (see the infrastructure section). At an early stage of the project, the syndicat collaborated with **city planners, engineering consulting firms** and **mobility experts** to define the amount and the size of the stations on the operating area. Two kinds of stations have to be differentiated: the ones on the public space and the ones on private spaces. For the public location, when a municipality joins the syndicat, it commits to provide the predefined amount of stations on its area (based on the previous technical studies). Below the predefined number of stations, the syndicat may reject the municipality inclusion in the project to preserve the densification and the related quality of the service. Helped by **experts**, a dedicated team from the syndicat will then launch the technical study to prospect the potential zones in the public space. Collaboration with the municipality and the Region is achieved at this stage. Once a potential zone is found, a technical study is conducted with all the relevant actors to validate the technical feasibility of the implantation (e.g. **water companies** to identify where the sewers and the water pipes are located and if they should/could be moved if needed, **electrical and gas companies** to locate the pipes and the cables, a **geological** study to check the quality of the ground, etc.). The **Prefecture of Police** is consulted to assess the level of security of the zone, so are the **Firemen** to assess the accessibility in case of accidents, etc. In the city of Paris, a specific regulation needs to be followed. **Architects from the *Bâtiments de France***, a public office from the Ministry of the Culture, should endorse the location choice to validate the compliance of planned infrastructure with the architecture of Paris and a proper insertion of the related furniture.

Beside the stations located on the public space, it is needed to negotiate with existing parking operators to get access to parking spaces that could be converted into a station. To get an idea, 700 stations will be installed in the city of Paris, 500 being located on the public space, the 200 remaining on underground parking or private parking zones. As an example, based on initial coverage analysis, more parking spots should be made available close to train stations

or highly frequented metro stations. Negotiations with **SNCF** and the **RATP** were conducted to get access to dedicated spaces for the Autolib. In the same ways, in the heart of the City of Paris where the public space does not allow installing a station, the city has concluded agreement with **parking operators** or parking owned by **private companies** to get space and to be allowed to equip them with the needed infrastructure. In suburbs, the same was achieved with **social housing operators** for example. The negotiations with the owners of these parking spots were conducted before the call for tenders, and a maximum rental price was defined independently of the selected final operator.

Once the location is finally decided, the construction of the station is taken in charge by Bolloré, which has concluded partnerships with industrial partners such as **EDF** – the French leader energy supplier – to install the recharging infrastructure. Bolloré needs also **designers**, **R&D partners** and **architect** to design and equip the stations.

A key risk that needs to be addressed and managed is the risk of vandalism. In order to prevent it, dedicated equipment will be installed on the cars, such as shock sensors or a GPS that will allow tracking the car. Moreover, a partnership with the **Paris Prefecture of Police** has been signed. Every charging station will be equipped by a video surveillance system directly connected to the police. Then, an **insurance company** will insure every car up to €4 000 annually for potential damage from accident or vandalism (the cost of the insurance being integrated into the operating cost supported by Bolloré). Finally, the **users** will be financially encouraged to take care of the cars through an evolving franchise policy. They will support €250 for the first incident, then €500, then €750 and so on. After one year without any incident, the franchise comes back to the initial €250 fee.

The core targeted users are the ones who cannot afford to buy a car or who do not still have a car but plan to buy a new one in the short run. More generally, Autolib targets both households already equipped with a car and those who do not. For households that already own a private vehicle, Autolib would allow to reduce its usage, or even to dispose it. For households that have no vehicle, it allows them to use a car when it is needed without having to equip.

Extensive market studies have shown that from a socio-demographic perspective, and compared to the total population examined, the future users of the Autolib will be composed of:

- Almost equally of women (49%) and men (51%);
- rather young people, with a proportion of 18-34 year olds by 42%;

- more active than average (63% against 57% of total respondents) and family, with 35% of households having at least one child under 18 years (against 30%)

A survey among a representative sampling of 598 parisian people aged above 18 has shown that⁴:

- 61% plan to use Autolib (compared to 39% that are already Velib users)
- But 5% only plan to use it every week (13% every month, 28% several times a year, 15% once or twice a year).
- The use would be more spread on the whole day than for the Velib, which concentrates the frequentation on peak times and working hours. The individuals who plan to use the Autolib have mentioned that they would use it in the morning or the afternoon during week-ends (49%) or during weeks (33%), or in the evening during week-ends (32%) and during weeks (40%) (several answers were possible).

The product

Since the conception of the project, Bertand Delanoë, Mayor of Paris, has put the emphasis on a mobility service relying on a “CO₂ emissions-free” car, the electric car being favoured. The call for tenders mentioned the obligation to operate the system with electric cars.

While all the eliminated candidates relied on existing cars (Smart ED Electric Drive, Peugeot Ion, Citroën C-Zéro or Mitsubishi I-Miev), Bolloré was the only one that had decided to develop a new dedicated car for Autolib in partnership with Pininfarina. The car is equipped with a Lithium-Metal-Polymer battery developed and produced by Bolloré with a capacity of 30 kWh offering autonomy of 250 km and recharged in 4 to 8h. The four seats vehicle will be equipped with a screen for managing Autolib and integrating a GPS. This one will allow to track every car and to identify potential abnormal use.

Of course, the car will be also equipped with dedicated equipment for car sharing, such as a card scan to unlock the car and a keyboard to encode his/her personal code to start the car.

Classically, the car-sharing systems are provided by operators other than the car manufacturer. Therefore, no disruptive redesign really occurs to make cars more eco-efficient.

With the Autolib, it is different. The car will be specifically designed for the purpose of the Autolib. We may therefore expect that the cars will be designed to be easily repaired and maintained, and to be easily disassembled. Moreover, we may expect that the car will be designed specifically for more intensive usership.

⁴ Source: <http://www.autolib-paris.fr/spip.php?article77>

The services

A key issue to foster customers acceptance of this new service is to make it easy and convenient. To reach this goal, many services will be implemented.

First, a simple and flexible pricing policy with a limited number of different subscriptions has been designed. The price structure is the following:

- Annual subscription: €12 per month; €5 the first 30 min (then €4 and then €6)
- 7 days formula: fee of €15; €7 the first 30 min (then €6 and then €8)
- 24h discovery formula: fee of €10; €7 the first 30 min (then €6 and then €8)

The design of the pricing policy has taken into account the potential use, namely intensive use versus occasionnal one, and a formula suitable for tourists. To subscribe, the user needs to physically go to an Auto-Lib kiosk or to the center with the following documents: ID, driver's license, permanent address proof, and payment tool (credit card for the 24h or 7 days subscription/an IBAN number for the annual one). It will receive a customized card to take the car directly in the stations. The kiosks will be located close to several stations and will be available from 8:00 am to 8:00 pm. Moreover, a center located at the heart of Paris will be available 24h a day, 7 days a week. In order to accelerate the subscription process, the user may achieve some operations on the Internet to prepare and pre-fill the documents. A deposit of €150 will be asked for the 24h or 7 days subscription, of €200 for the annual one. This deposit won't be cashed.

In terms of use, it will be possible to book a car through the Internet for 20' maximum, free of charge. To enter to the station, the user will scan his/her card and encode a confidential personal code. After disconnecting the car from the charging station, checking its state, the user scans the card on the reader fixed on the car, which is then unlocked. A GPS is embarked and a call button allows the connection with a call center if assistance is needed. When arriving at the destination, the car needs to be parked in an appropriate parking spot, reconnected in the electrical plug and locked. When you exit the destination station, you get a ticket that summarizes the price of the rental.

While the user is free to pick up or dropped off the car at various locations around Paris, logistic is a key issue. The user indeed should not face several full stations that would oblige him/her to drive far away from his/her destination point to find a station with available parking. This challenge will be solved through an adequate infrastructure design (see below) but also with a reliable service of car relocation. Dedicated staff will be hired to move the cars from one point to another so that stations could have enough vehicles but also enough free

parking. Every night, a complete redistribution of the cars among the stations will be achieved to prepare the stations for the morning. Moreover, when taking a car, the user will have the possibility to book a parking spot at his/her destination station. And last but not least, for the most frequented stations, if it is full, the user will have the opportunity to give the car to a station employee that will drive it to another station. The defined service level agreement plans that a user should never walk more than 600m between the station and his/her final destination.

The infrastructure



To date, approximately 1,120 stations will be deployed on the territory of the member municipalities, 700 being located in the City of Paris. These stations will include six parking spaces on average. In order to guarantee enough parking availability in the stations, a parking ratio of two places per car has been defined.

That means that there will be twice more available parking spots than the number of cars of the systems. A specific marking is expected to distinguish Autolib stations from standard parking spots. Each parking space will be equipped with a charging station for electric vehicle and each station of a touch screen kiosk allows the user to choose his destination station and various options. A control station will monitor in real time the availability of cars and parking spots enabling to progressively understand the demand of vehicles and to adapt the offer accordingly.

Some stations will also have an office on the sidewalk and then are called “*Espace Autolib*”. Throughout the served territory, 120 “*Espace Autolib*” will be provided for greater proximity. An agent will be present every day from 08:00 to 20:00, to inquire about the service and complete the users’ registration.

The Autolib service will be launched on 1st December 2011 with 250 stations in the heart of Paris. From December 2011 to May 2012, the remaining stations will be installed so that on 31 May 2012, the 1120 stations would be operational⁵. The meshing of the territory will be done so that a user will have to walk maximum 600m from its final destination to the nearest station.

⁵ It should be noted that the next French presidential election will take place in the month of April 2012 and due to the strategic role of this experimentation, the authors assume that there is strong pressure for a strict respect of this calendar.

Expected environmental and social gains of the system

When shifting to sustainable service systems, environmental gains at least are normatively looked for. But social benefits may also appear from the system. Both are generated by the Autolib system.

Being powered by electricity, the cars do not generate any CO₂ emissions during their use. Of course, the recharge of the cars depends on electricity, which generates an environmental burden related to the composition of the energetic mix. In France, almost 80 to 85% of the total energy production relies on nuclear energy⁶, which is decarbonized (but that generates other environmental key issues such as nuclear wastes and impacting uranium extraction). The French electricity is therefore low-emitting, which is positive for the development and the use of electric cars in this country.

Moreover, car sharing usually allows to remove cars off the roads. ZipCar, the US well-known car sharing operator, claims that every Zipcar introduced into local community takes approximately 15 vehicles off the road, reducing urban congestion, emissions and parking demand⁷. With the Autolib launch, the project manager would welcome a 1 for 7 conversion rate. Based on market research, 80% of car owners that plan to use Autolib have stated that they would modify their mobility behaviors thanks to Autolib. For the ones who plan to use Autolib but who do not have a car, 70% say it will help them solving mobility problems due to the lack of car ownership. Autolib seems therefore an attractive alternative option to a car purchase.

The impact on quality of life is important (less congestion, less pollution, less noise, more parking spots, etc.), and the associated reduction of pollutions contribute to better living conditions and positive impact on public health.

Moreover, as discussed above, the development of a dedicated car for the project would allow to design it for the purpose of its usage. Even if there is still a strong confidentiality in this development period of the car, and sustainability being explicitly sought, we may expect that the car will be designed following the eco-efficiency principles. Especially, it would make sense to make the cars easy to maintain and to repair. The car should also be designed to be robust and durable for intensive usership. The business and the revenue model indeed

⁶ The <http://www.rte-france.com> website provides information on a real time basis about the mix used to produce energy. As an illustration, on April the 10th, 89% was produced by nuclear plants, 3% by wind turbines, 2% by hydroelectricity and the remaining being exported. Coal-powered plant or peak centrals are only used during peak time consumption. This is the reason why the French electricity production is one of the lowest in terms of CO₂ emission all around the world.

⁷ <http://org.elon.edu/sustainability/documents/Zipcar%20FAQs.pdf>

encourage to make cars as durable as possible while the revenue is not generated from sales of the car but on the service it provides. The car is therefore here a cost for the system that gains to be made as efficient as possible to optimize the system and the revenue model.

If the Autolib should generate in itself important social and environmental gains, the city of Paris considers it only as one component among others mobility solutions to reduce the role and the position of individual cars in the city. Based on a deliberate public policy, the city of Paris indeed invests heavily in “smarter mobility” and tries to offer the adequate mobility solution for each kind of usage: Velib and Autolib for short distance moving, car-sharing or car rentals for longer distance moving, densification of public transportation (e.g. reintroduction of tramways in some areas) and optimization of their efficiency (e.g. dedicated bus lanes to improve the speed of the buses), development of the Navigo pass, a unique payment card for all the public transportation in Paris and Ile-de-France, etc. By investing on a system of efficient subsystems, public policy create incentives and constraints for Parisian and people from the periphery to give up individual cars possession.

Conclusion, discussion and directions for future research

This article has first introduced sustainable service system (3S) as an new innovative business approach to solve human needs in a much more sustainable ways. By detailing the key composants of the product-system service, we have tried to highlight the conditions under which a system may generate important environmental improvements. Several key principles are at stake:

- Eco-efficiency and eco-redesign of products, services and processes that are integrated in the system;
- Reuse so that the lifetime of the product should be maximized either by an extension of their life or by judicious replacement of some components only, the goal being to preserved as much material as long as possible;
- Recycle and close the loop whenever it is possible, to transform unvalued wastes into new resources that could reintegrate new economic cycles
- Shift from products to services to design a business model where “volume of product” is not anymore the key driver of the revenue, but rather a cost to deliver a service, that should therefore be minimized.

These elements are related to what we can call a system optimization or a system redesign. They plan to redefine a new industrial policy to make business more sustainable, and product-service systems are clearly one illustration.

Nevertheless, a true innovation system calls not only for products, services and production systems being optimized or redesigned in existing institutional frameworks and infrastructures, but also for new infrastructure, spatial planning and incentive systems to promote more sustainable lifestyles or behaviors (Tukker and Tischner 2004). The basic idea is that both disruptive offering in a evolving context and the related consumption patterns and lifestyles evolves in an iterative approach toward more sustainability.

In this article, we have presented the Autolib system as an ambitious mobility project developed first by the Parisian authorities and then enlarge to broader network of municipalities to question the mobility in a big city such as Paris and its periphery. This system is clearly first a system redesign. Based on a function innovation (providing a use-oriented service rather than a product), it is indeed a complete redesign of a service to provide efficient mobility to populations, while being less impacting for the environment.

To make this redesign possible, an important network of actors is needed, that designs an innovative value constellation with multiple interactions. This generates a huge amount of challenges, the coordination of the actors and the integration of their resources, especially operant ones, being two of them. But may we consider Autolib as a true system innovation in the sense of Tukker and Tischner (2004)? As discussed above, the users of the Autolib plan to change their mobility behaviors thanks to this new system. This system will therefore push toward a more sustainable way of moving in the city. But Tukker and Tischner (2004) insists that in a system innovation, spatial planning and incentive systems should be rethought so that more sustainable behaviors and lifestyle may emerge. In this case, it means a context of life with an inherent low need for transport. And in this case, Autolib will not necessarily modify the inherent need for transport, but rather the transportation modes that will be used to satisfy these unchanging needs. Awareness raising and the availability of inherent sustainable solutions should therefore complemented by adapting the context of life and incentive systems. Not only the attitude and behavioural control is addressed, but also social pressure is put in place. In this sense, a true innovation system would rather be the system of subsystems mentioned above, that links and coordinates all transportation systems in a suprasystem, but that should also be coupled with a surrounding context that would deeply modify our need for

transport. This is an other challenge in terms of network of actors and value constellation innovation⁸.

BedZed⁹, in UK, is an example of such system innovation. It was one of the first environmentally friendly eco-community based on housing development located at 20 minutes from London, England. It has been built in 2000 to concretely demonstrate that it is possible to live sustainably without sacrificing a modern, urban and mobile lifestyle. BedZed comprises 82 homes and 2,500m² of commercial or live/work space. The scheme was completed and occupied in 2002. This precursor site has been completely designed to reduce the ecological footprint of residents by half. This was achieved by rethinking completely the usages and the lifestyles of future residents at the scale of a district in terms of buildings,

	Kg CO ₂ ¹ /mile	Typical Sutton resident	Average BedZED resident	Model BedZED resident
Annual car mileage	0.36	6,000	2,061	0
Car club mileage	0.36		75	600
Public transport mileage	0.1		900	1,800
Cycling/walking	0		300	600
CO ₂ emissions		2.2 tonnes	0.9 tonnes	0.4 tonnes

energy and water supply, transportation, waste recycling, facilities and services, etc. It has challenged conventional approaches to housing by tackling sustainability in every area from the outset. For water saving for example, making more efficient equipments on the building was of course achieved, but investments were also made to encourage more water

efficient lifestyles. As an example, each resident got a BedZed residents' manual that gives water saving ideas and information on the environmental and financial advantages of saving water. Any residents wishing to install dishwashers are offered advice on purchasing water efficient models. A highly visible water meter, mounted in all kitchens reminds occupants about their water use, etc. In terms of mobility, special emphasis has been first put on reducing the need to travel. After that and only after that, a global mobility system was set up, based on electric cars in sharing system, bicycle sharing, convenient public transportation connection, etc. But the primary goal was first to modify the mobility habits and the lifestyle in terms of moving, as illustrated by the table¹⁰ here above.

	Monitored reduction	Target reduction
Space heating	88% (73%)	90%
Hot water	57% (44%)	33%
Electricity	25%	33%
Mains water	50%	33%
Fossil fuel car mileage	65%	50%

BedZed is an example of system innovation that has allowed a drastic reduction of the environmental impact

It is important to note that we assume that sustainability is a positive public policy goal. This assumption is far from being evident while public policies must deal with many goals, sometimes in contradiction. We believe that integration of multiple stakeholders is the most adequate way to enable the emergence of shared goals.

Knowledge of interest is important. The example of the use of hydraulic fracturing to exploit natural gas in the United States is interesting: assuming that a multi-party stakeholder debate takes place: what are the country priorities? Energy supply independence? Water supply preservation? ...

⁹ See for example <http://2005fr.ingenius.net/tiki-index.php?page=BedZED>; Thomas, 2003

¹⁰ http://www.bioregional.com/files/publications/BedZED_toolkit_part_2.pdf, p.35

on its inhabitants. The enclosed table shows comparisons with the National average and, for space heating and hot water, with new homes built to 2000 Building Regulations (in brackets)¹¹.

If developing the Autolib system is already a strong challenge in terms of value constellation innovation, just imagine the one that is needed for a true system innovation. Most radical ‘Factor X’ changes require a change of context, and hence cannot be realized by asking a company to change its business model alone (Tukker and Tischner, 2004). Infrastructure, designing of supra systems composed of existing or new subsystems should coordinate with public policies to help shaping other contexts and develop strong incentives to change. But the lack of numerous examples shows how it is difficult to encourage such change. Previous work on system innovation and transition management for example (Geels and Kemp, 2000; Rotmans et al., 2000; Geels, 2002 in Tukker and Tischner, 2004) suggest that niches play an essential role in processes of radical changes. Niches are here understood as a protected space where innovations may be tested and developed before being scaled up. Does Autolib may be considered as such a niche? Does the willingness of the public authorities – and especially the City of Paris – to develop a true smart mobility supra system could help moving toward such system innovation? The longitudinal survey of the project will allow us to follow its development and its major evolution.

Otherwise, this project aims to answer for recurrent calls in management and marketing research to bridge the research/practice gap (Reibstein, Day and Wind, 2009; Avenier, 2010). Theorizing at the innovation system level seems aims to call for the development of middle-range theories (Brodie, Little and Brookes 2010). A rich venue for research is the integration of complexity theory (Morin, 1992): modeling system innovation resembles modeling of complex systems integrating boundary definition, emergence of outcomes and so on.

Many research questions stay unanswered. First, how could we model the system so that we could understand all the interaction among the network of actors? In other terms, how could we model the value constellation and its possible innovative development to move from a system redesign to a true system innovation? How should we manage (if we should) such a system? How is it possible to integrate operand, but more interesting operant resources of various actors with their own logic and their own goals, some being profit minded, other being societal and public-oriented minded? How is it possible to shape a context in a city with a strong and wonderful heritage that does not allow from starting from scratch such as

¹¹ *ibid*, p.3

BedZed? Who should be the key actors of such innovations, and what should be their role in order to maximize the chance to reach the system innovation? How to direct the change and who should direct it? How co-creation between actors should help and facilitate such transition? For example, system innovation is a promising venue to tackle social issues: hunger fight, health issues, local monetary systems to name a few. Clearly, there are many more questions than answers, in other words so many promising future directions for research.

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