THE EMBEDDEDNESS OF BUSINESS MODELS: SYSTEMIC CHALLENGES TO BUSINESS MODEL INNOVATION

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Abstract

This article addresses the issue of the restricted freedom of incumbents’ business models under systemic and discontinuous innovation. With few exceptions, the state of the art literature on Business Models suggests that BM decisions are conducted within the organization and depict the business model design as an autonomous process driven by managers, and business pioneers (Osterwalder 2004; Zott & Amit 2010). However, this narrative did not fully explain our findings. Empirically, we went to study the business model (BM) challenges facing a bus operator while evaluating a new bus system building on opportunity electrical charging. While our findings relate to the BM literature by highlighting the tension between the present and potential BMs for the incumbents, they also illuminate a contribution that BM design of the bus operator is embedded in the rules of the public transportation authority. Hence, this paper illustrates how systemic innovation exposes the embeddedness of the business models in the context, and that business model design can’t be made in isolation.

Key words: Business models, incumbents, Public transport, Emerging technology management.
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ABSTRACT

This article addresses the issue of the restricted freedom of incumbents’ business models under systemic and discontinuous innovation. With few exceptions, the state of the art literature on Business Models suggests that BM decisions are conducted within the organization and depict the business model design as an autonomous process driven by managers, and business pioneers (Osterwalder 2004; Zott & Amit 2010). However, this narrative did not fully explain our findings. Empirically, we went to study the business model (BM) challenges facing a bus operator while evaluating a new bus system building on opportunity electrical charging. While our findings relate to the BM literature by highlighting the tension between the present and potential BMs for the incumbents, they also illuminate a contribution that BM design of the bus operator is embedded in the rules of the public transportation authority. Hence, this paper illustrates how systemic innovation exposes the embeddedness of the business models in the context, and that business model design can’t be made in isolation.

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1. Introduction

The business models of many incumbent actors are challenged by sustainability goals. The accelerating trend of global warming has triggered a genuine need for change in a number of industrial sectors, e.g. road transportation, which contribute to harmful emissions. Changing systems in order to reach sustainability has manifested in demonstration projects in transport sector. Multiple initiatives have been introduced to test and evaluate alternative transportation solutions utilizing innovative technologies connected to charging and alternative energies, such as electrical power. These systemic changes imply altering current technologies and introducing new artefacts.

However, such innovations pose a discontinuity to many industry players (Utterback 2004) transportation and reveal an immense pressure behind door on the incumbents business models.
System actors are discovering that their existing business models are at stake as their current ways of doing business don’t match the desired forthcoming systems. The vitality of this issue stems from probable dramatic scenarios that left strong incumbents out of markets, had these organizations not prove their resilience to be fit for future. This fit seems to require important and difficult business model changes.

Discontinuous technologies imply radical changes to business models and business ecosystems (Rayna & Striukova 2016). Consequently, it is critical to understand the dynamics in this interface between business models and technological change. Since radical changes contest existing technologies and operations, managing technology shifts of incumbent firms should incorporate both technological and business model innovation (Tongur & Engwall 2014). To continuously reconfiguring and innovating the company’s business model is a mean, not only to success, but also to survival (Velu 2015).

Anchored in a case study of a pilot project where the emerging technology of inductively charged, hybrid-electric bus technology was tested in real time commercial traffic this paper addresses business model design challenges of incumbent firms operating in the established socio-technical system of public bus transportation. Thus, the paper extends the understanding of business model design to a systemic innovation setting, by exploring specific challenges incurred a key actor of the system: the public bus transport operator in relation to the value network it operates in mainly the public transport authority (PTA) and main supplier the bus manufacturer. Consequently, the paper answer the following research question:

**What makes Incumbent business Model design/innovation difficult within systemic innovation?**

The paper contributes to the business models literature in two ways. First, while the focus in the literature is on a pioneer, creator of a business model who design a business model to create value (Osterwalder 2004; Teece 2010), this study shows that the rules of a powerful actor have significantly affected the business models design of an incumbent in the case of systemic innovation. Second, it debates the assumption of rational business model design and calls for a more profound understanding of contextual forces that limit the freedom of the business model innovation.

The article structure is as following: the next section discusses the theoretical background both of systemic innovation and business model design. The third section describes research design and methodology. The fourth presents the empirical data followed by the findings in the fifth section. We discuss the significance of the article results in the sixth section. Finally, in the seventh section, we conclude with theoretical, practical implications, and recommendations for further research.

### 2. Theoretical background

#### 2.1 Transitions and Discontinuous innovation challenging incumbents

A transition is a shift from one sociotechnical system to another not reorienting the current trajectory but rather shifting to a new one, this translates to changes in sociotechnical system elements: knowledge base, technologies, infrastructures, regulations, user practices (Geels & Kemp 2007). This approach relies on the notion that a technological change on its own is not sufficient to drive large-scale changes leading to a transition process. therefore, transition is viewed as a process resulting from interactive processes occurring on multiple levels (Geels & Schot 2007, p.400). This process
incurs innovation on different levels; on the niche level, innovations are usually radical. An Innovation comprises of certain technical knowledge about how to do things better than the status quo (Teece 1986) and involves new alternatives (products or processes), deviating from the present in one or more aspects. The nature of such change can be either of continuous or discontinues nature, while the continuous doesn’t incur dramatic changes, the discontinuous entails an irreversible new order (Watzlawick et al. 1974; Burt 2007). Discontinuity is the unexpected that will disrupt the trends of the present and by that forming the future; a future that is radically different from today. A Discontinuity can be attributed to a change of a great degree and can be described by its scale, results, and irreversibility (Drucker 1968; Ayres 2000).

On the other hand, discontinuous changes pose pressure on the incumbents leading to potential disruptions to the way business is done at the present. Such challenges defy the current way of doing the work, which often is not appealing to incumbent organizations (Bessant, et al, 2014). Within this context, many organizations face a puzzling situation, when signs of an external change are impending as the majority of organizations are hesitant to change their business as usual. Prahalad (2004) describes this phenomenon as the ‘blinders of dominant logic’, which hinders the organization from receiving new signals and allocating resources to prepare for the uncertain future. These dynamics translate to many attributes of the incumbent firms. Specifically, the business models of the incumbents become under subtle challenge with systemic innovations looming in the horizon. Therefore, incumbents may be required to change their business models to translate some aspects of the sustainable technologies into new economic value (Chesbrough & Rosenbloom 2002) as the current business practices of incumbents are challenged by sustainable technologies (Bohsack et al. 2014).

2.2 Business Model Design and Innovation

In mainstream business model theory, the underlying assumption is that the business model design is guided by a rational management decision directed either to capture an emerging business opportunity (Johnson et al. 2008) or to create value and generate profits (Teece 2010). The business model design creates, according to this literature, value for the focal firm and its partners, while simultaneously appropriating sufficient value back to the focal firm (Zott & Amit 2010; Markides 2006). The literature on business models entails many descriptions on the building blocks of business models (Zott et al. 2011). According to Amit & Zott (2001), a business model design can be structured into two main areas; the architecture consisting of content, structure and governance; and the value creation sources, including of key aspects such as novelty, lock-in complementarities, and efficiency. Frameworks from (Chesbrough & Rosenbloom 2002), (Osterwalder et al. 2005) (Johnson et al. 2008) and (Fjeldstad & Snow 2017) have value proposition, value network and revenue cost model as key components in common. Thus, designing a business model incurs choices on a combination on vertical and horizontal activities, and the evaluation on whether such activities can be done at appropriate costs to generate sufficient profits (Teece 2010). Thus, the main emphasis when it comes to designing business models in a multitude of the literature is on intraorganizational perspective.

This normative literature emphasizes the need for executives to understand the business model thinking in order to capture the emerging business opportunities (Johnson et al. 2008). It is not enough for entrepreneurs to own capabilities in product development and innovation, they also have be capable in designing their business models in order to create value (Teece 2010). The probably most famous conceptualization of these business models is the Business Model Canvas by Osterwalder
(2004), depicting the business model as consisting of 9 building blocks, which together describe the company’s business operations. This canvas approach manifests the structural normative tool for designing new business models that is dominating present thinking.

However, business models is also a significant theme in more non-normative, descriptive, research. Some literature, have extended this view by also acknowledging the significance of external factors and actors. Pateli & Giaglis (2005) acknowledge that development of business models is not only affected by internal firm specific actors but also by external industry-specific factors like industry structure, the type of players, and the balance between transaction costs and cost internal development. Moreover, Björkdahl (2009) also found out the limitations that external environments imply on the freedom of firms to alter their business models by revealing that the business model is highly dependent on external factor especially competition. With that the evolution of BM may be fundamentally affected by environmental shifts that lead to an internal choice, then to structural change leading to innovating business models (Demil & Lecocq 2010). This thinking is manifested in the advice given to the designers of complex activity systems to consider the four antecedents goals, templates, activities performed by stakeholders, and environmental constraints (Amit & Zott 2015).

In summary; business model configuration is conceptualized as a key executive decision of deliberately designing the firm’s activity system that sometimes may transcend the firm’s juridical boundaries (Zott & Amit 2010). (Magretta 2002) views business models as stories that explain how enterprises work. We view the existing business models as sediments of the histories of the incumbent organizations reflecting the logic of how problems have been solved over the years.

Thus literature is Impregnated by the normative handbook theories and tend to ignore the contextual contingencies. Even the part of the literature that address the contextual aspects, this thinking still reinforces and assumes the decision is in the hand of the focal firm deciding: which activities and functions to undertake, which ones to outsource, and how to govern business models.

3. Methodology

3.1 Research Design
The paper is based on a longitudinal case study following the stop inductive hybrid-electric bus demonstration project during the period 2016 to 2017. Currently, the research has been ongoing for more than one year. The case study method is applied to provide an in depth exploration of the business model design challenge with focus on contemporary phenomenon (Yin 2009, pp.2–9). Moreover, the case study is chosen as the current literature offered little guidance on the difficulty of business model design from an interorganizational perspective (Siggelkow 2007). The data has been collected from multiple sources by means of semi-structured interviews, participant observation, and document analysis. Moreover, a primarily inductive research strategy has been utilized to enhance identifications of patterns within the empirics and thereafter, retrospectively reflect the findings with relevant literature to set the scene for potential future research (Glaser & Strauss 1968).

The study applied an insider/outsider design (Bartunek & Louis 1996), with one insider researcher closely following the events within the project, as well as interviewing the actors’ representatives and relevant professionals in their organization; and two researchers applied outsider roles in order to discuss and reflect on observations and findings, as well as direct the upcoming planned work. The
observations from project meetings and facility visits resulted in field notes. Each of the notes consisted of quotes as well as observant reflections on project members’ evolving role and interactions as well as solution development activities incurred in bus manufacturing facility and infrastructure works in the road. Moreover, in order to understand the depth of the business model design challenges, the interviews were not restrained to representatives of the different project stakeholder organizations but to the managers who are indulged with business models decisions within the respective organizations.

3.2 Data Collection
The first phase of the study was designated to understand the purpose and design of the demonstration project at project level. Therefore, the inside researcher conducted a first round of interviews with project partners representing the participating stakeholders. Thereafter, the research aimed to explore the potential problems facing an incumbent business model, if the inductive charging technology should be implemented in commercial operations on large scale. Consequently, interviews were conducted with relevant professionals (business development, strategists, product developers, traffic planners.) of the key actors’ organizations.

The interviews followed a guide included open-ended questions. The first set of questions was for the project members concerning the interviewee’s roles and responsibilities in the project and their respective organizations, the motivation behind each actors’ participation in the project, the activities that each organization was entitled to conduct in the project, and the critical events and challenges that they have faced while participating in the project. The second set of questions were raised to the managers and engineers within the organization to understand the business models inquired into the offerings, the revenue logic, customers, and operational aspects affect the business operations. Furthermore, the effects of the new technology on the business were reflected upon with the managers as well as project staff to understand the technical as well as business side. Due to the longitudinal nature, the interview guide has been updated to follow the events that have been occurring along the study. In parallel to interviews, the insider researcher was also attending project meetings and making participant observations while e.g. visiting the charging site and the bus manufacturing facilities.

In total 26 semi-structured interviews were conducted with interviewees of the relevant stakeholders. The interviews lasted between 35 minutes and 2.5 hours. Most of the questions were open ended, with follow-ups to reach the needed depth on the research problem. All interviews were documented: 20 interviews were recorded and transcribed, and for 6 interviews, the insider researcher took notes. The interviews were complemented with documents analysis of project specific documents, e.g. project reports, financial documents, and technical descriptions for stop inductive technology, as well as general documents, such as technical documents for pilot projects with similar solutions, industrial reports, as well as reports from similar research projects on electric vehicles.
Table 1, A summary for the case study data sources

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Participating Actors</th>
<th>Representative Source</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 Interviews</td>
<td>-Bus operator&lt;br&gt;-Bus manufacturer&lt;br&gt;-Public transport authority&lt;br&gt;-Technical solution supplier&lt;br&gt;-Electric energy supplier&lt;br&gt;-Municipality&lt;br&gt;-Transport Research lab</td>
<td>-Managers working on marketing strategy&lt;br&gt;-Project managers&lt;br&gt;-Business strategists&lt;br&gt;-Bus business development manager&lt;br&gt;-Portfolio manager&lt;br&gt;-Head of R&amp;D for E-mobility&lt;br&gt;-Traffic planners</td>
<td>-Audio recordings&lt;br&gt;-Notes</td>
</tr>
<tr>
<td>Participant observation:&lt;br&gt;-23 Project meetings&lt;br&gt;-2 Field visits&lt;br&gt;-Attending relevant conferences</td>
<td>-Bus operator&lt;br&gt;-Bus manufacturer&lt;br&gt;-Electric provider&lt;br&gt;-Municipality</td>
<td>-Project meetings attendance&lt;br&gt;-Bus development facility visit&lt;br&gt;-Charging infrastructure site visit</td>
<td>Field Notes</td>
</tr>
<tr>
<td>Document Analysis</td>
<td>-Transport research lab&lt;br&gt;-Solution supplier&lt;br&gt;-Internet</td>
<td>-Technical&lt;br&gt;-project related, Financial, web material&lt;br&gt;-2 Industry conferences participation</td>
<td>-Project documents&lt;br&gt;-technical descriptions&lt;br&gt;-web material</td>
</tr>
</tbody>
</table>

3.3 Data Analysis

The analysis was undertaken in parallel to the data collection process, when we started to have an adequate level of understanding of the project dynamics and the challenges facing the participant actors. Moreover, a broad literature review of business models and technological change was conducted in order to identify commonalities between the empirical findings and the state of the art theory. Thereafter, we investigated the nature of the project and what kind of changes it entails to the actors afterwards we mapped out the different activity systems for the two actors.

To make sense of the data, we compiled the business model components for the public transport operator (PTO) or in terms of: value proposition (product and service), value network, including production/sales and governance (development, production, and sales activities), and profit formula (cost, revenue architecture, resource velocity). The previous dimensions were a common dimensions from the business models literature (Chesbrough & Rosenbloom 2002; Johnson et al. 2008; Amit & Zott 2001; Bohnsack et al. 2014), refer to table 1.

To acquire a precise picture of the implications that the hybrid inductive on the operator BM, we depict the BMs according to the dimensions in table 1 before and after adopting the hybrid inductive bus. Therefore, we utilize the business model framework in table 1 distinguishing four general components: value proposition, value network, key resources, and profit formula. We began the
process by mapping the current BMs of the two actors as activity systems. Afterwards, we discussed the controlling instruments that the hybrid inductive change revealed at the studied players. At the end of this section, we re-mapped the BMs of the organizations considered again in the case of adopting the new technology. The major findings from our analysis will be contrasted in tables (2-3). Accordingly, our Analysis yielded a fresh understanding of business models under systemic innovation. Finally, this approach allowed us to undertake a comprehensive and systematic understanding of the nature of the change that the technology brings utilizing the business models lens to contrast the effect that the hybrid inductive brings to the bus operator.

Table 1 Business model components

<table>
<thead>
<tr>
<th>Firm</th>
<th>Value proposition</th>
<th>Value network</th>
<th>Key resources</th>
<th>Profit formula</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Content and segment</td>
<td>Production\Sales &amp; Governance</td>
<td>People Technology Partnership and alliances</td>
<td>Cost Structure: Revenue architecture Resource velocity</td>
</tr>
</tbody>
</table>

| Product | Service | Segment | Cost Structure: Revenue architecture Resource velocity |

4. The Empirical Setting

Public bus operations in urban areas are based on bus transits following designated routes in order to transport high volumes of travellers. Since a couple of years, electric buses are gaining popularity in public transportation, posing a technology shift, from the conventional internal combustion engine to full electric or hybrid electric solutions. This upcoming change is however not only technological, but transcends also to social and regulatory aspects. At the moment, multiple pilot projects are conducted around the world in order to test which electric charging alternative that might be most viable for the future: conductive, inductive, opportunity charging, or overnight charging. Some examples utilizing different technologies are: full electric battery based buses, Slide in buses using dynamic conductive charging, conductive and inductive hybrid electric buses. In the following: a short description about the project and the new system.

This paper is based on a study following The stop inductive hybrid electric bus project. The field test is utilizing inductive opportunity electric charging bus done on a bus line in a suburban area of Stockholm, Sweden, with a path length of about 4.9 Kilometres. The overall value that this bus system can deliver is: the hybrid electric technology reduces CO2 emissions and noise, improves energy efficiency, and decreases fossil-fuel dependence. The specifications of such a solution are designed to match the suburban bus lines. the bus can go fully electric in the central part of the city. Afterwards it switches to the hybrid mode when it runs a long distance out of the inner-city the bus can go on hybrid mode. This is conveyed by chief electric solutions engineer: “This bus solution especially true for inner city, where the need is for high frequency, in special hours, which highlights that such a solution could be suitable for suburban context rather than innercity”.

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This new bus system incurs two main technological changes in artefacts: the hybrid electric bus and the electric charging infrastructure. While the former incurs changes within the bus powertrain, the latter represents a new item to a bus system that will incur electric charging of the bus during commercial operations, this is called opportunity charging. The bus is an electric hybrid city bus, equipped with wireless inductive technology. The batteries on the bus are wirelessly charged when the bus stands still at its terminal bus stop, providing it with the power it needs to complete the next route. The bus is equipped with a combustion engine in combination with an electric engine, electric propulsion, and a battery. During operations, the bus will stop at the end station for 6-7 minutes in order to charge the battery. The hybridization technology enables to shift between electric propulsion and combustion engine, when needed. The electric charging infrastructure is a new artefact introduced to the bus system, with a charging slab placed in the ground, under of the bus stop. The changes to the bus system influenced the business model of the bus operator which works closely with the transport authority to deliver reliable transport to commuters. In the following we shall review the current business model for the bus operator and the new business models following the change brought by the new transport system logic.

5. Findings
The hybrid inductive bus system is a potential business opportunity to run an environmentally friendly solution by reducing CO2 emissions, which would lead to important implications on the bus operator business models. The findings will be structured to visualize business model before/after applying electric charging. finally, the results of the analysis is organized in the tables (2-3).

5.1 Traditional business models
The public transport operator (PTO) is a private firm and one of the leading actors on the Nordic bus transportation market. In these markets, the bus transportation is run through contracts with transport buyers who are cities/transport authorities. They are managed on regional basis where transport operator promises to deliver bus operations on about 12 years period. To deal with this situation, the business model of the operator is designed of two logical phases: tendering for transport contracts and contract execution. Each phase includes different processes and engages relevant management and staff.

The first phase is tendering which includes all the business activities before the contract and actual transport operations. These activities include prospecting, within this the bus operator analyses the tenders received from cities, regions, and transport authorities. Afterwards, the operator selects and prioritizes the most attractive tenders, after negotiating terms with transport buyers like transport authorities and cities. at the end of this process the PTO submits the tenders. Finally , risk assessment is being done, through this phase, for the potential tenders to quote contracts. Within this phase, the fleet management and traffic planning teams start their involvement from the tender pricing. A notable aspects of these teams is that the drivers salary in northern Europe is a significant piece of the formula as bus fleet manager mentions: “the drivers salary is about 60% of our costs”. This shows the importance of optimization and efficiencies for the PTO in the contracts.

The second phase, contract execution, starts when a tender is won. Within this phase, the focus shifts to contract management including planning the traffic in agreement with the public transport
authority. This phase also incurs procurement of new buses and/or uses buses that already has which meet the contract demands. As the bus fleet manager states:

“Which buses to buy and how to utilize them among our different contracts is a key to compete at a low margin market”. Flexibility is very important in this phase. Often, the bus operator can utilize some of its existing buses, which already are running in operations in other areas. Usually, the operator rents bus depots and garages, which enhances the existing system of overnight charging of buses (diesel/bio diesel filling), from the PTA.

Within each phase, two distinct processes are triggered utilizing the resources in the company to deliver the value it promises see figure (3). An important to mention that two key processes commence which are fleet management and traffic planning cross the two phases. This is due to the involvement of the traffic planners in estimations during the tender pricing and submission as well as getting knowledge from their fleet managers in order to plan the operations. Within the demonstration project, the PTO is responsible for operating the bus line as they won the contract in the region where demonstration project is happening, with an interest of evaluating the solution from technical and business perspectives.

![Diagram of business activities for public transport operator](image-url)

Figure (3) The business activities for public transport operator
### Table 2, The traditional business model of the bus operator with current technologies

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>Value network</th>
<th>Key resources</th>
<th>Profit formula</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content and segment</strong></td>
<td><strong>Production\Sales &amp; Governance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bus Operator</strong></td>
<td><strong>Product:</strong> Plan and operate efficient bus traffic (provided to municipalities and cities)</td>
<td><strong>Tendering:</strong> Prospect tenders Selecting tenders Evaluating Tenders and quoting</td>
<td><strong>People</strong> Buses, Drivers, depot management staff, Planners</td>
</tr>
<tr>
<td></td>
<td><strong>Service:</strong></td>
<td><strong>Operation Executing:</strong> Timetable planning Plan the traffic areas</td>
<td><strong>Technology</strong> Overnight charging</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Driver management</td>
<td><strong>Partnership &amp; alliances</strong> Manufacturer, Municipality, PTA, energy provider</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Traffic Monitoring</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Depot operation (rental or build shared with PTA)</td>
<td></td>
</tr>
</tbody>
</table>

**Cost Structure:**
- Driver salary > 50% of cost

**Revenue architecture**
- Contracting
- Ticketing is subsidized 50% tax money

Revenue instalments are either fixed or payed in percentages depending on the passenger blips (revenue stream is ingrained)
- Low margins

**Resource velocity:**
- High volume of operations
- High bus utilization to rotate in the line
- Ability to rotate the bus among different regions

### 5.2 Proposed business models

#### 5.2.1 Guided Offerings

The offerings of both the PTO is subject to significant external influence. In the bus public transport contracting in Stockholm, the choice of which bus solutions in terms of technology is given to the PTO. However, while the contracts do not specify exactly what kind of buses the PTOs need to utilize, environmental guidelines affects this choice a large extent. The process of choosing which bus offering starts after tendering phase as PTO Bus manager says:

“After winning the contract, we quote different manufacturers for a number of buses to fulfil a 10 to 12 year contract, in order to pick the best solution that fits us”.
The offerings from bus manufacturers vary in price, performance, and different energy basis. However, this choice is highly delimited by environmental guidelines set by the transport authority in Stockholm. Such guidelines are tailored to control the environmental output of the bus operations in the city as bus strategist at the PTA mentions:

“The transport operations have three major impacts on the environment: The emissions mainly CO2, and then there is noise and energy efficiency usage, which we provide guidelines to the operators in order to reduce this impact”.

Therefore, the most challenging targets right now are energy efficiency and noise. Therefore, the bus offering choices made by the PTO or not free as Bus fleet manager of the PTO mentions:

“the guidelines may lead to some technologies or energy based solutions, which may not be efficient from operational standpoint. So if we make proposals with other solutions that are better operationally then we will be less competitive and we might lose a lot of contracts”.

5.2.2 Delimited value creation

The expectations of cities and regions along with guidelines from authorities qualify as important instruments to affect the value creation elements for the bus operator. In the following, the evidence from the operator reveal how this design block is inclined by these external measures.

The public transport authority relies on efficient operations to keep healthy profit margins. Therefore, planning and executing phases need to be managed effectively to lead to desired financial and operational results. However, our findings show that freedom in managing both phases is not expected. The following will show external effect on both executing and tendering processes for the PTO.

Regulated Tendering

Changes will not only affect the operations phase but also will trickle down to the tendering phase processes. The PTA targets leading to opportunity charging will eventually lead to disruptions of the PTO during the tendering phase, and traffic planners need to adapt to this lower asset. PTA bus manager:

“Our tendering phase plans and estimations are built over flexibility and efficiencies, the scheduling logic will change due to the time added up, we depend in our estimations on a flexible vehicle, buses are made to be flexible”.

Moreover, the scheduling process for the bus operations is highly influenced by certain thresholds set by the PTA, Bus operations engineer in the PTO reflects:

“The planning regarding bus schedules occur in order operate for a certain level of frequency demanded by the PTA. we need to meet specific objectives in terms of operations, timespans, frequencies, we have some extra margins, but if we cross these margins then we face penalties”.

The reasoning for this thresholds and penalties is that the PTA views bus operation not only in the business and economical sense but also the societal part to the biggest picture. PTA bus development manager speaks to the control over the operations:

“The operators are private companies that run for profit so it is in their incentive to close down the bus lines that are not profitable. Therefore the freedom that is given to the operator to plan and operate
the traffic is limited by a threshold, which is lowest level of traffic, the PTO cannot operate below this floor”.

Finally, the control seem to transcend the contract time. The new targets PTO also faces new regarding post contract on what to do with these specific infra-dependent buses. As the PTO has 12-year contract duration with the PTA, the PTO can only use these buses in areas that has this specific infra, which may represent a large restriction. PTO operations engineer:

“We usually roll some of our buses from contract to contract, however a bus that works on a specific infrastructure will hinder this, and affect our planning”.

Regulated Execution
The PTO value creation mechanisms relies on efficient transport planning. With the current charging solutions, the operators can keep the buses running all day as much as possible while all charging is done during the over-night stop in the depots (Biogas, biodiesel …). An operations engineer reveals that:

“We need to keep our buses running as much as possible within schedule because every minute matters”.

However, the PTA guidelines may lead to solutions that strikes the flexibility to utilize the assets and during the execution phase in order to win in a business with low margins.

The first aspect is reflected in affecting the PTO’s high utilization of the buses during operations in each line. As well as utility and ability to move buses among lines and regions. The PTO relies heavily on this aspect among different geographical areas when the needs arise for an extra bus. A bus manager reflects on the reasons behind the spikes in demand:

“Urgent needs could come from peaks in demand of certain areas, technical problems, or driver related issues”.

Hence, the challenge that arise in these types of situations when introducing the inductive hybrid solution is that it adds rigidity and, therefore, the PTO will be less flexible in utilizing the buses during operations. The flexibility issue is not only problematic for certain bus lines, but it transcends within the operations to different lines or even regions. Therefore, had the environmental targets lead to opportunity charging based solutions, then the charging time associated with opportunity charging of the hybrid solution will reduce the utilization of the bus in each line. The Bus fleet Manager demonstrates

“any extra times during the transportation extra cost translated in drivers salary is probably the need for more buses, stopping for 6-7 minutes to charge poses a significant challenge to u during the operations reducing current efficiencies transport, we don’t believe that any charging during operations will fly, we need to keep on charging overnight”.

5.2.3 Embedded Financial streams and decisions

Dependent revenue architecture
All PTOs have the freedom to run bus operations on their own without contracting with the public transport authority, as they have the freedom to opt in contracting with the transport authority or to run operations on their own. However, practical experience revealed to the PTO that the margins are tight and running solo operations does not make commercial sense as PTO bus manager mentions:
“In public transport, bus operation in itself is not self financing, so there are tax subsidies in some way in all systems. Typically it is the same all over Europe. There are very few lines or operations that you can actually make them fully commercial operation on local public transport, in Britain they have tried, the British system is quite liberalized – Deregulated, but they are also coming back to subsidizing because they don’t get the service that they want”.

In the last decade, the bus public transport has faced deregulation, previously, the public transport authority used to own buses and operate them. Nevertheless, the new changes opened the market to PTOs to run any operations in any part of Stockholm without coming back to the transport authority. But this freedom was a high cost as bus specialist at the PTA mentions:

“This freedom of choice allowed many operators to run the operations on their own however they discovered that it is not profitable, which lead them to requesting to contract to make use of tax subsidies”.

Consequently, this result triggered an interest in further exploring the possible explanations of the business model design delimitations for the PTO. The contracting terms set by the PTA play as an important controlling mechanism for the public transport operator financial streams and decisions (revenues, costs, pricing). Such elements are tightly locked.

**Controlled revenue mechanism**

Within the bus operations contract, the PTA through contracting terms controls the revenue stream flow of PTO. The revenue of the bus operations flow directly to the transport authority which gives back to PTO parts of the value contract over determined time periods. a bus fleet manager at the PTO:

“We don’t sell tickets, PTOs just validate the ticketing. SL have the system that manages the ticket selling”.

Moreover, transport authority decides the design of the revenue stream of the PTO. Bus engineer at PTO:

“We have two type of contracts from being performance motivated to number of passengers motivated, or a mix of both”.

The contracts payment ranges from old way based on production meaning that the PTO are charged per vehicle\km and they were common until around 2007, to a new way where PTOs are charged by passenger\KMs. A Bus strategist in the PTA clarifies the rationale of the new logic:

“The new contracts create financial motivation for PTO to get more passengers in the operations. I think they provide a great way to motivate PTO to get more passengers, this is to allow more people to go into the public transport, we would like to see more people leaving their cars and going to buses”.

Most contracts are a mix of the two logics, and include a revenue model, which typically consists of a fixed share and variable share, depending on the number of ticket sold to passengers boarding the buses.
Pricing and costs embeddedness

The PTA controls a significant deal of the financial decisions connected to the bus operations regarding tickets prices in terms of levels different categories of prices. Within the executing phase, the PTO is responsible for validating the tickets, however, the ticketing system is provided by the PTA. PTA bus development manager elaborates:

“The prices of the tickets are decided by the PTA’s board and the tickets re subsidized by the regional taxes to approximately 50% of their value”.

Therefore, the ticketing system acts as an instrument to control the operators who would like to undertake operations but looking for the tax subsidy. On the other hand, the new environmentally friendly bus solution reveals that the costs of the PTO are also locked. The electric based opportunity charging solutions will bring efficiencies on energy consumption to the PTO. However, The added time to the operations will lead us to have higher costs as the bus fleet manager demonstrates:

“New technological innovation would lead to challenging the efficient operations and leading to need of more buses, more times for drivers, a bus fleet manager reflects on this issue “”.
Table 3: The business model for the PTO adopting inductive bus technology

<table>
<thead>
<tr>
<th>Value proposition</th>
<th>Value network</th>
<th>Key resources</th>
<th>Profit formula</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content and segment</strong></td>
<td><strong>Production\Sales &amp; Governance</strong></td>
<td><strong>People</strong></td>
<td><strong>Cost Structure:</strong></td>
</tr>
<tr>
<td><strong>Bus Operator</strong></td>
<td></td>
<td>Buses, Drivers, depot management staff, Planners</td>
<td>Driver salary &gt; 50% of cost</td>
</tr>
<tr>
<td><strong>Product:</strong></td>
<td></td>
<td>Technology</td>
<td>Costlier operations (increased time for drivers or increased number of buses)</td>
</tr>
<tr>
<td>Plan and operate efficient bus traffic, bus dependent on infra, less noisy (operate in night times, noise sensitive areas)</td>
<td>Tendering:</td>
<td>Overnight charging</td>
<td>Costlier bus</td>
</tr>
<tr>
<td><strong>Service:</strong></td>
<td>Evaluating Tenders and quoting (extra costs will make the quotes probably higher)</td>
<td>Opportunity charging</td>
<td>Cut energy costs</td>
</tr>
<tr>
<td>Plan and operate efficient bus traffic, bus dependent on infra, less noisy (operate in night times, noise sensitive areas)</td>
<td>Executing</td>
<td>Partnership &amp; alliances</td>
<td><strong>Revenue architecture</strong></td>
</tr>
<tr>
<td></td>
<td>Timetable planning</td>
<td>Manufacturer, Municipality, PTA, energy provider</td>
<td>-Contracting</td>
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<tr>
<td></td>
<td>Plan the traffic areas (Schedule differences due to opportunity charge time)</td>
<td></td>
<td>Ticketing is subsidized 50% tax money</td>
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<td></td>
<td>Driver management</td>
<td></td>
<td>Revenue instalments are either fixed or payed in percentages depending on the passenger blips</td>
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<td></td>
<td>Traffic Monitoring</td>
<td></td>
<td>-Low margins</td>
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<td></td>
<td>Depot operation (rental or build shared with PTA)</td>
<td></td>
<td><strong>Resource velocity:</strong></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>High volume of operations</td>
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<td>High bus utilization to rotate in the line</td>
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<td>Ability to rotate the bus among different regions</td>
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<td>More rigid bus rotation (less flexibility and efficiency in the line and overall operations)</td>
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</tbody>
</table>

6. Discussion

In this paper, we set out to study the difficulty of business model design challenging incumbent firms while participating in a demonstration project inducing new charging technology to a bus transportation system. More specifically, we posed the following question: what business model challenges do incumbent firms experience while adopting a systemic innovation?

Our findings align with previous research, which has emphasized the difficulties associated with business model design and re-design, especially in an already existing context (Zott & Amit 2010). The introduction of new technology in the bus transportation system were associated with severe business model design challenges of inertia (Teece 2010; Zott & Amit 2010), experimentation costs (Chesbrough 2010). The inertia force have manifested in bus operator resistance to opportunity charging electric based solutions. Moreover, for the bus operator, the new charging technology implied increased purchasing costs for new, and more technologically complex, buses, as well as a less
flexible bus fleet, potentially decreasing the efficiency of the low-margin-high-volume logic of the bus operations.

However, while previous research has revealed how the activities of a firm’s business model may transcend the focal firm and span its boundaries to suppliers, partners, vendors, customers, etc (Zott & Amit 2010), our findings takes this aspect of cross-boundary dependencies of business models one step further. In the present case, while both the value proposition, value network, key resource, and profit formula of the operator was affected (locked), they still had to operate under a systems framework, which they had little possibilities to influence. Thus, given their decision to participate in the system, the autonomy of the business model design activities of the PTO was highly delimited.

In theory, the PTO could operate outside of a contract with the PTA and thereby push more of its cost on the customers. In practice however, the tax subsidiaries to the ticketing system of the public bus transportation, make this alternative commercially impossible. In practice, the PTO was locked-in by the rules defined by the systems owner: the PTA. Thus, in situations of systemic innovation, business model design activities may not be represented by autonomous and solitarian tasks by a focal firm. Instead, the business models of the systems actors need to be understood as components of a collaborative activity systems and there need to be, at least to some extent, a shared view among the actors on the future system’s functionality and common gains.

By studying a systemic innovation as the introduction of a new technology in a public bus transportation system, the interdependencies of the actors’ activity systems was brought to the fore. Especially the role of the PTA in this private-public business ecosystem is significant when determining fundamental conditions to the other actors. As such, this study underlines how embedded and locked-in business models of focal firms could be. Furthermore, in situations of systemic innovation, the system owner need to govern the system carefully and nurture the necessary adaptions of the system actors’ business model in order to improve the overall system functionality.

In a broader view, the demonstration project our study represents one of many concurrent initiatives to achieve sustainability through infrastructure innovation in the transport sector by e.g. reducing exhaust emissions, increase energy efficiency, and reduce noise levels (Nilsson et al. 2012). Furthermore, the aim of developing sustainable solutions is not isolated to the transport sector, but a major challenge facing several infrastructure dependent sectors such as the energy or water sectors. As such, these sectors are likely to face situations where both the infrastructure owner and the other system actors will perform systemic innovations similar to the one studied in this paper. Hence, out findings highlighting the embeddedness and look-in situations emerging among the actors when redesigning their BM related to the systemic innovation in the bus transportation system could also be valid in other infrastructure dependent sectors.

7. Conclusion
Current BM literature unanimously points at the difficulties associated with BM design. In order to better comprehend the complexity of BM design activities, more recent research on BM emphasize that the BM design decisions benefit from adopting a systems perspective. The results from the present study strongly underlines the critical aspect of adopting a systems approach into the analysis of BM design, especially in situations that involve actors within tight systems. In particularly, BM design decisions needs to be based on analyses where the systems actors, their roles and relative
power, as well as their BM dependencies are taken into account. Hence, these results imply that the current view of BM design decisions as autonomous activities performed by each actor is challenged. In the studied setting, BM design activities are described as acts based on elements of co-creation among different actors. Therefore, we suggest the rules as an antecedent and a guide to the business model design and reconfiguration processes.

In terms of practical implications our study has highlighted the pivot role of the PTA in the bus transportation system. The PTA acted as the system owner and the results show how critical this role was due to the significant influence that it had on the other actors by controlling the contract that defines the terms in the bus transportation system. Especially, as in the present study, where the contract represented a complex public-private market setup, changes in the contract was viewed as both powerful and difficult to comprehend. Therefore, our results suggest that system owners need to build well-functioning relations to other actors in the system and develop a sound understanding of the other actor’s BMs in order to manage the overall system functionality and effectiveness.

This study’s novel results need further research. We argue that BM design in the setting of systemic innovation is relevant for other infrastructural dependent sectors, especially related to the momentum in initiatives aiming at creating a sustainable society. Therefore, we suggest more studies, based on established BM design frameworks, focusing on different infrastructure dependent sectors. In particular, as our results points at the criticality of the system owner, it is suggested that future research pay extra attention to this role and its influence on BM design and system functionality.

Finally, the myth of isolation in making decisions may reflect an old human instinct of desiring to control. However, reality talks with rich examples that it is more complicated. While co-design is needed and encouraged in complexity, the relative power position of the actors need to be comprehended. The criticality of the system owner role emanates from the significant changes that the other actors will face had the owner manipulated the terms. The repercussions that the system owner can cause in the system doesn’t only reach the direct actors but also transcends to the shores of unexpected others endangering their survival. The powerful needs to comprehend how slight alterations could send shockwaves in the system. Therefore, the owner is ought to co-design and nurture the other as the powerful holds the key to the business model cage.

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