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Smart low cost design in complex value networks: The case of public transport

Milena Klasing Chen

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Milena KLASING CHEN

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Smart low cost design in complex value networks : The case of public transport

Directeur de thèse : **Armand HATCHUEL**

Co-encadrement de la thèse : **Blanche SEGRESTIN et Sophie HOOGE**

Jury

M. Stéphane COBO, Innovation Manager, RATP

M. Sébastien DAMART, Professeur, Dauphine Recherches en Management, Dauphine

M. Benoît DEMIL, Professeur, Ecole universitaire de Management, IAE Lille

Mme Sophie HOOGE Maître assistant, Centre de Gestion Scientifique, Mines ParisTech

M. Peter MAGNUSSON, Associate Professor, Service Research Center, Karlstad University

M. Christophe MIDLER, Professeur, Centre de Recherche en Gestion, Polytechnique

Invité

Rapporteur

Invité

Maître de thèse

Examineur

Rapporteur

M. Armand HATCHUEL, Professeur, Centre de Gestion Scientifique, Mines ParisTech

Directeur de thèse

MINES ParisTech

Centre de Gestion Scientifique

60, boulevard Saint Michel, 75272 PARIS Cedex 06

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Avertissement: Ce document est en anglais, une synthèse en Français se trouve à la fin.

*"Nowadays people know the price of everything and the value of nothing."
- Oscar Wilde*

Content overview

This manuscript is in English, but an extended summary in French is provided at the end of the document.

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Preliminary remarks:

This document is structured in an introduction, three parts and a conclusion.

Throughout the document, several boxes in white, green and orange can be found. This color-coding is supposed to make reading more fluent and draw attention to different elements:

White box	White boxes contain the research issue, research questions, research hypothesis and main results. Readers wanting a quick overview of the work done should focus on these boxes.
Green box	Green boxes contain examples and case studies. They provide more details for readers wishing to deepen certain points evoked in the main text.
Orange box	Orange boxes contain definitions. They help to guide the reader through the concepts introduced in the text.

Acknowledgements

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Introduction: Research issues, methodology and main findings

Companies nowadays are facing increasing competitive pressure. Products seem to be evolving faster than ever, and customers' demands for innovative products are increasing, to an extent that some authors speak of a context of intensive innovation (Lenfle and Midler, 2003) and of an innovation-intensive capitalism (Hatchuel et al., 2002). Not only is innovation becoming more intensive, it is also no longer only a technology issue, but expected in most aspect of the firm: technology, business model, processes...

In addition to the pressure to innovate, practitioners are furthermore confronted with competing products that have radically lower prices. For several years now, consumers have been able to profit from so called "low cost" products and services in some sectors, like flights, hotels or cars. With increasing pressure on household budgets, these have become rather attractive alternatives. Most of the clients choose low cost products for their lower price, even though they know they will not have the same experience as with a full cost product. Customers often associate low cost to a lower quality and are aware of the cost-quality trade-off they are making. Managers of "full-service" or "incumbent" firms have to face great challenges in fighting these competitors, who attracted the more price-sensitive customers as well as those looking for simpler products (Kumar, 2006).

Main issues treated in this thesis

A new form of innovation has emerged in the literature, consisting of disruptive low cost products. They have the particularity of proposing a higher value-for-money, and therefore to give the firms proposing them a unique advantage over their competitors. Instead of proposing innovations with a price premium, they propose them at a lower price than that of the existing possible replacement products and aim to achieve high volumes to make benefits possible despite low margins. These products have emerged under different names, amongst them frugal innovation (e.g. Rao, 2013), jugaad innovation (Radjou et al., 2012) and resource-constrained product development (e.g. Sharma and Iyer, 2012). Yet, the differences between these different terms remain to be clarified as the literature remains a very fragmented field and lacks a coherent classification.

Some of these products have found a great success like GE's handheld electrocardiogram (Immelt et al., 2009), and a series of examples are discussed in literature, we can cite the Tata Nano (Ray and Ray, 2011) or the Embrace infant warmer (Bhatnagar and Grover, 2014). Several studies give managers the keys to evaluate if the product is or is not a frugal or jugaad innovation (e.g. Bhatti and Ventresca, 2013). Some works go as far as to give advice on how to foster their emergence, pointing to resource constraints as opportunities (Sharma and Iyer, 2012) or to the need to "follow your heart" (Radjou et al., 2012). However, to our knowledge, there is no formalized model allowing companies to systematically design these

kinds of products. This lack of model makes it very difficult for practitioners wanting to propose this kind of products to profit from the research done so far.

Furthermore, trying to design products proposing superior value-for-money leads to ask ourselves how value can be created in the context we will be studying, public transport, a context involving numerous actors and under strong regulations. The value creation literature proposes the concept of value networks (Fjeldstad and Ketels, 2006) to study similar contexts.

Therefore, our problematic is the following:

Is it possible to propose a design model for low cost products and services? How could the design of low cost products and services become a new path for innovative design strategies in strongly regulated value networks with a great number of actors involved?

Methodology

To treat these research issues, different research methods were used: a multiple case study approach, an intervention research, a systematic literature review and an oriented creativity method. In particular, our research relies on a longitudinal analysis of low cost in urban public transport and an in-depth case study of low cost initiatives led by RATP, the French public transport operator, starting in 2012.

Positioning and originality of the research

Despite a large literature on innovation management, Crossan and Apaydin (2010, p1174) draw attention to the fact that “innovation research is fragmented, poorly grounded theoretically, and not fully tested in all areas”. In the more specific case of research on low cost innovations, the research is not only fragmented, but products are studied under different names, like jugaad or frugal innovation, or innovation for the base of the pyramid, and there seems to be lack of a common framework.

From the practitioner’s point of view there is still a great effort to be done on making innovation a systematic process (Leifer et al., 2000). Making innovation a systematic process, according to the authors, consists of including it into the firm and to organize it within a structure. The general challenge of systematizing innovation is also applied to low cost innovations: Although low cost products have been largely discussed in managerial literature, both by discussing its impacts on markets, how to face low cost competition, its positioning and what should be classified as low cost, their design, and therefore the “how” question, has been less discussed. Our work contributes to both of the identified research gaps, by proposing a design model for low cost innovations grounded on design theories and tested in an empirical setting.

This work's originality rests in approaching low cost products through a framework coming from design theories. Design theories seem to be the adapted framework to help answer the question on how to design low cost products, since they are able to model design reasoning and to "inspire forms of organizing collective design activities" (Le Masson et al., 2011, p. 218). We therefore propose a design model for low cost products that has two different strategies, one using systematic design theories and one using innovative design theories. These two strategies allow classifying products described in several different studies in innovation management, under different names, amongst them "low cost", "frugal innovation", "reverse innovation", "value-for-money" and "jugaad innovation". This allows assembling insights from several different fields and to create a coherent classification in a very fragmented field.

Furthermore, our work contributes to the field of innovation in value networks and ecosystems. Several authors (e.g. Westergren and Holmström, 2012; Chesbrough and Rosembloom, 2002) observe that combining elements from inside and from outside a firm often is needed to innovate. They therefore study partnerships, value networks and ecosystems to understand innovation. Ritala et al. (2013), draw attention to the fact that literature still lacks understanding of value creation in innovation ecosystems. Our work contributes to clarify this through the study of value creation through low cost innovations in the public transport sector, both through a case study and a structured framework.

A further academic positioning of this work is to complement knowledge on value creation through low cost products in management sciences. More particularly, we study the development of low cost products in complex value networks, where cost and price are not directly linked and a great number of interdependent actors participate in the value creation. Value creation and evaluation in innovative settings are part of the research programme on evaluating R&D performance inside the CGS and the DTMI chair (e.g. Hooge, 2010 ; Gillier et al., 2015).

This work follows the research program of the CGS (Centre de gestion scientifique or Center for Management Sciences of Mines ParisTech) on modelling and theorizing innovative design. It was done with the support of the design theory and methods for innovation (DTMI) chair, since it inscribes itself in the research on organization, management and methods for innovative design, articulated around the work of Hatchuel and Weil (2009). As such, this work contributes to the expansion of insights on one of the methods developed by the CGS, the KCP method, having been applied in several industrial settings (e.g. Arnoux, 2013; Elmquist and Segrestin, 2009). An important contribution of this research is to compare the coherence of results from a KCP with the current innovation trends in a sector, allowing a positioning of the firm's efforts inside the sector. Finally, we contribute to the works of innovation in double unknown contexts and genericity done inside the CGS by Kokshagina (2014) through a new approach to value creation in unknown ecosystems.

The empirical motivations of developing low cost mobility offers inside RATP, the public transport operator, are justified by several aspects. First of all, there is the classical industrial challenge of continuous research for levers to reduce costs, both through new strategies and

through operational efficiency. RATP already has to face competition in several of its markets, and like many other firms seeks costs reductions to avoid losing markets and to conquer new ones. Furthermore, proposing low cost innovations allows the firm to diversify its offers, allowing a new positioning in markets the firm does not currently have a satisfying offer for.

Research Questions

From a managerial point of view, the increase in low cost competition had several impacts. On one hand, it allowed innovations in business models and in products. On the other hand, it increased price wars and demanded strong adaptation skills from several businesses. This has led several companies to ask themselves if they should not propose low cost products to improve their competitiveness and attractiveness.

That was also the case of RATP, a French public transport operator. Confronted to intense competition when trying to reach new markets, they were frequently excluded from calls for tenders because their prices were too high. The initial question formulated by the transport operator for this work was therefore “How can RATP offer low cost urban public transport?” Clear models to design low cost products do not seem to exist, and therefore RATP decided to launch a research program on low cost. The practitioner’s question was reformulated in an overarching problematic, as explained previously, which we propose to address through three distinct research questions:

RQ1: Is there a design model for low cost products and services?

The first research question aims to find a theoretical model to design low cost products and services. As we have exposed previously, this is a question of great interest for practitioners.

RQ2: How can an established public transport operator like RATP design and propose low cost offers?

The second question aims to find a managerial framework for an incumbent company like the one we will study, RATP. The goal is to be able to guide a company in implementing a low cost design model.

RQ3: How can low cost products be designed in complex value networks, where price and cost are not linked?

Finally, the third question tries to generalize findings for RATP to other complex value networks.

Each one of these research questions will be handled in a separate part of the following work.

Structure of the document

This manuscript is structured in three main parts. Firstly, based on a critical review of the multidisciplinary literature on the properties of low cost products and services, and the analysis of 50 cases, we propose an innovation system for low cost on three aspects: Performance evaluation, design reasoning and organization. The design reasoning is based on a low cost design model that distinguishes two approaches: low cost adaptation and smart low cost design (Part I). Then, we apply this model to urban public transport, both to discuss previous initiatives of low cost and as an original design tool to manage on-going RATP's low cost initiatives (Part II). Finally, we develop the learning from the case study to describe properties of low cost design to improve innovation capabilities in complex value networks (Part III).

Part I – Low cost as a design strategy: Theoretical elements and managerial specifications

Part I proposes **a theoretical innovation strategy for low cost based on a performance evaluation, design reasoning and organization framework**. Our model proposes two different performance evaluations, one on the performance of the product, evaluated by the client value over cost; and another one on the low cost strategy, evaluated by the maximal coverage of the design space. The design reasoning is based on the ex-post evaluation of the low cost design through two different approaches, low cost adaptation and smart low cost design. And finally we identify three different organizations: creating a low cost brand inside an incumbent firm; creating a low cost firm that coexists with an incumbent firm; and becoming a low cost player. Part I also proposes five research hypothesis linked to our model that will be verified through our case study.

Chapter 1 **demonstrates the need for conceptualization of low cost product and service's properties and benefits to understand the performance of low cost products**. On the one hand, to understand these properties, we describe what is different between low cost and other cost reductions, through a critical literature review. On the other hand, we underline the interdisciplinarity of the concept of "low cost" that led to a different meaning in several different disciplines. We propose several models of the concept of low cost, but they are all insufficient to allow the design of low cost products. We emerge from this chapter with research hypothesis 1 (RH1), stating the importance of the reference model and research hypothesis 2 (RH2), stating the importance of a design performance model for low cost.

Chapter 2 combines the properties previously identified with design theory, to **build a structured framework to analyze the design of existent low cost products and service**. The used framework highlights the innovativeness level of the products and their approach to client utility. We propose a design model that differentiates two different design approaches for low cost: 'low cost adaptation', linked to systematic design theories, and 'smart low cost design', linked to innovative design theories. Based on secondary sources, we analyze fifty different low cost products and services through our proposed framework to validate our

model.

Chapter 3 expands the literature review **by discussing the managerial difficulties faced today by companies trying to design low cost products**. We analyze how the two approaches to low cost proposed in our design model can create different challenges for managers. This chapter allows us to state three further research hypothesis: research hypothesis 3 (RH3) states that it is essential to create awareness around low cost; research hypothesis 4 (RH4) stresses the importance of defining an organization around the low cost approach; and research hypothesis 5 (RH5) states the importance of ecosystem design rules.

The main contribution of part I is to, from literature, develop a design model and the framework of an innovation system based on performance evaluation, design reasoning and organization that can be used to design low cost products and services in conventional markets where cost and price are linked and clients use price/utility ratios (or value-for-money) to decide on which product to buy. It furthermore states the main research hypothesis we will verify in our field study, which is described in part II.

Part II – Low cost design: a strategy achievable for public services? The case of urban public transport

Part II applies the low cost design model developed in Part I and focuses on the **development of low cost initiatives in urban public transport**. This is illustrated by a field study done inside RATP, a transport operator, on developing a low cost strategy in urban public transport.

Chapter 4 **shows the need for low cost products and service design in the public transport sector, as well as the need for innovations**. We highlight the particularities of this market, which make it difficult for the model developed in part I to be transposed to this setting, and propose a model of the dominant design of public transport. Through a systematic literature review, we explore the main motivations for innovating in the sector. We furthermore describe some particularities of the French public transport that are essential to understand our research setting.

Chapter 5 **demonstrates how the development of a low cost offer using the smart low cost design and the low cost adaptation strategies inside a public transport operator is possible**.

To achieve these results, we conducted an intervention research inside RATP to develop a low cost strategy. A structuring part of this intervention research was our active involvement in an oriented creativity method (KCP - Knowledge-Concept-Proposition, based on the Concept - Knowledge or C-K theory). We show that, in the case of public transport, designed low cost products have to fulfil additional criteria to be interesting for all actors of the ecosystem. Besides having significantly lower costs, the offers have to create value for the final user or for other actors in the ecosystem. Furthermore we verified that working on very

innovative rule-changers, makes working on offers that would be perceived as “merely degraded” by the final user legitimate, thereby showing the importance of combining both approaches described in our model – ‘low cost adaptation’ and ‘smart low cost design’. Finally, **smart low cost design allows working on important dominant design breakthroughs that can radically change the actors involved in the value network.**

In chapter 6 we show how our empirical study allows expanding our innovation system. It leads us to add two performance evaluation levels: the innovation department level and the firm level. Furthermore, in the design reasoning the proposed design model can be used as a normative tool, not an ex-post evaluation and the ‘smart low cost design’ approach can be used to re-legitimate the low cost adaptation approach. Finally the work inside RATP proposes a fourth organization, **using low cost as a driver inside the incumbent firm to expand the firm’s design space and create new partnerships.** We also validate all five of our research hypothesis and show that ecosystems have to be further studied. We conclude the chapter by **stating that low cost strategies can be enriching to improve innovation capabilities.**

Part II shows how a design model for low cost can be applied in urban public transport. The innovation system proposed in part I couldn’t be directly applied to public transport, the application of this model in our research setting lead to an evolution in all three aspects. Our empirical study not only allowed evolutions of our proposed innovation system, but also validated our research hypothesis, giving valuable insights to managers wishing to design low cost products. We furthermore conclude that due to the transversal nature of costs, low cost strategies can be used to propose important dominant design breakthroughs.

Part III - Designing low cost based ecosystems in complex value networks

Part III focuses on the impact smart low cost design and the dominant design breakthroughs can have on other aspects than the product itself. **The disruption introduced by low cost products can be so radical as to demand the redesign of the entire ecosystem.** We introduce the concept of complex value networks and discuss the impact smart low cost design products have on these networks.

Chapter seven starts by showing the impact breakthroughs on the dominant design can have on the ecosystem. In the case of public transport it allows to highlight the great number of actors in the ecosystem and how they interact to create value. We therefore **propose a definition of complex value networks, which are value networks with multiple actors not only a buyer/user and a seller/provider.** Patterns of complex value networks are illustrated through the study of two other public services besides public transport — European water and sanitation markets; solid waste markets — and the example of system assemblers in the

airlines industry, that are in a BtoBtoBtoC context. The complex value networks seem to demand a different value creation than simple value networks to allow an emergence of low cost products: they demand value to be created for all actors of the ecosystem, and not only the buyer and the seller.

In chapter eight we expose how **low cost products in complex value networks open up new design spaces**. We identify two different settings, the first in trying to create value for all the actors in an identified ecosystem, the second one trying to redesign an ecosystem for the designed low cost product. Ecosystem design is illustrated by examples of legislation and infrastructure design to make the low cost products possible.

The main contribution of part III is to propose an extension of the low cost design model to be used in complex value networks beyond public transport. We show that in the case of complex value networks, to make low cost products acceptable, these have to create multiple forms of value within the entire ecosystem. Due to the complex value network, new design spaces emerge from the creation of value for actors other than the producer and the user. The design process in these contexts has to go beyond the simple product, and examine the ecosystem to see if the launch of a low cost product is possible, or if not, which parts of the ecosystem have to be designed. This confirms our research hypothesis 5, but goes beyond it. It shows that when smart low cost design challenges existing design choices, it affects not only the product, but demands to reconstruct the entire ecosystem, and therefore opens new interesting design spaces.

Conclusion and further research

The conclusion states the main contribution of this thesis: a model to design low cost products and services, with two different approaches and how they can be applied to complex value networks. We show how in these ecosystems focusing on the price reduction as main incentive to attract customers is not sufficient. Other incentives have to be created to take into account that the final user and the payer are not the same actor and have different expectations.

In this final part we also discuss the further research, which is divided into two aspects: the field study and the theoretical contributions. Concerning the field study, further research on this subject should deepen transversal analysis of low cost products and continue following the low cost offers proposed in the public transport operator. Their success in the market and the real cost reductions achieved by those adopting these offers, as well as the reductions that can be applied to classical offers should be studied. Concerning the theoretical contributions, this work could also be enriched by studying applications in different sectors, for example in the water treatment sector, to verify the applicability of the developed theory.

Graphical Summary

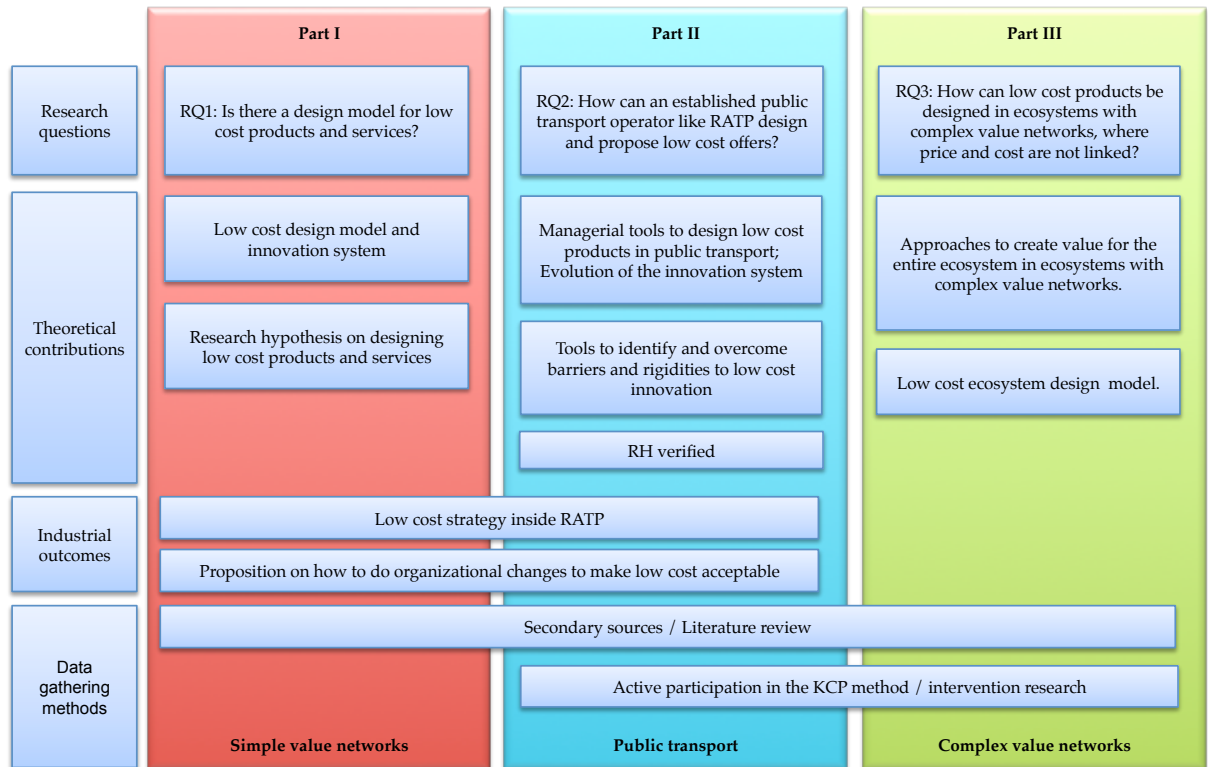


Figure 0.1 Graphical summary

**Part I - Low cost as a design strategy:
Theoretical elements and empirical
observations**

Part I - Low cost as a design strategy: Theoretical elements and empirical observations

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Since 'low cost' is a very broad concept that has been discussed in several contexts, the term has become ambiguous. In this first part, we will discuss low cost in the context of new product development. Our goal is to show how it can effectively be used as a design strategy. We therefore give an overview of theoretical elements on low cost found in literature and describe benefits, limits and managerial issues identified in literature. There are two main methods used to tackle this issue: a critical literature review and the analysis of fifty cases collected from secondary sources.

Our first chapter gives an overview of low cost in literature. We start by stating that low cost is positioned as a strategy in strategic management literature, unlike other cost reduction efforts such as operational effectiveness, since it establishes a hard to copy difference. **Low cost is a cross-disciplinary subject**, not only studied in management literature, but also in design and manufacturing or in marketing literature. The great diversity of sources and fields in which the term is used, leads to contradictions in its definition, leading us to state a need for conceptualisation.

Three conceptual models identified in the literature are further described: low cost as business model innovation, value analysis and design to cost. We also point to some difficulties faced nowadays in product design, amongst them **the need to have a low cost design model that covers all the existing low cost products**.

In the second chapter we propose a low cost design model as an answer to the identified lack of model. Our model includes two approaches:

- The **low cost adaptation** is an approach based on systematic design theories. It proposes to develop a low cost product starting from an existing product and stripping it from high cost and low value functions.
- The **smart low cost design** is an approach based on innovative design theories. It proposes to develop a product starting from a function that has high value for the customer. These products have a high level of innovativeness.

This model is built on theoretical elements from design theories, and is then validated through a database of fifty low cost products and services, built from secondary sources. The framework used to analyse the products consists of four **utility parameters**, linked to client utility (function removal, negative transfer, positive transfer and function addition) and of a measure of **innovativeness**, done through the evaluation of changes in the four aspects that define a dominant design (technological paradigm, business model, functions and client value).

Our third chapter sheds light on the managerial challenges faced when applying the two

approaches of our proposed low cost model. We identify difficulties to implement the low cost design model related to the context and to the conditions of implementation. Furthermore, we show how a specific organization has to exist in a firm to allow low cost design and how the ecosystem influences the success of low cost products. Finally these elements allow **proposing a new innovation system**, following a performance evaluation, design reasoning and organization framework for low cost design, around the developed design model.

We conclude by summarizing the main research hypothesis proposed in this first part and how they relate to the innovation system.

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Cost reductions have long been identified as essential to maintain competitive advantage. Most companies are continuously making efforts to keep their costs low, in order to reduce their prices or to increase their margins. Besides these continuous efforts, some companies have made low costs their strategic goal. In recent years, so-called 'low cost' product and services have flourished in several different sectors and industries. But when looking at the different descriptions of these products, a great variety of approaches seem to exist. This first chapter is aimed at clarifying the different approaches to cost reductions, the variety in low cost conceptualization and to highlight the need for a deeper modelling in what concerns low cost products. We do so through a critical literature review. The main results in this part are three different models for the low cost concept. Although these models allow a better understanding of the low cost concept, they do not allow designing low cost products. We therefore propose a set of specifications for a design model for low cost. We conclude by stating the diversity of existing low cost products and the need for one or several design models for low cost.

1.1. The differences between low cost and operational effectiveness

Low cost and operational effectiveness are often cited simultaneously or put together in the concept of cost reductions. Despite obvious similarities between both concepts, since they both allow firms to reduce costs, there are two main differences highlighted in literature between them. The first is that low cost is a strategy, while operational effectiveness is not. The second one is their approach to client utility. These two aspects will be discussed here.

1.1.1. Low cost is a strategy-based approach

Reflexions on cost reductions are recurrently found in operational research. According to Adam and Swamidass (1989), cost reductions were one of the main common themes in operations strategies between 1969 and 1988. As one of the levers to improve competitiveness, reducing costs has been one of the focuses of many different research currents: logistics (e.g. Qi, 2005), manufacturing, continuous innovation, amongst others.

In strategic management literature, cost reductions are an essential part of staying competitive and many authors draw attention to the need to 'do more with less' (e.g. Weiss and Hughes, 2005; Prahalad and Maskelkar, 2010). As stated by Venkatraman and Ramanujam (1986), effectiveness or performance improvements are at the heart of strategic management. Porter (1996) defines operational effectiveness as performing similar activities better than rivals perform them. It is important to notice that, in this case, performance is

evaluated by resource consumption and value creation by comparison with the other businesses.

Operational effectiveness has been an important research object for the industry, since it is linked not only to product costs, but also to delays and quality. It therefore influences the three main measures for classical project management: time, cost and quality. The study by McAfee (2002) for example looks into the impact of new processes or new IT system adoption on operational effectiveness.

Research done on operational effectiveness also highlighted that it is not the only way to achieve cost reductions. In his article "What is strategy?", Porter (1996) states that operational effectiveness is necessary in most industrial sectors, but that it is not a strategy, because it does not assure long-term competitive advantage. He therefore creates a first distinction inside cost reductions between operational effectiveness and a cost reduction strategy, as illustrated in figure 1.1.

According to Porter's (1996) definition of strategy, a strategic difference allows a company to outperform rivals by establishing a difference that can be preserved. In the case of low cost products, the cost-reduction is a clear strategy adopted by the company, which also defines each step of the product life cycle. We can therefore state that low cost is one possible cost reduction strategy.

Other authors draw attention to the difference between strategy and continuous improvement practices, like Crittenden and Crittenden (2008), who state continuous improvement practices are important to allow strategy implementation, therefore clearly separating them from the strategy. Mintzberg's (1987) 'five P's' for strategy, defining it simultaneously as Plan, Ploy, Pattern, Position and Perspective, corroborate to the importance of clearly distinguishing cost reductions coming from improvements in processes and a low cost strategy, which affects the most fundamental aspects of an organization.

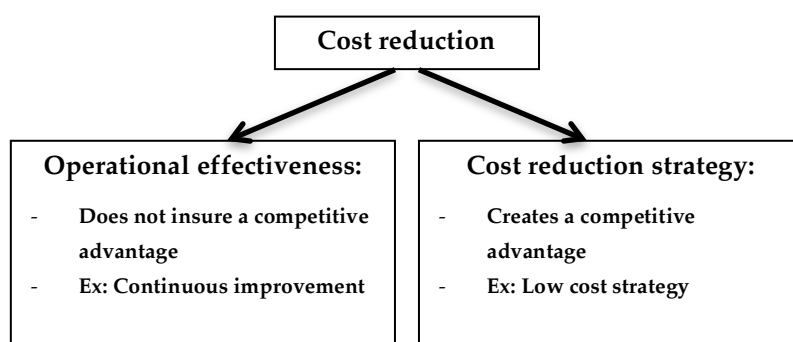


Figure 1.1 The different approaches to cost reduction

Cost reductions can therefore be separated into operational effectiveness, pursued by most companies, and cost reductions strategies, of which low cost strategies are one example adopted for some products by some companies. The low cost strategy will be further discussed in the following items.

1.1.2. Low cost changes the client utility

The importance of evaluating customer value is recurrently cited by authors discussing successful examples of low cost strategies (e.g. Butz and Goodstein, 1996). Several terms are used, such as 'client value', 'customer value', 'customer utility', or 'performance' to signal the usefulness of a given product or service for the buyer and user.

Definition of client utility

We will refer to client utility to describe product usefulness for the company's direct purchaser. For our research, we chose to use client over customer due to the fact that in our empirical setting, 'customer' was often used for the final user, and that was not the case with the word 'client'. And we will speak of utility instead of value, to avoid an only financial approach that might be attached to value.

The cost-reduction in low cost products is also combined to a client utility evaluation. Additional utility might be added, even if it increases cost, if this is considered to sufficiently improve client utility. The low cost strategy changes the client utility when compared to incumbent products, which is an essential difference between low cost and operational effectiveness. In operational effectiveness the goal is to deliver the same client utility at a lower cost, to be able to reduce prices for the customer. The approach used in operational effectiveness is illustrated in Figure 1.2.

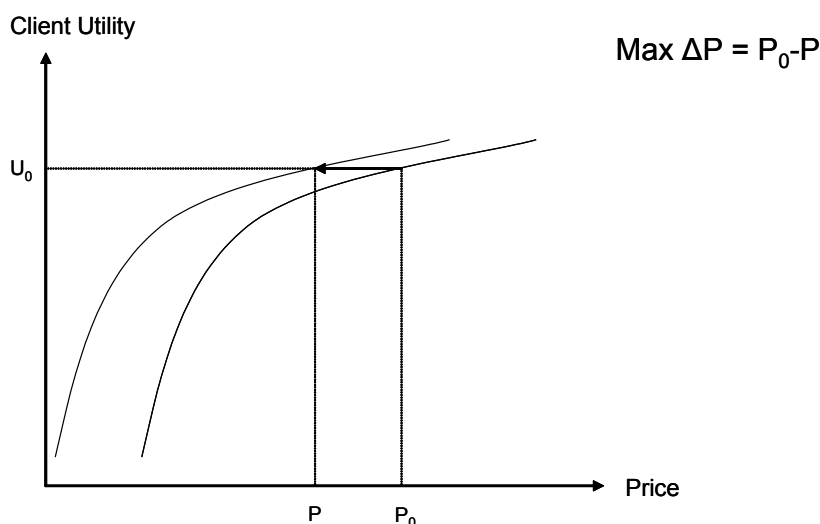


Figure 1.2 The client utility/price approach adopted in operational effectiveness

1.2. Low cost: a cross-disciplinary concept in new product development literature

The importance of “low cost” for new product development is highlighted by the large number of different aims and supports that discuss this concept. Low cost is at the same time a very common and non-scientific concept, being freely discussed in the press and used by customers and an important keyword in scientific literature. Amongst others, it has been discussed in marketing literature, management literature and sector specific literature. The different approaches in these fields show the transversal nature of low cost, and how it has to be taken into account on the early phases of new product development. Here we will highlight some important aspects of low cost in literature and how they impact new product development.

1.2.1. Literature fragmentation on low cost products: different aims and supports

Low cost in the general press, beyond innovation management

“Low cost” is a concept that can be found in a great number of different sources. It is often used in the non-scientific press, and like other terms, like “innovation”, that have both a scientific and a non-scientific usage, a lot of different interpretations and usages occur. Several newspaper articles try to explain low cost products¹, just as do TV reporting² and special numbers of magazines dedicated to the subject, which were launched quite frequently³. In addition to that, the general press consecrates a great number of articles that compare low cost and classical offers, especially when new low cost offers are launched, as was recently the case with Ouigo, a French low cost train offer⁴.

Furthermore, associations that had an effect on low cost businesses or products or were created around these emerged. We can cite the association of low cost companies that exists in France, under the name “Club low-cost”⁵, and that counted 16 different companies at the time of this writing. They declare their goal is to raise the awareness of customers and to

¹ Several different articles can be identified, one is available on <http://www.lesechos.fr/industrie-services/dossiers/0202573822009-le-low-cost-dans-tous-ses-etats-541349.php>, retrieved on the 12th September 2014.

² Several TV reports were done on the subject in France, we can cite one on France 2, in the program « Complement d'enquête » in March 2013, and a second one on M6, in the program « Capital » in February 2014.

³ One example is a special number of « Enjeux Les Echos » on low cost, published in May 2013.

⁴ Ouigo was discussed in French and European press, some examples are articles in the Figaro and in the Independent, available on <http://www.lefigaro.fr/societes/2014/04/01/20005-20140401ARTFIG00336-ouigo-le-tgv-low-cost-contraint-aux-prix-mini-pour-faire-le-plein.php> and <http://www.independent.co.uk/travel/simon-calder/ouigo-welcome-to-troisime-classe-8545498.html>, retrieved on the 21st January 2015.

⁵ The associations website is <http://club-lowcost.com/>, visited on the 21st January 2015.

break the association of low cost to low quality. Finally, low cost even made its way to movie theatres in 2010, in the movie “Low cost” about passengers on a low cost airline flight.

Not only has the subject been largely discussed in the general press, academic journals also dedicate an important number of articles to low cost products, services, procedures, companies or business models. This can be illustrated through the amount of results obtained in a search with the keyword ‘low cost’ in scientific databases. In the Science Direct database ‘low cost’ returns over 300 000 results⁶. **By looking at the first 100 academic papers given when the articles are sorted by relevance, we find articles in 80 different journals.** They are divided in several different and very wide-ranging literature domains, as can be seen in figure 1.3, and are not only limited to industrial questions, but also found in biology or medicine, clearly showing the importance in cost reductions in most domains. This shows how “low cost” has a wide usage.

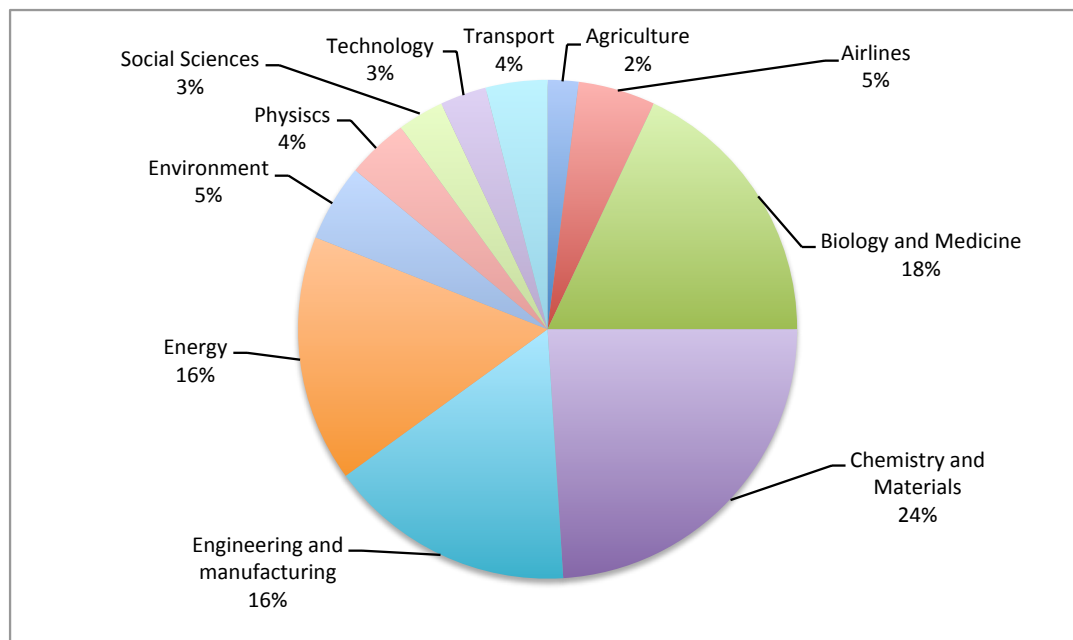


Figure 1.3 Classification of the first 100 articles found for the keywords “low cost” in Science Direct by relevance

Approaches of low cost in New Product Development (NPD) literature

Here we will focus mainly on academic literature relevant for NPD that will help us to study the design of a low cost mobility offer, and give an overview of different approaches by literature sector. We will focus on a literature that gives managerial indications, to which managers would turn when looking for elements to design low cost offer.

⁶ Search done in the Science Direct database on the 22nd January 2015, using “low cost” as keywords.

In the **strategic business literature** aimed at managers, low cost is discussed as a strategy by Porter (1996), as seen in point 1.1. But it is also discussed as a business model to be implemented by Combe (2011) and Santi and Nguyen (2012). The idea of the low cost business model is to give recipes for companies to put in place low cost products and services. **This literature stresses the importance of designing more than just the physical product and its manufacturing means, and introduces the need to evaluate the client value.** Santi and Nguyen (2012) state that a low cost product needs to have a higher client value over cost ratio than the established classical products to be attractive.

In yet another current in strategic business literature, Ryans (2009), Kumar (2006) and Berman (2015) discuss how to fight low cost competition. This literature is intended for incumbent companies that have to face low cost competition and are unsure of the path to follow to avoid losing market share. **In this literature, low cost is also seen as a business model or as a strategy, and its weaknesses and strengths are discussed.** A series of low cost companies' are described and the analysis tries to prescribe the best reaction in each of these cases, helping in decision making.

Low cost is also discussed in **innovation management literature**, in connection to different innovation models. Low cost is cited in the context of disruptive innovations, introduced by Christensen (1997) and extended by Christensen and Raynor (2003). They defend that product's performance often overshoots consumer needs, and that innovations with worse performance on some features can become interesting by the introduction of new features. For Christensen (1997) low cost is one of the possible ways to achieve disruptive innovation, cost reduction being one of the aspects that make the disruptive product more attractive. According to Christensen et al. (2006), these products are often attractive to new customers for being simpler, more convenient and less expensive, which means that **cost reductions are often associated to changes in other features, rendering the product more attractive.** This literature shows why certain products considered inferior if compared to the existing products succeed. It exemplifies cases in which low cost was achieved through new, and often less performing technologies, and also exemplifies cases in which business model innovations lead to lower costs. **The customers play a central role in this literature, but instead of speaking of customer value, the authors speak of customer demands and expectations of product performance.**

Still related to innovation management literature, Williamson and Zeng (2009) discuss low cost through cost innovations and stress that firms from emerging countries can serve as inspiration for firms throughout the world. As in the strategic business literature, we find an emphasis on the evaluation of the product value for the customer. **They use a 'value-for-money' approach, by saying companies should deliver more to their customers for less by reengineering their cost structures.** In this literature we find several interesting strategies for cost reductions, once more showing the difference between a cost reduction strategy and operational effectiveness.

A similar approach can be found in the literature on reverse innovation. Govindarajan and Trimble (2012) also defend companies should inspire themselves and develop products in

emerging countries, and then export these to developed nations. The authors describe the performance/price demanded by the developing nations as radically different from the existing and impossible to achieve by adapting existing products. They therefore defend that companies must let go of their “dominant logic” to be able to create for the new markets. They can do so by creating new products with different cost logics.

Furthermore, low cost is discussed in the **social innovations literature**, as part of frugal innovation. These have been discussed by Rao (2013) as cheap, tough and easy to use innovations, developed with minimal amounts of raw materials.

Low cost is also cited connected to jugaad innovation, a concept introduced by Radjou et al. (2012), as a frugal and flexible way to innovate by integrating the local constraints. It is presented as one of the six principles of these kinds of innovations by saying you have to ‘do more with less’⁷.

Low cost also has a prominent place in the literature on the Base of the Pyramid, also known as the BoP (Prahalad and Hammond, 2002). Low cost is seen as a condition that needs to be fulfilled to be successful in these markets. This literature is also aimed at managers, but since it also has a social aspect, giving access to services and products that are so far not available for these populations, it is also aimed at NGOs and policy makers.

All these concepts have been assembled by Sharma and Iyer (2012) under the resource-constrained product development question. The main focus in the social innovation literature is both on the need to reduce resources consumption and on the existence of important constraints that have to be integrated into the innovations. It also stresses the importance of understanding the customer needs and expectations that can often not be met by adapting regular products. We therefore have yet another evidence of the importance of analysing customer’s expectations and what has value for them.

Furthermore, when discussing some examples of frugal innovations, Rao (2013) draws attention to the fact that several of the frugal innovations have a better performance in some functionalities than regular products. This goes against the argument that low quality and low cost have to go together, and also shows the importance of analysing product’s functions.

In marketing literature, low cost is less discussed than low price. This does not mean that low cost is not important in marketing literature, but rather that low prices are seen as more relevant. Pricing strategies to face low cost companies for example find a place in this literature (Jost, 2014). This gives elements to better understand product positioning, as well as how low cost companies can integrate pricing strategies.

Besides that, low cost has also been linked to sourcing choices. Marketing literature discusses low cost as a result of global sourcing in so-called low cost countries and of purchasing decisions (Maltz et al., 2011). Low cost sourcing is often one of the cost reduction approaches

⁷The six principles of jugaad mindset are: seek opportunity in adversity, do more with less, think and act flexibly, keep it simple, include the margin and follow your heart. These six principles help drive resilience, frugality, adaptability, simplicity, inclusivity, empathy and passion. (Radjou et al., 2012)

used by low cost companies, as we can see in the example of the Dacia Logan (Jullien et al., 2013).

In manufacturing literature, low cost is often seen as a result of some approaches like design-to-cost and design-for-manufacturing (e.g. Shehab and Abdalla, 2001). In design to cost, the cost constraint is integrated early on in the design process, and changes in the design are encouraged to accommodate the cost constraint. In design to manufacturing, cost reductions in the manufacturing process are achieved by taking it into account from the beginning of the design.

Other similar approaches exist in this literature, like design for assembly, design for environment or design for recycling, and these have been assembled under the generic design for X. According to Kuo et al. (2001), using design innovations to reduce costs has become rather current in manufacturing. Many of the new design for X approaches now focus on reaching other goals, like reduced environmental impact, but Kuo et al. (2001) show that cost reductions are currently integrated.

Finally, some low cost businesses, products or services have been thoroughly discussed in the **literature of the sector** they were launched in. This was the case for low cost carriers and low cost flights (e.g. de Wit and Zuidberg, 2012), as well as for low cost retailers (Basker, 2005), also known as hard discounters.

Several different aspects of low cost are discussed here, like the business model (Wensveen and Leick, 2009), pricing strategies (Malighetti et al., 2009), impacts on the market (Basker, 2005), clients' perception of the offer (O'Connell and Williams, 2005), and impact on other aspects of the ecosystem (Francis et al., 2003).

This literature is rather rich in details, and is extremely interesting to make parallels between low cost in different sectors. Due to the great amount of articles on some sectors, like the airlines sector, it is also possible to observe evolutions in the low cost companies and products and to state the different approaches that exist in a sector. Mason and Morrison (2008) for example, show the differences in the business models of six different European low cost airlines.

This literature review allows us to state that low cost companies influence their ecosystems, that they evolve and that there is not a unique way to achieve a low cost position. We therefore can state one of our first research hypotheses: **Low cost is a transdisciplinary concept, which profits from the mobilization of knowledge and constructs from different disciplines.**

Table 1.1 gives an overview of the different domains in which low cost has been cited in academic literature.

Table 1.1 Approaches to low cost in different literature fields

Literature	Approach	Sources	Product examples
Strategic Business	Strategy	Porter (1996)	-
	Business model	Combe (2011); Santi and Nguyen (2012)	Airlines, hotels
	Competition	Ryans (2009); Kumar (2006)	Retail
Innovation management	Disruptive innovation	Christensen (1997)	
	'Value-for-money'	Williamson and Zeng (2009)	BYD batteries; Haier White goods
Social innovation	Reverse innovation	Govindarajan and Trimble (2012)	GE's portable ultrasound scanner
	Frugal innovation	Rao (2013)	Tata Swach Water purifier
		Radjou et al. (2013)	Embrace incubator
	Giving access to products for the BoP	Prahalad and Hammond (2002)	Shared-access internet
Marketing	Pricing strategy	Jost (2014)	Airlines
	Sourcing strategy	Maltz et al. (2011)	-
Sector	Combination of several aspects (business model, impact, client perception...)	de Wit and Zuidberg (2012);	Airlines
		Basker (2005)	Retail

The large number of different sources allows to treat a great number of aspects of low cost offers, but also has its downside: the heterogeneity of definitions. This aspect will be discussed in the next item.

1.2.2. A first modelling of the low cost concept: Objects, characteristics and markets

The multitude of sources in which low cost products and services have been discussed is probably one of the reasons why low cost products have seen several different definitions emerge. These are not only different, but some of them are actually contradictory.

Several definitions focus on the no-frills aspect of low cost products, and emphasise that lower cost are achieved either by removing aspects of the product, and therefore reducing client value, or by reducing the quality. For Karnani (2006) low cost products always have a cost-quality trade-off, and therefore a worse quality than the 'regular products'. Dameron (2008) also defends that low cost products can only propose sufficiently low prices for being attractive through simplified offers, with worse quality.

For Combe (2008, p2) low cost is a model that produces *“less expensive products or services whilst satisfying minimal and unconditional consumer demands”*, taking in account the ‘value for money’. Williamson (2010) also defends that more recent low cost products and what he calls ‘cost innovation’ are based on a logic of proposing more value-for-money. For these authors low cost and low quality do not have to be associated. And as stated by Kumar (2006) through the example of Aldi, a low cost retail chain, some low cost products actually have better quality than the branded competition.

Low cost can be used to describe products and offers. This approach is mostly chosen by authors speaking about a specific offer in a larger context, for example when talking about a low cost car, like the Tata Nano (Ray and Ray, 2011). Besides the authors that speak of low cost products, there are numerous authors who speak about low-cost companies or organizations, especially in the strategic management literature, which considers low cost a strategy. One often referred to example for low cost company or organization are low cost airlines or carriers (e.g. Gillen and Lall, 2004).

According to Santi and Nguyen (2012), low cost is a business model that allows companies to free themselves from established rules in a sector and that reduces costs through a series of coherent operational innovations. In their view, low cost companies achieve cost reductions through the removal of low added client value, but high cost activities, product components or services. They achieve attracting clients by proposing a higher client value over price ratio than incumbent companies.

Berman (2015, p87) states that many low-cost companies achieve their lower costs through *“a combination of the following strategies: producing ‘good enough’ products that provide extreme value by eliminating services that cost more than they are worth to consumers, utilizing simple business models, reducing research and development expenditures via joint ventures or through purchasing technology from bankrupt firms, using price cutting to drastically expand the market for a company’s goods and services, and having an organizational culture that stresses frugality and efficiency.”*

Literature also has a dual positioning when speaking about low cost and innovation. As seen in the literature review, some low cost products are classified as frugal innovations or jugaad innovations, which indicates a clear link. Some low cost products are considered highly innovative, either because of their different business model, or because they are based on an entirely different technology than the products they aim to compete with. Authors like Ray and Ray (2011) draw attention to the fact that important cost reductions, reducing costs to less than 50% of the original cost, cannot be achieved without innovation.

However, in opposition to that, studies like the one of Bengtsson et al. (2009), oppose low cost and innovation as two different strategies when trying to define the best strategy for manufacturing. For Bengtsson et al. (2009), low cost is mainly seen as a function removal, delocalisation or mass production approach, and is opposed to innovation. In these studies, innovations that reduce costs are not taken into account. The same kind of opposition could be seen in Porter’s first works on generic strategies (1980), where cost leadership was mainly linked to operational effectiveness and high volumes; and differentiation was linked to innovation.

However, one of the means to achieve a better cost-effectiveness is process innovation (Davenport, 2013). Significant cost reductions were achieved through process innovation, for example by automatizing the manufacture of different products. Process innovations do sometimes demand important investments, but they clearly show that low cost and innovation are not opposed.

We can therefore state that despite the fact that low cost and innovation seem under-linked and even some times contradicting in literature, low cost products can be highly innovative, and even have to be innovative if the cost reduction goal is radical. Consequently, it appears that low cost products cover the whole range of design from optimisation in systematic design to radically new products in innovative design.

The diversity of definitions for low cost, the different levels of detail and the fact that some definitions only take into account a part of the features of a low cost product or organization contribute to a certain ambiguity. One of the consequences of this is that according to some definitions, a product might be classified as low cost, while it would not be classified as low cost by other definitions. Figure 1.4 proposes a classification of the different definitions proposed in the literature. Definitions mainly describe three different aspects: the object (product, business model or firm), characteristics that make the object low cost (e.g. 'no-frills', simplified business model...) and the approach to markets (e.g. disrupt existing markets).

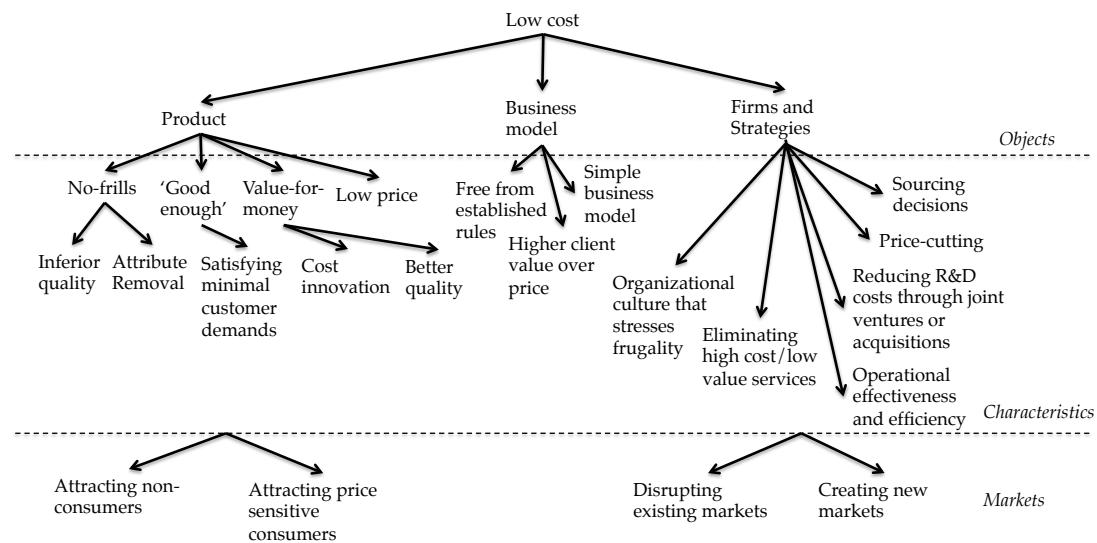


Figure 1.4 Definitions of low cost found in literature

The fact that low cost is used in a great variety of context to describe different objects, and that every actor has to some extent already heard of the concept, makes it difficult to have a common vision of low cost. Although it is not essential to have a unique definition, there is however a need for conceptualization to make sure that when asked to design a low cost product, designers have a similar understanding.

Besides this, the great number of different sources also shows the transversal impact low cost

has. The fact that low cost can refer to products, business models, strategies or firms, clearly shows that it is essential to have a coherent design strategy, taking into account all the impacted aspects inside a firm when doing new product development.

1.2.3. A second modelling of the low cost concept: The managerial objects of low cost

A great number of cost reduction sources can be identified when studying low cost products and services, as well as when looking at cost effectiveness models. The 'no-frills' approach, that consists of taking away non-essential features has often been discussed as the source of cost reductions in low cost products and has even been used as a synonym for low cost by some authors (Hunter, 2006). However, even if it is an important lever, this is far from being the only source of cost reduction in low cost products. When taking the example of low cost carriers, several other very important cost reductions have been observed by researchers.

Low cost airlines: a wide range of cost reduction levers

We will here describe the wide range of cost reduction levers observed in the low cost airlines. According to Gillen and Morrison (2005), the business model and value chain of low cost airlines are different. This starts by using a point-to-point instead of a hub-and-spoke network, which means connections are not the airline's concern, and reduces connecting costs (like baggage handling).

Low cost airlines also succeeded in transferring some activities to the customer, like doing his own reservation and printing the boarding pass, which is done by the passenger at his home. Furthermore the low cost airlines reduced costs by cutting the middleman, selling directly to the customers and not going through travel agencies who would charge a commission (Hunter, 2006).

Different processes and different usage of production means are also part of the cost reductions in the low cost airlines, like intensifying the use of expensive assets (Pels, 2008). The airplanes are used much more intensively in the case of the low cost carriers, reducing the cost per mile and per seat.

According to Brügger and Klose (2010), other important cost reductions were achieved through the standardisation of the aircrafts, which reduced personnel costs, since all the crew and the maintenance personnel was specialized in only one kind of aircraft. This also allowed reducing the spare parts stock costs and reducing aircraft servicing costs, since ground handling could be standardized and economies of scale could be achieved on the ground equipment. And finally it gives the airline more leverage to discuss with the plane supplier, and in general leads to lower prices for the planes.

Furthermore they introduced important changes in working conditions and contracts. According to Hunter (2006) and Dobruszkes (2006), jobs in low cost airlines are more flexible and entrepreneurial. Low cost airlines have introduced a different culture and different work

organization, making it possible for them to reduce the number of employees needed, partly due to a high outsourcing rate.

Besides this, some characteristics of the service offered were changed. One obvious change for every passenger is the reduction of the legroom (also known as pitch) and the change of the seats' model, which allowed increasing the number of available seats per flight, the relatively high seating density is cited by Pels (2008) as one of the main cost advantages of low cost airlines. Simplifying the offer, by proposing only one class also contributes to increase the number of available seats, since business and first class seats took up more space. It furthermore helped to reduce operational costs, since there is only one type of product to be sold.

A stricter luggage restriction is also put in place by several low cost carriers, thereby reducing loading time (Gross and Schröder, 2007) or increasing revenue by selling the remaining space for freight transport or to customers wanting to take more luggage, also contributed to cost reductions and revenue increase.

Cost reduction levers found in other businesses

Low cost airlines are a great example for cost reduction levers, but not every kind of cost reduction can be applied to airlines, due to regulations and sector specificities. Other cost reduction approaches can be found in other sectors. Here are some further examples:

- **Locate the business in less unionized and less expensive countries to have access to cheaper resources.** According to Williamson and Zeng (2009), inexpensive personnel is the main cost reduction in what they call the first wave of emerging low cost giants.
- **Locate the business outside the great cities for hotels, gyms and retail stores, to have access to cheaper real estate.** One example cited here are the "Formule 1" hotels, according to Combe (2011).
- **Global sourcing,** making it possible to buy resources there where they are the less expensive. This is typically the case of IKEA, as described by Schoettl (2009), where materials and manufacturing are globally sourced.
- **Changing the materials used,** both for the products and their packaging. The materials used on the Tata Nano for example, as described by Ray and Ray (2011), are on many parts of the car not the same as the ones used in regular cars. It is important to signal that the idea was not always to replace them against cheaper ones, but cost reductions could also come from reduced weight allowing reducing fuel consumption, reduced number of parts, or other interactions with the whole system.
- **Changing the communication channel,** to allow dematerialization and therefore less resource consumption and distribution costs reduction. This could already be observed in the case of the airlines, that stopped printing tickets, but was further developed in other sectors where the whole product was dematerialized, which is the case of newspapers that are now available over the Internet (Santi and Nguyen, 2012).

It was also employed by low cost banking offers, where a brick-and-mortar bank was mostly replaced by electronic banking (Cracknell, 2004).

- **Rethinking the value chain**, to integrate the higher value-added activities and to externalize activities that are costly for the company, both to other businesses and to the customer. Hillairet et al. (2009) give the example of the French sports equipment retailer Decathlon.
- **Reducing the size of the product range or stock-keeping units (SKU)**, which reduces stock keeping costs. This approach is often used by discount retailers, as signalled by Colla (2003).
- **Re-using parts and technologies developed for other products to reduce the development cost**. This is one of the cost reductions used in the case of the Dacia Logan (Jullien et al., 2013), where many pieces were carry-overs from other cars.

This non-exhaustive list illustrates the great number of cost reduction approaches found in low cost products. Some of them seem rather trivial, like the rethinking of the value chain, which mainly consists of making several “make-or-buy” decisions. They are nevertheless listed here to show that low cost products and services often rely on employing not only one, but a combination of several cost reduction approaches.

Classification of cost reduction approaches

This list also gives an idea of the different kinds of approaches possible. We classified the cost reductions into three main groups of approaches:

- Those linked to the **product or service**, that consist in removing features of the offered product or service (removing services, like giving the newspaper); others that consist in changing features of the product (reducing the comfort in a plane by reducing leg-room or changing the product material);
- Those linked to **processes and the production means** (like intensifying the aircraft usage).
- Those linked to the **business model and value chain** (removing the middle man or rethinking the value chain).

The classification into these three different approaches helps managers to understand and identify the coverage of the low cost offer they are designing. These approaches should be combined to develop low cost offers. Figure 1.5 recalls the cited approaches and places them in the three identified groups. And the fact that cost reductions can be achieved through so many different sources clearly show that low cost has to be a design approach from the beginning of the new product development, therefore making it possible to tap all the different sources and achieve a low cost strategy.

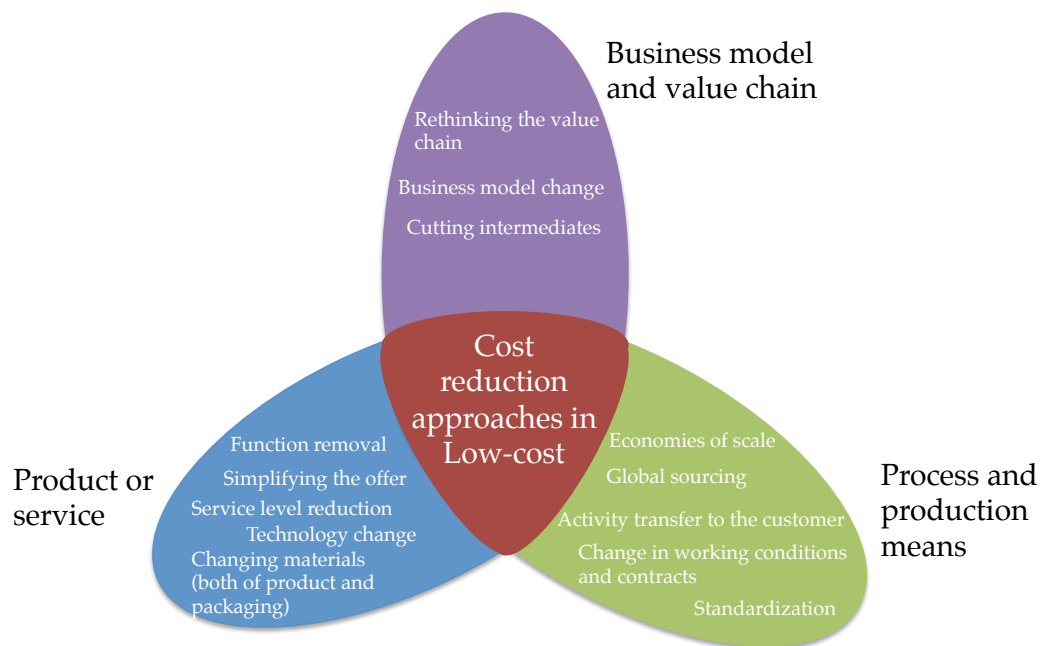


Figure 1.5 Classification of cost reduction approaches used by low cost

1.2.4. A third incomplete modelling of the low cost concept: An innovation system for low cost

The third modelling proposed in this work rests on the analysis of low cost as seen in literature through one of the frameworks found in design theories, the innovation system. According to Le Masson et al. (2014), from a management point of view, to understand the logic of collective action that leads to innovation, we need more than to discuss its design. To fill this gap they introduce the **innovation system**.

Definition of an innovation system

An **innovation system** is composed of one or several **performance evaluation** logics, particular **design reasoning** and the collective **organization**.

In our literature review, we identified that performance of low cost products is evaluated as being the **client utility over cost ratio for a product**, when compared to a “classical product”, used as a reference. One of the first difficulties faced when selling a low cost product is to know what to use as reference. Low cost products are always defined as such when compared to a “classical” product, so it is essential to identify what the customer will compare this product to and what will be the potential replacement products. Santi and Nguyen (2012) speak of a ‘reference offer’ and of a ‘reference business model’, which they define as being the industrial standard, the offer proposed by most major actors of the sector. A similar notion of industrial standard is also used in design theories, the dominant design, introduced by Utterback and Abernathy (1975). According to Suárez and Utterback (1995,

p416), a “dominant design is a specific path, along an industry’s design hierarchy, which establishes dominance among competing design paths”. In design theories that means it creates an industrial reference in terms of performance, functions, technology architecture and skills (Le Masson et al., 2014).

Definition of reference design

We will define the **reference design** as being the dominant design to which customers compare the low cost offer. This means the reference in terms of performance, functions, technology architecture and skills the customer compares the product to.

For low cost products that do not include radical product changes, the reference design might seem straightforward to establish, simply being a classical product. Customers might compare a low cost car to a car, for example. However this might not be the correct reference design. The reference design is used by customers to compare their options, and like with other purchasing decisions, comparison is often extended not only to direct competitors, but also to other possible substitutes, as seen in Porter (2008). According to Santi and Nguyen (2012), the reference design depends on how the customers evaluate the offer’s value. For example, considering the value of going to a restaurant is linked only to having good food without needing to cook, a take-out food-truck is an example of a low cost adaptation model restaurant. However, for clients for whom going out and the dining experience are as or more important as the food, this is a poor choice of low cost adaptation model, since for them a lot of value was removed.

Low cost products that are radically different from the classical product might have reference models that have nothing to do with the product they are originally named after. One example is the BRT, the bus rapid transit, that was developed to be a bus-based solution for mass transit, and that has since become known as the low cost metro⁸.

Low cost airlines found that 59% of their customers would not have taken the plane if it was not for the low cost offer, and that 12% of their customers would otherwise have travelled by car or rail (ELFAA, 2004). For these customers the reference design was not necessarily an incumbent airline.

Mistakes in establishing the reference model can have product failure as consequence. Clients can have trouble finding the value they would have expected in a low cost product because the reference model they use is not the same as the one the company uses. This imbalance can render the new product not at all attractive, and eventually even lead to the failure of the product. This was one of the problems faced by the Tata Nano. The reference model used to market this low cost transport mode was a car, but customers did not see the Tata as replacing a car on all aspects, only on a functional level (Kalla, 2015). This was linked

⁸ The BRT is described as a low cost metro in several publications, for example in the report done by UNEP on the low carbon mobility in India, available on http://www.unep.org/transport/lowcarbon/Pdf's/BRT_PolicySummary.pdf . Retrieved on the 12th September 2014.

to the fact that the Tata Nano did not give the user the expected status, some complained it looked cheap, or that it sounded like a rickshaw⁹. Besides that, the Tata's positioning in the press as 'the lowest cost car' and as a 'cheap car' was severely criticized because it did not correspond to the expectations customers had when buying a car in India: they were not only buying a transport mode, they were also buying a status symbol¹⁰.

We therefore reach our first research hypothesis, *RH1*: **Adopting a reference model is necessary to design low cost products**. Reference models seem to be very important. They need to be correctly approached since they can help generate client utility, but can also destroy it, by creating false expectations due to the associations done by the client.

We can therefore state that the design reasoning is articulated around **cost and client utility**, compared to a **reference design**. The choice of reference design is structuring for the offer. Cost has to be lower for the low cost products and reductions should come from different sources – **changes in the product itself, in the business value and value chain and in processes**. Cost reductions have to be hard to copy. Client utility can be lower than the reference design's utility, if the loss in client utility is smaller than the cost reduction.

Although we have little elements on the organization of most innovation systems on low cost, our literature review also allows us to identify a first element on low cost organization, through the literature of fighting low cost rivals. There seems to be an opposition in organization between incumbents and low cost companies.

Figure 1.6 gives a first model of the innovation system based on low cost in literature. This innovation system is clearly an incomplete model, since the elements in the innovation system so far are insufficient to guide the design of all the low cost products identified in literature.

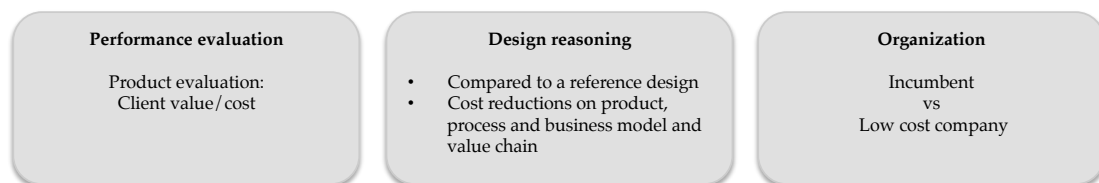


Figure 1.6 A first model of the innovation system around low cost based on the literature

⁹ 'Why the World's Cheapest Car Flopped'. Available on : <http://online.wsj.com/news/articles/SB10001424052702304520704579125312679104596>. Retrieved on the 4th August 2014.

¹⁰ "Learning from Tata's Nano Mistakes". HBR Blog Network. By Eyring, Matt J. (2011). Available on http://blogs.hbr.org/cs/2011/01/learning_from_tatas_nano_mista.html accessed in March 2013.

1.3. Design rules for low cost: limitations and challenges from the state of the art

This chapter allows us to state the difference between a low cost strategy – a hard to copy, deliberate design strategy that creates important changes in the cost and client utility and is often innovative - and operational effectiveness – a continuous effort to reduce costs without changing the client utility.

We can conclude that low cost is a deliberate and cross-disciplinary strategy, often impacting the whole product lifecycle. It is therefore important for companies to have in mind that they need to define their low cost strategy from the early stages of design.

1.3.1. Design rules for a low cost strategy identified in literature

Despite the fact that low cost is clearly identified as a strategy, many companies, having decided to launch a low cost strategy, are faced with the “how” question, that has not been as widely treated. Three different approaches of the “how” were identified in literature, and they are described below.

The “low cost business model” as business model innovation

Santi and Nguyen (2012) state that there was a specific business model behind low cost products and services. According to them, it was based on three main aspects: breaking the rules of the profession, operational innovations and redistributing a part of the increased value to the customers. The low cost airline, one of the examples discussed in their work, allows better understanding these three aspects:

- Breaking the rules: the low cost airlines rely on a different model than classical airlines, they use point-to-point flights instead of a hub-and-spoke model, where passengers can easily connect between flights.
- Operational innovations: by changing the hostesses attributions and creating new and efficient protocols, low cost airlines achieved considerable reductions in the turn-around time of the airplanes.
- Redistributing a part of the increased value to customers: The cost reduction achieved in low cost airlines is higher than the value reduction perceived by the customers. Therefore, they have more value for their money, are buying low cost is a win-win situation for them.

Santi and Nguyen (2012) also say that no revolutionary technological change is needed to create low cost products, and their statement is backed-up by the products they present, like low cost airlines, low cost hotels and low cost car rentals. The main technologies used to

produce these services are not changed, low cost airlines still use the same airplanes as classical airlines and low cost hotels have not revolutionized the building industry. However we can observe important changes linked to the business models that were only made possible through the development of new information and communication technologies.

Although the model proposed in the work of Santi and Nguyen explains a series of low cost products, their definition excludes a series of low cost products based on technological changes. The Aakash low cost tablet described by Mudliar and Pal (2013), typically relies in technological changes, and could not have been reached only through business model innovation. Applying their model to design products also presents some difficulties, since it is hard to identify which rules should be broken. This is exemplified in their work by the description of some failed low cost products, like the low cost cinema.

Value analysis – function's cost and value comparison

Value analysis is an old recurrently used method in product re-design, aimed at identifying the cost and the value of each function and at trying to reduce the costs of those aspects that have low added value, either by removing them or by changing them (Leber et al., 2014). Value analysis is applied on existing products to improve them.

Using the value analysis approach, it is possible to take an existing product, and by removing low value and high cost functions to create a new product with lower costs. This method has a very high capacity of evaluating existing products value for cost, as well as proposing functions to remove and aspects to change (Lester, 2013).

The problem designers and engineers using this method often face though, appears once they have identified a low value, high cost function. Removing it is often impossible because of other functions that can be supported by the same embodiment aspect, and the method gives little guidance on how to innovate to change the embodiment to change the function cost. Value analysis is therefore often linked to other methods for the redesign phase, as stated by Miles (1969) and Kettinger et al. (1997), who evoke the use of creativity methods without going any further into their description.

This method has been used to identify “frills” in the development of low cost products, Santi and Nguyen (2012) give an example of a value analysis done for low cost supermarkets (or hard discounters). However it cannot be used to develop low cost products with radically lower costs, like the Embrace infant warmer that has a cost of less than 2% of a classical infant warmer (Radjou et al, 2012).

Design to cost – integrating a cost target into the design goals

Design to cost consists in integrating a cost target into the design process early on, making achieving the cost target as important as the other design constraints, like performance criteria (Michaels and Wood, 1989).

In their work on the Dacia Logan, Jullien et al. (2013) discuss the importance of design to cost to make the Dacia Logan a reality. In the design of this car, the design to cost approach did not consist of doing a global cost-cutting exercise. Instead, the goal was to design the car in a way that costs would be minimized for all aspects not linked to the car's defined unique selling points: sales price, habitability and reliability. The main effect of using a design to cost approach was to create an incentive to come up with new solutions. It was also a useful tool for project managers, who could use it to remember all project members of the cost reduction goal. The cost goal could finally be reached using six cost-cutting levers:

- Product simplification – the product was re-focused on what was considered essential for the customer like safety;
- Carryover – this consists of re-using pieces developed for other cars, whose design has already been amortized;
- Digital validation and design productivity – the use of digital validation reduced prototyping costs;
- Manual processes – using local lower cost labour and not using automatic assembly lines also contributed to cost reductions;
- Equipment supplier involvement and local integration – over 80% of the value of the car is estimated to be produced by suppliers, using local suppliers allowed cost reductions and new partnerships reduced risks for Renault;
- Logistic gains associated to a compact site – the industrial site did not demand as much transport as regular car-assembly sites.

The same kind of approach could be observed in the design of the Tata Nano. Ray and Ray (2011) draw attention to the strong engagement to produce the “one-lakh car” (which meant a car costing US\$ 2500) that Tata had while producing the Nano. Since this strong cost constraint existed and was integrated into the design from the beginning, and the goal was to meet a price-performance target. The levers used to achieve this goal were slightly different for the Tata Nano than for the Dacia Logan. According to Ray and Ray (2011), they consisted of:

- Collaborative partnerships for low cost innovation – about a hundred of Tata's suppliers made a big contribution to the development of the Tata, being integrated early on in the process and receiving the cost goal as a challenge;
- Architectural innovation and the frugal use of resources – classical aspects of the car design were reconsidered, like the steering column that was reengineered and every component and material was analysed from a cost, functionality and performance point of view;
- Lowering costs of manufacturing and downstream activities – manufacturing costs were reduced both by using a labour-intensive assembly method, based on skilled but cheap local labour and doing assembly on small satellite units.

Design to cost appears as an extremely powerful tool to design low cost products, helping

managers to explore cost reduction levers that might have been hard to explore otherwise, like collaborative partnerships or product simplification. Design to cost also allows the emergence of radical innovations, since drastically lower costs (less than 50% of the original cost) can rarely be achieved without radical innovation. And it is clearly a tool that has to be associated to cost reduction levers, that can vary from one product to another to allow a low cost product design. This contributes to make this tool very generic: it is applied in the automobile sector, as seen with the cases described above, but also in other sectors like the aerospace (Vollerthun, 1998) and proposed by consulting firms like Capgemini as a solution for many sectors, including the services sector¹¹. However some of the low cost products on the market today would have been hard to develop through design to cost, since they have ground-breaking changes in customer utility, which would also have to be added to the design to cost to develop them.

1.3.2. Specifications for a design modelling of low cost: Design rules

When one looks at the multitude of low cost products that exist and at the three design models identified in literature, it is rather easy to see that some of the products lack a design model. The “low cost business model” explains the design of businesses like the low cost carriers, low cost retailers and low cost hotels; value analysis allows redesigning products to reduce their costs; and design to cost allows the design of low cost products like the Dacia cars. Table 1.2 recapitulates the different approaches to low cost product design and compares them according to their cost and client utility approach. This comparative table allows us to conclude that none of these models would have been enough to design the low cost infant incubator Embrace, or the MittiCool, a clay refrigerator. None of the proposed models allow designing a product or service that changes the business model, the processes, and the technological paradigm and simultaneously allows increased utility for the customer. These radical low cost innovations clearly lack a design model.

¹¹ Report on Design to Cost available on [http://www.fr.capgemini-consulting.com/resource-file-access/resource/pdf/le design to cost et la competitivite couts et hors couts - capgemini consulting.pdf](http://www.fr.capgemini-consulting.com/resource-file-access/resource/pdf/le%20design%20to%20cost%20et%20la%20competitivite%20couts%20et%20hors%20couts%20-%20capgemini%20consulting.pdf).

Retrieved on the 12th February 2015.

Table 1.2 Comparison of low cost models according to their cost and client utility approach, as well as the aspects changed in low cost products in the model when compared to classical products

Model	Cost	Client utility	Aspects changed
Low cost business model	Maximum reduction without a too strong client utility degradation	Reduced client utility, but higher value-for money	Different business model; change in operations; change in the value chain.
Value analysis	Maximum reduction without a too strong client utility degradation	Reduced, but mainly on low value added functions with high cost, to ensure higher value-for-money	Change in functions and in their performance
Design to cost	Fixed cost target from the beginning of the design process	Reduced, but with a limit. To control cost is the first priority in product design, while still meeting the critically required quality for target customers (Lim et al., 2013)	Change in process; change in materials and technologies.

We can conclude that there are some design rules a model should follow: It has to be able to take into account and to propose changes in the identity of the object, as well as to propose different utility for the user, not only lower utility, but also higher utility than the reference product.

We therefore state our second research hypothesis *RH2*: **Low cost design must adopt a design performance model to succeed.**

1.4. Conclusion: Diversity of low cost products and need of a design model

This first chapter allowed us to show the diversity associated to low cost and to propose several models for the concept of low cost. However, these models do not allow responding to manager’s needs. Despite the fact that they help clarifying the low cost concept, they are often incomplete, not accounting for all the existing low cost products. Furthermore, they do not answer the “how” question, they do not help designing low cost products. We conclude that there is a need for a more actionable design model for low cost that should be accompanied by a performance evaluation.

Despite the lack of actionability of the elements found in literature, they do give us indications on what design rules a model should follow to allow designing all the products seen in literature. A design model for low cost has to be able to accommodate changes in client utility and changes in the identity of the object.

These elements also lead us to conclude that all low cost products are not the same. They point to the need of studying different products to gain an overview of the different kinds of

low cost product. This will allow identifying if there is more than one low cost design model. Trying to propose design models that would help designing all kinds of low cost products is the goal of chapter 2.

Chapter 2. Low cost adaptation and smart low cost design: two design strategies based on empirical findings

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As stated in chapter 1, there is a lack of a design model for low cost products and the existing classifications do not seem to account for all low cost products. Furthermore, several different definitions of low cost exist, as was stated in chapter 1. “Low cost” is mobilized in a great number of different domains. We therefore state the hypothesis that a design model is necessary to explain the existing low cost products and to assist in the design of new low cost products.

We start by building a theoretical model for low cost products based on design theories, as discussed by Le Masson et al. (2010). To confirm our model, 50 different low cost products and services are analysed through a same framework. Thus their innovativeness and their approach to client utility are rated.

Based on the database composed of these 50 cases we confirm our design model, composed of two approaches: low cost adaptation and smart low cost design. We conclude by stating their particularities and by presenting their impact on the market. This model will be used in the design of low cost products for a product transport operator, as will be described in chapter 5.

This design model profited from remarks from communities of the IPDM, Innovation Product Development Management, (Klasing Chen, 2013a) and of i3, Interdisciplinary Institute on Innovation, (Klasing Chen, 2013b), for which we are very thankful.

2.1. Proposing a theoretical design model with two approaches for low cost products

We use the design theories to propose a low cost design model. This model has two approaches: one linked to systematic design theories and called **low cost adaptation** and one linked to innovative design theories, called **smart low cost design**. There are two main differences between the two approaches. The first one is their starting point: the low cost adaptation approach starts from an existing product, while the smart low cost design approach starts from scratch. The second difference is on their approach to the product’s cost and client utility. While the first approach tries to minimize the client utility reduction and to maximizing cost reduction, the second approach tries to maximize client utility for a given cost goal. We will here define the two approaches based on design theories and then make a comparison between them.

2.1.1. Using design theories to develop a low cost design model

In their work, Le Masson et al. (2014) discuss two different design theories: systematic design theories, linked to the industrial tradition and the work of Pahl and Beitz (1988) and Suh

(1990) and innovative design theories (Hatchuel and Weil, 2009).

In the introduction of their work, Pahl and Beitz (1988, p1) state: “The main task of engineers is to apply their scientific and engineering knowledge to the solution of technical problems, and then to optimize those solutions within the requirements and constraints set by material, technological, economical, legal, environmental and human-related considerations.” This is an approach we had identified in some of the studied products, the technology for the product being defined beforehand, and the low cost product evolving afterwards, by adapting the solution. Cost is in this case a validation variable.

Systematic design theories are mainly concerned with incremental innovations. Therefore they rely on reusing as much existent knowledge as possible, and on exploring some forms of divergence but ensuring global convergence (Le Masson et al., 2011; 2014). A systematic design project’s performance is therefore evaluated by the distance to a cost, quality and time goal.

As stated before, evaluating performance is key for strategic management (Venkatraman and Ramanujan, 1986). In the case of systematic design, an organization or ecosystem performance, which can be defined as a ratio of expansion over resources, according to Le Masson et al. (2014) can be evaluated in two different ways:

- For a given level of resources: performance is evaluated through the achievement of maximal market coverage and the highest functional level possible.
- Resources needed to achieve a given level of expansion: performance is evaluated by knowing how to get and arrange resources necessary to sustain a given innovation rhythm.

In innovative design theories, as described by Hatchuel and Weil (2009) on the other hand, the researched property of ‘having a lower cost’ can be integrated in the conception phase as a concept, and allow the development of radically different products through new knowledge development. This was observed when the technology behind the product was radically changed, mostly when the cost constraint was so important that the current product simply could not be adapted to achieve it.

When comparing systematic and innovative design theories, attention is immediately drawn to the different approach to knowledge in innovative design theories. Instead of trying to maximize knowledge reuse and minimize exploration, innovative design theories try to maximize exploration, therefore expanding both acquired knowledge and concepts (Le Masson et al., 2014). A successful innovation project should therefore create valuable new knowledge. An innovation project should therefore be evaluated by the variety of propositions, the value, their originality and their robustness (V2OR).

Innovative design theories also have a different evaluation of performance for organizations or ecosystems. According to Le Masson et al. (2014), in this case performance has to be evaluated by the dynamic inside the field. Performance can be evaluated by:

- The creation of objects outside the dominant design;
- A logic of creating product lines, through excess knowledge reuse.

Although the two design theories propose different approaches, they are not contradictory. One proposes to develop sustaining innovation, while the other one allows developing radical or disruptive innovations. Most companies nowadays work on both aspects to remain competitive. Based on these two theories we proposed a design model that would allow us to develop low cost products following both logics. Our low cost model is therefore composed of two design approaches, a systematic design approach, which we named low cost adaptation and an innovative design approach, named smart low cost design.

2.1.1.1. The systematic design approach of low cost: the low cost adaptation

As seen previously, systematic design (Le Masson et al., 2014) is concerned with sustaining innovation, improving existing products. Applied to low cost, this approach uses the same principles as value analysis, starting from an existing “classical” product, evaluating client utility for the product and changing or removing all aspects that have higher cost than client utility. The main functions of the product are identified and the product is then striped naked of all the functions considered “non-essential”, in order to reduce costs. As much already existing technology and elements as possible are used to further diminish development costs.

Example of Renault’s Dacia Logan

We consider Renault’s Dacia Logan X90 as an example of low cost adaptation. The car redefined client priorities as being safety and space, and removed a certain number of non-essential functions (Jullien et al., 2006). To help further reduce costs, the Logan platform was not designed specifically for the car, it was a ‘carry over’ from other existing products. Moreover, several of the car’s components are ‘borrowed’ from other models, like the door handles, and their development had already been fully amortized.

Further examples of low cost adaptation products are low cost hairdressers, like Tchip, and low cost car rentals, like Ucar. In the low cost hairdressers the number of possible options for hair and beauty treatments is reduced, and in some cases the haircuts and the cutting operations are standardized. Most auxiliary services, like having complementary coffee or magazines, are removed, and customers are served in a first arrived – first served basis, removing the need to have someone to take bookings¹².

In the low cost car rental case, the reduced costs are achieved through a reduced choice of car models, no agencies at the airports nor in the town centres, internet booking, clients filling-out the forms themselves, simplified offers (no free km offers) and employees multitasking, as described by Santi and Nguyen (2012).

¹² Source <http://www.lefigaro.fr/societes/2011/04/14/04015-20110414ARTFIG00740-des-coiffeurs-low-cost-dans-les-gares.php>, retrieved on the 2nd February 2015.

In literature, these kinds of products are often associated to the ‘core function’ or to ‘no-frills’. This approach can be summarized as starting from a given product with a given client utility (U_0) and a given price (P_0), minimize client utility loss ($\delta U = U_0 - U$) and maximize price reduction ($\delta P = P_0 - P$) through lower costs. This is illustrated in the approach number 1 in Figure 2.1.

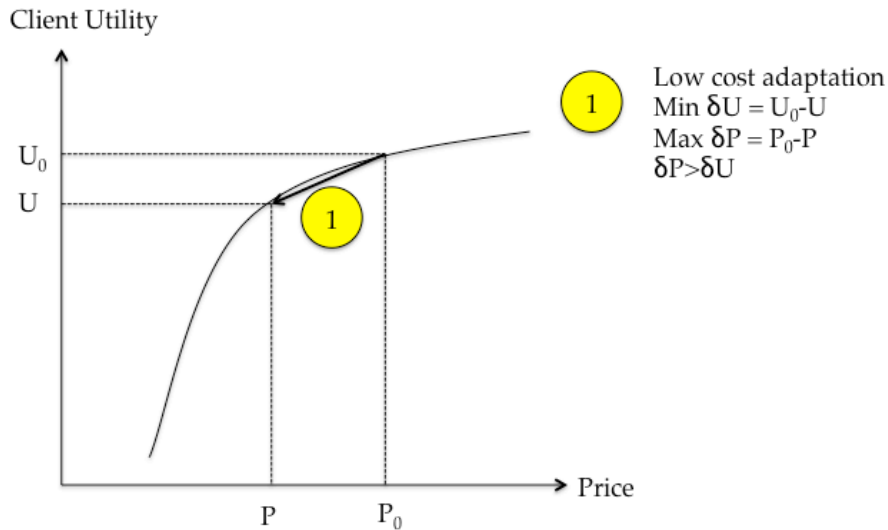


Figure 2.1 Client utility and price in the low cost adaptation approach

Definition of the low cost adaptation approach

We define the **low cost adaptation** approach as creating a low cost product that removes non-essential functions. By starting from an existing product, the designer removes functions or transfers activity to the client, having as a goal to achieve a maximum cost reduction, by keeping the client utility loss as small as possible.

2.1.1.2. The innovative design approach of low cost: the smart low cost design

In innovative design theories, one of the main characteristics of the innovations produced is that they are radical, disruptive and rule breaking (Le Masson et al., 2014). Innovations are considered radical when they demand a significant extension of the companies’ competencies and they often involve developing or applying new technologies (Oerlemans et al., 2013). They are considered disruptive in the sense of Christensen and Raynor (2003) because they challenge incumbent companies by proposing less-performing products in some aspects. And they are rule breaking because they go against established rules and often lead to reconfigurations of the entire ecosystem. We are therefore trying to propose new products that have little more in common with their predecessors than the fulfilment of a stipulated function.

In this approach in our model, the starting point is a function that needs to be fulfilled

associated to a double target of cost and price. The goal is to achieve maximal client utility given the cost target. A new product and a new organization are simultaneously designed around these two targets. Innovative organizations are targeted to involve the most competent internal and external stakeholders to achieve the low-cost strategy.

The targeted cost reduction is very high, often around 50%, which makes these innovations radical according to O'Connor and Rice (2013), who state that one of the criteria of classifying an innovation as radical is producing a significant (30% or greater) reduction in cost.

Example of Embrace, an infant warmer

We consider Embrace, a low cost incubator as a good example of smart low cost design. When Embrace was designed, the goal was to find a solution for infant death due to hypothermia. The cost target was of less than 1% of a classical incubator. The solution found has been classified as a radical innovation, not only due to its radically lower cost, but also because the sleeping bag like device has very little common points with a hospital incubator. It does not cater to the same clients and does not use the same technology. And being simple to use it actually allows a higher client utility than the one of a classical incubator.

Another example of a smart low cost design approach is the solar bottle bulb (Radjou et al., 2012). This device uses the sunlight diffraction in a PET bottle filled with water and sanitary water to illuminate closed rooms. We can furthermore cite the Revolo, a conversion kit to turn internal combustion engine cars into hybrid cars, as an interesting smart low cost design example (Chaudhary, 2014).

This approach can be summarized as starting from a very low price (P') and cost target and achieving maximal client utility (U''). This is illustrated as approach 2 in the Figure 2.2.

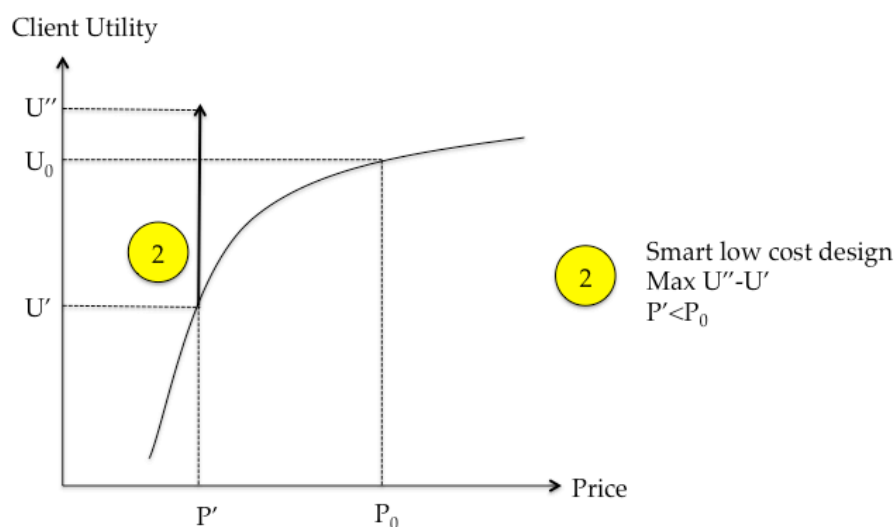


Figure 2.2 Client utility and price in the smart low cost design approach

Definition of the smart low cost design approach

We therefore define the **smart low cost design** approach as designing a solution that fulfils an identified set of functions, having a very low cost target when compared to other solutions providing similar functions. The smart low cost design approach tries to maximize client value given the cost target.

2.1.1.3. Comparing the two approaches of the model: a different impact on client utility

As stated in chapter 1, the existing models do not allow designing low cost products that have higher client utility than the classical product. The challenge in our model was therefore to propose a model that would allow both higher and lower client utility than for classical products. Figure 2.3 summarizes the two approaches of our model, by showing their approach to price and client utility.

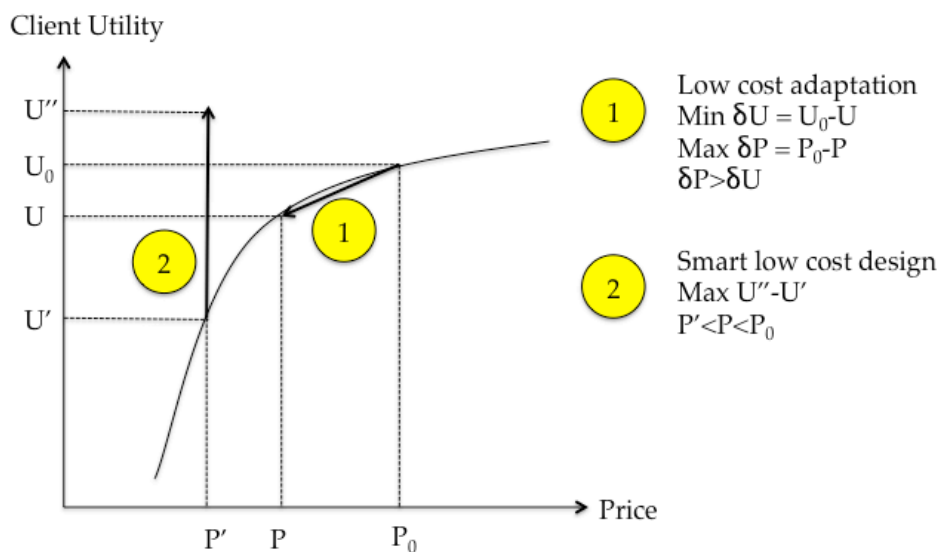


Figure 2.3 The two approaches in our model and how they handle price and client utility.

Figure 2.3 shows how the smart low cost approach creates a client utility/price couple that did not seem possible by looking at the reference product's client utility/price curve. This points to a disruption in the dominant design, the smart low cost design product does not follow the same rules. It can therefore hardly be evaluated through the same curve. Furthermore the new product can in its turn be the object of incremental innovation and low cost adaptation, so it creates its own client utility/price curve. We therefore propose that a comparison between these products would be more rigorous by employing a different graph. One proposition we make is that the functions of each product should also be plotted, to allow comparing the functions, value and cost simultaneously.

2.2. Empirical study and validation of the two approaches

Once our theoretical model has been developed, we verify its validity through a study of fifty different cases, identified through secondary sources. This approach was chosen since many low cost products have already been analysed in literature, and using secondary sources reduces the effort of data collection and permits studying a larger sample. We stopped adding cases to our database once we realized that new cases added little relevant information. Our fifty cases cover different sectors and there are both products and services amongst them.

These cases were furthermore analysed following an analytical framework on client utility and on product innovativeness. By the analysis of our fifty cases through this analytical framework we are able to confirm the existence of two different design approaches and to validate our theoretical model.

2.2.1. Building a database of low cost products and services

Data collection

Data on the studied products rely on triangulation of secondary sources: academic articles, press releases, exhibition materials and reports of use of the products. Secondary research method has become increasingly popular in business and management research (Bryman and Bell, 2011). This method was chosen here since it allowed to do longitudinal studies for some of the cases where information was available and to have access to high quality data on a large amount of low cost examples. This allowed analysing and comparing a greater number of different products and services, that improves the validity of the theory building process. (Eisenhardt and Graebner, 2007)

To reduce the risk of having incorrect or badly contextualized information, all the cases used to compose the database had been rigorously triangulated (Flick, 2014) and appeared in at least three different sources. Table 2.1 lists the kinds of sources and examples of sources used for the triangulation and gives details on the triangulation of one innovative case, the Embrace Incubator.

Table 2.1 Sources used for the triangulation of the cases

Type of source	Description	Used in the triangulation for "Embrace"
Academic journals	Journals on specific sectors (e.g. Journal of Air Transport Management); journals on innovation (e.g. Technovation); journals on strategic management (e.g. Strategic Management Journal);	Bhatnagar and Grover, 2014
Press releases and articles	Several articles collected newspapers (e.g. Le Monde); Special editions (e.g. Les Echos on low cost); TV shows (e.g. Dossiers d'enquête on M6)	CNN article in 2013
Books	Books on low cost strategies (e.g. Ryans, 2009); books on specific low cost products (Jullien et al., 2013); books on innovation (Gowindarajan and Trimble, 2012)	Radjou et al., 2012;
Conferences and expositions	Expositions on frugal innovation (e.g. innovation room Renault, 2012); Conferences on innovation (e.g. Navi Radjou for Mines ParisTech, 2014); Conferences on low cost (e.g. Anvie, 2013)	Innovation room Renault, 2012
Websites	Product websites (e.g. isanglitrongliwanag.org) Association websites (e.g. ; Blogs; Product evaluation websites	embraceglobal.org

Case selection criteria

To explore the existing low cost models, we built a database gathering the information on the cases selected through data sources methods (the full list can be found in appendix 1). The database consists of 50 products and services since by applying the data sufficiency criteria discussed by Voss (2009), we found that additional cases added no more relevant information for the study. We analysed fifty cases, and 34 of these were similar to other cases already existing in the database. Therefore, we considered that Voss' data sufficiency criteria were reached and the database contained sufficient different products for the research needs.

Following the theoretical replication selection criteria (Voss, 2009), we chose two polar types (case types with sharply contrasting characteristics) to select cases for the sample. The first polar type contained the mainstream low cost products and services, and was based on a cost and client value reduction approach, having the low cost airlines as a representative case.

The second polar type contained innovative low cost products and services, having the bus rapid transit as a representative case. Innovative low cost products were chosen because in business literature a very well known text of Porter (1996) opposes cost leadership and creating new value for the client through differentiation. Having an innovative low cost product goes against this logic, and could therefore create precious insights.

The first group of cases was chosen for its recurrence in the literature, it consists of a group of thoroughly discussed products and associated business models. To be considered recurrent, a product or service had to appear in at least 10 different sources. 26 products were identified in this group.

The second group of cases was chosen for the innovative characteristic associated to the product. These were chosen on an author's self-declaration, by picking products and services

that were designed as an innovation by the authors. Several products were identified in this case, and 24 classified in this polar type.

It should be noted that the criteria used to select the two polar types are not orthogonal, and a product can fit both cases. Orthogonality however is not necessary, since innovativeness and recurrence both bring important information about the product. Recurrence was chosen because it often allows more longitudinal studies on a case, since it often points to a great number of studies and analysis done in time, and often allows gathering lessons on failures and success. Innovativeness on the other hand was chosen to study the link between low cost and innovation.

A case that fits both cases is the Tata Nano, for example, that entered our database in the second group, since authors claimed it an innovation (i.e. Ray and Ray, 2011). During our triangulation phase however, we found more than ten articles concerning this product. The product first attracted interest due to its innovativeness, and then, when searching for more information on the product we found it was recurrent. Theoretical sampling, as done in this case, is relevant because the cases selected are particularly adapted to illuminate and extend relationships and logic among constructs (Eisenhardt and Graebner, 2007). Our first polar case allows illuminating what are considered low cost best practices, while the second polar case allows illuminating the relationship between low cost and innovation. In cases similar to this one, we chose to maintain the first classification concerning the polar type. This allowed us to maintain the main characteristic for which the product drew our attention, and to help illuminating this construct.

Each case studied was entered into the database and assigned a number according to its entry into the database. Table 2.2 describes the 50 cases studied. We also listed information on the sector in which the product is, the cost reduction strategies employed, the way these products interact with the customer's environment and constraints, the type of company that launched the product (incumbent or newcomer) and if there are already studies on the impact of the product in the market when available. Furthermore, we classified each case according to the same framework, which we will further discuss in the next item.

Table 2.2 Description of the cases in our database

#	Product	Company or developer	Sector	Short description	Impact study?
1	Low cost airlines	Ryan Air, Easy Jet, Southwest	Airlines	Point-to-point flights, ancillary revenues, reduced turnover time due to standardized processes and use of less busy airports, on-line ticket sales and homogeneous fleet to reduce maintenance and personnel training costs.	Yes
2	Hard discount retailers	Lidl, Aldi, Wall Mart	Retail	Smaller choice of products; smaller store surface; less "big brands"; simplified product display; and no complementary services.	Yes
3	Transmilenio	City of Bogotá	Transport	A bus-based transport system with the same capacity and service quality as a metro system.	Yes

#	Product	Company or developer	Sector	Short description	Impact study?
4	Tata Nano (low cost car)	Tata	Automobile	A four-wheeled vehicle to transport four people by all-weather. Smaller than classical cars, with a motorcycle motor and a distribution system based on distributed assemblers.	Yes
5	Dacia Logan X90 (low cost car)	Renault	Automobile	A "no-frills" car (no airconditioning, no radio, etc), the design was thought to simplify manufacturing, pieces designed for other cars were re-used, the sales were done through the existing network but with a different reward system for the sellers and the plant was in a low cost country and contained less	Yes
6	Mitticool	Mansukh Prajapati	Household goods	A low cost refrigerator made of clay, that reduces the temperature through evapotranspiration.	No
7	Chotukool	Godrej& Boyce	Household goods	A low cost refrigerator using a semi-conductor chip for cooling, portable, with top-opening and integrated battery.	No
8	Low cost haircut	Tchip, Self Coiff	Services	A simplified hairdresser service with standardized cutting operations that limit the time spent with each customer. No advanced booking possible and reduced number of services (coffee or magazines).	No
9	Low cost furniture	IKEA	Household goods	A new concept of furniture sales, where part of the activities have to be executed by the customer, like transporting and assembling the furniture. The furniture is designed to be easily assembled and packaging to allow easy transport. Costs are further reduced through global sourcing.	Yes
10	Mobile phone payments	Tagattitude	Banking	Payment through mobile phones, without the need for a bank account.	Yes
11	Swachh water filter	Tata	Household goods	A water purifier that does not need electrical power nor running water.	No
12	Baby warmer	Embrace	Health care	A sleeping-bag like infant warmer, that uses a change-phase material to keep a constant temperature without electrical power for up to 6 hours.	No
13	Mobile Product Authentication	Sproxil	Services	Anti-counterfeiting solution through a mobile product authentication service.	No
14	Single dose	Procter&Gamble	Personal goods	Packaging for consumption goods like shampoo or candy in smaller, one-use packages.	No
15	Solar bottle bulb (Isang Litrong Liwanag)	A liter of light	Utilities	A pet bottle filled with water and sanitary water used to illuminate closed rooms through solar light diffraction.	No
16	Vscan	GE Healthcare	Health care	A handheld, battery operated, pocket-sized ultrasound.	Yes
17	Nokia 1100	Nokia	Telecommunication	A rugged cell-phone, with new added functions, like heat and dust resistance.	No
18	Eye surgery	Aravind Hospital	Eye Health care	Hybrid business model with paying and non-paying clients, focus on cataract surgery and an "assembly line" with doctors and support staff working together.	Yes

#	Product	Company or developer	Sector	Short description	Impact study?
19	Pellets cooking system	BP, First (India)	Energy Household goods	A biomass stove that is more efficient and produces less smoke, using pellets made of agricultural residue.	No
20	Revolvo	KPIT Cummins	Automobile	A conversion kit for internal combustion engine cars that turns them into hybrid cars.	No
21	Low cost hotel	Formule 1, Etap Hotel, Motel 6	Hotel	Simplified hotel offer, often outside the city centre, offering good bedding, but almost no service beside that.	Yes
22	Internet banking	Bursorama, ING direct, Fortuneo	Banking	Replacement of brick-and-mortar banks by e-banking, with virtual contact.	Yes
23	Low cost insurance	Amaguiz (Groupama); Idmacif (Macif); Directassurance (AXA)	Insurance	Simplified insurance offers, with less options but easier to understand, mostly internet based with no direct customer contact.	No
24	Telecommunication service	NRJ, Virgin, Breizh	Telecommunication	Mobile virtual operator networks that rely on buying minutes in bulk from classical operators, and therefore do not have the fixed implementation cost.	Yes
25	Clothing	DPAM	Personal goods	Several micro-collections in a year, leading to instant buying without any sales, prices from five to six times lower than the main brands in the sector	No
26	Low cost car rental	Ucar	Services	Reduced choice of car models, no agencies at the airports nor in the town centers, internet booking, clients have to fill-out the forms themselves, simplified offers (no free km offers), employees multitask, some companies work with used cars.	No
27	Microwave ovens	Galanz	Household goods	Smaller microwaves, adapted to customer's space restrictions, re-use of mature technology.	No
28	Dust (low cost car)	Renault/Nissan	Automobile	Small truck, with a lot of 'carry-over' from other cars and re-use of older designs.	No
29	Mac400 (handheld electrocardiogram)	GE Healthcare	Health care	A simplified, inexpensive, small, hand-held ECG machine oriented to emerging markets. It can run on batteries as well as main power source. Has only four buttons and the printer of a portable ticket machine.	Yes
30	Washing machines	Haier	Household goods	Very resistant washing machines adapted for innovative uses, like cleaning vegetables and turning yak milk into butter.	No
31	Aakash (low cost tablet)	Data Wind	Technology	Low cost tablet (40 US\$), with resistive seven-inch touch screen, a rugged plastic casing, has two gigabytes of flash memory, two USB ports, headphone and video output jacks and Wi-Fi capability.	No
32	Dentistry	Addentis	Health care	The offices tend to be located in rather poor neighbourhoods, the material is bought mainly from low cost countries and in bulk, Strong task separation and specialisation, the dentists act on complete treatment plans, reducing the number of times each client has to come in, and by this reducing the time lost between clients.	No
33	Cleaning services	Anett	Services	A cleaner service focused only on big customers with homogeneous material.	No

#	Product	Company or developer	Sector	Short description	Impact study?
34	Free newspapers	Metro, 20 minutes	Journalism	Delocalised printing, own distribution network, smaller journalist team and the mock-up is done by journalists aided by a special software, recycled low quality paper used.	Yes
35	Free internet news	Mediapart, blogs	Journalism	Similar model as free newspapers, but without the printing and distribution issues	Yes
36	Silicones	Xiameter (Dow Corning)	Construction & Materials	B2B sale of silicone with a smaller number of available products, longer shipping delay, no technical service, web site orders or e-mail and phone orders with a fee, extra fees for changing a delivery day, rushing an order or cancelling one. Uses idle capacity of the regular line to produce its products.	Yes
37	Heart surgery	Doctor 'Health City' Shetty	Health care	An "assembly line" where only the most complex tasks are fulfilled by doctors, the other tasks are done by less qualified personnel. The group runs their own training program.	No
38	Palliative care	Kerala's neighbourhood network	Health care	Replacement of the classical doctor-led healthcare by a network of volunteers to identify the chronically ill in an area.	No
39	Solar power for rural poor	SELCO	Utilities	Solar power as service, charged on a pay-per-use base.	No
40	Foetal heart monitor	Siemens	Health care	Uses microphone systems instead of ultrasound technology to measure an unborn child's heartbeats.	No
41	Telecommunication service	Grameen phone village	Telecommunication	A shared phone service, where one person rents out the phone minutes, making the service available for the whole community.	Yes
42	Batteries	BYD	Batteries	Different technology allowing change in the production process, avoiding costly sterile rooms and the need for a highly trained workforce.	No
43	Low cost train	SNCF	Transport	A train where passengers only have the right to transport one luggage, where they have to arrive	No
44	Funeral services	Ecoplus Funeraire	Services	Simplified offer with less choice of options, only the 'basics' included in the price	No
45	Real Estate	Efficity	Services	On-line service, where the clients take over part of the real estate agents functions, like organizing visits.	No
46	Low cost gym	Curves	Services	A gym-only proposition, with extended opening hours, often with heavy technology and web use, that can be operated by a reduced team and is not in an expensive zone.	Yes
47	MOT (technical control)	CTEasy	Services	Technical car control, done with an internet appointment only, payment beforehand by internet, the customer has a limited number of possible services which he has to book beforehand.	No
48	Advertising	TV lowcost	Services	Simplified offer containing advertisement production and screening. Use of only digital material to record advertising, different contracts with employees, screening mostly outside "premium time" and on less expensive channels.	No

#	Product	Company or developer	Sector	Short description	Impact study?
49	Gillette Guard (low cost razor)	P&G	Personal goods	Not focused on a close shave but on safety, usable without running water.	No
50	Low cost rocket launch	Space X	Aerospace	Private company proposing a rocket launcher with inferior price to the government mainly due to innovative sourcing and the use of different technologies.	Yes

2.2.2. Analytical framework

Our proposed framework was used to analyse all products in our database and to verify if the empirical data confirms our theoretical model. Since our model's approaches had three major differences between them, one concerning client utility, one concerning the price and cost reduction and the other one concerning the design theory they follow, and therefore if they allow radical innovations, these were the two main aspects proposed in our framework. How we classify our products according to their client utility and their innovativeness will be described in the next items.

Evaluating client utility: Introducing utility parameters

One of the main aspects we want to evaluate is linked to client utility. We have established that client utility can be increased or decreased in the two approaches in our design model. We will here define utility parameters as being the different ways in which a product's client utility can be changed. The utility parameters we list here have been identified in a literature review. However, due to their transversal nature, the language used is not uniform. We will therefore redefine each of the identified parameters.

When looking at how client utility can be influenced, we find one path relying in changing the product's functions. According to O'Connell and Williams (2005) the 'no-frills' airlines for example rely on removing non-essential service, by removing or degrading functions. On the other hand, adding new functions has been identified as one path to create innovations (Le Masson et al., 2014). We therefore define two utility parameters linked to functions: **function removal** and **function addition**.

Another possible path to change client utility and to reduce costs is to transfer a part of the activities to the customer. Transferring a part of the activities to the customer has already been discussed in management literature, where Bitner et al. (1997) describe this phenomenon as one of the roles of customers in service experience: the customer as productive resource. Furthermore, in design literature von Hippel (2005) discusses shifting different parts of the innovation effort to customers. And Rouquet et al. (2010) discuss the transfer of logistics activities.

These activity shifts toward the customer take different formats, with a higher or smaller degree of company effort needed to make them effective. Activity transfer can happen in many ways, in some cases the company simply stops providing one activity, and leaves it up to the client to absorb the task, or to pay another actor to assure it. We will call this utility parameter a **negative transfer**.

In other cases, the company creates conditions that make the activity transfer easier for the client. These conditions can be created by providing adapted tools, through clear guidelines given by the company or even by changing the product. These three approaches can be exemplified by IKEA furniture. The necessary tools are often included in the furniture kit. It also contains complete and imaged instructions, as well as a hotline number if the customer has questions. Furthermore the products are designed to make transport and assembly easier. This more organized transfer will be called **positive transfer**.

The deliberate choice was made to divide activity transfer in two different utility parameters, since there is a big difference from a cost and client utility point of view between both kinds of transfer: negative transfer decreases client utility, while positive transfer increases it.

The function removal therefore has the smallest client utility, followed by the negative transfer, the positive transfer and finally function addition has the highest client utility.

Table 2.3 recapitulates the four defined utility parameters. They have been classified according to their client impact on client utility, going from the most negative to the most positive impact.

Table 2.3 Our four utility parameters definitions and examples

Utility Parameters	Definition	Case references
Function removal	The new product does not fulfil a function the reference product fulfilled	Low cost gym – removal of annexe functions like spa or lounge facilities
Negative transfer	The client can have the same or a similar function fulfilled by the product if he uses his own resources to get it	Low cost airlines – customers have to pay for meals
Positive transfer	Part of the functions can only exist through the client’s co-production, but this co-production is organised by the former producer	IKEA – Customers have to assemble furniture themselves, but are provided with the tools and instructions with the furniture.
Function addition	New product adds function that does not exist in the reference product	Nokia 1100 – Added heat and dust resistance

Measuring a product or service’s innovativeness

Another aspect along which the two approaches inside our model differ is whether they produce sustaining or radical innovations. As discussed in chapter 1, the link between low cost and innovation is often not evident, authors like Bengtsson et al. (2009) still oppose these notions. However, the great number of cases where author’s self evaluation points to innovativeness in our database (24 cases) seems to contradict this opposition. We therefore decided to evaluate the low cost product’s innovativeness.

Several definitions of innovativeness can be found in literature, as stated by Danneels and Kleinschmidt (2001), with different approaches to from whose perspective innovativeness is measured (like a customer or a firm perspective) and of what is new. According to them, while from a customer's perspective innovation attributes and changes in behavioural patterns are regarded as product newness, from a firm's point of view, technological, marketing and organisational change are regarded as product newness.

Based on 21 different studies Garcia and Calantone (2002, p113) state that "... product innovativeness is a measure of the potential discontinuity a product (process or service) can generate in the marketing and/or technological process". They also draw attention to the fact that product newness is normally assessed from a firm's perspective, but that other views exist, like new to the world, new to the market or new to the industry. Garcia and Calantone (2002) also show that the number of evaluated factors varies greatly between studies, going from a single to up to nine different factors.

Innovativeness or newness of a product has been linked to the crisis of the identity of objects (Le Masson et al., 2010). In their discussion on the shift of the identity of an object, Le Masson et al. (2010, p29) draw attention to "*the new value spaces, new features, new technologies and new functions, new business models and new forms of market relations*" that emerge and are linked to this shift. Their analysis uses several factors to evaluate innovativeness and is consistent with the aspects Garcia and Cantalone (2002) state product and service innovativeness should take into account. It makes a combination of the micro and macro perspective (by looking at the client perspective and the market perspective) and it models marketing and technological discontinuities (through the change in the business model and the change in technologies and features).

We therefore classified our products according to their shift in four essential dimensions that are part of the object's identity: the technological paradigm (which includes new technologies and new features), the functions, the business model and the client value (Agogué et al, 2014). Each product or service had a note 0 or 1 associated to each evaluated aspect, 0 for when no change was made to this aspect and 1 when it was changed. In addition to that, a global "innovativeness" note going from 0 to 4 assigned according to the accumulation of dimensions of the product's identity that were changed. Table 2.4 shows the evaluation of innovativeness used in our study.

Table 2.4 Evaluation of innovativeness used

Dimension	Definition	Case reference
Change in technological paradigm	New features or new technology when compared to the reference product	Siemens foetal heart monitor – used microphones
Functions addition	New product adds function that does not exist in the reference product	Chotukool – added portability
Change in business model	Business model different from the reference product	Aravind Eye hospital – different prices for different customers and hospital run like a production chain
Change in client value	Increased value when compared to the reference model	Mobile Product authentication – creates additional value for the customer by allowing him to validate product authenticity with his mobile phone
Innovativeness	Sum of the four dimensions	-

2.2.3. Data analysis

Analysis of utility

The studied products were classified according to their utility parameters – function removal, negative transfer, positive transfer and function addition – and according to their innovativeness – change in the technical paradigm, change in the business model, functions improvement and value improvement for the client.

We noted that several products combined more than one utility parameter. Utility parameters that increase client utility (function addition or positive transfer) were often combined with utility parameters that decrease it (function removal and negative transfer). The ChotuKool, produced by Godrej&Boyce, and sold for US\$65 is an example of low cost refrigerator that combines two utility parameters. It has a function addition – portability and adaptation to intermittent power supply available in India (Govindarajan et Trimble, 2012) – and a function removal – the temperature inside the fridge is not the same as in a regular refrigerator.

Table 3.2 shows the different combinations of utility parameters found in the studied sample. Function removal is the most used utility parameter, 42 of the 50 studied products use it, a fact that justifies the recurring associated made between low cost products and function removal.

Table 2.5 The 50 products classified according to their utility parameters (the products' names can be found in Appendix 1)

	No change	Functional removal	Negative transfer	Functional removal+ Negative transfer	Total number of cases
No change		5, 8, 14, 18, 25, 27, 28, 32, 33, 34, 36, 37, 40, 44, 48		1, 2, 21, 22, 23, 24, 26, 43, 45, 47	25
Positive transfer	9, 10, 13	41			4
Function addition	19, 39, 42	3, 4, 6, 7, 11, 12, 15, 16, 17, 29, 30, 31, 38, 49, 50	35	46	20
Positive transfer+ Function addition	20				1
Total number of cases	7	31	1	11	50

Analysis of innovativeness

To describe the innovativeness we used the number of parameters of the product's identity that had changed, going from 0 to 4. The low cost airlines for example, that changed only the business model will have an innovativeness of 1, while the MittiCool, the low cost refrigerator, that changes the business model, the technical paradigm and improves client value and functions will have one of 4. By using this system we give the same value to all four of the product parameters, all items are assumed to be equally important and relevant.

Innovativeness and low cost – two linked concepts

Our analysis clearly shows that innovativeness and low cost are not incompatible. As can be seen in Table 2.6, there are several low cost products that have an innovativeness level of 4, like the Tata Nano, the Mitticool, Embrace, the Solar bottle bulb, Revolo, Free internet news and Space X. These products have significant lower costs than their reference products, and they have important changes to the identity of the object, all four attributes being changed.

Table 2.6 Innovativeness of the fifty analysed cases (the products' names can be found in Appendix 1)

Innovativeness	Cases	Total number of cases
0	8, 21, 22, 23, 27, 28	6
1	1, 2, 5, 18, 24, 25, 26, 32, 33, 34, 36, 37, 43, 44, 45, 47, 49	17
2	9, 10, 13, 14, 30, 40, 41, 42, 46, 48	10
3	3, 7, 11, 16, 17, 19, 29, 31, 38, 39	10
4	4, 6, 12, 15, 20, 35, 50	7

When looking at the main factors for innovativeness in each product, we see that business model change is the most common factor, being present in 62% of the products (31 out of 50). The other factors are present at equivalent levels, function addition being found in 44% of the cases and technology change and customer value change in 42% of the cases. And in the case of a level of innovativeness of 1, the business model change accounts for 94% of the cases.

Joined analysis of innovativeness and utility

The results on innovativeness and utility parameters were then combined, and as can be seen in Figure 2.7, we found that function removal could be found at all levels of innovativeness. Negative transfer was mostly found at low levels of innovativeness, while positive transfer and function addition were mostly found at higher levels of innovativeness.

Table 2.7 Innovativeness and utility parameters combined (the products' names can be found in Appendix 1)

Innovativeness	Function removal	Negative transfer	Positive transfer	Function addition	Cases
0	X				8, 27, 28
0	X	X			21, 22, 23
1	X				5, 18, 25, 32, 33, 34, 36, 37, 44
1	X	X			1, 2, 24, 26, 43, 45, 47
1	X			X	49
2	X				14, 48
2	X	X		X	46
2	X			X	30, 40
2	X		X		41
2			X		9, 10, 13
2				X	42
3	X			X	3, 7, 11, 16, 17, 29, 31, 38
3				X	19, 39
4	X			X	4, 6, 12, 15, 50
4		X		X	35
4			X	X	20

Figure 2.4 plots the studied products according to its innovativeness and utility parameters. We can clearly identify two main zones where the products are located, which confirms our hypothesis of the existence of two design models for low cost. These zones are delimited by the innovativeness of the products: the function addition and positive transfer, independently of the function removal, produce more innovative products. Function removal and negative transfer alone have poorer innovativeness performance.

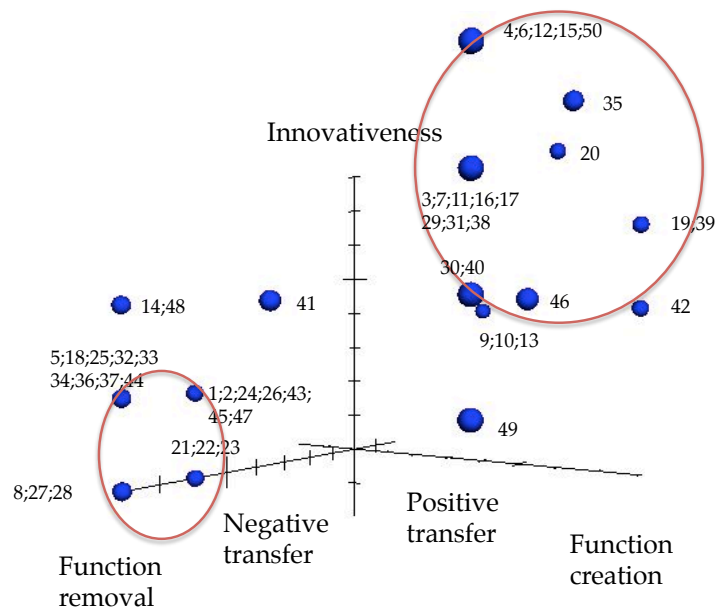


Figure 2.4 The 50 products classified according to their utility parameters and innovativeness (the products' names can be found in Appendix 1)

Representation in figure 2.4 was chosen since it allows a clear visualisation. However, this representation might not be accurate, since the parameters utilized are correlated. A principal component analysis was done to verify that there are really two groups, as can be identified in figure 2.5. Principal component analysis or PCA, is used to transform possibly correlated variables into a smaller number of uncorrelated variables, the principal components (Jolliffe, 2002). In our case, the principal components and the variance explained by them can be found in tables 2.8 and 2.9.

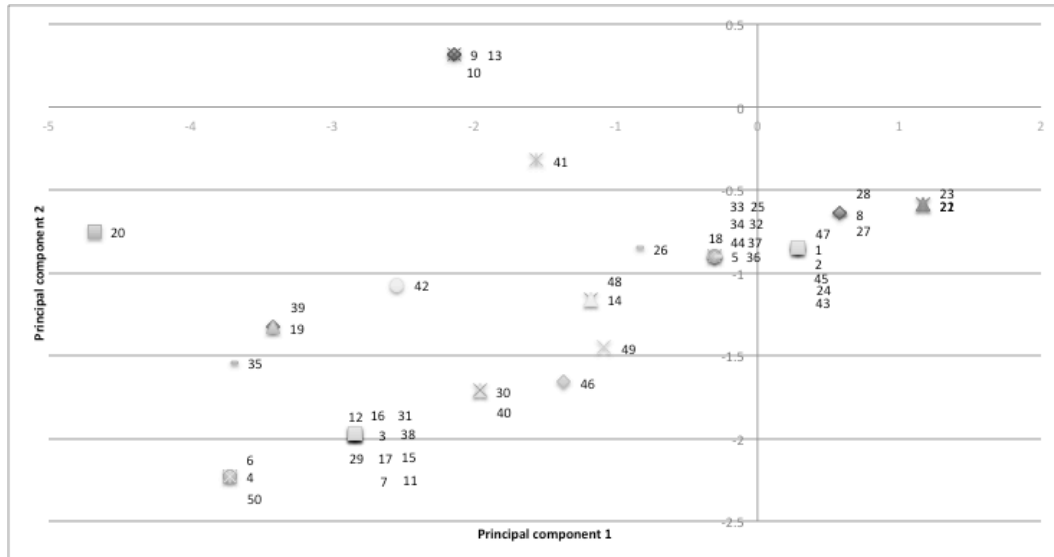


Figure 2.5 Principal component analysis

Table 2.8 Component matrix

Component	1	2	3	4
Function removal	0.58	-0.64	0.3	-0.41
Negative transfer	0.59	0.05	-0.79	-0.14
Positive transfer	-0.38	0.84	0.09	-0.36
Function addition	-0.78	-0.55	-0.19	0.02
Innovativeness	-0.88	-0.26	-0.21	-0.23

Table 2.9 Total variance explained

Component	Total	% of Variance	Cumulative %
1	2.22	44.47	44.47
2	1.48	29.69	74.16
3	0.80	15.97	90.13
4	0.36	7.29	97.42
5	0.13	2.58	100.00

This analysis of 50 cases confirms our theoretical model for low cost design and allows us to show a certain number of advantages of using this kind of model that will be discussed in the next item.

2.3. Benefits of a theoretical model of low cost design

The following chapter gives some benefits of this theoretical model of low cost design. We will discuss the managerial advantages as well as the impacts the different products have on their environments.

We defend that these two different approaches in a design model could be used as devices to explore new product design.

Managerial advantages of a double approach design model for low cost

The fact that both low cost design models seem to be widely represented and the great number of differences identified between them, suggest that the studies in low cost products could be enriched in studying these different models separately. The lack of a theoretical framework and of separate studies of the different approaches makes it hard for product designers to have a clear view of the effects and implications of each model. The model and the framework proposed here allows a more structured approach to low cost product development, allowing designers to better target the wanted design model.

The study of several products showed that, the more innovative products seem to be developed by the smart low cost design model and through a combination of function addition and function removal. This leads to the assumption that to attain a more innovative product, designers should focus on a 'smart low cost design' approach, trying to create new functions, but keeping in mind that some functions can be removed. This approach allows a trade-off between the functions, which is not the case in the 'low cost adaptation' model, where the only trade-offs are between costs and functions.

The simple removal of functions does not redefine the object identity, and can be achieved through a classical managerial model. In the 'smart low cost design' however, we have a greater change in the identity of the object through the removal and creation of functions, which needs a richer managerial model, as is often the case when innovative design activities are taken into account by management (Le Masson et al., 2010).

When taking the user's point of view, there are clear differences between the models. The 'smart low cost design' products are often more interesting, because beyond being more accessible (due to their lower price) they often achieve to create more utility and help to reduce usage constraints, like eliminating the need for electrical power (seen in the case of the Mitticool (Radjou et al., 2012)) or creating new usages for one of the user's assets (like for a cell phone in the case of Taggatitude, that allows payments through the cell phone).

The double approach of our low cost design model, can therefore be used to increase not only client utility, but also user utility, where the user and the client do not always have to be the same actor.

Impact of the two kinds of low cost products on their environments

The effects on markets of low cost products and services observed in the cases studied are similar for both models, however the cost reduction (and therefore also the price reduction in most cases) achievable by the smart low cost design model seems to be higher, and this increases the intensity of certain effects.

The Tata Nano's price, for example, is less than 50% of the price of the Dacia Logan X90 (around 2500 US\$ for the first against 6000 US\$ for the second). Although in this case the low cost adapted model seems to have had a greater market success than the smart low cost design model, many authors believe that this is linked to the particularities of the Indian car market and the high pre-launch expectations that accompanied the Tata Nano's launch¹³. And as the authors having followed the Tata Nano's evolution have stated, even though the sales of this car did not reach the expected level, this car already had a clear impact on its market and might continue its evolution like other disruptive products¹⁴. And the market is surely evolving; several companies in the same sector have announced their entry into low cost cars development.

If it is too early in several markets to evaluate the long-term impact of the low cost products, some more mature low cost markets, like the airline market, can give us an idea of how a low cost product can affect a market. The first point observed by Dresner et al. (1996) is a decrease of prices of the incumbent companies. The price decrease affects not only the flights with the same inbound and outbound airport, but also those with a potential replacement airport. The price change however seems to be strongly linked to the context and route, while Dresner et al. (1996) observe an 35 to 40% price decrease on some routes, the reduction observed by Fageda and Fernandez-Villadangos (2009) was of only 6.5%. Kumar (2006) states that, a classical approach by incumbents who feel threatened by low cost entrants is to set off price wars. It is therefore not unreasonable to expect the prices of a sector to be globally affected by the low cost offer, even if this offer is not a perfect substitute for the existing offers.

Another fact observed by Dresner et al. (1996) is the attraction of former non-consumers to the market by low cost products. Attraction of new consumers is also one of the main goals of most products developed for the base of the pyramid (Prahalad and Hammond, 2002). A study by the ELFAA (2004) shows that, in the airlines sector, the new demand creation by the low cost airlines was of 59% of the passengers flying with them. The low cost ultrasound developed by GE Healthcare also created new demand, since its price made it accessible for other applications (like in emergency rooms to identify ectopic pregnancies; at accident sites to check for fluid around the heart; in operating rooms to place catheters for anaesthesia) and

¹³ "Learning from Tata's Nano Mistakes". HBR Blog Network. By Eyring, Matt J. (2011). Available on http://blogs.hbr.org/cs/2011/01/learning_from_tatas_nano_mista.html accessed in March 2013.

¹⁴ "Why you shouldn't write off the Tata Nano just yet". Firstpost business. By Kaul, V. Available on <http://www.firstpost.com/business/why-you-shouldnt-write-off-the-tata-nano-just-yet-429044.html> accessed in September 2012.

to new markets, like rural china (Immelt et al, 2009).

The same phenomena of new customers and broader application is being observed for products such as the Haier washing machine, which was used in China by the customers for unexpected uses like cleaning vegetables and turning yak milk into butter (Abonyi, 2012; Radjou et al. 2012). In these two cases, the broader application found by the customers was integrated by the company, extending the products usage possibilities. This is a clear example of how the cooperation with new users can spur innovation, since their needs are different than those of the customers targeted by the regular products. Although the main objective of these low cost products was not the development of new functions, but to offer a product to former non-consumers, these products led to the development of new uses and functions.

The study of low cost products through the lenses of this design model also allowed the identification of new actors and the disappearance of previously existing ones, especially in the products following the 'smart low cost design' model. This change lowered cost and often allowed other advantages when compared to the established product.

The emergence of collective usage as a means to reduce costs for each of the users is not a new phenomenon; agricultural cooperatives have rested on this principle for very long. But collective usage has been spreading to new personal objects lately, like portable phones in the case of the Grameen village phone. In this particular case, a new actor was introduced, the "Village Phone Ladies", who were responsible for renting out the telephones (Seelos and Mair, 2007). Low cost products can therefore be a way to change the actors involved in the value chain.

The disappearance of actors can be observed in the example of Decathlon, a French sports equipment retailer, who in an attempt to control the whole upstream-downstream value-chain removed actors in the value chain by launching its own brands (Hillairet et al., 2009). Decathlon's "passion-brand" products have an attractive pricing, and are recognized as having high innovativeness, the FLP 500 swim fin for example has won several design awards (Turner et al., 2005).

Context validity of the model

It remains unclear through the examples studied if the emergence of a low cost product is possible in all kinds of markets. Although Ryans (2009) declares that low cost products rarely appear in markets that are not yet mature, this study found no evidence to support this. It is also impossible to state if some markets are more adapted to receive one or the other kind of low cost product, since in some markets both models exist. The examples studied seem to cover a broad spectrum of products and services in several different sectors. Some sectors have seen an appearance of several different low cost products, based on both approaches in our design model, as can be verified in table 2.10.

Table 2.10 Examples of low cost products using both approaches of the proposed design model

Classical product	Cost efficiency	Low cost adaptation	Smart low cost design
Car	Taylorism, JIT, global sourcing	Dacia Logan X90	Tata Nano
Cell phone	Economies of scale, global sourcing	Simplified phone models ("no-frills")	Grameen village phone
Appliances	Economies of scale	Haier's smaller microwave ovens	Mitticool, Chotukool

Updating the innovation system for low cost

Our low cost design model is a proposition of a new design reasoning, which we can integrate into the innovation system for low cost.

Although the performance of a single product continues to be evaluated by the client utility over cost ratio, like in the case of innovative design theories we have a second performance evaluation that emerges – the low cost strategy performance. As in the case of innovation strategy performances, it's success is measured through two aspect: the maximal coverage of the low cost designs (both in a low cost adaptation and a smart low cost approach) by the company and the knowledge reused in reducing overall costs on all products of the company. The introduction of a design model, with a low cost adaptation and smart low cost design complements design reasoning. Low cot products and services can now be classified according to one of the two low cost approaches, allowing to identify the chosen design ex-post. This allows a more structured comparison with the reference design, not only on the price or cost, but also on client utility.

Performance evaluation and design reasoning are changed by the use of low cost adaptation and smart low cost design, as can seen in Figure 2.6. The organization is not an aspect investigated by our design model; we will further discuss it in chapter 3.

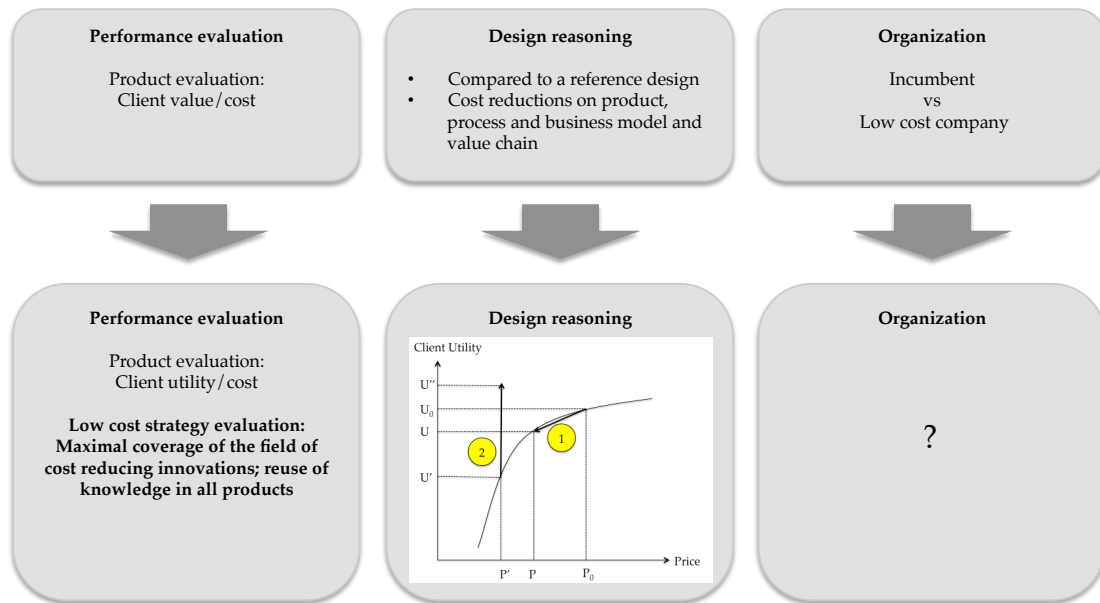


Figure 2.6 Evolution of the low cost innovation system applying our model

2.4. Conclusion: Challenges of performance and organizational requirements of design strategies

This chapter allowed us to propose a new design model for low cost, built on theoretical elements from design theories and validated through its application to fifty low cost products. The combined use of design theories, our low cost design model and the literature review allows us to further extend our innovation system. We find that the elements identified so far are insufficient to organize collective action around low cost, since elements on the organization are still lacking.

Despite the clear interest of this model for low cost design, new questions emerge from our double approach design model and from the evolutions of our framework. The great diversity of settings and sectors in which low cost products are found in, and the lack of specific evidence of a low cost adverse sector lead to the first question. We ask ourselves if **low cost adaptation and smart low cost design products can emerge in all contexts**. Furthermore, we interrogate ourselves about **the conditions for the emergence of both models and if they are the same for low cost adaptation and smart low cost design**. The challenges managers have to face when wanting to design low cost products have not been clarified so far. These could be different according to the chosen approach in the design model, since the design models are different. These points will be discussed in the following chapters.

Chapter 3. Managerial challenges in the design of low cost products

3.1. Avoiding the “low cost = low quality” trap	85
3.2. Organizing to launch low cost products	87
3.3. The influence of environments on low cost product reception	92
3.4. Conclusion: An innovation system adapted for low cost in all ecosystems	95

Despite the importance low cost products have gained in the past years, designing them still is not an easy task. As in every new product development, the definition of the product's functions, technology, business model and customer value are essential. But managers trying to design their low cost products are often confronted to several difficulties that go beyond the more classical difficulties of NPD. Some of the questions they can be confronted to, are how a low cost product might affect their brand image, if they do not risk cannibalization and if they can actually achieve a low cost product by keeping their company's previous organization.

The following chapter will discuss some of the challenges managers have to overcome nowadays to design low cost products and services, as well as some approaches chosen today to do so. Most conditions are independent from the approach of the design model chosen (low cost adaptation or smart low cost design), but specificities of these approaches can also lead to different conditions for their implementation. Unless otherwise noted, the discussed conditions are valid for both approaches. We will start by discussing managerial specifications linked to the image of low cost, then we will discuss organization around low cost and finally we will discuss the impact ecosystems have on the success of low cost design. All these elements will allow us to extend our innovation system. We then conclude the chapter by stating the need to verify the innovation system on an applied case.

3.1. Avoiding the “low cost = low quality” trap

Some managerial specifications are linked to the image of low cost and to how products are perceived by management. Often there is ambiguity around what a low cost product is and about which are the consequences of its design. We will give some details about two common associations, between low cost and low quality, and between low cost and low price. These associations can have a negative impact on low cost product design.

Stating the difference between low cost and low quality

Low cost has often been closely associated to low quality. Karnani (2006) states that the low cost products always have a worse quality than regular products, due to a cost-quality trade-off. Although the cost-quality trade-off is a way to reduce costs, it is not the only one. Some low cost products have furthermore been found to have an equivalent or even better quality than regular ones, as is the case of some of Aldi's products (Kumar, 2006). In yet other cases, comparison is extremely difficult, since the low cost product's emphasis is on some aspects of the product while others are removed. That is the case for example of low cost hotels, like Ibis or Formule 1. When comparing the quality of the bedding of these hotels to the bedding in other two starred hotels, the quality in the low cost hotels is superior (Santi et Nguyen, 2012).

However other features, like a 24h receptionist might be unavailable, which makes a global quality comparison very difficult.

It is therefore important to break the low cost – low quality link, since it often can be the source of refusals from higher management when the development of a low cost product is proposed. The fear of having their brand associated to what they believe is bad quality can represent an important barrier.

Ambiguity between 'Low cost' and 'low price' as managerial lever

Another point contributing to the manager's difficulties with low cost products is that an ambiguity between low cost and low price seems to exist, not only from a client's point of view, but also in the literature. Ryans (2009), defines low cost products as "good enough" products and services at very attractive prices. Kumar (2006, p106) speaks of low cost businesses, and not only products, and defines them as businesses that "offer products and services at prices dramatically lower than the prices established businesses charge".

The link between low cost and low price that is made here is easily explained due to the fact that price is the variable that customers use for buying decisions, and that cost is closely linked to the price in many markets. The "price equals cost plus margin equation" is very straightforward and easy to grasp. However, even if this link exists in most markets, a clear differentiation has to be done between 'low cost' and 'low price'.

Indeed, most low cost products have lower prices, and their lower prices are often the motivation for customers to buy low cost. However, it is important to keep in mind that low prices can be achieved through other levers. When looking at low cost carriers for example, we can find moments where the incumbent carriers tickets have a lower price, due to their yield management policies (Piga and Bachis, 2006). Also, in the retailer's case, the use of sales or other commercial offers can be the reason why products sold by the classical retailers are less expensive than the ones found in the low cost retailer. Furthermore, in public services for example, lower prices are achieved through subsidies and government financing. Subsidies are not found only in public services. In some sectors the lower prices are achieved through cross-subsidies.

Another approach used by companies trying to sell products to low income populations at lower prices is the change in the size of the packaging, like for example the one-time-use sachet for shampoos and soaps developed by Procter & Gamble (Nakata and Weidner, 2012). These products are much more affordable, but that does not necessarily mean they have lower costs. Adding more packaging per serving can be a consequence of these one-time-use products, actually increasing costs per serving instead of reducing it.

These examples clearly show that we must make a difference between low cost and low price, although the low cost products tend to have lower prices. Throughout this manuscript, 'low cost' will be used to describe products and services where costs have been reduced. However, when looking at products that were declared as low cost in literature or in the media, this

might not be the case.

We therefore state our third research hypothesis *RH3*: **To avoid a direct link between low cost and low quality, as well as between low cost and low price, it seems important to create awareness around what is a low cost product and to clarify how the product that will be developed is expected to position itself relatively to existing offers.**

3.2. Organizing to launch low cost products

As we saw in chapter one, based on the example of low cost airlines, part of the cost reductions does not come from changes in the product itself, but rather from changes in the production process, in the value chain or in the business model. This means that the organization of the company is essential to design competitive low cost products. Launching low cost products inside an incumbent company can therefore be challenging, since the organization inside the incumbent company might not be best way to achieve low costs.

Secondly, as an incumbent launches a low cost product, it has to have reflexions on the positioning of its product and on how the new product will affect the brand image.

Several different solutions have been proposed to solve these challenges, going from creating a completely new company to simply creating a new brand. We have identified three in literature, which will be discussed in the following items.

Setting up a new venture, creating a new division or creating a new brand

Another approach to launch low cost products and services is to launch it inside the company, through a new venture, a new division, a new brand or a combination of these factors. The airlines-within-airlines is one example of launching a low cost division inside an incumbent company. Since a part of the cost reductions that low cost airlines can achieve come from operating point-to-point flights instead of flights passing through a hub, having a different division to operate these flights was one of the chosen approaches by incumbent operators (Lin, 2012). Launching a new division allows the company to keep its existing position and to enter the low cost market, by having slightly different organizations for the two businesses. Having several different business models inside the same company is very challenging, and has been cited as one of the main causes of strategic failure, but some businesses, like LAN airlines, succeeded in creating complementary business models, and achieving higher profits thanks to them (Casadesus-Masanell and Tarjizan, 2012).

Launching a new brand can also be an interesting approach when synergies exist or when benefits can be harvested from associating the new brand to the incumbent company. A

company that fully profited of synergies possible through this model was Dow Corning, a company producing silicones. Through its low cost brand Xiameter, they were able to launch a more affordable way for their customers to buy some of their standard products (Kumar, 2006). The new brand was still produced with the same quality as the classical silicones, but customers had to accept some compromises on the business and service conditions, mostly concerning the delivery time, the service offered (no direct contact with a salesperson, the Xiameter offer is a self-service one) and the purchase channel (only online sales).¹⁵ And considerable cost reductions could be achieved by producing the Xiameter silicones on the machines idle time and in bigger batches than was previously the case for the other silicones, since the longer delivery time allowed to better predict production cycles.

Introducing so-called “fighting brands”, as described by Jost (2014) is one of the main responses to low price entrants. A similar approach can be found in the luxury sector, where some brands, like Cartier, introduced more affordable products that would cater to a greater public (Catry, 2003). But despite the advantages cited, to have a low cost and a regular business in the same company or in the same group or holding, can be risky. One of the risks these companies incur is that the different organization and job contracts might lead to strikes. The shift of operations and jobs of Air France to Transavia (Air France’s low cost subsidiary) announced in September 2014, started a massive pilots’ strike¹⁶, that lasted two weeks. The strike’s cost for the company was estimated around 280 million euros¹⁷, and it also had a negative impact on the company’s image. Furthermore, as can be seen in the case of luxury goods, the introduction of a more affordable brand can, even though it increases sales, tarnish the image of the mother brand. According to Catry (2003), by introducing its more affordable brand Must, Cartier lost some of its luxurious allure.

Launching low cost products inside an incumbent company raises another big concern: the cannibalization of their existing offers. Launching a lower cost product with a lower price and a different client utility can attract customers away from a more premium offer.

Although cannibalization happens upon the launch of low cost products, low cost products and services can also attract a great number of new clients. This was notably the case when low cost airlines started operating. The ELFAA (2004) statistics showed that of the clients the low cost airlines transported in Europe in 2002, only 37% were formerly clients of other

¹⁵More information on the Xiameter business model can be found on <https://www.xiameter.com/en/Pages/BusinessTerms.aspx>. Consulted on the 8th September 2014.

¹⁶The strikes gave place to media coverage by several different journals, like the New York Times, available on http://www.nytimes.com/2014/09/12/business/international/air-france-klm-restructuring-puts-new-focus-on-its-low-cost-airline.html?_r=0, retrieved on the 16th September 2014; or the Morning Journal, available on <http://www.morningjournal.com/general-news/20140915/air-france-strikes-as-europe-faces-low-cost-shakeup>, retrieved on the 16th September 2014; or the Financial Times, available on <http://www.ft.com/intl/cms/s/0/02ab0260-3cdc-11e4-9733-00144feabdc0.html#axzz3DOc9Xnzq>, retrieved on the 16th September 2014.

¹⁷ These cost estimates were given by Reuters, available on <http://www.reuters.com/article/2014/09/28/us-airfrance-strike-idUSKCN0HN0GE20140928>. Retrieved on the 1st October 2014.

airlines. The new demand represented 59% of all the passengers, and was composed of people who would otherwise not have travelled, as well as people who would have taken another means of transport.

Many companies are extremely concerned with potential cannibalization, despite the fact that cannibalization might be lower than the number of clients attracted. To attack this issue, one of the ways to reduce cannibalization is what has been called 'fencing' in the literature, an approach also used by companies using yield management. The fences are the rules used to decide which customer gets which price. It consists in creating differentiated products for the different prices, to make sure that those customers willing to pay a higher price will do so, because they see the added value of the higher priced offer. Fencing is also a tool to increase perceived fairness by customers (Kimes and Wirtz, 2003), who see the value for money in the different offers.

Creating a new company for the low cost product

Well-known figures in low cost companies have defended an incumbent company can never become low cost. The phrase "you don't become low-cost, you are born low-cost", attributed to Ray Webster, EasyJet Chief Executive¹⁸, has been used by many executives and managers to criticize any approach that is not creating a new low cost company from scratch. Tréguer (2014) gives the example of the Formule 1 hotel to corroborate this sentence, and believes it is often applicable due to the possibility new companies have to "start from a blank sheet".

New entrants have used a similar argument when justifying why their low cost company was disrupting the market: having hard to copy cost reductions. These are often linked to investments done previously by incumbents, Brügggen and Klose (2010) for example point to hard to copy attributes for incumbents like fleet commonality as one of the success factors of low cost companies.

However, despite the favourable arguments to launch a new company, few incumbents were successful taking this approach. One example that can be cited is Lufthansa's low cost spin-off Germanwings. The new company, when created by an incumbent, can then be part of a group or holding of which the parent company is a part, too, or it can be completely independent. Germanwings is part of the Lufthansa holding, which can lead to some confusion with the next model we will discuss, setting up a new venture inside an incumbent company.

Another interesting case is the Dacia Logan, an example thoroughly described by Jullien et al. (2013). Although this example is particular, since Dacia was a company integrated by Renault, it clearly shows what can be done with a different brand and organisation inside a group. The Dacia Logan was launched with different means (the factories for producing

¹⁸ Communication on the EasyJet website http://corporate.easyjet.com/latest-news-archive/news-year-2004/31-03-04a-en.aspx?sc_lang=en (visited on the 31st July 2014)

Dacia cars were different from the ones used for Renault's cars), different rules (the commissions for the car's sales were different) and different demands for the project development. Dacia is also an example for important synergies that can emerge: an important part of the cost reductions made possible in developing the Dacia came from the carry-over of already amortized parts from other cars of the Renault group. Furthermore, using Renault's distribution network to sell the Dacia dramatically reduced sales costs and using an extensive existing network simplified distribution efforts. Synergies inside a group or holding can be very important, but they can often be easier explored by setting up a new venture or brand, as seen before, instead of setting up a new company.

Becoming a low cost player

Becoming a low cost player is one option that avoids having to cope with different models, but it is an extremely challenging option. It has been qualified as close to impossible because of the need not only to completely change the business model, but also to acquire new capabilities, all that while maintaining a part of the incumbent business. Examples of such a complete turnaround do exist though, and Kumar (2006) cites the example of Ryanair, that was transformed by Michael O'Leary from an unprofitable, high-cost, traditional airline in 1991 to one of the leading low cost airlines in 2005.

Besides the considerable difficulties a company faces when becoming a low cost player, according to Combe¹⁹, becoming low cost means to give up part of the clients, since most markets are not composed only of clients searching for a low cost offer.

Positioning of new entrants

Low cost products seem to often be associated to new low cost entrants, like has been stated before in the case of creating a new firm. It is important to highlight though that new entrants can position themselves in any of the three proposed organizations. A new entrant can position himself as a pure low cost player from the beginning, can have two businesses, a low cost and a classical business, or can position himself as a classical player with a low cost brand.

The need of reflecting on organization for the launch of low cost products

Organizing for low cost can therefore be done in three different ways, as shown in Figure 3.1.

¹⁹ Combe, E. « Comment réagir face au low cost », Cahiers de l'Anvie, Best of 2013, available on http://issuu.com/anvie/docs/anvie_-_best_of_2013. Retrieved on the 17th September 2014.

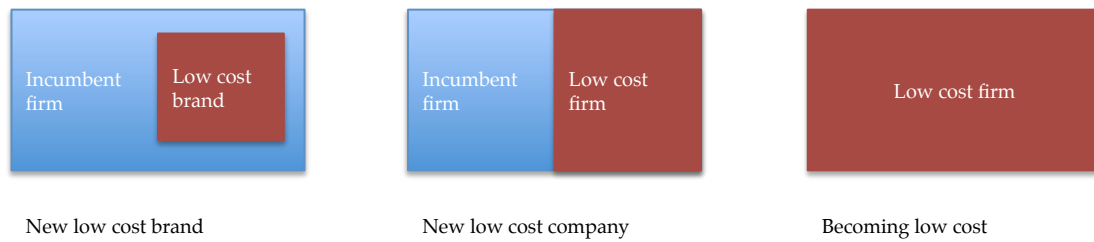


Figure 3.1 Organizations around low cost identified in literature, these can be adapted both by incumbent firms and new entrants

In any of the three organizational choices, significant risks and challenges exist. But not proposing a low cost offer might be even riskier. As stated in the analysis on fighting low cost rivals by Ryans (2009), incumbent companies often underestimate the value of creating a low cost offer, for example because of negative returns by their current clients concerning a low cost offer. That often has as a consequence not only the entrance of new competitors on low-end markets, but also the loss of market share from incumbents in higher end markets, once the low cost companies are established.

In some markets new competitors were attracted by the lack of simpler low cost products or services. Customers were not only looking for lower prices, but also for a different utility. That is clearly the case of the advertising company TV low cost, or of simplified insurances. TV low cost is an advertising company, proposing to create TV and web adds²⁰. Their specificity is to propose an “all-inclusive package”, where the tests, the add creation, the space on TV or on line as well as all other agency costs are already included. This gave the customers a clearer overview of how much they had to spend for the entire campaign and offered them a complete package, where they did not have to add anything, which was not the case with many other advertising companies. And to lower costs and to be able to propose a full package at low price (the first all-inclusive package starts at 100 k€), the company has different working contracts, working almost exclusively with associates and free-lancer, does not use the same material for filming and advertises on TV slots outside prime time, that are less expensive but still have high impact, amongst other cost reduction approaches. Simplified insurances try to capture price-conscious clients that want an easy to understand and basic insurance (Combe, 2011).

According to Christensen (1997) the development of technologies and of new products at some point in time tends to overshoot the needs of some customers, offering more than what these customers want. As described by Christensen and Raynor (2003) with the example of Honda’s bikes, not proposing a lower end product leaves the market open for new entrants, who can then move up to challenge incumbents in the other market segments once they are established in the lower end. Not proposing a low cost product or service can therefore represent a high risk for the incumbents, who can be challenged by new entrants.

²⁰ Information on TV low cost comes from their website <http://www.tvlowcost.fr/>, consulted on the 17th September 2014, and from a presentation at ANVIE in 2013 on low cost chaired by Emanuel Combe.

This leads us to state our fourth research hypothesis (*RH4*): **A clarification of interactions of the low cost organization with the former organization is needed to succeed in low cost design.**

3.3. The influence of environments on low cost product reception

Although low cost products and services seemed to be flourishing in a great number of markets and environments, some aspects seem to make their launch more complicated. This can clearly be seen in the example of the low cost carriers. Although the first low cost carriers existed from the 70's in the US, the model was only adopted in Europe in the 90's and is even more recent in Asia, where several countries are still reluctant to open their markets to the low cost competition (Zhang et al., 2008). This chapter will therefore describe some environmental aspects that can make it harder to launch low cost products.

Finding a design space in regulated environments

Regulated environments can create barriers to the creation of low cost products and services. In regulated commercial aviation for example, the government had control over fares, routes and market entry of new airlines. This made the entry of low cost carriers almost impossible, since their main argument for offering less service is their lower fares, and these cannot be offered in a regulated environment.

Regulations can take several different forms and so can the barriers they will represent for the entry of low cost competitors. Entry regulations can make it impossible for any company to enter the market, independent of its approach to costs.

Fare or price regulations are the strongest barriers for low cost players that use a low cost adaptation approach, since they demand these players attract their customers by something else than low fares or low prices. As cited before, this kind of regulation was in place in most countries on airline fares, and it's removal is cited as one important condition for low cost airlines emergence. In the case of smart low cost design, radical changes to the product can be a way to bypass fare and price regulations, in the same way as private drivers bypassed taxi regulations.

Finally, protectionism policies can make the entry of foreign low cost companies difficult, all the same allowing the creation of national low cost companies, both in the adaptation and smart low cost design approaches.

Specific regulations can also be found in different sectors; this was namely the case for

airlines in China, where airplane purchase was subject to government approval.

In regulated environments, to make low cost offers possible it is often essential to change the regulation, making lobbying an essential aspect of low cost offer development.

Certifications as a barrier to create low cost products

Certifications can be another barrier to create low cost products. There are different kinds of certifications, some being linked to the product, others linked to processes. The product certifications seem to be the more restrictive one for low cost companies. This is particularly the case when certification is linked to the embodiment of the product, and not its functions. The certification of the embodiment makes it much more difficult to change a product's technology or to remove non-essential features, since the new product will not be certifiable, and a new certification has to be created for it. We will discuss one example of the impact certification can have on the creation of low cost products with the example of the low cost cockpit.

The low cost cockpit (Fricker & Mouldi, 2014)

Although airlines are part of the most discussed low cost businesses, there were some aspects even these companies were not able to change. That was the case of the aircraft, where no significant physical and technical changes were done, except by reconfiguring the inner space, to increase the number of seats available. This was partially due to the fact that the airlines only have limited impact on the technology inside a plane, being the last actor in a very complex value chain, including several different manufacturers (engine manufactures, airframes manufacturers, component manufacturers) besides the aircraft manufacturer.

Another reason why creating a low cost airplane or a low cost technical part of an airplane is a difficult task will be discussed based on the low cost cockpit. Fricker and Mouldi's (2014) work on this subject was done inside Thales, a group that builds electrical systems for the aerospace markets, amongst others. Their analysis of Thale's approaches to reduce the cockpit's costs showed that significant efforts had already been done to achieve higher operational effectiveness. They considered applying the two approaches of our proposed design model – low cost adaptation and smart low cost design – and decided to focus on smart low cost design, because there was more room for value creation in the second approach. In their work on how to design a smart low cost design cockpit, Fricker and Mouldi (2014) identified a significant barrier: the aircraft certification. When trying to develop a low cost cockpit, they showed that functionally and technically a low cost cockpit was feasible. Many pilots already used tablets with different apps that helped planning their flight. Although these tablets were not authorised as flight instruments, they could with some changes fulfil all the functionalities demanded from a cockpit.

However, introducing a low cost cockpit was more challenging than that, since every technological change required a new certification. And since the certification was based on an existing technology, it was not adapted to the changed technology. And although they identified that certifications do evolve, the evolution is often linked to accidents or other exogenous constraints. This created a vicious cycle, where it was necessary to change the certification to change and test new technologies, and to develop and test new technologies to be able to change certification.

Their conclusion was, that to make a low cost cockpit possible, it was necessary to use a new approach to the certification. It meant in their case focusing on non-certified products that create value when associated to the cockpit. These objects, not being part of the cockpit allow the electrical system constructor to prove their innovation's value. They can test their innovations as a non-certified object and certify it afterwards, once all actors have recognized its value. As in the case of regulated environments, lobbying becomes essential to make low cost offers possible.

Fricker and Mouldi (2014) showed a new way to face certification constraints, by enriching a minimal object under strong constraints, which allows overcoming limitations linked to certification.

The example of Fricker and Mouldi's (2014) low cost cockpit clearly shows how certification issues can be overcome in a smart low cost approach. Since this approach opens completely new paths in which to innovate, it is often even possible to create completely new spaces in which no certification interferes, and later on to integrate tested and approved innovations into the certified product.

In the case of low cost adaptation, certification cannot be approached in the same way. Since low cost adaptation mostly focuses on removing certain aspects and reducing performance in other aspects, certification is not a barrier when the certification constraints are respected. In the case of low cost cars for example, like the Dacia, Jullien et al. (2013) point to an "over quality" on several elements for the customer, that could be removed while the car continued to follow safety certification needs. However, when function removal changes the product in a way that it might impact certification, low cost adaptation offers no means to help overcoming this barrier.

Environments lacking infrastructure

Although in frugal innovation and in jugaad innovation the lack of infrastructure is often cited as an inspiring constraint, allowing the development of original low cost products (Radjou et al., 2012), the lack of infrastructure can also make the launch of low cost products difficult. In the case of low cost airlines, one of the main success factors cited is the availability of secondary or low cost airports. For Warnock-Smith and Potter (2005) the airport choice is crucial to determine the carrier's success or failure. Secondary airports are an

important part of the low cost airline model, because they lead to lower airport charges and shorter aircraft turnaround time.

Zhang et al. (2008) identified the lack of these secondary airports in Asia as yet another barrier to the development of Asian low cost carriers. Since there are not enough secondary airports available, low cost companies have not been able to propose competitive prices on some interesting routes. In other cases they were forced to accept the primary airports higher costs. Lacking infrastructure can be the reason why some low cost products can simply not be launched.

The lack of infrastructure is not reserved to low cost products, and is often found in developing countries. The case of lacking distribution networks for example, was also identified in the case of Danone Grameen social project, aimed at proposing a yogurt fulfilling basic nutritional needs at low price in Bangladesh. In this project the barrier has been overcome and the solution helped creating social welfare, by creating the door-to-door sales through the 'Grameen ladies' (Yunus et al., 2010). We can therefore conclude that lack of infrastructure is not a barrier impossible to be overcome, but it is one that might demand to interact with a large number of actors in the environment in which the offer is to be proposed. These examples allow us to state that in the case of a low cost adaptation approach, the lack of infrastructure is a barrier for the development of low cost products. In the case of smart low cost design however, the lack of infrastructure can be transformed into yet another a value creation aspect, as in the case of the Tata Swach water filter, described by Ahlstrom (2010) that by integrating the lack of running water and electrical power was able to create a product that could be used in a greater range of contexts.

We can therefore state our research hypothesis five, *RH5*: **Low cost design needs compliant ecosystem design rules, like regulations, certifications and infrastructure.**

3.4. Conclusion: An innovation system adapted for low cost in all ecosystems

Based on the previous chapter, we can propose a complete innovation system for low cost design based on a performance evaluation, design reasoning and organization framework, as seen in figure 3.2. The main change we introduce concerns the organization proposed, which can take different forms: either the launch of a new brand for low cost, the creation of a new low cost company or becoming a low cost player. It is important to highlight that new entrants can also adopt all three organizations.

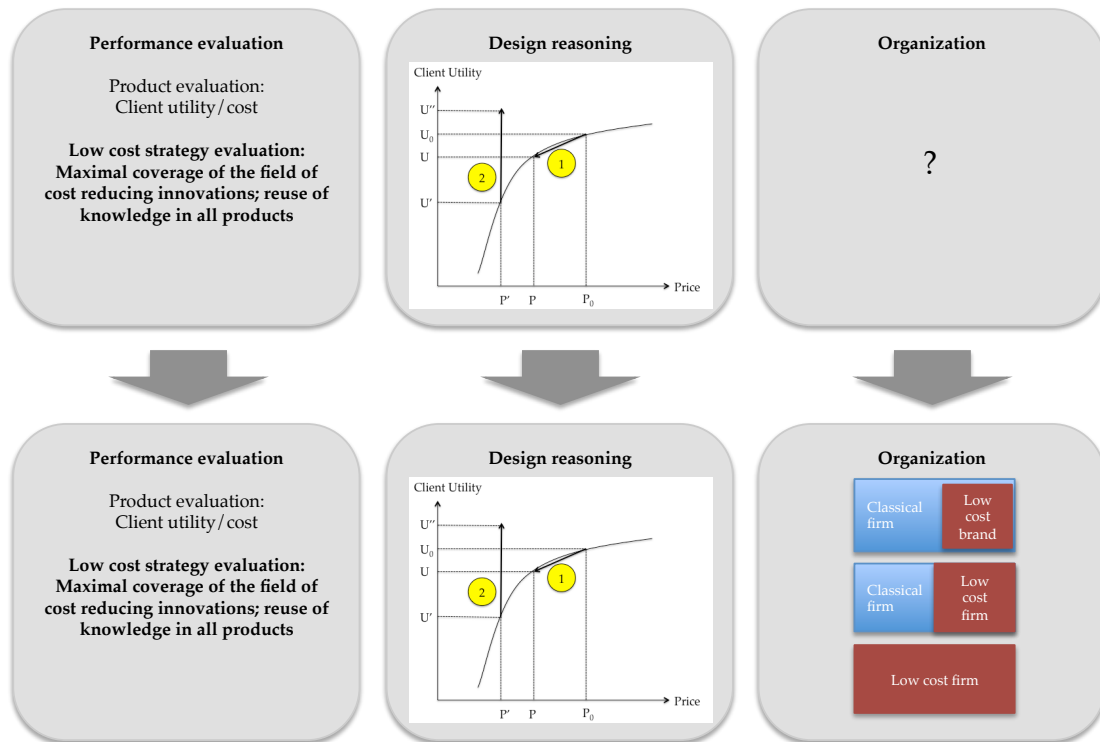


Figure 3.2 A complete innovation system for low cost based on our design model and literature

Our innovation system and design model however, present one common point that makes their generalization difficult. They are built based on classical firms, who have rather simple ecosystems. There is a client and a provider, and these have a price and a linked cost. This is not the case in all ecosystems however, and we have a new question that emerges: How can our design model and our innovation system be applied in the case of more complex ecosystems? This aspect will be treated in part II.

We can conclude that our innovation system should allow designing low cost products, but is far from answering all the questions and challenges a manager will face when doing so. These aspects are treated by our research hypothesis. We furthermore conclude that a test in an empirical setting would allow validating both the innovation system and our research hypothesis. It would furthermore allow verifying if there are other challenges in low cost design not identified in literature.

Conclusions of Part I

This part allowed us to propose an innovation system for low cost design based on the performance evaluation, design reasoning and organization framework and the approaches of these aspects found in literature, combined with a design model proposed by us. In our innovation system, the performance evaluation has two components: evaluating a low cost product and evaluating a low cost strategy. The low cost product is evaluated through the client value over cost and the low cost strategy is evaluated through the maximal coverage of the field and the maximal reuse of knowledge in other innovations. The design reasoning consists of using a design model to explain two different approaches found in literature: **low cost adaptation** and **smart low cost design**. And three different organizations were found around low cost: launching a low cost brand in a classical firm,

Literature review done in this part also allowed us to list five research hypothesis linked to challenges managers faced when designing low cost products. RH1 and RH2 are linked to performance evaluation; they are about the importance of a reference design and the need to adopt a design performance model. RH3 is linked to the need to create awareness about low cost to avoid a direct link with low quality; it is about the communication of the design reasoning used. The RH4 highlights the importance of clarifying the organization. Finally RH5 concerns the entire ecosystem. These research hypothesis are linked to our innovation system as illustrated in Figure 3.3.

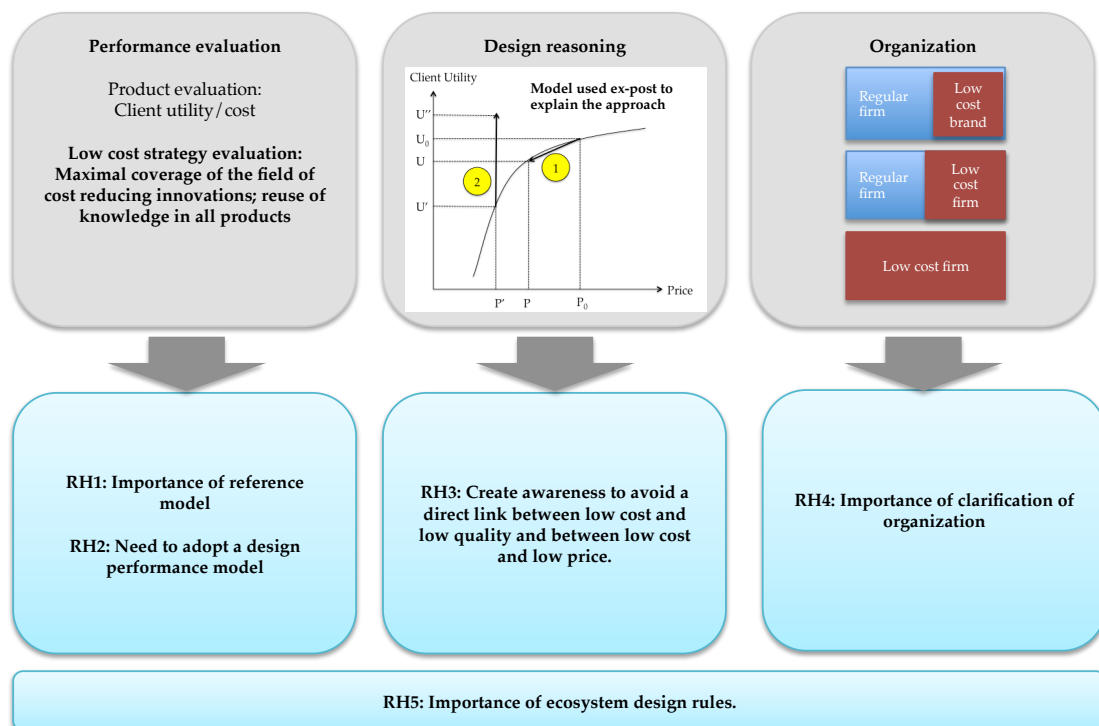


Figure 3.3 The proposed innovation system and how our research hypothesis are linked to them

Both our innovation system and our research hypothesis need to be verified. That is why they will be tested through our empirical case study inside RATP, a transport operator, that will be described in part II.

**Part II - Low cost design: a strategy
achievable for public services? The case
of urban public transport**

Part II - Low cost design: a strategy achievable for public services? The case of public transport

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As stated in part I, questions arise from the proposed design model with a double approach. The first ones are: Can the low cost design model be applied in all types of sectors? Do we need to work on both models simultaneously? How can we apply the two approaches simultaneously in the same sector? What are the tools and instruments that have to be implemented to coordinate the two design approaches?

In this section, we will study the potential of an application of the two approaches of the design model in the context of public transport. Public transport is a good example to verify if low cost can be applied in all sectors since it has a particularity. Instead of having a buyer and a seller involved in transactions, like in the case of white goods or cars, being a public service, there are usually more actors involved in the value network, for example public transport authorities. In addition to that the fare paid by the final users could not reflect the full cost of producing the service, since public transport is often subsidized. This allows us to verify that the low cost design models can also be applied to sectors in which the price of a good and its cost are not directly linked.

Furthermore, public transport allows us to find elements to answer the second and third question on the simultaneous launch of the two approaches in the model. To treat these questions we make a systematic literature overview of public transport in this part. In public transport, the first approach, low cost adaptation, has been rejected in some cases, because it was seen as removing services. Stakeholders cannot justify this in the case of public transport, since it is considered a public service. Therefore, the same level of service should be available for all users. Proposing an offer with a lower service level would go against this fundamental principle. We therefore already have an indication on applying only the first approach of the low cost design model. The case of public transport allows us to highlight the limits of the low cost adaptation strategy. There are however several indications that point to the need of simultaneously reducing costs and innovating in this sector. The smart low cost design strategy therefore seems to respond to the identified needs in the sector. Verifying if low cost adaptation can be launched when combined to the smart low cost design is therefore a very pertinent question.

This part is therefore structured in three chapters. Chapter 4 gives an overview of the characteristics of the public transport sector, starting by a critical overview of the definitions of public transport and **we propose a model of the elements of the dominant design for public transport**. It describes the particularities of this sector, like the actors in the sector and the different configurations adopted that differ from one city to the next. Since so many different settings and organizations can be found in public transport, we focus on some of the recent tendencies in the French and Parisian public transport. Some examples are the increase of public authorities wanting to operate transport themselves and the gratuity of public transport in some cities, which are further arguments to push RATP, the transport operator in which this research took place, to develop a low cost strategy. We discuss the

difficulties found in the sector to innovate and to reduce costs, despite a long history in innovation. Through a systematic literature review we show the **strong link that exists between low cost and innovation in this sector.** We conclude the chapter by stating the main particularities of the public transport sector that make it an interesting research setting for the development of our low cost design models. It is a highly regulated setting and the cost and the price paid by the user are not directly linked, due to the fact that there is not only a producer/seller and a user/buyer, but other actors are involved in these transactions.

Chapter 5 describes the context in which our research took place: the Parisian transport operator RATP and the research and innovation unit. It continues by describing the applied method, as well as the instruments that have to be put in place to allow a simultaneous development of both approaches of the low cost design model inside RATP. We used an oriented creativity method to be able to develop both low cost adaptation and smart low cost design public transport offers. Other managerial tools and a reflexion on the company's strategy accompanied this method to produce relevant outcomes. Next, we analyse the case study inside RATP. We bring evidence of the company's lock-in in a the public transport dominant design, and we show the paths opened up by breaking the dominant design through a smart low cost design strategy. **Being transversal to the entire company, working on cost reductions allows changes in all the aspects of the dominant design.**

Chapter 6 presents the evolutions of the innovation system (the performance evaluation, the design reasoning and the organization) needed to develop a low cost strategy in a setting like public transport, which is highly regulated and involves a great number of actors. We have three different performance evaluations, besides the product evaluation: (1) **Low cost strategy evaluation**, which is evaluated as the strategy's capacity to serve as a tool to rethink the dominant design; (2) **Innovation department evaluation**, which is done through two aspects, the maximal reuse of knowledge acquired through the work for the development of the low cost offers in all products and the possibility to use the low cost strategy as a tool to select and justify chosen innovation projects; (3) **Company evaluation**, through the increased awareness about low cost and federation around the strategy. The double approach low cost design model is still used as design reasoning, but it evolves **from an ex-post tool used to explain the different products to a design tool, used to deliberately create low cost offers in one or the other approach.** Furthermore, the development of a smart low cost design strategy legitimates the low cost adaptation strategy, so a simultaneous application of both models is possible. And finally through the case study inside RATP we show a fourth possible organization, where **low cost is used as a driver inside the incumbent company to create new partnerships and to go beyond what was first considered the companies boundaries.**

We conclude this part by stating how applying a low cost design model in the public transport sector allows to gain new insight on how it could be applied in similar markets.

Chapter 4. Urban public transport: an industrial sector adverse to low cost?

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The following chapter will give a brief description of the sector our case study took place in: the urban public transport sector. When trying to develop a low cost urban mobility, we were confronted to the particularities of this sector. Decisions on public transport are highly political and the decision makers are not the final users.

The urban public mobility sector is a very ancient one; the first public buses being operated in 1662 (Costa and Fernandes, 2012). It has been evolving continuously ever since, with changes in the power source used (the first buses were drawn by horses), in the ticketing and fare systems, in safety and in regulations. Despite these important changes taking place over the years, public transport operators do not figure in strategic consulting firms' rankings as the top 100 global innovators 2012 of Thomson Reuters, or in the 50 most innovative companies 2012 by the Boston Consulting Group.

The chapter starts by the description of some particularities of this sector and its controversial relationship to innovation. A lack of interest in innovation is identified in this sector, even though there are several tendencies that indicate the need to innovate. Ongkittikul and Geerlings (2006) state *"there is a lack of interest in the issue of innovation in the public transport sector"* (p283). Nevertheless, a great number of changes have been introduced in urban mobility in the last years.

Difficulties to innovate, a lack of interest for the issue and even a lack of innovation seem to have been common in several public services, not only in public transport, but more and more authors write on the possibility to innovate in public services and on the need to do so (Windrum and Koch, 2008). Besides, the public transport history shows us a steady change in the public transport systems and that innovation occurred on several occasions in the past.

Furthermore the importance of cost reductions and innovation is brought forward by the description of some recent societal evolutions. Some particularities of the French public transport sector, in which this study took place, are then listed. The chapter concludes on the close link that should be made between cost reductions and innovation in this sector, which justifies the low cost approach we will describe in chapter 5.

4.1. Building a model of the dominant design of French urban public transport

Here we will discuss a model of the dominant design for French urban public transport that we can build based on the literature. We start by recapitulating some elements of the definition of dominant design in literature, and then apply the discussed framework on the urban public mobility sector, the sector we chose to experiment our low cost design model. This sector was chosen due to its particularities, one of them being a controversial relationship with innovation. Although innovation is seen as extremely important for the

development of the sector, and that important innovations have been developed in this sector in the past, there seems to be a recent difficulty in developing innovations. We will therefore describe some of the particularities of this sector, allowing us to model a dominant design for it.

4.1.1. The dominant design framework applied to public transport

As stated in chapter 1, Utterback and Abernathy (1975) were the first to work on the notion of a dominant design. In the first works, the dominant design referred only to key technological features, as can be seen in Abernathy and Utterback (1978). The framework has been mobilised to explain technology lock-in and to try to orient technology-linked policies (e.g. Sandé and Hillman, 2011).

In later work, like the work done by Le Masson et al. (2014), the dominant design has been extended to an object's performance, functions, technology architecture and skills. This new framework is consistent with the one we used to evaluate innovativeness in chapter 2. A product's dominant design can coherently be described by the technological paradigm, the business model, the functions and the client value. We will therefore use this framework once more to explicit the dominant design of urban public transport. This work on the dominant design is useful because it can be used to show on which aspects innovations are emerging nowadays, as well as help to explain on which aspects innovations are challenging today, and lock-ins exist. It will furthermore be a tool to direct exploration in our applied case inside RATP.

Efforts for creating a general definition of public transport have been made and we will start from one such definition to build the dominant design for public transport. For Simpson (2003), public transport is **“any means of passenger transport available to anyone without restriction as to membership of any group, provided that the conditions of the operator are met, including payment. It may be publicly or privately owned and will run regularly, usually to a timetable.”** (ibid, p. ix). Simpson's definition allows us to give some elements of the public transport dominant design. The main characteristics of public transport seem to be its availability, its non-exclusion of passengers, the fact that a transport operator exists and that he operates under certain conditions and for a payment, and finally its regularity. Figure 4.1 allows giving an overview of the aspects of the public transport dominant design described by this definition.

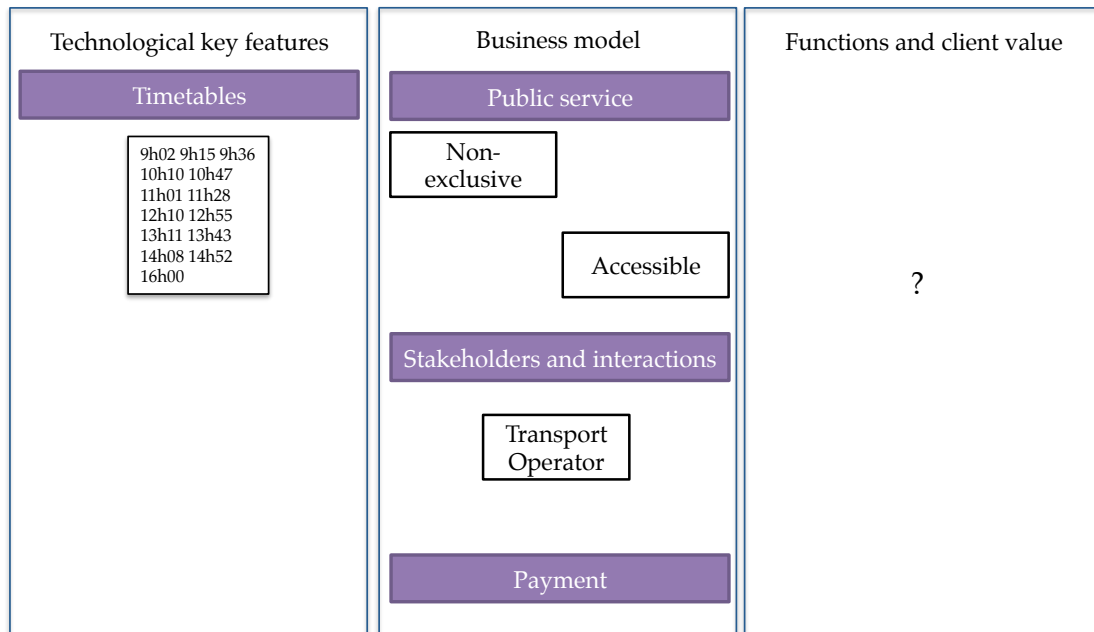


Figure 4.1 The dominant design of public transport according to Simpson’s (2003) definition.

4.1.2. Patterns of the urban public transport in literature

The one definition chosen in the previous point and studied through our framework in Figure 4.1 does clearly not give a complete overview of the dominant design of public transport. Although it describes some of its aspects, mainly linked to the business model, it does not enter into details on the function or on the client value. To extend this dominant design, we searched for elements that would complete our framework in literature. We will recapitulate them here; they allow us to render explicit a dominant design of public transport.

Extending the technical features

Simpson’s (2003) definition, although it captures one very interesting technical feature, the timetables, does not give many details on other key technical features; he speaks only of “any means of passenger transport”. The means of passenger transport are often decomposed into transport modes, and the importance of having several modes is highlighted in several studies, e.g. in the one done by Mao et al. (2009). Each transport mode has its defined vehicle and infrastructure. Changes on either one of them lead to the emergence of a new mode, as was the case with bus rapid transit (BRT), (Cain et al., 2007). Although the vehicle in this mode can be a classical bus, it is a new mode because of the dedicated infrastructure. We can therefore add three elements to the dominant design: the transport mode, the infrastructure and the vehicle or rolling stock. Infrastructure comprises highways and tracks, but also other physical elements used for public transport, like stations and stops.

Another less top of the mind key technological feature of public transport is the existence of

fixed itineraries. The importance of this technological feature can however easily be verified through the comparisons often made between private and public urban transport. One of the reasons pointed by Redman et al. (2013) that make modal shift from the private car to public transport more difficult is that public transport is perceived as less flexible and less accessible. The existence of fixed itineraries is part of the reason for that. Furthermore, demand-responsive transports (DRT) or flexible transport services (FTS) have been described as interesting innovations in certain market niches with potential to improve public transport (Mulley and Nelson, 2009). FTS are not only considered flexible because they do not follow classical timetables, they also can follow routes that are not open to public transport, since they do not have fixed itineraries. We therefore propose to extend the technological key features to what can be found in Figure 4.2.

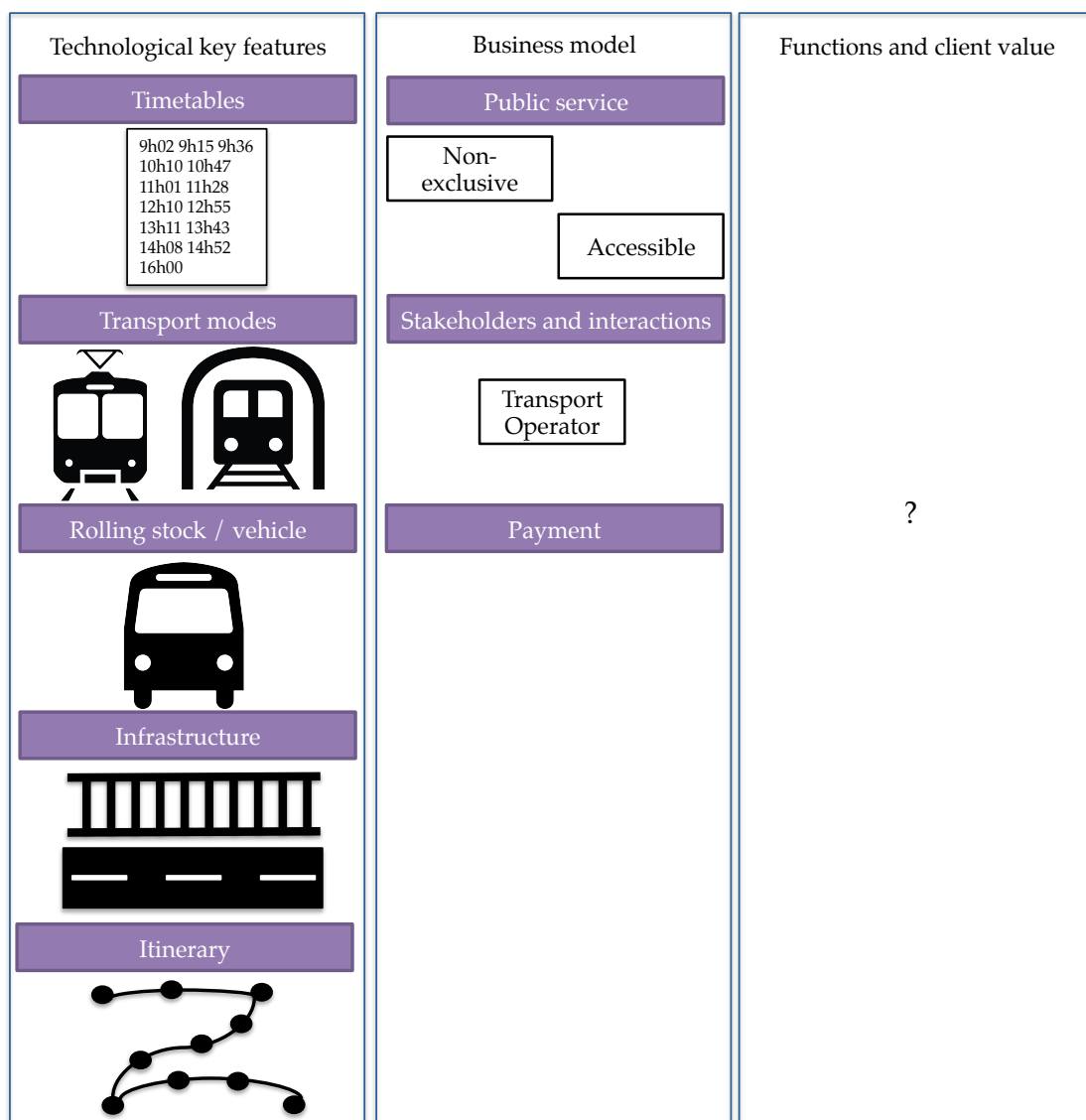


Figure 4.2 Inclusion of additional technological key features into the explicated dominant design of public transport

Understanding the business model through a study of the involved actors

One of the particularities of the public transport sector not captured by the first definition is the great number of actors involved in offering a public transport service. Besides the user and the transport operator, there are transport authorities, policy makers, user associations, residents of the zones the transport passes through, employers in the zones the transport passes through, governments, infrastructure builders, infrastructure maintainers, urban designers, engineering and consulting companies, rolling stock manufacturers, rolling stock maintainers, ticket selling points, ... Figure 4.3 schematises these actors and their interactions. Not identifying all the involved actors makes it hard to explicit the business model, especially when not all revenues covering the transport's costs come from final users. That is the case in many countries, where transport is subsidized.

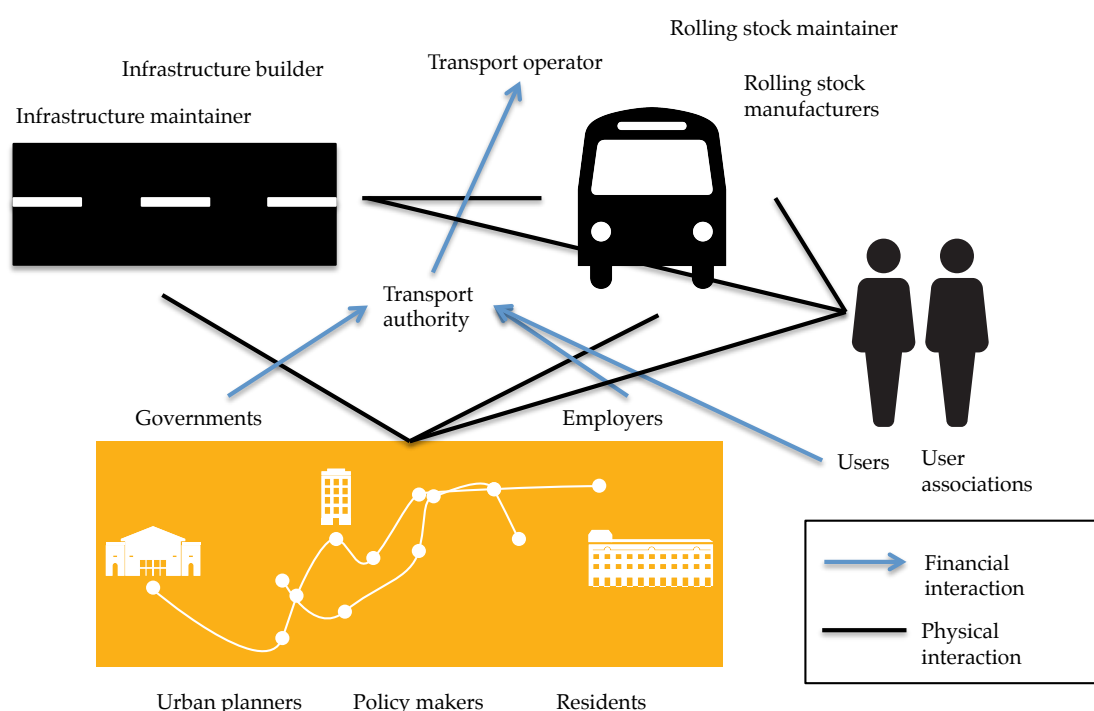


Figure 4.3 Actors in the public transport ecosystem and their interactions

Some of the actors seen in Figure 4.3 are specific to the transport ecosystem and have a direct impact on the innovativeness of other actors. That's the case of the transport authority, in charge of the major decisions concerning the transport operation. It chooses the transport operator (most of the time through a call for tenders) and defines the operation conditions, like the service level expected, as well as the risks the operator will take concerning the transport income. The conditions defined by the public authority can hinder innovation in certain fields, since it defines the operator's scope. This was the case in the Parisian region with the 2012 STIF contract²¹, which rendered innovation in fares and ticketing service outside the operator's scope.

²¹ "Contrat entre le Syndicat des Transports d'Ile- de-France et la Régie Autonome des Transports Parisiens 2012 – 2015", internal document.

The actors listed previously can be part of the mobility ecosystem, but that is not always the case. Different configurations exist, and since public transport is very local, it is often hard to speak of a national model, each city or region being autonomous to define its own ecosystem. Finding common patterns in urban public transport can be a great challenge, since as stated by van de Velde (2008), even in Europe, where the recent internationalization of the sector on the supplier's side has led to certain uniformity, great differences are still allowed in the actors and regulations, to accommodate the different countries' prior models. We will therefore focus mostly on the French and on the Parisian setting, since these are the settings in which our case study took place.

The first difference can be found in the attributions as well as the risks taken by the transport authorities, which can be very variable. In some cases the transport authority only delegates the service to an operator and fixes the service level for operation. In other cases, the transport authority's responsibilities can go as far as to operate the service itself. The risk taken by the transport operator concerning the incomes and costs of the system depends on the kind of contract. It can be zero when the transport authority sells concessions giving the right and obligations to operate the transport and collect fares to an operator. On the other hand the transport authority can also take the full risk, by covering the transport operator's costs plus a margin, and collecting fares by themselves. Besides that, transport authorities can be responsible for different perimeters, some operating at the national level, others on the region level, or on the city level. The combination of these factors makes it particularly difficult to evaluate if an innovation that was fruitful in one setting will have the same effect in another setting.

In the French mobility transport sector, the transport authorities are responsible for the main decisions in public transport, like market attribution, investment, fares... Transport authorities have a decisive influence on the capacity to innovate of all actors in the French public transport. According to the GART's²² report on public transport in 2011²³, 63.6% of the French transport authorities excluding the Parisian region are in charge of transport for more than one "commune" (the equivalent of a township or municipality). This means transport is handled at another level than many other local aspects, making it easier to circulate between closely linked towns, but often demanding important negotiations between the different townships when investment decisions have to be made. The Parisian region is often separated from the rest of the country for analysis, because of its specificities.

There are currently three big transport operators in France: RATP and its subsidiary RATP dev, mainly important because of its operations in the Parisian region, being in charge of only 1% of the total number of trips in the rest of France in 2011; SNCF in the Parisian region and its subsidiary Keolis, in charge of 40% of the total number of trips in the rest of France in 2011; and Veolia Transdev, in charge of 38% of the trips in France outside the Parisian

²² The GART or "Groupement des autorités responsables de transport" is a group formed by the French transport authorities.

²³ The Report "L'année 2011 des transports urbains" on public transport in France in 2011 is available on [http://www.gart.org/S-informer/Nos-publications/\(offset\)/10](http://www.gart.org/S-informer/Nos-publications/(offset)/10). Retrieved on the 5th September 2014.

region²⁴. Besides these three big operators, a great number of smaller operators exist, some of them affiliated to groups like AGIR or Optile, and others independent. The figure 4.5 illustrates the split by operator.

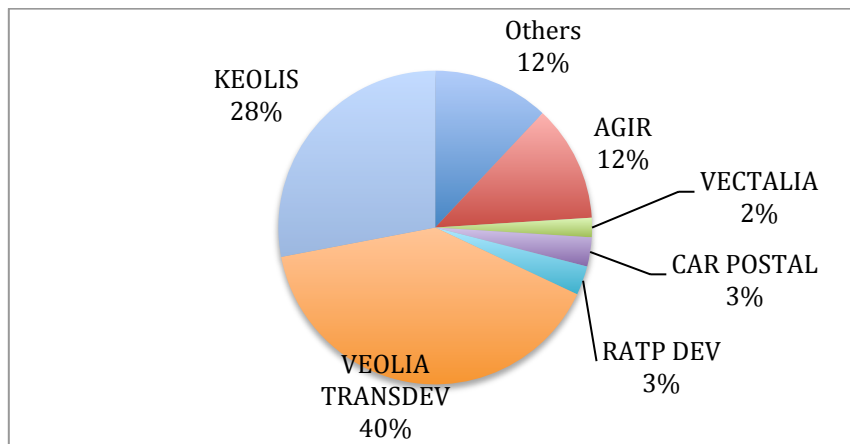


Figure 4.4 The main actors in the French public transport sector and their share of trips in 2011 (adapted from the report done by the GART)

As cited before, the Parisian region has a specific organisation. The main operator is RATP, originally named Régie Autonome des Transports Parisiens, who in 2013 was in charge of 75% of the trips in the Parisian region (STIF, 2014). RATP operates the underground, part of the RER train network, the tramway lines and part of the bus network. Other operators, like the SNCF or smaller operators who are part of the Optile group, operate the rest of the bus network, mainly in the suburbs. The independent operators and those inside the Optile group were in charge of 8% of the trips done in the Parisian region (STIF, 2014). Trains are mainly operated by the SNCF, who was in charge of 17% of the trips done in 2013 (STIF, 2014). The split of trips by operator is illustrated in figure 4.5.

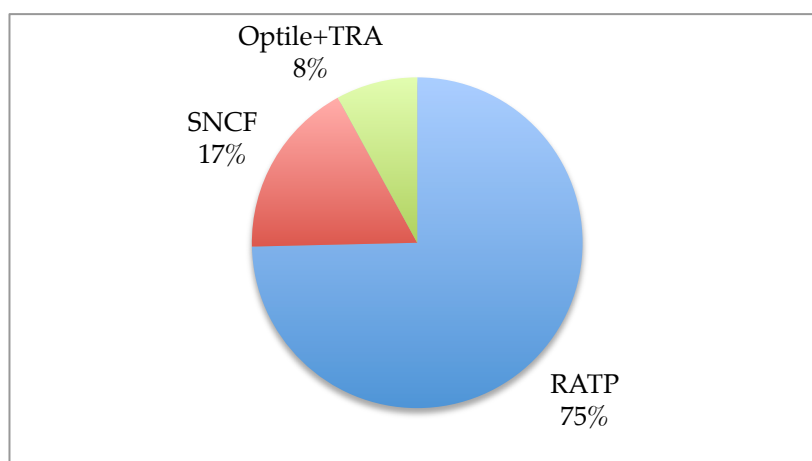


Figure 4.5 The main operators in the Parisian region by share of trips in 2013 (STIF, 2014).

²⁴ The Report “L’année 2011 des transports urbains” on public transport in France in 2011 is available on [http://www.gart.org/S-informer/Nos-publications/\(offset\)/10](http://www.gart.org/S-informer/Nos-publications/(offset)/10). Retrieved on the 5th September 2014.

The transport authority in charge is known as the STIF (Syndicat des Transports en Ile-de-France). The transport authority is in charge of defining the service levels for transport operators, of the ticketing system and of choosing the transport operators, amongst others. In the Parisian region transport is strongly regulated.

We must therefore signal another aspect that can differ from one city to another: the one found between regulated and deregulated markets, with substantial disparities in legal regime, going from authority provision until free market regimes (van de Velde, 2008). In the completely regulated market, the price of public transport is fixed by the transport authorities, as well as all other operating aspects, such as the routes, the stops, the operating hours, transport frequency, vehicle/rolling stock definition and expected service level. In the deregulated market, there is no restriction on pricing, on routes, on stops, on operating hours... Each transport operator can choose to service the region he wants, with the vehicle of his choice and to charge the price he wishes, and there is no call for tenders to define who should operate on which route.

It is important to point out that there are many levels of regulation and deregulation between the two extreme cases cited here. The extreme regulation case does not foster innovation and makes the development of low cost products more difficult, as seen in chapter 3. The deregulated markets have seen a wide range of different innovations, as well in the transport operation as in the policies put in place by governments either to regulate the market or to reduce the risks linked to the deregulated markets (Cervero and Golub, 2007). This diversity exists since, as pointed out by Cervero and Golub (2007, p.457) concerning the deregulated markets, there is "no overarching conclusions on what, if anything, should be done about it". But once again, these innovations are sometimes in some public transport actors' blind spot, since some of the deregulated transports offered are not considered as public transport.

Having these elements in mind, we will make a simplified overview of the economical aspects of public transport. Several books and articles have been written on the economical aspects of public transport, giving a global overview (i.e. Button, 2010) or focusing only on one kind of transport (i.e. Hensher (2007), who focuses on bus transport). Our goal is not to give an exhaustive overview of transport economics like done in the works cited, but to give enough elements to understand the business model behind public transport in the Parisian region. The economics of public transport are rather complex, since there are, as described by Muñoz and Grange (2010), several different resources made available by different actors that have to be taken into account. First, there are the public transport infrastructures, mostly provided and maintained by the governments. Secondly there is the question of the infrastructure management and user information, which can be provided by private or public companies. Third are the vehicles, which require investment, maintenance and operation. The public transport operators can provide all these, but mixed regimes exist, where the vehicles belong to the transport authority.

Public transport being considered a public service to be supplied by the government to populations in several countries, it can receive a variable level of subsidies. The subsidies have to be separated into two different kinds: those for building public transport systems

(also known as capital subsidies) and those for operating public transport systems (also known as operating subsidies).

Investments required for public transport can be separated in two main categories: infrastructure and vehicles. The transport infrastructure is often owned by the government, so capital subsidies are very common to finance this part of public transport. Private investments do exist though, and Zhang and Durango-Cohen (2012) draw attention to the increase in public-private partnerships to finance transport infrastructure. Vehicles can be owned by the governments, or can be the property of transport authorities, but are also often owned by transport operators. Investments in public transport infrastructure are often very important; investing in innovative technologies is a high risk, one that many governments might be unwilling to take. And the fact that these investments are long lasting creates an important path dependency. This makes the introduction of a new system very expensive and the governments reluctant to adopt them, since a malfunctioning system can have unforeseeably high costs²⁵.

The main operating costs of public transport are the direct labour costs (payroll and related), material and services costs and depreciation. The split between these costs is different from one mode to the other. In bus-based systems labour costs are the most important ones, representing around 60% of the total operating cost in some cities²⁶.

The first source of revenue that comes to mind when thinking about public transport is fares, the price paid by the customer to use the transport service. Most public transport networks demand passengers to pay fares, and different kinds of fares exist. The simplest approach is a unique fare allowing a transport using one mode, without a connection. But time or distance-related fares also exist, where the fare paid depends on the transport distance, as well as tickets allowing connections with the same or different modes in a given time frame. Besides the one-transport fares, many networks propose unlimited transit for a given fare in a given timeframe (a day, a week, a month) and the first efforts in yield management have been done in some networks, like London and Copenhagen, proposing reduced fares for non-peak transport.

Fares are most of the time linked to ticketing services, and integrated ticketing and fare systems are thought to increase patronage (Ashmore and Mellor, 2010). And most ticketing services go beyond only a payment system. They can also be associated to infrastructure to control access to transport. More modern ticketing and control systems can furthermore be used to collect data on passengers' routes and on transport usage in general (Bagchi and White, 2005).

²⁵ One example of very expensive innovative system introduced can be found in Caen, where a streetcar on tires was put in place in 2002, and the choice was made to replace it in 2011. The replacement was estimated to cost 170 million euros. <http://www.mobilicites.com/011-1133-Caen-2018-clap-de-fin-pour-le-tram-sur-pneus-TRV.html>. Retrieved on the 2nd September 2014.

²⁶ This cost was estimated at 67% for Dublin in Redmond, P., Dublin Bus: Funding and Financial Performance. Available on <http://www.publicpolicy.ie/wp-content/uploads/DublinBus130513.pdf>. Retrieved on the 1st September 2014.

However fares are only one of the possible revenues for public transport, many networks operate at loss, and require important operating subsidies to cover the gap between the fares and the costs. When looking into operating subsidies, an important distinction has to be made, according to their coverage. They can be for all kinds of users, as is the case when a part of the entire operator's cost is covered by a subsidy. Or they can be reserved to a particular kind of users, as is the case in the São Paulo, where transport is free for the elderly²⁷, and the case for Paris, where transport is free for some of the people facing financial difficulties and part of the unemployed²⁸. Gratuity is one option, but another one are 'fare-discount schemes', that stipulate a certain class of passengers (recurrent examples are the elderly, the disabled or students) will pay lower fares. An important political aspect exists behind operational subsidies, and from an economical point of view not all of the subsidies make sense. Taking in account the financial restrictions existing today, Simpson (2003, p. x) states "there are many opportunities to get better value for money at the same level of public expenditures". Working on innovation can greatly contribute to get more value out of public expenditures and reducing costs could even lead to reduce these expenditures.

Another point that can have a negative impact on the sectors innovativeness is the interaction of national, state, and local levels in developing transport policy. The fact that all three levels often finance public transport during some point of its life-cycle, can be a barrier for financing innovation, since the transport policies and political goals of the different levels might not be the same. The operation of public transport in the Parisian region for example is 19.4% financed by public funds, according to the STIF (2014). Of these funds, 69% come from the cities, 12% from the departments, 8% from the region and 8% from the state, as can be seen in figure 4.6.

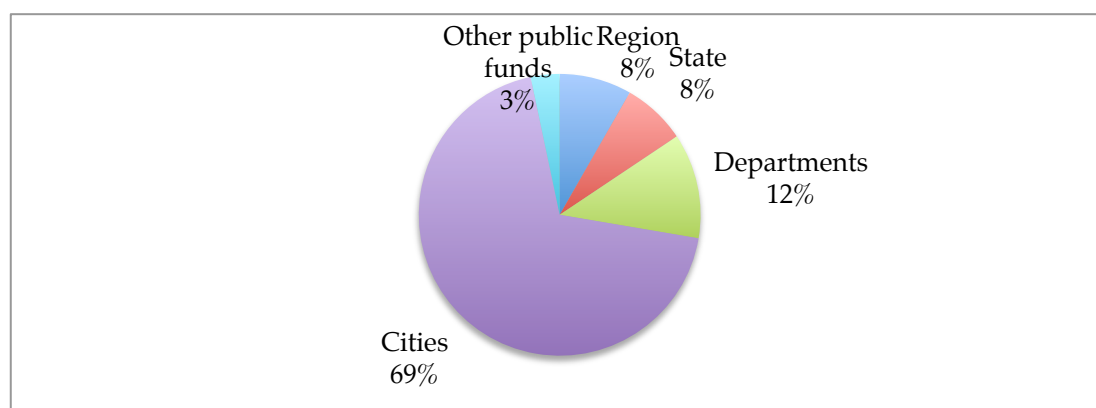


Figure 4.6 The sources of public financing in the Parisian region according to the STIF (2014)

²⁷ <http://governo-sp.jusbrasil.com.br/legislacao/125585081/decreto-60595-14-sao-paulo-sp?ref=home> Retrieved on the 8th August 2014.

²⁸ <http://www.navigo.fr/la-presentation-du-forfait-gratuite-transport.html> Retrieved on the 28th August 2014.

Some transport operators and transport authorities furthermore rely on so-called ancillary revenues (or non-transport related revenues) to help cover their costs. Typical examples for ancillary revenues are renting out space for publicity inside or outside the vehicles and stations, as well as renting out space inside train or metro stations for businesses. In fact, several positive externalities are also created by public transport (for example having important pedestrian traffic at some stations), and are currently not thoroughly explored. Innovations in revenue management and new services linked to public transport need to be explored to improve the public transport's financial health.

These different revenues finance public transport operation at different levels, according to the country and the policies in place. In the specific case of the Parisian region, public transport is financed through the combination of direct transport revenues (40%), public funding/subsidies (19%), ancillary revenues (3%) and by a specific transport tax (38%), that we will further discuss when describing the French public transport sector. This distribution can be found in Figure 4.7.

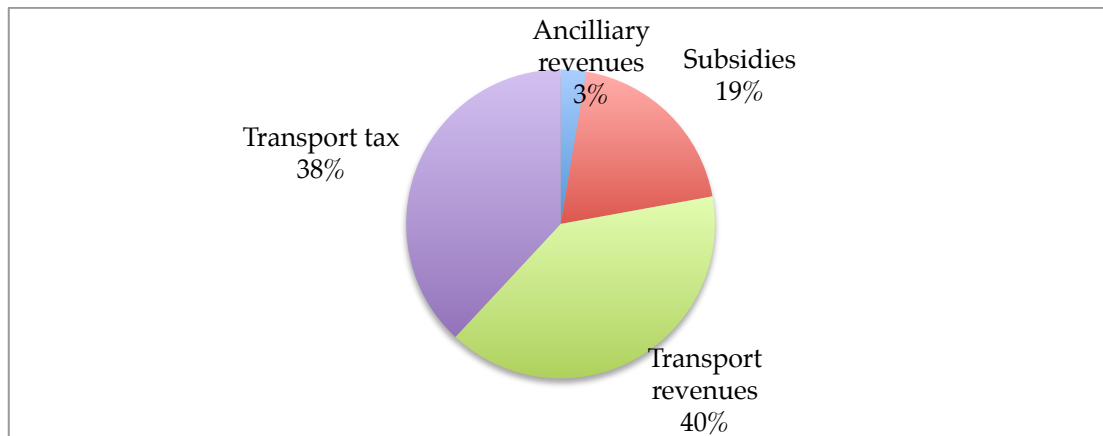


Figure 4.7 The sources of financing for public transport operations in the Parisian region, adapted from STIF (2014)

All these elements allow us to conclude that the business model of the dominant design of public transport contains much more than what was explicit in Figure 4.1. First, public service not only needs to be non-exclusive and accessible, but also have a given quality level and an acceptable price, both controlled by a transport authority. Secondly, stakeholders and actors are numerous and need to be completed. These actors and their interactions are often restricted by regulations. Furthermore, revenues come from fares, subsidies and non-transport revenues. And ticketing and pricing is an important aspect, since it is used to regulate access to transport, to improve social impact of public transport through special fares, as revenue source and as a tool to measure the volume of passengers. Figure 4.8 gives a completed model of the dominant design taking these aspects into account.

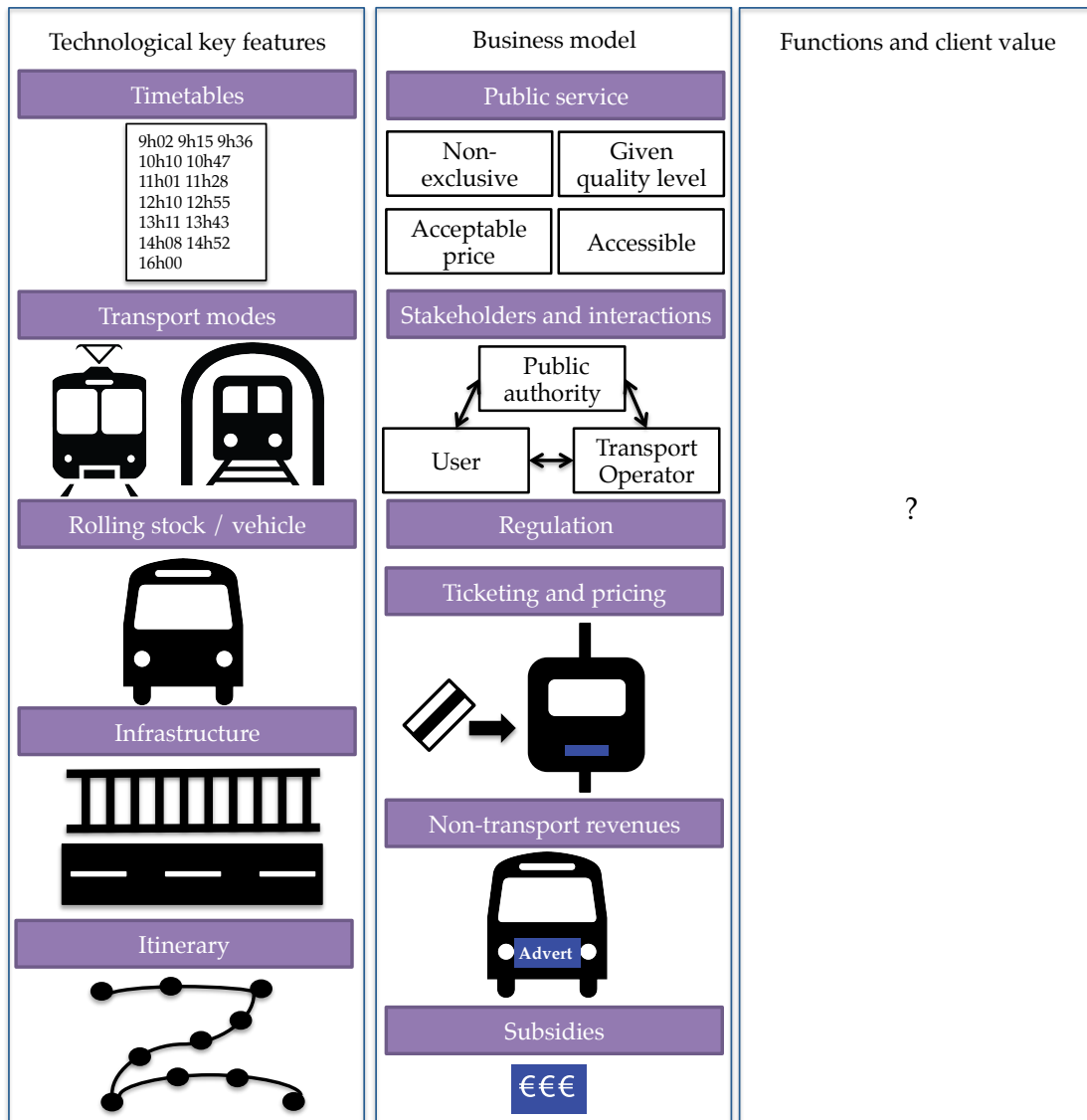


Figure 4.8 Completing the main aspects of the urban public transport business model in the dominant design model.

Client value and functions beyond transport

Although Simpson (2003) does not cite it in his definition of public transport, there is a consensus that one of the main functions of public transport is to transport passengers. Beyond this function, many texts, like Button (2010), draw attention to the fact that the need for public transport is a derived one, transport is not important for the sake of transport, but is essential to insure access to widely accepted human rights and to provide social inclusion, by giving access to jobs, health facilities and other services. As pointed out by Duranton (2009), so that cities can foster economic growth in an effective way, facilitating commuting through the provision of road and public transport is important. The social aspect of transport is taken into account by most cities when developing their public policies, and some have integrated the fact that it is a regional problem, and search for solutions with the cities nearby. Social inclusion is also the reason why several development banks, like the World Bank, or programs financed by the European Union, like PREDIT, invest and finance public

transport.

Besides that, the value for cities in developing public transport is often linked to reducing environmental impact. This can be explained by the important impact transport in general has on greenhouse effect gases and to the constant increase in transport demand. Due to the rising urbanisation in the last years, more than half the urban population already resided in cities in 2007 (Quigley, 2009). This, linked to the increase in urban sprawl, the general increase of global population and the increase in global welfare, has more specifically increased demands for urban mobility. Most estimates on transport demand in 2050 believe transport demand will continue to rise (Moriarty and Honnery, 2008). The reports on climate change and energy depletion often have important technology changes and fuel efficiency improvements for private cars as part of the hypothesis for the emissions of the transport sector, but even with these the private transport greenhouse gas emissions cannot be reduced²⁹.

Public transport has often been put forward as a more environmental-friendly transport than private cars. When comparing the climate change costs generated by public and private transport in Auckland in 2001, Jakob et al. (2006) estimated the public transport cost could be evaluated at \$0.67million, while private transport was evaluated at \$57.8 million, which represented \$0.001 per passenger and km for public transport and \$0.0067 per passenger and km for private cars, almost seven times as much as for public transport. They also did a similar estimation for the air pollution costs, evaluated at \$17.2million for public transport and \$211.1 million for private vehicles in 2001.

However, public transport adoption is still weak in many countries since, as defended by Simpson (2003), many efforts still have to be made to render public transport more attractive when compared to private car use. This points towards the need to innovate in public transport to render the experience more pleasant, and to another point that creates value in transport – comfort and safety. The environmental impact of an almost empty public transport can be more important than the one of a private vehicle. And the environmental impact of creating more mobility or of using public transport instead of walking or biking is negative, too. So to reduce the environmental impact through public transport, it is as important to make sure public transport attracts car-users and makes them give up their private vehicle as to create public transport.

Figure 4.9 takes the different functions and the client value described here into account, and gives a complete model of the dominant design of public transport.

²⁹ Two examples are the European Commission report (Available at http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2050_update_2013.pdf, retrieved on the 5th September 2014) and the Australian CSIRO report (Available at <http://climatechangeauthority.gov.au/sites/climatechangeauthority.gov.au/files/files/Target-Progress-Review/Transport-Greenhouse-Gas-Emissions-Projections-2013-2050/Transport%20greenhouse%20gas%20emissions%20projections%202013%20-%202050.pdf> retrieved on the 5th September 2014)

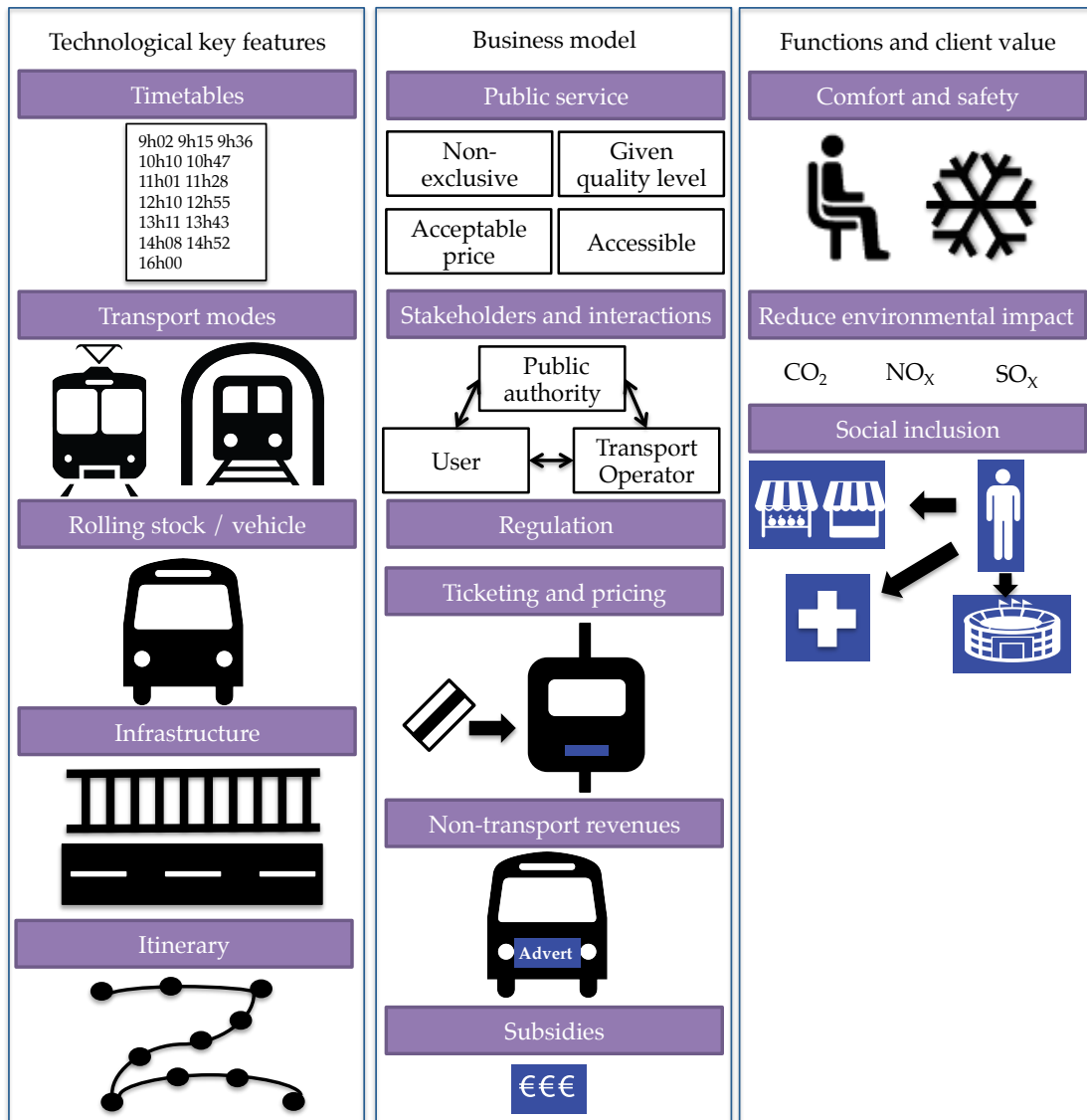


Figure 4.9 Completed model of the dominant design of public transport

4.2. Contemporary challenges of urban public transport: difficulties to innovate and need for cost reductions

As pointed out by Buehler and Pucher (2011), many public transport networks need high government subsidies to operate, because they suffer from high costs and low productivity. The potential of reducing governments' budgets alone would be reason enough to work on cost reductions in this sector. But Buehler and Pucher (2011) also point out that the environmental and social potential benefits of public transport could be better captured if transport costs were lower, which also advocates for cost reductions. An analysis of the

European Projects³⁰ of the 2007-2013 programme on transport however shows that cost reductions are not always depicted as central. Of the 134 projects, only 20 cited cost reductions as one of the outcomes, and 24 others would indirectly lead to cost reductions (for example by reducing fuel consumption).

In the same time, Ongkittikul and Geerlings (2006) point to a lack of interest in innovation, although there seems to be a great potential to reduce costs and improve services through innovation, when looking at the public transport difficulties described by Gakenheimer (1999). Despite the difficulties to innovate in the urban public transport sector today, several innovations have been developed and studied in the scientific literature. Some motivations have been used more currently than others to justify innovation and cost reduction.

To identify the main motivations used in the last years, the author conducted a systematic literature review in three different scientific databases: ScienceDirect, Web of Knowledge and Transport Research Board. This work was the object of a communication in the Design 2014 Conference (Klasing Chen et al., 2014) and will be further described in the following points. The identification of the motivations used today, allows us to show how close cost reduction and innovation motivations are. Innovation and cost reductions should not be studied separately, since their combination allows working on a broader set of motivations and to attack the main problems found today in the sector.

4.2.1. History of innovations in public transport and difficulties faced today

History of innovations in public transport

The fact that actors in the public transport are having difficulties to innovate may come as a surprise by looking at the history of innovations in the transport sector. This sector, and more specifically the urban public transport sector, has a long and prolific history of extremely important innovations. To cite just a few, there is the appearance of the first underground in London in 1863, or the replacement of the horse powered tramways by electrical tramways. More recently we have had the introduction of NFC (near-field communication) in ticketing and control and the successful transformation of an existing underground line into a completely automatic and driverless line (Ning, 2010).

Several innovations were structuring to create the public transport sector as it is today. We will recapitulate some important innovations in the history of public transport in the following frame. The author selected the innovations cited here because they helped define the dominant design or illustrate evolutions in the four different aspects of the identity of the object (technological paradigm, business model, functions or client value. Since our setting is the RATP and the French public transport sector, we will mainly focus on innovations relevant for these two settings.

³⁰ We analyzed the European projects of the Sustainable Surface Transport Research 7th Framework Programme 2007-2013, through the project synopses published by the European commission (2011).

Important innovations in public transport

1662 – Invention of the first public bus by Blaise Pascal in Paris. The bus was horse drawn (Costa and Fernandes, 2012) and had a fixed price (5 sols), but was not accessible to all, soldiers, pages and other workers were not allowed to take it. The bus followed a fixed itinerary and had a fixed time schedule.

1863 – First underground railway system started in London. The line operates between Paddington (then called Bishop's Road) and Farringdon Street.

1888 – Introduction of the first electrical powered tramway that could provide a regular service, without major interruptions in Richmon, Virginia, US. According to Costa and Fernandes (2012), this allowed a cost reduction of 45% and therefore made public transport accessible for those having a low income. This is evidence that cost reduction and innovations have long been linked in public transport.

1949 – Creation of the RATP. The transport operator already operates different transport modes (bus and underground).

1959 – Creation of the Parisian transport authority, the STP (Syndicat des transports Parisiens), that became the STIF later on. The creation of this transport authority demanded a change in the relations with the transport operator and was also the occasion to redefine the public transport financing.

1973 – Introduction of the “carte orange” in the Parisian network, a transport card that allowed unlimited travel throughout the network. This was a personable and non-transferable card that fundamentally changed the relationship between the transport user and the transport operator.

1983 – Launch of the first automatic driverless metro in Lille. This was structuring for improving speed and reliability of the underground and in reducing costs.

1999 - Introduction of the NFC card in ticketing in Paris, after successful tests in 1997

2012 – End of the transformation of line 1 of the Parisian metro into a completely automatic and driverless line without stopping traffic on the line

History of innovations inside RATP

RATP has had a long history of innovation and different motivations to innovate throughout its history. Due to its historical partnership with Mines ParisTech, and more specifically with the Centre for Management Sciences (CGS), a great number of sources are available to retrace this history. We will therefore not be exhaustive, but will only give some elements that will help to better understand the context in which this work took place.

In the beginning of Parisian public transport history, the main focus was in increasing the transport coverage, speed and accessibility. One example of the importance of speed was the

replacement of horse-drawn buses by internal combustion buses between 1910 and 1913³¹. This took place in a time where RATP did not yet exist; its creation was official in 1949. In the 1960's the main concern is still to be able to provide a public transport that can cover the needs of the Parisian population, and to do so the regional trains, known as RER³² were put in place.

As can be found in Margairaz (1989) and in several internal documents on RATP's history³³, a first phase of innovation in the 60's and 70's is based on technological innovation, like the creation of a centralized control, the autopilot for trains, as well as the automatic ticket control lines. The changes on the identity of the object are concentrated in changing the technological paradigm. The goal of these innovations is to increase the transport offer and to increase productivity.

The increase in transport accessibility can also be found as one of the goals of the new ticketing services put into place in 1973 with the "carte orange", a monthly ticket allowing access to all modes with the same ticket, thereby integrating the different transport modes for the first time (Jougleux, 1993). This innovation focuses on increasing client utility.

At the same time as changes in the transport operator took place, the ecosystem also evolved. Important policy changes took place in the history of Parisian transport, the creation of the local transport authority (called STP at the time), which occurred at the same time as the creation of the transport operator RATP, is one of them. Another very structuring policy change was the creation of the "versement transport", a tax paid by the local businesses with more than 9 employees³⁴, and supposed to help cover the gap between the price of the tickets and the actual cost of transport.

With the evolution of transport offer and its increasing safety and reliability, the focus shifted to improving the client service. One important innovation we can cite here as part of this trend consists of important changes in the ticketing system and the invention of the "carte integrale" (Hatchuel et al., 1990). The main goal of the creation of this ticket was a cost reduction, by reducing the need of employees to sell the monthly tickets at the beginning of the month. Although this might seem like a minor change at first glance, since the annual ticket seems like the natural continuity of the monthly ticket, it created unforeseeable changes. As described by Jougleux (1993), one of them was linked to the evolution of the relationship the company had to the client. The new card demanded the company to have complete client records (inexistent before that), creating a lasting link with the customer, and

³¹ « Des lignes d'histoire. L'histoire des transports - Des origines à 1948 » Available on http://www.ratp.fr/fr/ratp/r_96248/lignes-d-histoires/. Retrieved on the 4th November 2013.

³² « Des lignes d'histoire. L'histoire des transports - De 1949 à 1999 ». Available on http://www.ratp.fr/fr/ratp/r_96248/lignes-d-histoires/. Retrieved on the 4th November 2013.

³³ Different sources : internal reports and a Master's report by Mackillop, F., 2002.

³⁴ Information on the "versement transport" is available on [http://www.urssaf.fr/employeurs/dossiers_reglementaires/dossiers_reglementaires/le_versement_transport_\(vt\)_01.html](http://www.urssaf.fr/employeurs/dossiers_reglementaires/dossiers_reglementaires/le_versement_transport_(vt)_01.html) . Consulted on the 2nd September 2014.

allowed to receive feedback in a much more structured way. It created a new function, accidentally changing the objects identity, and demanding a considerable effort of the company to adapt to it.

To follow this important change in company-customer relationship and to keep up with a changing environment, a huge organizational restructuring took place between 1989 and 1992 inside RATP, lead by Christian Blanc (David, 1994). One of this reorganization's goals was to open the company to the users' and transport authority's needs and another one was to improve the company's competitiveness. Despite the important improvement introduced by this reorganization, RATP continues to work on improving its competitiveness and on improving the integration of users' and transport authorities' needs.

More recent trends indicate that sustainable development and client satisfaction are strong motivations for innovating nowadays. This was reflected in the company's organization, through the creation of an entity dedicated to the environment and sustainable development (RE) inside the department in charge of development and innovation (DIT) and the development of a client satisfaction entity inside the marketing and commercial department (CML). And these kinds of innovations are stimulated by innovation contests organized inside the company, like the annual eco-design challenge, launched in 2012 for the first time. The company continues to work mostly on technological paradigm change and on increasing client value, and work in the two other changes in the identity of the object (business model change and change in the functions) is not as successful. People trying to launch new functions are often confronted to the "that's not our core business" argument³⁵.

The main motivations for innovation were formalized in 2011 inside RATP, through the letter of orientation for research and innovation (LORI 2011³⁶). Six different aspects are part of the company's strategy:

- To design, operate and maintain at the lowest cost
- To improve the reliability of the network to cope with congestion
- To increase the system's resilience, allowing to anticipate risks and threats
- Integrate or design new mobility systems
- Improve energetic efficiency and develop the use of renewable energy sources.
- To enhance the effectiveness of working in a group.

This letter of orientation and the organization described above explain the landscape inside the company when the research program on low cost was launched in 2012.

Challenges to innovate in the sector today

Despite the great history of innovation in the sector, there currently seems to be a difficulty to

³⁵ Statements from two innovation managers.

³⁶ The letter of orientation for research and innovation 2011 is an internal document.

produce innovations. When looking at some of the recent innovations in public transport, many of them are linked to information systems. In 2014 for example, one of the four public transport innovation prizes of the European Mobility Exhibition was awarded to Cofely Inneo, an electrical engineering and information and communications system company³⁷. Incumbents in this sector are often finding they lack the competencies to develop these innovations, and are trying to overcome this lack through new partnerships or finding new suppliers.

Additionally, actors outside the classical public transport ecosystem are financing some of the most radical innovations in mobility already proposed or being developed. Some examples are the case of Shweeb³⁸, a monorail powered by cycling being tested in New Zealand, being developed by a start-up and co-financed by Google Inc, as well as of Skytran³⁹, a NASA Space Act company, currently working on what they describe as a personal rapid transit for Tel Aviv, using magnetic levitation (Maglev) technology.

Lack of acknowledgment of innovations by the sector

Other important innovations for public transport users seem to have been little acknowledged by most of the public transport sector. That's mostly the case of innovative uses of transport data and of collecting data from the users to improve user information. These innovations have, for a long time, stood outside the transport operator's radar as interesting innovation, mostly because of the fear of broadcasting incorrect information. And some of them have even been classified as tools that encourage users to fraud⁴⁰, and have been actively fought by the transport operators. This might be another reason why there seems to be little interest in innovation in this sector.

Furthermore, some new schemes have been appearing recently, like car-sharing and bike-sharing amongst others, which are hard to be placed, there is an ambiguity on their status on public or private transport. The shared cars are the hardest to place, since they do not give an exclusive usage of the car to the users in the long term, but they do during the time the user has the car. And they are open to the general public that meets the conditions of the operator (in the case of the car-sharing scheme of Paris this means paying for the service, being at least 18 years old, having a valid passport or identity card, a valid driver's licence and a credit car

³⁷ [http://www.transportspublics-expo.com/sites/default/files/files/CP%20lauréats%20trophées\(1\).pdf](http://www.transportspublics-expo.com/sites/default/files/files/CP%20lauréats%20trophées(1).pdf). Retrieved on the 8th August 2014

³⁸ <http://shweeb.com/>. Consulted on the 26th August 2014

³⁹ <http://www.skytran.us/skytran/>. Consulted on the 26th August 2014

⁴⁰ Two examples of platforms where users can signal the presence of ticket controls and check where other users have signaled controls can be found in France: "CheckMy!Metro", (Available on <http://www.lefigaro.fr/actualite-france/2011/10/13/01016-20111013ARTFIG00762-checkmymetro-dans-la-lignede-mire-de-la-ratp.php> . Retrieved on the 12th August 2014); and "Un ticket?", (Available on <http://www.franceinfo.fr/societe/actu/article/facebook-appbis-des-outils-pour-frauder-dans-les-transports-245821>. Retrieved on the 12th August 2014).

or bank account on his/her name⁴¹), but do demand a subscription. Even in the literature, a shady zone exists around car- and bike-sharing systems, which have been, at some times classified as “new public transport systems” (Kaltenbrunner et al., 2010) or “innovative transportation modes that complement public transport” (Huwer, 2004), as a hybrid, a “public-private transportation modes” (Firnkorner and Müller, 2011) and at other times were seen only as a shift from ownership to service, but remained an individual, private transport mode. This is one possible reason why for some authors there is little innovation in public transport, since they classify some of the innovations as being outside the public transport scope.

Barriers and rigidities to innovation identified in the sector

When discussing difficulties to innovate, two concepts are often mobilized in literature: barriers and rigidities. The difficulties, challenges and obstacles that companies have to face to innovate are often classified as barriers (D’Este et al., 2012). According to a widely used classification by Piatier (1984), barriers can be external, linked to legislations, customer resistance or other ecosystem factors; or internal, linked to mindsets inside the company for example. Leonard-Barton (1992) introduced core rigidities, one kind of internal organizational resistance that induces difficulties to innovate in large firms. Flip side to the concept of company’s core capabilities, core rigidities appeared when technologies, skills, management systems and values become over-stabilized through organizational routines and impede the firm to catch competitive opportunities (Levinthal, 1997; Hacklin et al, 2009).

Barriers for innovation have recently been analyzed in a great number of studies; Sandberg and Aarikka-Stenroos (2014) analyzed 103 articles on barriers to radical innovation in a recent systematic review. We will use their definition of innovation barriers, “*an issue that either prevents or hampers innovative activities in the firm*”, combined with Leonard-Barton’s framework on core rigidities in our analysis.

The public transport sector also has to face some of the recurrent or typical barriers to innovation, like the ones cited by D’Este et al. (2012) – path dependency and lock-in for big companies and lack of resource and market structure for smaller companies – or those listed by Verganti (2013) – fear of change, lack of vision or of competencies and the not-invented-here syndrome.

Path dependency is an important barrier in public transport. The long life cycles of the products, which vary greatly between modes and countries (for example 10 to 15 years useful life for buses⁴², 60 years useful life for rail structures⁴³), have as a consequence that

⁴¹ Conditions for the Autolib service available on <https://www.autolib.eu/terms-and-conditions/june2013/>. Retrieved the 8th August 2014.

⁴² The useful life of vehicles and infrastructures is different from one country to another, 12 years is the useful life defined by the US Department of Transportation available on http://www.fta.dot.gov/documents/WVU_FTA_LCC_Final_Report_07-23-2007.pdf, retrieved on the 10th September 2014. However, in Brazil for example, the useful life is different in each state (15 years in Minas Gerais and 10 in São Paulo). More details can be found on http://www.em.com.br/app/noticia/gerais/2012/09/19/interna_gerais,318290/der-reafirma-disposicao-de-

investment decisions are rather long-lasting, and hard to change. Besides that, since public transport needs to be integrated into the city, the cities development and the high cost of changes in the urbanization contribute to the path dependency. One of the major costs of developing surface transport in existing cities is the cost of relocating families and businesses that have to be removed to make place for the new transport mode.

Besides that, path dependency is often reinforced by the fear of change, some projects having to face important protest from inhabitants of the impacted zones. A recent example is the protest against a bus rapid transit project in Toulouse, where an important reason cited for the protest were the changes the neighborhood would have to undergo⁴⁴.

The lack of competencies is also a barrier for innovation in this sector, especially because of the call for tenders' structure that is often found in transport project's attributions. The transport authorities are often complied by legislation, or by a desire to search certainties in the service quality delivered, to write very detailed specifications for the calls for tenders (Eerdmans et al., 2010). They do not, however, always have strong competencies in transport innovation and in competitive tendering, since this is a secondary activity done once every several years, nor do they have strong competencies in the clients' expectations, which reside with transport operators. And the nature of the call for tenders being very closed, it does not allow the operators to innovate by themselves. Another risk of the call for tenders is that the operators do not get enough effective incentives to innovate in their contract (Eerdmans et al., 2010).

A largely discussed external barrier for innovation in small and medium companies is the access to credit and loans (Freel, 2000). This barrier also applies for public transport, due to the large investments necessary for some of the projects. Another important barrier linked to financial aspects in public transport is due to the different sources of financing. Due to the high cost, financing can come from different levels (union, state, province,...) and the disengagement of one of the actors is often enough to stop or postpone a project, and the great number of actors increases risks of this happening.

Besides that, the long time many projects take from the plan approval until the completion of the system consists an important barrier for all public transport projects, not only the innovative ones. Since the political cycles are often shorter than the transport project cycles (4 to 6 years for a political cycle against 10 to 20 years observed in many transport projects), it is often necessary to convince of the pertinence of the project at every political change, to avoid disengagement. More than one project has been started by one government, and deeply

[proibir-veiculos-com-mais-de-15-anos-em-2013.shtml](#) and <http://www1.folha.uol.com.br/cotidiano/2014/02/1417950-frota-de-onibus-da-cidade-de-sao-paulo-e-a-mais-velha-em-8-anos.shtml>, retrieved on the 25th September 2014.

⁴³ 60 years is the useful life used in the lifecycle analysis for the Bothnia Line by the Swedish Environmental research institution. Available on <http://www.ivl.se/webdav/files/B-rapporter/B1943.pdf>. Retrieved on the 11th September 2014.

⁴⁴ "Toulouse: opération escargot contre le projet de bus express", available on <http://www.metronews.fr/toulouse/toulouse-operation-escargot-contre-le-projet-de-bus-express/mnbA!8mI4sTtlMkE/>. Retrieved on the 25th September 2014.

modified or even canceled by the next, due to changes in the political program. One example is Toronto's Transit City light rail plan. When it was announced in 2007, it planned the construction of 7 light rail lines. The government elected in 2010 canceled five lines, and militated for a subway instead⁴⁵. Although part of the plan has been resurrected in 2012, the original plan has undergone considerable changes and suffered with important delays due to the change of actors.

Legal barriers can also be identified when trying to innovate in public transport, since, sometimes, new laws have to be edited or a law has to be changed to allow an innovation to be launched. One widely discussed example concerning regulations that need to be updated to allow an innovation to be used concerns driverless cars, like the Google car. So far, driverless cars are not allowed in most cities. Discussions on the subject mostly concern road safety and manufacturer and personal liability in the case of accidents⁴⁶, and it is clear that these points need to be treated in order to allow this innovation to be introduced. But legal barriers can be linked to legislation outside the studied sector: protectionist measures, like the ones existing in china to protect the national manufacturers (Gan, 2003), can create barriers to innovate by making exchanges with international innovative firms more difficult.

Finally, there is an additional barrier public transport has to face today, which makes it hard to reduce costs: the choice of public transport mode is not done only on rational and technical criteria. According to Edwards and Mackett (1996) this is not only the transport planner's fault; it is linked to a political framework that is not always rational. The lack of rationality is often made worse by the fact that decision makers are often not transport experts. And since the decision is not rational, the rational arguments for a low cost solution (mainly the cost reduction achieved) is often less receivable than other arguments.

Recent trends in the French public transport sector and challenges faced by RATP

When looking at the French urban mobility sector, the need for cost reductions and innovations cannot be overseen. The French networks have been suffering from a margin squeeze, with increasing operating costs and reduction in the coverage of the total cost by the operations income. Although the transport networks have been expanded considerably in the last years, the usage of public transport did not increase as expected. The situation has become so critical, that the GART (the French transport authorities group) launched a reflexion group in 2012 with all the French transport authorities to evaluate how to make

⁴⁵ Information on Toronto Transit City available on <http://transit.toronto.on.ca/streetcar/4121.shtml> and <http://www.theglobeandmail.com/news/toronto/a-timeline-of-transit-planning-in-toronto/article13237591/>. Retrieved on the 23rd September 2014.

⁴⁶ Recommendations on aspects to be treated by policymakers concerning driverless cars can be found in "Autonomous Vehicle Technology - A Guide for Policymakers", abstract available on http://www.rand.org/pubs/research_reports/RR443-1.html, retrieved on the 19th September 2014.

public transport financing more sustainable⁴⁷. And the group actually recommended to increase fares, a very unpopular approach in a country where public transport is praised as a human right, like in France. The issue is not a recent one; a research project had already been launched in 2006⁴⁸ to evaluate the same question. Of the four different studied scenarios, only two seemed viable without a drastic increase of the government's contribution, and both demanded important cost reductions: 19% and 16%. Both also predict important increases in public transport usage, 20% for the first scenario and a variable rate going from 2.2% to more than 20% depending on the size of the city. This study highlights the need for cost reduction and for innovation, seen as one of the ways to achieve the expected increase in usage, by increasing the value of public transport for users.

Evolutions in the competition in the sector

Challenges faced by the French operators are partially linked to the fact that **companies have had to face increasing competition for the transport market** in their country, due to the European policies on public transport. In France, starting in 1993⁴⁹, all public transport authorities (with the exception of that of the Parisian region) were compelled to open a call for tenders when wanting to replace their current transport operators. This opened the sector to foreign competition. Other European countries had to face the same challenge, but the opening did not take place at the same pace in all European countries, the integration of European directives into the national laws being more or less long in each country.

Although the renewal rate of transport operator between 1995 and 2006 has been estimated at only 16% by Yvrande-Billon (2009), probably because of a lack of transparency in the call for tenders in the sector and of a lack of expertise from the transport authorities, the opening of the sector to foreign competition did increase pressure on the operators. Even though at the end of a transport contract some authors prefer to speak of contract renegotiations (Gagnepain et al., 2009) instead of a real call for tenders, having propositions from different operators gives transport authorities more elements to compare and more negotiating power.

Furthermore, the public transport operators in France have seen a re-emergence of another competitor, the public authorities themselves. As discussed previously, different configurations of the public transport operation exist, and **having a local transport authority in charge of the public transport operation** is a possible configuration. Although this was a model that seemed to exist less and less, since it was argued that calls for tenders allowed to find cost effective transport operators and to save the transport authorities money, it has recently been re-adopted by some cities, like Nice in 2012⁵⁰.

⁴⁷ <http://www.localtis.info/cs/ContentServer?pagename=Localtis/LOCActu/ArticleActualite&jid=1250266259308&cid=1250266256570&np=ex3403989> Retrieved on the 12th August 2014.

⁴⁸ <http://www.developpement-durable.gouv.fr/IMG/pdf/LPS140.pdf> Retrieved on the 12th August 2014.

⁴⁹ More information on this law, also known as "Loi Sapin" can be found at <http://www.utp.fr/transport-urbain/etapes-legislatives>. Retrieved on the 5th September 2014

⁵⁰ Available on <http://www.lemonde.fr/economie/article/2012/07/09/transports-publics-nice-opte-finalement->

The reasons given for this re-appropriation of public transport are the dissatisfaction with the propositions of transport operators, often considered a more expensive than expected and as not responding to service level expectations⁵¹. This creates another potential competitor for public transport operators, and gives yet another reason why they should work on improving their offers' innovativeness and in reducing costs.

In the case of RATP, having another competitor, who is not at the same level as the other transport operators, has two impacts. First, it makes it even harder to win calls for tenders, since winning means not only to be better than all other competitors answering the call for tenders, but also to be better than what the issuing authority believes it can be. Second, it impacts the relationship between the operator and the transport authority during a call for tenders. The change in position makes it necessary to find a new balance between the actors, and this is reflected by reluctance from the transport operator in disclosing detailed information on operations when responding to a call for tenders.

The “free” public transport trend

Some other particularities make innovation and cost reduction particularly relevant for the French public transport sector. One of them is an often-cited trend in public transport, which seems to re-appear in a rather cyclic way: to **provide public transport free of charge for the final user**. This “free” public transport means the passengers do not pay a fare to use the transport, but they do pay for it indirectly, most of the time through their taxes. One of the consequences of this model is that the whole community, including those who do not use the public transport, pays for it. In France, 23 of such free public transport networks existed in 2012⁵². The reasons put forward for putting in place a free public transport network are different from town to town. One important reason is, no doubt, always a political one, trying to live up to campaign promises or to improve the city's image. However, other reasons like reducing global warming impact, by fostering the increase of public transport usage instead of private cars; or trying to reduce public transport costs, by reducing ticketing and control costs are also cited⁵³.

Gratuity generates a lot of debate, around the justice of making non-users pay for the service, about the benefits of the increase in transport usage generated, or around the impact gratuity has on the value attached to the service by users. What seems to be consensual is that the gratuity increases public transport usage. And that removing the revenues coming from transport operation means that funding needs to be found elsewhere (Cordier, 2007). In

[pour-une-regie-municipale_1731219_3234.html](#). Retrieved on the 5th September 2014.

⁵¹ Available on <http://www.ifrap.org/Regie-ou-delegation-raisons-economiques-ou-politiques,12816.html>. Retrieved on the 30th August 2014.

⁵² Doumayrou, V. (2012). La gratuité, un projet de société - Rôle pilote des villes moyennes. Available on <http://www.monde-diplomatique.fr/2012/10/DOUMAYROU/48294>. Retrieved on the 11th August 2014.

⁵³ UTP (2011). La gratuité dans les transports publics urbains : une fausse bonne idée. Available on http://www.utp.fr/images/stories/utp/publications/Fiches_Gratuite.pdf. Retrieved on the 11th August 2014.

France, subsidies for transport come from two different sources: a transport tax, paid by companies with more than nine employees, known as “versement transport” or VT; and the city’s or region’s general budget. On average, they cover one third of the operating costs each, the last third being covered by the transport fares, but very different configurations exist, in Châteauroux, one of the “free” networks, the coverage by the transport tax is as high as 90%⁵⁴. And since the two other funding sources are not indefinitely expandable, cost reductions are especially interesting for these networks and all the networks wishing to follow this model.

4.2.2. Identifying motivations for cost reduction and innovation in urban public transport through a systematic literature review

Despite the challenges that firms have to face when trying to innovate in urban public transport, innovations do emerge. To better understand innovation in this sector, as well as to try to explain its link with cost reduction, we conducted a systematic literature review.

Systematic literature reviews are known for its relevancy “to identify key scientific contributions to a field or question and its results are often descriptively presented and discussed.” (Becheikh et al, 2006, p645) According to Tranfield et al. (2003), traditional ‘narrative’ literature reviews are frequently biased by the authors and do not capture the collective meaning of research done in a field. This can be a source of problems when inadequate or incomplete studies are used as a basis for decision-making. Systematic review allows to reduce the bias and to provide more reliable results for taking decisions. In the current case, the choice was made to do a systematic literature review on the motivations of innovation and cost reductions in urban public transport, to verify the motivations cited in the literature and to check how low cost and innovation were related.

Methodology for the systematic literature review on innovation in public transport

To identify the main innovation motivations in public transport in the last years, a systematic literature review was conducted. It was based on the search-terms “public transport” AND “innovation”, in three databases — “ScienceDirect”, “Web of knowledge” and “Transport Research Board”, from 2006 to mid-2013. These three databases were chosen as they allowed systematically covering the main public transport journals. Only scientific articles were taken into account, to facilitate comparison.

The year 2006 was chosen as the first year of study because of the article by Ongkittikul and Geerlings, (2006), where authors stated that “*there is a lack of interest in the issue of innovation in the public transport sector*”(ibid, 2006, p283), although according to the authors the term

⁵⁴ Available on <http://www.scribd.com/doc/110208259/Bilan-de-la-gratuite-2001-2011-a-Chateauroux> . Retrieved on the 5th September 2014.

innovation has come into popular use in some public sector areas, including the transport sector. This article gives a review of areas in which innovation exists in public transport and *“attempts to explain how the innovation in public transport takes place and what the important factors are”* (ibid, 2006, p291). The goal of choosing this starting point was to see how the interest in innovation in transport evolved from a moment where it was stated that it was very low.

To be part of our database, the articles should treat an innovation in public transport. Innovativeness was assessed based on the authors' self-evaluation. Articles that included the word 'innovation(s)' or 'innovativeness' in their title, keywords and abstract were included. Furthermore, articles that contained 'technological change', 'technical change' and 'organizational change' in their title, keywords and abstract were also included.

The rejection criteria used for our systematic review were:

1. Since the goal of this study is to evaluate the main areas in which urban public transport has seen significant innovations, the papers that were mainly about air transport and long distance trains were eliminated.
2. The papers that were only about a new technology, for example fuel cells, but did not cite a possible use of this technology for public transport were also eliminated.
3. The papers that were only about private transport modes, like cars or bikes owned by the user and used only for personal transport, were also eliminated.

Car and bike-sharing systems were considered as part of the public transport system, and were not excluded from the study.

The identified articles were screened twice, once only using the titles and keywords, and afterwards by reading the abstracts, to eliminate all articles that fulfill the rejection criteria.

Methodology for the systematic literature review on low cost in public transport

The systematic literature review was then repeated using the keywords “public transport” AND “low cost” in the same three scientific databases, and using the same timeframe, from 2006 to mid-2013.

The rejection criteria used for this second review were the same as the ones used previously, but with a different inclusion criteria: to be part of this database the articles should be on low cost or cost reduction. Once again this was assessed by author self-evaluation and we included articles that contained the words 'low(er) cost', 'cost reduction', 'cost efficiency', 'cost minimization', 'cost savings' or 'affordable costs'.

“Low cost” and “cost reduction” as part of the motivations for innovating in urban mobility seen in scientific literature

The systematic literature review allowed us to identify the main motivations cited by the scientific literature to innovate in urban public transport. This search allowed us to find 1594 articles in the ScienceDirect database, 96 additional articles in the Web of Knowledge

database and 26 others in the TRB database (the decreasing number of articles is a consequence of the large similarity of rough results between the databases and of the decreasing number of journals in each base). By applying our rejection criteria and excluding identical articles, we were able to reduce the number of articles to 94 (67 from the ScienceDirect database, 18 from the Web of Knowledge and 9 from the TRB database), they can be found in Annexe 2.

The articles were catalogued in a unique database and classified according to their motivations for innovation. We identified 15 different motivations, listed in table 4.1. The three most cited motivations are the environment and developing more sustainable public transport, policy making and new legislations and new technologies. Cost reductions and low cost are cited as one of the possible motivations, but come rather low in number of times cited, being eight in the list, together with modelling and creating new methodologies.

Table 4.1 Motivations for innovation in public transport from 2006 to mid-2013

Motivation for innovation	Description	Occurrences
Environment/sustainability - climate change and pollution	Encompasses the fight against climate change and reducing greenhouse gas emissions and/or reducing pollution, as well as the dwindling resources problem.	46
Policymaking and legislation	The public transport sector is highly affected by public policies and legislations, since it's a public service, often receiving high levels of subsidies.	34
Technology change	Several technological developments linked to public transport can be observed, ex: energy recuperation from braking. This theme does not take into account the new information and communication technologies.	19
ICT	Contains the works about innovations in information and communication technologies.	12
Organisation and management	The way transport operators and transport networks are organised differs from city to city and has a clear impact on the effectiveness of the transport system.	12
Users Behaviour change	The adoption of innovations in the public transport sector can often only be achieved by making the customers and users adopt new behaviours.	11
Public-Private-Partnerships (PPP), contracts, tendering and financing	Different contracting and financing schemes emerged recently, and collaboration between the public and the private sector are multiplying in this sector. Treats aspects linked to how public and private sector interact.	6
Low cost, cost reduction and cost effectiveness	Cost reduction is a rising concern in all public services.	5
Modelling and methodologies	In order to better design new transport networks or to evaluate the impact of changes on existing networks, these must be modelled or tested. Considerable efforts are put into improving these models	5
Service quality and client satisfaction	This group contains those studies motivated by improving service quality and client satisfaction.	3
Social inclusion	Social inclusion and giving access to services is one of the main goals of public transport.	3
Physical accessibility and universal design	As most services, public transport has a physical accessibility issue, which is widely discussed. The distance between public transport stops, as well as vehicle and station design to allow the use by the broadest variety of client profiles is taken into account here.	2
Improving transport safety	The passengers and operators safety is a major concern in public transport.	2
Pricing strategies	Public transport is often seen as a public service. The price therefore does not, in many cases, reflect the real cost of the service produced. However, different pricing strategies (like different pricing for certain hours) can be used to shift demand or to increase ridership.	2
Improving public health	A series of public health issues are linked to public transport or could be improved by the use of public transport, like traffic accidents, stress-related diseases due to the crowding, or diseases linked to the pollution.	2
Travel Information	Travel information has been identified as one aspect that increases public transport ridership.	2

Most authors cite only one main motivation, but up to five motivations can be found in each of the articles studied (see table 4.2), which shows us that a combination of motivations can be enriching. Only 10 articles (11% of our sample) did not use one of the five main motivations.

Table 4.2 Number of different motivations indicated by authors in each article

Number of motivations	Occurrences	% of the panel
1	40	43%
2	37	39%
3	13	14%
4	2	2%
5	1	1%

The motivations for cost reductions in urban mobility are mostly the same as those for innovating

The scientist databases search on “low cost” and “public transport” allowed us to find 1059 articles in the ScienceDirect base, 13 additional papers in the Web of Knowledge base and 30 in the TRB base. Of these, 408 had also been identified in the first systematic review. When applying the rejection criteria, the number of articles was reduced to 49 (46 issued from ScienceDirect, 1 from the Web of Knowledge and 2 from the TRB database), which can be found in Annexe 2.

The study of the motivations for cost reduction in the same time period allowed the identification of 18 different motivations (see table 4.3), with 13 motivations that had also been identified in the systematic review on motivations for innovation. As was also the case with motivations for innovation, cost reduction and other motivations are often combined (see table 4.4).

Table 4.3 Motivations for cost reduction in public transport from 2006 to mid-2013

Motivation for cost reduction	Additional motivation description	Occurrences
Low cost, cost reduction and cost effectiveness		49
Modelling and methodologies		15
Policymaking and legislation		11
Benchmarking and comparing networks	Some cost reductions are linked to easily replicable productivity efforts. Best practices and comparisons between networks are therefore an important part of the cost reduction effort.	9
Environment/sustainability - climate change and pollution		9
Organisation and management		9
Socio-economical advantages	As a public service, the benefits of public transport are not only measured by financial criteria. In the interest of winning tenders or increasing the satisfaction with the current government other socio-economical advantages are often important.	6
Technology change		6
PPP, contracts and financing		5
Social inclusion		3
Behaviour change		3
Improving transport safety		3
ICT		2
Combining transport modes	A transport mode is defined by a vehicle, an infrastructure and a specific operation. Combining modes consist of trying to assemble parts of two different modes.	1
Travel information		1
Physical accessibility and universal design		1
Reliability	Unreliable services (experienced by users mostly by lack of punctuality and inconsistency of time travel) are less attractive for users, leading to decreased ridership by unsatisfied users. A level of reliability can also be part of the transport contract, and fines for unreliability can increase costs for operators.	1
Improving regularity	In frequently served transport routes, users are more concerned by regularity than by punctuality at a stop.	1

Table 4.4 Number of different motivations besides “low cost” cited by article

Number of motivations	Occurrences	%
1	26	53%
2	13	27%
3	7	14%
4	2	4%
5	1	2%

The systematic literature review shows that both in innovation and in cost reduction the **impact on the environment and the sustainability of transport; policymaking and legislation** and **organisation and management** are part of the five most important motivations. The **technology change** and **innovations in ICT (information and communication technologies)** are furthermore important for innovation, but less cited for cost reductions, where **modelling and methodologies** and **benchmarking other networks** are more relevant.

This insight gives us some first elements that help explaining why the established actors in the urban public transport are experiencing an innovation lock-in. The questions around the environment and sustainability are very transversal and often demand the action of several actors

4.3. Conclusion: Interest of applying a low cost approach to public transport

This chapter starts by highlighting that although the interest for innovation in public transport seems limited, the sector is far from being static. Innovations are emerging in different aspects linked to public transport, but they are most often not carried by the main incumbent actors of the sector. These seem to be locked-in in a dominant design, a situation that hinders them in their innovation efforts. Therefore, although cost reductions are part of the public transport agenda, and considerable efforts have been done in some cities, these are mostly operational efficiency efforts. These are far from being sufficient; many networks still depend greatly on subsidies.

From the studies done, we can conclude that innovation and cost reductions/low cost are seldom linked, but they have a great potential to be linked, since they have common motivations. Linking cost reductions and innovations would allow a new approach to the transport sector's difficulties. It would allow proposing dominant design breakthroughs, to increase innovativeness and to reduce costs in the sector. How this link, seen in the smart low cost design in chapter 2, can be applied in public transport will be discussed in chapter 5, based on a case study in the French public transport operator RATP.

This chapter allows us to state the need to develop low cost products in public transport. However it also illustrates particularities of the sector that make the design model developed in chapter 2 hard to transpose to public transport. This design model is based on products where the customer made a choice about which product to buy, by comparing the prices and utility offered by several products. The price/utility diagrams are therefore important decision tools. The client evaluates which product has a higher value-for-money for him through them. And in the case of low cost products, the prices could be lowered thanks to lower costs, due to the link between price and cost.

In the case of public transport however, the user and the buyer are not the same. The transport authority decides which transport operator to use and which transport projects to finance, and is therefore the buyer. The transport authority has to balance its political interest and the final transport user's utility. This can make it hard for transport operators to know where they are placed on a price/utility diagram by the transport authority. And legislations concerning the attribution of transport markets combined with the structure of calls for tenders often make it impossible for transport authorities to choose freely, only based on a price/client utility ratio.

The final user also cannot always make a decision based on a price/client utility rate. In most

cases, the final user cannot choose between several different operators for the same itinerary⁵⁵, but can only choose if they want to use the service or not. The market is often captive, and alternatives can have other limitations that are not linked to the utility or cost, like needing a driver's license to drive a private vehicle. And in many public transport markets, the public authority defines fares. Therefore costs and price are not coupled for the final user. So even when the final user makes a choice based on a price/client utility ratio, this does not reflect the real cost of the transport. Final users often get the feeling that public transport is already low cost, since its price is low, even though this is not true.

We therefore have a combination of two factors that make urban public transport different from the ecosystems the two low cost design models were developed in:

- A complex ecosystem, with more than a user/buyer and a producer/seller, where several actors have to be considered in the transaction.
- Price for the final customer and the cost for the producers are not directly linked, due to subsidies and because the transport authority fixes the price.

These factors hinder the direct transposition of the two approaches of the low cost design model (low cost adaptation and smart low cost design) to urban public transport. For urban public transport, the model needs to be completed by other aspects. The field application done in a public transport operator, RATP, will be discussed in the following chapters.

⁵⁵ Exceptions to this exist in deregulated markets, where several operators can offer the same lines, for example in Great Britain.

Chapter 5. Designing a low cost strategy in the French public transport operator RATP

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To allow verifying if the low cost design model could be applied to public transport, we applied them inside a Parisian public transport operator, RATP. This operator was suffering a lot of pressure to reduce its costs and to propose a competitive strategy. This chapter aims to describe how a low cost strategy was designed inside RATP using the double approach low cost design model.

The chapter starts by describing the general setting in which the design was done - the innovation unit – and this unit's position inside the transport operator. It furthermore describes the research programme, based on an oriented creativity method, the KCP (knowledge, concept, project) method, whose outcome was the low cost strategy. The different steps of the research program are detailed, as well as their articulation with RATP's organization. The development of a low cost strategy can be started by an oriented creativity method, but must be supported by other managerial tools, like a capability roadmap. Finally the strategy's main elements are described in the end of the chapter. The development of a low cost strategy means proposing more than just a low cost offer. It means proposing a covering approach of the low cost innovation field. This also allows exploring aspects linked to developing low cost offers that should be employed in innovative offers that do not have lower costs.

Through the development of the low cost strategy inside RATP we were able to show that the two approaches of our design model, "low cost adaptation" and "smart low cost design" can be applied inside a public transport operator. Through the application of these two models, the operator was able to revisit the dominant design of public transport. The development of a low cost strategy based on this model also gave the innovation unit an additional tool to evaluate, select and justify their choices of innovative projects. The application of these models through an oriented creativity method allowed to spread awareness about what low cost offers really are and how they could be useful inside the company. This chapter furthermore highlights that the "low cost adaptation" approach can be legitimated through the simultaneous application with the "smart low cost design model".

Finally, we show how the low cost strategy allowed the company to change its organization and to revisit its design space. Some of the research projects linked to radical innovations that needed to be developed to have a coherent low cost strategy called for new channels to launch projects inside the company. And using low cost as a driver, the innovation unit was able to show the importance of creating new partnerships and to extend the innovation initiatives beyond what was first considered the company's boundaries.

5.1. Context of intervention research: Organization and motivations of internal R&D stakeholders

To conduct this research, the author was placed inside the research and innovation unit during the three years she spent at RATP and was able to accompany the evolutions taking place in this organization during these three years.

We will here explain RATP's organization around research, innovation and development, to justify why the low cost question was studied inside this unit. Furthermore, we will detail the mission of this unit, which is helping to develop cross-departmental innovations and validating and accompanying the research and innovation projects of the other units and departments. This unit was in charge of the low cost research program because developing a low cost strategy is a transversal question that demands efforts between departments to be coordinated by an unit that has the company's global strategy in mind.

RATP's innovation unit however, was confronted with several difficulties in its task, because although they are in charge of validating the interest of research projects, they are often not the owners of the resources needed to execute a project.

5.1.1. The Research-Innovation-Development organisation at RATP

RATP has a history of technical innovation, and the head of RATP has recently cited innovation several times as part of the company's strategy⁵⁶. Innovation was historically placed inside the different business units or departments, each one being responsible for innovation in its sector. Although significant innovations were developed in this model, this model made it hard to have a global vision of all the innovation efforts. Often it also hindered collaboration between departments or units. The lack of a global vision made it more difficult to avoid squandering, by make sure all the innovation efforts were strategic for the company. It also made it difficult to make sure all the opportunities were seized.

To overcome these difficulties and to reduce the risks identified, RATP decided to formalise a research, innovation and development model (RID) (Le Masson et al, 2010), through the creation of a research and innovation unit. This model completes the classical research and development (R&D) model by adding the innovation function I. The expected outputs of the RID model are: validated scientific knowledge (for R projects), definition and fabrication rules of product fabrication (for D projects) and new rules for dominant design projects like R and D (for I projects) (Kokshagina, 2014).

⁵⁶ Multiple sources : Pierre Mongin's (chairman and executive chief of RATP) speech in the "Forum ING" on the 10th December 2010 (internal document, 2010); Pierre Mongin's editorial for the strategic plan "Vision 2020" (internal document, 2013); Interview published by the Cercle des Européens on the 13th October 2010 (Available on: <http://www.ceuropeens.org/interview/pierre-mongin-le-transport-urbain-est-un-des-secteurs-qui-repond-le-mieux-aux-trois-priorites-de-strategie-europe2020>, consulted on the 5th August 2014).

IDD: The unit in charge of innovation and research inside RATP

In 2012, when the work on low cost was launched, the unit in charge of RID was inside the DIT department and was working on clarifying its mission. The current research and innovation mission statement and organisation were approved in 2013 (they are detailed in an internal document, the IG 545⁵⁷). The innovation and sustainable development unit (IDD, from the French “Innovation et Développement Durable”) is responsible for research, development and innovation inside RATP. This unit is supported by a strategic committee, who is responsible for validating the budget and the RID projects. Committee meetings take place four times a year.

The main functions of this unit are:

- To evaluate if the proposed research, development and innovation projects are strategic for the group. Those considered strategic will be submitted to the strategic committee. These projects can be proposed by one of the business units, by external partners (like European projects) or by the innovation unit.
- To offer financing and managerial support to projects which are considered as contributing to the group’s strategic RID efforts. The innovation department’s support function consists in helping the project manager to overcome some barriers inside the company or to facilitate contacts between some departments.
- To propose the tools necessary to improve the RID efforts.
- To identify weak signals in the transport landscape and propose workshops, projects or research collaborations around these subjects.
- To communicate about RID efforts inside the company, to make sure information is available to all the interested parties.

The innovation and research unit works in partnership with the other units and departments to make sure the project deadlines and goals are achieved.

The business units’ efforts to contribute to the innovation function of the group

Although the innovation unit decides which projects are strategic for the group and can offer financing for those projects they decide are relevant and strategic, the main resources for the projects are inside the other business units. Not only can business units offer part of the financing when the project contributes to the business unit’s development, but it is also them who make their human resources available to work on the project. And the fact that the innovation department does not approve a project for their financing does not mean the business unit cannot do this project. Business units finance a great number of projects by themselves and when a project is considered interesting, they can launch it without external

⁵⁷ The general directive 545 is an internal document on the research and innovation of the group RATP, published in July 2013, defining the principles, rules and processes for the innovation, research and development activities.

financing.

The project managers are employees of the business units (some exceptions occurred, with project managers coming from the innovation unit) and the expertise needed to develop these projects is often also in the business units. However, they often lack transversal knowledge that would have helped them in their project.

Development is considered as part of the business units' task: the research and innovation unit's tasks only go as far as the end of the first prototype. All the steps needed to bring a product to market after the first prototype and testing are part of the business units' responsibility. This means that the definition and fabrication rules of product fabrication (the expected outcomes of development projects) are mainly done by the business units.

Each department has his main research, development and innovations goals written in its annual targets statement. Part of their evaluation will be linked to them reaching or not these goals. This is intended to be an incentive to innovate.

5.1.2. Launching a low cost strategy inside RATP: a strategic move

In 2012 RATP's innovation department was given the direction of a research program on low cost. RATP's strategy already contained cost reductions as one of the 6 main directions to be explored; this step was therefore aligned with company strategy. Several cost reductions efforts had been launched throughout the company and the company's efficiency had been improved. However part of the effort made consisted in reducing the number of employees (this was called "increasing productivity" inside the company). This had some negative effects, with departments and unions reporting work overload from their remaining employees and some activities being abandoned. Launching a low cost strategy was seen as essential, since even with the different efforts launched, the company still lost some of the calls for tenders for which it submitted a proposition, amongst other facts due to higher costs⁵⁸.

The launch of a low cost strategy was also identified as a strategic stake for RATP due to the increasing competition the company is facing. This is due to three different aspects. First, comes an aspect already discussed, the opening to foreign competition. A regulation on the obligation of public service that came into vigour in end of 2009⁵⁹ and stipulated that the Parisian transport, historically RATP's main market, will be opened up to competition shortly

⁵⁸ One well-known example is the call for tenders for an electrical bus line in the 15^e arrondissement of Paris, the first bus line not operated by RATP in Paris. The market was attributed to a private company called B.E. Green, due to lower costs and a more adapted offer. More information can be found on <http://www.20minutes.fr/paris/1237571-20131016-20131016-paris-hegemonie-ratp-mise-a-mal-bus-electriques> and <http://www.metronews.fr/paris/une-nouvelle-ligne-de-bus-electriques-lancee-dans-le-15e-a-paris/mmjd!C1rjkCK2voEu2/>, retrieved on the 23rd January 2015.

⁵⁹ More information on this regulation, the OSP can be found on <http://www.senat.fr/rap/r08-220/r08-22015.html>. Retrieved on the 29th August 2014.

(2025 for the bus lines, 2030 for the light rail, 2040 for the underground). Secondly, the recent ambition of the company to increase its internationalization and have 30% of the group's consolidated revenues coming from another source than the contract with the STIF, the Parisian transport authority⁶⁰, by 2020, meant the company had an increasing need to be able to propose attractive offers to developing countries. And finally the evolutions in the mobility ecosystems with the rise of new actors proposing new mobility services, some of them based on data made available by the company, created new offers and new competition. With this, came the need for RATP to create innovative offers to remain competitive.

The low cost strategy was further motivated by recent trends in the industry and the emergence of several low cost products in the last years. The decision to launch this program was also influenced by the fact that SNCF, the national French train company, had launched a low cost offer. A great number of new offers linked to more sustainable transport had been proposed, but departments faced difficulties to work on these transversal projects.

Since no expertise about low cost offers existed inside the company and since the launch of a strategy seemed like a long-term effort, the choice was made to hire an executive PhD to work on the subject. The program was launched by the research and innovation department, since it is a transversal subject, that cannot be confined to one business unit. The research program was organized in three different steps:

- A benchmark of existing low cost products and services, to allow the company to better understand which low cost strategies other companies had adopted. This benchmark is detailed in chapter 2, when discussing the database on low cost products;
- An oriented creativity method to allow the launch of the projects needed to make low cost offers possible;
- Development of the projects and the proposition of different low cost offers coming from the results of these projects.

At the time of this writing the first and second steps had been completed, and the third step was on-going. Furthermore, a **strategy around cost innovation** is currently being launched inside the company, to capitalise on the results from the workshops and on the work done on low cost in general.

⁶⁰ Stated in the RATP group's goals on http://www.ratp.fr/fr/ratp/c_5069/activites/. Retrieved on the 2nd September 2014.

5.2. Materials and methods to develop a low cost strategy: The KCP “Less Is More”

A series of difficulties to develop innovative offers inside RATP had already been identified before the launch of the low cost strategy. Launching this strategy had as one of its goals to help overcome identified difficulties. To allow the development of a low cost strategy, there was a need to create the concept for low cost offers, but also to make sure these offers would be developed inside the company, through project teams and managers that felt deeply engaged.

The goal of the low cost strategy was not only to develop new low cost offers, but also to inspire the development of other innovative offers that would take advantage of knowledge gained by working on problems linked to the development of low cost offers. It was furthermore a way to federate around a common goal.

To allow a deeper understanding we will start by describing the chosen methodology, the KCP, and reasons that led to choosing this method. We will then go into the detail of the actors and content of the KCP done inside RATP, called “Less Is More”.

5.2.1. The choice of a staged innovative methodology: The KCP workshops

The oriented creativity method chosen to reach these goals was the KCP method (Agogu e et al, 2014). The method is named after its three main phases: knowledge, concept and project. In this chapter we will briefly introduce the method and the reasons why it was chosen, before describing the application inside RATP.

Brief introduction of the KCP method

The KCP method is issued from the C-K theoretical framework (Hatchuel et Weil, 2003) and was originally developed in a partnership with RATP. The KCP classically consists of three phases K, C and P.

The knowledge phase (K) consists of several workshops aimed at sharing knowledge. Knowledge can come from internal or external actors, like suppliers, users or other partners, who can be involved as presenters or as participants. According to Hatchuel et al. (2009), the main pieces of knowledge to be addressed in this face are: users, clients, company strategy, state of the art and phenomenology. The Knowledge sharing phase is essential because it creates the basis of knowledge upon which the experts and non-experts will collaborate to develop new concepts. As stated by Cohen and Levinthal (1990), common knowledge improves communication, which is another reason why this phase is important.

The concept phase (C) is an oriented creativity phase, whose goal is to explore different

concepts chosen due to their capacity to shed light on a great number of different aspects linked to the initial concept. These propositions are surprising and strongly contrasting and have been named “disruptive searchlights” (Elmqvist and Segrestin, 2009) or “projectors” (Hatchuel et al., 2009), for their ability to increase visibility in an unknown field, like a searchlight at night. These concepts are formulated and chosen in order to ensure the greatest possible coverage of the innovation space. The extended group is divided into smaller groups in this phase and each one of them works on one concept, proposing developments and solutions for it. The goal is not to maximize the number of “ideas” produced, but to create “original” ideas.

The proposition and prototype phase (P) aims to further explore the propositions issued so far. It aims at selecting the best ideas of the previous phase, separating and recombining them, in order to make them more actionable and understandable for the organization. It formulates a design strategy, which is not limited to mere product or service new ideas, but includes the roadmap that allows achieving the planned strategy. This roadmap not only includes the actions needed to achieve this strategy but also the actors and their tasks (Elmqvist and Segrestin, 2009). One essential aspect of this roadmap is the identification of the missing knowledge, which directs the launch of research projects. This phase allows structuring the outcomes, in a way that their presentation shows the variety of alternatives inside the innovation field.

The three K, C and P phases are often preceded by a preparation phase, which consists of selecting the subject and identifying relevant knowledge. Relevant knowledge consists both of existing knowledge, that would be relevant in the K phase, as well as the lacking knowledge, that should be looked for elsewhere. Once the KCP workshop is over, there is often a “run” phase, which consists of launching and accompanying the research projects.

Figure 5.1 recapitulates the different phases of the KCP method.

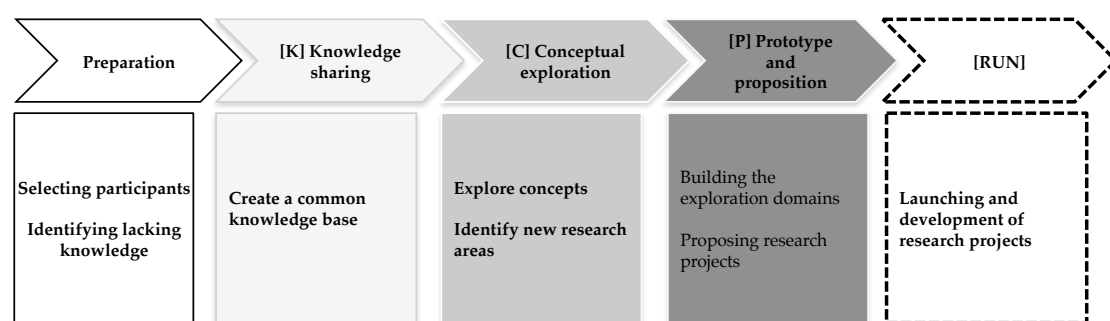


Figure 5.1 The phases of the KCP method

Main expected outcomes when applying the KCP method

The outcomes of a KCP can vary greatly, because they are highly dependent of the fixed perimeter, as well as of the people mobilized. They can be a strategy for the company as well as a roadmap for an entire innovation field. And as stated by Hatchuel et al. (2009), the KCP

covers the four different dimensions of collective creative workshops: it covers the whole conceptual potential of the initial concept; it involves and supports people in a rule-breaking process; it enables knowledge activation, acquisition and production; it manages collective acceptance and legitimacy of rules (re)building.

This method has been used in several different industrial settings, and we can cite some valuable outcomes, like the new cockpits designed by Thales or the sustainable turbines at Snecma (Le Masson et al., 2014). Other companies applying this method are Vallourec, Sagem, Areva and Turbomeca, and in the transport sector it has already been applied by the RATP and by the SNCF (Le Masson et al., 2014; Arnoux, 2013).

Reasons why this method was chosen at RATP

When RATP started developing its low cost strategy, several different methods were considered. Each method presented its advantages and flaws, and the KCP was finally seen as the most adapted. This method was chosen for four main reasons.

Lack of involvement:

Some actors involved in the innovation department had identified the lack of involvement of the other departments early on, in the definition of the projects, as one of the reasons why they were not able to find the needed human resources for their project in the other departments. They had also pointed out that this lack of involvement sometimes led to badly defined projects, since the knowledge about the existing expertise level inside the departments was often incomplete. The chosen method had to allow collaboration between the departments from the beginning of the definition of the projects. This was the case of the KCP method when the extended group was sufficiently transversal.

Flexibility:

Due to the dual exploration that the use of the two low cost design models asks for (a functionalist approach and a disruptive approach), the method chosen had to be flexible enough to allow the simultaneous exploration of very radical and sustaining innovations. The fact that KCP is an oriented creativity method allowed to introduce this kind of dual guided exploration. This might not have been the case with other creativity methods, which tend to focus on one or the other kind of innovation.

High federative power and the ability to create highly original ideas:

In his work, Arnoux (2013) analysed several creativity methods for radical innovation and concluded that most of them are focused either on a social perspective or on a cognitive perspective. The KCP method allows tackling both perspectives.

A method already accepted and supported inside RATP:

The KCP method was already well known in the company and was accepted and supported by the higher management and the innovation department, since it had been co-developed inside the company. There was no doubt that this method would bring results, since there had been several other occasions when it had been used with interesting outcomes (de Soos,

2007). The experience with this method also allowed for a better assessment of the needed means and a better understanding of what could be expected.

Once the method for the oriented creativity methods had been chosen, a series of workshops on designing the low cost strategy of the company was launched.

5.2.2. The “Less Is More” workshops: Actors and proceedings

A series of workshops called “Less Is More” were launched in February 2013. The name “Less Is More” was purposefully chosen due to a certain reticence felt during the first months of the work on low cost inside the company. Low cost seemed to be associated with negative values, so the decision was made to avoid its use in the workshops’ name.

The workshops’ proposition was to develop a surface transport offer that had 50% lower costs than the offers currently proposed by the company. This very ambitious objective was chosen to push participants beyond their classical logic. These offers were supposed to complement (and not replace) the existing offers. The participants were asked to place themselves in developing markets, and not in the markets currently served by the company. This was to avoid them being influenced by the contract that exists between the operator and the transport authority, which contains several restrictions to changing the transport offer.

Actors of the workshops: a wide coverage of all the functions

From an organizational point of view, there are four different groups that have to be mobilized for a KCP (Arnoux, 2013):

- An animation team, responsible for organizing the workshops and conducting them, always having the goal and the defined perimeter in mind.
- An extended group composed of people from different backgrounds and hierarchical levels, which participate in the K and C phases.
- A working group, consisting of experts issued from the extended group, which participates in the P phase.
- An approval or steering commission, which approves the different phases of the KCP and makes sure that the work being done is inside the defined perimeter.

Animation team

The animation team was composed of one person from the innovation unit, three external consultants and the author. The external consultants were important to the process because they allowed to bring a different view and to avoid fixation effects that were common in RATP and linked to its ecosystem and culture. They had an important expertise in KCPs, having done several in other settings and were able to introduce expansive examples.

Extended group

Thirty participants were chosen amongst different business units and in one of the subsidiaries of the company (RATP Dev) to form the extended group. The participants of the extended group came from different hierarchical levels inside the company, to insure a maximal diversity inside the group. Each one of the participants had his (or her) own expertise and knowledge, which could contribute to the process. Individuals from different backgrounds are chosen because knowledge diversity facilitates the innovative process (Cohen and Levinthal, 1990). Besides that, having individuals from different departments of the company helps to diffuse the initiatives.

The following departments and units were present in the extended group: Bus and light rail department (BUS); financial, controlling and accounting department (CGF); marketing and sales department (CML); communication department (COM); development, innovation and territories department (DIT); engineering department (ING); equipment maintenance department (M2E); extension and improvement projects department (MOP); bus maintenance department (MRB); rail maintenance department (MRF); metro operations department (MTS); Strategy and management department (SDG) and purchasing and logistics department (VAL). Figure 5.2 shows their tasks in the company's operation. A deliberate choice was made to work mainly on the surface transport, which already has lower costs, so the heavy rail and subway departments were less associated. The reasons why each participant was invited are detailed in the table 5.1 below.

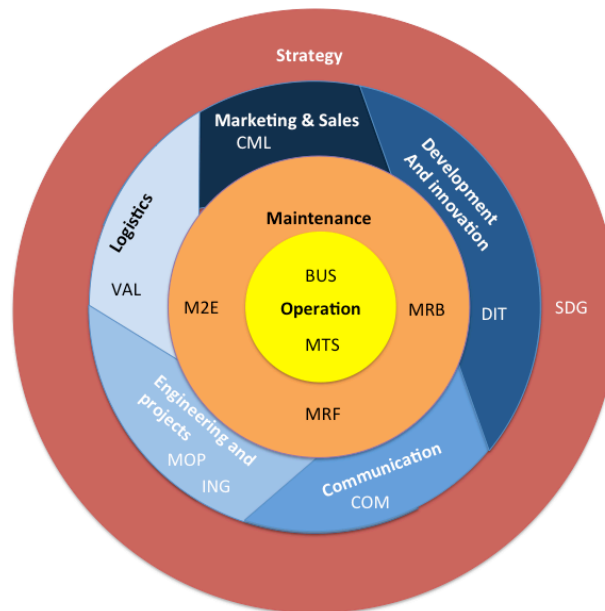


Figure 5.2 The departments of the participants in the workshop inside RATP and their attributions

Table 5.1 The participants of the workshop by department and the knowledge brought by them

Department	Participants	Knowledge brought
BUS	4	Creating new offers and integrating new elements to the existing offers; bus operations; research and innovation projects; development projects.
CGF	1	Costs overview of operating a transport system
CML	1	Value perceived by clients
COM	1	Communication inside the company around the low cost strategy; input about other transversal projects.
DIT	5	Contact with transport authorities; projects and studies to enlarge the transport offers for the transport authorities; sustainable development; research and innovation.
ING	1	Expertise in important technological projects for the rail-based transport
M2E	1	Costs and maintenance activities for equipment linked to bus and underground stations
MOP	5	Extension and improvement projects; studies; programming and specifications; design and identity of spaces.
MRB	2	Bus maintenance cost; bus maintenance best practices
MRF	1	Rail and train maintenance best practices
MTS	2	Operation of mass transit; impact of automation.
SDG	2	Benchmark of other networks
VAL	1	Functional analysis; purchasing activities.

Working group

A small number of experts were chosen from the extended group to compose the working group. They were 6 and came from the BUS, MOP, MRB, CGF departments and from RATP Dev.

Approval commission

Finally, a transversal approval commission was put in place, to validate the results of each phase and to make sure the work done was according to the company's strategy. This commission was composed of the directors or delegates of the five business units that were most concerned by the development of a low cost offer and by two delegates from RATP Dev, RATP's subsidiary responsible for operating public transport around the world, and a potential seller of the developed offers in the future. The five concerned departments were:

- BUS - The department in charge of all bus and light rail operations
- CGF - The financial, controlling and accounting department
- CML - The client service, marketing and sales department
- DIT - The development, innovation and territories department, responsible for the contact and relationship with transport authorities, as well as for the research, innovation and development.
- MOP - The department in charge of all extension and improvement projects for the Parisian network

Four approval commission meetings were set up during the workshop period. The first

approval commission took place during the preparation phase. Its main goal was for the approval commission to voice their expectations concerning this work. This was also an occasion to discuss and validate the workshop's proposition, the participants of the extended group and the presenters that were invited for the K phase. This first meeting was seen as a milestone for the building of a low cost strategy, since the directors of several departments approved the goals and the means engaged for this oriented creativity method. It was also the first formal validation outside the research and innovation unit and outside the strategic committee of the interest of working on a low cost strategy.

The second approval commission took place after the K phase and was the occasion to validate the concepts that would be explored in the C phase.

Shortly after the C phase, the third approval commission took place. This commission had as goal to discuss the results of the C phase and to validate the participants of the P phase. On this occasion they expressed serious concerns about the viability of one of the proposed initiatives. The experts later on confirmed these concerns and the initiative was finally abandoned, as described in the KCP results. The importance of having an approval commission was once more confirmed by this meeting, through a proposition made by one of its members to make a relevant resource available for the P phase.

After the P phase the last approval commission meeting took place. This meeting had a double goal: to present the low cost initiatives and the low cost strategy and to validate and get human resources for the launch of the projects proposed. To have a validation where the departments engaged themselves in supplying resources was crucial for the launch of those projects that could be launched afterwards.

Organization of the workshops

The workshop was composed of five phases. Besides the classical K, C and P, a preparation phase took place before the K phase was launched and a 'Run' phase. The 'Run' phase consists of the launch and development of the different projects and the building of the different partnerships, and is still on going. Parallel to these five phases, four approval commission meetings took place, they were called 'Copil'. The phases are detailed below and are illustrated by figure 5.3.

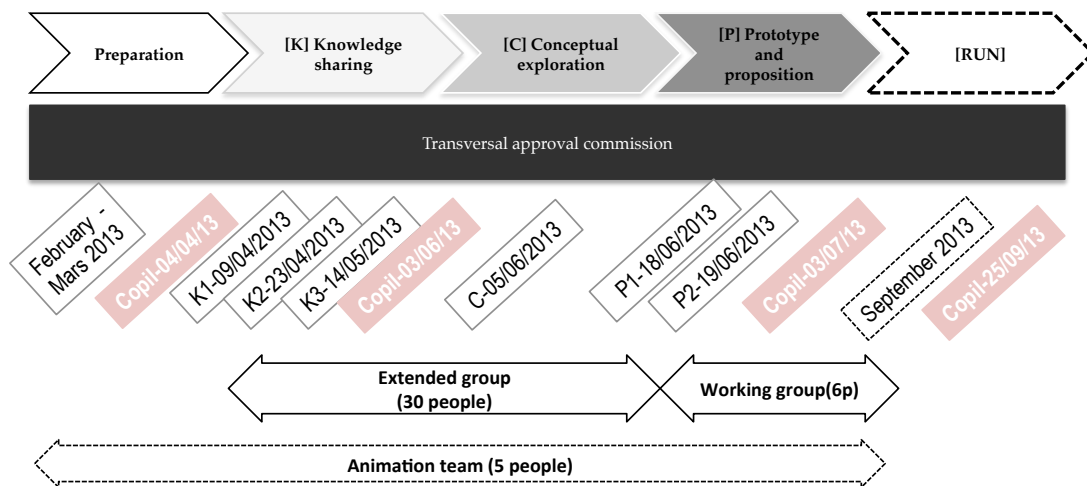


Figure 5.3 The 'Less Is More' workshops

5.2.3. General phases and low cost strategies in KCP

Here we will shortly describe the contents of each of the phases of the KCP, as well as the main outcomes of the method.

The preparation phase: defining the participants and the researched knowledge

The preparation phase had as main objectives to identify the contributors to the workgroup, to identify and contact the speakers for the K phase and to prepare the logistics and invitations for the K, C and P phase. The preparation was done during the months of February and March 2013.

Building an approval commission

The first step in the preparation phase was to identify and implicate the future members of the approval commission. To this means, the director of the innovation unit presented the research program on low cost and the aimed outcomes to the directors of several departments, and invited them to participate in the approval commission.

Identifying relevant knowledge and starting to build concepts

During this phase, a first effort was made to identify potentially interesting concepts to be explored, and a first structure was given to the existing knowledge about low cost coming from the benchmark phase. The knowledge needed to define a low cost strategy for RATP was of three different natures: on low cost products and services, about creating transport offers and about emerging markets. The preparation phase allowed us to identify interesting speakers on these topics. Some of these speakers were identified through their academic work

(books or articles they had written), others were recommended by their colleagues inside RATP and finally, some were part of the research partners. Once we had identified experts in these domains, we issued them invitations to come and expose their knowledge in a short 20 min presentation followed by 20 minutes of questions during one of the K sessions. Some of the experts were unable to be present at one of the days we invited them to come and we only had 8 presentations. However three other experts provided precious insight through three five-minute videos. We were able to record individual interviews with them and to edit short movies that could be diffused among participants.

Building the extended group

The extended group was built during this phase. The creation of this group was one of the most difficult tasks in the preparation phase. First we needed to identify relevant participants in all the departments. Although we could rely on the research and innovation delegates inside the departments to advise us in this task, in some larger departments it was still hard to make sure we were able to reach all experts. Furthermore, some of the research and innovation delegates were designed by their superiors to participate since the workshops were branded as a research and innovation initiative. This was not always desirable, since they were not always the best placed inside their department to bring relevant input to the workshops or to spread the knowledge gained inside their department.

Participants had to engage themselves to participate in all workshops (which meant two and a half days for the extended group and three and a half days for the working group). This was often difficult, because the participants' hierarchy had to agree to this. We had many complaints about this engagement that seemed to important for some of them, since the participation was often judged as unproductive time by their superiors.

Once the expanded group and the presenters had been defined and invited, we were able to officially launch the workshops, through an announcement on the company's innovation website and the creation of an on-line shared workspace for all participants. This workspace was designed to allow participants to interact and to share content. After this preparation phase, the K phase could begin.

The K phase: creating a common knowledge base

The first of the K workshops took place in April 2013. In this case, the knowledge phase was composed of three four-hour sessions, where the participants listened to different speakers. There were three presentations from experts in the first and the second sessions and two presentations and three videos in the third session.

During this phase there were three main different themes: examples of low cost products (low cost airlines, low cost hotels, the SWATCH, the Dacia Logan...); the transport sector (how the calls for tenders work, recent trends in the transport sector, the World Bank

transport projects financing...) and emerging markets (Latin America, evaluation of market risks...). The speakers came from different backgrounds. Some were researchers, others were employees of the transport operator and others were employees of other companies (like the World Bank).

Creating a common vocabulary and a common knowledge base

Through this phase we aimed to create a common vocabulary around low cost and a common knowledge base, as well as on the setting in which low cost offers should be developed for RATP. The first goal of this phase was achieved by introducing the participants to the innovation system for low cost around a performance evaluation, a design reasoning and an organization proposed in part I. To do so, we first gave the participants an in-depth understanding of some low cost products, services and organizations and the different cost reductions behind them. Once a common knowledge on low cost and on cost reductions had been created (giving participants knowledge on the performance evaluation and organization), the low cost design model was introduced (design reasoning). The second goal was to describe the markets and ecosystems in which the low cost offers should be designed and should operate. This was achieved through descriptions of the transport sector and on emerging markets.

Additional activities done during the K phase to guide the animation team

The participants were also already asked to participate in two group activities in each one of the sessions to allow the participants to better assimilate the content of the presentations. These activities furthermore allowed the animation team to better understand the group's concerns and yielded interesting results about some barriers to low cost.

The first activity consisted of answering some questions about the presentations, to point out what they considered the most important message of each presentation and what had surprised them. A third question was asked, being different in the first session than in the two other sessions. In the first session we asked them which associations they made between the presentations and their context inside the transport operator. However, the participants expressed their difficulty in doing this association, and during the animation we noted that in many cases the conclusion of any association was to render explicit a barrier inside the company. For the following sessions participants were therefore asked to explicit what they did not agree with or what they considered a possible barrier.

The second activity consisted of a number of short, filmed interviews, where participants had to answer three short questions about the day's work. The questions were also aimed to make them expose their vision of low cost, and what they considered the most important knowledge presented to them. The filmed answers were furthermore assembled into a video to help communicating about the work done. Having the participants express themselves before the camera had a double benefit: it helped them to take a critical stance to the work they were doing and to reformulate what they integrated from each session and it also allowed to gather material for a video on the whole process that would be diffused inside the

entire company.

The K phase was further enriched by the sharing of documents on low cost offers on the workspace that had been set up. Three participants posted contents they thought were important to enrich the common knowledge base and all the content of the K phases was made available for the participants through this workspace.

After the K phase the animation team was able to restructure the knowledge about public transport low cost offers and to propose new concepts, that would be explored during the C phase.

The C phase: Working on the concepts with a dual approach of low cost

The concept phase was articulated around three projectors: 1. **Operating a transport line like a low cost airline**; 2. **Designing a transport system that would have lower investment and operations costs**; 3. **A low cost transport ecosystem**.

The concepts proposed can be divided into three different levels. The first level was the operational level, the second level was the transport system level and the third one was the transport ecosystem level. The three levels were considered relevant because they allowed covering all the possible aspects of low cost identified through the benchmark done in part I: a low cost offer that mainly changes the business model and operations, like low cost airlines; a low cost that also changes the technical system and infrastructure needed like the Transmilenio bus rapid transit; and finally a low cost offer that demands changes on the ecosystem level, like the Space X Dragon, which introduced new actors and even demanded changes in the legislation.

This phase took place in beginning of June. The extended group was divided into three smaller groups. Each one of the smaller groups was asked to work on one part of the development of a low cost offer. The goal of this phase was to explore a concept and try to identify new research areas. Each concept that had to be explored can be described as a searchlight that tries to light a certain part of the knowledge, shared in the K phase. The concepts explored in this phase were chosen in order to make sure that the greatest possible space of innovation was covered. The main difference between the Less Is More workshops and a regular KCP was that we forced the usage of the low cost design model we proposed in Part I. **Each group was asked to bear in mind the two low cost design approaches – low cost adaptation and smart low cost design - and to propose at least one solution in each one of the approaches.** This is illustrated in Figure 5.4.

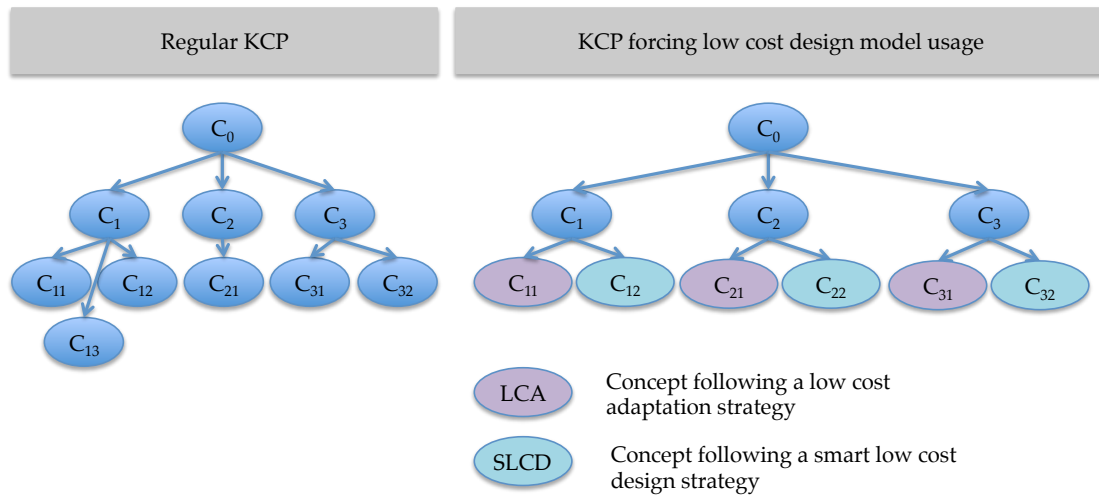


Figure 5.4 Difference between the C phase of a regular KCP and the Less Is More KCP, where participants were asked to use the two design strategies of low cost.

The first group worked on **operating a transport line with lower costs**. The main aspects of the dominant design targeted by this searchlight concept were on the transport operation organisation: ticketing, the existence of timetables, of a fixed itinerary, of a given frequency, as well as all the aspects linked to the user's comfort (seats, luggage space, air conditioning...). Additionally, the goal was also to make the group work on the notion of what would be a public transport that does not respond to all the criteria of a public service.

The second group worked on **designing a transport system that would have lower investment and operations**. The goal here was to break the transport mode fixation of the dominant design, by proposing transport hybrids, composed of some aspects of different modes. To do so the participants needed to revise both the infrastructure and the vehicle or rolling stock.

The third group worked on what would be a **low cost transport ecosystem**. They were asked to rethink the actors and stakeholders in the transport ecosystem and their interactions. They were asked to enlarge the ecosystem by taking into account all the local actors that could be involved and how they could contribute to develop a new ecosystem at a lower cost.

The aspects de-fixated at each level can be found in Figure 5.5.

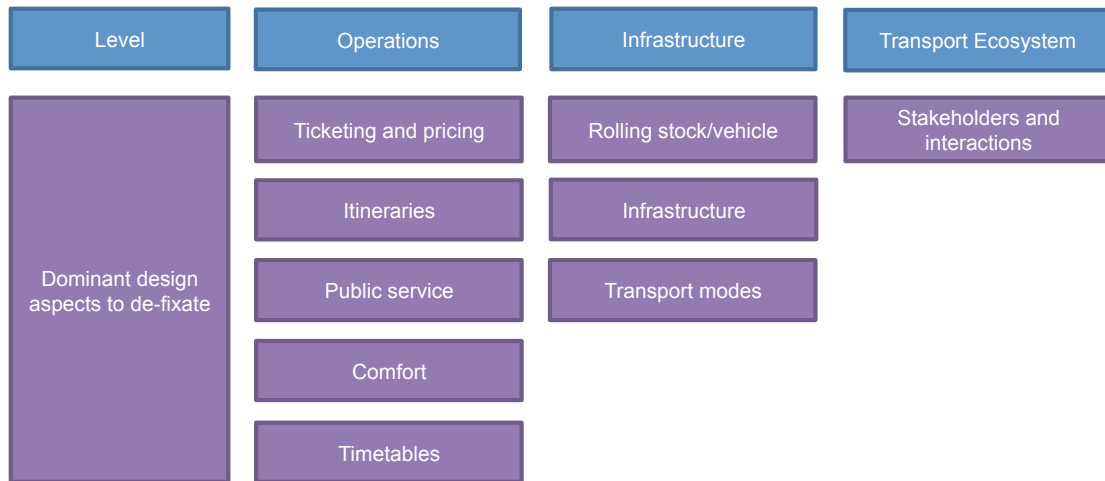


Figure 5.5 The aspects of the dominant design to de-fixate at each level

To increase the creative power of the whole group, each subgroup was asked to present its work, so that everyone could react to the propositions made. There were two presentations, one to present the results of the first work done in the morning and one to present the final results found after the work done in the afternoon. During this phase, two graphical designers were mobilized to help the groups to illustrate their concepts. Having these graphical designers available to sketch their offers and discuss them with them made it easier for the participants to present them clearly to the other participants. The material produced by them was furthermore used in the formalization of the concepts prior to the P phase.

The concept phase took one whole day, and participants were once more asked to answer some questions about the work they had done and about their vision of low cost in short recorded interviews. The outcomes of the C phase were restructured by the animation team and were used as inputs for the next phase, the P phase.

The P phase: Restructuring and recombining the outcomes of the previous phases

In the middle of June the P phase was launched. The P phase was composed of two half-day sessions with a reduced group of experts, designed as the working group, in the domains identified as essential for developing low cost offers. The participants of the working group were also present in the K and C phases. These experts helped to restructure and recombine the outcomes of the previous phases. This phase composes a strategy for the company linked to the explored subject.

The experts discussed the different concepts proposed in this phase, trying to bring up feasibility issues, existing knowledge and lacking knowledge inside RATP and to define what they saw as next steps. This phase's outcomes were five initiatives around which RATP's low cost strategy was articulated. **Due to confidentiality issues, we are not able to disclose the content of these initiatives. This is not an issue for the discussion of the initiatives in the next points, since using a higher conceptual level is sufficient for our validation purposes.**

These five initiatives will therefore be referred to as I1, I2, I3, I4 and I5. I1 is based on the low cost adaptation model, while the other four initiatives are based on the smart low cost design model.

The start of the 'Run' phase: a meeting to present the outcomes and to identify potential project managers

At the end of the P phase the 'Run' phase started, which consisted in structuring the work to be done, launching the different research and exploration projects and creating new partnerships.

A closing meeting was organized with the extended group to officially announce the results of the oriented creativity workshops. This meeting aimed to inform the working group and at the same time to thank them for their active participation and collect feedback. By presenting the results to the extended group first, we were able to get a first assessment of the projects' relevance from people who were involved in their creation. Their questions and remarks were essential to help create a coherent proposition that could be understood by people throughout the company.

The working group is also the best way to disseminate the initiatives inside RATP, so they were also invited to propose potential project managers. We encouraged them to discuss the initiatives with their colleagues and superiors, as well as to continue interacting with the other working group members.

After the meeting, a four-minute video was broadcasted inside RATP to communicate about the 'Less Is More' workshops outcomes and about other similar workshops that would be launched by the innovation department. This aimed to inform about the future projects on low cost as well as about the possibility for experts inside the company to participate in similar workshops if they were interested.

In the 'Run' phase, the five developed initiatives and all the proposed next steps were translated into actionable items by the author and an intern. This meant to formulate research projects opportunities to acquire the lacking knowledge, to identify possible prototyping opportunities and to contact those potential project managers indicated by the extended group or the approval commission. Once the projects had been formulated in the appropriate corporate language, they were submitted to the innovation department and the strategic committee for approval. Although over twenty projects had been initially proposed to cover the entire scope of the low cost strategy, the deliberate choice was made to submit five of them to the approval committee in 2014, the others should be launched according to a proposed roadmap. Of these five projects, one was linked to the "low cost adaptation" approach and the other four projects were linked to the "smart low cost design" approach.

5.2.4. Beyond the KCP: Managerial support of the creation of low cost strategies

To develop a low cost strategy, the KCP done in the company is essential, but it needs to be further supported, otherwise the strategy would probably fail. In the case of other similar work on other subjects inside RATP, the lack of other managerial initiatives led the subject to be gradually abandoned, due to internal resistance to change, lack of clear leadership, lack of understanding of their value, subject considered as not urgent, turnover inside the company amongst other challenges. This shows that the oriented creativity method is not a “stand alone” to allow the development of a strategy. Beyond it, there is a need for managerial initiatives and the adaptation of tools to make the strategy possible.

We will describe several managerial initiatives and tools developed inside RATP that helped in the strategy’s development. To be able to better place them inside an innovation field, we will use the model of an innovation field proposed by Vera (2014) in a work co-tutored by the author, based on an extensive literature review. This model is illustrated in Figure 5.6, and will be used as a framework to show the aspects of an innovation field lifecycle addressed by the KCP method and those that were also addressed by other initiatives or methods.

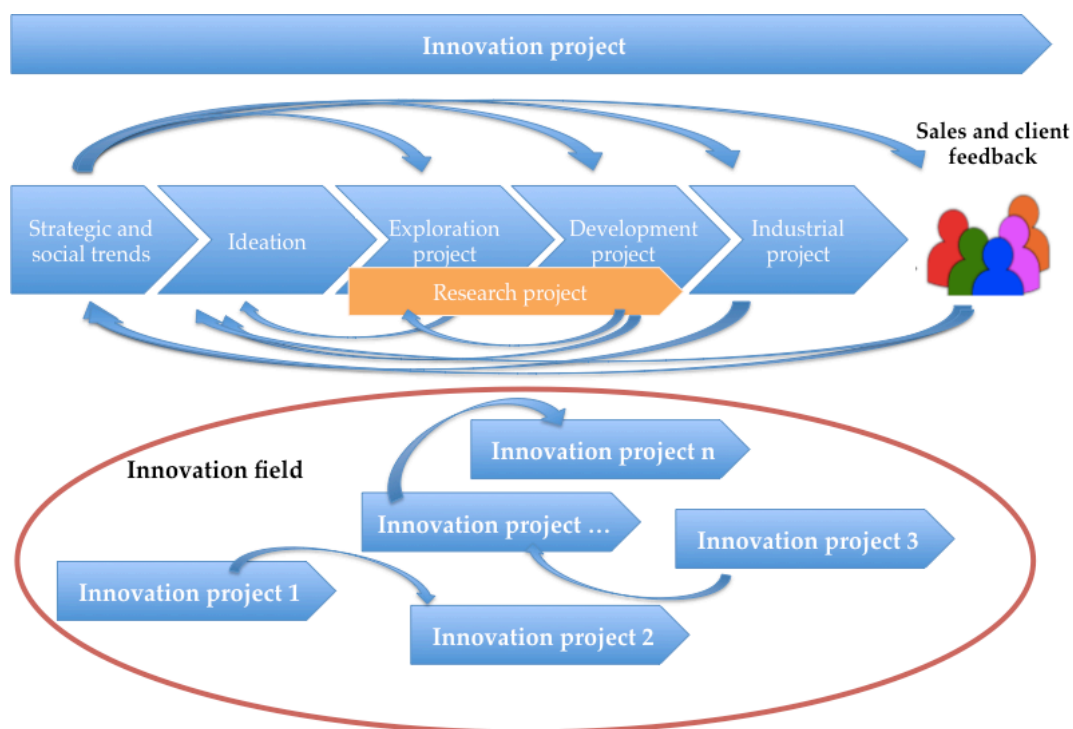


Figure 5.6 Model of an innovation project and of an innovation field adapted from Vera (2014)

The KCPs launched inside RATP classically concerned an entire innovation field. That was also the case of the Less Is More workshops. The KCP was launched after important strategic and social trends had already been identified; the innovation field of “low cost” was defined

thanks to them. But the strategic and social trends were further explored in the K phase. The C phase mainly encompassed the ideation phase and the P and Run phases proposed research, exploration and development projects. Several aspects of the innovation field management, like the identification of strategic and social trends, the creation of links with other innovation projects or the transition of a development project to an industrialization project are not covered by the KCP, and demand other managerial tools and initiatives, which are detailed below.

A video on the Less Is More workshop

A four-minute video was compiled based on images filmed during the KCP and the participants' and presenters' interviews. The video was intended to be diffused inside the company to help diffuse the KCP method and to advertise the research and innovation unit's work. But it also helped to diffuse the low cost initiatives and the value of the entire innovation field. It helped to increase the acceptance and leadership position of some of the members of the group, who were accepted by their colleagues as contact points on subjects linked to low cost. And it was a powerful communication tool to explain the innovation field to potential contributors of one of the projects.

Putting in place procedures for research projects and a new information system

During the KCP, a series of difficulties linked to accessing knowledge were uncovered. There was often a lack of information on research projects finished more than two years ago. The research projects were traceable through the research budget in the information system, but this system was not build to give access to relevant non-financial information on the project. Most of the time, retrieving information about one project meant to find the person that had been in charge of the project and hope that he or she had time to explain what had been done. It has to be added that, in many cases, relevant knowledge existed inside the business units, and was hard to access even when it was developed in a research project. Research projects were only traceable through the information system when they were partially funded by the research department. All the projects that been developed without this kind of funding were simply not listed here. And when there was important turnaround in the company, relevant information simply got lost.

To improve knowledge management inside the company, new procedures were put in place. One of them was to demand the filling in of a record for every research project launched, and a record with the main results for every finished project. Although these procedures were mostly developed independently of the author and the KCP team, their development was fundamental to improve the innovation field management inside RATP. These procedures and records were linked to a new innovation and research information system, developed by a specialized consulting firm. This new information system should allow having a centralized access to all project-linked information, both to allow knowledge management and to help in a more strategic view of projects, by showing the value of each project for an innovation field.

Non-financial project evaluation

Another way to help in the understanding of the value of different research, exploration and development projects, is currently being developed through a new non-financial evaluation of projects. A work group in which the author was included was constituted to develop this new evaluation system. The main goal is to avoid missing important opportunities, like with long term research projects that do not have an immediate payback, but are essential to develop other research projects. It will be included in the new information system for research and innovation discussed above.

Complete and simplified C-K and project maps for knowledge management and communication

Since each KCP tackles an entire innovation field, and that these are part of RATP's global strategy, it is extremely important that the work done inside a KCP should be easily actionable, so that projects can be launched when all conditions are reunited to do so. To improve capitalisation of work done inside the KCPs, a C-K and project map, like the one represented in figure 5.7 was drawn for each KCP and made available to the entire research and innovation team. Thanks to the C-K and project maps, the main concepts and proposed projects for each KCP are easily accessible and they can be placed in a global strategy. Being very visual, the C-K and project maps have also been used in simplified versions to improve communication concerning the innovation field or an innovation project (see figure 5.8 for an example of simplified C-K and project map).

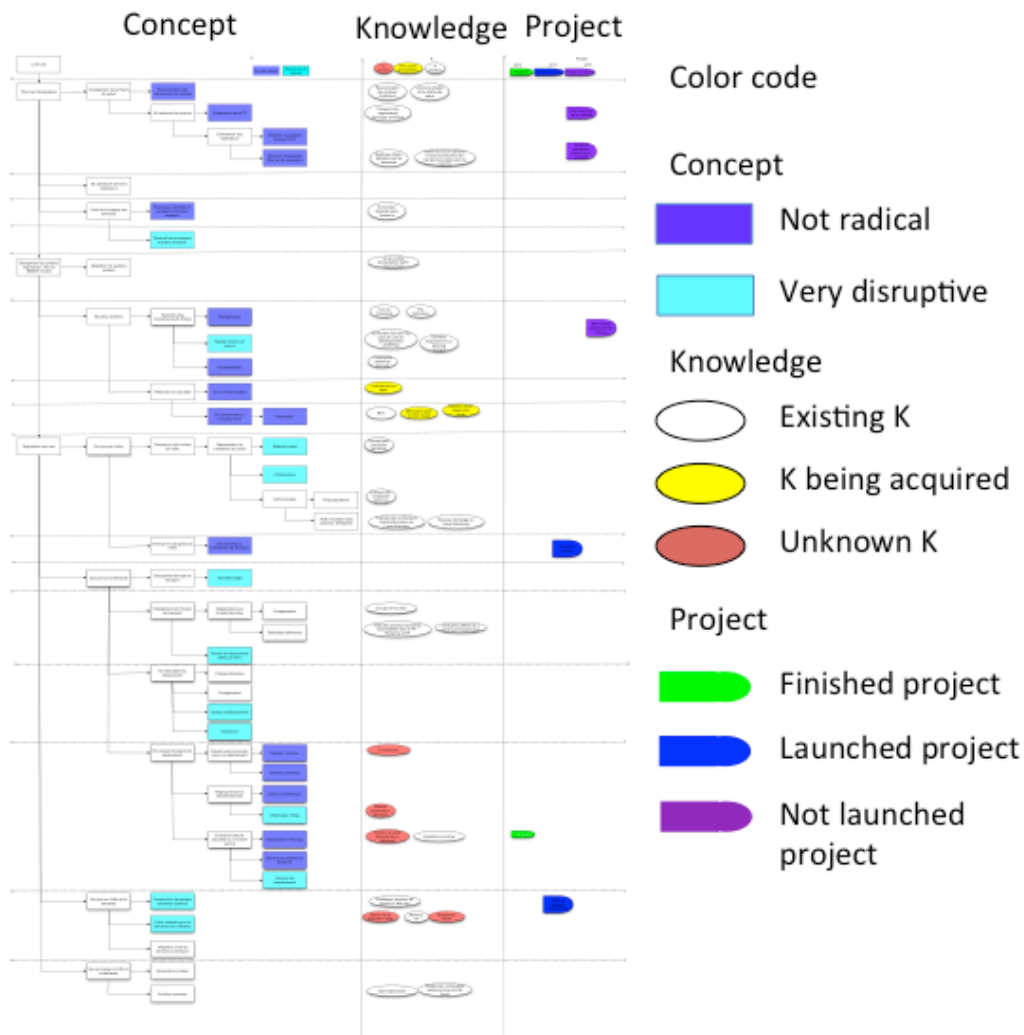


Figure 5.7 The C-K and project map used to track evolutions in an innovation field explored by a KCP

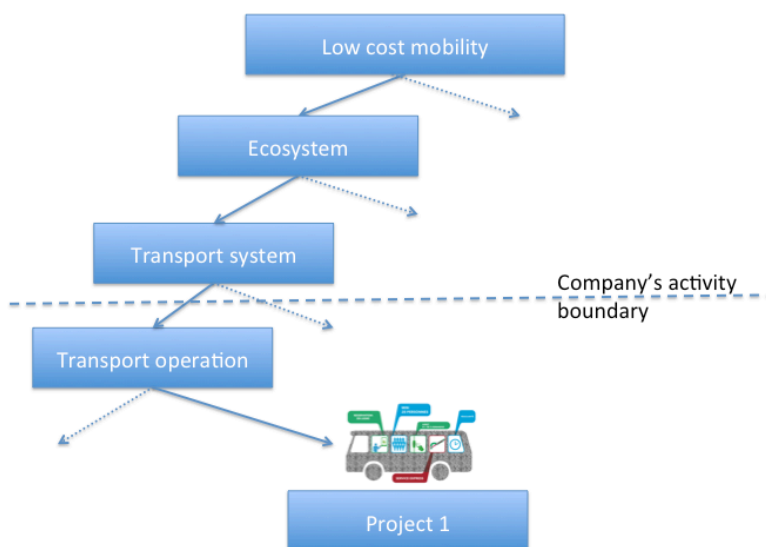


Figure 5.8 Simplified C-K and project map used to communicate on a project or on an initiative inside an innovation field

Using a capability roadmap for a temporal vision

A capability roadmap (see figure 5.9) was proposed to help giving a temporal vision of the subjects that should be developed in the coming years to have a successful low cost strategy. This roadmap encompasses two major events RATP will have to face: the opening of its historical bus market in the Parisian region to competition in the end of 2024 and the opening of the light rail market in the Parisian region in the end of 2029. It positions the next steps to be taken on a timeline, and therefore avoids one risk identified in innovation management only with a KCP: that the subject could be considered not urgent. The roadmap allows showing how not working on one aspect this year will have a negative impact on the development of a strategy on the long run and might compromise the company’s goals for 2025.

This representation was chosen since capability roadmaps are amongst others recommended for mature businesses facing threats from new competition, and who need to identify new or adjacent business opportunities, for businesses facing strong pressures on increasing efficiency and productivity in development work and for businesses with critical skills and capabilities which could be lost through retirement (Eagar et al, 2013). This roadmap’s goal is to give directions for the “how” and “when” once the “what” has been decided.

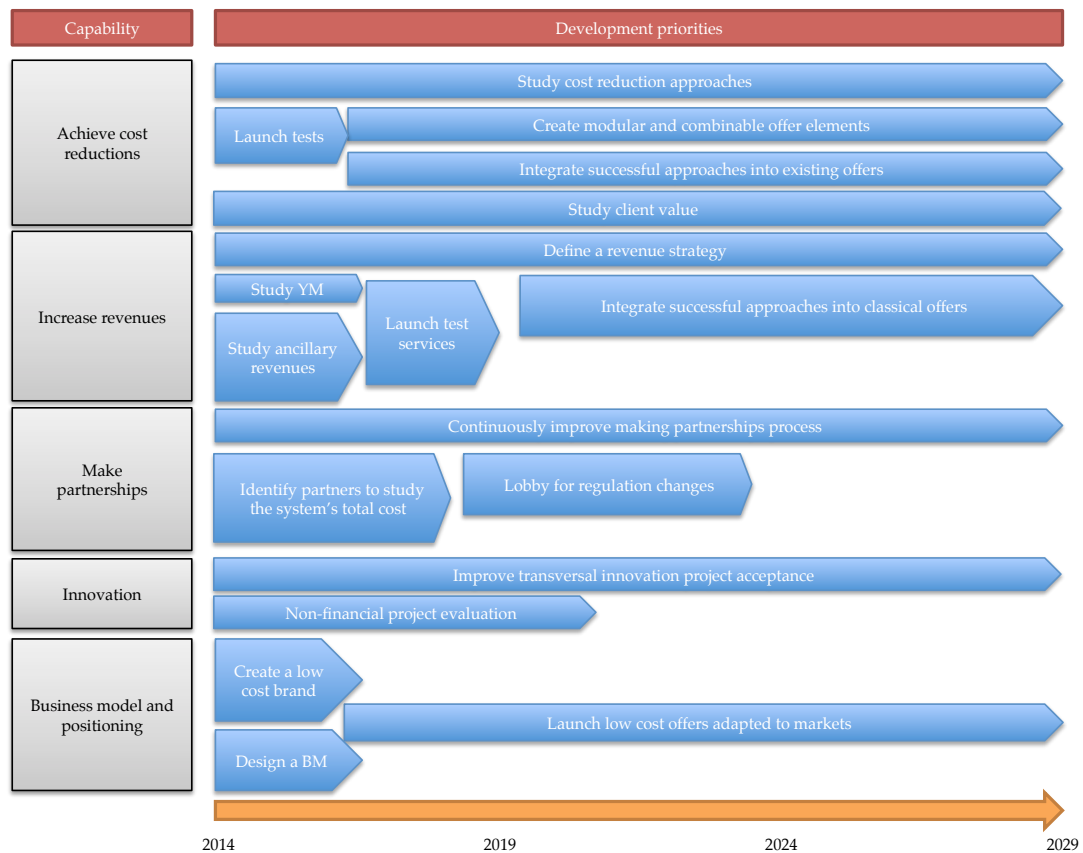


Figure 5.9 Proposed capability roadmap for the low cost strategy

Several actions contained in this roadmap have already been started; they will be further

discussed in the chapter on the results of the KCP. That's the case for studying cost reductions and client's perceived value, as well as the identification of partners for the study of the system's total cost. RATP also already started to develop dynamic capabilities for innovation through the low cost research program.

Table 5.2 recapitulates all the tools and managerial initiatives discussed in this section and the phases of the lifecycle of an innovation project/innovation field they were used to cover.

Table 5.2 Tools and managerial initiatives discussed in this section and the phases of the lifecycle of an innovation project/innovation field they were used to cover.

Tool, initiative or method	Innovation field lifecycle	Challenge or difficulty approached
KCP	Entire innovation field, excluding industrial projects	Creating legitimacy, proposing innovative ideas
Video	Entire innovation field, excluding industrial projects	Communication, creating legitimacy
Procedures for research projects	Research, exploration and development project	Knowledge management
Innovation and research information system	Research, exploration and development project	Knowledge management, Strategic vision
Non-financial project evaluation	Research, exploration and development project	Identifying value creation
C-K and project maps	Entire innovation field, excluding industrial projects	Knowledge management
Simplified C-K and project maps	Entire innovation field, excluding industrial projects	Communication, Strategic vision
Capability roadmap	Entire innovation field	Temporal vision

5.3. Strategic impact of the KCP innovation process and results

As discussed in the beginning of this chapter, the main goal of launching the KCP was to develop a low cost strategy for RATP. The KCP aimed to give a clear roadmap of the different actions that should be taken to develop that strategy. The actions proposed were research or exploration projects to be launched and partnerships to be made. They were articulated around five initiatives issued from the KCP. These initiatives had as a goal to cover the low cost innovation field as thoroughly as possible. They should allow identifying the lacking knowledge needed to create low cost offers inside RATP.

The initiatives were compared inside the company to concept cars. They allowed studying most aspects of low cost that could be included in offers latter on through five offers that would not necessarily be launched. But the fact that the low cost aspects that should be studied were integrated into offers made them more understandable for all actors and easier

to grasp.

Beyond this proposed strategy and the initiatives that were launched inside RATP with its associated projects, the case study inside RATP allows us a certain number of analysis and returns on the theoretical elements proposed so far. We will here discuss the capacity low cost as a managerial object has of rendering explicit the innovation paths around the company's vision of the dominant design of their product and how it allows the discussion around breakthroughs. Our analysis allows us to state that working on a transversal object, like costs, allows us to propose innovations that cover all the aspects of a complex system like public transport.

5.3.1. Expliciting the dominant design and fixation effects

As stated above in the description of the method, during the K phase, participants were asked to respond to a series of questions after each presentation, on what was considered important knowledge; of what surprised them; on associations they saw inside RATP; and on what they considered possible barriers. These answers were used during the KCP to better organize the following sessions, and to make sure the important content was integrated. However their analysis also allows identifying tacit aspects of the dominant design, as well as lacking knowledge inside the group.

We collected 214 answers for the first question on what was considered important knowledge by the participants, 132 answers on what surprised them, 49 answers about an association inside RATP and 65 answers on what they considered possible barriers. The split of answers per session can be found in table 5.2.

Table 5.3 The number of answers from the participants by session

Session	Important knowledge	Surprises	Association inside RATP	Barrier or do not agree with
K1	103	65	49	-
K2	60	40	-	55
K3	51	27	-	10

The author furthermore classified the answers into 22 different categories, and the classification and number of answers per category transmitted to the participants after each session with a synthesis of each session. In the collected participants inputs, they declared that the most important knowledge they acquired during the entire K phase was on the **transport ecosystem** (14% of the responses), on **function removal and function creation** (12% of the responses), on **disruption** (8%), on **change in the identity of the object** (7%), on **change in value, price and cost** (7%) and on the **importance of the client value** (7%). The total split of answers can be found in Figure 5.10.

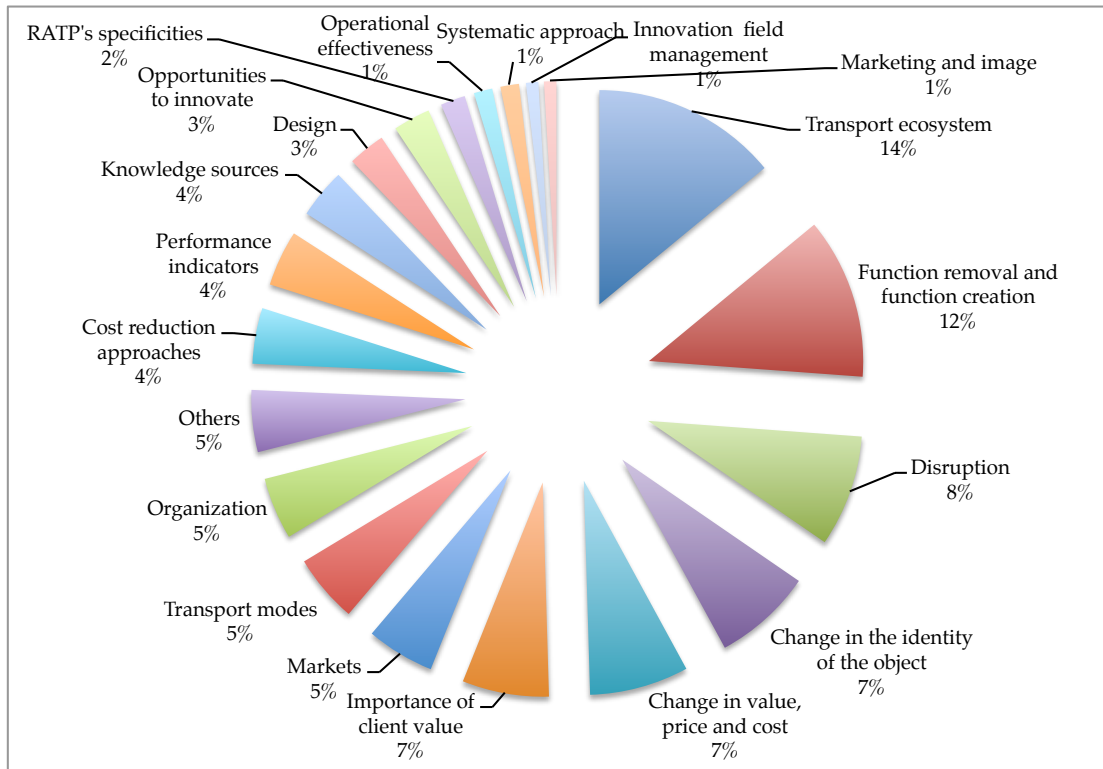


Figure 5.10 The most important knowledge brought in the K phase according to the participants

In the six main points that surprised the participants after the presentations we find three of the six most important messages, which are the **change in the identity of the object** (10% of the answers on what surprised the participants), the **transport ecosystem** (8%) and the **change in value, price and cost** (7%). The total split of the answers in the different categories can be found in figure 5.11.

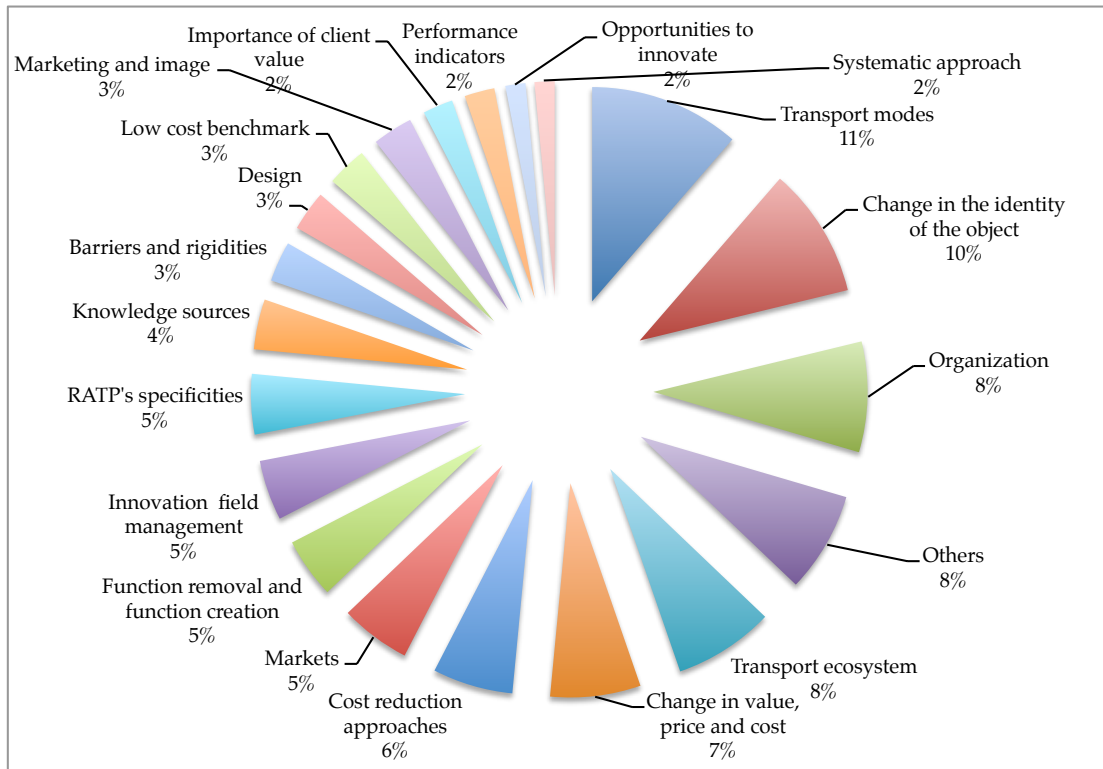


Figure 5.11 The surprises the participants expressed after the presentations in the K phase

Our analysis allows us to conclude on the importance of working **on the transport ecosystem**. It clearly shows that actors inside the transport operator do not have a global overview of their ecosystem and did not consider the entire ecosystem when proposing solutions. Therefore, they were blind to a great part of the dominant design of public transport, greatly linked to other actors in the sector. That made it impossible for them to rethink some aspects of that dominant design.

We can furthermore state that many participants were not aware that innovation could mean a change in the identity of the object. This indicates how the company is used in working inside its sector's dominant design and has difficulties in proposing breakthroughs. The realm of the solutions proposed inside the operator mostly tuned around three technical aspects of the dominant design: The classification in transport modes, the vehicle or rolling stock and infrastructure. This was mainly linked to what was considered the core activity of the transport operator, operating a public transport, and to the historical perimeter of the company, which included the maintenance of infrastructure and vehicles. Most of the proposed innovations so far were therefore linked to reducing operating costs, as illustrated in Figure 5.12.

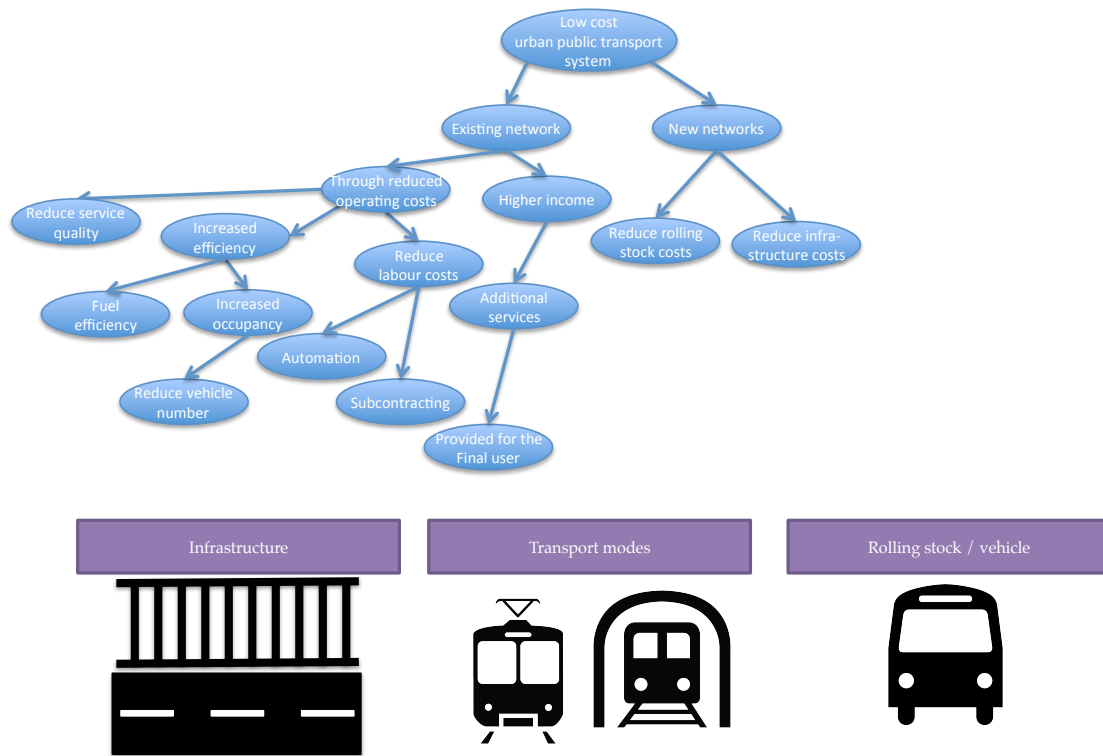


Figure 5.12 The low cost propositions intuitively explored inside RATP and the aspects of the dominant design first considered

These are some elements that demonstrate the company’s lock-in in the dominant design, and the need to use a deliberate strategy and an oriented creativity method to explore paths outside this lock-in. As proposed in the case of orphan innovations (Agogu e et al., 2012), there is a cognitive lock-in, and illustrating the possible paths-in-the-unknown helps identifying the existent gap between the existing paths and paths considered valuable. These are relevant information for the launch of research projects trying to explore paths outside the lock-in. We will discuss how these paths could be explored further on.

5.4. Validation of the KCP outcomes through our utility framework

At the beginning of the ‘Run’ phase, five initiatives had been defined. These five initiatives allowed covering the three levels described previously. The first level was to allow low cost operation of an existing transport network; the second level was to develop a transport system that was low cost to build and to operate; the third level was to propose a low cost transport ecosystem that contained other actors besides the transport operators. Each one of the initiatives was supposed to allow RATP to learn about different aspects of low cost offers, enriching their knowledge base on the subject.

We here verify that the five initiatives allowed exploring all the different aspects identified in our theoretical framework leading to our double approach low cost design model. The

initiatives not only explored the two different design approaches – low cost adaptation and smart low cost design – but also explored all the utility parameters – function removal, negative transfer, positive transfer and function addition. Furthermore, the initiatives allowed to re-discuss the dominant design of French public transport, challenging different aspects of this dominant design: the technological paradigm, the business model, client value and functions. We will explicit how each of these aspects was treated based on examples from the initiatives.

Function removal: the most currently used utility parameter

All the initiatives treated function removal, but the one who did it in the most systematic way was the initiative build by following a low cost adaptation model, I1. The initiative mainly aimed to identify what are the essential functions in a bus-based system, and which are the functions that can be considered secondary. The goal was to evaluate the costs and perceived client value of each function, and to recompose a new offer containing only the essential functions and the high value and low cost secondary functions. This initiative aimed to learn about what are considered ‘frills’ by the customers. Following the ‘low cost adaptation’ logic, it evaluated the existing offer and tried to remove all the frills.

This study could quickly be launched and some interesting insights had already been gathered from this study and explored by the marketing department in 2014. We can for example cite that some functions that might have been considered essential, like being able to sit comfortably or being able to buy tickets inside the bus, were clearly less important to the users than expected. This and similar insights gave the operator a better view of the user utility and elements to negotiate with his client, the transport authority.

One proposed function removal is to remove the possibility for all users to have access to seats in the bus. The idea is to keep only seats reserved for the elderly and disabled. Although participants of the workshop were quick to joke about removing seats, they were uncomfortable in proposing this seriously, because they did not reflect on the insured function, but only on the technical solution. This was added to the fact that they did not explicit some aspects of the dominant design, and therefore were unable to discuss changes in these aspects. Many of the possible options were therefore not even considered before the work done inside the workshop. Another proposed function removal was to remove the possibility to purchase tickets inside the bus. The driver assures this function nowadays, which makes it possible for users to go on-board even without a ticket.

These propositions allowed rendering explicit aspects that were tacit in the dominant design for the transport operator and opening new paths in the design space previously not explored. Figure 5.13 illustrates the kind of path opened by these reflexions in green, as well as some of the tacit aspects of dominant design.

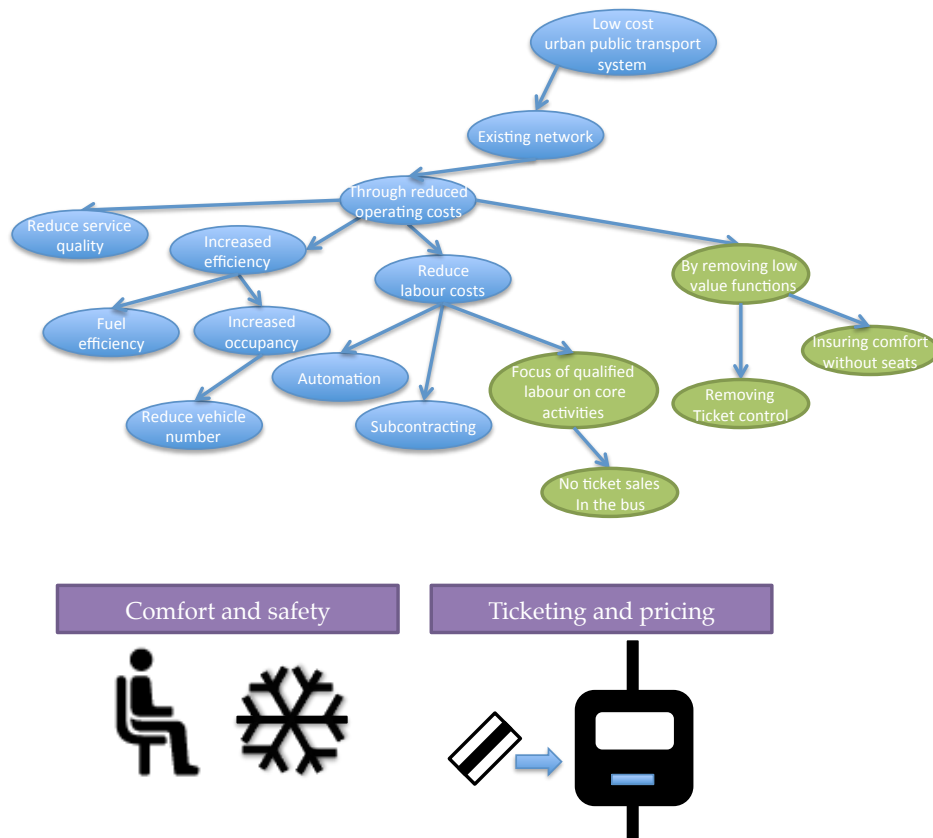


Figure 5.13 Example of paths opened by the use of function removal and the tacit aspects of the dominant design challenged

Removing some functions clearly made it important to find other ways to create value, so many function removals had to be accompanied by other function additions to make coherent offers. One possibility was to remove seats inside the bus, but that also meant insuring a minimum comfort and safety to passengers through other possibilities, like introducing bars, and demanded to study the comfort when standing in a bus.

Function removal was also a way to create awareness amongst the participants of the workshop of the importance of creating value for different actors. The removal of ticketing control inside the bus would have little impact on the customer value (and might even potentially increase it), but would greatly reduce value for the transport authority and for the operator. The ticketing control system is nowadays used to gather important data about users' journeys and also to pay the transport operator. Removing this system demanded to find other ways to insure the data gathering and also another payment system for the transport operator.

Negative transfer: how to transfer activities to the client without challenging safety and security

Negative transfer was discussed in different configurations. Many activities seemed hard to transfer to the customer without a support, due to safety, security or control reasons. Many of

the activities evoked as possible transferable to the user were therefore rather considered for a positive transfer. The classical negative transfer activities found in low cost airlines were also considered in this case. Asking the customer to print his own ticket and to print his own paper plan were some of the options. But in the ticketing case a positive transfer on the tickets has already been operated for some types of tickets. It is already possible to recharge monthly tickets through the Internet by using a device sold by the company. And the possible cost reductions of this negative transfer were difficult to evaluate.

However, negative transfer was considered as clearly more rewarding in the case of a risk transfer. Nowadays, the transport operator always insures the transport that has been defined with the transport authority. The risk on frequentation, which means the number of users inside the transport, and therefore if financially the transport reaches the break-even point, is carried by the operator or the transport authority, depending of the type of contract. One negative transfer proposed was to transfer this risk to the client in the case it was carried by the operator. But instead of having a transport operate at loss like would have been the case previously, in this case the transport would not be assured in the new offer. Instead, the transport would be cancelled if not enough customers booked their transport beforehand. This negative transfer not only reduced costs, but further transformed a financial risk for the operator into an operational risk for the client.

Positive transfer: building tools to allow the client to participate in the production process

Positive transfer was also proposed as part of the 'smart low cost adaptation' initiatives. As cited beforehand, many activities seemed more adapted for a positive transfer due to safety reasons. One example consisted of giving the client part of the work of itinerary creation. The company proposed to give the client the tools to do so through software, allowing the client to profit from the company's expertise. And this would also allow the company to avoid the proposal of itineraries that might not comply with public transport safety regulations or traffic laws. Figure 5.14 gives an example of path opened by positive transfer, as well as the challenged aspect of the dominant design. This aspect was tacit inside RATP, and was explicated by the work done during the workshop for the participants. Even though they were all aware of the need for the itinerary design, it was hardly considered as an aspect that could be changed.

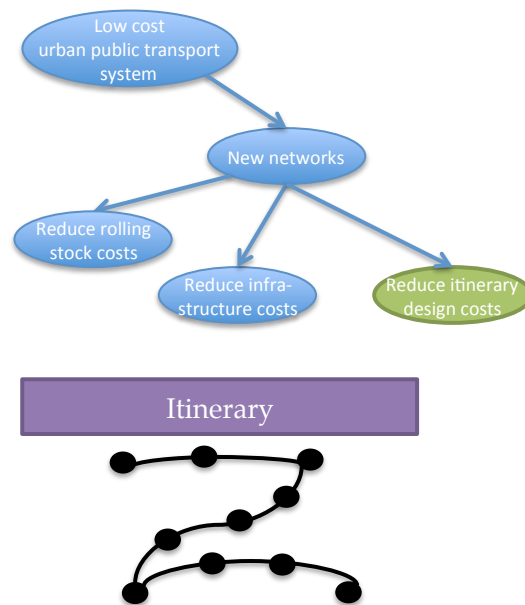


Figure 5.14 Example of paths opened by the use of positive transfer and the tacit aspects of the dominant design challenged

Function addition: Creating 'smart low cost design' innovations

Function addition was developed in all the initiatives in the 'smart low cost design' approach. Different functions were considered as relevant for the client or for the user and were therefore developed in different initiatives. The interest in adding several new functions also explains the great number of initiatives launched in the 'smart low cost approach'. Due to their diversity and to the interest expressed by RATP's managers to integrate new functions, launching four initiatives in this approach was relevant.

Mass customization was at the heart of some of the proposed additional functions. Hatchuel et al. (1990) already speak of service customization in public transport when discussing the creation of the 'carte integrale', and customization is described as the next step to modernize public services. In the added functions in the low cost initiatives, the customization is taken even further, by proposing not only a customized ticketing system, but also an entirely customized transport offer: the client can choose where he wants to go and at what time. The creation of itineraries according to customer demands is already done in the case of some transport services like Kutsuplus.

Advanced booking in public transport and therefore being sure of the time and location where to get public transport were also part of the studied functions to be added. Booking public transport is already possible in some cities, where on-demand flexible transport exists, also known as demand-responsive transport (DRT) and that has been described as a niche market to replace conventional transport (Mulley and Nelson, 2009).

Another group of functions added are linked to extra services. Some extra services, like having a seat, are currently very demanded by public transport users. A well-known blog in

Paris, called “My Little Paris” broadcasted the possibility to book a seat for one euro in the metro⁶¹ as an April fool’s joke. The joke was commented on a series of different websites and voted best⁶² and/or most desired to come true⁶³ by some. This is a clear indication that extra services are called for in public transport and that some customers are even willing to pay extra for these services.

Table 5.4 recapitulates the approach to the utility parameters and some examples of how the subject was treated.

Table 5.4 The utility parameters in the low cost public transport initiatives inside RATP

Utility parameter	Dominant design	Examples of applied change
Function removal	Existence of seating for all the users	No seating available for the users, except for the elderly and the disabled
Function removal	Sales of tickets in the bus by the driver	No possibility of buying tickets in the bus
Negative transfer	Printed plans made available by the transport operator	Printing plans transferred to the user, the operator only makes the information available
Negative transfer	The transport operator always assures the transport. For a transport that is empty the transport operator carries the financial risk.	The user carries the risk of not having his transport in the case where there is no sufficient interest in the transport and the financial break-even of the transport is not reached
Positive transfer	The itineraries and transport services are created by the transport authority and the transport operator	Allowing the user to create his own transport service with a personalized itinerary for an identified need through a software made available by the transport operator
Function creation	No seating reservation	Allowing for seating reservation for a fee
Function creation	No booking of public transport possible	Advanced booking possible, making it possible for the user to be sure his transport will be available

Breakthroughs in the dominant design of public transport

Besides the fact that each utility parameter already allowed challenging the public transport’s dominant design, a more structured view of the dominant design was made possible through the work done on costs. Several elements were not seen as aspects of a dominant design by the operator, but as constraints, imposed on them by other actors. The work done during the workshops allowed to explicit a dominant design for public transport comprising all the elements. Every aspect of the dominant design was then revisited through the KCP.

⁶¹ Available on <http://www.mylittleparis.com/>. Retrieved on the 1st April 2014.

⁶² Available on <http://tempsreel.nouvelobs.com/vu-sur-le-web/20140401.OBS2205/les-10-meilleurs-poissons-d-avril-vus-sur-le-web.html>. Retrieved on the 4th September 2014.

⁶³ Available on <http://toutelaculture.com/actu/vous-y-avez-cru/>. Retrieved on the 5th September 2014.

Challenging the technical paradigm

The technical paradigm was revisited in all aspects identified, which were the existence of well-defined transport modes; the need for a physical transport infrastructure, composed of tracks, rails, stations, etc...; the technology of rolling stock and vehicles ; itineraries and timetables. Challenging the technological paradigm for example went through proposing new hybrid transport modes, to attain markets for which the existing modes are not adapted, but keeping low costs. Rolling stock and vehicles were also revisited in the initiatives. Some proposed changes concern the adaptability of the vehicle to the demand, while others tried to reduce costs by looking for new propulsion modes and using local resources.

Furthermore, on the transport system level, propositions were made to apprehend transport infrastructure differently. This was inspired from the competition of services like Uber and other transport services that can be booked. These services partly rely on already existing infrastructure like parking spaces and drop-off zones to collect customers and have replaced part of the physical infrastructure by a virtual infrastructure. For those infrastructures that still need to be constructed, time and cost constraints were integrated, and a new, prefabricated infrastructure was proposed, to reduce the construction delays that would allow less local impact, being assembled from standardized parts.

Changing the public transport business model

The business model was challenged both by changing the relationship with the user and the relationship with the transport authority. The initiatives allowed introducing mass customization into the transport offer, but one of the main consequences of allowing the user to customize his transport was the introduction of client refusal – in some cases the transport operator needs to turn down a customer because the demanded transport is not feasible. This goes against one of the main characteristics of the public service dominant design, which is the fact that it does not exclude anyone. Once one of the characteristics of public service had been challenged, this opened up a reflexion on how to challenge all of them. Figure 5.15 illustrates paths opened up by challenging the public service characteristics.

The business model was also radically challenged by the vertical integration of some activities previously done by other actors. The integration of crowd funding and crowdsourcing, to allow the different actors to develop their own transport was also a possibility, and also demanded a radically different business model.

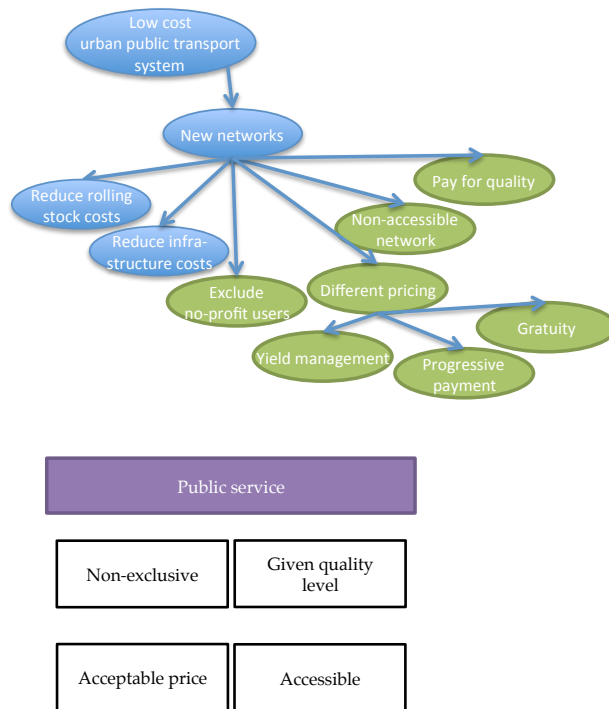


Figure 5.15 Example of paths opened by challenging the public service characteristics (in green)

Revisiting client value

Reconsidering who was the client and what were his essential concerns revisited client value. The importance in the creation of new meaning to produce successful innovations has been thoroughly discussed by Verganti (2013) in his work on design driven innovation. This creation of new meaning is one of the aspects of innovations in changing the objects identity, the client value change. As pointed out by Verganti (2013), many companies do not see the importance of meaning, and others do not see how to innovate them. The KCP showed that this was also a barrier to innovation for a low cost mobility: the change in the client value of transport and mobility was hard to envision inside RATP.

When asked during the workshops of what the value of mobility consisted, most of the participants answered it was “going from point A to point B”. Further questioning led them to included adjectives like “safely”, “quickly” or “comfortably”. But despite some recent repositioning of the group’s business, by starting to operate sightseeing tours in some cities⁶⁴, that clearly do not have “going from A to B” as its main value, other value positioning was hardly brought up. And despite recurrent programs inside the company aiming to change the view on the value of mobility, like the “cognition et mobilité” or “metro du XXI siècle”, other value propositions were still discarded as outside the core business, especially by those in

⁶⁴ RATP dev, one of the subsidiaries part of the RATP group operated sightseeing circuits in Paris, in New York and in Bath in the beginning of 2014 and acquired a new service in London in September 2014. A press release on the acquisition is available on http://www.ratpdev.com/sites/default/files/ratp_dev_announces_the_acquisition_of_the_original_tour.pdf, retrieved on the 25th September 2014.

direct contact with transport operation. This showed an awareness of the importance of changing the client value inside some departments, but this was confronted to a core resistance, linked to the expertise in operating public transport.

Finally, another important aspect that was a barrier to changes in client value was the definition of the client. In the classical business model inside RATP, the client is the public authority. However, in the proposed innovations, the client might be someone else – a business trying to put in place a private service, an association or even the travelers themselves. The value identified for the transport authority was in improving service for the users. Value identified for the user in the dominant design was mainly evaluated through the comfort and safety. During the workshop, this was complemented by allowing access to transport and increasing transport flexibility, both in space and time. Furthermore, by challenging current stakeholders and their interactions, it became clear that the operator could not only provide additional services to the final user, but also for the public authority, for other operators and for other actors, like associations. This also led to a different reflexion, on a low cost transport ecosystem, not only a low cost transport system. Some of these paths are exemplified in Figure 5.16.

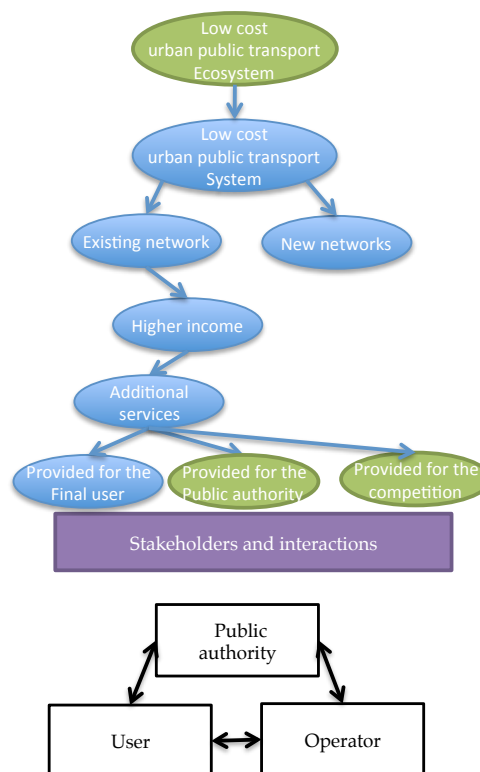


Figure 5.16 Example of paths opened by revisiting stakeholders and their interactions (in green)

Changing the functions of public transport

The functions of public transport were radically changed by all initiatives proposed, since every one of them had either a function removal or function addition as utility parameter. One example of breakthrough concerns the fixed itinerary and timetables that are part of

public transport's dominant design. Through our initiatives we allowed users to define not only from where to where they wanted their transport to take them, but also at what time, completely independent of timetables.

Table 5.5 shows how the dominant design was challenged by our proposed initiatives, through some examples on the proposed breakthroughs in the dominant design.

Table 5.5 Examples of breakthroughs in the dominant design of public transport proposed by our initiatives

Aspect	Dominant design	Proposed breakthrough in the dominant design
Technical paradigm	Physical transport infrastructure: stops, tracks and roads	Replacement of real infrastructures by virtual infrastructures
Business model	The transport operator provides public transport to the users following instructions from the transport authority. The transport authority is in charge of ticketing and pricing.	Transport is funded and defined through crowd funding and crowdsourcing organized by the transport operator, without the intervention of the transport authority.
Client value	Client value defined as safety and comfort inside the transport.	Complemented by allowing access to transport and increased transport flexibility
Functions	Fixed itinerary and timetable	The user can compose his own itinerary and stops and can define the time of his transport, independently of a timetable.

We can therefore state that the main outcome of the KCP was to propose a strategy that allowed covering all the aspects of low cost and to propose several breakthroughs in the identity of the studied object, public transport. This allowed the public transport operator to justify and structure the research programme.

The changes in the dominant design and the approaches to utility parameters discussed previously, clearly show that the low cost strategy is therefore interesting not only to propose low cost offers, but also to **revisit the identity of public urban transport**. The work on low cost helps the company to **justify challenging the dominant design and working outside what was first considered its scope**. It can therefore reinvent what should be public transport. The research and innovation department was able to use the work on the low cost strategy to propose new partnerships that allowed the company better extend its research effort beyond its core competencies boundaries.

Furthermore, it supplies the company with tools to **discuss its tasks and the design space with other concerned actors**. Through the work done in the low cost strategy, there was a creation of awareness on what is low cost, but also on what are the actors that would be concerned by any change in the system.

The work on a low cost strategy is therefore a catalyst for the change of urban public transport. It allows not only to propose low cost offers, but simultaneously working on a low cost adaptation and a smart low cost design approach demands to understand and revisit every aspect of the dominant design.

5.5. A validation in the sector: comparing the KCP coverage with current trends in innovation

When working on changes in the dominant design and at creating new functions, it is interesting to verify if these follow the global tendency of the sector or if they point to contradicting directions. This information is relevant for the research and innovation unit, because it's a powerful argument to justify its activity. It is also relevant for researchers, because it allows verifying if low cost can be used as a catalyst to develop other important innovations. Furthermore, it permits verifying that the creativity method used allows proposing relevant innovations. We therefore analysed the European projects in public transport from the 2007 – 2013 programme⁶⁵, as well as the main innovation awards by the UITP in 2013⁶⁶ and the main tendencies cited by the April 2014 Newsletter for 'Transports publics', the European Mobility Exhibition as being the focus of the Public transport 2014 exposition⁶⁷ and the innovation awards for this exposition. These settings were chosen because they allow an international overview with an European focus of efforts done by practitioners and researchers that complements the academic literature review done in chapter 4.

Trends in the UITP innovation awards

In the case of UITP's innovation awards, there were six different prizes awarded in 2013:

- Business model, awarded to MTR for a new business model proposed for structuring public transport funding. This shows two motivations, both one for developing improved funding, and one for renewing business models in the sector.
- Customer service, awarded to Swiss Federal Railways for providing more services to passengers of public transport by allowing them to connect with other passengers inside the train and chat. The main motivation here is providing more services to passengers and this motivation is supported by developing information technologies (IT) innovations.
- Integrated mobility, awarded to Singapore's Land Transport Authority for the development of a mobile application allowing commuters, motorists and cyclists to make informed decisions about the best transport mode to take. There are two identified motivations here, developing IT innovations and integrating all transport modes in public and private transport.

⁶⁵ We analyzed the European projects of the Sustainable Surface Transport Research 7th Framework Programme 2007-2013, through the project synopses published by the European commission (2011).

⁶⁶ Details on the UITP awards can be found on <http://growpublictransport.org/awards/2013-edition/international-awards/>, retrieved on the 8th march 2015.

⁶⁷ The Transports Publics Newsletter from April 2014 is available on www.transportspublics-expo.com. Retrieved on the 3rd March 2015.

- Information technologies, awarded to IVU – Traffic Technologies AG (Germany), that in a joint effort with transport for London made real-time information on bus traffic available. The main motivation here is to develop IT innovations.
- Design, awarded to RATP for the Osmose bus station, a bus station offering passengers more services and improving urban integration of the bus station. This points to two motivations: developing new services linked to public transport and improving integration of public transport with other sectors.
- Political commitment, awarded to the Istanbul Metropolitan Municipality for its project on the integration of transport and urban development. It shows a tendency of thinking public transport integrated with other sectors.

Trends in the European projects

The 134 European projects from the 2007-2013 programme were classified into 6 sub-themes: The Greening of Surface Transport, Encouraging Modal Shift and Decongesting Transport Corridors, Ensuring Sustainable Urban Mobility, Improving Safety and Security, Strengthening Competitiveness and Cross-cutting Activities for Implementation of the Sub-theme Programme.

Inside these sub-themes, through the title and abstract of the projects we identified the following motivations:

- Technological innovation, present in 70% of the projects;
- Reducing environmental impact, present in 39% of the projects;
- Cost reductions, present directly or indirectly in 33% of the projects;
- Benchmarking and studying best practices, present in 31% of the projects;
- Studying behaviour and encouraging behavioural shift, present in 20% of the projects
- IT innovation, present in 14% of the projects;
- Business model innovation, present in 5% of the projects.

Trends in the 'Transports publics' exposition

On the 'Transports publics' Newsletter, four main tendencies were cited:

- The development of urban cable cars, which shows a motivation in developing new technologies;
- The development of "flash charging" electric buses, which also shows a motivation of developing new technologies;
- The inclusion of more connected services inside mobility, like providing wi-fi inside public transport, which shows a motivation in developing new IT innovations and of providing more services for public transport users;
- The use of data coming from the passengers and their active involvement in improving transport services, which shows a motivation both in developing IT innovations and in transferring activity to the user.

Besides these tendencies, innovation awards were awarded during the exposition in four different categories:

- Energy and environment, awarded to Safra for the 'Businova multi-hybrid propulsion bus', which has two main motivations: technological innovation and reducing environmental impact of public transport;
- Service Management Systems, awarded to Cofely Ineo for 'Navineo', a smartphone and tablet-based solution that brings together passenger information and service management for operators, which points both to providing new services for the users as a motivation as well as developing IT innovations.
- Passenger information and ticketing systems, awarded to Transdev for its 'EMMA' multimodal space, which provides users with multimodal information and tickets. This points to two motivations, integrating transport modes and developing IT innovations.
- Accessibility, facilities, comfort and design, awarded to Translohr for 'NewTL', a one-way light transport system, whose motivation is the development of new technologies.

Comparison between observed trends and outcomes of RATP's KCP

This panorama of motivations from practitioners and researchers can then be compared to the work done inside RATP. When looking at the outcomes of the KCP, we have identified that the main motivations covered by our initiatives were cost reductions, the technology and IT innovations, the renewal of business models, proposing new services to the users, integrating transport modes, integrating public transport with other sectors, transferring activity to the customer.

Table 5.6 recapitulates the domains covered by our three different sources and confronts them to the outcomes of the KCP, the proposed initiatives and projects. We can conclude that most of the tendencies seen in innovations in the transport sector nowadays are covered by the low cost initiatives. This means that low cost is a good catalyst to build an innovation strategy inside a transport operator. However, the low cost initiatives also cover additional client value through transport flexibility, an aspect not discussed in the practices seen so far in the sources analysed. This indicates that the development of a low cost strategy also allows exploring aspects outside the consecrated innovation paths, allowing RATP to keep one step ahead of competition on some aspects.

Table 5.6 Domains covered by the European projects, by the UITP innovation prize and by the public transport exposition confronted to the outcomes of the KCP

Aspect	UITP	European projects	'Transports publics' Exhibition	KCP
Improve funding	X			X
Renewing business models	X	X		X
Providing new services to passengers	X		X	X
Developing IT innovations	X	X	X	X
Integrating all transport modes	X		X	X
Integrating transport with other sectors	X			X
Technological innovation		X	X	X
Reducing environmental impact		X	X	
Cost reductions		X		X
Benchmarking and studying best practices		X		
Behavioural studies and behaviour shift		X		
Transferring activities to transport users			X	X
Adding new aspect to client value				X

5.6. Conclusion: A low cost design model in public transport: innovations that create added value for all actors of the ecosystem

This chapter's aim was to present how a low cost strategy was designed for RATP using an oriented creativity method and to present the benefits of this approach. To do so, the first aspect presented was the research innovation and development organization inside RATP, to show the settings in which the strategy design took place. Since the strategy design was very transversal, and needed inputs from several different departments, we also comment on their roles inside RATP. This was followed by the description of the "Less Is More" workshops and the five initiatives that were the result of these workshops. Furthermore, the first aspects of the low cost strategy were described, the different steps that had to be taken, as well as the launch of the projects.

The four goals of the creative workshop discussed by Hatchuel et al. (2009) were reached. First, the use of the KCP allowed developing both 'smart low cost design' and 'low cost adaptation' public urban transport offers, thereby covering the whole conceptual potential of the initial concept. It allowed involving and supporting people in a rule-breaking process, since to develop low cost offers meant to change the object's identity. The activities done

during the KCP and the research projects launched showed that the KCP enabled knowledge activation, acquisition and production. And finally, the fact that a 'low cost adaptation' project, that was first seen as impossible to be launched, was finally started is an evidence that the KCP managed collective acceptance and legitimacy of rules (re)building. Using a 'smart low cost design' approach allowed the public transport operator to re-legitimate the 'low cost adaptation' approach, which they previously had difficulties in working on, due to the negative association to service quality loss.

We also identified that the 'smart low cost design' offers have a higher innovativeness level than the 'low cost adaptation' offer and fundamentally change some aspects of the public transport dominant design. Breaking the dominant design lead to interesting new design paths, and expanded the design possibilities for the transport operator, not only enlarging it's perimeter, but also including new actors into the transport ecosystem.

The change in the identity of the object was thoroughly explored in these products. Through the four 'smart low cost design' initiatives all the aspects of the identity of the object were challenged: the technological paradigm, the business model, the functions and the client value. The change in the public transport offer's identity is radical, and one of its immediate consequences is a change in the actors and their roles in the value chain. This is due to the strong "de-fixation effect" allowed through the KCP and the choice of searchlight concepts. The use of the KCP method allowed identifying and removing important barriers, which will be discussed in the next chapters.

We were furthermore able to validate that using the two low cost strategies allowed to cover the four utility parameters we had identified in our model: function removal, negative transfer, positive transfer and function addition. The second validation we were able to make concerns the innovation trends in the public transport sector. We were able to verify that exploring low cost through our two proposed strategies allowed covering the full scope of innovations in the sector and to open paths little explored so far.

Finally we can conclude that the 'smart low cost design' in public transport means to introduce new high value functions into public transport, like the possibility to book a transport, and to keep costs low through function removal and activity transfer to the client. This is an essential aspect, since it shows that in order to sell low cost products in public transport providing lower cost is not enough. While in the classical markets in which our models were developed providing higher value for money to the customer was enough, due to the particular organisation in the public transport sector this is not enough anymore. There is a need to add value for the final user, for the public authority and sometimes for the mayor or other influencer. This means adding value for the client but also for other actors, to make sure that the new service is not seen as only a degrade option by key influencers. Higher value can be proposed to the different actors through the addition of different functions and through other changes in the dominant design.

Chapter 6. Low cost as a driver to rethink the company's design space and build dynamic capabilities for innovation

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The case study done inside RATP sheds new light on the innovation system proposed in part I. We were able to analyze how each one of the aspects proposed inside our framework, performance evaluation, design reasoning and organization were adapted inside the company, and will therefore propose some evolutions of all three aspects in this part. We can therefore propose evolutions of our theoretical framework through an empirical case.

The application of this system to public transport furthermore allows us to verify our research hypothesis one to five. We were through our case study able to confirm our five research hypothesis. We furthermore conclude that the importance of the ecosystem goes beyond what was stated in research hypothesis five, and propose to further look into the link between the ecosystem and the product in part III.

6.1. Evaluating low cost performance as a strategy inside the company: evaluation on the innovation department and company level

In our model in part I, performance was first evaluated on two aspects: product evaluation and low cost strategy evaluation. Our case study allows us to review these aspects and to add two new aspects: the innovation unit evaluation and the firm evaluation. This highlights the impact a reflexion on a transversal theme like costs can have, since its impact has to be evaluated on a firm level.

As discussed in chapter five, the low cost strategy was successful in helping to propose breakthroughs in the dominant design. The lock-in in the current dominant design was one of the difficulties to innovate identified in RATP's case. Therefore, we added a performance evaluation for the low cost strategy, as its **capacity to challenge the dominant design** and to help proposing breakthroughs.

The innovation unit, described in chapter 5, was also evaluated on its financial performance inside the company. This was measured by the results delivered by the available resources. Results could be in the form of original research studies, but were considered more useful when they could be applied or were demanded by the other departments to develop projects or new offers. There was therefore a clear goal of being able to maximize **knowledge re-usage**. The knowledge created during the development of the low cost strategy should be useful in the development of other projects and other products.

Furthermore, the innovation department needed to select and justify the selection of innovation projects. Selection of innovation projects is often done by financial criteria, but due to the great uncertainties associated to the more disruptive projects, as signalled by Hooge (2010), it is not a very adapted tool to select research and innovation projects. The innovation unit therefore saw the potential of the low cost strategy as a **tool to help in the**

selection and justification process. Since the low cost strategy was oriented by a roadmap leading to a strategic goal, it made it possible for the innovation unit to more easily justify its choices.

On the company level, two goals were pursued through the low cost strategy. The first one was to **federate the entire company around a transversal innovation project.** Low cost was considered relevant for this goal, because costs permeate all the activities and departments of a company, and reducing them demands collective efforts and can bring benefits for the entire company. The second level in which this strategy was important for the company was on **creating awareness** inside the company about low cost and cost reductions and their importance for the entire company. The success of this awareness creation can be shown by the fact that the company is now launching a program on cost innovation.

6.2. Using a design reasoning as a normative tool

Although the design reasoning used in our case study still turns around the low cost design model, this model was used in a different way in our case study. While in the framework previously suggested the model was a tool applied to explain existing products, inside RATP it was a **normative tool.** The two approaches were actively used to develop products following one of the two approaches. In the design, the logic described behind each one of them was deliberately employed, and the use of the four utility parameters was one of the conditions to consider the design space was being thoroughly explored by our initiatives. To do so, the participants were familiarized with the design reasoning they were supposed to use during the K phase. Afterwards their propositions were challenged during the C phase according to the model, and they were asked to actively use the four utility parameters. During the P phase, recombination of the proposed concepts was also guided by the proposed design reasoning, and the final initiatives and projects proposed were built in a way that both strategies, 'low cost adaptation' and 'smart low cost design', were explored.

The case study inside RATP allowed us to verify how the application of the low cost design model was received inside an organization. As stated before, we chose to simultaneously apply both approaches of the design model, trying to develop both 'low cost adaptation' and 'smart low cost design' products. By doing so, we wanted to verify that both approaches were compatible and could both be developed inside the same organization. Our case study showed not only that both approaches could be used simultaneously, but also that **the 'smart low cost design' approach allowed re-legitimizing the 'low cost adaptation' approach.**

The work done on function removal and negative transfer inside some of the 'smart low cost design' initiatives allowed showing that the company was over delivering on some aspects. That clearly advocated for low cost adaptation offers in some cases.

6.3. New organization: Low cost as a driver to rethink the company's design space and expand the company's boundaries

Finally, the case inside RATP allows us to propose yet another organization. Instead of launching a low cost brand or creating a low cost business, RATP decided to have a different approach. Low cost was used as a driver inside the company to **rethink the company's design space**. It also acted as a driver to **expand the company's boundaries through the creation of new partnerships**, outside the classical ecosystem. This allowed the company to work on aspects not considered part of their core activity, but that were part of interesting breakthroughs and new value networks in which the company wanted to have a say. Through the work done to build the low cost strategy, new partnerships could be built, leading to an expansion of classical activities.

Figure 6.1 illustrates the evolution of our framework.

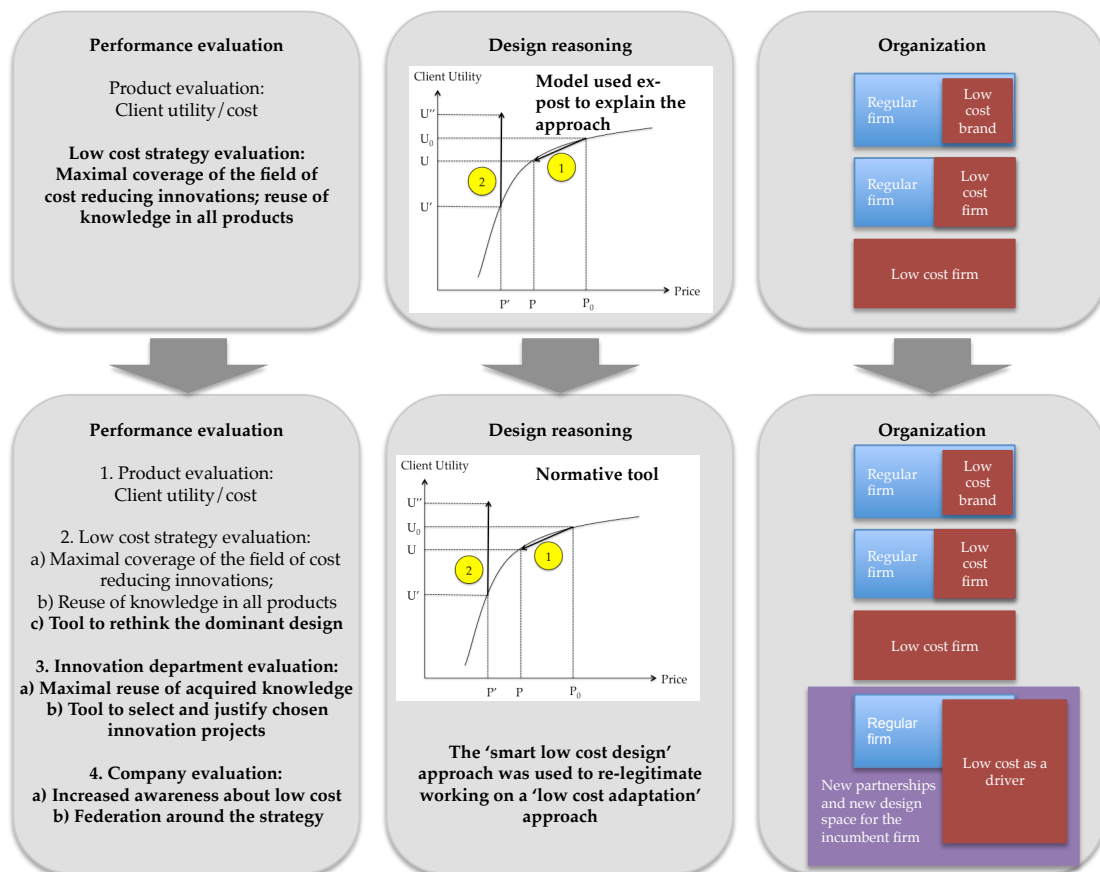


Figure 6.1 Evolution of the performance, reasoning and organization framework through the case study inside RATP

6.4. Confirmed managerial tools to increase acceptance of low cost: creating awareness and rendering the innovation system explicit

The application of a low cost design model inside RATP also allowed us to test and confirm our research hypothesis stated in Part I. We will here discuss how each one of the research hypotheses could be confirmed, and the points that could be expanded through our case.

Results on RH 1: Importance of a reference model

Our first research hypothesis was **“Reference models seem to be very important. They need to be correctly approached since they can help generate client utility, but can also destroy it, by creating false expectations due to the associations done by the client.”** The importance of a reference model, as well as the possible negative effects a wrong reference model can have were verified through the work done during the KCP. The choice of words seemed very important inside the groups during the different phases. The work on a “low cost offer”, instead of the work on a “low cost bus” helped to open more options. And to describe the BRT, a bus-based solution as a “low cost metro” allowed the participants to seize the importance of the reference model. This helped them to build new offers, and to allow them to use references that first seemed like not relevant. By allowing themselves to propose a low cost mobility that was not comparable to a bus offer, but to a private car or bike, the groups dramatically increased the possibilities.

As described in the second chapter, while discussing problems faced when developing low cost offers, the fear of cannibalization was present. The offers having a reference model other than a public transport mode not only responded to the users’ and transport authorities’ need for different offers, they also made for more complementary offers, reducing the risk of cannibalization. Therefore we confirm the importance of a reference model, and show that using a reference model that forces an innovation outside the dominant design helps to avoid cannibalization.

Results on RH2: Need of a design performance model

The second research hypothesis we had, was **“Low cost design must adopt a design performance model to succeed.”** This hypothesis was confirmed by the need to include new performance evaluations in our innovation system, as seen previously. It became evident through the effort done in applying the low cost design model inside RATP that the performance evaluation of the efforts done around low cost could not be done based only on the evaluation of the final product. The low cost strategy also had to be evaluated, as well as the impact of this strategy on a unit and firm level.

Furthermore, the low cost strategy highlighted that the performance evaluation being used for transport offers by RATP was not adapted to some of the innovative offers proposed. This was mainly linked to the fact that performance was evaluated according to criteria coming from two different sources: the public authority (the client) and the operator (the supplier). The public authority was mostly interested in providing a certain volume and quality of transport in a limited budget. So transport performance was evaluated through a number of transported passengers and through a service level, including indicators like delays and respect of the contracted volume. The operator in turn, was interested in keeping its costs low and in showing the quality of its service, and therefore had indicators to measure transport efficiency, which meant cost per available seat, and user satisfaction. None of these indicators captured the real cost to be reduced, the cost per user. Nor did they evaluate other aspects identified as relevant in the dominant design of public transport, like the social link created through the transport. The low cost innovations proposed often changed the client (the buyer of the offer) or at least changed the relationship between the buyer and the provider, and therefore performance cannot continue to be evaluated by the former standards. We therefore show that there is a need for a more adapted performance model, not only to evaluate the design process, but also to evaluate the offers.

Results on RH3: Creating awareness allows avoiding the low cost equals low quality link.

Our third research hypothesis stated that **“To avoid direct association between low cost and low quality, as well as between low cost and low price, it seems important to create awareness around what is a low cost product and to clarify how the product that will be developed is expected to position itself relatively to existing offers.”** RATP being an historical transport operator, with a high quality offer, one of the main concerns was the new, low cost offer might compete with the existing one. And the fear of proposing an offer that did not live up to the company’s current high quality image was also very present. These barriers were uncovered thanks to discussions in the K phase. It was made evident that the link between low cost and low quality was done by many of the experts inside RATP. Furthermore, the fear of cannibalization clearly existed.

The first step to avoid this negative image linked to low cost was to create a common knowledge base among the workshop participants. In this case, creating common knowledge was not only important to improve communication, as stated by Cohen and Levinthal (1990), but also to increase awareness around low cost. Showing through examples that low cost objects did not have to be low quality and that some were even desirable was the main way to achieve that.

Making the participants use the design model we developed for low cost and proposed in chapter 2 was the second step in the effort of breaking the low quality image associated with low cost. The model in the smart low cost approach forced participants to create higher value with lower cost, and to start a new offer from scratch. Therefore the low cost offers often had a higher quality in some aspects, since they had higher value for the final user. And even

though the low cost adaptation approach sometimes led to what could be considered lower quality by the operator, the work done on identifying value for users and the client showed that they did not always perceive it as lower quality.

To reduce the fear of cannibalization also demanded to increase awareness inside the company about the offers that would be developed. But an awareness not only on low cost product's attributes and position inside the markets, as was done in the case of the low cost-low quality link, but also on the interest of developing a low cost strategy. The low cost strategy aimed not only to propose low cost offers, but also to increase the firm's knowledge on low cost and help to face competition. However, making low cost an acceptable strategy for the company did not only mean convincing participants of the relevance of studying this subject. It also meant convincing the main stakeholders inside the company and all the participants in the projects. The support of key stakeholders was essential to allow the launch of the proposed transversal projects and of projects inside departments as previously discussed in chapter five. And the participants in the projects had to be convinced of the relevance of their project for the company. This was partially achieved through the steering committee put in place described in chapter 5. But it also demanded several smaller meetings with potentially important actors, to explain the strategy and the potential benefits for the company and for several stakeholders.

We furthermore made the strategy more acceptable through the video that was made about the work done in the Less Is More workshop and other communication like presentations, done inside the company and made available in the internal website. Finally, the strategy gained in legitimacy through its presentation and formal approval at the strategic committee, and integration in the innovation department's roadmap.

The low cost equals low price link was less present in the case of public transport, since the transport operator does not define the price for the final user. Price was therefore often dismissed as the transport authority's problem. But when working on the dominant design breakthrough on proposing services with fares not fixed by the transport authority, the first reflex of participants was that customers should expect a lower fare than the one of classical public transport. Knowledge on what had value for the customer and on the price of other offers that could be used as reference model (like a private car or a taxi) helped them to see that this did not have to be the case. Once more, working on awareness and on the reference model showed to be essential to increase low costs acceptability inside the company.

Results on RH4: Importance of a clarification of low cost organization

RH4 stated that **“A clarification of interactions of the low cost organization with the former organization is needed to succeed in low cost design.”** This RH was confirmed by the demands of the participants as well as of the steering committee, who wanted to know how the low cost offers that could result from the exploration could be positioned on the market. They considered it a risk to propose a low cost offer under the RATP brand, because they feared it might harm the firm's name. They were however also convinced of the benefits the

work on low cost innovations could have for the entire groupe, not only through new offers, but also in proposing best practices to be integrated into the existing offers. Therefore, instead of choosing one of the three organization we had identified previously in literature, which were launching a new low cost brand, launching a new low cost firm or becoming low cost, RATP decided on a fourth different organization, as we saw in the evolution of the innovation system. Low cost was positioned inside the firm as a driver that would not only help to expand the design space, but also to create new and enriching partnerships.

Cooperating with other actors and actively striving to influence the environment, as well as identifying lacking competences inside the company and creating partnerships with companies possessing these competences are some examples of the ways to overcome barriers and rigidities cited by Sandberg and Aarikka-Stenroos (2014). Both approaches were pursued inside RATP through the low cost organization put in place, that encouraged new partnerships and cooperation.

Beyond the clarification of low cost organization, the work on low cost also contributed to make RATP's organization evolve. Amongst the organizational changes we can identify linked to the KCP on low cost, it is important to cite the improvement of RATP's absorptive capacity. The method allowed, in a targeted way, to identify and assimilate external knowledge that was essential for the company. Cohen and Levinthal (1990) indicated that absorptive capacity is key to maintain and achieve competitive advantage, since it has been observed that innovative capabilities are linked to the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends. Identifying and targeting relevant knowledge is one of the big challenges companies have nowadays. In this particular case, RATP had decided low cost products were an interesting goal, but did not know how to go beyond monitoring press releases on the subject. The modelling of the innovation field done during the KCP allowed identifying the knowledge needed to develop a low cost product, dividing it into knowledge already existing in the company and the knowledge that had to be sourced externally. It also allowed placing the knowledge acquisition that had to be done in the strategy, and therefore to keep in mind why it was important.

Furthermore, another important organizational change identified was the improvement in the capacity to launch transversal projects. To develop its low cost strategy, RATP chose to use a KCP, as besides its goal to develop the low cost strategy it also had as a goal to federate the departments around the developed projects, which is known property of the method across the participants (Arnoux and Béjean, 2010). Beyond participants, an approval commission was constituted to make sure top management would support the developed projects and that the developed strategy did not conflict with the company's global strategy. It gathered the directors of five departments that would be deeply impacted by the new offer. This approval commission came together before the KCP was launched to approve the scope and participants of the KCP and to approve the results after every phase, as well as the needed next steps. The creation of such an approval commission is not mandatory when doing a KCP, but proved very useful in this particular case, since the company is very large,

that its departments sometimes have conflicting interests. Besides, this kind of commissions is a unique commonplace in the studied organization. The meetings of this commission were also beneficial because it allowed the concerned directors to get more information on the planned projects than is usually the case for innovation projects in this company and to increase the legitimacy of the whole process. Finally, it also made it easier to mobilize the participants for the needed time – between 2.5 and 4 days, according to if they participated in the P phase or not - since managers found it harder to refuse their collaborators' participation when the invitation was endorsed by five directors, overcoming thereby a rigidity of the managerial system.

The gain of legitimacy observed in our case is very similar to the effect observed by Kelley et al. (2011, p252), who defends that “managers can offer critical assistance to project leaders needing legitimacy and support for their innovation projects”. Thus, low cost appeared as an effective managerial guidance to involve the internal stakeholders of the firm's dynamic capability in a collective action for organizational improvement.

Results on RH5: Importance of the ecosystem

Our fifth research hypothesis stated that “**Low cost design needs compliant ecosystem design rules, like regulations, certifications and infrastructure**”. The importance of ecosystems was highlighted through a series of barriers to a low cost offer uncovered by the work done on a low cost strategy. There were barriers linked to the classical customer, the transport authority. When the idea of developing a low cost offer was first discussed with experts responsible for the contact with public authorities and in charge of composing answers for calls for tenders, their first reaction was to say their customer (the public authority) would never be open to this kind of offer. There were two main reasons cited for this resistance. The first one was the way the calls for tenders were organized. Due to the need to have comparable offers, many calls for tenders demand an extremely well defined service or operation, with very little possibility for innovation or changes of any kind, like proposing a low cost offer with different services. The second reason cited for the resistance to low cost offers was the fear of tarnishing their image. Public transport is part of the image of a city, and therefore also of the government in place. Proposing a low cost offer was seen by many as “cheap” and as hard to explain to the citizens, who might not understand the choice of a low cost system. This shows how the entire ecosystem impacts the acceptance of a low cost product.

Another aspect linked to the ecosystem identified was the difficulty of introducing standards, often a big part of operational effectiveness efforts. Standards are hard to be put in place in the case of the Parisian network because the vehicles and infrastructures belong to the transport authority. The transport operator has no or very little influence concerning the acquisition of new material, which is done through tendering. The operator can therefore find himself with several different models and brands of vehicles, which make it difficult to reduce maintenance costs and sometimes even demand specialized labor. This particularity

of the ecosystem also made it difficult to propose innovations that demanded different material. Lower costs were visibly made more difficult by this aspect of the ecosystem.

Furthermore, the infrastructure was also a limiting aspect for the development of low cost offers. Since decisions on the infrastructures were done on the long term often many years before the proposal of low cost solutions, they were often not adapted for the desired cost reductions.

To summarize, all five research hypothesis were confirmed by the empirical case inside RATP, and, furthermore, some of them could be extended, as is the case of RH5. These results are graphically represented in figure 6.2. We thereby could, through the case study inside RATP, confirm that creating awareness around low cost and rendering the organization, the reference model, the performance evaluation and interactions in the ecosystem explicit for the collaborators are powerful tools to increase low cost acceptance.

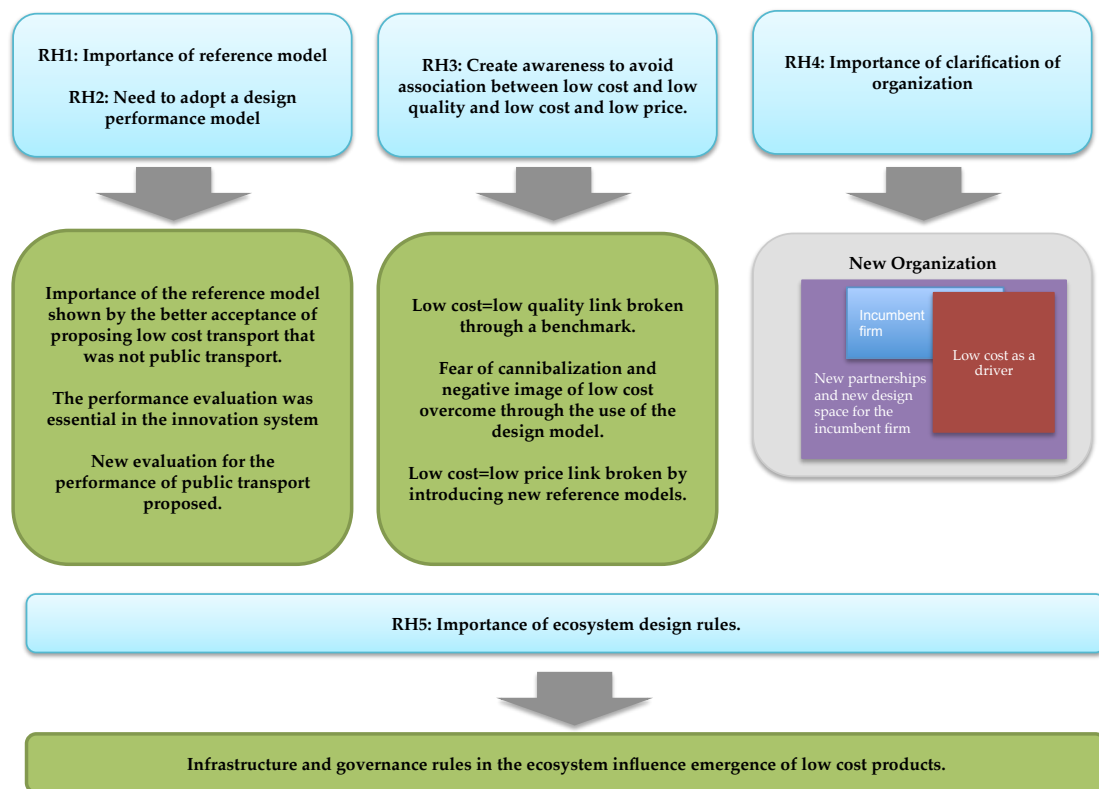


Figure 6.2 Confirmation of our research hypothesis through the empirical case

6.5. Conclusion: Building dynamic capabilities for innovation in the transport operator

The work done to build a strategy around an innovation field as broad and as transversal as low cost was an occasion to look into building dynamic capabilities for innovation inside

RATP. As pointed out by Wang and Ahmed (2007) and Barreto (2010), a consequent body of research has already been developed around the dynamic capabilities approach since its founding paper by Teece et al. (1997), but the research points in different directions, with different approaches and definitions of dynamic capabilities. Although there is still a discussion if the link between performance (competitive advantage) and dynamic capabilities is direct, as defended by Teece (2007), or if it is more indirect, dynamic capabilities being necessary but not sufficient to assure competitive advantage (Eisenhardt and Martin, 2000), all authors agree that the link exists. While the dynamic capabilities approach was first developed for rapidly changing ecosystems, more recent work argued that the same is also applicable when change rates are lower (Zollo and Winter, 2002; Eisenhardt and Martin, 2000). Therefore, Zollo and Winter (2002, p340) proposed to define dynamic capability as “a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness”. This definition underlines the depth and the continuity of the organizational innovation process. However, while there is a great number of scholars’ work focusing on the existence on dynamic capabilities, the introduction of dynamic capabilities in mature firms is less discussed (Borjesson et al., 2014). According to these scholars, building capabilities to innovate is related to change management and involves overcoming organizational resistance and barriers.

Through the work done on the innovation field of low cost, we were able to develop dynamic capabilities to innovate inside RATP and to overcome important barriers to low cost innovation. Creating awareness around low cost (RH3) and proposing the right reference models (RH1) reduced the fear of cannibalization and of loss of quality through low cost products, and also improved the firm’s knowledge on its own weaknesses. Our study shows how using smart low cost design for the strategy building for a company can allow important organizational changes, as we can see on the confirmation of RH4. Finally, confirmation of RH5 points to the importance of the ecosystem in the success of low cost products, and we will further analyze this aspect in part III.

This leads us to state that **building a strategy around low cost, a transversal subject inside a firm, is a good driver to build dynamic capabilities for innovation**. Similar transversal subjects, like sustainable development, could also be used for the same goal, allowing the organization inside a company to evolve, and to improve absorptive capacity.

Conclusions of Part II

Several insights could be gained through a case study applying the low cost design model to the public transport sector. By studying the public transport sector we were able to highlight difficulties for developing low cost offers that can be linked to a sector. First, we showed that markets where the user and the buyer are not the same make the interest of developing low cost offers more difficult to assess. In these markets, as in public transport, price for the final user and costs are not directly linked and the final user does not have the classical lower price incentive to buy low cost. Furthermore, public transport is a highly regulated environment, which also makes changes in the organization of transport services or breaking the rules in place more difficult. In markets like these, our case study shows that there is a need to create value for other concerned actors that are not the client to make low cost offers viable.

The case study inside RATP also allowed us to show the importance of simultaneously applying both approaches of our design model. Through the simultaneous application of both approaches of the low cost design model, we were able to show that the 'smart low cost design' approach can be used to **re-legitimate the 'low cost adaptation' approach**. The 'smart low cost design' strategy, furthermore allowed developing important breakthroughs of the dominant design, and legitimated the work on these innovations inside the operator. This not only allowed the operator **to overcome the cognitive and technological lock-in in which he was, but also to create new partnerships**. And the low cost strategy furthermore allowed the operator **to develop innovations**

We furthermore were able to make our innovation system evolve through this case study. The performance in the case of RATP was not only evaluated by the performance of low cost products, but also by **the performance of the strategy and its capacity to renew the public transport's dominant design**. The low cost strategy furthermore influenced the research and innovation unit's performance by giving them **a tool to evaluate and justify innovation projects**, as well as the entire company's performance by improving the awareness about low cost inside the company. And although reasoning was still based on the low cost design model, it was not used afterwards to explain developed products, but as a tool to design the products. We were able to show that a different organization can exist, where **low cost is used as a driver to redefine the organizations' research and design space limits, as well as a driver to create new partnerships**.

The five research hypothesis of part I were confirmed through our case study, giving further guidance for managers wanting to design low cost products. Furthermore, we state that the process of creating a low cost strategy inside the public transport operator allowed the **development of dynamic capabilities for innovation**.

We can therefore conclude that applying the low cost design models inside a company, when accompanied by the proper managerial tools, can lead to question the identity of an object and to compose a pertinent innovation strategy that can be justified inside the company.

The main questions that remain after this part are if there **are other settings that are similar**

to public transport to which we could transpose the insight gained in the case of public transport and if it is possible to create value for all actors through low cost products. Furthermore we ask ourselves if there is a possibility of influencing the ecosystem when it is not compliant with the development of low cost products. We will gather elements to answer these questions in part III.

Part III: Designing low cost based ecosystems in complex value networks

Part III: Designing low cost based ecosystems in complex value networks

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Our case study inside RATP allowed us to show how an innovation system based on low cost design model could be used to develop a low cost strategy inside a company. It furthermore showed that low cost could be an appropriate catalyst for developing innovations and breakthroughs in the dominant design in the case of public transport. As stated in part II, we chose the public transport setting because of its particularities, which made it challenging to develop low cost offers. Most of the time, low cost products attraction for the final users is linked to their low price. And in ecosystems like public transport, a low cost product does not always have a lower price, because the cost and the price for the final user are not directly linked.

The questions that arise from this case are what kinds of ecosystems, with similar configurations as those found in public transport – strong regulation and indirectly linked cost and price for the final user – could also profit from the development of a low cost strategy through the low cost design model? What possible benefits could be created through these applications? What are the conditions that should be respected to create successful low cost strategies?

To gather elements of response, chapter 7 starts by describing the particularities found in the public transport ecosystem, which make it little adapted to the development of low cost products. Public transport relies on a **complex value network** of stakeholders, with more than one supplier and a customer needed to make value creation possible. The existing patterns in complex value networks and three further examples of similar ecosystems are described, two in public services and one in the case of a private sector. We conclude this chapter by stating the main managerial challenges for applying the low cost design model for firms within complex value networks.

In chapter 8, we discuss how to fulfill some of the conditions to create low cost products in complex value networks and discuss some of the possibilities opened up through the application of a smart low cost design strategy. Value creation for the final user is not enough in these networks, and we show how value creation in these ecosystems demands to take into account more design parameters, namely the value creation for the other actors of the ecosystem. Since the dominant design is challenged through the smart low cost design approach, the value networks often suffer changes. Not only does the value for other actors need to be redesigned, but the relations between actors in the network also have to be redesigned. One possible approach to these evolutions to increase possibility of including new unknown actors is to focus on **generic value creation**. We furthermore show through three examples - the infrastructure, the distribution networks and the contracts and regulations – how some aspects of the ecosystem have a decisive influence on the successful launch of low cost products. Smart low cost design, by challenging the dominant design, demands these aspects to be re-designed. Through co-design with other stakeholders, lobbying actions or a repositioning in the value chain, the low cost product designer becomes

an ecosystem designer or influencer, thereby making sure all the desired aspects for the success of their low cost product will be present.

We conclude this part by proposing a framework, which firms in highly regulated, complex value networks, desiring to launch low cost products or offers, should mobilize to increase the acceptability of their low cost products in these settings.

Chapter 7. Low cost design in complex value networks – new challenges and opportunities

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The case study on RATP is an example of how the development of low cost services in the 'smart low cost design' strategy can lead to important breakthroughs in the dominant design. The dominant design however, is anchored in an ecosystem. We will show in this chapter how changes on the dominant design highlighted some aspects of the public transport ecosystem.

The particularity of the public transport ecosystem starts by the fact that the buyer and the user are not the same actor. As discussed in part I, many customers buy low cost products due to the lower price low cost companies can offer. Affordability is an important aspect of low cost offers, and often a decisive one for the final user, when it allows him to have more value for money. But allowing more value for money for the final user can be challenging in some industries like public transport, where the purchasers who pay for the service or product differ from the actual user, as pointed out by Kim and Mauborgne (1999). In this case, the value for the final user and the price are no longer linked, since the final user does not pay. A reduction in costs, even if it has a considerable price reduction associated with it, might not satisfy the final users since they can get the feeling they are getting less value without gaining any benefit from it. The purchaser, who sees the interest of a price reduction, might be unable to profit from it, depending on the relationship he has with the final users.

In this case, value creation can no longer be evaluated through the positioning in the value chain and the business model, and we will mobilize literature on value networks. Furthermore, we will show how our low cost model could also be applied to networks where there is more than only a customer/buyer and a provider/seller that we will call **complex value networks**. We will here discuss these networks and the impact developing low cost products has inside them. Through the discussion of value creation inside these ecosystems we will show the challenges and opportunities opened up by low cost products in these particular networks.

This chapter starts by stating how 'smart low cost adaptation' products, through their challenge of the dominant design, also challenge the ecosystem, these two aspects being closely linked. We therefore defend the importance of studying these ecosystems and show how their value evaluation can no longer be done through value chains and business models, but must resort to value networks. Our literature review on value networks is complemented by a description of the patterns of complex value networks drawn from three empirical cases, and how they contrast with those on which low cost has usually been developed. Based on the insights gained in the case study and on our database, we will further expand on the reasons for choosing a low cost product that can be used when the classical incentives are not present.

7.1. Business model design and the link to the ecosystem in public transport

As we have described in part II, the 'smart low cost design' strategy inside RATP led to several breakthroughs in the dominant design. The dominant design however, is not internal to the firm, it is linked to an ecosystem that depends on this dominant design and sustains it (Soh, 2010). According to Suárez and Utterback (1995), the dominant design contributes to determine the structure of the industry, as well as the form and the level of competition. The link between dominant design and its surrounding ecosystem becomes even clearer in the case of strongly regulated ecosystems, since industry regulation and government intervention impact the emergence and sustainability of a dominant design, for example by enforcing a standard (Suárez and Utterback, 1995).

The breakthroughs introduced by the smart low cost design strategy, that deeply challenged some aspects of the identity of the object, therefore demand changes both inside the firm and in its ecosystem. When challenging the ecosystem, and in view of what we saw in chapter four when describing public transport, the complexity of the ecosystem made it impossible to model it according a very currently used representation, the value chain (Normann and Ramirez, 1993). Nevertheless, trying to model the value chain also allowed us to realize that the different actors of the ecosystem were interdependent, and that value creation was only possible through their cooperation. We therefore needed to introduce another model, more adapted to our context, and that could both model these more complex relations in value creation and the great number of involved actors. We will therefore introduce the notion of value network in the next item.

According to Normann and Ramirez (1993), strategy has for a long time been placed in literature as the art of correctly positioning a firm in the value chain. The concept of value chain was introduced in the 1980's by Michael Porter (1985), and has since been widely used as a tool to analyze value creation at the firm level (Fjeldstad and Ketels, 2006). It is used to describe the series of activities operated by manufacturing firms, which create value for their customers by transforming inputs into products. Literature on business models is abundant, and we will not treat here the entire literature, but will only give a brief overview of certain concepts we need to mobilize to understand the value creation challenge in the public transport context. While the value chain is used as a tool to analyze value creation, business models articulate how value is created for users by an offer based on a certain technology (Chesbrough and Rosenbloom, 2002). Demil and Lecocq (2010) add that the business model also explains the dynamic consistency of how value is created over time for two actors, the customer and the firm, taking in account a flow of changes from market and firm's core components.

As the core of a firm's competitiveness, the notion of business model has captured a lot of attention in the last years, despite a great number of different definitions, according to

Casadesus-Masanell and Ricart (2010, p201), and we will here adopt the same definition they did: *“The particular set of choices an organization makes about policies, assets and governance - and their associated consequences are the organization’s business model, because they determine ‘the logic of the firm, the way it operates and how it creates value for its stakeholders’.”* According to the authors, this view of the business model implies that every firm has a business model, and that no evaluation about its effectiveness or success could be made at a given time: it’s more a decisional continuum that drives collective action. All organizations make choices, and these choices have consequences.

The business model is supposed to describe the positioning inside the value network, by linking suppliers and customers (Chesbrough, 2010). Through the business model, the firm evaluates how it can create value and the part of that value it will be able to capture in the value chain. And although value creation for several actors is part of some business models (many of the recent e-businesses rely on more than one client for whom they create value), the business model is a firm-centric approach. This means that even though the interactions with other stakeholders are taken into account (for example by evaluating how positioning oneself as a low cost company might impact suppliers and competitors), the value creation is essentially considered from a firm’s point of view, the focal firm (Iansiti and Levien 2004, Adner and Kapoor 2010). This creates a difficulty for proposing low cost products in settings similar to public transport, where we identified that a transport operator cannot launch a product focused only on their own ability to create value. As we described in chapter 5, some business model innovations were proposed as parts of the low cost offers. And besides having to face the barriers most firms have to face when challenging their business model, like conflicts with the prevailing business model (Chesbrough, 2010) and the challenges linked to have more than one business model inside a firm, like confusing its customers or alienating stakeholders (Markides, 2013), we identified an additional difficulty. It was that value could only be created if other actors also involved themselves in a value creation process. And the amount that could be created depended on the business model these other actors chose, as much as of the business model chosen by the focal firm.

According to the RCOV model proposed by Demil and Lecocq (2010), a business model is based on a firm’s resources, competences, organization and value proposition. Other scholars have build on that framework and proposed ‘open business models’, where the resources and capabilities of third parties are taken into account, as well as the activities these perform for the focal firm (Zott and Amit, 2010). But in the case of public transport ‘open business models’ do not seem to take into account the entire scope of the interactions – the value proposition and organization of the third parties being left out. As we have stated before, a firm-centric approach seems insufficient in the case of public transport, and taking into account the other actors only through the activities that they directly execute for the focal firm does not capture the complexity observed when a firm’s success depends on how well its organization matches regulations in place, local policies completion or how well it can influence regulations, beyond a collective involvement of industrial players, yet already hard to induce.

The design of business models has also been discussed in literature, and although Casadesus-Masanell and Ricart (2010) declare it is more an art than a science, Zott and Amit (2010, p.217) propose a framework to design business models based on *“design elements (content, structure and governance) that describe an activity system’s architecture, and design themes (novelty, lock-in, complementarities and efficiency) that describe the sources of its value creation”*. This approach as an activity system taking into account the governance once more highlights that in the case of public transport a firm centric business model view is not enough. In the case of public transport the governance depends strongly on the prescribers and on the standards in place. So these actors, prescribers and regulators also have to be involved in the value creation process and develop their own interests.

As highlighted by Chesbrough (2010), business models are an essential aspect in the value creation and developing capabilities to innovate in the business model is essential to create value and increase the firm’s competitiveness. This is also the case in public transport, and one of the efforts described through the low cost initiatives is to innovate in the business model. But we realize in the case of a public transport operator, that renewing the operator’s business model is not enough. We also need to innovate on the business models of other actors and involve in the design of value some players usually perceived as exogenous of this process. These elements lead us to ask ourselves how to take the entire ecosystem into account in the value creation and in the value creation analysis, without a focal firm centric vision but through an ecosystem approach. We will try to answer that challenge in the following points.

7.2. Limits of the value chain model: Defining complex value networks

The value chain approach seems less and less adapted to describe value creation and strategic positioning, especially in sectors where products and services are more and more dematerialized and in certain areas of the public sector (Peppard and Rylander, 2006). One of the options to value chain introduced in literature is the concept of value networks, where the value creation addresses a network of numerous customers who benefit of their interdependence (Stabell and Fjeldstad, 1998). The concept has been discussed by scholars in link with the service-dominant logic and the value co-creation literature (Lusch et al., 2010), and has been applied to telecommunications, e-business, insurances, and supply management, amongst others (Fjeldstad and Ketels, 2006). Value networks are considered more adapted to describe some industries, because instead of following a linear activity logic where each activity adds value as seen in value chains, value networks allow connecting multiple buyers and sellers at a single node (Funk, 2009).

Furthermore, Funk (2009) draws attention to the fact that the relationships in value networks are harder to model than those in value chains. Instead of having a buyer/seller logic and each actor adding value through his activities, as in value chains, value networks describe

value creation as the result of interactions between different actors. These interactions do not have to be only a circulation of goods, services and revenues, but can also be linked to the circulation of knowledge and intangible benefits, which can be brand recognition, information or loyalty (Zhang et al., 2014).

To describe value creation at the ecosystem level in strongly regulated markets, the concept of value networks appears relevant because it does not only focus on how a firm creates value for its customers, but on the entire value-creating system. One firm's business model is therefore insufficient to describe the entire value-creating process; we have to look into the entire ecosystem and how all the actors (suppliers, business partners, allies, competitors, prescribers and customers) interact to create value. Therefore an important organizational element of the value network structure is the rules that govern participation in the network (Kogut, 2000). This does not exclude the fact that in value networks new business models can emerge, but as described by Peppard and Rylander (2006) in their work on network value analysis, the business model is just a part of the issue of creating value in a network. The comprehensive description of where value lies in a network demands to take into account all stakeholders of value creation in the meaning of stakeholders from Freeman (1994), i.e. all actors that influence or are affected by the value creation and identifying the value for all participants.

According to Gebauer et al. (2012), value is always created by at least two actors, for example a supplier and a buyer. Therefore, they defend all contexts have value networks: value chains as seen in manufacturing are simple value networks for them.

Gebauer et al. (2012) apply the concept of value networks to public transport services, and state that the value network in this context is not as simple as in cases where there is only a supplier and a buyer. Their research highlights the importance of other actors in public transport that help co-create value. Based on their work, we propose therefore to introduce the notion of complex value networks, which will refer to the networks in which there are numerous actors involved in value creation, and where value creation cannot be described in a linear way, like in manufacturing value chains. Due to the introduction of several actors for whom value is created through the network of multiple buyers/sellers, like in the case of multi-sided platforms, the cost and the price for a certain product are dissociated. This separation happens because the different actors are linked and might be willing to cover costs of producing a product for another actor because that creates value for them. In such context, the business model approach, which focuses on value creation for the customer, is uneasy to apply to analyze the value creation process at the ecosystem level because the dissociation between cost and price induces interdependencies among actors. Furthermore, some stakeholders of value creation in complex value network lead activities exogenous to buyers/sellers business interactions, but which support or reduce the value creation at the ecosystem level. Thus, we will find key influencers or prescribers in complex value chains, which are highly relevant for value creation. As stated by the study on the mobile phone industry done by Funk (2009), policy makers need to be involved in the value creation issues and in value evaluation, because they influence the standards put in place, which in return

impact the potential of value creation for business players.

In the case of a stabilized complex value network, value creation at the ecosystem level could be analyzed through a dominant design model approach (Abernathy and Utterback, 1978). But in the context of innovation, value creation analysis and building is an effective research question (Lee et al., 1995). As stated by Midler and Beaume (2010), breaking the dominant design renews the customer practices and values, as well as the ecosystem and its perimeter. They show on the example of the electrical vehicle that there are difficulties in addressing value creation in innovative projects. The question is especially understudied in networks and standard-based ecosystems (Gallagher and Park, 2002; Soh, 2010) to which our research aims to contribute. Beyond a tool for analyzing value creation, we propose to investigate through two case studies the managerial patterns of value creation from innovation in complex value networks. Table 7.1 summarizes the main differences found between simple and complex value networks.

Table 7.1 Summary of a comparison between simple and complex value networks

	Simple value network	Complex value network
Main actors	<ul style="list-style-type: none"> • Buyer/Final user • Producer/Seller 	<ul style="list-style-type: none"> • Interdependent final users • Multiple buyers • Interdependent producers/sellers • Prescribers
Direct price-cost link for users	Yes	No, products and services often subsidised or not only paid for by final user
Value creation analysis	Business model and value chain positioning	Collective rules and governance mechanisms
Low cost attractive through	Lower price and better value-for-money for the buyer/final user	Lower price for buyer and additional benefit for the other actors in the network
Example	White goods	Public transport

Definition of complex value networks

We can state that **complex value networks** rely on several actors for value creation, amongst them the final users, the buyers, the producers/sellers and prescribers. Cost and price for the final user are not directly linked, so value creation for the other actors of the ecosystem is important. The value creation analysis cannot be done only on the firm's business model, it has to go beyond and take into account the collective rules of the ecosystem.

The elements presented in table 7.1 allow getting a first theoretical overview of complex value networks. We will in the next item study empirical cases of complex value networks to allow identifying patterns in these networks.

7.3. Extending the notion of complex value networks: Patterns from empirical evidence

Our case study inside RATP allowed us to study a value network that differs from most manufacturing firm's, with only a supplier-buyer (or provider-customer) relationship. We have therefore introduced the notion of complex value networks. As previously pointed out, cost and price for the final user are not linked in these value chains, as is the case in our research setting: the public authority pays for more than 50% of the cost of public transport.

One could argue that public transport is a multi-sided platform (Hagiu and Wright, 2015), but being a subsidized public service, public transport slightly differs from other multi-sided platforms. The product sold by the transport operator is transport for the final user, but it is partially paid for by the transport authority. And although there is some feedback from transport authorities when there are not many travelers onboard a transport, many transport offers are maintained for their social aspect, even though they are far from an economical break-even. Therefore value creation for the public authority often does not depend on reaching a minimum critical volume of passengers, as is the case with the free newspaper, who needs to reach many readers to be interesting for its advertisers.

Public transport can profit from similar revenues as the one existing in multi-sided platform markets (Zhang et al., 2014), and they are often called non-transport revenues. That is for example the case with advertisement, often one of the 'ancillary revenues' of public transport that can help to pay for the transport operation.

Another important aspect of public transport is the existence of strong regulations. The public authority has the obligation to provide public service for the users, and cannot justify providing a worse service to users. Public authorities would be interested in lowering its costs, since demand for public transport is still increasing, but transport budgets have not been following this increase. They can only resort to low cost offers if they can convince the final users of the interest of this offer.

Furthermore, the public authority is under constant pressure of important influencers, like the governors and mayors of the concerned regions, who need the user's support for their re-election. These actors also often need convincing when a new offer is to be put in place. Concerns about the impact of a new offer on the image of a city exist, as has been highlighted in studies linked to the image associated with new light rail services (Carmona, 2001). Value creation for these influencers is therefore also an important issue in the case of public transport.

Other ecosystems with similar constraints as those observed in public transport can be found in other public services. We will through a study of these constraints verify that two of them also have complex value networks: the **water supply and sanitation** ecosystem and the **solid waste management** ecosystem.

Water supply and sanitation

In the case of providing clean water and sanitation in Europe, we can observe a similar ecosystem as in public transport. As in the case of public transport, an authority exists, who is in charge of regulation. The figure 7.1, adapted from Nakhla (2013), shows the relationship between the final user, the authority and the service provider.

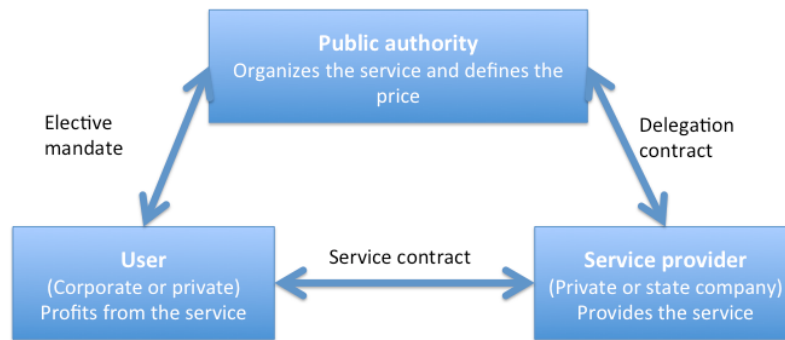


Figure 7.1 Relationship between user, public authority and service provider in the clean water and sewage treatment. Adapted from Nakhla (2013).

Providing clean water is often linked to a local authority, whose catchment area does not have to coincide with the city or the country, but is often defined by the groundwater network. As Jones (2000) states, an evolution to groupings of municipalities has been observed, due to inefficiencies observed when there are too many local authorities. The same can be the case in public transport for authorities that cover several cities. The authorities' coverage can in these cases be defined according to the passenger flows.

Another similarity between public transport and water supply and sanitation is the great number of different configurations that can exist. Regulation is not done in the same way by all authorities. In his work, Nakhla (2013) makes a comparison of the different regulation systems put in place throughout Europe. He identifies four types of organization, according to the type of investment and operation (public or private) and according to the coverage (local or regional). Despite this classification, enormous differences can exist inside each one of these types of organization, with public-private hybrids for example. As in public transport each authority decides which organization it wants to put in place, as long as it is compliant with national legislation.

We can also cite the need to build expensive and long lasting infrastructures for water treatment as a common point with public transport. This can lead to several difficulties concerning funding and loans, as described in the example of the city of Tallinn by Vinnari and Hukka (2007). The decisions about building these infrastructures are mostly not taken by the companies who will later operate them. This often leads to difficulties in optimization and in operational cost reductions. It can also make creating a standard more difficult.

Water and wastewater treatment is a key service that demands important infrastructures and important investments. And besides the impact on water security and cost, investments in

water supply also have a broader impact on the environment (Kandulu et al., 2014).

Solid waste management

Solid waste management, like public transport, is a public service mostly managed by local authorities. Two different levels of local authorities for waste management can exist: one responsible for collection and one for waste treatment. Waste management policies are often defined on a regional or national level. However waste schemes are expected to be more optimized when local authorities are partially autonomous, as long as they comply with regional and national directives, since there are often local aspects that influence the optimal management (Broitman et al., 2012). As described by Zotos et al. (2009) on the example of the Greek waste management ecosystem, there are a great number of stakeholders, as in the case of public transport.

In the case of waste treatment, there are important potential revenues besides those coming from waste collection and treatment fees. These can influence the system's break-even point. One of these revenues comes from the sale of recyclable or compostable materials (Broitman et al., 2012) and another one comes from using waste as an energy resource (Juul et al., 2013). The sale of recyclable materials often demand additional treatment phases, like separation processes. In the separation process we already observe positive transfer to the user, since separation can be partially assured by the final users. This is made possible through infrastructures that enable final users to separate (different bins and different collection services), as well as policies and incentives to create interest in doing so.

These first examples shows a particular kind of complex value network that have a lot of common points with public transport: some public services. Providing public services is considered to be the government's obligation. Governments can, most of the time, choose to do so by hiring a private company to provide the service, or they can provide the service by themselves. Therefore the government has a high responsibility in providing public service, not only in creating legislation with which providers must comply, but also in choosing the provider for some services.

In France, public service is supposed to fulfil some important conditions, among which are non-exclusion and affordability. The government has to ensure the provision of the service with a certain quality level for all consumers and users at an affordable price. The condition of affordability should normally be an incentive to put low cost products and services in place. However, the demand of a certain quality level for all consumers makes it very difficult to do so.

BtoBtoX markets

Another kind of ecosystem in which similar difficulties with launching low cost products

exist, was identified outside the public services context. It consists of extremely regulated ecosystems with complex products, as is the case of aviation or the automobile industry. The companies that produce parts and are very far from the customer, in a business to business to customer setting or even in a business to business to business setting. We will refer to these settings as BtoBtoX ecosystems, borrowing an expression used in marketing (Malaval and Bénaroya, 2013). We will describe the particularities of these markets below.

In some cases, even though the final product seems to have a simple provider – buyer relationship, we find similar difficulties as those faced in the case of public transport in the object’s value network, due to the distance existing between the final customer and some businesses. In this case, several intermediate businesses exist and we will use Malaval and Bénaroya’s (2013) expression for these businesses, BtoBtoX.

One example in this case is airplane parts suppliers. The final customers for the planes are the airlines, but the suppliers often sell their parts to assemblers, and there might be several assemblers between the part producer and the final customer, so there might be no contact whatsoever between the producer and the final customer. However the value creation for the final user depends greatly of the parts manufacturers. And the final users of the plane are the passengers and the cabin crew, who have different demands and usages of the different parts of the plane. Finally, there are strong regulations to which the producers must comply, since the plane needs to be certified in the end.

In the case analysed by Fricker and Mouldi (2014), and previously described in chapter 3, the challenge was to develop a low cost cockpit. The direct customers of Thales are the assemblers, like Airbus. The final users of the cockpit are the pilots, who do not really pay for the product they are using, and who expect to find a product adapted to their needs and to their training. There are extremely strong regulations on the cockpits because they need to be certified by international institutions, so most of the aspects cannot be changed. And although cost is an issue for the buyer, the airline, safety comes first, and there cannot be a compromise on this aspect. This ecosystem is described in figure 7.2.

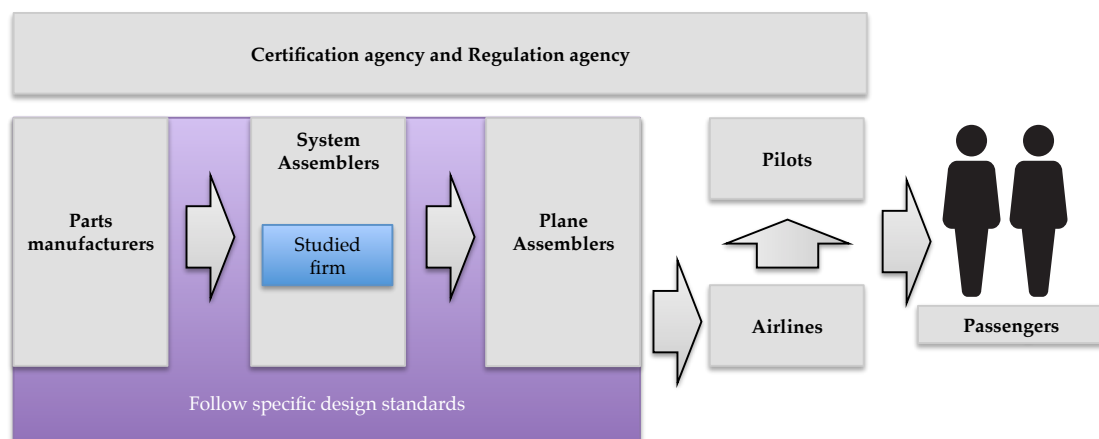


Figure 7.2 Ecosystem in which Thales evolves for the development of a low cost cockpit. Adapted from Fricker and Mouldi (2014).

When comparing the BtoBtoX market and the other public services with public transport we do find many common points between them, all of them being subject to strong regulations, coming from different levels, having prices for the final user dissociated from costs and a wide range of stakeholders composing the value network. These are aspects we could have foreseen through our model of complex value networks from literature. Additionally, these examples allow us to identify a series of common patterns, which we can use to expand the previously proposed model of complex value networks, based on literature.

The first observed pattern is the importance of collective rules of coordination. Since a great number of actors contributes to value creation, like in the case of product complexity managed through modularity (Baldwin and Clark, 1997), the standards and regulations put in place are essential to allow producing viable products or services. In the observed cases these standards and regulations can take different forms. In the BtoBtoX case we analysed, certification was an essential part of putting the standards in place. In the case of water and waste treatment, the infrastructure also plays an important part in setting standards.

Furthermore, we observed a big difference in the governance mechanisms. While in the case of simple value networks there was a competitive approach, with companies trying to optimize value for the customer, this was not the case in the complex value networks all the time. Since many of the actors in these networks are linked, and depend on each other for value creation, there is a more collaborative approach. In the case of water management, for example, despite competitive moments, when there are calls for tenders, all actors work to increase the number of connected homes and to make sure the service is available for all at all times.

Finally, as stated before, the business model and the positioning in the value chain are not enough to guide value creation analysis. We observe that in stable ecosystems, value creation analysis can be guided by the dominant design. Value creation is analysed by comparing a proposed solution to the dominant design. However, in the case of innovations or in emergent value networks, there seemed to be no framework for value creation analysis.

These different patterns can be added to our model of complex value networks, as can be seen in table 7.2.

Table 7.2 Model of complex value networks extended through patterns observed in empirical cases

	Simple value network	Complex value network
Main actors	- Unique Buyer/Final user - Unique Producer/Seller	- Interdependent Final users - Multiple Buyers - Interdependent Producer/Seller - Prescribers
Direct price-cost link for users	Yes	No, products and services often partially or completely paid for / by other actors of the ecosystem
Governance mechanisms	Competitive (Optimization of value for customer)	Collaborative (Optimization of the number of beneficiaries in the network)
Collectives rules of coordination	Firms processes to market launch	Standards and regulations (infrastructure & certifications)
Value creation analysis	Business model and positioning in value chain	In stable ecosystems: dominant design In emergent ecosystems or in case of innovation: ?

7.4. Conclusion: Low cost potential in complex value networks

As already pointed out on the example of public transport, complex value networks have as main particularity the great number of actors involved, that have to be taken into account and their needs satisfied. Although calls for tenders are not mandatory in these settings, the fact that the final user cannot choose his provider freely is. This does not mean that the final user does not influence the decision, only that he is not the ultimate decision maker. The BtoBtoX market example illustrates that clearly, the parts of each plane are not bought through a call for tenders and pilots do not get to choose which cockpits will be inside the plane their airline will buy, although they might influence the decision.

The overview we did on value networks allows us to underline the main differences between simple and complex value networks. These influence the design of low cost products, as we were able to show through the case study inside RATP.

Besides the question we have already highlighted in the previous item, on how to create value in complex value networks in an innovative context, several managerial challenges for low cost arise from the patterns identified in complex value networks. These are listed in table 7.3.

Table 7.3 Managerial challenges for low cost in complex value networks (CVN)

Patterns in CVN	Potential for low cost	Risks for low cost
Wide range of stakeholders	Value creation for several stakeholders and integration of new stakeholders in the value network	Refusal of low cost because it only reduces cost for the buyer and does not create value for all stakeholders
Strong regulation	Participate in regulations design to make them compliant with low cost	Reduced design space due to strong regulations
Dissociation of user and buyer	Possibility of creating a new ecosystem around a value proposition that allow proposing a satisfying low cost product for the final user and the buyer	The low cost product must be attractive both for the user and the buyer
Dissociation of cost and price for the final user	Possibility to create even more affordable low cost products, by creating value for several stakeholders	Lower costs will not always lead to lower prices, and lower price is no longer enough to create an incentive to buy low cost, there is a need to create other incentives

We can therefore state that low cost in complex value networks open a great number of opportunities for value creation in other configurations. In complex value networks there seems to be a need to create value for the entire ecosystem to produce successful low cost products and avoid the managerial risks for low cost of this configuration. We will therefore develop how to create value in complex value networks when designing low cost offers in chapter 8.

Chapter 8. Designing low cost ecosystems for complex value networks

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In this chapter we will show how smart low cost design products can become attractive in complex value networks, and give a first possible approach of the challenges identified in chapter 7. We will discuss 3 different ecosystem configurations cited in the literature and observed through our empirical studies, in which the complex value network can be. The first is an existing known and relatively stable ecosystem, the second one an existing but partially unknown or unstable ecosystem, and the third one is a new ecosystem. These different ecosystem configurations and the approaches proposed for them can be found in Figure 8.1.

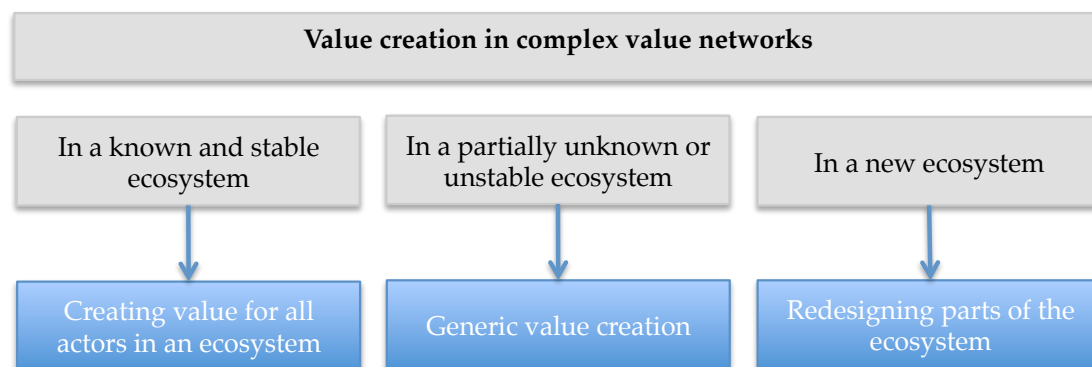


Figure 8.1 Ecosystem configurations when creating value in complex value networks and proposed approaches

In the case of complex value networks in existing stable ecosystems, several actors exist and there is a **need to create value for all of them** to create acceptable low cost products. This leads to a radical increase of the aspects to be designed, since the design has to take into account not only creating value for the final customer, as is the case in simple value networks, but also for all the other concerned actors. On the other hand, having a greater number of “customers of value creation”, also allows working on products that only increase value for some of them, maintaining the same value as in the regular offer for some of these customers. This opens up another design space.

Identifying all the actors of an ecosystem can be very difficult, and when that is not possible, or when the ecosystem evolves quickly, being unstable, we will show that firms can rely on what we will describe here as **generic value creation**.

Furthermore, smart low cost design, as seen in part II, leads to strong changes of the dominant design. These changes of the dominant design have an impact on the value chain and on the ecosystem. The study of different low cost products shows that due to these changes in the ecosystem, some conditions linked to the evolution of the ecosystem for the successful launch of low cost products might exist. We discuss three aspects of the ecosystem that were identified in literature as conditioning success of low cost products studied inside our database and the approach to these aspects of the ecosystem proposed in our case in

public transport. Instead of waiting for conditions to be reunited in their ecosystem to launch their low cost offers, two solutions were part of the low cost strategy. The first was to **redesign some aspects of the ecosystem** to render it more compliant with conditions for low cost product emergence. The second was to **place the product in a new ecosystem**. We further illustrate these two solutions through the case of Thales in its BtoBtoX market.

We therefore conclude our chapter by showing why these aspects of the ecosystem are relevant for low cost products in complex value networks. We further propose an approach to their design.

8.1. Low cost design in complex value networks: taking into account the value for all the actors in the design process

Usually, low cost products are designed to be attractive for the final user, who is also the buyer. Attractiveness can go through lower prices, but can also come from creating additional value for the final user. We have seen that simply creating value for the final user is not sufficient in complex value networks. Although in these networks creating value for the final user can increase the low cost product's acceptability, it is essential to take into the other actors of the network into account. Therefore there is a need for ecosystem value creation, creating value for all the actors in the value network.

In this part, we will show how creating value for the entire ecosystem can be achieved in two different ways. The first approach consists of creating value for all the identified actors in the ecosystem. Secondly, value networks might evolve due to changes in the dominant design, and it might be necessary to integrate new actors into the value network. These might be hard to identify, so creating value for them might be challenging, since this might be a situation of double unknown (unknown value and unknown actor). We therefore propose that these actors might be integrated through what we will call generic value creation.

8.1.1. From creating value for the customer to creating value for the entire value network

As we saw in chapter 4, rendering the dominant design of public transport explicit clearly showed that there were other actors inside the transport system besides the supplier (the transport operator), the buyer (the transport authority) and the user (the passenger). When applying the complex value network framework to public transport, we identified all the actors inside the transport ecosystem and how they contributed to the value creation process of transport. This allowed us to evaluate who were possible influencers, and also who would be affected by the introduction of breakthroughs in the dominant design. As we discussed in chapter 7, the dominant design is linked to the ecosystem. So each aspect of the dominant design that was challenged pointed to changes for different actors, who would need to be

convinced of the advantages a low cost product would have for them. In many cases, when discussing the propositions issued from the KCP inside RATP, experts agreed that this could only be a successful proposition if one or several actors agreed to it.

Our work on a low cost strategy inside a complex value network therefore allowed us to identify the need to create value in a broader way, for the entire ecosystem. An evolution from a logic of creating value for a final user in an ecosystem to a logic of creating value for all the actors in an ecosystem is therefore necessary.

This can be illustrated by different examples of breakthroughs seen in the case of RATP. Changing the technological paradigm could mean changes in the type of infrastructure, like discussed through the replacement of the physical through a virtual infrastructure. The value network around infrastructure is completely changed by this shift: the infrastructure builders can be excluded of the new value network, while app developers and other smartphone platform actors must be included. This kind of offer can only be worked on if there is value creation for all the actors in the new network.

The new proposed business models, based on crowd funding and crowdsourcing clearly allowed value creation for the classical actors: the user, the transport authority and the transport operator. It also allowed the integration of additional actors in the value chain, in charge of putting in place and organizing these platforms. However, as can easily be seen in other crowdsourcing activities, the classical actors could easily be excluded. The study of these possibilities clearly shows the interest classical actors have in working on these solutions. It allows them to continue being a part of the value chain, as well as to create new partnerships.

In the case of public transport offers proposed inside RATP, adding functions was part of most of the initiatives proposed in the smart low cost design approach. The functions added covered a wide range and were destined to different actors, going from functions for the user, like proposing to book your seat inside the transport, to functions for the competition, like a coordination of all transport modes. Each one of the added functions represented additional costs, and some were evaluated as having little chance of being accepted on their own. The reason for this was that they failed to create value for more than one actor. Combining these new functions often resulted in products that increased value for the entire ecosystem, making them much easier to be accepted.

More than just having RATP create value for the different actors, working on value creation for the entire ecosystem showed **the need to cooperate with other actors in the value network**. Especially when analyzing how to create value for the transport operators (both for RATP and for other operators in the region), a competitive positioning destroys value, while collaboration can create value for all operators.

8.1.2. Generic value creation: how to propose value creation in an evolving value network

One of the difficulties in creating value for the entire ecosystem in complex value networks relies on the great number of involved actors and on the constant evolution introduced by breakthroughs in the dominant design. The network for a proposed breakthrough might not be the same as the ones found in the dominant design. According to Christensen and Rosenbloom (1995), changes in the paradigm address new performance sets, valued in a new or a different value network. This creates a new difficulty, of correctly identifying actors inside the new value network.

As we have stated in the previous parts, the success of the proposed low cost products often depends of the ability to create value for the entire network. Low cost products in complex value networks therefore have to allow creating value for actors that we might not know, putting the designer in a position of double unknown: an unknown value and an unknown actor for whom value is created. We propose to approach this double unknown situation through **generic value creation**.

We transpose *genericity* as defined by Kokshagina (2014), meaning in this case the ability to simultaneously create value for unidentified actors. As proposed by Kokshagina (2014) in the case of generic technologies, that should be adapted for several applications that are often still unknown, **generic value creation** should create value for several actors, some still unknown and sometimes not part of the previous value network.

Definition of generic value creation

We therefore propose **generic value creation** as the approach to create value for several actors in a double unknown situation: an unknown value and an unknown actor for whom value is created.

According to Kokshagina (2014), achieving *genericity* is linked to the construction of a validity domain $D(x)$. Through her empirical work she identified three strategies of domain design: strategy of environment superposition, of environment projection and environment attraction.

We propose these strategies could also be transposed to generic value creation. Instead of evaluating the potential a technology would have for different markets, we evaluate the value of a low cost offer for actors in the value network. The strategy of environment superposition for example was used inside RATP, although it was not done in a systematic way. When evaluating the potential of a low cost offer for a small volume of passengers, doing a single trip, intuitively it was seen as creating value for the final user and for the transport authority, because it allowed increasing accessibility to public transport. However it seemed risky to develop a product on what was considered a niche market. RATP's experts estimated public authorities were less concerned with these one-shot trips than with the high volume of

commuters still having difficulties with their transport. Therefore other applications were analysed and it quickly became evident this kind of offer might, with minor changes, interest firms or associations.

Expanding the offer to new markets showed that it could create value for different actors in different configurations, this considerably reduced the risk for the company to develop this offer, since it had several options to explore. It furthermore opened up new potential participants in the value network. These new participants bring new knowledge and needs, and could be the basis of new partnerships, as well as be the source for the development of yet other offers. Figure 8.2 shows different evolutions of the value network. As can be seen in this figure, the network can be extended, by adding new actors, or revisited. In the revisited value network, actors of the original value network can be excluded. In the case of our generic value creation, the offer creates value for all actors in the three value networks proposed in Figure 8.2.

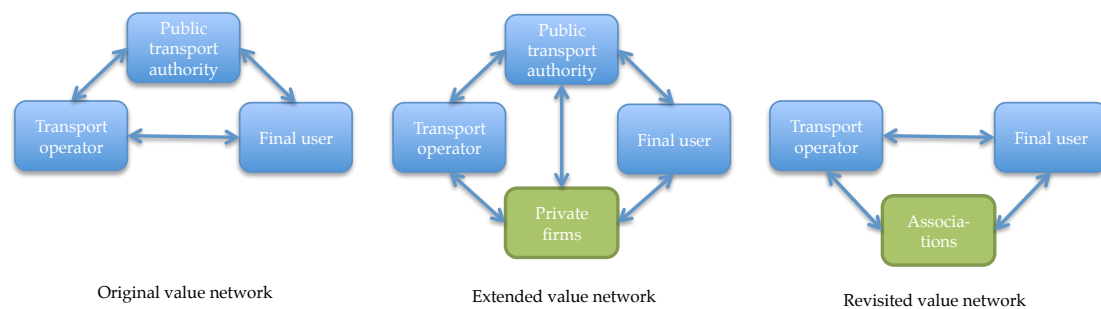


Figure 8.2 Evolutions of the value network

We therefore have yet another approach to create value for the entire ecosystem: it consists of having a clear value proposition and then associate the interested actors to the value network.

8.1.3. Creating value for an ecosystem goes through a cooperative approach of actors in the value network

Value creation is central to launch successful low cost products in complex value chains. In an existing ecosystem, this can be done on several levels. While in many products in simple value networks the focus lies only in creating value for the final user, the study of several low cost products in our database show that taking the ecosystem in which the final user is into account can create superior value. However, this is not sufficient in a complex value network, a cooperative approach of the entire value network, seeing the other actors as co-creators of value, is needed. This allows creating value for all the actors of the ecosystem. The examples inside RATP show how value could be created for actors inside the value network, other than the final user, like the transport authority. It also shows that new design spaces, closed when seeing other operators as competitors, are opened by this approach.

Finally, we also observed that smart low cost design in complex value networks could also

change the network configuration. And in some cases, value could be created for actors that are currently unknown. This is what we called generic value creation. Figure 8.3 shows the different options of value creation we have when considering an existent ecosystem. Smart low cost design in complex value networks is only possible when value is created for all the actors, or when there is generic value creation.

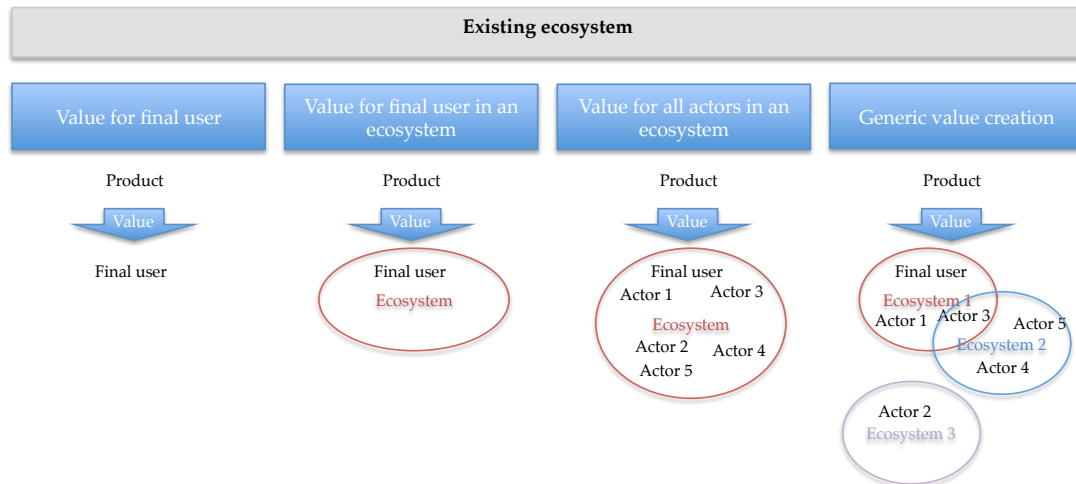


Figure 8.3 Value creation in existing ecosystems

We can from this part conclude that a shift in the approach of value creation is needed: we can no longer approach value creation only for the final user, as done in simple value networks. And to be able to create value for the entire network, either creating value for all actors or through generic value creation, the operator needs to form partnerships. So a cooperative approach of the value network is needed.

8.2. Inducing new ecosystem design through low cost products

Value creation is essential for a successful low cost product, but there are also other aspects might create barriers to introducing a low cost product. Although to our knowledge there are no studies so far that have shown the conditions under which low cost products can emerge, ecosystems clearly have a strong impact on this emergence. In the cases studied in our database, scholars identified three aspects of the ecosystem that might constitute barriers. And when the ecosystem did not allow the emergence of low cost products, these were greatly influenced and often designed by the firms launching the low cost product. They are the **infrastructure**, the **distribution network** and **legislation, contracts and policies**. This is not an exhaustive list of aspects of the ecosystem that could be influenced by the low cost design, but only those that were identified in our database. We will describe below how their design was done in the cases we encountered. Furthermore we will describe how a smart low cost design strategy can be used to design the ecosystem once an opportunity of value creation for several actors has been identified.

8.2.1. New ecosystem design: evidence from the literature

As we have highlighted in chapter 7, the dominant design and the ecosystem are closely linked. When the dominant design is challenged, the ecosystem is also challenged, having to be completely re-built or at least partially restructured. In the 50 cases we analyzed in our database, and found in Appendix 1, we saw how necessary changes in some aspects of the ecosystem were identified as barriers to be overcome to successfully introduce low cost products in an ecosystem. The three aspects identified in our database are the infrastructure, the distribution network and contracts and legislations. Not only were these aspects identified as relevant in the cases we studied, but they are also coherent with aspects identified as structuring in complex value networks. The regulations and infrastructure are part of the collective rules of coordination in a complex value network, as we saw in chapter 7, and are essential to insure value creation in these networks.

Designing the infrastructure

Stories of multinationals failing in globalization, due to the fact that they were confronted with the lack of essential infrastructure in developing countries (like roads, pipelines, suppliers or even grocery shops), are already part of the business and management mythology. Many works, like the ones of Khanna and Palepu (2006) and Khanna et al. (2005) highlight the importance of taking the lack of infrastructure into account and recommend companies either to help building them or to induce others to do so.

In some cases, designers of low cost products and services were confronted to a lack of needed infrastructure to make it possible to produce and sell their products. In these cases, infrastructure design was often done with inputs from the low cost producer, and in some cases actually was done by the low cost producer, which made them more adapted to their needs.

A first example can be found in the case of low cost airlines. When developing their product, low cost airlines also decided to reduce costs linked to the airports. Therefore, when possible, they chose secondary airports that still had available timeslots, and were uncongested, sometimes with less developed services, to allow lowering costs. Besides that, low cost airlines also changed the basis of the airport-airline relationship, and negotiated better deals with airports, having airports cover a part of “marketing fees” or reduce handling costs. Airports had to adapt to having smaller incomes from the airlines and higher income linked to the passengers (Francis et al., 2003).

In Europe, many of the secondary airports used by low cost airlines were military infrastructures that already existed and were reconverted to civil usage. Most of them had very little traffic before low cost airlines, one example is Frankfurt Hahn, where the annual traffic was of 7000 passengers when operations started, but rose to 8000 passengers a day in 2004, thanks to the low cost airlines (Barbot, 2006). But these secondary airports are not

present everywhere, as Zhang et al. (2008) point out, one of the big challenges for Asian low cost carriers is to find secondary airports in metropolitan areas in the region. One of the answers found for this challenge is the construction or adaptation of low cost terminals in main airports, aimed at providing a “minimalistic and efficient terminal facility at a reasonable price” (Njoya and Niemeier, 2011, p55). The fact that low cost carriers have different demands than incumbent companies drove the development of these terminals in existing airports.

The other solution found was to create low cost airports. Dedicated low cost airports take a long time to be built and often have to overcome other barriers, linked to the environment and the competition, but this is the approach chosen in India, where 200 low cost airports are planned in the next 20 years⁶⁸.

And studies on the airport choice factors for low cost carriers, like the one conducted by Warnock-Smith and Potter (2005), show the importance of having the input of the low cost carriers to design this infrastructure. As furthermore pointed out by Francis et al.'s (2003) comparison of the deals of two airports with low cost airlines and on Laurino and Beria's (2014) analysis of Italian airports, the airports need to have a clear analysis of the impact low cost carriers can have on their business, to avoid deals that might compromise the airport's results. According to Francis et al. (2003), win-win situations can be established if airports' and airlines' needs are both taken into account.

Designing a distribution networks – going beyond the brick-and mortar

Once the dominant design of the product is stabilized, Markides and Sosa (2013) cite having a distribution network that can serve the mass market as one of the essential elements to have a winning business model. Building a distribution network when it is not available can be very time consuming and costly. Different approaches can be cited here on how this problem has been solved in a way that contributes to keep low cost product's costs low.

The first example we can cite is the one used by Renault to sell the Dacia Logan. As described by Jullien et al. (2013), when Renault decided to sell the Dacia in countries where a distribution network for it did not yet exist, they first had the regular distribution network for Renault cars as a model. A model that would be extremely costly to replicate, which motivated using the existing network for Renault cars to sell Dacia cars instead of building a new one.

The second example also comes from the automobile industry, since it describes how the distribution network for the Tata Nano was built. Ray and Ray (2011) describe this case and draw attention to the importance of insuring efficient and low cost logistics and distribution

⁶⁸ Available on: <http://www.deccanherald.com/content/391030/india-build-200-low-cost.html>. Retrieved on the 17th October 2014.

to make the low cost product a success. The idea in the case of the Tata Nano was to use local entrepreneurs closer to mass markets for assembly, sales and service. The car was sent in a kit for local assembly, and could therefore be distributed more widely through already existing and established local businesses.

Another example consists of building a distribution network from scratch through the creation of new sales channels. This was the case with the “Grameen ladies”, a network created by the Grameen-Danone initiative to sell their dairy products (Parmigiani and Rivera-Santos, 2015). In this case, there was a great difficulty in reaching customers, since a classical distribution network through supermarkets did not exist. Besides that, the goal was to produce and consume locally, so there was not necessarily a need for an extensive distribution network. Re-creating a classical distribution network would have been extremely costly, and probably not the most efficient solution. So Grameen-Danone decided to distribute their products through existing food stores and to create an additional door-to-door distribution system. According to Yunus et al. (2010), the Grameen ladies are small-scale entrepreneurs. They use credit from the Grameen bank to buy a small stock of product at the factory and go out to sell the product, receiving a commission for every product they sell.

These three examples have variable costs and allow different access to consumers. They illustrate how low cost firms have designed the distribution network and how this does not always mean creating new facilities. Furthermore, it does not always mean relying on the firm’s resources alone. The entire ecosystem can be mobilized for this goal.

Designing legislation, contracts and policies

Legislation and policies are not often adapted to innovations, and low cost products are not an exception. The creation of new technologies, business models, actors or relationships between them, often make the existing legislation obsolete, or demand changes to accommodate the new reality. We will discuss two such changes linked to low cost firms to show the impact they can have.

Our first example concerns changes in legislation brought about by the case of private space flight and the so-called “New space” firms. Due to its historical development and to the high cost associated to the first missions, space activity was, during a long time, reserved to governments and dedicated space agencies (Genta, 2014). Private companies did contribute to these activities, but only by producing components under strict control. More recent evolutions in the 90’s and the 2000’s increased the importance of small private companies, also known as “New space”, like SpaceX (Cornell, 2011). Additionally to their part as component manufacturers, private companies were also awarded contracts allowing them to launch their own missions. SpaceX was awarded a Commercial Orbital Transportation Services (COTS) contract by Nasa, allowing the company to resupply the international space station (ISS) through several missions.

According to Cornell (2011), the main elements that define New Space companies are their focus in cutting costs and their emphasis on innovation. Not being bound by the same

constraints as Nasa and not sharing their development history, SpaceX for example achieved significantly lower costs, with launch crew costs an order of magnitude smaller than the one's of United Launch Alliance.

These radical cost reductions justify the interest of governments to work with these companies. However, allowing private companies to perform activities that were only done by governments before was a radical change, one that was not foreseen in the legislation on space missions when it was drafted. The space legislation mainly took into account that countries were to be responsible for the launch of spacecraft, and that there could be a crew onboard the spacecraft. The traditional orientation of international space law establishes state responsibility for private activities on exactly the same level as it does for state activities (von der Dunk, 2011). The operation of unmanned missions by private companies therefore demanded that in the states in which these companies operated, national space laws were enacted, to ensure that the private operations would be under legal control of the government.

Further evolutions can also be observed in the legislation concerning private spaceflight and space tourism. According to von der Dunk (2011), we can identify three different phases: A first one when all space activity was only conducted by states and the liability lay with governments through the international space act; a second one where private companies started operating unmanned spaceflights, and where national laws were passed to make sure these companies would comply with international space legislation; and a third one that concerns private companies operating manned spaceflights and organizing space tourism.

Today, legislation on space tourism is still taking its first steps, the first legislation concerning non-crew members, also called "spaceflight participants", was the 2004 Commercial Space Launch Amendments Act (CSLAA). Several questions, like how and if to do vehicle certification and on liability are still open for discussion, and will have to be decided in the coming years. And it is in the companies wanting to provide these services' interest to be influencers in these decisions.

Space flight and new space are a good example of how new low cost players demand changes in legislations, which had to be adapted in the past to allow a private company to operate in this environment and will continue to be adapted to allow new activities.

Our second example concern low cost airlines, whose history is clearly entwined with policies and legislation in place. Many studies on low cost airlines cite air deregulation as one of the main conditions for low cost airlines success (Gillen and Morrison, 2005; Francis et al., 2006).

Furthermore, introduction of some policies and practices by low cost carriers, clearly impacted the airlines market, and actually lead to the creation of new laws. One example of new regulations linked to practices first introduced by low cost carriers (many of which have since however been adopted by former full service carriers) are the new airline passenger protection regulations put in place in 2012 in the US⁶⁹. According to this new regulation, all

⁶⁹ More information about these regulations can be found on <http://www.dot.gov/affairs/2012/dot0812.html>. Accessed on the 11th December 2014.

airlines now have to disclose their full price, with all taxes included, as well as the price for taking extra luggage. Although this might not be seen as a very structuring change in legislation, it clearly shows the impact low cost operators can have as game changers in a market, and therefore on regulations. As described by Yunus et al. (2010), business model innovations often bring new strategies, which modify the competitive rules in a market. The new legislations are a symptom of that change.

Airlines are a good example because they show the impact both ways. In the case of market deregulation, the possibility of having low cost airlines was conditioned by regulations. Therefore low cost companies have every interest in lobbying for deregulation – and did so in several countries. In the case of the new airline passenger protection regulation, the new business model introduced by low cost airlines led to new regulation. So low cost companies also often influence the creation of new regulations through their existence.

This kind of shift, from public operations to public-private partnerships or to privatizations has been seen in other activities as well, and has always had to be accompanied by changes in legislation. One example discussed by Wallsten (2001) is the telecom sector: the legislation always has to evolve to accommodate the privatization.

8.2.2. New ecosystem strategies through smart low cost design innovations

Evidence from the empirical study inside RATP

Our case study inside RATP highlighted several interactions with the transport ecosystem. In the innovations proposed inside RATP, we often realized the ecosystem was not ideal for their development. But instead of stating that innovations were not feasible due to an unfavorable ecosystem, an effort was made to understand and to overcome difficulties. The work on low cost products actually provided the operator with some of the lacking arguments to discuss changes in the ecosystem with other actors. It furthermore provided an occasion to compare the ecosystem in which RATP was with other ecosystems, and this benchmark helped to show which aspects were really barriers linked to the ecosystem, and which were rigidities linked to the company.

We identified two of the three aspects seen in literature, in which adaptation of the ecosystem played a determinant role to the successful development of low cost offers: infrastructure and contracts and regulations design. In these aspects we also showed the transport operator could be an important influencer, and even game changer. Through the low cost strategy, we could also easily show the interest the operator had in doing so. Therefore the design space of the operator was once more extended.

In public transport, designing transport infrastructure is mostly part of the assignments of the transport planner, and the transport operator is picked once the infrastructure already exists. This is often justified by the calls for tenders, which might be biased if one of the operators participated in the infrastructure design. But it is sometimes also linked to the lifecycle of

infrastructure, which is very long when compared to the shorter cycles for which transport operators receive a contract through calls for tenders.

Our work inside RATP on a smart low cost design of an entire transport system showed that many potential cost reductions could only be achieved by rethinking infrastructure in a direct link to operations. As was observed with low cost airlines and airports, having an infrastructure designed especially for the low cost operation allows positive feedback, adding value both for the airports and the airlines. The same can be observed in the case of low cost transport. Not carrying unnecessary elements inherited from classical operations reduces infrastructure and operating costs. The use of a smart low cost design strategy therefore allowed including transport operators in discussions on infrastructure design, and reopened a previously closed design path.

When looking at existing **contracts and regulations** around RATP, a service contract exists between the user, the transport operator and the transport authority. A second contract exists between the transport operator and the transport authority. The contract between the user and the transport operator/transport authority is described in the “Guide du savoir voyager”⁷⁰. The main rights of the user and his main obligations are recalled in this document, and they include but are not limited to the obligation to have a valid transport ticket, to validate it when entering public transport and to produce it on demand; to respect the premises and not litter them; and to respect the security rules.

This contract is only possible in this format because of the existence of the contract with the transport authority and of the orders and decrees’, stipulating what is expected of passengers and of the transport operator. In the service contract with the user as it exists nowadays, there are no penalties for train delays, nor for service interruptions. These are all handled in the contract between the public authority and the transport operator. In the Parisian region, if the operator wants to avoid being regulated by the transport authority (the STIF), it has to propose a service that would not be part of its public transport mission. This aspect has already been discussed in part II, as one barrier to be overcome. Not operating a public service would free the transport operator of a series of constraints.

However, to operate a service that would not be part of its public transport mission regulated by a transport authority, the operator would need to create new service contract with the user. Although RATP’s subsidiaries already have different contracts with their users (RATP Dev operates several services that are not regulated by transport authorities in the same way as the STIF does in Paris), this is nevertheless a great challenge. But being able to create a different user contract also means being able to change the relationship with the user. Transferring a part of the activity to final users could be part of this new contract. One of the aspects the transport operator has to work on to develop its low cost strategy is on the arguments to make the new contract attractive for the user and its current customers.

Furthermore, in complex value networks, not only legislations applying to the operator are important, those linked to the authority are also essential. And shifts in the value network

⁷⁰ Available on www.ratp.fr, Retrieved on the 10th October 2014.

including new actors also demand a more comprehensive analysis of legislation. This allows understanding the impacts of these new actors and identifying weaknesses in legislation. But instead of only trying to exploit regulation voids, as has been done in the case of the e-cigarette (Etter et al., 2011), these elements are being used by RATP to re-open discussions on regulations.

These elements, on the re-integration of the transport operator on discussions on infrastructure and on discussions on contracts and regulation illustrate how smart low cost design can be used as a tool to influence the ecosystem.

Evidence from the empirical study inside Thales

A similar approach to regulations as the one described in the RATP case was found in the case of the 'low cost cockpit' by Fricker and Mouldi (2014). As observed inside RATP, strong regulations made it impossible for the incumbent firm to propose a low cost product. One of the solutions proposed by Fricker and Mouldi (2014) consisted of opening a certification innovation space. This space would assemble all the actors of the value network, and allow to discuss and to recreate a new certification. The actors of the value network have to be convinced of the importance of this space. This will only be possible if the new certification space and the products it will allow to certificate can actually create value for the entire ecosystem.

A further possible approach to complex value networks and strong regulations was proposed to launch the low cost cockpit. It was to launch it as a non-certified object sold directly to pilots, clearly classified in some other category than a cockpit. That meant excluding the buyer who used to decide on the service and pay for it and offer the services directly to the final user. This is rather challenging, since it means excluding the firm's main buyer of the value network, and represents certain risks. But several examples exist, although many of them are part of informal economies. That is the case of carpooling services like Uber, or of private waste collection schemes, like those organized by recycling companies. We can also cite the Grameen Veolia initiative (Yunus et al., 2010), where water is directly sold to the population through prepaid cards, with a business model that resembles more to the bottled water business model than to the one seen in European water supply.

The study of the Thales case not only gives another example of how low cost products can be used to redesign regulations, it also shows us that moving to another, more compliant ecosystem might be a possible solution when the low cost object proposes a significant breakthrough in the dominant design.

8.3. Conclusion: When low cost supports ecosystem design

In this chapter we discussed how to create value through a low cost product or service in a complex value network. We start by an analysis of value creation in existing ecosystems and we concluded that creating value for the entire value network is essential to improve success chances. The first managerial implication of our results is that focusing on creating value for the final user in the case of complex value networks is not enough. Although creating value for the final user is important, when placed inside a complex value network, firms must focus on creating value for the entire ecosystem. Therefore they have to carefully study all the actors inside the ecosystem and their relations.

Creating value for the entire ecosystem might demand value creation for actors not yet identified. Low cost can be a catalyst to propose **generic value creation** in strongly regulated complex value networks. Offers that can create value even for yet unknown actors in the value chain can be proposed through the smart low cost design suggested here, when combined with strategies to build a validity domain. As with generic technologies these offers reduce risks for the firm working on them.

This chapter allows us to draw another managerial implication on smart low cost design products. Through the breakthrough in dominant design that they propose, these products strongly impact the value network, and sometimes demand its entire redesign. Not only do they shift value from one actor to the other, as can be the case when one actor is removed from the value chain, but they also introduce new actors, who can be game changers. Established firms like RATP should therefore work on these products, since **it allows them to propose new value networks in which they are still active actors**. Not working on dominant design breakthroughs can mean not being part of the new value network. This is a situation most firms wish to avoid, since it might be a risk for their business' continuity.

However, we also observe that the launch of low cost products, despite an identified value creation, might sometimes be blocked by characteristics of the ecosystem. In these cases, making changes in the ecosystem is one possible solution if low cost products are to be launched. We can therefore confirm our fifth research hypothesis (RH5), that said that ecosystems low cost design needed compliant ecosystems, but we can add to it that the ecosystem can be redesigned to become compliant. This is illustrated in Figure 8.4.

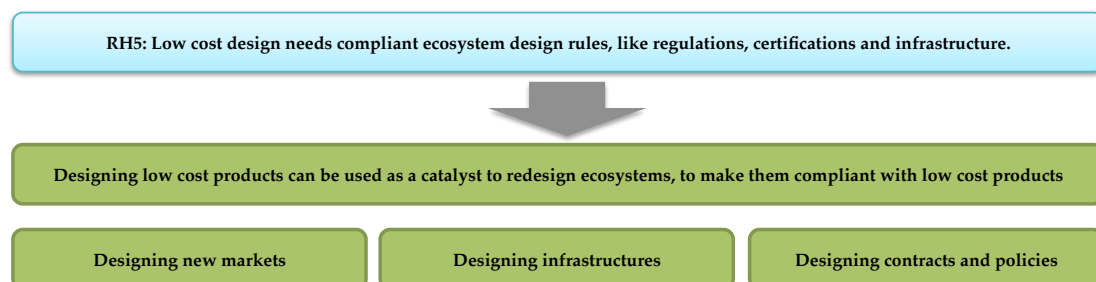


Figure 8.4 Using low cost products as a catalyst to design ecosystems

Furthermore the value creation studied in these cases allows us to further identify patterns that complement our previous framework on complex value networks, as can be seen in table 8.5. It is important to highlight that low cost design in complex value networks demands a collaborative approach, and not a competitive one as in the case of simple value networks. Our cases furthermore draw attention to the importance of the collective rules of governance in the case of complex value networks, which are the standards and regulations. And finally they show how business models and the positioning of the firm inside a value chain are insufficient in the case of complex value networks to analyse value creation, especially in the case of innovation, where the dominant design is insufficient to do so. We propose the generic value model could be applied in these cases.

Table 8.1 Specifications of complex value networks (CVN) for low cost design

	Simple value network	Complex value network
Main actors	<ul style="list-style-type: none"> • Unique Buyer/Final user • Unique Producer/Seller 	<ul style="list-style-type: none"> • Interdependent Final users • Multiple Buyers • Interdependent Producer/Seller • Prescribers
Direct price-cost link for users	Yes	No, products and services often partially or completely paid for / by other actors of the ecosystem
Governance mechanisms	Competitive (Optimization of value for customer)	Collaborative (Optimization of the number of beneficiaries in the network)
Collectives rules of coordination	Firms processes to market launch	Standards and regulations (infrastructure & certifications)
Value creation analysis	Business model and positioning in value chain	In stable ecosystems: dominant design In emergent ecosystems or in case of innovation: Generic value model

We are able to, through examples from literature and from our case, show how low cost products have already been used to successfully redesign some aspects of the ecosystem, like infrastructure, distribution networks and regulations and legislation. This opens up new questions on how can we design ecosystems that would allow and foster smart low cost design offers emergence? So far the design has been done case by case, but it would be interesting to propose a generic “low cost friendly” ecosystem design. This should be part of further research. This chapter therefore not only shows the importance of designing the ecosystem for a successful low cost product launch in complex value networks, it also opens up new research paths concerning ecosystem design.

Conclusion of Part III

Part III aimed to propose how insights gained in the case of public transport could be extended to other similar sectors, which also have a **complex value network**. We highlighted the advantages of a smart low cost design strategy in these settings: 1) **Smart low cost design supports value creation dynamics and a collaborative method for multiple actors, opening up new design spaces**; 2) **Smart low cost design can be used as a catalyst to design ecosystems, allowing their renewal or creation**.

In chapter 7, we introduced the value network framework, which made it possible to compare public transport to other sectors. This comparison led us to state that public transport has a **complex value network**, which can be opposed to simple value networks often found in manufacturing firms. Through three examples, the water management, the waste management and BtoBtoX markets, we were able to identify common patterns in complex value networks: they have a great number of actors implied, have a cost and a price for the final user that are not linked, need a collaborative approach of value and are coordinated through standards and regulations. These patterns represent managerial challenges for low cost - both risks and opportunities - that lead us to conclude that an ecosystemic view was needed.

In chapter 8, we elaborated on the managerial challenges for low cost in complex value networks identified previously. We started by applying the ecosystemic view to value creation in an existing ecosystem, that allowed the emergence of low cost products. We showed the pertinence of creating value for all the actors in the ecosystem, not only the final user. We furthermore show that, to reduce risks and costs associated to new offers, smart low cost design can lead to a generic value creation that is profitable at the ecosystem level. We then analyse another case, when the ecosystem does not allow the emergence of low cost products. In that case, if a pertinent value creation for certain actors is identified, smart low cost design can be used as a catalyst to design a compliant ecosystem. Figure III.1 sums up these different opportunities.

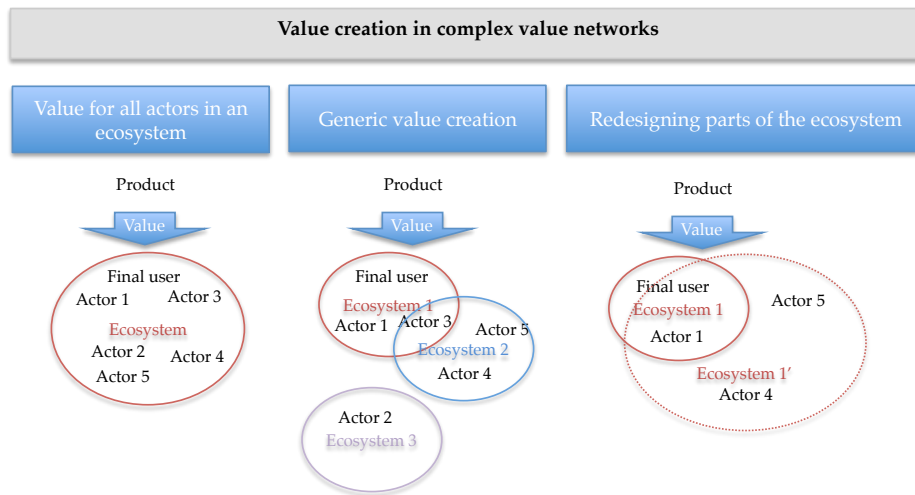


Figure III.1 Opportunities of value creation through smart low cost design in complex value networks

We can conclude this part by stating that smart low cost design has great potential in innovation management in complex value networks, not only to help reducing costs, but also to help to increase value creation in the networks and their ecosystems. It can furthermore allow renewing the dominant design, and therefore make the value network and ecosystem evolve. Incumbent companies like the one this study took place in, should interest themselves for these approaches, since they are one way to continue being part of the value network, even when products evolve.

Conclusion and further research

Our thesis' main goal was to answer a research problematic, on **how the design of low cost products and services could become a new path for innovative design strategies in strongly regulated value networks with a great number of actors involved**. This issue is contemporary challenge for managers as low cost become both a widely used concept in innovation and a necessity in competitive markets.

In this conclusion section, we propose firstly a synthesis of the research. Then, we will come back to some specific aspects of our thesis' main results, by a more detailed description of three of them: the innovation system we proposed, the guidelines and managerial implications of low cost, and the opportunities of value creation in complex value networks. Our aim in this detailed description is double: providing practitioners managerial guidelines and tools to apply our results in their own context; and giving researchers enough elements to continue building on our research.

We will then discuss the research methods used and their contributions to this work, as well as their shortcomings and some potential improvements. Finally, we will discuss the perspectives opened up by this research and possibilities of further research.

Overview of thesis contributions

Our research was articulated around three research questions, and each question was treated in one of the three parts of this manuscript and investigated with specific research methods:

First of all, we tried to answer the question **RQ1: Is there a design model for low cost products and services?** studying existent low cost products and looking for commonalities and divergence in their design. Thus, this question was treated through a critic literature review and a multiple case study from secondary sources in 'Part I - Low cost as a design strategy: Theoretical elements and managerial specifications'. The study of 50 products and services allows us **to propose a design model for low cost products and services**.

Second, we study the challenge of the implementation of such design model through the **RQ2: How can an established public transport operator like RATP design and propose low cost offers?** This second research question was treated through a systematic literature review of innovation and low cost in public transport literature, and the intervention research in 'Part II - Low cost design: a strategy achievable for public services? The case of urban public transport'

The transport operator was trying to find an answer for a more applied question: **how can RATP propose low cost public transport offers?** This thesis allowed both to address the practitioner's and the research problematic. We therefore were able to contribute to the

research effort on low cost, by **proposing both a design model and an innovation system for low cost products.**

Third, we investigated the **RQ3: How can low cost products be designed in complex value networks, where price and cost are not linked?** This question was treated in Part III - Designing low cost based ecosystems in complex value networks, building on the results of our case study inside RATP, a case study inside a system assembler in the aeronautic industry and on literature review.

In this section, we contribute to research on innovation management in complex value networks by **proposing how to renew the dominant design and to create value for the entire network through the use of low cost as a driver.** Furthermore, we contribute to practitioners' efforts on how to design low cost products through **the guidelines and managerial insights yielded from the empirical study inside RATP.**

Overview of main results

As underlined previously, our research allowed us to answer to three research questions on how to design low cost products for complex value networks through three propositions.

- Our first proposition describes **a design model for low cost** products and services **with two approaches:** *low cost adaptation* and *smart low cost design*. We show that a design model is not sufficient for a successful design of low cost products; it has to be completed by a performance evaluation grid and an organization framework inside the firm. We therefore propose an **innovation system around our design model.**

- Our second result is to describe how a firm like RATP could develop a low cost strategy. With practitioners, we apply the low cost design model combined with several tools to allow organizational change. Through this we were able to propose an improved version of our innovation system. We show how low cost can be **used as a driver to overcome cognitive and technological lock-in, to propose breakthroughs of the dominant design.**

- Our third result is the extension of the validity domain of our design model in complex value networks that gathered ecosystem settings similar to public transport. In complex value networks, value creation has to be handled differently, either by **creating value for all actors in an ecosystem in place, or by designing the ecosystem that would allow value creation for all its actors through the proposed low cost product.**

Figure 0.1 recapitulates our research questions and the main results achieved in each part.

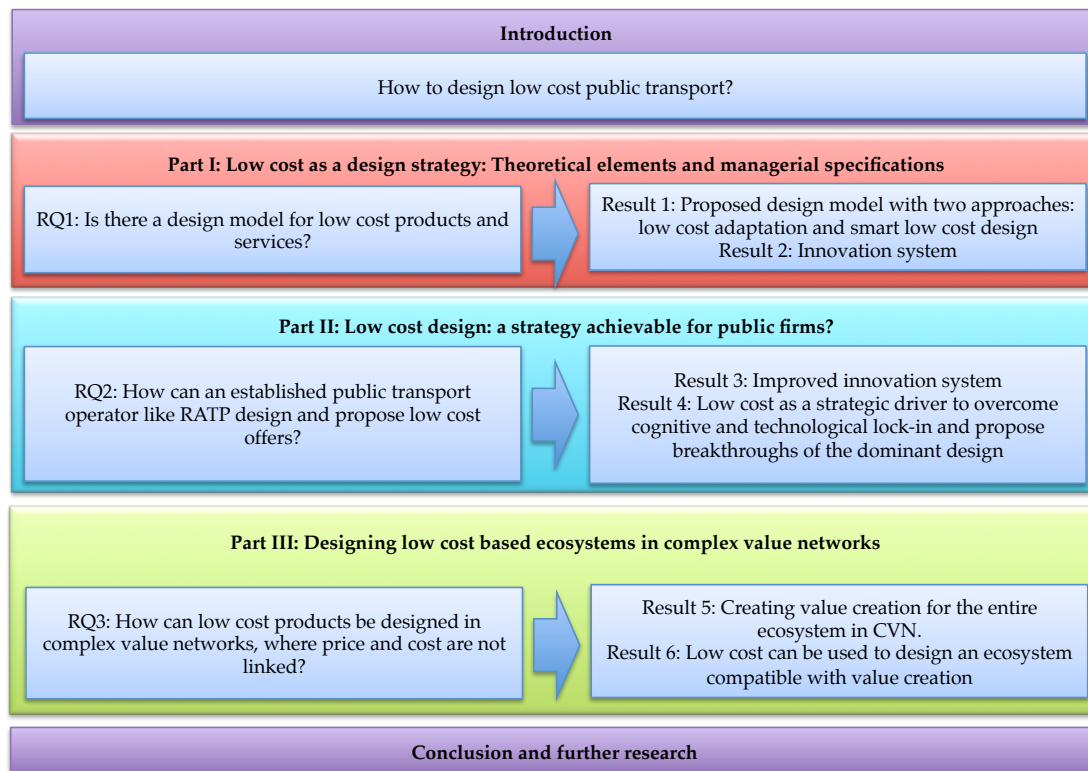


Figure 0.1 Summary of research questions and overview of the main results

Focus on three specific results

Through a more detailed description of some of the main results, we here highlight some guidelines for practitioners wanting to implement low cost in their firms. It should also allow researchers wanting to build on these specific results to have a quick overview of the work done.

Focus 1: The innovation system

Based on the framework by Le Masson et al. (2014), we propose an innovation system, composed of one or several **performance evaluation** logics, a **design reasoning** modelling and the collective **organization framework**.

The innovation system evolved throughout our work, gaining from every aspect of the work, both from theoretical and empirical results. We illustrate the innovation system evolutions through figure 0.2. At the beginning, we propose an innovation system based only on the literature review of low cost product and services. Through the application of design theories and product data, our system evolves, and we propose a new design reasoning modelling, based on a design model with two strategies of low cost: low cost adaptation and smart low cost design. A further literature review allows us to expand the variety of organization frameworks around low cost. Finally, the empirical results from RATP allow us to propose a complete innovation system, with a performance evaluation grid on four levels (product, low

cost strategy, innovation department and company), the use of the low cost design model as a normative tool, and four different organizations, amongst them using low cost as a driver to expand the design space and partnerships of a firm.

Through the final innovation system, **we propose a tested tool for companies desiring to develop low cost products or services.** It is also a step-by-step guide to building an innovation system that could be used in other contexts. Researchers willing to study ways to design low cost products and implement low-cost driven innovation strategy could build on our innovation system to further the understanding of a dynamic capability relying on low cost concept.

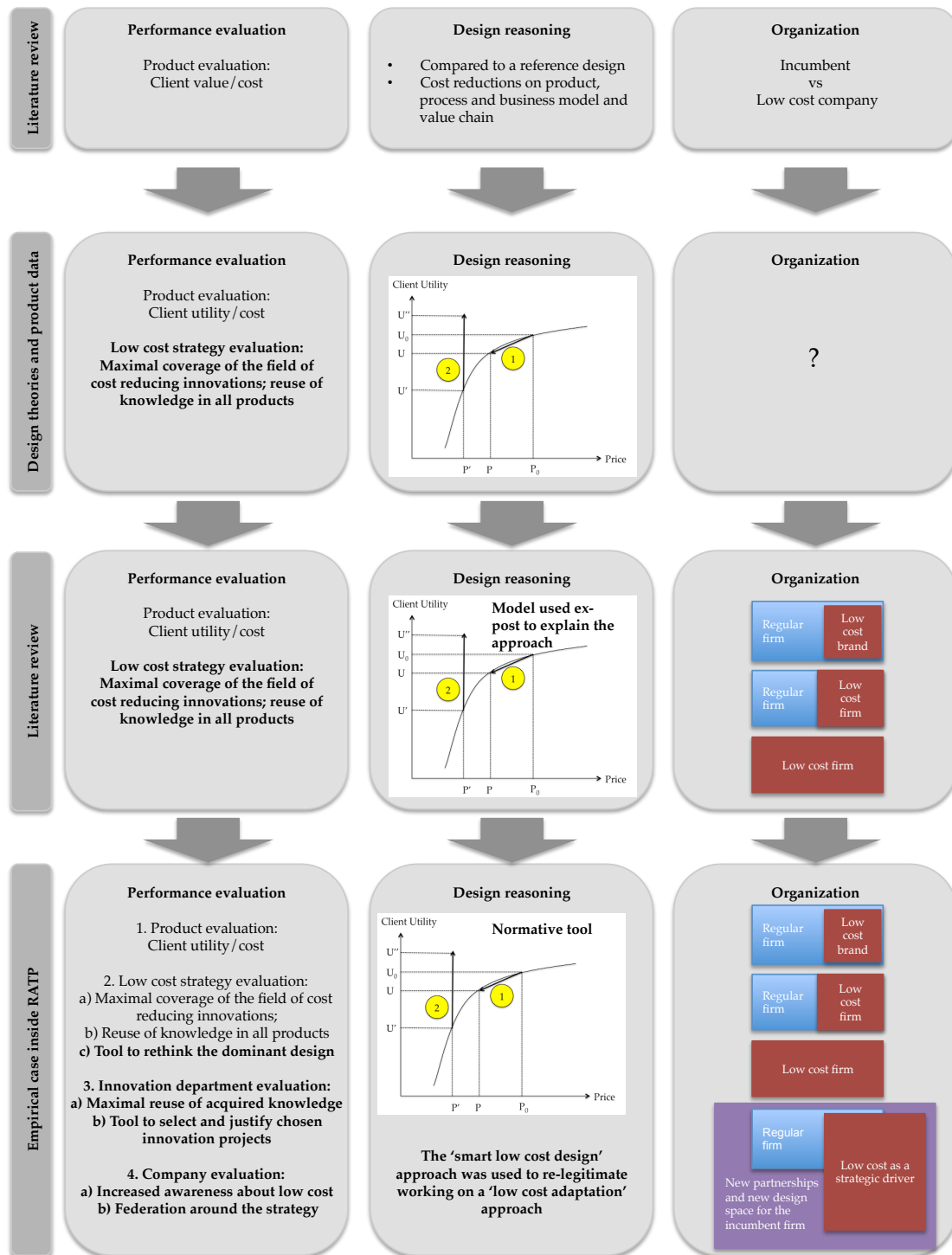


Figure 0.2 Evolutions of the proposed innovation system

Focus 2: Practical guidelines and managerial implications for the design of low cost products

The first guideline for managers is **the rigorous elicitation of a reference model** for the low cost strategy. The reference model will not only have an impact on the possible design spaces,

but it might also influence customers' reactions. Furthermore, managers should be aware of the importance of performance evaluation metrics that are part of the innovation system. A shift in performance evaluation metrics can be a great argument for the need for low cost products.

Another important aspect to make sure low cost can be developed inside a firm is to create awareness inside the firm through the elicitation of the reference model combined with a description of the targeted breakthroughs on technology as well as changes on uses, functions or business models. This can allow both to overcome fear of cannibalization and of as well as a false association between low cost and low quality.

Finally, we showed how a low cost based strategy could be used as a driver to make **the internal organization and the organization of the value network evolve**. In terms of internal organization, we showed not only that clarifying the organization was important, but we also proposed a new organization, where low cost was used as a driver to create new partnerships and expand the design space.

These proposals come from the validation of our research hypothesis through our empirical study, and are illustrated in figure 0.3.

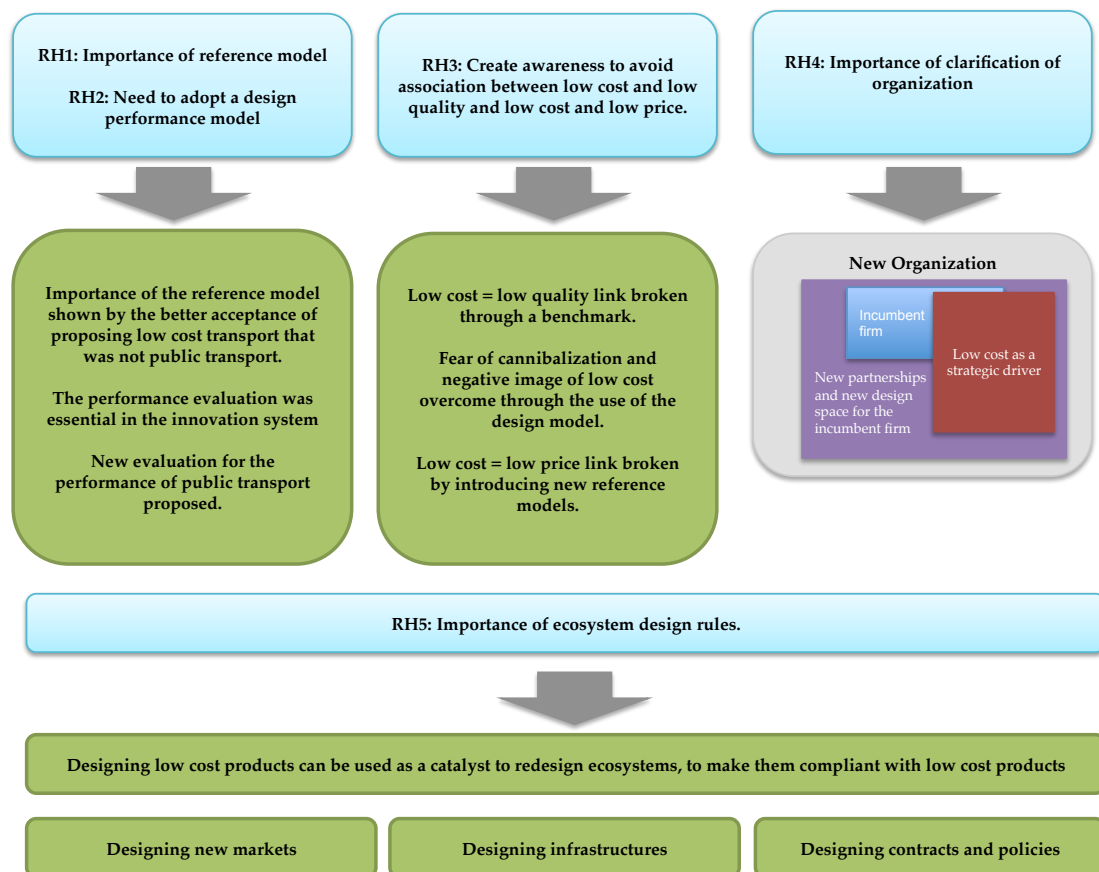


Figure 0.3 Validation of the research hypothesis

Focus 3: Value creation at the ecosystem level through low cost offers

In terms of ecosystem and value network, we showed new ways to create value using a collaborative approach, and propose ways to create value for an entire ecosystem. The design of low cost can also be used to create new ecosystem rules. This is the third result we wish to detail: the value creation in complex value networks through the proposed low cost offers. In the case of complex value networks, value creation of low cost products should go beyond the value creation for the final user, up to **value creation for the actors of the ecosystem even if they are not directly linked to the market**. We observe that this new approach to value creation opens up new design spaces. Practitioners working on low cost products in complex value networks should have in mind the need to carefully identify all actors in the ecosystem and the need to create value for all of them to give the offer a chance to exist.

Another interesting aspect we showed is that value creation in unknown value networks can be done through a **generic value creation**. We hereby contribute to research on value creation in innovation management, and further research in this domain is needed to continue exploring possibilities opened up by the concept of generic value creation.

Another result linked to the value creation is that breakthrough low cost products can be used to reopen discussions on the **legislations and infrastructure, allowing the redesign of the ecosystem**. We presented several cases, from the literature and empirical ones, which show how this ecosystem design was done. Practitioners can take this result and the presented cases as possibilities opened up to them by low cost design. Despite the identified cases, our research of aspects of the ecosystem that can be redesigned through low cost is not exhaustive, and researchers could use our result as a base to continue expanding ecosystem redesign through low cost.

Discussion of the research methods

We applied four different research methods during our research: intervention research, multiple case study approach, systematic literature review and oriented creativity method. These methods contributed to our research through various aspects we want to underline, but each also introduced some limitations we have to remind.

The main method used was an intervention research method (Radaelli et al, 2012; David and Hatchuel, 2008), used in the empirical research done inside RATP. This method allowed us to gain precious insight on the firm, both on the internal process of developing innovations and on its organization. It also allowed us to develop grounded theories on the development of low cost offers in complex value networks. Nevertheless, this method has been severely criticized, since researchers applying this method do not have the distanced stance of researchers that are only observers (David et al., 2012), and could be biased. Another aspect that is criticized is the difficulty of generalization, as well as the lack of rigour claimed by

some scholars (McKay and Marshall, 2001). Despite these critics, this research method allowed us, due to the complementation of the intervention research method with data from the literature, to propose a general model of low cost design. However, inside the firm, we often relied on field notes and on the internal documents. To make our work more rigorous, it would have been interesting to complement this method with semi-directive interviews with the main deciders, done at different moments during the research, to have their view of the evolutions recorded.

Furthermore we used a multiple case study approach (Eisenhardt and Graebner, 2007), to analyse the different low cost products found in the literature. The case study approach is often used in operations research and in the analysis of managerial issues (Hartley, 2004). This method is recurrently used because of the possibility to have rich and contextualized data. This multiple case study research was done based on secondary sources. Using secondary data allows analysing a greater number of cases with a smaller time investment. However this has also been criticized because despite triangulation efforts this data might be less rich than primary data. It would in our case have been interesting to complement secondary data with primary data, to make sure the products are correctly contextualized. Besides that, the classification of innovativeness of all products was done only by the author. A more rigorous approach would have been to have a double classification to check the validity of the classification done.

To identify the main motivations for innovation in public transport, a systematic literature review (Becheikh et al, 2006) was used. Systematic literature reviews are powerful tools to show the tendencies in literature, since they allow a quantitative approach of studies in a field. However, they can be extremely resource consuming, because they demand to read and classify a great number of documents. In our case, it was crucial to show the link, in public transport literature, between low cost and innovation, to show other motivations for innovation that can be found in the sector, as well as to quantify these links. Even though the link between low cost and innovation could probably have been uncovered by a series of interviews with researchers in the domain, the quantification could not have been done by another method. And the other motivations uncovered would probably not have been identified either, because they were not the main focus when building the research.

Finally, we used an oriented creativity method (the KCP) to guide exploration on low cost. As has been said before, this is one amongst many other methods and it was chosen because of its ease of use inside the company, already familiar with this method, and for its capacity to federate around innovation. When looking at results of our research, it was sometimes hard to distinguish which results were due to the oriented creativity method used, and which results came from the unique object we were studying, low cost. A consequent effort had to be done on comparing the results of this KCP to those of other KCPs to separate results linked to the object and the method. Our research would have benefited from a comparative study with another method, done on the same object, to help disambiguate these results' origins.

Perspectives opened up and further research

The subject of low cost design is very vast, and a series of new perspectives were opened up through our work. However, there are several aspects we were not able to treat, and that would be interesting to be explored in further research to complement our work. We will here discuss some of these aspects.

We showed that low cost, being a transversal subject, could lead to important breakthroughs in the dominant design, and therefore allow a firm in a cognitive and technological lock-in to expand its design paths and to find new partnerships to reverse that situation. The new explored paths were proven to be coherent with the sector's main innovation paths. As we have stated before, we believe other transversal subjects could have the same effect. Some transversal subjects like sustainable development were identified as drivers of innovation in our systematic literature review. It would be interesting to explore the other main drivers of innovation in public transport identified in our systematic literature review: sustainable development and climate change; policymaking and legislation; new technologies and ICT; organization and management; and user behavior change. Further research should focus on how these transversal subjects can be used to bring about breakthroughs in the dominant design and if they can also lead firms to build new partnerships and expand their design path. The existence of a unique design model of these transversal objects, and the associated innovation system(s) is to explore.

One of the paths uncovered in this work to achieve value creation for numerous actors in the ecosystem is generic value creation. Although we were able to show how powerful generic value creation can be in complex value networks, our study would benefit to be deepened by more applications in different settings, both in private as in public services. Furthermore, the development of generic value was seen inside RATP, but the different ways of proposing generic value have not been studied in this research. As was done in the case of generic technologies, more ways of developing generic value should be explored. We also did not study several aspects linked to generic value creation that deserve to be developed, like the new business models that should be constructed to be able to capture value from different actors, nor how insights from product line management could be used in generic value creation. Further research should try to explore and deepen these aspects.

As we have cited before, one of the insights we propose is that low cost can be used as a driver to redesign ecosystems. In our work, we cite three aspects, but mainly focused on the redesign of two aspects of the ecosystem: the infrastructure and the legislation. There is definitely room to continue exploring if and which aspects of the ecosystem can further be redesigned, as well as how the redesign should best be approached by firms.

Our research focused mainly on complex value networks, where there are several involved actors, with multiple buyers that are often different from the final user and multiple providers who co-create a product and prescribers or influencers. We opposed them to simple value networks, with only a provider and seller and one buyer and final user. Of course that does not capture all possible configurations. Further research should try to explore intermediate

ecosystems, where even though the buyer and the user are the same, there are very strong influencers that can completely change the buyer's decision. One example of this kind of market is the medical market. These influencers have been studied (e.g. Hatchuel, 1995), but in our knowledge, their impact on low cost product's markets has not yet been evaluated. If these ecosystems could also benefit from low cost products and their composition and effects of the low cost products on them have to be further studied.

Finally, most of the outcomes of the smart low cost design strategy inside the transport operator are not yet finished and will continue to be developed. The operator launched a program on "cost innovation" in the beginning of 2015, and other research projects are still on going. It would be interesting to continue a longitudinal research to evaluate both if the final low cost offers could successfully be launched and the positioning chosen by the company to do so. Although it was not the main object of this thesis, the marketing positioning of several low cost products proved to be part of its failure or success, as could be seen in the case of the Tata Nano. A longitudinal study of a low cost strategy in a public service company could surely bring important insight, not only on the question of positioning, but also on other questions concerning value creation under strong constraints.

Synthèse en Français :
La conception "low cost" innovante dans
des réseaux de valeur complexes :
Le cas du transport public

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Introduction : Problématique de recherche

Les entreprises contemporaines font face à des pressions compétitives croissantes. Nous observons non seulement une accélération du renouvellement des produits, mais aussi une demande croissante pour des innovations de la part des clients, à un point tel que certains auteurs parlent aujourd'hui d'un contexte d'innovation intensive (Lenfle et Midler, 2003) ou d'un capitalisme d'innovation intensive (Hatchuel et al., 2002). Cette intensification de l'innovation est de surplus accompagnée d'un changement dans les attentes sur l'innovation : elle ne doit plus seulement être un changement de technologie, mais doit intervenir dans d'autres aspects de la valeur créée par l'entreprise, comme le business model et les processus.

A cette pression pour innover vient s'ajouter la concurrence des produits à très bas coût. Les produits dits *low cost* ont gagné leur place dans plusieurs secteurs industriels dans les dernières années, entre autres l'aviation, les voitures ou encore le secteur hôtelier. Un des principaux attraits des produits *low cost* est leur prix, qui attire les consommateurs malgré le fait que l'expérience produit n'est pas toujours la même que celle d'un produit ou service traditionnel. Les consommateurs associent souvent le *low cost* à de la mauvaise qualité, et s'attendent à une qualité inférieure quand le prix est plus bas. Faire face à des entreprises proposant ces produits *low cost*, qui attirent les clients très sensibles au prix et les clients qui cherchent des produits plus simples, est aujourd'hui un des grands défis des entreprises établies (Kumar, 2006).

Dernièrement, sont venus se rajouter à cela des produits *low cost* en rupture, qui proposent un meilleur rapport qualité-prix. Ces produits ont été décrits comme des innovations frugales (e.g. Rao, 2013), des innovations jugaad (Radjou et al., 2012) ou encore des produits développées pour les populations décrites comme la « base de la pyramide » (Base of the Pyramid ou BoP) (Prahalad et Hammond, 2002). Malheureusement les disparités entre les différents termes restent peu discutées et la littérature dans le domaine est encore fragmentée.

Certains de ces produits ont connu des grands succès, menant à des études sur comment ces produits émergent grâce aux contraintes de ressources (Sharma and Iyer, 2012) ou grâce à l'intuition d'entrepreneurs prêts à « suivre leur cœur » (Radjou et al., 2012). Cependant, à notre connaissance, il n'y a pas de modèle formel permettant aux entreprises de concevoir systématiquement ces types de produits. Ce manque de modèle de conception rend très difficile aux industriels l'application de ces travaux de recherche non unifiés.

Finalement, la conception de produits avec un ratio coût-bénéfice plus élevé nous mène aussi à nous interroger sur le processus collectif de création de valeur dans le contexte dans lequel nous avons été amenées à conduire une partie des travaux présentés ici, le transport public, où des nombreux acteurs sont impliqués et observent des réglementations strictes. Nous nous appuyons ici sur un concept issu de la littérature sur la création de valeur, le réseau de valeur (Fjeldstad and Ketels, 2006), pour étudier ce contexte industriel spécifique et des contextes similaires.

Problématique et questions de recherche

Ancrée dans ces enjeux théoriques et managériaux, notre problématique de recherche est la suivante :

Existe-t-il un modèle pour concevoir des produits et services *low cost*? Comment la conception de produits et services *low cost* pourrait-elle devenir une nouvelle stratégie de conception innovante dans des réseaux de valeur complexes très régulés, avec beaucoup d'acteurs impliqués?

Nous avons structuré l'investigation de cette problématique autour de trois questions de recherche. La première question visera à explorer la possibilité de proposer un modèle de conception pour des produits *low cost*. La deuxième question étudiera l'application de ce modèle au sein d'une entreprise de transport public et la troisième question traitera d'écosystèmes similaires au transport public, pour généraliser nos résultats.

QR1 : Est-il possible de proposer un ou plusieurs modèles de conception pour des produits et services *low cost* ?

QR2 : Comment un opérateur de transport établi comme la RATP peut-il concevoir et proposer des offres de mobilité *low cost* ?

QR3 : Comment concevoir des produits *low cost* dans des réseaux de valeur complexes, où le prix pour l'utilisateur final et le coût ne sont pas directement liés ?

Positionnement et originalité des travaux

Les travaux ont été réalisés pendant une thèse CIFRE effectuée au sein de la RATP (Régie Autonome des Transports Parisiens) en collaboration avec le Centre de Gestion Scientifique de l'École des Mines et la chaire TMCI (Théories et Méthodes de Conception Innovante). Cette thèse s'inscrit dans un partenariat de longue date, pendant lequel plusieurs travaux de recherche collaboratifs portant sur la gestion de l'innovation au sein de la RATP ont été effectués. L'objet de cette thèse est d'étudier la conception innovante d'offres de mobilité à bas coût, aussi connues comme *low cost*.

L'enjeu académique de ces travaux est de proposer un modèle pour la conception d'offres innovantes à bas coût. Plus particulièrement, ils étudient des écosystèmes avec des réseaux complexes de valeur, qui ont plus de difficultés à proposer des produits *low cost*, à cause du grand nombre d'acteurs avec des fortes interdépendances impliqués dans la création de la

valeur de l'offre et parce que le prix pour l'utilisateur final et le coût dans ces réseaux ne sont pas liés. Cela répond à une difficulté identifiée dans la littérature en sciences de gestion, qui aborde les produits *low cost* sous divers angles, mais ne propose pas de modèle de conception. Le modèle de conception que nous proposons s'appuie sur les théories de conception innovante et systématique. Cela rejoint un travail conséquent de modélisation et de théorisation de la conception innovante autour des travaux de Hatchuel et Weil (2009) au sein du CGS.

Dans les contextes peu propices à accepter des offres à bas coût trouvés dans des réseaux de valeur complexe, nous explorons comment l'innovation *low cost* peut être utilisée pour créer de la valeur, non seulement pour l'utilisateur final, mais pour tout l'écosystème. Ritala et al. (2013), attirent l'attention sur le fait que la création de valeur pour les écosystèmes innovants n'est pas assez comprise et modélisée. Le travail sur la création de valeur pour un écosystème innovant est aussi en cohérence avec d'autres travaux sur la création et évaluation de la valeur dans des contextes d'innovation réalisés au sein du CGS et de la chaire TMCI (e.g. Hooge, 2010 ; Gillier et al., 2015). Et en nous appuyant sur la notion de généricité travaillée par Kokshagina (2014) au sein du CGS nous proposons une nouvelle approche à la création de valeur pour un écosystème, la création de valeur générique.

L'enjeu industriel du développement d'offres de mobilité urbaine *low cost*, au sein de la RATP est multiple. En tant qu'EPIC (établissement public industriel et commercial), la RATP a des objectifs de résultats. Pour les atteindre, des efforts constants sont poursuivis pour améliorer l'efficacité industrielle, l'utilisation des ressources et de baisser les coûts. L'étude des pratiques *low cost* au sein de la mobilité, ainsi que dans d'autres secteurs industriels est de grand intérêt pour l'entreprise, puisqu'elle permet de trouver des nouvelles approches managériales pour réduire les coûts. Il s'agit aussi pour la RATP d'une stratégie pour diversifier ses offres de transport, pour lui permettre de rester compétitive dans ses marchés et de conquérir des nouveaux marchés où ses offres actuelles ne sont pas nécessairement adaptées.

Partie I – Produits et services *low cost* : éléments théoriques et pratiques industrielles

Résumé de la partie I

Cette première partie donne une première lecture de la question du *low cost* à partir d'une analyse de la littérature sur la conception de produits nouveaux. La question de recherche traitée dans cette partie est : Est-il possible de proposer un ou plusieurs modèles de conception pour des produits et services *low cost* ? L'objectif de cette partie est de montrer que le *low cost* peut être utilisé comme une stratégie de conception. Comme le *low cost* a été traité dans beaucoup de contextes différents, nous commençons dans le chapitre 1 par une revue critique de la littérature sur les questions industrielles et managériales soulevés par ces produits. Cette revue permet de constater qu'il n'existe pas un modèle universel pour concevoir des produits ou services *low cost*.

Dans le deuxième chapitre, nous utilisons les théories de la conception ainsi qu'une base de données de 50 produits et services *low cost* que nous avons constitué à partir de sources secondaires pour proposer un modèle de conception pour le *low cost*. Notre modèle différencie deux approches de la conception de produit et services *low cost* :

- Le *low cost* par adaptation (*low cost adaptation*) – Le point de départ est un produit existant, à partir duquel on essaye de réduire au maximum les coûts, tout en diminuant le moins possible l'utilité perçue par le client. Pour cela on enlève les fonctionnalités ayant une faible utilité perçue. Ce type de démarche est souvent associé au *no-frills* (sans fioritures) des compagnies aériennes qui réduisent les prestations gratuites à bord pour réduire leurs prix.
- La conception *low cost* innovante (*smart low cost design*) – Le point de départ pour ce modèle est la recherche conjointe d'une fonctionnalité que le client valorise dans le produit, et d'un objectif de coût. En termes économiques, cette approche vise le coût le plus bas pour un maximum d'utilité perçue par le client. Cette logique de conception de produits est souvent associée à l'innovation frugale.

Le Masson et al. (2014) signalent qu'un modèle de conception n'est pas suffisant pour mener à bien le lancement de produits car il ne décrit que le raisonnement suivi. Ils défendent que pour mener à bout la réalisation, il est nécessaire d'avoir un régime de conception composé d'une évaluation de performance et d'une organisation en complément du raisonnement de conception. Nous inscrivons alors notre modèle de conception dans un régime de conception, s'appuyant sur les éléments théoriques et pratiques identifiés lors de notre revue de littérature.

Pour finir, la revue de littérature nous permet également d'identifier un certain nombre d'éléments managériaux qui nous semblent pertinents pour mener à bien le lancement de produits *low cost* et leur acceptation au sein d'une entreprise, qui seront discutés dans le chapitre 3. Nous formulons alors cinq hypothèses de recherche (HR) concernant ces éléments,

qui seront vérifiés lors de notre étude de cas.

Chapitre 1. Eléments théoriques sur le *low cost* : une revue du concept

Ce premier chapitre propose une revue du concept de *low cost* dans la littérature. Le premier élément théorique à souligner issu de cette revue est la différence entre l'efficacité industrielle qui consiste à réduire les coûts sans changer l'utilité perçue par le client ; et le *low cost* qui change le coût et l'utilité perçue par le client. Dans la littérature sur le *low cost*, l'utilité client est massivement définie comme le bénéfice et le *low cost* est positionné comme une stratégie, ce qui n'est pas le cas de l'efficacité industrielle. La Figure R.1 montre comment l'efficacité industrielle réduit les prix sans réduire l'utilité perçue client.

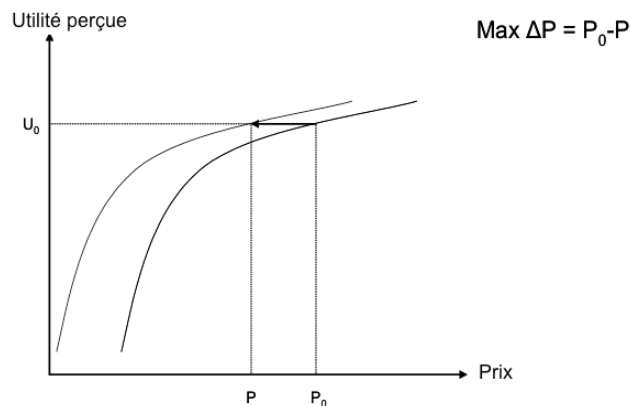


Figure R. 1 Approche au prix et à l'utilité client en efficacité industrielle

À partir de cette revue nous avons pu constater qu'il y avait une grande ambiguïté sur ce qu'est un produit ou service *low cost*. Cette ambiguïté est liée à la transversalité du sujet et au grand nombre d'ancrages disciplinaires et professionnels des littératures qui traitent du sujet. Des analyses sur des produits ou services *low cost* peuvent être trouvées à la fois dans la littérature spécifique à un secteur industriel, comme par exemple l'aérien, ou dans des revues spécifiques à un domaine scientifique, comme la stratégie, l'innovation ou le marketing. Il est donc nécessaire de conceptualiser ce qu'est le *low cost*. Plusieurs modèles ont déjà été proposés pour décrire des produits *low cost* dans la littérature (e.g. le business model du *low cost* proposé par Santi et Nguyen (2012), l'analyse fonctionnelle et de la valeur ou le *design-to-cost*, vu dans le cas de la Dacia Logan dans Jullien et al. (2013)), ces modèles ne permettent pas de décrire ni de concevoir tout l'éventail de produits existants. Ces modèles sont récapitulés dans le tableau R.1.

Tableau R. 1 Les modèles de conception *low cost* proposés dans la littérature, leurs approches par rapport aux coûts et l'utilité perçue par le client

Modèle	Coûts	Utilité perçue par le client	Changements
Low cost business model	Maximise la réduction de coût, en gardant une faible réduction de l'utilité client	Réduction de l'utilité client, mais meilleur ratio utilité client sur coût	Business model; chaîne de valeur ; processus.
Analyse fonctionnelle et de la valeur	Maximise la réduction de coût, en gardant une faible réduction de l'utilité client	Réduction de l'utilité client sur des fonctions avec un coût élevé et à faible valeur, pour avoir un meilleur ratio utilité/prix	Fonctionnalités et performance
Design to cost	Un coût cible est défini dès le début de la conception	L'utilité perçue est réduite, mais il existe un seuil de réduction acceptable. La priorité est le contrôle des coûts, tout en atteignant le niveau de qualité requis. (Lim et al., 2013)	Procédés; matériaux et technologies.

Ces modèles sont néanmoins incomplets pour rendre compte de l'innovation décrite par certains des auteurs. Ainsi, l'apparition des produits *low cost* innovants en rupture, comme par exemple le MittiCool, souvent décrit comme un réfrigérateur *low cost*, ne peuvent pas être expliqués par ces modèles. En effet, ce réfrigérateur ne remplit pas toutes les fonctions qu'un réfrigérateur classique remplit (on ne peut par exemple pas réguler sa température, ni conserver de la viande fraîche pendant plusieurs jours), et il est parfois difficile de dire s'il s'agit encore d'un réfrigérateur. Mais du à son prix nettement inférieur, et le fait qu'il remplit bien une fonction bien identifiée (conserver des fruits, légumes et produits laitiers pendant quelques jours), il intéresse un public spécifique. La revue de littérature nous permet aussi d'établir deux hypothèses de recherche :

- HR1 – Il est nécessaire d'adopter un produit de référence pour concevoir un produit *low cost*.
Les modèles de référence semblent être très important. Ils doivent être correctement abordé, car ils peuvent aider à générer de l'utilité client, mais peuvent aussi la détruire, en créant de fausses attentes en raison des associations effectuées par le client.
- HR2 – Il est nécessaire d'adopter un modèle de performance pour la conception pour que la conception *low cost* puisse avoir du succès.

Ces éléments mènent à la conclusion de qu'il faut développer un modèle de conception pour des produits *low cost*. Nous en proposerons un dans le chapitre suivant.

Chapitre 2. Un modèle de conception pour les produits et services *low cost*

Comme vu précédemment, les produits *low cost*, contrairement à l'efficacité industrielle, changent l'utilité perçue par le client, en plus de changer les coûts. Nous avons donc proposé un cadre d'analyse basé sur l'approche de l'utilité client, en introduisant quatre paramètres d'utilité. L'utilité client est souvent diminuée dans les produits *low cost*, en enlevant des fonctionnalités. Le premier paramètre d'utilité est donc la suppression de fonctionnalités. Une autre approche à l'utilité client observée dans un grand nombre de produits *low cost* est le transfert d'activité au client : plutôt que d'enlever une fonctionnalité, celle-ci reste possible mais impose la collaboration du client. Nous avons deux paramètres d'utilité liés au transfert d'activité au client : le transfert négatif et le transfert positif. Le transfert négatif se produit quand l'entreprise laisse le client « se débrouiller avec ses propres moyens » s'il souhaite avoir une fonctionnalité. Dans le transfert positif, l'entreprise fournit des outils au client qui lui permettent d'accéder à la fonctionnalité souhaitée, par exemple en fournissant des modes d'emploi détaillés pour le montage. Le tableau R.2 reprend les quatre paramètres d'utilité.

Tableau R. 2 Les paramètres d'utilité mobilisés

Paramètre d'utilité	Définition	Références
Suppression de fonction	Le nouveau produit n'a pas toutes les fonctions du produit de référence	Sale de sport <i>low cost</i> – enlèvement de fonctions annexes, comme le spa ou salle d'attente
Transfert négatif	Pour avoir les mêmes fonctions qu'avant le client doit contribuer avec ses propres moyens	Compagnie aérienne <i>low cost</i> – les clients payent pour les repas
Transfert positif	Une partie des fonctions n'existent que si le client les coproduit, mais l'entreprise fournit des outils pour aider le client dans leur production	IKEA – Les clients doivent assembler les meubles eux mêmes, mais les outils et des instructions détaillées sont fournies avec les meubles.
Rajout de fonction	Rajout de fonctions qui n'existaient pas dans le produit de référence	Nokia 1100 – Rajout de la résistance à la chaleur et à la poussière

Etant donné que les produits *low cost* innovants ne semblent pas trouver de modèle de conception, mais qu'un grand nombre de produits *low cost* sont décrits dans la littérature comme étant innovants, nous avons aussi proposé un cadre qui analyse le degré d'innovation de ces produits. Le cadre appliqué dans ce travail est basé sur les quatre dimensions de l'identité de l'objet, comme décrit dans Agogué et al. (2014) : le paradigme technologique, les fonctionnalités, le business model et la valeur pour le client. Pour évaluer le degré d'innovation nous attribuons une note de zéro à quatre, suivant le nombre de dimensions qui ont évoluées par rapport à l'identité du produit de référence.

En s'appuyant sur les théories de la conception, à la fois sur la conception réglée (Pahl et Beitz, 1988 et Suh, 1990) et sur la conception innovante (Hatchuel et Weil, 2009), nous proposons un modèle théorique de conception *low cost* avec une double approche :

- Le *low cost* par adaptation ou *low cost adaptation* s'appuie sur les théories de la conception réglée. Le point de départ dans cette approche est un produit existant

stabilisé au sens de la conception systématique. Les fonctionnalités considérées comme superflues sont enlevées, dans un effort de réduire les coûts, sans trop diminuer l'utilité client.

- La conception *low cost* innovante ou *smart low cost design*, sur les théories de la conception innovante. Le point de départ de cette approche est la re-conception d'une ou plusieurs dimensions de l'identité d'un objet de référence.

Ces deux stratégies se différencient aussi par leur approche de l'utilité client. Tandis que dans le *low cost* par adaptation on essaie de minimiser la réduction de l'utilité client, tout en maximisant la réduction de coût, pour pouvoir maximiser la réduction de prix ; dans le *low cost* innovant l'objectif est de maximiser l'utilité client pour un objectif de prix et de coût donnée. Les deux approches sont illustrées dans la Figure R.2.

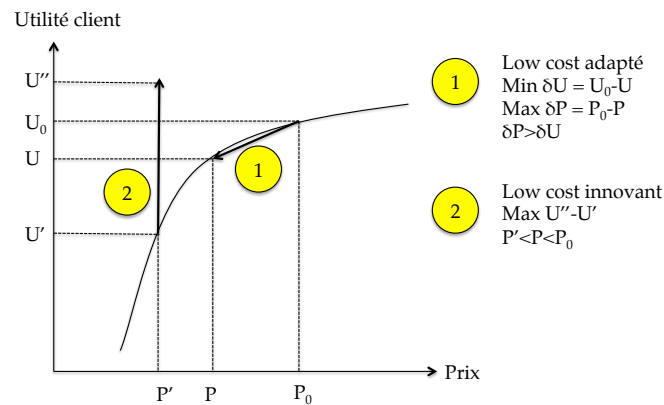


Figure R. 2 Les deux stratégies du *low cost* et leur approche au prix et à l'utilité client

Pour poursuivre l'investigation, nous avons construit une base de données de 50 produits et services *low cost*. Les produits retenus ont été choisis suivant deux critères : leur récurrence dans la littérature, ou le fait qu'ils étaient décrit par les auteurs comme étant innovants. Ces cas ont ensuite été analysés sur les quatre paramètres d'utilité et leur degré d'innovation. Ces produits ont ensuite été confrontés aux deux approches proposées dans le modèle, le *low cost* par adaptation et la conception *low cost* innovante. L'adéquation obtenue nous a permis de valider empiriquement notre modèle de conception.

Sur la base de la répétitivité de ces modèles dans les données, nous défendons que ces deux stratégies dans notre modèle de conception pourraient être utilisées en tant que dispositifs d'exploration dans la conception de nouveaux produits.

Chapitre 3. Les défis managériaux dans la conception de produits *low cost*

Dans ce troisième chapitre, nous étudions plusieurs défis managériaux auxquels peuvent être confrontés les industriels souhaitant développer des produits *low cost*, indépendamment de l'approche du modèle de conception choisi. Il s'agit de challenges liés à l'image négative associée au *low cost* comme l'association de mauvaise qualité au *low cost*, l'association des prix bas au *low cost* et la peur de la cannibalisation des produits existants par les produits *low cost*. La littérature nous donne des éléments pour répondre à ces défis, et nous permet de proposer une nouvelle hypothèse de recherche :

- HR3 - Pour éviter l'association directe entre mauvaise qualité et *low cost*, ainsi qu'entre prix bas et *low cost*, il semble important de sensibiliser à ce qu'est un produit *low cost* et de clarifier comment le produit qui sera élaboré devrait se positionner par rapport aux offres existantes.

Nous reviendrons ici aussi à la revue de littérature pour compléter notre régime de conception. Dans la littérature, trois organisations différentes sont proposées autour du *low cost* : Devenir un entreprise *low cost*, créer une entreprise dédiée, ou créer une organisation dédiée au *low cost* dans l'entreprise. Chacune de ces organisations comporte ses risques et avantages, qui doivent être pris en compte lorsque l'organisation est choisie et qui sont précisés dans les pages 81 à 86 de ce manuscrit. Néanmoins, tout semble indiquer qu'il est essentiel de clarifier l'organisation autour du *low cost* pour permettre le lancement de ces produits. Ce constat nous permet de formuler notre quatrième hypothèse de recherche :

- HR4 – La clarification des interactions de l'organisation *low cost* avec l'ancienne organisation est nécessaire pour réussir dans la conception *low cost*.

Nous introduirons ici aussi une étude de cas exécutée au sein de Thales, sur le développement d'un cockpit *low cost*. Les détails de cette étude de cas peuvent être trouvés dans les pages 87 et 88 de ce manuscrit. Nous constatons une grande difficulté pour concevoir des produits *low cost* à cause d'un processus de certification très rigide. De cette étude ressort que certaines difficultés liées à la conception de produits *low cost* viennent de l'écosystème dans lequel l'entreprise conceptrice est immergée. Ce constat est confirmé par d'autres exemples issus de la littérature qui pointent les infrastructures ou la réglementation en place comme de possibles barrières au succès des produits *low cost*. Cela nous permet de formuler notre cinquième hypothèse de recherche :

- HR5 - La conception *low cost* a besoin de se conformer aux règles de conception de l'écosystème, comme la réglementation, les certifications et les infrastructures.

Finalement, nous observons ici aussi que le régime de conception que nous avons développé s'appuie sur des produits issus d'entreprises qui ont des écosystèmes assez simples, avec un acheteur/utilisateur et un vendeur/producteur. Cela ne correspond pas nécessairement à tous les écosystèmes dans lesquels des industriels pourraient vouloir lancer des produits *low cost*. Une nouvelle question émerge alors : Comment notre modèle de conception et le régime

de conception associé peuvent-ils être appliqués dans des écosystèmes avec des configurations plus complexes ?

Ce chapitre nous permet de conclure que malgré le fait que notre régime de conception devrait permettre la conception de produits *low cost*, il est loin de traiter toutes les questions et tous les défis auxquels un gestionnaire pourrait être confronté lors de cette conception. Ces aspects seront traités par l'étude de nos hypothèses de recherche. Nous concluons en outre qu'un test dans un cadre empirique permettrait de valider à la fois le régime de conception et la validité de nos hypothèses de recherche.

Partie II – Conception d’offres *low cost* : une stratégie atteignable pour les services publics ? Le cas du transport public

Résumé de la partie II

Dans cette deuxième partie, nous étudions plus précisément le *low cost* dans le contexte du transport public. Comme nous avons vu dans la partie I, le régime de conception que nous proposons n’est pas nécessairement adapté à tous les contextes industriels : il a été construit à partir de données venant d’industries où l’utilisateur et l’acheteur sont le même acteur. Cela n’est pas nécessairement le cas dans tous les secteurs, et nous étudierons dans cette partie le cas du transport public, où l’acheteur et l’utilisateur sont dissociés. Cette partie apporte alors des éléments de réponse à notre deuxième question de recherche : Comment un grand groupe établi de transport comme la RATP peut-il concevoir et proposer des offres *low cost* ?

Pour y répondre, nous décrivons dans le chapitre 4 le secteur du transport public et les particularités de ce secteur qui rendent difficile l’application du modèle de conception *low cost* proposé dans la première partie. Dans ce chapitre, nous proposons une modélisation de l’identité de l’objet « transport public », en identifiant ces principaux attributs dans la littérature. Nous montrons aussi, grâce à une revue de littérature systématique, que l’innovation est présente dans ce secteur et qu’elle est en partie motivée par les mêmes raisons que les réductions de coût.

Cette partie propose ensuite, dans le chapitre 5, la description du travail mené sur le terrain, au sein de la RATP, où grâce à l’application des deux approches du modèle de conception *low cost*, associée à une méthode de créativité participative, le KCP (*Knowledge-Concept-Proposition*) des propositions d’offres *low cost* ont pu être conçues. Nous montrons aussi comment d’autres outils de gestion et une réflexion sur la stratégie de l’entreprise ont été nécessaires pour le développement d’offres *low cost*. L’analyse de ce cas empirique nous permet de montrer l’enfermement dont souffrait l’entreprise dans une conception à l’intérieur de l’identité actuelle du transport public. Nous montrons également comment la méthode KCP ouvre de nouvelles voies en brisant l’identité de l’objet grâce au *low cost* innovant. Étant transversal à l’ensemble de l’entreprise, le travail sur la réduction des coûts se révèle particulièrement catalyseur d’innovations de rupture multidimensionnelles puisqu’il permet des changements dans tous les aspects de l’identité de l’objet.

Dans le chapitre 6, nous décrivons les apports de notre étude de cas au régime de conception *Low Cost* proposé dans la partie I. L’application au sein de la RATP nous permet **d’identifier des nouveaux axes d’évaluation de la performance**, une nouvelle utilisation du modèle de conception, non pas comme une évaluation *ex-post*, mais comme un **outil de conception** et une nouvelle organisation, ou le ***low cost* est utilisé pour créer de nouveaux partenariats et pour rediscuter l’espace de conception de l’entreprise.**

Cette partie nous a permis d’enrichir notre régime de conception à partir d’une étude de cas empirique mais soulève de nouvelles interrogations liées à l’introduction du modèle de

conception et de son régime de conception : Pouvons-nous appliquer le modèle de conception *low cost* dans tous les secteurs ? Comment pouvons-nous appliquer les deux approches simultanément dans le même secteur ? Quels sont les outils et les instruments qui doivent être mis en place pour coordonner les deux approches de conception ?

Nous verrons dans cette partie que le régime de conception proposé en partie 1 peut être adapté aussi à des secteurs comme le transport public, avec des acteurs différents pour l'achat et l'utilisation. De plus, l'application du modèle dans le secteur du transport public nous permettra de montrer que l'application simultanée des deux approches du modèle est intéressante puisque le *low cost* innovant permet de ré-légitimer l'approche du *low cost* par adaptation. Et finalement, nous donnerons des indications managériales sur comment faciliter le développement de produits *low cost* au sein d'une entreprise.

Chapitre 4. Le transport public urbain : un secteur industriel adverse au *low cost* ?

Dans ce chapitre nous dressons un panorama du transport public comme secteur et nous donnons quelques particularités du transport public en France. La littérature identifie aujourd'hui dans le secteur des transports public un grand besoin d'innover et de réduire les coûts, mais certains acteurs attirent l'attention sur une certaine difficulté contemporaine à innover, malgré une histoire du secteur riche en innovations. Une étude plus approfondie montre que cette apparente difficulté est surtout vérifiée en regardant les acteurs historiques du secteur. La plupart des innovations proposées aujourd'hui dans ce secteur proviennent de nouveaux entrants.

Le secteur semble en plus présenter une certaine aversion aux offres *low cost*. Le transport public diffère des marchés des produits *low cost* de notre base de données, dû à une dé-corrélation entre prix et coût. En effet, une partie du coût du transport est payée par des subventions. Par conséquent, le prix payé par les utilisateurs finaux ne reflète pas le coût complet du transport. En plus, le tarif (le prix à payer par l'utilisateur final), est souvent fixé par une autorité organisatrice. De ce fait, des réductions sur le coût ne peuvent pas systématiquement être répercutées aux utilisateurs finaux. Le prix d'un billet est une décision qui affecte l'accessibilité et de ce fait est souvent fixé assez bas, dû à des volontés publiques. Donc des réductions de prix ne sont pas toujours intéressantes pour les utilisateurs, qui ont déjà un produit de qualité acceptable à un prix bas.

Vient s'ajouter à cela que l'acheteur et l'utilisateur du transport sont des acteurs dissociés dans le cas du transport public : la décision d'achat d'une offre de transport est prise par l'autorité organisatrice, tandis que les passagers en sont les utilisateurs. Pour mieux comprendre le secteur du transport public et cette relation aversive avec l'innovation, nous proposons ici une modélisation de l'identité du transport public construite à partir de la littérature. Pour cette mobilisation nous mobilisons le cadre du *dominant design* proposé par Utterback and Abernathy (1975). La Figure R.3 illustre cette modélisation, décrivant le transport public suivant le paradigme technologique employé, le *business model* où modèle d'affaires, la création de valeur pour le client et les fonctionnalités.

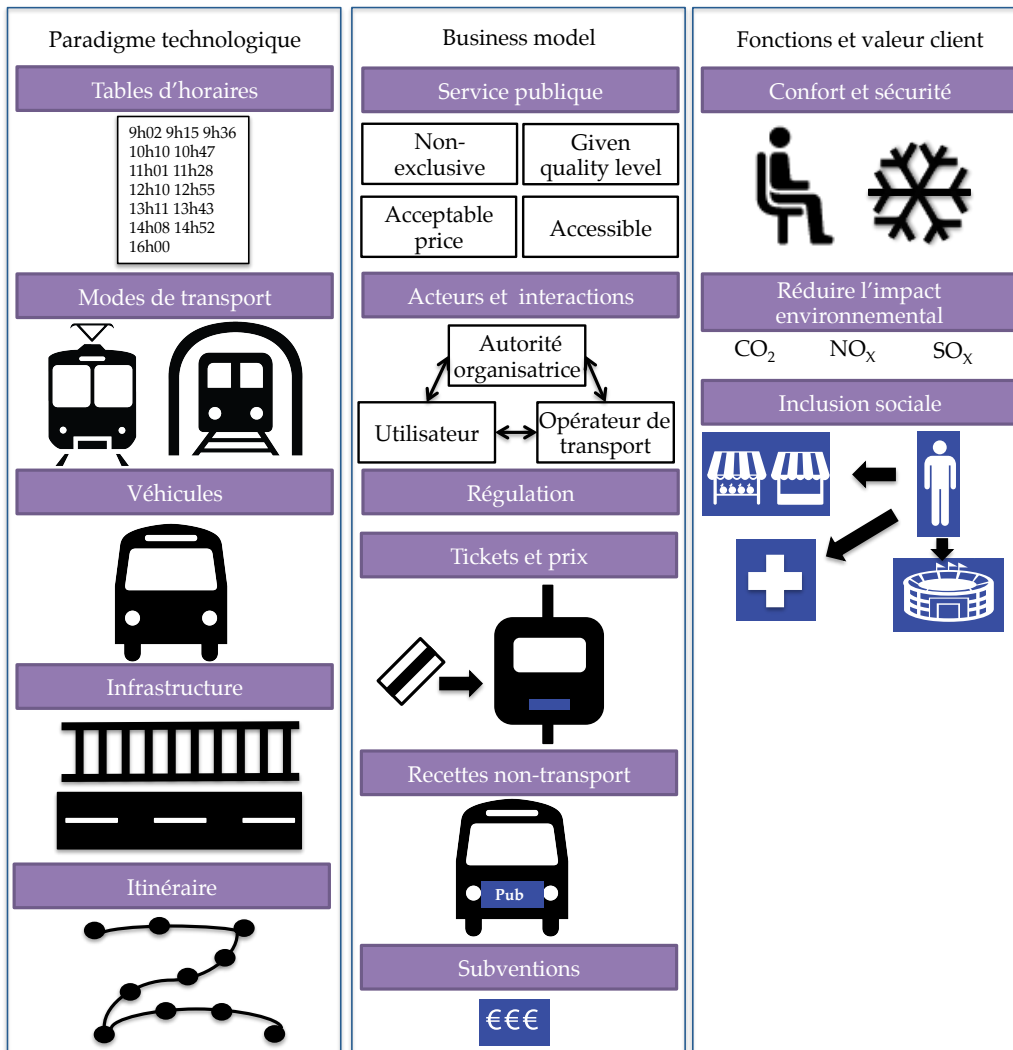


Figure R. 3 Les deux stratégies du *low cost* et leur approche au prix et à l'utilité client

Dans ce chapitre nous proposons ensuite, à travers une revue de littérature systématique, d'identifier les principales motivations dans les transports publics pour deux aspects : l'innovation et les réductions de coûts. Nous identifions 15 motivations pour innover, incluant la réduction de coûts, et 18 motivations pour travailler sur la réduction des coûts. Les motivations identifiées et leur classement par récurrence dans la littérature peuvent être trouvés dans les tableaux 4.1 (page 127) et 4.3 (page 129). Au delà de l'identification de ces motivations et de leur prépondérance les unes par rapport aux autres, ces revues de littérature nous permettent de mettre en avant le lien entre l'innovation et les réductions de coût. 13 des motivations identifiées dans les revues systématiques sont communes à l'innovation et à la réduction des coûts. Cela démontre le grand potentiel d'allier innovation et *low cost* dans les transports publics.

Nous concluons ce chapitre en soulignant le grand potentiel pour développer du *low cost* innovant dans le secteur du transport public, ainsi que le fait que ce secteur du à la complexité de son écosystème est un bon terrain de test pour notre régime de conception.

Chapitre 5. Conception d'une stratégie *low cost* à la RATP, un opérateur de transport français

Dans ce chapitre nous exposons la recherche intervention effectuée au sein du département DIT (Développement, Innovation et Territoires) de la RATP, ayant pour but de développer une stratégie *low cost*. Nous commençons par la description de l'unité de rattachement (IDD – innovation et développement durable) dans laquelle cette recherche a été effectuée et de l'organisation générale autour de la gestion de l'innovation dans la RATP pour donner le contexte dans lequel notre recherche se place.

Nous passons ensuite à une description plus détaillée du programme de recherche sur le *low cost*. Cette recherche s'est articulée autour d'un atelier de créativité orienté, organisé selon la méthode KCP (Arnoux, 2013). Cette méthode a été choisie par les managers de l'unité pour sa capacité à allier la fédération des équipes et l'exploration dans l'inconnu, et parce qu'elle était déjà connue au sein de l'entreprise. Lors de cet atelier, l'auteur a activement participé à l'organisation et au développement des propositions.

Le KCP est une méthode de conception innovante de stratégie en grand collectif composée de trois phases, une phase d'apport de connaissance (K), une phase de développement des concepts (C) et une phase de propositions ou projets (P). Dans son opérationnalisation à la RATP, en plus de ces trois phases, il comporte une période d'initialisation, où le scope et les principaux paramètres de l'atelier (participants, équipe, logistique, ...) sont définis ; et une période de « Run », où les propositions ou projets définis dans la phase P sont exécutés. A cause de son double objectif d'exploration de l'inconnu et de fédération des équipes, les résultats d'un KCP dépendent du périmètre choisi, ainsi que des acteurs impliqués.

Dans le cas du KCP réalisé à la RATP, l'objectif était de travailler sur une stratégie *low cost* pour l'entreprise, et de proposer un plan d'action pour mettre en place cette stratégie. Cet objectif d'innovation par le coût étant transversal à toute l'entreprise, il demandait une implication et un apport de connaissances venant d'un grand nombre de départements différents. Le détail des participants peut être trouvé pages 142 à 146. En plus des participants, un comité de pilotage a été mis en place, pour s'assurer de l'alignement stratégique des ateliers. Finalement, une équipe d'animation, composé de consultants externes, d'employés de la RATP et de l'auteur a organisé le déploiement de la méthode.

Les ateliers ont permis la structuration de cinq initiatives différentes, une suivant l'approche de conception par le *low cost par adaptation* et quatre suivant le *low cost innovant*. Les détails concernant les cinq initiatives et le déroulement de chaque phase des ateliers peuvent être trouvés dans les pages 146 à 152. Pour le développement de la stratégie *low cost*, ces ateliers de conception étaient néanmoins insuffisants. D'autres outils et méthodes ont du être mobilisés, comme par exemple une *roadmap* des capacités que l'entreprise avait besoin de développer.

Au delà des initiatives proposées, il est important de souligner un certain nombre de résultats issus du KCP. Le premier, est que le KCP a permis d'utiliser notre modèle de conception

comme outil et développer à la fois des offres basées sur le *low cost par adaptation* et sur le *low cost innovant*, couvrant tout le potentiel du concept initial. Il a permis d'impliquer et soutenir les participants dans un processus menant à revoir et casser les règles en place. Cela a été illustré notamment par le lancement du projet sur le *low cost par adaptation*, considéré comme peu légitime précédemment, à cause d'une association du *low cost* avec une réduction de qualité, perçue comme incompatible avec la notion de service public pour nombre de collaborateurs. Les activités exécutées pendant le KCP ont de plus mené à l'activation, l'acquisition et la production de nouvelles connaissances au sein de l'entreprise.

Le travail fait pendant le KCP a aussi permis aux collaborateurs de la RATP d'identifier les effets de fixation en place dans l'entreprise et de les dépasser par le développement d'innovations qui allaient au delà de ce qu'était considéré la frontière de l'entreprise. Les initiatives *low cost innovant* ont notamment réinterrogé l'identité du transport public, en proposant des changements dans le modèle d'affaires, dans le paradigme technique, dans les fonctions remplies et dans la valeur pour le client. Ces initiatives permettent non seulement d'élargir le périmètre de conception de l'entreprise, mais aussi d'inclure des nouveaux acteurs dans l'écosystème de transport et de créer des nouveaux partenariats.

Nous concluons ce chapitre par le constat que dans les transports publics le *low cost innovant* demande d'introduire de nouvelles fonctions à forte valeur ajoutée, comme la possibilité de réserver un transport, et de maintenir les coûts bas grâce à la suppression de fonctions et le transfert de l'activité vers le client. Ceci est un aspect essentiel, car il montre que dans le but de vendre des produits *low cost* dans les transports publics, un coût bas ne suffit pas. Alors que dans les marchés à partir desquels notre modèle de conception a été développé, proposer un meilleur ratio valeur/prix était suffisant, en raison de l'organisation particulière dans le secteur des transports publics cela ne suffit plus. Il est nécessaire de prendre en compte la création de valeur pour l'autorité publique (le client payeur) et pour d'autres prescripteurs, comme le maire ou les associations de riverains, en plus de celle pour l'utilisateur final. Une création de valeur pour ces différents acteurs est possible grâce à l'ajout de nouvelles fonctions et grâce à une révision de l'identité du transport public.

Chapitre 6. *Low cost* : un outil pour repenser l'espace de conception et pour construire des capacités à innover

Dans ce chapitre nous faisons un retour des résultats issus de l'étude de cas faite au sein de la RATP par rapport aux propositions que nous avons faites dans la partie I. Pour commencer, nous discutons les diverses évolutions apportées au régime de conception que nous avons proposé à l'issue de la partie I. Les résultats empiriques au sein de la RATP ont fait évoluer notre régime de conception à la fois sur l'évaluation de la performance, sur le raisonnement de conception et sur l'organisation adopté. Nous donnerons ici un rapide résumé de ces évolutions, pour plus de détails, le lecteur pourra se référer aux pages 179 à 181.

En ce que concerne l'évaluation de la performance, notre régime de conception proposait qu'elle s'opère au niveau du produit et au niveau de la stratégie *low cost*. Nous rajoutons à partir de notre expérience à la RATP un critère à l'évaluation de la stratégie : la capacité de revoir l'identité de l'objet. De plus, nous rajoutons deux niveaux d'évaluation. Le premier s'applique au niveau du département d'innovation, qui a comme critères la maximisation de la réutilisation des connaissances produites et la capacité d'utilisation de la stratégie comme outil d'évaluation et sélection des projets. Le deuxième s'applique à l'entreprise, mesuré par la fédération autour de la stratégie et par la sensibilisation au *low cost*.

Pour le raisonnement de conception, nous continuons de nous appuyer sur le modèle de conception proposé dans le chapitre 2. Mais à la place de l'utiliser comme un outil *ex post* pour évaluer les produits existants, il a été ici utilisé comme un outil de pilotage pendant la conception. En outre, nous avons, à travers l'étude réalisée au sein de la RATP, pu constater que l'application simultanée des deux approches du modèle est bénéfique. Le *low cost innovant* permet de ré-légitimer le *low cost par adaptation*.

En ce que concerne l'organisation autour du *low cost*, nous identifions une nouvelle forme d'organisation : l'utilisation du *low cost* comme outil pour étendre l'espace de conception de l'entreprise et nouer des nouveaux partenariats.

Nous faisons ensuite un retour sur nos hypothèses de recherche. Nous avons pu confirmer nos cinq hypothèses de recherche. Nous avons vérifié que le choix d'un modèle de référence (RH1) est essentiel pour le développement d'offres *low cost*, et doit être fait avec soin, pour éviter d'enfermer les concepteurs dans un espace de conception confiné. Comme nous l'avons déjà précisé précédemment, l'importance d'un modèle de performance pour la conception a pu être vérifié (RH2). Nous avons aussi observé que la sensibilisation au *low cost* (RH3) réduit la peur de la cannibalisation et de perte de qualité en proposant des produits *low cost*. L'importance de la clarification de l'organisation autour du *low cost* (RH4) a été confirmée par la proposition d'une nouvelle organisation au sein de la RATP, utilisant le *low cost* comme outil pour étendre l'espace de conception. Finalement, l'importance des règles de l'écosystème (RH5) a été soulignée par les difficultés rencontrées en développant un service public *low cost*.

La conclusion de ce chapitre est que la construction d'une stratégie *low cost* innovante, sujet

par essence transversal à l'intérieur d'une entreprise, est un bon outil pour renforcer les capacités dynamiques d'innovation. Le développement d'une stratégie *low cost* permet l'évolution de l'organisation interne d'une entreprise et permet d'améliorer sa capacité d'absorption.

Partie III – Conception d'écosystèmes autour des produits low cost dans des réseaux de valeur complexes

Résumé de la partie III

Cette troisième partie porte sur des écosystèmes similaires à celui du transport, où le prix payé par l'utilisateur final et le coût ne sont pas directement liés. Elle répond à notre troisième question de recherche : Comment concevoir des produits low cost dans des réseaux de valeur complexes, où le prix pour l'utilisateur final et le coût ne sont pas directement liés ?

Lorsque des entreprises veulent proposer des produits *low cost* innovants, le changement dans l'identité du produit a souvent un impact sur tous les acteurs de l'écosystème. Pour comprendre cet impact, qui ne peut pas être évalué selon une description des chaînes de valeur, nous introduirons dans le chapitre 7 la notion de réseaux de valeur complexes. Nous étudierons d'autres réseaux similaires au transport public, comme les réseaux d'eau et de gestion de déchets, pour trouver les éléments de gestion communs à ces réseaux de valeur complexe.

Dans le chapitre 8, nous discutons comment rendre des produits *low cost* innovants acceptables pour tous les acteurs. L'engagement de tous les acteurs dans un processus de création de valeur semble être la clé pour le succès des produits *low cost* dans les réseaux de valeur complexes. Cela élargi considérablement l'espace de conception de ces produits, qui doit inclure la création de valeur pour plusieurs acteurs. En plus, les acteurs du réseau peuvent évoluer car les changements dans l'identité de l'objet peuvent conduire à de nouvelles collaborations et donc, un nouveau réseau de valeur. Il faut donc réussir à créer de la valeur pour des acteurs nombreux, parfois encore partiellement inconnus lors du développement du produit, ce qui va nécessiter un effort de **création de valeur générique**, il s'agit d'une approche de création de valeur en double inconnu, la valeur et l'acteur pour lequel la valeur est créée sont inconnus. Finalement, le produit *low cost* innovant dans ces réseaux de valeur peut aussi mener à la ré-conception de certaines des règles de coordination de l'écosystème d'origine, comme les réglementations ou l'infrastructure.

Nous concluons cette partie en mettant en avant que le *low cost innovant* dans des réseaux de valeur complexes soutient une dynamique de création de valeur pour de multiples acteurs, en ouvrant de nouveaux espaces de conception. Aussi, le *low cost innovant* peut être utilisé comme un catalyseur pour concevoir les écosystèmes, permettant leur renouvellement ou leur création.

Chapitre 7. Le *low cost* dans des réseaux de valeur complexes – des défis et opportunités nouveaux

Le développement de produits suivant la stratégie du *low cost innovant*, comme nous l'avons vu dans la partie II, peut réinterroger de façon radicale l'identité des objets. Les changements dans l'identité de l'objet entraînent, en retour, des impacts importants sur tout l'écosystème industriel du produit. En effet, l'identité du produit et son environnement sont liés : l'identité du produit façonne la forme de l'écosystème, comme nous pouvons constater dans les travaux théoriques sur le *dominant design* (Suaréz and Utterback, 1995). Nous devons donc, lors du développement d'un produit souvent aussi nous interroger sur les évolutions de l'écosystème, vu qu'elles influencent la création de valeur atteignable par le nouveau produit, définie par le business model de chacun des acteurs impliqués et leur positionnement dans la chaîne de valeur.

Dans le contexte du transport public, ces deux éléments pour classer la valeur ne semblent pas suffisants, la chaîne de valeur n'étant pas linéaire. Néanmoins, la création de valeur est possible s'il y a des interactions entre plusieurs acteurs : cela nous conduit à reprendre la notion du réseau de valeur, concept souvent utilisé pour décrire justement des contextes dans lesquels plusieurs acteurs contribuent à la création de valeur. Pour clarifier, nous différencions ensuite les deux contextes différents de conception d'offres *low cost* : les réseaux de valeur simples (composés d'un acheteur/utilisateur final et d'un producteur/vendeur) et les réseaux de valeur complexes, qui peuvent avoir plusieurs acheteurs, des utilisateurs interdépendants, des producteurs et des vendeurs multiples.

Dans ce chapitre nous construisons un modèle des réseaux de valeur complexes en partant de la littérature et l'enrichissons à partir des observations de quelques cas empiriques. Le tableau R.3 récapitule le modèle que nous proposons.

Tableau R. 3 Modèle des réseaux de valeur complexes enrichie par les observations des cas empiriques

	Réseau de valeur simple	Réseau de valeur complexe
Principaux acteurs	- Un seul acheteur/ utilisateur final - Un seul producteur/ vendeur	- Utilisateurs finaux interdépendants - Plusieurs acheteurs - Producteurs et vendeurs interdépendants - Prescripteurs
Lien direct entre le coût et le prix pour l'utilisateur	Oui	Non, les produits/services sont partiellement ou entièrement payés par d'autres acteurs que l'utilisateur
Mécanismes de gouvernance	Compétitif (Optimisation de la valeur pour le client)	Collaboratif (Optimisation du nombre de bénéficiaires dans le réseau)
Règles collectives de coordination	Processus des entreprises jusqu'au lancement sur le marché	Standards et réglementations (infrastructure & certification)
Analyse de la création de valeur	Business model et positionnement dans la chaîne de valeur	Ecosystèmes stables: dominant design Ecosystèmes émergents ou dans le cas d'innovations : ?

Nous concluons ce chapitre en indiquant que les particularités des réseaux de valeur complexes ont des conséquences pour la conception de produits *low cost* : grand nombre d'acteurs impliqués, réglementation forte, dissociation entre acheteur et utilisateur, et absence de corrélation entre les coûts et le prix pour l'utilisateur final. Le tableau R.4 liste les opportunités et risques pour le *low cost* pour chacune de ces particularités. Le chapitre 8 apportera quelques éléments de réponse à comment ces risques et opportunités peuvent être pris en compte.

Tableau R. 4 Challenges managériaux pour développer des produits *low cost* dans des réseaux de valeur complexes (RVC)

Particularité du RVC	Opportunités pour le <i>low cost</i>	Risques pour le <i>low cost</i>
Grand nombre d'acteurs impliqués	Ouverture de nouveaux espaces de conception par la création de valeur pour plusieurs acteurs et intégration de nouveaux acteurs dans le réseau de valeur	Refus du <i>low cost</i> parce qu'il ne crée pas de la valeur pour tous les acteurs dans le réseau de valeur
Réglementation forte	Possibilité d'influencer la conception de la réglementation	Restrictions de l'espace de conception par la réglementation
Dissociation de l'acheteur et de l'utilisateur	Possibilité de créer un nouvel écosystème autour d'une nouvelle création de valeur pour l'utilisateur et l'acheteur	Le produit <i>low cost</i> doit intéresser à la fois l'acheteur et l'utilisateur
Absence de corrélation du coût et du prix pour l'utilisateur final	Possibilité de créer des produits encore plus accessibles en créant de la valeur pour plusieurs acteurs de l'écosystème	La baisse des coûts ne conduit pas toujours à des prix plus bas, et le prix inférieur ne suffit plus à créer une incitation à acheter <i>low cost</i> , il est nécessaire de créer d'autres incitations

Chapitre 8. Conception d'écosystèmes autour du low cost dans des réseaux de valeur complexes

Dans ce chapitre, nous analysons les opportunités et défis ouverts par l'application d'une stratégie *low cost* innovante dans des réseaux de valeur complexes, notion décrite dans le chapitre précédent. Nous commençons par une analyse de la création de valeur dans les écosystèmes existants et nous concluons que la création de valeur pour chacun des membres du réseau valeur est essentielle pour améliorer les chances de réussite. La première implication managériale de nos résultats est que se concentrer sur la création de valeur pour l'utilisateur final dans le cas de réseaux de valeur complexes ne suffit pas pour implémenter avec succès une offre *low cost*. Bien que la création de valeur pour l'utilisateur final soit importante, lorsqu'une entreprise est placée à l'intérieur d'un réseau de valeur complexe, elle a besoin de rendre possible la création de valeur pour l'ensemble de l'écosystème. Par conséquent, analyser les acteurs et comprendre leurs interactions dans l'écosystème est essentiel, mais au delà, l'entreprise qui soutient une offre *low cost* doit réunir les conditions d'implication du collectif nécessaire à l'offre dans un processus de création de valeur.

Ainsi, le besoin de créer de la valeur pour plusieurs ou tous les acteurs du écosystème ouvre des nouveaux espaces de conception qu'il faut instrumenter et piloter. Cela peut demander de créer de la valeur pour des acteurs encore inconnus, plaçant l'entreprise dans une situation de double inconnu (l'acteur et la valeur sont des inconnues). Pour répondre à cette situation de double inconnu, nous nous inspirons des travaux de Kokshagina (2014), en transposant ses travaux sur la conception de technologie générique en double inconnu {Marché/technologie}, pour proposer que les entreprises pourraient y répondre par une création de valeur générique. Un processus piloté sur la création de valeur générique réduit les risques d'échec, comme dans le cas des technologies génériques.

Ensuite, en regardant l'impact que les produits *low cost* innovants ont sur leur écosystème, nous constatons que souvent ces produits demandent une ré-conception du réseau de valeur et par voie de conséquence de la composition et des règles de coordination de l'écosystème. Nous voyons à travers d'exemples issus de la littérature et de nos deux études de cas, à la RATP et chez Thales, que le travail sur des produits *low cost* peuvent ainsi conduire à la ré-conception d'aspects structurants de la coordination des acteurs de l'écosystème, comme les infrastructures ou la législation.

Nous concluons ce chapitre en exposant les implications managériales de ces résultats. Les entreprises en place dans un réseau de valeur complexe ont des intérêts multiples à participer dans la conception de produits *low cost* innovants : d'abord pour étendre leurs espaces de conception et créer des nouveaux partenariats, ensuite pour s'assurer qu'ils seront présents dans le réseau de valeur des nouveaux produits, et enfin, pour les utiliser comme catalyseurs pour faire évoluer la valeur et les règles de coordination de leur écosystème.

Conclusion générale

L'objectif de cette thèse était de répondre à la problématique de recherche suivante : Comment la conception de produits et de services *low cost* pourrait devenir une nouvelle voie pour les stratégies de conception innovantes dans des réseaux de valeur fortement règlementés avec un grand nombre d'acteurs impliqués ? Il s'agit d'un défi contemporain pour les gestionnaires, vu que le *low cost* est devenu à la fois un concept largement utilisé dans la gestion de l'innovation et une nécessité sur des marchés compétitifs de plus en plus internationalisés.

Dans cette section conclusive de notre manuscrit, nous proposons d'abord une synthèse de nos principaux résultats, suivie par une discussion des méthodes de recherche et de leurs limites, puis des nouvelles perspectives de recherche ouvertes par nos travaux. Pour les chercheurs qui souhaiteraient s'appuyer sur nos travaux de recherche ou les industriels intéressés par l'application de la méthode que nous proposons, une description plus détaillée des aspects centraux de nos résultats est fournie pages 234 à 238.

Principaux résultats

Notre recherche a permis de répondre à trois questions de recherche sur la conception de produits *low cost* dans les réseaux de valeur complexes, et nous proposons trois résultats principaux :

- Notre premier résultat est la proposition d'un modèle de conception pour les produits *low cost* avec deux approches: le *low cost par adaptation* et le *low cost innovant*. Nous montrons qu'un modèle de conception ne suffit pas pour une conception réussie de ces produits; il doit être complété par une grille d'évaluation de la performance et un cadre d'organisation à l'intérieur de l'entreprise. Nous proposons donc un régime de conception comprenant ces dimensions autour de notre modèle de conception ;
- Notre second résultat est de décrire comment une entreprise comme la RATP a élaboré une stratégie *low cost*. Avec les industriels, nous appliquons le modèle de conception à faible coût combiné avec plusieurs outils au sein de la RATP pour permettre le changement organisationnel. L'analyse de l'expérience au sein de la RATP nous conduit à étendre le régime de conception que nous avons proposé. Nous montrons comment le *low cost* peut être utilisé comme outil de gestion pour surmonter des effets de fixation et pour réinterroger l'identité des objets traditionnels du transport public ;
- Le troisième résultat est l'extension du domaine de validité de notre modèle de conception aux réseaux de valeur complexes, qui sont composés d'éléments de gestion similaires à celui du transport public (grand nombre d'acteurs impliqués, réglementation forte, dissociation entre acheteur et utilisateur, et absence de

corrélation entre les coûts et le prix pour l'utilisateur final). Dans les réseaux de valeur complexes, la création de valeur doit être pilotée au delà des limites de l'entreprise à l'initiative de l'offre, soit par l'implication des acteurs de l'écosystème en place dans un processus de création de valeur, soit par la conception de l'écosystème (acteurs et règles de coordination) qui permettrait la création de valeur pour tous ses acteurs à travers le produit *low cost* proposé.

Discussion des méthodes de recherche employées

Pendant notre thèse, nous avons mobilisé quatre méthodes de recherche : la recherche intervention, l'étude de cas multiples, la revue de littérature systématique et une méthode de créativité dirigée. Chacune de ces méthodes a eu des apports spécifiques à nos recherches, que nous souhaitons souligner ici. De plus, ces méthodes présentaient des limites, que nous discuterons ici.

Tout d'abord, la principale méthode employée a été la recherche intervention (Radaelli et al, 2012; David and Hatchuel, 2008), utilisée pour la recherche empirique au sein de la RATP. Cette méthode nous a permis d'avoir une vision détaillée des enjeux managériaux de la RATP, à la fois sur le processus interne de développement d'innovations et de son organisation. C'est aussi grâce à cette méthode que nous avons pu développer des théories sur le développement des offres *low cost* dans les réseaux de valeur complexes ancrées dans un terrain. Une des critiques récurrentes à cette méthode est le risque que les chercheurs soient biaisés par leur immersion dans le terrain. Une façon de se distancier et de rendre le travail plus rigoureux aurait été de compléter cette méthode avec des entretiens semi-directifs avec les principaux décideurs, fait à différents moments au cours de la recherche, pour enregistrer les évolutions dans leur vision.

Ensuite, dans l'analyse des 50 produits et services *low cost* issus de la littérature, nous avons utilisé la méthode d'études de cas multiples (Eisenhardt and Graebner, 2007). Pour cette recherche, nous nous sommes appuyées sur des sources secondaires. L'utilisation de données secondaires permet d'analyser un plus grand nombre de cas, et donc de réduire l'impact des contingences sur l'analyse, en un temps réduit. Cependant l'utilisation de données secondaires a été critiquée parce que ces données sont souvent moins riches que les données primaires et peuvent être moins fiables. Notre recherche aurait donc pu être enrichie en complétant les données secondaires avec des données primaires (comme ce fut le cas pour l'étude Thales), afin de s'assurer que les produits sont correctement contextualisés. Dans l'analyse des cas, nous pouvons ajouter une autre limite, liée à la classification du degré d'innovation des produits. Celle-ci a été codée uniquement par l'auteur. Une approche plus rigoureuse aurait été d'avoir un double codage, afin de rendre plus robuste la validité de la classification.

La troisième méthode mobilisée est la revue systématique de la littérature à partir de mots clés (Becheikh et al, 2006). Elle a été utilisée pour identifier les motivations pour innover et

pour travailler sur des réductions de coûts dans le transport public. Cette méthode peut être chronophage et fastidieuse dans le codage mais elle est extrêmement puissante pour montrer les tendances dans un champ de littérature, vu qu'elle permet de fournir des données chiffrées sur les différents éléments de codage (ici, les motivations explicitées par les académiques). Dans notre cas, même si le lien que nous avons constaté entre l'innovation et le *low cost* dans le transport public aurait pu être mis en lumière par d'autres méthodes, par exemple des entretiens avec des experts dans le secteur, cette méthode a été très enrichissante. En plus de montrer ce lien, elle a permis d'identifier les autres motivations pour innover dans le secteur et de quantifier l'importance de chacune de ces motivations dans la littérature.

Finalement, nous avons utilisé la méthode de créativité dirigée KCP lors des ateliers sur le *low cost* au sein de la RATP. Cette méthode a été choisie parmi d'autres méthodes de créativité à cause de son implémentation ancienne à la RATP et pour sa capacité à fédérer autour de l'innovation. Par contre, en regardant les résultats issus du KCP, il était parfois difficile de distinguer lesquels étaient liés à la méthode de la créativité orientée, et lesquels étaient liés au *low cost*. Un effort conséquent aurait pu être réalisé en comparant les résultats de ce KCP à ceux d'autres KCP pour distinguer les résultats liés à l'objet de ceux liés à la méthode. De même, notre recherche aurait pu bénéficier d'une étude comparative avec une autre méthode, appliquée sur le même objet, pour aider à lever l'ambiguïté sur l'origine de ces résultats.

Perspectives de recherche

Notre recherche sur le *low cost*, un sujet extrêmement vaste, permet d'indiquer un ensemble de perspectives de recherche et d'indiquer un certain nombre d'aspects qu'ils nous sembleraient intéressant d'approfondir mais que nous n'avons pas pu traiter lors de notre recherche.

Nos travaux indiquent que le *low cost*, grâce à sa transversalité, peut être un catalyseur pour réinterroger l'identité des objets, aidant des entreprises à surmonter des effets de fixation. L'innovation dans le secteur du transport public est, comme nous l'avons constaté dans le chapitre 4, motivée aussi par d'autres sujets transversaux à l'entreprise, comme le développement durable ou les politiques publiques. D'autres recherches pourraient se concentrer sur la façon dont ces objets transversaux sont mobilisables pour renouveler l'identité des objets et si elles peuvent également conduire les entreprises à établir de nouveaux partenariats et élargir leur champ de conception comme cela a été observé dans le cas du *low cost*.

Un autre résultat de ces travaux a été l'identification de la création de valeur générique comme axe de pilotage de la valeur pour plusieurs acteurs dans l'écosystème. Ce concept de création de valeur générique gagnerait à être étudié plus en profondeur et dans d'autres contextes, pour permettre d'identifier par quels moyens il peut être piloté, ainsi que son lien avec des nouveaux modèles d'affaires et l'impact de son utilisation pour les entreprises.

Comme nous l'avons mentionné précédemment, l'une des idées que nous proposons est

L'utilisation du *low cost* comme outil de réconception des écosystèmes. Dans notre travail, nous nous sommes concentrés sur la conception de deux aspects de coordination de l'écosystème: l'infrastructure et la législation. Notre exploration n'a pas été systématique et n'a probablement pas couvert toutes les règles collectives de l'écosystème qui peuvent être reconçues. Il y a certainement un intérêt de continuer à explorer quelles structures collectives peuvent être redessinées favorablement pour l'écosystème, ainsi que comment la conception pourrait être abordée.

Une autre piste qui mérite d'être plus creusée concerne l'impact des produits *low cost* et les opportunités pour leur conception dans les différents types d'écosystèmes. Nous nous sommes principalement penchés sur les écosystèmes avec des réseaux de valeur complexes et notre modèle de conception s'inspire de ce que nous avons défini comme des réseaux de valeur simples. Il existe néanmoins des configurations intermédiaires entre les réseaux de valeur simples et les complexes, qui demeurent encore à explorer.

Finalement, il serait intéressant de continuer à suivre les projets et offres proposés au sein de la RATP dans le cadre de la stratégie *low cost*. Cela permettrait à la fois d'évaluer si les offres proposées auront le succès attendu et d'étudier le positionnement de ces offres par rapport aux existantes. Sur le plan managérial, une étude longitudinale d'une stratégie *low cost* dans une entreprise de service public pourrait avoir des apports, non seulement sur le positionnement des offres, mais aussi sur d'autres questions relatives à la création de valeur sous fortes contraintes.

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Appendix 1

Table A.1 : Studied products

Ent ry	Product	Company or developer	Sector	Innovativeness				Utility parameters				Design model		
				Technical system change	Business model change	Customer value creation	Function addition	Function removal	Negative transfer	Positive transfer	Function addition	Low cost adaptation	Smart low cost design	
1	Low cost airlines	Ryan Air, Easy Jet, Southwest	Airlines		x				x				x	
2	Hard discount retailers	Lidl, Aldi, Wall Mart	Retail		x				x				x	
3	Transmilenio	City of Bogotá	Transport	x	x		x		x				x	
4	Tata Nano (low cost car)	Tata	Automobile	x	x	x	x		x				x	
5	Dacia Logan X90 (low cost car)	Renault	Automobile		x				x				x	
6	Mifitcool (low cost refrigerator)	Mansukh Prajapati	Household goods	x	x	x	x		x				x	
7	Chotakool (low cost refrigerator)	Godrej & Boyce	Household goods	x		x	x		x				x	
8	Low cost haircut	Tdhip, SelfCoiff	Services						x				x	
9	Low cost furniture	IKEA	Household goods		x	x				x				x
10	Mobile phone payments	Tagattitude	Banking	x		x				x				x
11	Swachh water filter	Tata	Household goods	x		x	x		x				x	
12	Baby warmer	Embrace	Health care	x	x	x	x		x				x	
13	Mobile Product Authentication	Sproxil	Services	x		x				x				x
14	Single dose	Procter & Gamble	Personal goods		x	x			x				x	
15	Solar bottle bulb (Isang Litrong Liwanag)	A liter of light	Utilities	x	x	x	x		x				x	
16	Vscan (portable Ultrasound)	GE Healthcare	Health care	x		x	x		x				x	
17	Nokia 1100 (cell phone)	Nokia	Telecommunication	x		x	x		x				x	

Ent ry	Product	Company or developer	Sector	Innovativeness				Utility parameters				Design model		
				Technical system change	Business model change	Customer value creation	Function addition	Function removal	Negative transfer	Positive transfer	Function addition	Low cost adaptat- ion	Smart low cost design	
18	Eye surgery	Aravind Eye Hospital	Health care	x						x			x	
19	Pellets cooking system (biomass stove)	BP, First Energy (India)	Household goods	x		x	x						x	
20	Revolvo	KPIT Cummins	Automobile	x	x	x	x				x		x	
21	Low cost hotel	Formule 1, Etap Hotel, Motel 6	Hotel							x			x	
22	Internet banking	Bursorama, ING direct, Fortuneo	Banking							x	x		x	
23	Low cost insurance	Anagtiz (Groupama); Idmacif (Macif), Directassurance (AXA)	Insurance							x			x	
23	Telecommunication service	NRJ, Virgin, Breizh	Telecommunication		x					x			x	
25	Clothing	DPAM	Personal goods		x					x			x	
26	Low cost car rental	Ucar	Services		x					x			x	
27	Microwave ovens	Galanx	Household goods							x			x	
28	Dust (low cost car)	Renault/Nissan	Automobile							x			x	
29	Mac400 electrocardiogram	GE Healthcare	Health care	x		x	x			x			x	
30	Washing machines	Haier	Household goods			x	x			x			x	
31	Aakash (low cost tablet)	Data Wind	Technology	x		x	x			x			x	
32	Dentistry	Addentis	Health care		x					x			x	
33	Cleaning services	Anett	Services		x					x			x	
34	Free newspapers	Métro, 20 minutes	Journalism		x					x			x	
35	Free internet news	Mediapart, blogs	Journalism	x	x	x	x			x			x	

Entry	Product	Company or developer	Sector	Innovativeness				Utility parameters				Design model			
				Technical system change	Business model change	Customer value creation	Function addition	Function removal	Negative transfer	Positive transfer	Function addition	Low cost adaptation	Smart low cost design		
36	Silicones	Xiameter (Dow Corning)	Construction & Materials	x						x				x	
37	Heart surgery	Doctor Shetty 'Health City'	Health care	x	x					x				x	
38	Palliative care	Kerala's neighbourhood network	Health care	x	x		x			x					x
39	Solar power for rural poor	SELCO	Utilities		x	x	x							x	
40	Foetal heart monitor	Siemens	Health care	x			x			x					x
41	Telecommunication service	Grameen village phone	Telecommunication		x	x				x	x				x
42	Batteries	BYD	Batteries	x			x								x
43	Low cost train	SNCF	Transport		x					x					x
44	Funeral services	Ecoplus Funeraire	Services		x					x					x
45	Real Estate	Efficity	Services		x					x					x
46	Low cost gym	Curves	Services		x		x			x					x
47	MOT (technical control)	CTEasy	Services		x					x	x				x
48	Advertising	TV lowcost	Services	x	x					x					x
49	Gillette Guard (low cost razor)	P&G	Personal goods				x			x					x
50	Low cost rocket launch	Space-X	Aerospace	x	x	x	x			x					x

Title	Journal	Authors	Year	Modeling	Policy making	Sustainability	Benchmark	Organizational change	Technology change	Socio-economic advantages	Contracts	Social inclusion	Attitude and behavior	Safety	Reliability	Improve regularity	Accessibility	Passenger information	Combine modes
Effective ways to grow urban bus markets - a synthesis of evidence	Journal of Transport Geography	Currie, G. & Wallis, I.	2008	1	1		1												
Demand responsive urban public transport system design: Methodology and application	Transportation Research Part A: Policy and Practice	Fernandez L., J. E. et al.	2008					1											
Developing work schedules for an inter-city transit system with multiple driver types and fleet types	European Journal of Operational Research	de Malta, R. & Peters, E.	2009	1				1											
A route set construction algorithm for the transit network design problem	Computers & Operations Research	Mauttone, A. & Urquhart, M. E.	2009	1															
Citywide Transit Integration in a Large City	Transportation Research Record: Journal of the Transportation Research Board	Hidalgo, D.	2009		1				1										
Restating modal investment priority with an improved model for public transport analysis	Transportation Research Part E: Logistics and Transportation Review	Trachini, A. et al.	2010	1			1												
Comparing operator and users costs of light rail, heavy rail, and bus rapid transit over a radial public transport network	Research in Transportation Economics	Trachini, A. et al.	2010				1												
Effects of contracting on cost efficiency in US fixed-route bus transit service	Transportation Research Part A: Policy and Practice	Iseki, H.	2010								1								
Towards the adoption of low-cost rail level crossing warning devices in regional areas of Australia: A review of current technologies and reliability issues	Safety Science	Wullems, C.	2011											1					
Impacts of Bus Priority in Coordinated Traffic	Procedia - Social and Behavioral Sciences	Wahlstedt, J.	2011	1					1										1

Title	Journal	Authors	Year	Modeling	Policy making	Sustainability	Benchmark	Organizational change	Technology change	Socio-economic advantages	Contracts	Social inclusion	Attitude and behavior	Safety	Reliability	Improve regularity	Accessibility	Passenger information	Combine modes
Signals																			
Making public transport financially sustainable	Transport Policy	Buehler, R. & Pucher, J.	2011					1											
Passengers' valuations of universal design measures in public transport	Research in Transportation Business & Management	Fearnley, N. et al.	2011														1		
Approaches for Increasing The Similarity of Resource Schedules in Public Transport	Procedia - Social and Behavioral Sciences	Amberg, B. et al.	2011	1															
Making the connections between transport disadvantage and the social exclusion of low income populations in the Tshwane Region of South Africa	Journal of Transport Geography	Lucas, K.	2011			1				1									
Bike Lane Design: the Context Sensitive Approach	Procedia Engineering	Dondi, G. et al.	2011											1					
The role of attitudes toward characteristics of bicycle commuting on the choice to cycle to work over various distances	Transportation Research Part D: Transport and Environment	Heinen, E. et al.	2011										1						
Route layout analysis for express buses	Transportation Research Part C: Emerging Technologies	Wirasinghe, S.C. & Vandebona, U.	2011																
Cost-effectiveness of greenhouse gas mitigation in transport: A review of methodological approaches and their impact	Energy Policy	Kok, R. et al.	2011			1													
Comparative analysis of evaluation techniques for transport policies	Environmental Impact Assessment Review	Browne, D. & Ryan, L.	2011		1														
Model and Algorithm of Regional Bus Scheduling with	Journal of Transportation Systems Engineering and	Wei, M. et al.	2012	1															

Title	Journal	Authors	Year	Modeling	Policy making	Sustainability	Benchmark	Organizational change	Technology change	Socio-economic advantages	Contracts	Social inclusion	Attitude and behavior	Safety	Reliability	Improve regularity	Accessibility	Passenger information	Combine modes
Grey Travel Time	Information Technology Applied Geography	Cardozo, O. D. et al.	2012	1															
Application of geographically weighted regression to the direct forecasting of transit ridership at station-level																			
How to make the unpopular popular? Policy characteristics, social norms and the acceptability of environmental policies	Environmental Science & Policy	de Groot, J. I.M. & Schuitema, G	2012		1														
Real-Time Information System for Small and Medium Bus Operators	Procedia Technology	Cachulo, L. et al.	2012						1										1
Development of an integrated flexible transport systems platform for rural areas using argumentation theory	Research in Transportation Business & Management	Velaga, N.R. et al.	2012					1											
Feeder Bus Network Design Problem: a New Metaheuristic Procedure and Real Size Applications	Procedia - Social and Behavioral Sciences	Ciaffi, F. et al.	2012																1
Economic Evaluation of Urban Track Systems: Integration of Life Cycle Costs and Socio-Economic Assessment	Procedia - Social and Behavioral Sciences	de Jong, M. & Declercq, K.	2012						1										
Cost-saving properties of schedule coordination in a simple trunk-and-feeder transit system	Transportation Research Part A: Policy and Practice	Sivakumaran, K. et al.	2012																1
Unbundling public infrastructure financing and access charge regulation in the German rail sector	Journal of Rail Transport Planning & Management	Link, H.	2012																1

Title	Journal	Authors	Year	Modeling	Policy making	Sustainability	Benchmark	Organizational change	Technology change	Socio-economic advantages	Contracts	Social inclusion	Attitude and behavior	Safety	Reliability	Improve regularity	Accessibility	Passenger information	Combine modes		
A decomposition approach for the integrated vehicle-crew-roster problem with days-off pattern	European Journal of Operational Research	Mesquita, M. et al.	2013	1																1	
Integrating bus services with mixed fleets	Transportation Research Part B: Methodological	Kim, M. & Schonfeld, P.	2013	1																	
Factors affecting the adoption of vehicle sharing systems by young drivers	Transport Policy	Efthymiou, D. et al.	2013										1								

Table A.3 : Motivations for innovation found in our systematic literature research

Title	Journal	Authors	Year	Sustainability	Policy making	Technology change	NTIC	Organization and management	Behavior change	Contracts and financing	Low cost, cost reduction	Modeling and methodology	Service quality and client satisfaction	Social inclusion	Improving public health	Physical accessibility	Travel Information	Improving safety	Pricing strategies	
Opportunities for innovation in public transport: Effects of regulatory reforms on innovative capabilities	Transport Policy	Ongkitkikul, S. & Geerlings, H.	2006																	
Securing public values in public transport projects: Four Dutch cases on innovation	Transport Policy	Veeneman, W. & Koppenjan, J.	2010		1	1		1												
Innovation and integration in urban transport policy	Technology in Society	May, A.D. & Tight, M.R.	2006						1											
A case study of flexible solutions to transport demand in a deregulated environment	Transportation Research Record: Journal of the Transportation Research Board	Brake, J. & Nelson, J. D.	2007		1															
Techno therapy or nurtured niches? Technology studies and the evaluation of radical innovations	Transportation Research Record: Journal of the Transportation Research Board	Hommel, A. et al.	2007					1												
The effect of mergers on efficiency and productivity of public transport services	Journal of Transport Geography	Odeck, J.	2008			1														
Local public transport on the basis of social economic criteria	Research Policy	Ljungberg, A.	2010			1					1									
Workshop report - System development	Journal of Cleaner Production	Veeneman, W. & Nelson, J. D.	2010					1												1
A multi-level analysis of sustainable mobility transitions: Niche development in the UK and Sweden	Journal of Transport Geography	Nykvist, B. & Whitmarsh, L.	2008																	

Title	Journal	Authors	Year	Sustainability	Policy making	Technology change	NTIC	Organization and management	Behavior change	Contracts and financing	Low cost, cost reduction	Modeling and methodology	Service quality and client satisfaction	Social inclusion	Improving public health	Physical accessibility	Travel Information	Improving safety	Pricing strategies
Competitive tendering in The Netherlands: Central planning vs. functional specifications	Research Policy	van de Velde, D. et al.	2008							1									
Kickstarting growth in bus patronage: Targeting support at the margins	Journal of Economic Dynamics and Control	Bristow, A. L. et al.	2008			1		1		1									
Managing motorization in sustainable transport planning: the Singapore experience	Research on Organizational Innovation-2007 Proceedings of International Conference on Enterprise Engineering and Management Innovation	Han, S. S.	2010			1		1		1									
Accelerating hydrogen implementation by mass production of a hydrogen bus chassis	Transportmetrica	Ally, J. & Pryor, T.	2009	1															
Sustainable mobility: from technological innovation to societal learning	Transportation Research Part A: Policy and Practice	Vergara, P. J. & Brown, H. S.	2007	1															
Accelerating Moving Walkway: A review of the characteristics and potential application	Technological Forecasting and Social Change	Kusumaningtyas, I. & Lodewijks, G.	2008	1															
Enabling technologies for demand management: Transport	Transportation Research Part A: Policy and Practice	Smith, R. A.	2008			1													
Transport and climate change: a review	Journal of Transport Geography	Chapman, L.	2007																
Transit network design with allocation of green vehicles: A genetic algorithm approach	Transportation Research Part A: Policy and Practice	Beltran, B. et al.	2009			1		1		1									

Title	Journal	Authors	Year	Sustainability	Policy making	Technology change	NTIC	Organization and management	Behavior change	Contracts and financing	Low cost, cost reduction	Modeling and methodology	Service quality and client satisfaction	Social inclusion	Improving public health	Physical accessibility	Travel Information	Improving safety	Pricing strategies
application of computational mechanism design																			
Users' preferences towards innovative and conventional public transport	Technology analysis & strategic management	Site, P. D. et al.	2011			1	1	1			1								
How much can public private partnership really do for urban transport in developing countries?	2009 3RD International conference on power electronics systems and applications: electric vehicle and green energy	Willoughby, C.	2013																
The Development of Local Implementation Scenarios for Innovative Urban Transport Concepts: the NICHE5+ Approach	Research in Transportation Economics	Cre, J. et al.	2012							1									
Business strategies and technology for access by transit in lower density environments	Research in Transportation Economics	Teal, R. F. & Becker, A. J.	2011			1	1												1
Four decades of changing transport policy in Santiago, Chile	Research in Transportation Economics	Figueroa, O.	2013					1	1										
A master plan for low carbon and resilient housing: The 35ha area in Hashtgerd New Town, Iran	Journal of Transport Geography	Seelig, S.	2011			1													
Exploring the socio-technical dynamics of systems integration - the case of sewage gas for transport in Stockholm	Technological Forecasting and Social Change	Vernay, A. et al.	2013																
Non-technological innovations for	Energy	Hyard, A.	2013																

Title	Journal	Authors	Year	Sustainability	Policy making	Technology change	NTIC	Organization and management	Behavior change	Contracts and financing	Low cost, cost reduction	Modeling and methodology	Service quality and client satisfaction	Social inclusion	Improving public health	Physical accessibility	Travel Information	Improving safety	Pricing strategies
development?																			
Research Board																			
How do cities approach policy innovation and policy learning? A study of 30 cities in Northern Europe and North America	Transportation Research Part C: Emerging Technologies	Marsden, G. et al.	2011																
Transport and social exclusion: Where are we now?	Transportation Research Record: Journal of the Transportation Research Board	Lucas, K.	2012	1	1														
The role of ICTs in everyday mobile lives	Procedia - Social Sciences	Line, T. et al.	2011			1								1					
Kingdom's multiple streams model and automobile dependence reversal path: the case of Curitiba, Brazil	Research in Transportation Business & Management	Khayesi, M. & Anekudzi, A.A.	2011				1												
Critical factors for implementing and diffusing sustainable product-service systems: insights from innovation studies and companies' experiences	Cities	Ceschin, F.	2013																
Developing a Decision-Making Framework for Collaborative Practices in Long-Short Distance Transport Interconnection	Safety Science	Adamos, G. et al.	2012	1															
Personal Rapid Transit in an open-control framework	Transport Policy	Berger, T. et al.	2011			1													
Park-and-Ride motivations and air quality norms in Europe	Journal of Transport Geography	Dijk, M. et al.	2013	1			1												

Title	Journal	Authors	Year	Sustainability	Policy making	Technology change	NTIC	Organization and management	Behavior change	Contracts and financing	Low cost, cost reduction	Modeling and methodology	Service quality and client satisfaction	Social inclusion	Improving public health	Physical accessibility	Travel Information	Improving safety	Pricing strategies
Green projects: An information drives analysis of four cases	Journal of Transport Geography	Watson, R.T. et al.	2011	1				1									1		
Understanding the diffusion of public bikesharing systems: evidence from Europe and North America	Computers & Industrial Engineering	Parkes, S. D. et al.	2013																
Sustainable urban development and the multi-level transition perspective	The Journal of Strategic Information Systems	Petter Nass & Vogel, N.	2012	1	1	1		1											
Lessons from the spread of Bus Rapid Transit in Latin America	Journal of Transport Geography	Mejía-Dugand, S. et al.	2013	1	1														
Can innovative business models overcome resistance to electric vehicles? Better Place and battery electric cars in Denmark	Journal of Rail Transport Planning & Management	Christensen, T. B. et al.	2012			1	1												
Cities, mobility and climate change	Administration & Society	Banister, D.	2011	1		1		1											
The future of mobility in cities: Challenges for urban modelling	Environment and planning A	Wegener, M.	2012	1				1											
Optimal multi-class rescheduling of railway traffic	Journal of urban technology	Coman, F. et al.	2011									1							
A new approach to modelling the 4 th international conference on mechanical engineering and assessment in transport studies	Proceedings of the 4 th international conference on mechanical engineering and assessment in transport studies	Martinez, L. M. & Viegas, J. M.	2013									1							
ENHANCED WISETRIP: Wide Scale Multimodal and Intelligent Journey Planning	Transportation Research Record: Journal of the Transportation Research Board	Solar, A. & Marques, A.	2012									1							
How Does Urban Public Transport Research Part A: Change Cities?	Transportation Research Part A: Policy and	Pfleger, G et al.	2009														1		

Title	Journal	Authors	Year	Sustainability	Policy making	Technology change	NTIC	Organization and management	Behavior change	Contracts and financing	Low cost, cost reduction	Modeling and methodology	Service quality and client satisfaction	Social inclusion	Improving public health	Physical accessibility	Travel Information	Improving safety	Pricing strategies
Correlations between Past and Present Transport and Urban Planning Policies	Practice																		
Transfer of Innovative Policies Between Cities to Promote Sustainability Case Study Evidence	Environmental Innovation and Societal Transitions	Marsden, G (Marsden, Greg)	2010																
The rise and fall of self-service in Amsterdam trams: user-technology relations in a case of service innovation	Procedia - Social and Behavioral Sciences	Nahuis, R (Nahuis, Roel)	2009			1													
Promoting the Wider use of Electrical Vehicles in Hong Kong: A Strategic Proposal	Transport Policy	Lee, T.C. & Wong, S.C.M.	2009			1							1						
Singapore - The Air-conditioned Nation	Transport Policy	Richmond, J.E.D.	2008			1													
Organization innovate research on public traffic enterprise benefit	Procedia - Social and Behavioral Sciences	Li, C.Y. & Ou, G.L.	2007																
Sustainable transport: Challenges and opportunities	Environmental Innovation and Societal Transitions	Banister, D.	2007																
Coordinating Transport and Urban Planning: From Ideologies to Local Realities	Energy Policy	Gallez, C. et al.	2013			1													1
Improvements and Innovations in Aerial Ropeway Transportation Technologies: Observations from Recent Implementations	Transport Policy	Aishalalfah, B. et al.	2013																
Making Sense of a New Transport System: An	Procedia - Social and Behavioral Sciences	Jones, C.H.D. et al.	2013																1

Title	Journal	Authors	Year	Sustainability	Policy making	Technology change	NTIC	Organization and management	Behavior change	Contracts and financing	Low cost, cost reduction	Modeling and methodology	Service quality and client satisfaction	Social inclusion	Improving public health	Physical accessibility	Travel Information	Improving safety	Pricing strategies
sustainable transport planning: the Singapore experience																			
CityMobil, Advanced Transport for the Urban Environment	Energy	van Dijke, J.P. & van Schijndel, M.	2012	1														1	
Estimating Additional Mass Transit Needed to Reduce Carbon Dioxide Emissions from Regional Passenger Transport in Japan	International Journal of Hydrogen Energy	Ito, K. et al.	2011																
Bus Rapid Transit in Curitiba, Brazil	Global Environmental Change	Lindau, L.A. et al.	2010							1			1						
Glattalbahn	Environmental Science & Policy	Schneebeli, H. et al.	2010			1													
Environmental Efficiency Model Based on Data Envelopment Analysis and Its Application to Environmentally Sustainable Transport Policies	Ecological Economics	Yoshino, D. et al.	2010																
Innovative Policies Between Cities to Promote Sustainability	Journal of Cleaner Production	Marsden, G. et al.	2010	1															
Implementation of Nationwide Public Transport Smart Card in the Netherlands: Cost-Benefit Analysis	Journal of Transport Geography	Cheung, F.	2006		1														
Improving Urban Mobility Management: Case Study of Rome	Journal of Transport Geography	Musso, A. & Corazza, M.V.	2006																
The impacts of Internet use upon	Journal of Cleaner	Kenyon, S.	2010	1															1

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Smart low cost design in complex value networks : The case of public transport

ABSTRACT: “Low cost” is nowadays a very mobilized concept in innovation and new product development both in the general press and in the scientific literature. In management sciences, the concept is widely mobilized in strategy, marketing as well as new product development. However, there seems to be a lack of a design model for such an approach, making difficult for managers to implement the development of low cost offers. Our work shows that existent low cost products had followed different design rules that could be modelled. We propose a low cost design model that distinguishes two approaches: *low cost adaptation* and *smart low cost design*. In low cost adaptation approach, the product is designed through a “no-frills” approach to a regular product: the aim here is to reduce the performance of the existent product on secondary needs to reduce the reference cost. In the smart low cost design approach, a new solution is designed for an existing need with a cost goal. Thus, this specific design approach allows creating products with lower cost and higher value than regular products.

Beyond the design rules of a product, we show the possibilities opened by smart low cost design to renew the dominant design through a longitudinal study done in the urban public transport sector. The case study underlined three main results: 1/ legitimization of a low cost adaptation needs a dual strategy that combines both approaches; 2/ the performance of low cost strategy relies on the strategy performance beyond products and its capacity to renew the public transport’s dominant design; 3/ Low cost approach supports the dynamic capability for innovation when low cost is used as a tool to redefine the organizations’ research and design space limits, as well as a tool to create new partnerships.

Finally, the study of such industrial context, as a complex value network, underlined how low cost design help to overcome ecosystem barriers to innovation and propose new partnerships, leading firms to redesign and reconfigure their ecosystem and the value creation process.

Keywords: low cost Design, public transport, complex value network

La conception "low cost" innovante dans des réseaux de valeur complexes: Le cas du transport public

RESUME : Le « low cost » est aujourd’hui un concept très mobilisé en innovation et dans le développement de nouveaux produits, à la fois dans la presse en général et dans la littérature scientifique. En sciences de gestion, le concept est aussi bien employé en stratégie, qu’en marketing et dans le développement de nouveaux produits. Néanmoins, les managers ont souvent des difficultés à concevoir des produits *low cost*, dû au manque d’un modèle de conception pour le *low cost*. Nos travaux montrent que tous les produits *low cost* existant ne suivent pas les mêmes règles de conception, et nous proposons un modèle de conception pour le *low cost* dissociant deux stratégies: le *low cost adapté* et le *low cost innovant*. Dans la stratégie de *low cost adapté*, le produit est reconçu à partir d’un produit existant en enlevant les fonctions non-essentiels. Dans le cas du *low cost innovant*, une solution complète est conçue pour un besoin défini avec un objectif de coût. Le *low cost innovant* permet donc de proposer des produits à plus faible coût, mais avec une valeur pour le client plus élevé que les produits existants.

Au-delà des règles de conception d’un produit, nous montrons à travers une étude longitudinale effectuée dans le secteur du transport public urbain, les possibilités ouvertes par le *low cost innovant* pour renouveler l’identité d’objets stabilisés. L’étude de cas souligne trois résultats principaux: 1 / la légitimation du *low cost adapté* par une stratégie qui combine les deux approches; 2 / la performance de l’approche *low cost* repose sur la performance de la stratégie d’innovation au-delà des produits et sur sa capacité à renouveler l’identité du transport public; 3 / le *low cost* renforce les capacités dynamiques d’innovation quand il est utilisé comme outil pour redéfinir les limites de la recherche et de l’espace de conception des organisations, ainsi que comme un outil pour créer de nouveaux partenariats.

Enfin, l’étude d’un tel contexte industriel, comme un réseau de valeur complexe, a souligné combien la conception *low cost* aide à surmonter les obstacles à l’innovation des écosystèmes renouvelant l’identité des objets, proposant de nouveaux partenariats, conduisant les entreprises à redéfinir et reconfigurer leur écosystème ainsi que leur processus de création de valeur.

Mots clés : Conception innovante « low cost », transport public, réseau de valeur complexe