NON-MONETARY COSTS AND THE INTERDEPENDENCE OF PLAYERS IN B2B MULTI-SIDED MARKETS: A STUDY INTO THE ADOPTION OF A DEMATERIALIZATION PLATFORM

Patrick Loux

Ecole de Management de Normandie

ploux@em-normandie.fr

Mathilde Aubry

Ecole de Management de Normandie

maubry@em-normandie.fr

Sébastien Tran

ISC Business School

stran@iscparis.com

Emmanuel Baudoin

Télécom Ecole de Management

emmanuel.baudoin@telecom-em.eu

Abstract: According to the growing body of literature dedicated to the study of two-sided markets, the pricing policy applied by the platform provider is recognized as a key driver of the platform's adoption. Used strategically, an appropriate pricing policy can lower the barriers to entry for at least one side of the market and stimulate the activation of cross-network externalities which will attract new users from the other side of the market. Yet, positing the central role of the pricing policy in shaping the future success of a two-sided platform is a debatable proposition. First, it is theoretically rooted in the industrial economics literature which typically focuses on how the price may influence behaviors as a key coordination mechanism (Parker and Van Alstyne, 2005; Rochet and Tirole, 2003). Second, it has been inspired by and confirmed for empirical settings where the platform's adoption problem is mostly seen from a consumer's standpoint, either in C2C (e.g. online dating) or in B2C (e.g. video game consoles) contexts (Liu, 2010). By contrast, when a two-sided platform allows transactions to be made between businesses (i.e. in B2B contexts), the platform's adoption decision for a specific organization sometimes requires the implementation of a technological process innovation. This, in turn, entails collective learning and reorganization efforts. In such situations, the possibility that other factors than the pricing policy could influence the platform's adoption pattern cannot be ruled out.

To investigate this avenue of research, our paper explores the case of a dematerialisation platform for B2B transactions between construction industry firms and public contracting authorities. Different qualitative materials, including 28 semi-structured interviews, were gathered over a two-year period.

Our findings highlight two main contributions to the existing literature on two-sided markets. First, this paper reveals new boundary conditions within which the pricing policy of a platform provider loses its ability to coordinate and stimulate users' adoption behaviors. Under these specific circumstances, inter-organizational collaboration in the selection of a unique platform emerges as a key condition to produce cross-network externalities, and therefore as a major source of technological change in the area of a radical process innovation. Second, we show that the gains stemming from the adoption of a dematerialisation platform follow a non-linear

path. Specifically, an increase in the volume of new users in one side of the market first reduces the utility of the platform for the other side of the market. Indeed, it causes the contracting parties to duplicate some transactions while incurring reorganization costs. As the number of users increases, the adoption path reaches a tipping point above which using a dematerialisation platform creates gains compared with using and exchanging paper documents.

Key words: two-sided markets, B2B, dematerialisation, process innovation, construction industry

Acknowledgements: This work was supported by the European Regional Development Fund and the *Région Basse Normandie* (Region of Lower Normandy).

Competitive Paper

INTRODUCTION

As early as 2006, Eisenmann, Parker & Van Alstyne pointed out that a lot of the products and services making up the modern economic environment shared the characteristic of connecting two distinct user groups. The scholars gave the credit card as an example of this type of two-sided market, as it is indeed an interface between consumers and retailers. This trend then increased, with a growing number of industries organized around "platforms" (Kang & Doning, 2015), especially "new economy" industries (Hagiu, 2009). This change led Evans & Schmalensee (2008) to try to classify them into four different categories of platform. The first category concerns the "exchange" platforms such as dating websites or online auction websites. They make transactions between buyers and sellers easier, by enabling them to look for possible contracts. The second category groups together advertiser-supported media like TV and newspapers. They act as an intermediary between advertisers and the public. The third category of platform is that of transaction systems, such as credit cards mentioned above. Trade dematerialization platforms also belong to this category. They are used for the dematerialized management of procurement contracts and private contracts throughout the performance of the contract: from the call for tenders to payment. They are therefore the intermediation between the different players involved in the contract. The fourth category is that of hardware or software platforms like video game consoles and computer operating systems. In each of the cases mentioned above, the two types of end-user are interdependent in the sense that the advantages that one group gains from using the platform depend on the number of users in the other group having joined the platform (Armstrong, 2006). It is thus possible to give a thorough definition of the term "platform": according to Sriram, Manchanda, Bravo, Chu, Ma, Song, Shriver & Subramanian (2015), it refers to intermediaries that facilitate economic interaction between two sets of agents wherein the decisions of one set of agents are likely to have an effect on the other via direct and/or indirect externalities. This relatively wide definition enables us to realize the great diversity of the existing platforms and of their ubiquity in our daily lives.

Since the turn of the century, researchers in industrial economics and management sciences have been interested in two-sided markets (or more generally multi-sided market) (Rochet & Tirole, 2003, 2006). The existing research was originally very theoretical, and the key question with which the scholars were faced was that of the means needed to attract each side of the market. The theory of two-sided market [1] was therefore used to emphasize the role of interdependence of the players and network externalities (Rochet & Tirole, 2003, 2006; Armstrong, 2006). The empirical research in this field remains very limited (Sriram *et al.*, 2015). Furthermore, the studies are about the processing of data using econometric models, except for very rare occasions (e.g. Tan, Lu, Pan & Huang, 2015). Most importantly, this literature has three key limitations.

First, most studies focus on the pricing structure as a key factor in the adoption of a platform (Rochet & Tirole, 2006; Armstrong, 2006; Hagiu, 2009; Liu, 2010). Non-price dimensions are not investigated enough (Sriram *et al.*, 2015) although some recent studies have found promising results in this area (Muzellec, Ronteau & Lambkin, 2015; Tan, Lu, Pan & Huang, 2015).
Second, the examples that are most often given in the research into multi-sided markets are C2C platforms (especially websites) or B2C platforms whether they be Internet platforms (e-

[1] The theoretical literature focuses on two-sided markets for expositional simplicity. However, authors accept that many markets are multi-sided. They consider that the insights obtained for two-sided platforms apply more generally to multi-sided ones (Richet & Tirole, 2006).

retailers like Amazon or eBay) or physical platforms (like supermarkets) (Liu, 2010). Studies focusing on B2B platforms are much scarcer. Such cases have hardly been studied, except for the noteworthy exception of the research by Tan *et al.* (2015). The study of B2B platforms is interesting because the adoption of a new B2B technology by a company is likely to have organizational consequences, above the price dimension.
Third, the literature tends to focus on the problem of platform editors that must adjust their business model to the existence of network externalities (Kang & Downing, 2015). The platform provider seems to be the key actor responsible for ensuring the presence of a critical mass of users on both sides of the market. However, most studies do not consider the users' perspective. Such a perspective may appear to be interesting, especially in a B2B context, as it could help to better identify organizational challenges and constraints in adopting a multi-sided platform. In addition, it may help to examine if a network or a cooperative dimension between potential company users is at work in the adoption decision.

This paper tries to fill these gaps by examining the drivers that guide the decision of the two segments of users to choose a specific B2B platform.

This study contributes to the literature on two-sided markets in various ways.
From a theoretical standpoint, this paper enriches the thinking on multi-sided markets in two aspects. First, we question the price as a key coordination mechanism in multi-sided markets and we find the relevance of non-price dimensions in the adoption decision. Second, we show the central role of cooperation within the network of users in the adoption decision, especially in a context characterized with negative cross-network externalities at the beginning of the adoption process. Such negative externalities appear because an increase in the number of users on one side of the market leads to additional costs related to the use of the platform for the other side.
From an empirical standpoint, we study an original category of multi-sided platforms compared to the extant literature focused on exchange platforms. Specifically, we focus on the specific case of a platform acting as an interface between two organizations (B2B). We chose a dematerialization platform for documents interchanged between construction industry firms and public contracting authorities, represented by local authorities, during the life cycle of a public works contract. As a consequence, it is a transactions system rather than an "exchange platform".

This paper is organized as follows: we will firstly establish the conceptual basis by presenting the main fundamentals of the two-sided market theory. The subsequent section will be dedicated to a presentation of the methodology and case study. We will then give the detailed results and discuss them before concluding.

THEORETICAL BACKGROUND

The theory of two-sided markets emerged at the turn of the century, upon the initiative of scholars in industrial economics (Caillaud & Jullien, 2003; Rochet & Tirole, 2003, 2006; Parker & Van Alstyne, 2005; Armstrong, 2006). At its early stage of development, this theory was strongly related to the theories of network externalities initiated by Katz & Shapiro (1985, 1986) and the theories of multi-product pricing (a very well-known example used in order to illustrated this theory is the razor-and-blade pricing. Indeed a buyer of a razor will take into account, not only the price of the razor itself, but also, the price of razor blades). Platforms have always, or almost, existed. For example, Hagiu (2009) refers to village markets or matchmakers. However, some of the major innovations associated with digital communication technologies concern the process of intermediation which characterized a platform (Jullien, 2005). As a consequence, hundreds of academic papers have been written about it in the last ten years.
Since the first research conducted, there seem to be three divisions. The first one continues and goes further into the conceptualization of the problems raised by two-sided (or more generally, multi-sided) markets by resorting to mathematical modeling to a large extent (for example, Bourreau & Verdier, 2014; King, 2013). Indeed, most of the extant work is theoretical and operationalized in stylized analytic models (Sriram *et al.*, 2015). Today, it could be considered as one of the most widely discussed topics in modern industrial organization scholarship (Auer & Petit, 2015). Theoretical research has sought to characterize some basic properties that arise in multi-sided markets. To be precise, we talk about multi-sided markets when the platform is aimed at several distinct segments of end-user whose adoption behaviors are interdependent in that they use the platform to establish transactions among themselves. We talk about two-sided markets in the specific case of a platform aimed at two segments of interdependent end-users. Authors of these branch consider that the insights obtained for two-sided platforms apply more generally to multi-sided ones (e.g. Rochet & Tirole, 2006). However, it is important to notice that multi-sided market are "more complex in that they serve a variety of distinct entities with diverse interests" (Tan *et al.*, 2015). The second avenue is sustained by both industrial economists and management scholars, and tries to empirically test certain significant theoretical propositions of the multi-sided market approach by adopting quantitative methodology mainly based on econometrics (Koh & Fichman, 2014; Lee, 2013; Liu, 2010; Tucker & Zhang, 2010). This field is still relatively nascent (Sriram *et al.*, 2015). The third avenue of research was initiated by researchers into strategic management, and also proposes conceptual investigations into multi-sided markets, but based on an inductive approach using case studies or observed examples (for example: Eisenmann, Parker & Van Alstyne, 2006, 2011; Tan *et al.*, 2015; Muzellec *et al.*, 2015).
This paper is in line with this last avenue of research relating to multi-sided markets, and its purpose is to investigate this theory by focusing on the lesson learned from a unique case study.

This part dedicated to the theoretical framework of multi-sided markets is broken down into two sections. We will firstly define multi-sided markets, before presenting the main factors influencing the platform adoption path.

MULTI-SIDED MARKETS: DEFINITION AND NATURE OF THE PROBLEM

Network externalities exist when consumer utility in a certain market depends (usually, in a positive way) on consumption of the same good or service by other agents (Roson, 2005). The originality of multi-sided markets is that externalities depend on consumption of different and compatible agents on an opposite market side. More generally, users' benefit from participation depends on user participation on the other side of the market, which varies with market conditions (Weyl, 2010). In this situation, we talk about cross-network (or cross-group)

externalities. In most cases, cross-network externalities are positive. For example, in video game industry, greater involvement by video game developers increases the value of a console to players (Lee, 2013). Such network effects can be due to economies of scale on the demand side, for example, and increase the value economic agents can realize (Evans & Schmalensee, 2013). However, externalities may also appear negative like in media industries. Indeed, the number of advertisers have a negative impact on audience size (readers/viewers/listeners are ad adverse) while audience size have a positive effect on advertisers demand (advertisers are viewer loving, they like to get a large audience) (Reisinger, 2004; Wilbur, 2008 quoted in Sriram *et al.*, 2015). If it is clear that advertisers always value access to more readers, the value that readers place on advertising is ambiguous.

According to Rochet & Tirole (2003, 2006) most markets with network externalities are characterized by the presence of, at least, two distinct sides whose ultimate benefit stems from interacting through a common platform. As a consequence, there is "some kind of interdependence or externality between groups of agents that are served by an intermediary" and it is possible to talk about a two-sided market (Rysman, 2009). Platforms play an important role throughout the economy by minimizing transactions costs between entities that can benefit from getting together (Evans & Schmalensee, 2007). Indeed, they bring two or more different types of economic agents together providing a common (real or virtual) meeting place and facilitate interactions between them that make all agents better-off (Evans & Schmalensee, 2013). A "platform creates value by coordinating the multiple groups of agents and, in particular, ensuring that there are enough agents of each type to make participation worthwhile for all types" (Evans & Schmalensee, 2013). It provides a distinct service to two sides of the market, which can be explicitly charged different prices (Weyl, 2010). In order to capture the key features of platform businesses, Evans & Schmalensee (2007) proposed a definition with a managerial savor (Auer & Petit, 2015) : a multi-sided platform (which they call an *economic catalyst*), "has (a) two or more groups of customers; (b) who need each other in some way; (c) but who cannot capture the value from their mutual attraction on their own; and (d) rely on the catalyst to facilitate value creating interactions between them."
Multi-sided platforms can be differentiated by considering the identity of each end-user segment. Indeed, we can distinguish between end-users who are in fact individuals, and end-users which are organizations (private or public users). We can use this basis to highlight three categories, or triangular configurations, of multi-sided markets: 1) C2C when a platform connects individuals (for example, platforms for exchanging services between individuals or online dating platforms), 2) B2C when a platform connects organizations with individuals (for example, online search engines connecting firms that display adverts and individuals looking for information, recruitment platforms bringing together firms offering jobs and job seekers), 3) B2B when a platform connects organizations with other organizations (for example, dematerialization platforms bringing together firms and public authorities with the purpose of interchanging electronic documents). As far as we know, the current literature tends to deal with the three triangular configurations (C2C, B2C, B2B) in the same way, by focusing on their similarities more than on their differences. We can nevertheless query the limits of such an approach and the clarifications that may result from a specific analysis conducted on each type of configuration. The majority empirical research into multi-sided markets is mainly concentrated on the cases of C2C and B2C (e.g. Lee, 2013; Tan *et al.*, 2015; Muzelec *et al.*, 2015).

It is assumed that, regardless of their identity, the number of end-users in each segment adopting a platform depends on two factors. The first factor is intrinsic; it is the platform price. The second factor captures the interdependence effects; it corresponds to the network size on the

other side of the market (Parker & Van Alstyne, 2005). This factor illustrates the traditional "chicken and egg" problem: "to attract buyers, an intermediary should have a large base of registered sellers, but these will be willing to register only if they expect many buyers to show up" (Caillaud & Jullien, 2003). It is considered as the specific feature – and interest – of multi-sided markets. If the value of platform membership to an entity increases as the number of other entities on the platform raises (Katz & Shapiro, 1994), platform owners must be careful to get both sides on board (Rochet & Tirole, 2006). The demand behavior of the two types of platform user is assumed to be homogeneous, i.e. the factors determining adoption behavior are similar for the two types of end-user.

PLATFORM ADOPTION FACTORS

The scholars who tried to analyze the problem facing platform sponsors are generally looking at it from either a static profit maximization perspective (Rochet & Tirole, 2003, 2006; Parker & Van Alstyne, 2005) or a dynamic user base growth perspective (Evans & Schmalensee, 2010; Muzellec, Ronteau & Lambkin, 2015; Tan *et al.*, 2015). In the profit maximization perspective, the problem for platform sponsors lies solely in the definition of an appropriate pricing policy.

Armstrong (2006) proposes a distinction between two pricing policies: platforms might charge for their services on a lump-sum basis, or on a per-transaction basis. In the former case, an agent's payment does not explicitly depend on how well the platform performs on the other side of the market. Therefore, to attract one side of the market, it is important that the platform first gets the other side "on board" as an agent will pay even in the absence of any successful interaction. In the latter case, the opposite is true – that is, the payment becomes an explicit function of the platform's performance on the other side. It follows that if an agent pays a platform only as successful interactions occur, attracting one side of the market first becomes much less important to get the other side "on board". However, "cross-network externalities are weaker with per-transaction charges, since a fraction of the benefit of interacting with an extra agent on the other side is eroded by the extra payment incurred" Armstrong (2006 : 669). In the context of a lump-sum pricing policy, an additional precision can be made as to the use of a discriminatory pricing policy between end-users segments. In a first case, the platform sponsor charges each end-user segment a similar price for access to the platform. In the second case, the platform sponsor demands payment from a user segment to obtain the right to access the platform, and subsidizes the right to access the platform for the other user segment.
In a two-sided market setting, choosing the right pricing formula depends on three parameters. Firstly, the extent of the price elasticity of demand in a segment i in comparison with the price elasticity of demand in segment j. Secondly, the extent of the cross-network elasticity of segment i toward user segment j. Finally, the extent of the cross-network elasticity of segment j toward user segment i. Depending on the values of these parameters, it may be rational for platform designers to subsidize or even distribute their platform to one of the end-user segments free of charge. If this enables demand from the other end-user segment to be stimulated, the loss recorded on one side of the market will be more than offset by the gain generated on the other side.

The issue of stimulating adoption and achieving critical mass at the different stages of a platform begins to attract attention in the multi-sided platforms literature. Within this user base growth perspective, Evans & Schmalensee (2010) study the dynamic process of adoption of multi-sided platforms with cross-network effects on which it is easy to reverse participation decisions. When the costs of reversing participation decisions are small, a platform generally faces a critical mass, demand-side, constraint that must be satisfied at launch if the business is

to be successful. As participation by each side of the market affects the quality of the product or service experienced by the other side of end-users, participation levels below critical mass may set off a downward spiral, which would rapidly signal the failure of the platform. Evans & Schmalensee (2010) describe a variety of mechanisms that platforms can employ to build demand on all sides of the market, for instance low introductory prices, advertising or viral marketing. If a platform sponsor makes an adequate use of these marketing actions in a context where consumer tastes turn out to be favorable, the critical mass constraint will probably be satisfied and user base growth will follow.

Using qualitative data, Muzellec, Ronteau & Lambkin (2015) attempt to understand the evolution of the marketing strategies of Internet start-up companies towards businesses and/or end consumers in order to attract demand. The results of this study reveal that the business models of Internet ventures evolve over time. In the early stages of development, the value proposition is mostly directed towards the end-consumers as the platform sponsors spend a great deal of time to convince end-users of the worth of their services. This persuasion effort can be carried out through a push communication strategy on social networks. In addition, platform sponsors generally offer their services free of charge to attain critical mass. At the second stage of development, the startup companies shift their focus to business partners in order to raise money. At the third stage of the business model lifecycle, the startup companies start to redefine their core services in order to find a better balance between both the business partners and the consumers' expectations towards the platform.

In a similar vein, Tan *et al.* (2015) argue that the majority of the existing studies that deal with the process of adoption of multi-sided platforms tend to be centered on the pricing policy while largely ignoring other factors that could influence the platform's development. By adopting a longitudinal perspective of multi-sided platforms' development and using a case study of Alibaba.com, Tan *et al.* (2015) examine how Alibaba's successful platform was developed and reveal the sequence and boundary conditions of some of the enablers for platform development. The authors identify four new types of platform development strategies, namely the encapsulating, delegating, meshing, and empowering platform development strategies. In addition, they differentiate between the various stages of platform maturity when identifying the enablers of platform development. For example, "the emphasis of the sponsor in the nascent stage should be on developing a compelling value proposition and attaining critical mass". This conclusion is similar to the one presented by Muzellec *et al.* (2015).

The two-sided approach is very useful as it allows to understand and propose solutions to the "chicken and egg problem". However, the mainstream authors make an important distinction between producers and consumers. They seem to consider that the producer, that is to say the platform provider, creates value (by coordinating the multiple groups of agents) while consumers or users destroy value. In their view, the aim of a firm activity is to make something that is to say to produce and sell a good or a service. They use, in their analysis, a "good-dominant logic" while they should adopt a "service dominant logic". A service is defined by Vargo & Lusch (2008) as a "process of using ones resources for the benefit of and in conjunction with another party". This could be explained by the fact they focus on C2C or B2C contexts, where the customers have a rather passive role. However, from another viewpoint, the aim of the firm is to design systems of activities to help customers to create value (Vargo & Lusch, 2008; Wikström, 1996). Thus, a wider and more holistic perspective than the one typically found in the mainstream literature on two-sided markets could be adopted in order to highlight other drivers that may guide the adoption of a platform.

In this perspective, a multi-sided platform may exhibit the property of a service system which is broadly defined as "[a] value cocreation configuration of people, technology, value

propositions connecting internal and external service systems and shared information" (Maglio & Spohrer, 2008, p. 18). In a multi-sided B2B context, each partner participates to the co-creation of value within a network of interdependent actors and the importance to take into account organizational factors appears clearly. According to Vargo & Lusch (2011), a network structure can be conceptualized as an open system: "(1) capable of improving the state of another system through sharing or applying its resources…and (2) capable of improving its own state by acquiring external resources" (Spohrer, Vargo, Caswell & Maglio, 2008, p. 7).

It appears that the platform sponsor is not the only one to have the responsibility to get all sides "on board". As a consequence: first, non-prices dimensions must be examined and second, it is important to study the role of customers in the adoption process.

METHODS AND DATA

Dematerialization of the entire procedure of awarding contracts exceeding the sums of money dictated by European thresholds will be mandatory as of 2018. The lead for this comes directly from European enactments that encourage the modernization of public actions. Using electronic media to process, publish, interchange and store information is seen as a means of simplifying institutional purchasing operations for public bodies (Assar & Boughzala, 2006). This is how dematerialization platforms have become the center of attention. As part of the monitoring of the development of a platform prototype called Egovbat, we tried to understand what users thought of the use of a dematerialization platform. Egovbat is a secure platform project used to dematerialize the interchanges between the players in both public and private organizations, in the construction industry. Its development has been supported by a research contract funded by the ERDF[2] and the *Région Basse Normandie* (Region of Lower Normandy). The contract began in March 2013 and ended in August 2015. The project was conducted by a SME specialized in dematerialization, called SCRI, and labeled by the French competitiveness cluster called *Transactions Electroniques Sécurisées* (TES), meaning Secure Electronic Transactions.

RESEARCH DESIGN

The choice of qualitative methodologies can be explained by problems accessing the right equipment for quantitative processing. Besides this is an exploratory study. Qualitative data can indeed be used for descriptions and explanations that are both rich and solidly grounded in a local context (Miles & Huberman, 2003)[3].

Twenty-eight semi-structured interviews were conducted to gather the data for this research. As our study is exploratory, our aim was to understand the phenomenon of dematerialization platform selection. Seven main questions, about general subjects such as the advantages and disadvantages of dematerialization or the factors encouraging the adoption of a dematerialization platform, were used to structure the interviews. Finally, we used several types of follow-up requests in addition to these questions (request for examples, request for details about a certain point or even reformulation by the interviewer of what he had understood so that the interviewee could confirm or invalidate this). The interviews were conducted on a face-to-face basis, and lasted between 45 minutes and two and a half hours. All of them were recorded and transcribed. All the stakeholders of a project have been questioned: members of the *FFB* (French Construction Industry Federation), a phone operator, a bank, a consultancy firm, construction industry firms, public authorities, a payment solution consultant, an architect…We tried to meet different kinds of person so as to vary the standpoints about dematerialization. A body of more than 500 pages of data was processed using content analysis (Miles & Huberman, 1994). Codes were developed on the basis of the literature review. Codes were able to be added during processing thanks to flexibility on the part of the researchers. Two of the researchers encoded the first codes using Nvivo[4] and the others individually. Furthermore, the project was monitored for around two and a half years, enabling different sources of data to be gathered. This also produced a triangulation in order to check the statements made by the interviewees.

[2] European Regional Development Fund

[3] 'Another characteristic of qualitative data is their richness and encompassing character, with high potential for decoding complexity' (Miles & Huberman, 2003, p. 27)

[4] Nvivo is a software used for encoding and analyzing qualitative data

The data sources are presented in the table 1 below.

Table 1: Presentation of data sources

Data analyzed	Types of source	Comments
Minutes of steering meetings, technical meetings and distribution media	Secondary data	Participation in 9 steering meetings with analysis of discussions and documents (PowerPoint)
28 semi-structured interviews (sometimes with several interviewees during an interview)	Primary data	Semi-structured interview guide, recording and transcription of interviews, data encoding
Minutes of technical meetings	Secondary data	Analysis of the content of media distributed during technical meetings by SRCI
Dematch conference on 21/11/2013 in Alençon	Secondary data	Note taking during the conference on dematerialization in the construction industry
Participation in a user training session on 19/09/2014 on the TES cluster premises	Primary data	Recording and taking of notes during a session to train users how to use the platform by SRCI

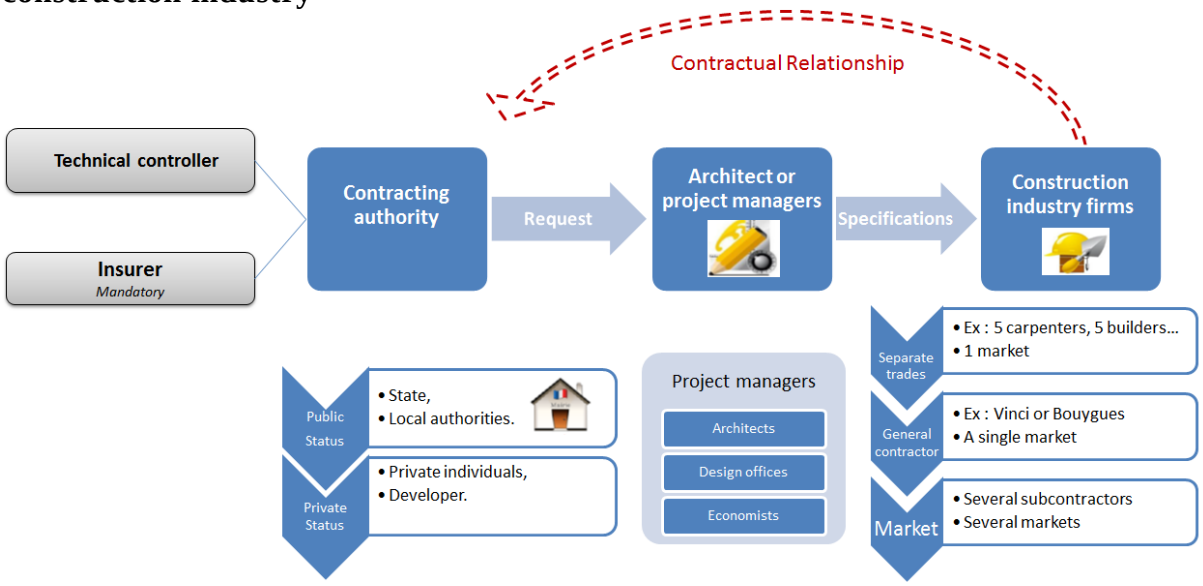
CASE STUDY

Case studies are a research strategy that is used to explore complex, little-known phenomena in order to capture their richness and identify patterns, in the same way as the work conducted by Glaser & Strauss (1967), with the perspective of generating a theory (Eisenhardt, 1989; Yin, 2003). A case study can be defined as "an empirical survey that examines a contemporary phenomenon within its actual context […], for which multiple sources of data are used" (Yin, 2003, p. 17).

The empirical survey in this study concerns the relationships between the players involved in a public works contract, for three main reasons. The first reason is that the dematerialization of procurement contracts benefits from regulatory support at European level. The second one is that public works contracts represent 50% of procurement contracts. The third one is that public works contracts are more complex than other types of contract, due to the fact that there are a lot of players; this implies that a platform capable of managing the dematerialization of public works contracts will quickly be capable of managing the dematerialization of any other type of contract.

As shown in figure 1 below, the all-out dematerialization of interchanges in the construction industry requires a platform shared between the various players.

Figure 1: Simplified modeling of the relationships between the players in the construction industry



We can therefore say that the construction industry is a sector where the interactions between the players are numerous and particularly complex as they are extremely regulated and controlled. Many documents and information must be interchanged at different sequenced stages. There are numerous, ordered stages. Each one of them necessarily involves several players, which are therefore interdependent despite having a different organization and structure for their work processes or information system.

When a public works contract is being performed, three types of players have a significant role and are brought together through a dematerialization platform. Then the dematerialization platform appears to be a multi-sided platform. Firstly the public players, that include public contracting authorities and Government services; then, the project manager and finally, the construction industry firms. The public contracting authorities needs have been formalized in specifications. The construction industry firms conduct the construction and renovation works on behalf of their state client. Project management is often entrusted to an architect's office that will act as the interface between the public contracting authorities and the chosen construction industry firms. The project manager's main role is to monitor the worksite to ensure that it is progressing as specified in the contractual provisions of the specifications, and to check the validity of the bills issued by the construction industry firms before sending them to the public bodies. The Government services regularly check the administrative documents with help from the French Prefectures (regional chief administrators' areas of authority) in order to check that the worksite is progressing in compliance with regulations. Finally, the municipal government finance offices are in charge of paying the firms for their services once instructions for payment and supporting documents have been sent by the public contracting authorities. The different types of player correspond to the main sides of the dematerialization platforms used for the performance of public works contracts.

FINDINGS

PARALYSIS IN THE DEMATERIALIZATION PLATFORM ADOPTION PATH

Despite a favorable legal framework in France and Europe since the late nineties, the dematerialized management of transactions during the performance of a public works contract still seems limited in comparison with the traditional way of managing paper documents. The large number of players involved in the performance of a contract and the amount of potential partners in the same region seem to be an obstacle when it comes to the development of dematerialization.
As far as the first point is concerned, document dematerialization is hardly of interest if the parties involved in a public works contract are not jointly committed to the approach. It therefore follows that the interest of using a dematerialization platform for a specific category of player depends on the willingness of the other players to adopt a similar behavior.

Everyone must accept the rules of the game. (Director in charge of public procurement in a city hall)

To begin with, switching from paper documents to 100% dematerialization of documents implies that we only receive dematerialized bids. This means that all the players must also be involved in the chain. (…) If we consider that we receive paper-based bids that need to be rematerialized in-house, we will effectively spend time doing this. This means human resources, physical resources, storage space, etc. It's the transition from a paper document to a dematerialized version… that then may be rematerialized when a document is sent to the subprefecture (administrative city of a particular region). This means a lot of backwards and forwards between digital and paper documents. […] If we are the only ones to commit to dematerialization, it won't be the best solution, and it will mean a lot more work for us, for little benefit. (Person in charge of general administration and procurement contracts for a public authority).

In addition to the large number of distinct players involved in a construction operation, we need to remember that the main two dematerialization platform user segments for the performance of public works contracts – construction firms and public contracting authorities – are fragmented markets. The significant number of players located in the same region exposes each one of them to a heterogeneous situation in which the use of a dematerialization platform by the partners will be inexistent, partial or total depending on the construction operation. Such a variety of uses of dematerialization is seen as a serious problem. A technical and legal expert explains the following from the point of view of both firms and public contracting authorities:

The problem is that not all the public contracting authorities are doing it at the same time, so the firms will be confronted by some authorities saying: "We're ready, great, let's go" and others in the same region saying: "Definitely not".

If the public contracting authorities feel that there is no response from the firms, I don't see why they'll commit to it. Everyone's waiting for everyone else and it's not working, or not working well.

It therefore seems that many public contracting authorities are putting off the transition to dematerialization in answer to the wait-and-see attitude of firms, and vice versa. Firms have a passive response to dematerialization due to the varying degrees of use by public contracting

authorities. This finding suggests that the interest of using a dematerialization platform for a specific player is low when the number of users already active in the other market segment is seen to be insufficient. There is therefore a kind of interdependence between the players in the public works sector when it comes to assessing the expected utility of the use of a dematerialization platform.
Moreover, the spontaneous, gradual development of dematerialization does not seem to be able to solve the reciprocal wait-and-see attitude. Conversely, the development process seems to be blocked by the large number of public contracting authorities and construction firms in the same region. Indeed, in a context of interdependence between fragmentary user segments, the decision taken by a specific player to use a dematerialization platform can only have a marginal effect on the perceived utility of the platform for all the other players. All in all, the development of dematerialization platforms is based on a paradoxical interdependence situation. On the one hand, both public contracting authorities and firms are reluctant to use a dematerialization platform because of the small number of active users on the other side of the market, which indicates that a high number of users would make a platform attractive for the other side of the market. On the other hand, no player seems capable of significantly contributing to increasing the utility of a platform for the users of the other side of the market with its adoption behavior alone. The development of dematerialization platforms therefore finds itself paralyzed.

THE IMPORTANCE OF NON-MONETARY CRITERIA IN ASSESSING THE COSTS OF USING A DEMATERIALIZATION PLATFORM

If the gross utility of a dematerialization platform for a player is essentially based on its ability to make dematerialized transactions possible with a high number of other users, the assessment of its net utility requires taking its cost in use into consideration. The players having responded to this question mention four constituents of costs in use which correspond either to fixed costs or variable costs.
Firstly, there are direct monetary costs related to the fixed price of using a platform and indirect monetary costs resulting from the need to invest in equipment such as that used for electronic signatures or in software for editing, processing and storing electronic documents.

Before, there was no cost for a remote transmission system shared by local authorities. Now, we're going to have to pay 2,000 or 3,000 euros a year for this. Electronic signatures didn't exist, they do now, 180 euros every two years for each signature. All these costs add up. So behind this, we improve our procedures, we work faster, we have hidden costs that are disappearing, but generally speaking […] when you have to present your budget for the year N+1, there are extra lines that need explaining." (Director of Information Systems of a commune).

So that also means that we need a structured storage space in-house (Person in charge of the Procurement Contracts department of a commune and urban community).

Secondly, the use of a dematerialization platform incurs substantial fixed costs resulting from the need for reorganization, learning and training. Replacing the management of paper documents by the management of dematerialized documents is seen as a major change in the in-house processes and new technology to be mastered, by both firms and public authorities.

[Dematerialization] also enables the implementation of a system to validate documents, […] something which doesn't yet exist and which I think may be a source of error. It is especially

used to homogenize procedures and make them more transparent, and this requires a lot of reorganization. (Person in charge of the public procurement department of a region).

There also need to be methods of operation afterwards. How to reject documents, how to request changes… Methods of operation need to be implemented so that each player knows what is to be done, how and for when… (Director in charge of public procurement in a city hall).

So, we talk about that [Note: dematerialization] as if it's simplified, but it's actually complicated for small players that aren't used to this, that don't submit (Note: tenders) to dematerialize everything at the beginning. These are tools that they're not familiar with, it's going to take them longer. They're bound to be reluctant. It's easy to send paper documents. (Director of the financial department of a city and urban community).

Dematerialization demands both internal reorganization efforts and the adaptation of collective methods of operation. This requires the creation of new standardized procedures to manage each dematerialized transaction between the players. The example of collective bill management is a good illustration of this stake. Generally speaking, when using paper documents, a firm edits and sends its bills to the project manager (usually an architect) who performs the first control. The bills are then sent to the contracting authority (a public authority) which will also perform several controls in-house. The bills are finally sent to a municipal government finance office which performs the last control before proceeding with the payment due to the firm. Any errors noted at each stage of the control procedure are often corrected manually and sent to the next department without the firm having to re-edit the bill, unless the errors are considered to be too significant. On the other hand, if bills are dematerialized, the collective coordination procedures for editing and processing bills need to be totally redefined. An interviewee confided us with the following:

I think that we can organize it. […] But it will require a change in organization. […] [The project manager] must sign the bill and be able to rectify it. If we tell him that he must check the signature electronically and sign the bill, that means that it needs to be a modifiable electronic document, and this is where it becomes difficult. […] This means that we'd have to totally change strategy, bills will have to be issued by the project manager and no longer by the firm… If we did that, the firms would just accept. Or maybe the contracting authority could be in charge of prebilling, issuing the prebills that the firm accepts, as it is in possession of all the contracts etc… It's a different logic. […] Or every player adds a document, and the last document is the one that triggers payment, that could be a solution. I don't know, we'll have to look into it… (Director of legal resources and public procurement for a public authority).

Operational efficiency related to individual habits of working with paper documents is questioned with the use of a dematerialization platform. Reading, analyzing and checking dematerialized documents can take longer than for paper documents.

It's not easy for everyone to read on a screen. It demands a lot of visual work. (Director of the finance department of a city and urban community).

It takes us 10 minutes to check a hard-copy application and […] sometimes, one hour to check an electronic application; honestly, it's a real hindrance" (Director of the procurement contract administration of a city).

When we need to analyze, it's easier to have paper documents, especially when they're long technical memoranda; I think my colleagues print everything off. (Assistant to the Corporate and Legal Director in charge of awarding procurement contracts in a city hall).

I think that we'll still have to print off the hard-copy of a bill to check it, for important operations. Because when we check it on a screen, it's not at all the same as when we check it on paper. (Representative of a regional council).

The persons we interviewed often mentioned that the use of a platform means that employees must be informed and then trained in how to use it and its related equipment.

This requires consultation, and time, to explain the project upstream. […] We then need time for training, because these are tools that they're not used to using even if they're not necessarily reluctant. (Person in charge of the procurement contract department of a city and urban community).

Conversely, when the efforts made to learn and train are not agreed on in an appropriate manner, firms run the risk of losing the opportunity of winning bids.

Another problem is that we reject firms upstream because they haven't dematerialized all of their bid by not signing electronically. They've scanned the documents before putting them on the platform. This means that they're not valid documents, which leads us to reject bids that have been submitted in dematerialized form but which are in fact not dematerialized bids. (Person in charge of public procurement for a public authority).

Thirdly, users are often confronted with additional transaction costs when they start using a dematerialization platform. These extra costs are generally in line with the amount of documents interchanged per contract and may be in various forms: costs of duplicating documents, fiscal risks, risk of receiving a bid from a firm after the deadline and risk of opportunism from partners. These costs are particularly high in a context characterized by the lack of homogeneity in the equipment used for dematerialization and by the insufficient stability of the technical and legal standards providing the framework for dematerialization.
Costs of duplicating documents may be incurred when the players are in a situation of partial dematerialization, which can be defined as a situation in which two distinct document management technologies co-exist in the same organization, paper and dematerialization. As part of the performance of a works contract, this hybrid technological situation arises when an organization interchanges paper documents with some partners which do not use a dematerialization platform, and electronic documents with other partners which use a dematerialization platform. This means that some players have to manage transactions in both paper and electronic formats. This redundancy therefore increases the transaction costs in the form of money and time dedicated resources in comparison with a context where technology is exclusively based on paper.
By way of example, when firms make the effort to send dematerialized tender packages to public authorities while the prefectures and municipal government finance offices do not have the appropriate equipment, several redundant transactions involving paper documents will be added to the electronic transactions.

And due to the fact that we have to send it (note: the firm's package) to the subprefecture as a paper document after, we ask the firm to sign a bid that it has already signed electronically, by hand.(…) We have to rematerialize everything to send it on to the subprefecture, so we're

obliged to ask for another signature. We have the proof that we received a signed bid when the bids were submitted, so legally speaking, the bid is valid, we can prove it by computer. On the other hand, when we rematerialize, you can't see it on the paper document (…) It's true to say that the administrative formalities seem complicated when we do that. But that's because the chain is incomplete between the players: firms, local authorities… and the prefecture. (Person in charge of general administration and procurement contracts for a public authority).

The use of a dematerialization platform is seen as being likely to expose a player to fiscal risk if there is a difference between the standards used to edit, sign and store documents and those used to validate these documents if there is a tax inspection several years later.

Two European directives have changed the fiscal and legal rules in France. […] I mean that there was something which worked and we don't know if this will continue to be valid or not in the future. […] If we keep a bill for 10 years, we need to be nearly 100% sure that the system that we've implemented is really sustainable and that if we have a tax inspection in 4 or 5 years, no-one will be saying "Oh no, no, no. Everything that you did [Note: is not valid]. (Technical and legal expert)

Both firms and public contracting authorities mention the risk that a tender package, sent correctly before the deadline, may not be received in time due to a technical problem inherent to the dematerialization platform or communication infrastructure. If a package is received after the deadline, it is purely and simply rejected. This is a huge waste of resources for the unlucky firm, as it will have put a lot of work into preparing the tender package. Moreover, the firm may run the risk of losing potential earnings in the event that its bid would have been chosen after deliberation.

And if they see to it a bit late or if ever there's a problem with the flow or a virus, it [Note: the firm's bid] will automatically be rejected by the system. (Person in charge of public procurement for a public authority).

We've seen firms that have told us, for example […] "we had to submit a dematerialized bid by 5p.m. on a Friday, we submitted our package, it didn't go through the pipeline and it arrived at 5.01 p.m., only to be rejected!" We know when it's submitted, but we have no warranty about when it arrives. (Representative of a construction industry federation).

Besides, one of the partners may behave in an opportunist manner when using a dematerialization platform, for example when the terms of payment to firms are extended. The effective exposure to such a risk could lead to mistrust in the future when it comes to using a dematerialization platform again.

We have seen ourselves obliged to use software for dematerialized pay requests […] and final accounts on several occasions for procurement contracts, it was dramatic! For the following reasons: as the amendments hadn't been drawn up by the local authority or the Government, they claimed that they didn't have to pay our requests, when they were indeed responsible for the fact that such amendments hadn't been drawn up […]. Just because such and such a document hadn't been drafted by the authorities, the software didn't validate our sent requests. We ended up being paid really late! (Director of a construction industry firm)

The three types of cost in use of a dematerialization platform mentioned above must be borne by both firms and public contracting authorities, regardless of the platform acting as a medium

for document interchange. Firms must also nevertheless agree to a fourth kind of cost inherent to the dematerialization platform market. Indeed, when the number of competitive platforms available on the market is high, the public bodies equipped for document dematerialization will tend to make more use of different platforms, due to the independence of their investment policies. In such a context, the firms that decide to interchange their documents in a dematerialized way will often be confronted with costs related to changing platform depending on the identity of the public contracting authority. The data we collected suggest that the fact that the platforms used by public contracting authorities are not homogeneous is a major drawback for dematerialization due to the extra costs incurred, as they are proportional to the number of distinct platforms. Each time a firm performs a works contract with a public authority equipped with a platform that is different to the one used by the other public authorities, some methods of operation will have to be modified or learnt again.

Each commune is likely to have a different platform. This is one of the main obstacles to dematerialization. (…) Each firm may be confronted with a different platform, depending on whether it's submitting a bid to the City Hall, to the Regional Council, to Montville, to the middle of nowhere. This means different procedures for obtaining a package (Person in charge of public procurement for a public authority).

Persons who are used to one platform […] are going to [be] completely disorientated on another one. (Representative of a construction industry federation).

The interest of firms belonging to EdiBuild France was to say: "I'm not going to learn again like we did in the sector of tendering, each time I change public contracting authority, I'm not going to learn a new way of billing". Ideally, we need a unique portal for billing works, if possible, one that is used by all the French public authorities. (Technical and legal expert)

To summarize, the net utility of the use of a dematerialization platform for each player corresponds to the gross utility proportional to the number of dematerialized transactions likely to be made with other users minus the cost in use of the platform. This cost can be broken down into a fixed monetary and non-monetary cost (reorganization and learning efforts), and a variable transaction cost proportional to the number of electronic documents interchanged. In the specific case of firms, an additional cost of changing platforms proportional to the number of distinct platforms used by the public bodies in a particular region should be included. These findings about the costs in use of a dematerialization platform have two main implications.

The first one is that the price billed by the platform editor is not a determining factor in the global assessment of the cost in use of a platform, for both construction industry firms and public contracting authorities. On the other hand, the amount of the costs of reorganization, learning, additional transaction costs and platform switching costs following the decision to resort to dematerialization is strongly emphasized by the persons we interviewed. To the extent that these costs can be put down to dematerialization itself, the ability that the platform editors have to influence the development process via their pricing policy is considerably diminished, without being completely suppressed.

The second implication is that the net utility of a dematerialization platform compared to managing paper documents exclusively may be negative, even if the pricing policy is free use for all user segments. This comes from the fact that the increase in gross gains made from the interchange of a growing number of dematerialized documents between the different players in public works contracts may be more than offset by the costs in use of a dematerialization platform. This situation arises and lasts as long as 1) the number of persons using dematerialization in all market segments does not reach a high level, 2) the costs of internal

reorganization are not amortized, 3) transactional risks are not satisfactorily mitigated, and 4) the number of competitive platforms has not drastically decreased in order to reduce the switching costs.

THE AMBIVALENT EFFECT OF LEGAL OBLIGATIONS

When faced with the obstacles to the development of dematerialization platforms, the persons interviewed mention the importance of legal obligations to force the players involved in public works contracts to replace the management of paper documents by the management of electronic documents.

We'll have to add a regulatory touch at some point, when there is the technology, when its effectiveness has been demonstrated, when there are enough persons who have adopted it. (Technical and legal expert)

As far as the contracts are concerned, the impetus is going to be more at the level of the regulatory codes and constraints that we may be subject to. This is more a question of the legal framework for procurement contracts. We don't anticipate the obligations that will be imposed on us regarding contract dematerialization. For example, we have to dematerialize 95% of our tender documents for contracts worth a minimum of 90,000 euros, we don't do more than that. (Person in charge of general administration and procurement contracts for a public authority)

We also need a regulatory framework that encourages that. It is precisely because the general code of public authorities allows us to send dematerialized agendas that we were able to decide on this. (Person in charge of general administration and procurement contracts for a public authority)

Legally obliging the main players involved in public works contracts to resort to dematerialization would have two major positive effects. First of all, it would be accompanied by the stabilization of the technical and legal standards providing a framework for dematerialization. This would make a significant contribution to the reduction of transactional risks to which users of dematerialization platforms could be exposed. Then, it would force public authorities to find a technological solution in order to ensure compliance with the regulatory framework. At the same time, firms would be obliged to acquire the appropriate equipment and to learn how to edit and process dematerialized documents. This would lead to firms and public authorities rapidly adopting the dematerialized management of documents, until such management totally replaces paper document management. The gross gains of dematerialization would increase thanks to the ability of each player to make dematerialized transactions with a large number of players.

Despite all that, imposing a legal obligation of dematerialization on the main players involved in public works contracts, the firms and public bodies, does not seem to be a sufficient condition to maximize the net utility of the use of a specific dematerialization platform. On the one hand, it does not ensure that the Government services will be equipped for dematerialized document management. The potential gross gains of dematerialization for the firms and public authorities would therefore not reach their maximum level. On the other hand, a legal obligation might generate a proliferation of different platforms because the breadth of the dematerialization platform market which is created might attract a lot of newcomers. This would subsequently encourage the selection of distinct dematerialization platforms if the public bodies do not coordinate the way in which they respond to the legal compliance process.

If we had to make an assessment about what exists, each public authority chooses its own platform, there's no coordination […]. We are aware that it's annoying for a firm to have to go on different platforms to find a call for tender, to be subscribed to different platforms, in order to be informed about the pending tenders. […] Each public authority has been left to meet its obligations, to find a dematerialization platform. […] So, it's obvious that the chosen service provider won't be the same everywhere, insofar as we didn't consolidate coordinated orders between all public authorities, and as each authority launches its tenders individually." (Person in charge of general administration and procurement contracts for a public authority).

The consequences for construction industry firms will clearly be negative, as they would have to bear the prohibitive platform switching costs with respect to the identity of the public contracting authority. Rather than bearing these costs, it is likely that several firms would prefer to restrict the scope of the calls for tender to which they submit a bid depending on the platform(s) on which they have accepted to work. In comparison with the paper era, the ability of public bodies to ask firms for competitive bidding in response to a call for tender would be lessened, and this would have adverse effects on the quality and price of the services proposed. The extent of the gains of dematerialization is reduced if the players in a particular region are spread over a large number of platforms.

THE NEED FOR COOPERATION BETWEEN PLAYERS TO MAKE IT EASIER TO ADOPT A UNIQUE DEMATERIALIZATION PLATFORM

An additional mechanism to coordinate adoption behaviors is necessary, due to the fact that there is little encouragement for the development of dematerialization platforms because of the price, and due to the negative effects resulting from making the dematerialization of interchanges a legal obligation. The data suggest that only a cooperation strategy deliberately organized by the future users themselves would orient the collective adoption path toward a specific common platform. In this respect, large public bodies are seen as legitimate players to initiate this approach for two reasons – their size and their status as end-user.

If we move back upstream of dematerialized platforms, the contractors were the ones to say "let's group together" so that there's just one platform for firms, and not 50 communes and 50 different platforms. There must therefore be a public player which decides to be 'project leader' and organize something. This cannot be the firms as they're clients of the public body. So, it has to be the one at the origin of the contractual relations with all the partners, the contracting authority, the city, region, urban community. (Person in charge of public procurement for a public authority).

I think this should be a public authority at a sufficiently high level, so that it can bring together more public authorities. […] But the questions is, which communes, EPCI (public institutions for inter-community cooperation) would be interested in joint procurement? (Person in charge of general administration and procurement contracts for a public authority).

This is a political choice that must be made by the elected representatives. Grouping together for joint procurement means that there must be a meeting to discuss the constitutive agreement of the grouping, or joining an existing procurement grouping. […] Having said that, it's do-able, it's even a trend at the moment. (Person in charge of general administration and procurement contracts for a public authority).

The result of such a cooperation effort would be collective, synchronized procurement from the same service provider. The effect of this would be to decisively increase the number of public contracting authorities equipped with the same platform in the same region, and the number of other users (firms, Government services) of the platform having participated in the cooperative agreement, in a short period of time. As a result, the assessment of the net utility of all the constituents of a dematerialization platform could be thoroughly modified. The gross gains would rapidly reach a high level thanks to the fact that each player would be able to make dematerialized transactions with several other users of the same platform, including Government services. The non-monetary fixed costs of reorganization and learning would be more easily incurred and accepted, as they would be shared among a large number of dematerialized transactions. Transaction costs would be considerably lower as the fact that dematerialization users use the same technology would reduce the problem of duplicating documents. Finally, switching costs would disappear thanks to the selection of a single platform. The players committing to a cooperation strategy must agree to coordination costs beforehand, in return for these advantages.

Afterwards, we will probably have to work with the Association of Architects or things upstream to avoid there being a rebellion but… Either we impose a solution and no-one submits a tender so we have no project manager, or they refuse to submit a tender when the City Hall launches a call for tender […] but I think that we all agree on the goal to be reached. Having said that, everyone has a well-defined role in the process, so everyone will be out to defend his own patch. So, at the end of the day, it's a question of who's going to make concessions and how we're going to agree to make the necessary changes. (Person in charge of public procurement for a public authority).

DISCUSSION

The paralysis in the development of dematerialization platforms in the region of France we studied reveals the significance of the interdependence of the players involved in public works contracts when it comes to adopting such platforms. There is indeed a critical mass of users to be reached on the other side of the market, for each player to seriously consider deliberately migrating toward dematerialized management of document interchange via a dedicated platform. The cross-network externalities have two different characteristics: they can both prevent any development process and act as a driver for development, depending on whether the appropriate facilitating mechanisms are present or not.

The existing literature on multi-sided markets suggests that an adapted pricing policy should encourage the adoption of a dematerialization platform. Our study nevertheless reveals that non-monetary costs are the most significant obstacles to the adoption of a dematerialization platform insisted upon by the persons we interviewed. We can divide these costs into three distinct categories: reorganization and learning costs, transaction costs and platform switching costs. The price of using a platform is hardly mentioned, and does not appear as a key facilitating tool in the performance of public works contracts. In other words, the net utility of a dematerialization platform is assessed using the difference between the variable gross gains based on cross-network externalities and a total cost of use broken down into a monetary cost and a non-monetary cost. Our study therefore suggests that there is a boundary condition where the pricing policy is no longer a decisive factor when adopting a multi-sided platform. This is a specific case where users perceive the fact that the non-monetary costs to be borne to effectively use the platform significantly outweigh the monetary cost, which comes down to saying that the total cost is positive even when use is free. Consequently, if the gross gains of

using a platform are low due to the limited number of users, its net utility will be negative and the platform development process will not be triggered.

Proposition 1a: The pricing policy is not a key factor in the adoption of a multi-sided (B2B) platform when there are significant non-monetary costs that the users must agree to.

Proposition 1b: The multi-sided (B2B) platform development process becomes paralyzed when the net utility of a platform is negative despite a no-charge pricing policy.

Generally speaking, the existing literature on multi-sided platforms hardly takes into account the non-monetary costs incurred in the use of a platform. This is probably due to the fact that the former research conducted into C2C, B2C or B2B platforms used the platform editor rather than the users for analysis purposes, which does not enable us to understand the difficulties encountered by the latter when adopting a platform. In our case study, the costs of reorganization and learning come from the major changes in individual and collective working habits regarding the editing, processing, interchanging and storing of documents throughout the life cycle of a public works contract. More generally speaking, these costs are likely to be incurred whenever the use of a platform requires a change in methods of operation or the command of a radically new technology. This finding may also be applied to B2B and B2C platforms. Although the transaction costs were addressed by Rochet and Tirole (2003, 2006), the weight of them in the assessment of the cost in use of platforms seems to be underestimated in the theoretical and empirical literature on multi-sided markets, including for B2C and C2C platforms. For example, the risk of opportunism from a partner can be a major problem when a platform dedicated to the exchange of services between individuals is launched. This can explain the importance of the display features for the mean opinion of the existing users in order to provide a signal of credible reputation able to reassure new potential users. The platform switching costs also seem to be decisive when users are confronted with a lot of very different competitive platforms. In our case study, the firms should adopt several different platforms in order to maximize their chances of making dematerialized transactions with public contracting authorities. This would oblige them to pay to use each new platform, as well as to learn how each different one works. These costs are an obstacle to adoption if the platform market is competitive enough to prevent the emergence of a dominant platform gathering together a satisfactory number of users. Generally speaking, this problem may occur for any user confronted with a large number of competitive platforms in C2C, B2C or B2B.

The fact that the net utility of a dematerialization platform may be negative does not mean that the situation is irreversible. As long as there are not a lot of users, the gross gains of dematerialization remain limited and are more than offset by prohibitive non-monetary costs. Our study nevertheless suggests that the use of a dematerialization platform can turn out to be of benefit compared with managing paper documents, if the number of users reaches a sufficiently high level on all segments of the market. Indeed, the gross gains of dematerialization should increase at the same time as the non-monetary costs decrease, especially through economies of scale in the fixed reorganization costs and the elimination of duplication costs. It therefore seems that transaction costs may decrease if the number of users on all sides of a platform increases, like reorganization and learning costs.

In contrast, if the number of users reaches a sufficiently high level solely on some segments of the market (firms and public contracting authorities) while other user segments do not follow (services provided after the progress of works), the gross gains of dematerialization will be more than offset by the increase in the costs of duplicating documents. In other words, the cross-network externalities could become negative if the increase in the number of users on some market segments was unbalanced. Consequently, during the transition period when a

dematerialization platform is developed, the increase in the number of users on one side of the market generates a decrease in net utility for any new platform user on the other side of the market, as other user segments do not follow. It therefore seems that the transaction costs can increase with an unbalanced increase in the number of users on the different sides of a platform. From then on, a certain amount of users needs to be reached on all the other sides of the markets for the cross-network externalities to become positive again and offset the reorganization costs. To sum up, the process of adopting a dematerialization platform for each side of the market may follow a non-linear path regarding the relationship between the net utility and the degree of development of dematerialization.
This finding makes a significant contribution to the understanding of the multi-sided platform development process, as the cross-network externalities may be negative if the increase in the number of users is unbalanced on the various sides of the market, and positive in the event of a balanced increase in the number of users. The fact that the number of users increases is therefore not enough for the net utility of a dematerialization platform to become positive; this increase must be the same for all user segments in order to activate positive cross-network externalities. This finding contrasts with the way in which former research has conceptualized cross-network externalities as a stable positive or negative phenomenon throughout the platform development process (Parker & Van Alstyne, 2005; Reisinger, 2004; Wilbur, 2008)

Proposition 2: In a multi-sided B2B platform environment, the use of which incurs transaction costs, cross-network externalities will be positive if the number of users increases in the same way on all sides of the market and negative if the number of users increases in different ways on the various sides of the market.

The heart of the problem lies in the fact that the transition toward a state of positive net utility requires the presence of facilitating mechanisms beforehand, able to help the players to commit to the use of a specific dematerialization platform rapidly, simultaneously and massively. The pricing policy cannot be one of these mechanisms, as the players may consider the net utility of a free dematerialization platform to be negative. On the other hand, two mechanisms seem to be effective, especially when implemented in a complementary way: the legal obligation to dematerialize, and the adoption of a collective cooperation strategy between the future users when selecting a common platform.
There are two opposing effects of the legal obligation to use dematerialization: firstly, the technology to manage electronic documents in place of paper documents is rapidly adopted. Secondly, it creates a risk of multiplication of distinct platforms, which could limit the gross gains related to the use of a specific platform while exposing firms to significant switching costs. These drawbacks may be offset by a cooperation strategy in which the future users work together to select a specific platform. Such an approach helps to maximize the gross gains of dematerialization while minimizing the non-monetary costs to be borne by each player. The scope of this finding can be extended to B2B platforms characterized by substantial non-monetary adoption costs. Under this condition, a legal obligation to use the technology underlying the platforms would effectively force the players to adopt it while encouraging the multiplication of competitive platforms. The net utility resulting from the use of a specific platform would only become optimal through a deliberate strategy to adopt a unique platform agreed on by the future users themselves.
This study therefore enhances the literature on B2B platforms, by showing that the influence of the editor through its pricing policy regarding the development of its platform decreases for the benefit of either the government or the future users, or both, in an environment where non-monetary adoption costs are substantial.

Proposition 3: The legal obligation to use technology encourages persons to use it but introduces a risk of increasing the number of distinct platforms adopted by the players to use such technology. This phenomenon restricts the net utility of each platform and increases the platform switching costs for at least one category of user.

Proposition 4: Among a set of competitive platforms (B2B) the use of which incurs substantial non-monetary costs, cooperation between the future users when selecting a unique platform enables their net utility to be maximized.

An editor may possibly resort to using strategies which do not consider the price to influence future users, but this remains an extrapolation and not a finding resulting from the data collected.

CONCLUSION

The purpose of this article was to understand the factors determining the adoption of a B2B platform from the standpoint of user segments. According to the theory of multi-sided markets, it seems that a platform development process should be based on the activation of positive cross-network externalities. The existing literature insists heavily on the role of the pricing policy to attract users from the various sides of the market, and to then enable cross-network externalities to sustain the adoption process. Former research nevertheless tends to concentrate on the editor's standpoint and has essentially considered C2C systems (online dating websites or car-sharing websites) or B2B systems (game consoles, online recruitment), without assessing the actual transferability of the conclusions made using these contexts to B2B environments. Conversely, by examining the case of B2B dematerialization platforms connecting public bodies and construction industry firms, and by focusing on the analysis of the standpoint of these players, this study succeeds in making two major theoretical contributions.

Firstly, we have shown that cross-network externalities can be negative when the increase in the number of users is not the same on all sides of the market, at least in the beginning. This can be explained by the onset of transaction costs stemming from the technological discontinuity with which certain players involved in public works contracts are confronted when interchanging documents with their partners. This leads certain players to make transactions in two distinct technological formats, paper and electronic format.

Secondly, the main factors of adoption highlighted in the existing literature do not seem to be determining. Indeed, our findings question the role of price as a coordination mechanism able to stimulate the adoption process of a unique dematerialization platform. They actually contradict the literature by stressing the importance of both the legal obligation and the deliberate cooperation of the future users when choosing a common platform in order to optimize and accelerate the activation of positive cross-network externalities. This finding can be explained by the significance of the non-monetary costs to be agreed on when using a dematerialization platform, especially the costs relating to transactions, reorganization and learning, and platform switching. Consequently, the net utility of a platform will necessarily be seen as negative in the beginning, even if it is distributed free of charge, encouraging the players to keep up the habit of interchanging paper documents.

REFERENCES

Armstrong, M. (2006). Competition in Two-Sided Markets. *RAND Journal of Economics*, 37:3, 668-691.

Assar, S., Boughzala, I., & Boughzala, Y. (2006). Aspects collaboratifs dans la dématérialisation des achats publics en France, *Actes 11ème congrès AIM 2006*, 07-09 juin 2006, Luxembourg.

Auer, D., & Petit, N. (2015). Two-Sided Markets and the Challenge of Turning Economic Theory into Antitrust Policy. *Antitrust Bulletin,* 60:4, 426-461.

Bourreau, M., & Verdier, M. (2014). Cooperative and Non-cooperative R&D in Two-Sided Markets. *Review of Network Economics*, 13:2, 175-190.

Caillaud, B., & Jullien, B. (2003). Chicken & Egg: Competition among Intermediation Service Providers. *RAND Journal of Economics*, 34:2, 309–28.

Eisenmann, T., Parker, G., & Van Alstyne, M. (2006). Strategies for two-sided markets. *Harvard Business Review*, 84:10, 92-101.

Eisenmann, T., Parker, G., & Van Alstyne, M. (2011). Platform envelopment. *Strategic Management Journal*, 32:12, 1270-1285.

Evans, D. S., & Schmalensee, R. (2007). The Industrial Organization of Markets with Two-Sided Platforms. *Competition Policy International*, 3:1, 151-179.

Evans, D. S., & Schmalensee, R. (2008). Markets with Two-Sided Platforms. *Issues in Competition Law and Policy*, 667:1.

Evans, D. S., & Schmalensee, R. (2013). The Antitrust Analysis of Multi-Sided Platform Businesses. In R. Blair, & D. Sokol (Eds.), *Oxford Handbook on International Antitrust Economics*. Oxford University Press: Online Research Paper No. 623.

Eisenhardt, K.M. (1989). Building Theory from Case Study Research. *Academy of Management Review*, 14:4, 532-550.

Glaser, B., & Strauss, A. (1967). The Discovery of Grounded Theory, New-York: Aldine Publishing Company.

Hagiu, A. (2009). Two-Sided Platforms: Product Variety and Pricing Structures. *Journal of Economics & Management Strategy*, 18: 4, 1011–1043.

Jullien, B. (2005). Two-sided Markets and Electronic Intermediaries. *CESifo Economic Studies (2005) 51 (2-3): 233-260*

Kang, J.-S., & Downing, S. (2015). Keystone effect on entry into two-sided markets: An analysis of the market entry of WiMAX. *Technological Forecasting & Social Change*, 94,170–186.

Katz, M., & Shapiro, C. (1985). Network Externalities, Competition, and Compatibility. *American Economic Review*, 75, 424-440.

Katz, M., & Shapiro, C. (1986). Technology Adoption in the Presence of Network Externalities, *Journal of Political Economy*, 94, 822-841.

Katz, M., & Shapiro, C. (1994). Systems Competition and Network Effects. *The Journal of Economic Perspectives*, 8:2, 93-115.

King, S.P. (2013). Two-sided markets. *The Australian Economic Review*, 46:2, 247-258.

Koh, T.K., & Fichman, M. (2014). Multihoming users' preferences for two-sided exchange networks. *MIS Quarterly*, 38:4, 977-996.

Lee, R.S. (2013). Vertical Integration and Exclusivity in Platform and Two-Sided Markets. *American Economic Review*, 103:7, 2960-3000.

Liu, H. (2010). Dynamics of Pricing in the Video Game Console Market: Skimming or Penetration ? *Journal of Marketing Research*, 47:3, 428-443.

Maglio, P. P., & Spohrer, J. (2008). Fundamentals of service science. *Journal of the Academy of Marketing Science*, 36(1), 18−20.
Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: A sourcebook of new methods* (2nd ed.). Thousand Oaks, CA: Sage.
Miles, M. B., & Huberman, A. M. (2003). *Analyse des données qualitatives*, Louvain-la-Neuve: De Boeck.
Muzellec, L., Ronteau, S., & Lambkin, M. (2015). Two-sided Internet platforms: A business model lifecycle perspective. *Industrial Marketing Management*, 45, 139–150.
Parker, G., & Van Alstyne, M.V. (2005). Two-Sided Network Effects: A Theory of Information Product Design. *Management Science*, 51:10, 1494-1504.
Spohrer, J., Vargo, S., Caswell, N., & Maglio, P. (2008). The service system is the basic abstraction of service science. *41st Annual HICSS Conference Proceedings, Honolulu, Hawaii.*
Sriram S., Manchanda, P., Bravo, M. E., Chu, J., Ma, L., Song, M., Shriver, S., & Subramanian, U. (2015). Platforms: a multiplicity of research opportunities. *Marketing Letters*, 26:2, 141-152.
Reisinger, M. (2004). Two-Sided Markets with Negative Externalities. *Discussion Paper Mimeo*, 27, University of Munich.
Rysman, M. (2009). The Economics of Two-Sided Markets. *Journal of Economic Perspectives*, 23(3): 125-143.
Rochet, J. C., & Tirole J. (2003). Platform competition in two-sided markets. *Journal of the European Economic Association*, 1:4, 990–1029.
Rochet, J.-C. & J. Tirole (2006). Two-Sided Markets: Where We Stand. *Rand Journal of Economics*, 37:3, 645–667.
Roson, R., (2005). Two-sided markets: A tentative survey. *Review of Network Economics*, 4:2.
Rysman, M., (2009). The Economics of Two-Sided Markets. *Journal of Economic Perspectives*, 23:3, 125-143.
Tan, B., Lu X., Pan S.L. & Huang L. (2015). The Role of IS Capabilities in the Development of Multi-Sided platforms: The Digital Ecosystem Strategy of Alibaba.com. *Journal of the Association for Information Systems*, 16:4, 248-280.
Tucker, C. et Zhang, J. (2010). Growing Two-Sided Networks by Advertising the User Base: A Field Experiment. *Marketing Science*, 29:5, 805-814.
Vargo, S. L., & Lusch, R. F. (2008). From goods to service(s): Divergences and convergences of logics. *Industrial Marketing Management*, 37:3, 254−259.
Vargo, S. L., & Lusch, R. F. (2011). It's all B2B…and beyond: Toward a systems perspective of the market. *Industrial Marketing Management*, 40:2, 181−187.
Weyl, E. G. (2010). A Price Theory of Multi-sided Platforms. *American Economic Review*, 100:4, 1642-72.
Wikström, S. (1996). Value creation by company–consumer interaction. *Journal of Marketing Management*, 12, 359–374.
Wilbur, K. C. (2008). A Two-Sided, Empirical Model of Television Advertising and Viewing Markets. *Marketing Science*, 27:3, 356-378.
Yin, R. K. (2003). *Case Study Research. Design and Methods*, New-York: Sage.