

Modelling cloud computing adoption in major French local public authorities

*Erick LEROUX & Pierre-Charles PUPION***

*University of Paris 13 – Sorbone Paris City, laboratory CNRS 7234

**IPAG-CIMP, University of Poitiers

ABSTRACT

The proliferation of cloud computing offers now affects the public sector, so we wish to analyse the patterns of and barriers to adoption of these cloud systems in a highly institutionalized context. After outlining the main principles of diffusion models and the TOE models and HOT-fit, the article analyses the processes and factors of adopting technology innovation in the public context with respect for legality and confidentiality in the public interest. We then propose a synthetic model for the adoption of cloud computing by local authorities. The empirical study is based on a survey on the form and type of cloud with participation by 61 Chief Information Officers (CIOs) or IT directors from French local authorities. We go on to test the model, identify the main factors of innovation adoption, and highlight the importance of safety concerns as central to public choices.

Keywords: Cloud computing, local authorities, adoption, innovation, institution.

RÉSUMÉ

La prolifération des offres de cloud computing touche désormais le secteur public, aussi souhaitons-nous analyser les motifs et les freins à l'adoption de ces différents systèmes de cloud dans un contexte fortement institutionnalisé. Après avoir rappelé les principes des modèles diffusionnistes et des modèles TOE et HOT-fit, l'article analyse le processus et les déterminants de l'adoption de l'innovation dans ce contexte public fortement institutionnalisé où les règles de légalité et de confidentialité sont centrales. Nous construisons un modèle synthétique explicatif de l'adoption des systèmes de cloud computing par les collectivités locales. L'étude de terrain repose sur un questionnaire auquel ont répondu 61 Directeurs des Services d'information et services informatiques de grandes collectivités locales françaises. L'étude statistique permet de tester le modèle et d'identifier les principaux facteurs ou freins d'adoption. Les résultats obtenus mettent en évidence la logique de sécurité comme centrale dans les choix publics.

Mots-clés : Cloud computing, collectivités locales, adoption, innovation, institution.

INTRODUCTION

The world cloud computing market is experiencing tremendous growth. This is concomitant with increasing needs from the public sector. French and European governments are inviting public organisations to adopt cloud computing. A report by the *European Union Agency for Network and Information Security* entitled *Security Framework for Governmental Clouds: All steps from design to deployment* (February 2015) highlights the interest of such integration for public administration in terms of elasticity, cost-efficiency, and resilience. Yet it raises issues in terms of data safety and security.

According to the *National Institute of Standards and Technology* (US), cloud computing is a model that allows easy network access to a series of shared configurable IT resources (network, servers, back up, applications, and services), which can quickly be made available while minimising management efforts and contacts with the service provider. The latter gathers all resources, thanks to a physical presence in several places all over the world, hence the word “cloud”. Users pay according to the resources and services they use. According to the MARKESS study, which edits annual baseline data on cloud, computing market trends in France, the market for cloud computing solutions and related services is enjoying sustained growth. The share of SaaS and its related services is still predominant, representing over 60% of the overall market, thought to be worth around 5 billion euros in 2015.

Cloud computing is a generic term for very different service offers that can be divided into three main families: *SaaS*, *PaaS*, and *IaaS*. *Software as a Service (SaaS)* concerns services that the client can use from light interfaces such as a web research engine (rooted in the Web email) or a programme interface (Yang *et al.*, 2015). *Platform as a Service (PaaS)* rents a platform to the user, who can use it to develop, test and run applications. The main PaaS suppliers are Microsoft (via AZURE), Google (via Google App Engine), and Orange Business Services.

Infrastructure as a Service (IaaS) supplies clients with IT infrastructures (such as virtual environment platforms) on demand. They rent out IT components such as backup spaces, bandwidths, central units, and exploitation systems. Network architects set up and manage those infrastructures (Amazon via EC2 or Orange Business Services via Flexible Computing). Marston *et al.* (2011) propose a classification of different suppliers, which distinguishes between traditional suppliers such as IBM, Google, Microsoft and ATT, key technology suppliers such as Apache, and innovators such as Amazon.

Cloud computing is an innovation since it is a new approach for organisations (West & Altink, 1996) and their actors (Van de Ven, 1986) and it introduces changes (Becker & Whisler, 1967). According to the dominant relativist position (Tushman & Nadler, 1986; Lachman, 1993), innovation is any idea, method or material object that is considered new by the adopting organisation. According to Zaltman *et al.* (1973), “An innovation is any idea,

practice, or material artifact perceived to be new by the relevant unit of adoption". Rogers (2003) adopts the same approach: "an innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption". Adoption and cloud operationalization bring about deep organisational changes by modifying the existing processes at different levels of the organisation. Cloud computing is an innovation, a new operational model, a new way of thinking and of consuming IT resources. It lowers mobility and internal collaboration barriers, it increases external cooperation opportunities, and it can lead to new business models and ecosystems. Some researchers consider it a decentralised approach (Lyer & Henderson, 2010), and even a form of externalisation (Lacity & Willcocks, 2013). It is an organisational and administrative innovation, one of the six public innovations identified by Windrum (2008). Eventually, the Cloud leads to a phenomenon of organisational transformation. Public authorities are either in a phase of exploration and construction dynamics, or one of stabilisation and institutionalisation (Besson & Rowe, 2011). When dealing with public organisations as potential users of innovation, it makes sense to consider the adoption of a cloud computing system. Why do public authorities adopt cloud computing innovation?

This research perspective is different from many previous studies that mainly deal with the use of new technologies in organisations through the use of models such as Davis' technology acceptance model (TAM, 1989). It helps understand why some organisa-

tions go faster than others in adopting an innovation, and it describes the adoption process (Geczy *et al.*, 2012, 2013). This research draws on theoretical studies on innovation adoption. It investigates the factors that speed up or slow such a decision (Hecker & Ganter, 2013). It addresses a dual need: the lack of surveys about the adoption of cloud computing systems and the insufficient number of analyses about IT management in the public sector, even though this sector represents more than 20% of French activities. Caring about innovation in the public sector is an answer to the public policies that try to improve the quality and efficiency of services (Hartley, 2005; Osborne & Brown, 2013), two performance dimensions associated with cloud computing market performance (Mazalov *et al.*, 2015; Garrisona *et al.*, 2015).

From a theoretical perspective, this survey is useful as it analyses adoption factors in terms of IT management innovation in a sector that is strongly institutionalised. A sector is considered strongly institutionalised when the pressure of social norms is high due to an environment with numerous rules and expectations to which the organisation must adhere in order to have social legitimacy (Scott, 2008). The main parameters of this institutionalisation are: public values such as general interest and confidentiality; public policies that support modernisation and enhance efficiency and quality; and governmental regulatory powers. It makes sense to identify the effect of this institutionalisation on the innovation adoption process, especially concerning cloud computing choices (type

of cloud computing services such as SaaS, PaaS and IaaS, and forms of cloud computing, whether private, public or hybrid). In terms of deployment, organisations can choose between an internal, a private external and a public cloud. The internal cloud delivers services within the organisation from its own infrastructure. The external private cloud is devoted to a single entity but is hosted by an outside service provider. The public cloud is managed by an outside provider and delivers services accessible by multiple users (individuals or companies), whereby these multiple entities share the same computer resources provided by the supplier.

From a managerial point of view, this research aims to identify resistance issues in public IT adoption, and to help managers develop environments that contribute to growth in innovative public behaviour.

Our methodological approach allows us to develop hypotheses based on a review of the literature and test a synthetic model with a quantitative approach, the objective being anchored in an arranged positivist perspective where phenomena are observable in reality although they are intimately linked to the actors' representations.

The theoretical model is built from two theoretical approaches:

- diffusionist, using Rogers' analyses, as well as the *The Technology-Organization-Environment model (TOE)* (Tornatzky & Fleischer, 1990) and the *Human-Organization-Technology fit model (HOT-fit)* (Yusof, Kuljis, Papazafeiropoulou, & Stergioulas, 2008);

- and institutional, with neo-institutional analyses and convention theory.

We include the Public Management perspective and the New Public Management analysis, showing how they determine the different types of institutional pressure, whether normative, coercive or mimetic.

These approaches all explain motivation to adopt based on a given behaviour. The diffusionist approach, which explains adoption through the attributes of innovation, allows us to identify the cloud's attributes that specifically attract or put off the managers and decision-makers representing public authorities. The neo-institutionalist approach and the convention theory allow us to identify the possible conventions and institutions that condition cloud computing choices. Yet these institutions do not impose any behavioural rules; actors can always contest and suggest changes. These approaches are rooted in a cognitive framework and reject the possibility of environmental determinism where the organisation could only fit to its environment. According to Powell and DiMaggio (1983), institutions are tendency-based stable supra-individual cognitive apparels that structure and guide action. According to the convention theory, the adoption of a convention is the result of the computation of an individual whose rationality is bounded and procedural.

The empirical study aims to describe, understand and explain the cloud computing adoption in major local authorities. It is based on a survey implemented from September 2014 to

November 2014 using a sample of IT directors from “general councils” in France (general councils were renamed local councils in 2015), working in towns with 50,000 inhabitants or more. After the second phase, 61 useful replies were collected, representing more than 12% of the original population.

In the first theoretical section, we analyse the factors underpinning cloud computing adoption in a highly institutionalised environment. In this regard, we use various diffusion perspectives and neo-institutionalist approaches, and we develop an adoption model where technologies, humans and organisational factors play an important role, but where socio-institutional factors play a dominant part in terms of cloud computing choices. In the second section, after processing the data, we highlight the factors explaining the adoption of cloud computing systems and we analyse the importance of rules and social norms in the choices that are made.

1. THEORETICAL ANALYSIS OF THE ADOPTION DECISION IN THE PUBLIC SECTOR

The proposed analysis of the cloud computing adoption phenomenon is rooted in diffusionist perspectives and institutional theories.

1.1. Diffusion approaches

Starting with Rogers’ analyses of diffusion, and HOT & TOE models, we propose a series of hypotheses on the influence of human, technological, or-

ganisational, and environmental factors on cloud computing adoption.

1.1.1. Rogers’ approach

Rogers (1995) introduces innovation adoption as a communicational process that takes place between a transmitter and other actors who can be real or potential users. The spreading of an innovation and, above all, its adoption rhythm, can be explained through its perceived attributes, the adopters’ profile, their social system, and their environment’s communication system.

Rogers (1995) defines diffusion as “the process by which an innovation is communicated through certain channels over time among the members of a social system”. Adoption depends on the pre-collected information about the innovation, as well as on the characteristics the innovation is suspected to have that the communication channel transmits. Adoption is the result of a sequential process: the first phase corresponds to increasing knowledge about the innovation (its existence, how and why it is used) (1); the second phase corresponds to the emergence of an attitude towards it (2); the third corresponds to the decision to acquire or reject it (3); the fourth corresponds to its implementation (4); and the last phase corresponds to the final confirmation of adoption (seeking information to confirm the decision) (5). Just like in Davis’ TAM model (1989), or the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh *et al.*, 2003), an attitude emerges towards the innovation, especially based on its perceived techno-

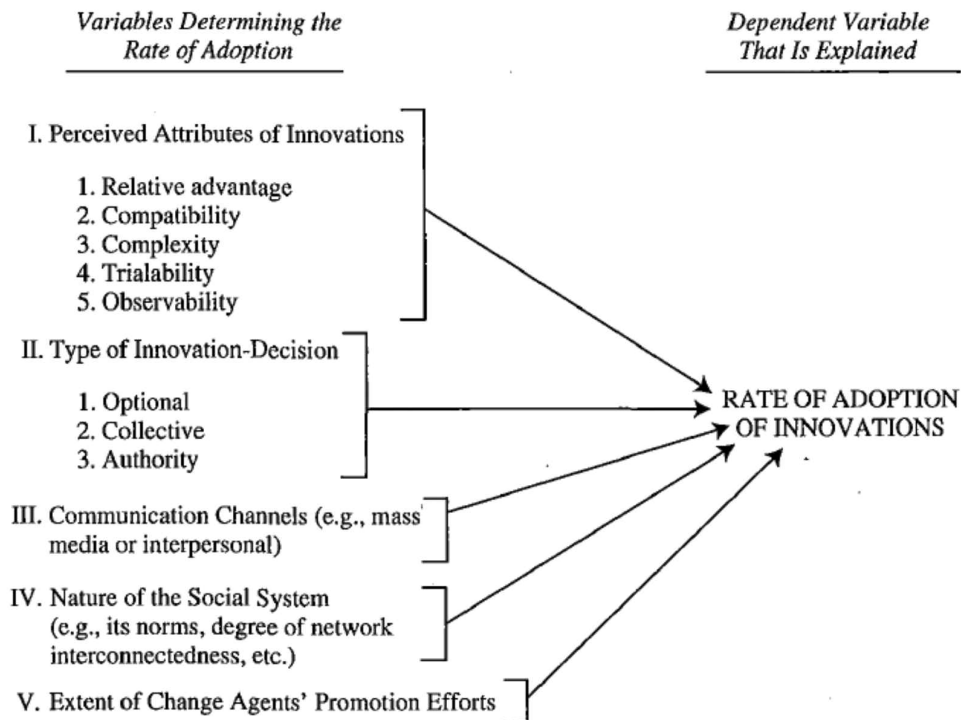


Figure 1: Rogers and the communicational process
(source Rogers, 1995)

logical characteristics. Notwithstanding, if the TAM model, based on Fishbein and Ajzen's reasoned action theory (1975), mainly deals with the intention to use a technology and, ultimately, and its use by the members of the organisation that has adopted it. Conversely, the diffusionist model is interested in the decision of one individual or organisation whether or not to adopt an innovation. (1) In the first phase of innovation diffusion, the individual seeks knowledge about it in terms of attributes. Studies from the diffusion school show that mass communication makes it possible to reach large groups of individuals, but is less

efficient than interpersonal networks at promoting innovation adoption. Intelligence activity involves reading specialised reviews, information collected and experiences shared between local authority CIO networks. Granovetter (1985) defines "social networks" as groups of social identities, individuals or organisations, which are linked after social interactions and maintained thanks to various organisational or technical means. Intelligence within the organisation is a prerequisite for awareness of the existence of a cloud computing system, and thus conditions the adoption decision. This observation and intelligence activity can feed

upstream anticipation and creativity actions, as well as lead to a quick innovation reaction and process.

H1. The higher the quality and extent of intelligence activity, the higher the probability that the organisation will adopt a cloud-computing system

In contrast, we could also consider that the organisation only benchmarks other local authorities' behaviours and choices, meaning that they are not significantly influenced by the quality of its intelligence. The collateral aspect of this is that intelligence has greater impact when it concerns less common cloud computing systems.

(2) The perceived attributes of an innovation that will allow potential adopters to assess it are its:

- relative advantage or degree of superiority;
- compatibility with the organisation's values, objectives, and past experience;

- complexity, measuring the difficulty of understanding and using it;
- trialability, or flexibility in terms of pre-testing;
- observability, in line with Moore and Benbasat's distinction (1991) between an innovation's visibility and the possibility to demonstrate results;
- and associated image (Moore and Benbasat's attribute, 1991).

According to cloud providers, the main advantages of cloud computing are elasticity, lower cost, and the possibility of having generalised access (Chou, 2015). Cloud computing simplifies uses by avoiding traditional IT constraints (installing and updating software, backup size, data mobility, etc.). It generates cost savings as well as creating new sharing levels by ensuring access and service availability for colleagues who are located away from the organisation. This aspect

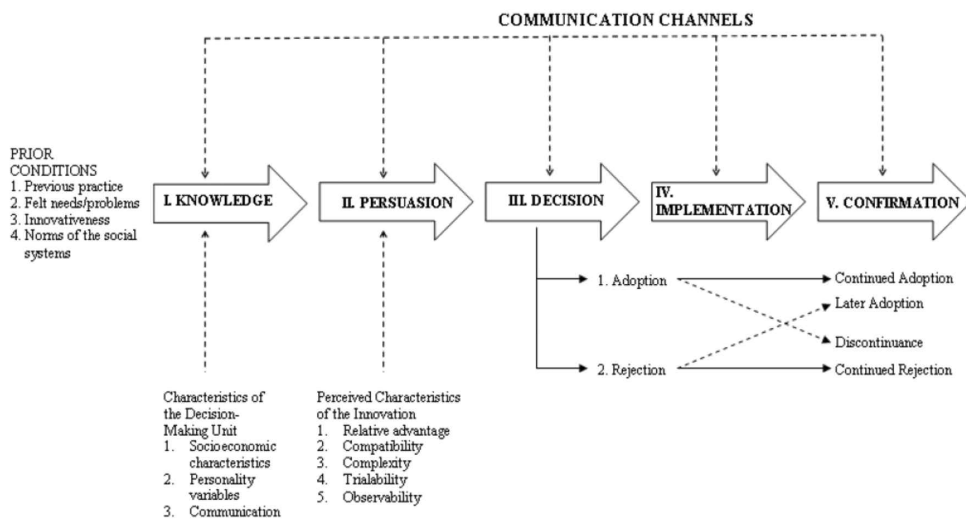


Figure 2: Rogers' sequential process of innovation adoption (source Rogers, 1995)

makes sense for France, which is reorganising its regions and cities; adopting cloud systems would allow various users (belonging for example to a similar town or community) to access their application securely online wherever they are and at any time. Local authorities no longer have to manage the evolution of their infrastructures when the organisation's structure and realm change (association of local authorities) since the editor manages the necessary changes. It allows quicker access to IT resources (server, database or bandwidth) via a simple web portal. From a budgetary point of view, it allows users to access top-level technology at a reasonable cost and without initial investment if the cloud is public. In the case of an internal cloud, substantial resources are necessary for the study, the purchase, the hosting, the updating, the maintenance, and the protection of the hardware. Financially speaking, deploying an internal cloud can also require high initial investment and further spending to purchase new equipment and increase capacity.

H2a. Higher level of perceived relative advantages for cloud computing will increase the probability of its adoption.

Perceived complexity often determines choices. The higher the perception of an innovation as complex and requiring sharp skills is, the lower the probability that it will be adopted (Teo *et al.*, 1995). Complexity is often linked to the project implementation, the difficulty of migrating existing systems to the cloud computing platform, the integration of systems and learning cloud computing applications. The associated risks of service interruption or

data accessibility loss opposes to the legal principle of public service continuity. In public environments, such projects can generate high reluctance to change from the staff, should it be personal or collegial, conscious or sub-conscious, coming up from the very moment the project is exposed. Of course, the adoption of an internal or private cloud is fundamentally more complex and requires managing wider projects.

H2b. Higher levels of perceived complexity decrease the probability that a cloud computing system will be adopted.

As a collateral aspect, this perceived complexity would be higher in the case of a PaaS or IaaS system, or even an internal cloud, and lower in the case of a SaaS system, or even a public cloud.

Compatibility with needs, values, objectives and organisational processes is a major innovation attribute. Incompatibility with these can block the adoption of an innovation. Numerous studies have shown that compatibility with existing practices is an important factor influencing the adoption of new technologies (Lin *et al.*, 2012). Using the cloud strengthens managerial skills and reduces dependency on operational skills, meaning fewer but more highly qualified people.

H2c. Higher levels of perceived incompatibility decrease the probability that a cloud computing system will be adopted.

As a collateral aspect, this perceived incompatibility would be higher in the case of a PaaS or IaaS system, which

requires changes in practices, and lower in the case of an internal cloud, which can fit organisational goals and values more easily.

Observing an innovation (Teo *et al.*, 1995) increases the likelihood of its adoption because a visible innovation attracts the attention of potential users. The difficulty of observing others' practices (visibility dimension) and adoption-associated results (result dimension) can slow down cloud computing adoption. The limited cloud services that are dedicated to local authorities are slowing down experience gathering; in contrast, the non-competitive aspect between local authorities supports information sharing. Experience gathering can be achieved by witnessing the providers' websites or through CIO-dedicated professional networks.

H2d. Higher levels of perceived observability increase the probability that a cloud computing system will be adopted.

The possibility of trying out a system can help cope with specific fears of adoption. If an innovation can be freely tested for a given period, then organisations can remove doubts about their choice. While most SaaS providers provide free testing versions, PaaS and IaaS cloud offers do not propose similar flexibility. Moreover, such diffusion approaches often highlight a choice rationale whereas they could borrow from other approaches.

H2e. Higher levels of perceived trialability increase the probability that a cloud computing system will be adopted.

As a collateral aspect, the adoption probability would be lower in the case of a PaaS or IaaS system than in the case of a SaaS system, since the latter is easy to give up.

Beyond confirming these hypotheses, it is relevant to identify the different attributes of this technology that could make sense in the public context, thus justifying its adoption.

(3) As far as decision type is concerned, deciding to adopt cloud computing is optional. This does not mean there are no social pressures in such an institutionalised sector, as we highlight in section 1.2.

Under the diffusion approach, analysing the decision-maker's "receptivity to innovation" or his/her individual reluctance to change and innovate is crucial (Midgley & Dowling, 1978). Beyond this individual attitude, we need to consider the collective dimension and the various actors' attitudes in the initial phase of the project.

The image that is associated with the innovation can influence its adoption. The higher is the positive impact of the adoption on the decision-maker in the social system, the higher the probability that the innovation will be adopted. The role played by IT directors in the choice or development of an IT system obviously makes them social actors (Lamb & Kling, 2003).

H3 CIOs adopt cloud computing to strengthen their image.

1.1.2. TOE and Hot-Fit approaches

We broaden our scope by considering all factors that help explain the

adoption of an innovation. The *Technology-Organization-Environment model (TOE)* (Tornatzky & Fleischer, 1990) and the *Human-Organization-Technology fit model (HOT-fit)* (Yusof *et al.*, 2008) list these factors.

In their model, Tornatzky & Fleischer (1990) identified three TOE-related factors that affect the IT adoption process: organisation, technology, and environment. The technology context includes internal and external technologies that are relevant to the firm. It includes both equipment and processes. The organisational context refers to the firm's resources and characteristics: its size, its levels of centralisation and formalisation, its management structure, its HR, and its "slack". The environmental context includes the industry's size and structure, the competition, the macroeconomic context, and the legal environment. Although this framework was not conceived for the public sector, it was used to support the understanding of adoption in some sectors, such as health (Chong & Chan, 2012).

HOT approach supporters explain adoption through the adjustment between human, organisational and technological factors. Enhancing the human aspect, this model highlights human skills and competences as a central factor in terms of technology adoption (Chou, 2015).

Technological factors once again relate to perceived attributes, i.e. advantages, project complexity, observability and trialability. Cost-based advantages and the technology's compatibility with existing IT systems can be crucial in the decision to adopt a cloud computing system. This brings us back to

hypotheses H2a, H2b, H2d, and H2e, expressed within the first diffusion model.

The organisational dimension is tackled while analysing the organisational conditions that are favourable to cloud computing adoption. Adopting an IaaS and PaaS or choosing a private or internal cloud requires a broad project. Since large organisations are used to manage major IT projects, they adopt such projects more easily.

H4. The bigger the local authority, the more likely it is to adopt IaaS and PaaS and choose a private or internal cloud.

We shall also consider H2c in terms of the necessary project alignment to the organisation's goals and structures.

Since we insist on the human dimension when adopting an innovative technology, it makes sense to investigate to what extent the IT director's positive attitude towards adoption of a cloud computing technology (Thong, 1999) affects the decision. Decision-makers' skills and competencies are crucial when adopting innovative IT (Lin *et al.*, 2012; Liu, 2011). The higher is the IT staff's knowledge of cloud computing adoption, the higher are the levels of trust within the organisation throughout the process (Agarwal & Prasad, 1998). Some cloud systems such as PaaS, IaaS, and private-types of cloud computing require more significant resources for implementation than SaaS systems or public clouds. Thus, we formulate this hypothesis:

H5a. The higher the IT staff's experience and skills in terms of IT project development, the greater the probability

that the organisation will adopt PaaS or IaaS systems and private cloud computing systems.

We also suppose that a positive attitude towards innovation on the part of the IT director positively affects the probability of cloud computing adoption.

H5b. The more positive the IT director's attitude, the greater the probability that the organisation will adopt cloud computing.

The environment can have a positive or negative impact on new IT technology adoption. Competitive pressure, often considered as an explanation, has a low level of influence in such public environments, where managers do not have to cope with the laws of the market. In order to explain the environment effect, it is useful to draw on neo-institutionalist theory.

1.2. The institutional approach to adoption

While current public policy in France tends to support the use of cloud computing, security regulations for personal data, based on the CNIL's recommendations and the principle of keeping archives where they are, tend to slow the adoption process.

1.2.1. The explanatory neo-institutional approach to cloud computing adoption

Organisations are part of a social context. They are influenced by their environment's practices and symbols (March & Simon, 1958). The organisational field comprises all actors who

together, make a recognised institutional life area: suppliers, resources and products consumers (users), legal institutions (legislator), other organisations producing similar services (other local authorities), professional associations (IT directors associations), professional press...". Through their individual and collective participation, these actors help develop coercive pressure (laws and rules), norms (professional or implicit norms defining appropriate behaviours within IT directors' networks), and imitation (imitation of other local authorities' behaviour), which influence organisational behaviours and lead to a choice convergence that is called "isomorphism".

The French government is trying to introduce cloud computing to the public sector in a context characterized by both traditional administrative rules and the development of NPM principles. In the public sector, a highly institutionalised environment, public organisations must cope with traditional public service values such as confidentiality, transparency, and the regular application of the law. However, it must fit the values of efficiency, flexibility, and service quality, which are aligned with the NPM principles. NPM reforms shift the emphasis from traditional public administration to public management. This includes different forms of decentralizing management within public services, increasing use of market mechanisms and competition, increasing emphasis on results, and the development of a customer-orientated mind-set. Adopting public cloud computing or private external computing is rooted in a mind-set that

is close to outsourcing, so dear to New Public Management (NPM). We will see that public administration and the perspective of public management determine coercive, normative and mimetic pressures.

Coercive isomorphism comes from formal and informal pressures exerted by organisations on other organisations, and from the cultural expectations of the society. It is the result of the organisational field's persuasion or attraction force. The main coercive source comes from governments and international organisations. In fact, state-based law is an obstacle to adoption by imposing hosting data in Europe while calling for the emergence of national suppliers and data centres. This brings us back to the effect of this coercive pressure when dealing with securing and locating data in the choice that is made.

The compatibility of the innovation with the law in terms of data protection is an obstacle for its adoption. Local authorities have to respect personal data in line with France's "Informatique et Libertés" (IT and Freedom) legislation. This is essential since data is ultimately intended to be shared. IT security is considered for all personal data-related processes (creation, use, backup, archive, destruction) and it must guarantee data confidentiality, integrity, authenticity, and availability. In principle, data spreading risk is crucial when authorities make choices due to the weakness of the available IT security services that exist in terms of data coding or cryptographic keys. Data collected by authorities are confidential, whether addresses or telephone details, family structures, voting rights,

or sensitive social data (handicaps, financial aid, etc.). It might be difficult to make sure that the service provider cannot access confidential data through its systems' events. From this perspective, a public organisation is not managed according to the principles of NPM as a private company; it is subject to other constraints related to respect for citizens' lives.

Another dimension to consider is the physical location of data hosting: a French local authority is not allowed to send its data outside the national territory. Hosting one's emails at Google is illegal, and goes against national and European law. The former also forbids local authorities from subcontracting the archiving of their documents, since these must remain inside the office of the responsible administration. Not having knowledge of data localisation or other States' regulations makes it difficult to abide by the law when you use cloud computing. Due to the diversity of actors that are able to interfere with the service, the difficulty of mastering data security throughout the process is extremely high. Yet, having recourse to internal clouds makes it possible to move beyond those constraints (Hoffman & Woods, 2010). Tiers *et al.* (2011) identified four maturity phases while investigating the process leading to a cloud settlement decision: organisational, security-linked, cloud solution, and legal environment. As far as local authorities are concerned, the latter has not reached the point of legal maturity required to adopt a cloud, due to public laws and recent public policies that open the door to the use of such tools. Data security is a fundamental factor (Lin *et*

al., 2012; Liu, 2011) in terms of adoption, both linked to environmental and technological factors.

H6a. The perceived risk of non-compliance of cloud computing with legal obligations of data security reduces the likelihood of adoption.

As a collateral aspect, higher levels of this perceived risk would lead to the adoption of an internal cloud and the rejection of a public cloud.

Normative isomorphism is the consequence of guild members' collective efforts – those of local authority IT directors who define their practices and set up a legitimate basis for their activities. The existence of business fairs and the development of communications between such IT directors within associations (Coter Club...) on the theme of cloud computing can help make its adoption easier.

H7a. Positive pressure from the community of local CIOs leads to the adoption of cloud computing systems.

Based on NPM principles that a community is wider than the local CIO community, it should include all CIOs that belong to the public or private sectors. In the case of the public sector, according to NPM principles, we can observe the dichotomy between the actors who design policies and those who apply them. This automatically leads to inquiries into the roles and attitudes of all IT directors, of the general service director (DGS), and of the relevant elected representative in the local authorities' decision-making process. In the public sector, support for top management is often the key to change. Yet, we defend the idea that

IT directors are the main actors in the adoption of cloud computing projects thanks to their level of expertise.

H7b. The CIO initiates the decision to adopt cloud computing systems.

Of course, collegial support from the general services director, IT director, and the elected representative makes the adoption of a cloud computing system easier. Adoption could be slowed down by the IT director's fear of losing control (Benlian & Hess, 2011; Chou, 2015) because outsourcing reduces the number of tasks that are performed by his/her department. The results will allow us to determine how IT directors can be forced to make a particular choice by the general services director or by the elected representative.

In this research, the technology selection process is highly ambiguous and the choice is highly difficult, high-risk, and expensive. DiMaggio and Powell, referring to the work of Meyer and Rowan (1977), assume that organisations, which lack well-defined technologies, will import institutionalized rules and practices. Mimetic isomorphism results from standardized responses to uncertainty and refers to the imitation of one organisation seen by another as more legitimate or successful (DiMaggio and Powell, 1983). Meyer and Rowan's groundbreaking paper (1977) suggested that legitimacy may be a greater organisational force than economically predicted, particularly as an organisational field is structured.

Imitation isomorphism refers to the imitation by local authorities of organisations that are famous for their legiti-

macy, innovative approaches, and size. An organisation will seek to copy actions from other public organisations that suffer from similar pressures, whether the Government or at a European level.

There is mimicry when someone appropriates the behaviour and opinions of others (Asch, 1951) to join a group (Allen and Wilder, 1977) or for fear of sanctions resulting from deviant actions. Fear of real or symbolic sanctions (disapproval, loss of esteem) creates conformity. Some authors believe that the decisions made by reference organisations are more salient for decision makers, who replicate the selection decisions made by other firms even if they believe these decisions to be inferior or suboptimal (Tingling and Parent, 2002).

Adoption frequency is a crucial factor. If a high number of local authorities have made the choice to adopt a cloud computing system, as shown by many statistical studies of SaaS systems, then this choice is made relevant and there is less resistance. Equally, local authorities can benchmark and copy other organisations in order to acquire legitimacy. The benchmarked organisations are often local authorities considered big, innovative, or high-performance.

H8. Imitation pressures lead to cloud computing adoption.

From a collateral perspective, we identify towards which types of cloud this pressure tends to develop, and which models are eventually retained: PaaS, IaaS, SaaS, internal or public clouds. From the so-called NPM perspective, the organisation imitated

might be a private company and not specifically a public organisation. However, the results might be biased, as some actors are unwilling to recognise the influence of others on their choice.

We note that this hypothesis complements H2d, according to which observing cloud computing benefits its adoption. It highlights an imitation phenomenon, or substitutive learning, in a context where observation is carried out based on others' experiences. However, we contest this overly deterministic approach since organisations self-contribute to redefine the institutional rules of the game. Upstream of the institutionalisation and convergence process, we note the dominant interactions and the roles of the various actors in defining what is considered legitimate, since institutional pressures can be very influential as long as practices are not institutionalised (Delmas & Toffel, 2008).

1.2.2. Analysing adoption through conventions theory

The strategic conventions school is rooted in the work of Lewis (1969). Language philosopher Lewis borrows from Schelling's game theory (1960) to describe the multiplicity of Nash's balances associated with these coordination games. Agents have to deal with coordination problems (several equilibria), which can be favourably solved or not. Convention is defined as behaviour regularity whereby everyone rationally tries to fit the expected behaviour of others. This convention, or behavioural regularity, is anchored in a system of mutual expectations in terms of agents' actions and preferences. It

offers coordination between individuals, without explicit agreement. Convention becomes established and it develops thanks to this preference for conformity. It is rooted in the world of rational calculation; agents adopt a convention because they have an interest in doing so. Convention can be observed through the condition of common knowledge, which supposes that everyone knows that everyone knows... (it is never-ending). For Lewis (1969), a convention is a behavioural (or belief) R regularity that, in a P population, satisfies six conditions: (1) everyone conforms to R, (2) everyone believes that everyone does the same, (3) this belief makes everyone actually conform to R, (4) all prefer a general conformity to R than a less general one, (5) there is at least another R regularity that satisfies conditions (3) and (4), and (6) the previous five conditions are known by all. Actually, the existence of a convention in the field of cloud computing should allow IT director to know how to react when they must choose whether or not to adopt the cloud. Following the convention, helps justify one's own position towards others' in a context that can be very uncertain given that adoption consequences and results are doubtful. Notwithstanding this, any rule is incomplete and cannot propose a full solution.

The decision may result from a common framework, a cognitive device established within a behavioural pattern. The leader conventionally knows the solution to retain in terms of the cloud and makes this choice because he believes that his peers share this choice. Needing reassurance, he considers that

a decision is more credible if the largest majority takes it. We hypothesize that in a situation of uncertainty, communities rely on convention. The adoption of a SaaS system, widely diffused according to statistical studies, could result from a convention.

H9. A convention governs local authorities' choices in terms of cloud computing.

Models of assessment are necessary to interpret rules. Assessing models are ways to coordinate representations and judgements that are made about behaviours. Following a convention is first about following a rule, then seeking its meaning. Choosing between several conventions is not the result of a random approach. It is done according to a world such as justice values and principles. Boltanski & Thévenot (1991) propose six judgement models called cities (to which Boltanski & Chiapello (1999) add project city), which define agents' representations. For these authors, making a judgement about a rule means mobilising a justification based on one of these six cities. In the case of cloud computing adoption, two cities are crucial: the civic world, held by the public agent who above all cares about the collective interest, and the industrial world, held by the expert who above all cares about the technical object and scientific method. In both cases the evidence is, respectively, law and measure. If a local authority IT director refers more to the industrial world than the civic one, he should attribute lots of weight to the advice of experts. If IT directors come from the private sector, the technical aspect should dominate.

However, conventions can evolve endogenously due to the dissidence of certain actors or the dissonance of a convention following a contextual evolution (Amblard, 2003). Conventions change according to existing contacts with other actors who follow different conventional rules or due to State intervention. These texts may redirect agents' behaviours by shifting behavioural norms.

1.3. A synthetic and syncretic model

Faced with these various explanations of the innovation adoption process, we propose a syncretic model, based on the idea that each theory presents a facet of the adoption process. This syncretic model retains the factors identified as critical to the adoption by the different theoretical approaches. It helps explain the choice of adoption of an innovation in a highly institutionalized environment. Thus, we propose a four-dimensional explanatory model of adoption:

- Human dimensions, comprehended through the more or less favourable attitudes of decision-makers (elected representatives and IT directors) towards new technologies, available skills to develop IT projects, the public context, and the legitimacy of the IT director and elected representative;
- Technological dimension, considering perceived advantages, systems integration complexity, cloud computing applications' knowledge, cloud testing applications, cloud observations;

- Organisational dimension, with the role attributed to intelligence in the knowledge of cloud computing systems, to the size effect, and to the possible compatibility of cloud computing systems with the current organisation;
- Institutional environment and quest for legitimacy, which can involve imitating the local authorities that seem to be the most legitimate, or can be expressed by the adoption of a convention. This bloc includes coercive pressure and especially the respect for data security and confidentiality laws, which is linked to technology choices.

2. EMPIRICAL ANALYSIS OF THE ADOPTION OF CLOUD COMPUTING SYSTEMS BY LOCAL AUTHORITIES

In this second section, we describe the empirical methodology of our study; then we investigate the influence of the various technical, human, organisational, and institutional factors in the attitudes of local authorities towards the cloud, as well as their decision whether or not to adopt a cloud system.

2.1. Building and processing the questionnaire

We shall describe below how we built and processed our questionnaire; then how we measured the main adoption factors.

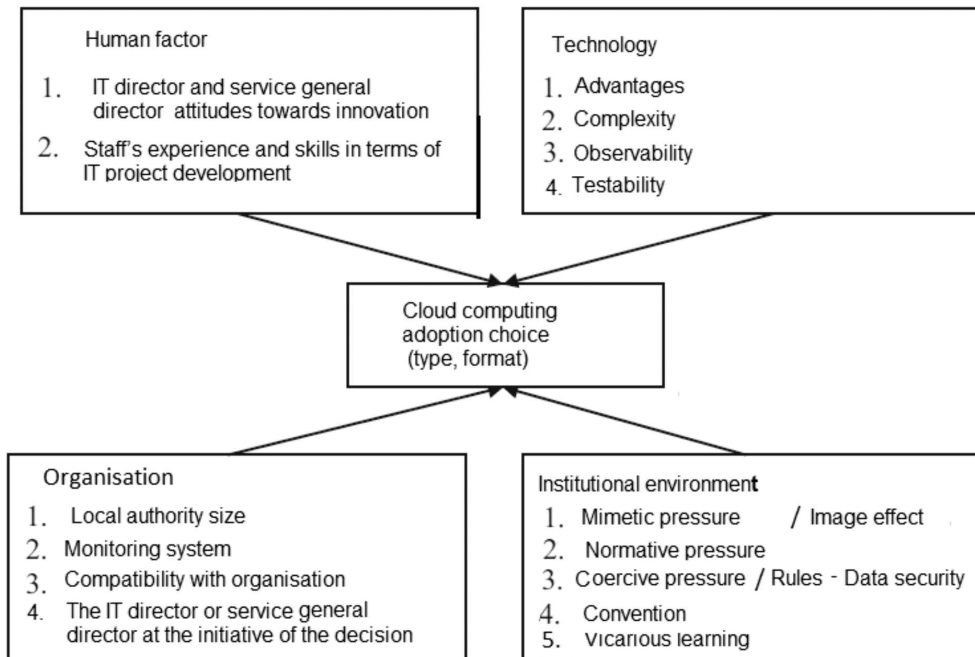


Figure 3: Our synthetic model of adoption

2.1.1. Target and questionnaire processing

This research targets IT directors in major French local authorities (regional councils, general councils, large towns, etc.). It aims to describe their choice motivations in terms of cloud computing. We did not consider small towns since their size naturally stops them from possibly integrating some cloud types such as internal clouds. This survey was made with a large sample of local authorities. “Local authorities” here means towns, departments and regions, as well as town groups. By “large”, we mean towns with over 50,000 inhabitants, making a total of 124 units. Local authorities are France’s primary public investors. The local authorities report stated in 2013 that their gross budget was €43.3 bil-

lion, compared to €10.2 billion for the central administration, and €7.2 billion for health administrations.

After testing our questionnaire and simplifying certain scales, we emailed it to the IT directors of 180 local authorities randomly selected from the official phone book. We received 61 replies, roughly a 33% success rate, corresponding to 12.5% of the parent population. We obtained the email addresses by phone interview with the various local authorities, and the questionnaire responses were collected from 15 September to 15 November 2014. To analyse the results, we used inferential statistical methods, which are relevant for small sample sizes, like univariate (median trust interval), bivariate (Mann-Whitney’s comparison test and Spearman’s independence

test), and multivariate (Exact Logit model).

2.1.2. Concept operationalisation and measures of adoption model factors

Our questionnaire is built around the variables and the dimensions defined in the theoretical section about motives, resistance, and conditions of adopting cloud-computing systems. The questionnaire was made up of closed questions, under a dichotomy format, and attitude scales (Likert's 7-point) and open questions. The objective was to obtain information about the conditions for adopting a cloud system: knowledge of the different cloud types and formats, intelligence quality, innovation perceived attributes (advantages, complexity, security, compatibility, trialability, observability), decision-makers' attitudes towards new technologies, IT departments' ability to develop such a project, and the extent of institutional pressures (weight of peers and experts, elected models, etc.). This study includes 15 major variables and 42 items; these measurements were modified /extended from prior studies referred to in the different tables where the items are presented. Some measures result from interviews conducted with the IT directors of major local authorities'. Each variable was measured using a 7-point Likert-type scale, with values ranging between 1 (very unimportant or absolutely disagree) and 7(very important or absolutely agree). A higher value represents greater importance or agreement perceived by respondents. In order to be sure that the survey was

suitable for the research context, the survey was reviewed first by two local authority CIOs.

In line with Churchill's paradigm (1979), we pre-tested this questionnaire on 10 IT directors, and we measured multiple scale accuracy using the traditional Cronbach's alpha. We then performed a principal component analysis (PCA) on our sample of 61 IT directors in order to check if the chosen multiple scales were or were not multidimensional, and we measured the scale's reliability based on Cronbach's alpha. We present below the various scales for the technological and human fields.

The technological dimension. After performing a factorial analysis or more precisely a principal component analysis, it became necessary to distinguish costs from other perceived benefits and to make this a full dimension.

- Perceived advantages are measured thanks to a 6-item scale after depuration, considering the advantages that were associated with cloud computing. This scale's reliability is confirmed by Cronbach's alpha of 0.759, above the 0.7 usually considered as a reference. Accessibility is one of the major advantages emphasised by respondents; the median value equal to 6 proves this advantage is perceived as strong. It seems right to have this advantage considered important as it enables local authorities to cope with the integration of new members into a group of towns, for example. Capabilities adjustment is also considered a strong advantage (median value of 5).

Dimensions	Items (scale from 1 to 7)	Average	Median	Cronbach's Alpha
Advantages (adapted from Lian <i>et al.</i> 2014 and inspired by Lin and Chen, 2012)	Assess on a scale from 1 to 7 the advantages that are linked to the use of cloud computing (1 very weak, 7 very strong)			0.759
	It makes services better for the user	4.29	5.00	
	It increases the accessibility of services	5.02	6.00	
	It increases applications' execution speed	3.57	4.00	
	It increases storage capabilities	4.45	4.00	
	It ensures quick adjustment of capabilities to needs in terms of hardware and software	4.78	5.00	
	It reduces investments costs	4.08	4.00	
Costs (inspired by Lian <i>et al.</i> , 2014)	Assess on a scale from 1 to 7 (1 very low, 7 very high) the costs of cloud computing adoption			0.729
	Technology setting up costs	4.37	5.00	
	Users' professional development costs	4.38	4.00	
	Higher user costs	5.08	5.00	
Complexity (adapted from Lin and Chen, 2012 and Moore and Benbasat, 1991)	Assessing the complexity of adopting a cloud computing system on a scale from 1 to 7 (1 very low, 7 very high), you would say that complexity is linked to:			0.769
	Learning cloud computing applications	3.49	4.00	
	Migrating current systems to the cloud computing platform	4.98	5.00	
	Irregularly performing the cloud computing platform maintenance	4.07	4.00	
	The lack of cloud computing applications	4.57	5.00	
	Staff professional development	3.36	4.00	
Security (adapted from Oliveira <i>et al.</i> , 2014) and linked to coercive pressure	Assessing cloud computing security on a scale from 1 to 7 (1 very strong, 7 very weak), you would say that adopting this technology could jeopardize:			0.943
	Data transfer process security	4.33	4.00	
	Respect for private data	3.96	4.00	
	Respect for the law that data should be hosted locally	4.43	4.00	
Triallability (inspired from Kolodinsky <i>et al.</i> , 2004)	Regarding the possibility to test the system, you would complain about (1 fully disagree, 7 fully agree):			0.782
	Lack of relevance of the proposed simulations	3.84	4.00	
	Lack of real estimate regarding cloud-based costs	5.42	6.00	
	Lack of experience feedback and examples from cloud users in the public sector	4.46	5.00	

Table 1: Technology-linked perceived attributes

- The multi-item scale corresponding to the different types of adoption-related costs is reliable, with Cronbach's alpha of 0.729. Perceived costs would mainly come from higher usage costs and technology implementation.

The PCA confirms that complexity and legal risk are two different dimensions.

- Complexity is measured through a 4-item scale. This scale is reliable, with Cronbach's alpha of 0.769. The lack of applications dedicated to the public administration's needs and the difficulty of transferring current systems to the cloud-computing platform contribute significantly to the innovation's perceived complexity
- Legal security dimension, in other words conformity to the law, which is both an institutional and technological variable, is assessed from items measuring respect of legal constraints in terms of data hosting on the territory, respect for private data, and the security of the data transfer process. This multi-item scale is reliable, with Cronbach's alpha of 0.943, and the cloud-associated risk is considered moderate.

- A multi-item scale (1 to 7) assesses trialability by measuring the relevance of the proposed simulations. This scale is reliable, with Cronbach's alpha of 0.782. Results enhance the lack of evaluation of the real costs and the lack of examples and narratives in the public sector.

Cloud computing security judgement is shared and close to the average value. However, it appears for more than 25% of respondents that the risk linked to not respecting the law is high (the third quartile is worth 6). Interviewees highlight the lack of experience or feedback about the use of the cloud, and the difficulty of assessing the gains and costs that are linked to its adoption. Given that the multi-item scales are reliable, we now associate each of them with a variable corresponding to their item averages.

When reading Table 2, it seems that advantages are considered slightly weaker as an average than costs, and they are both higher than the neutral value of 4. We note that for 25% of respondents, advantages and costs are considered quite strong (the third quartile is equal to or above 5). While the risk or, conversely, the security aspect appears to be average (a median

		Advantages	Cloud cost	Security	Complexity	Trialability
Average		4.36	4.55	4.21	4.06	4.64
Percentiles	25	3.83	4.00	3.00	3.40	4.17
	50	4.64	4.66	4.00	4.25	4.66
	75	5.00	5.33	6.00	4.95	5.33
IC at 90% of the median		4.17-4.83	4.33-5.00	3.33-5.00	3.60-4.60	4.33-5.00

Table 2: Cloud computing technological dimension

value of 4 and an average of 4.21 on a scale from 1 to 7), the risk aspect is high for 25% (the third quartile is worth 6 and corresponds to a very high perceived risk). Complexity and trialability have respective median values of 4.25 and 4.66, above 4 (for scales from 1 to 7), which shows that decision-makers consider it quite difficult to simulate the consequences of cloud computing adoption.

Studying the third quartile complements this: different dimensions (advantage, risk, cost, complexity, and trialability) are quite important or rather important and, in this regard, can influence choices. For the individuals located over the third quartile, the risk dimension is significant resistance to adoption (since the third quartile equals 6), and to a lesser extent, complexity, costs, and the impossibility of testing the system would constitute resistance to adoption.

The organisational dimension. From an organisational perspective, access-

ing information might be a key factor in the decision whether or not to adopt. As far as intelligence quality is concerned, we asked the interviewees to use a scale from 1 to 7 to assess the internal effort to obtain information about IT news actuality, review reception frequency and the quality of the information collected from the cloud. We observe an average intelligence quality with a median value reaching 4 for review reception frequency and the internal efforts made to obtain information about IT news. The detail of the information collected from the cloud reaches an average of 4.2 and a median of 4, a first quartile of 4 and a third of 5. This observation leads to reject the hypothesis of substantive rationality among interviewees. In contrast, the level of interviewees' knowledge of PaaS and IaaS cloud systems is high (the confidence interval for median is [5-6] at a confidence level of 90%). IT directors are largely aware of the various systems (cf. table below). PaaS services are lightly less well known since

Assess on a scale from 1 to 7 (1 very weak and 7 very strong) the quality of the intelligence and your degree of knowledge of cloud computing systems	Average	Percentiles			CI for the median at 90%
		25	50	75	
[Reception frequency of specialised IT reviews]	4	3	4	5	3-5
[Internal efforts made to get information about IT news]	4.19	4	4	5	4-5
[Level of information detail about the cloud]	4.3	4	4	5	4-5
[knowledge of SaaS services]	5.19	4	6	6	5-6
[knowledge of PaaS services]	4.53	4	5	6	4-6
[knowledge of IaaS services]	4.8	4	6	6	4-6

Table 3: Intelligence quality measures

the median degree of knowledge in this regard is 5 and the average is 4.53, meaning that these values are below the IaaS and SaaS systems.

The quality of the information collected from the cloud, here measured by its level of detail, is significantly linked to the perception of internal efforts in terms of information and to the reception of specialised reviews (the significant level of the Spearman correlation tests between the quality of the collected information and those two dimensions is below 1/1,000).

The size of the IT department that is able to set up a cloud project is the second organisational factor. It is significantly linked to the size of the local authority in terms of jobs (Spearman's correlation coefficient is 0.8). The minimum department size is 12 individuals and the maximum is 90. In the sample, the median is close to 30. 40% of IT directors hold an engineering degree, 30% hold a management master de-

gree with IT specialisation, 10% have two years' higher education, 10% come from a business school, and the remainder come from other knowledge resources. This means that experts lead most IT departments.

The third organisational factor that is able to influence cloud adoption is the cloud's compatibility with the local authority's objectives and organisational structures. The multi-item scale can be considered reliable, with Cronbach's alpha of 0.78. Both, the individual item analyses and overall compatibility with confidence interval for the median, show that the perceived compatibility is average, and even rather weak. It seems not very compatible in 25% of cases.

As far as pioneering actors are concerned, we observe from the sample that the IT director proves to be the cloud computing project starter in 75% of cases. S/he often shares this dynamic with the general services director

Attributes	Items (scale from 1 to 7)	Average	Median	Cronbach's Alpha
Compatibility with objectives and current organisational structures (adapted from Lian <i>et al.</i> , 2014)	Assess on a scale from 1 to 7 (1 very weak and 7 very strong) the compatibility of cloud computing systems with:			0.78
	Your institution's organisational processes	4.02	4.00	
	The organisation's public values and objectives	3.56	4.00	
	The current IT systems organisation	3.72	4.00	
Compatibility global dimension (3-item average)				
Percentile 25 2.66	Median 4.0	Percentile 75 4.75	Average 3.75	
Median IC to 90%			3.5-4.4	

Table 4: Compatibility dimensions

(32% of cases) and the elected representative (15% of cases). In contrast to the idea of clear division of powers between politician who makes the decision and the administrator who applies it, it is the expert and/or administrative staff member who are most often the starters in adopting cloud computing.

The human dimension. The human factors influencing cloud adoption are the leaders' attitudes towards new technologies, and the IT department's ability to manage the project.

Human capabilities, in terms of project development, are comprehended by four items: including two items measuring IT staff potential to develop IT and drive change. Cronbach's alpha

is 0.76. It is clear that two elements are usually considered crucial for cloud computing development in local authorities: the time available to manage the project and the support from top management. Responses for both items were above 5. IT directors usually give weight to the human factor in project management since responses to the first quartile are above 4. The confidence interval for the median at 90% shows the importance of this competency and staff's capability in terms of project and change management.

IT director's innovation spirit is measured using a 3-item scale. The scale is very coherent since Cronbach's alpha is 0.867, but the influ-

Dimensions	Items (scale from 1 to 7)		Average	Median	Cronbach's Alpha		
Human capability to conduct a cloud project (adapted from Kuan and Chau, 2001)	For a cloud project development, please asses on a scale from 1 to 7 the importance of:						
	IT staff experience in terms of IT development		4.49	4.00	0.76		
	Available time to manage the project		5.16	5.00			
	Staff professional development policy		3.93	4.00			
	Project users' active participation		4.55	5.00			
	Top management and managers' involvement in the project		5.30	5.00			
Capability to conduct a cloud project (average of 5 items)							
Percentile 25	4.2	Median	4.6	Percentile 75	5.32	Average	4.59
CI for median at 90%						4.4-4.8	

Table 5: Human capability to conduct a cloud project

ence of these elements seems to be average. Interviewees are not considered primo-adopters (innovators or early adopters), and the various IT directors' attitudes mostly converge (cf. Table 6). Yet, more than 25% of them consider themselves as such by giving a reply that is above 5 (the third quartile is 5).

The institutional dimension. Institutional factors influencing cloud adoption come from the desire to imitate the IT directors in other organisations (if generalised, this can take the shape of a convention), the wish to benefit from other local authorities' experience, the influence of the law or coercive pressure, and eventually the influence of IT experts.

The effects of institutional factors were addressed using single scales and multi-item scales.

- Single scales were used to measure the relative importance of

various organisational field actors and their influence on the adoption of a cloud system. Based on a scale from 1 to 7, we sought to measure the influence of various cloud computing advice on IT directors. Influence from other actors was observed in 20% of cases.

- The influence of SSII (consulting agencies) and company IT directors is average and even rather weak, except for local authorities in the third quartile. The influence of IT directors from other authorities is the most significant and is described as high (median value equals 5). The vicarious learning experience effect was addressed using a multi-item scale that demonstrates the importance of the opinions of local authorities when they converge. The scale is reliable, with Cronbach's alpha of 0.836.

Dimensions	Items (scales from 1 to 7)	Average	Median	Cronbach's Alpha			
	Concerning your attitude towards innovations, you would say that (1 totally disagree, 7 fully agree)						
IT director's openness to new technologies (adapted from Agarwal & Prasad, 1998)	When I hear about a new IT technology, I seek experimentation	4.09	4.00	0.867			
	I am often one of the first among my peers to try new technologies	4.07	4.00				
	I like testing new IT	4.54	5.00				
IT openness dimension to new technologies (average of three items)							
Percentile 25	3..83	Median	4.33	Percentile 75	5	Average	4.23
CI for median at 90%						4.4-4.67	

Table 6: IT director's openness to new technologies

Please assess the influence of the following on a scale from 1 to 7:	Average	Percentiles			CI for the median at 90%
		25	50	75	
[a consulting agency, an external advisor]	3.77	3	4	5	3-5
[another authority's IT director]	4.64	4	5	5.75	4-6
[a company's IT director]	4.21	3	4	5	3-6

Table 7: Influence of experts and peers

The median answers given for the various items show that, consistent advices from adopters strongly influence IT directors (median of 5). The advices from local authorities that have already adopted a cloud strongly influence (cf. Table 8) the choices of other local authorities (cf. table below) when they match. The quite high third quartile value, above 5, is an indication of this. This influence is general because the first quartile's value equals 4. These results prove that local authorities try to benefit from vicarious

learning by collecting adoption experiences from others.

The existence of a convention is validated using a multi-item scale with items corresponding to the five conditions for a convention: cloud systems are frequently adopted; others adopt them through imitation; other local authorities' adoption influences you; there are other alternatives; and others think the way you do. Cronbach's alpha is 0.785. If the scale is coherent,

Dimensions	Items (scales from 1 to 7)	Average	Median	Cronbach's Alpha		
Vicarious learning and adopters' advice constancy (created with expert advices)	With regard to local authorities that have adopted cloud computing, give your opinion about the following statements on a scale from 1 to 7:					
	Their advice is more important than that of non-adopters	4.51	5.00	0.836		
	The importance of this advice depends on the homogeneity of adopters' positions	4.80	5.00			
	Their influence depends on the number of positive opinions versus negative ones	4.48	5.00			
		Average	Percentiles			CI of median at 90%
			25	50	75	
Vicarious learning (average of 3 items)		4.6	4	4.66	5.33	4.00-5.00

Table 8: Vicarious learning and adopters' advice constancy

there is a doubt over the existence of a convention since the average answers to the various criteria are below 4, except for one case.

Although IT directors do not seek image improvement through cloud adoption, interviewees do not totally rule out image effect (Table 10).

Dimensions	Items (scales from 1 to 7)		Average	Median	Cronbach's Alpha	
Presence of a convention (created using Lewis's criteria)	Concerning the cloud computing phenomenon within local authorities, you would say that:				0.785	
	Cloud systems are frequently adopted		3.70	4.00		
	Cloud systems are adopted by others through imitation		3.77	4.00		
	Other local authorities' adoption influences you		4.00	4.00		
	Other alternatives exist		4.64	5.00		
	Others think the way you do		3.93	4.00		
		Average	Percentiles			CI for the median at 90%
			25	50	75	
Convention (average of 5 items)		4	3.6	3.9	4.4	3.6-4.20

Table 9: Convention

	Average	Percentiles			CI for the median at 90%
		25	50	75	
Assess on a scale from 1 to 7 (1 very weak, 7 very strong) the influence of the following on your choice:					
[cloud computing associated image]	2.89	2	3	4	2-4
[geographically close local authorities]	3.8	2	4	5	3-5
[institutionally close local authorities]	4.34	3	5	5	3-5
[large local authorities]	3.8	2	4	5	3-5
[innovative local authorities]	3.45	2	3	5	3-5

Table 10: Cloud computing associated image and legitimacy models

Wishing to identify legitimacy sources, we asked the IT directors to what extent their decision whether or not to adopt a cloud could have been influenced by decisions made by large, innovative, or geographically or institutionally close local authorities. We created these measures, which match the various types of models. This influence can be quite high for more than 25% of directors, since the third quartile value is above 5.

2.2. Factors determining adoption

2.2.1. Cloud computing types and format adoption

While it is quite common to have knowledge of the various cloud systems, adoption frequency varies according to the cloud computing type. Two local authorities out of three use SaaS, whereas only 20% use PaaS and/or IaaS cloud system offers (cf. table below).

Using SaaS cloud computing systems can be considered usual or common since nearly two thirds of local authorities use such services (the confidence interval at 90% of the proportion give an interval from 38% to 69%. More-

over, 8% admit having used it in an experimental or marginal way. The most used applications are file sharing, emailing and schedule. The most recurrent cloud services are RESA, DRPAL, CIS, VALLEY and WEBEX.

However, adopters of PaaS or IaaS can be considered as early adopters since fewer than 20% of respondents have adopted them (cf. table above). It should be noted that local authorities could use two or three different types of services; in this regard, one third of SaaS subscriptions also concerned PaaS and IaaS services.

Table 11 shows that 58% of local authorities from our sample use a public cloud with access to a mutualised service hosted by a provider; 36% use an internal cloud with internal deployment of an authority-managed service. In 75% of cases, PaaS and IaaS services are used within internal or private clouds. Local authorities sometimes use two or even three formats. The internal cloud format allows data hosting inside the local authority. 26% of local authorities use a private cloud with internal deployment of a privatised service version (but still managed by the providers). They use internal cloud in 50% of cases for PaaS and IaaS services.

Services	[IaaS]	[PaaS]	[SaaS]	Public Cloud	Internal Cloud	Private Cloud
Having adopted a system	19.7%	19.7%	65%	58%	36%	26%
CI of number of local authorities having adopted at 90%	11.5% -27.8%	11.5% -27.8%	56%-75%	47%-68%	26.1%-45.8%	17%-35%

Table 11: Cloud computing systems adoption: types and formats

We focus our analysis on the adoption of general cloud computing services (SaaS, PaaS, IaaS) before determining if the local authorities that adopted the SaaS type have a different profile from those, which concomitantly adopted a PaaS or IaaS system. Indeed, except for one case that we removed from the analysis, all local authorities that had adopted PaaS and IaaS systems also used a SaaS system.

2.2.2. Cloud computing system adoption factors

The use of non-parametric methods allowed us to identify trends in probability and to determine the different factors of cloud computing adoption.

The technological dimension. Using Mann-Whitney's test to compare the distribution of the different technological attributes on both "adopters" and "non-adopters", we determine the key attributes in terms of cloud computing adoption.

Concerning perceived technological attributes, it seems that the cost of cloud operationalisation limits adoption (the observed significant level of the unilateral test is 2.6%), while the perception of the advantages is a key factor in terms of adoption. With a mistake risk close to 5%, we note that the legal risk limits adoption (the Mann-Whitney significant level of the unilateral test is 5.4%). In contrast, neither complexity nor trialability significantly affect choice; the Mann-Whitney significance levels are respectively 29% and 30%. We can then confirm hypotheses H2a and H6a, linked to the influence of the perceived advantages and of the

associated risks in a strongly institutionalised context, where respecting personal data security is an important issue.

The organisational dimension. Surprisingly, authorities with better intelligence do not acquire more SaaS cloud computing systems than others. Mann-Whitney significance levels exceed 45%. H1 is not confirmed. It seems that the adoption of SaaS services is linked to the IT department's size; a large size makes the adoption of IT cloud projects easier, as per H4. Using Mann-Whitney's test to compare size distribution on two populations of "adopters" and "non-adopters", we obtain a significance level of below 10% for the unilateral test. However, perceptions of compatibility with the organisation's values and objectives do not have a significant influence (significance level of bilateral test is 98%). Consequently, H2c is not confirmed.

The IT director initiates cloud projects in more than 75% of cases, and shares this initiative with the general director in 35% of cases. We cannot talk about forced choice, although the IT directors may overestimate their role in their responses. The fact that the IT director or the general director initiates the project is key to its adoption (the significance level of Kruskal-Wallis test is under 1%), as per hypothesis H7b. The support of the elected representative does not have a significant impact on the decision to adopt a cloud. Only 47.5% of the organisations that adopted a cloud system admit making a cost-benefit calculation to justify their investment. The usage frequency of this technique has nothing to do with the status of the person ini-

tiating the project (IT director, general director, elected representative). Inversely, perceptions of compatibility with the organisation's objectives and values have no significant influence (significance level of bilateral test is 98%).

The human dimension. Human capabilities to support the project, especially the experience of IT staff in terms of IT development and driving change, influence adoption. Using the Mann-Whitney test to compare the distribution of the variable human capabilities to support the project on the populations of both "adopters" and "non-adopters", we find a significance level of 10% for the unilateral test. Thus, H6a hypothesis is confirmed. This dimension can block adoption. The fact that the IT director is open-minded to new technologies does not significantly affect adoption (unilateral Mann-Whitney significance level of 27%). H5b hypothesis is not confirmed.

The environmental and institutional dimension. Mann-Whitney's test shows that those who adopt the cloud are more influenced than non-adopters by the advice of another authority's IT director (the unilateral test significance level is below 5%). As per hypothesis H7a, IT directors appear to suffer from pressure coming from local authorities leading to the adoption of cloud computing systems. IT directors from the same academic background or, who meet at conferences or professional development sessions share a positive view of adoption. Similarly, there is a difference between the two populations when it comes to the influence of company IT directors (significance

level of 1%), which is more important for local authorities that have adopted a cloud computing system. There could therefore be a dual formative pressure, one linked to the IT director's job in a local authority, and the other one coming from the private sector as part of a vision of new public management where the private company serves as a management model for the public sector. Here, the IT director can be positioned in an industrial Boltanski-type mode, where the leader is the expert.

Local authorities try to benefit from vicarious learning, as per H2d hypothesis. Indeed, the adopting local authorities give more weight than others to the advice of adopters and to their convergence. We also remind that adoption is not linked to a convention. In both populations (we conducted similar analyses to those presented in Table 9), we conclude that there is no convention for or against adoption. H9 is not therefore confirmed. Although the existence of an adoption convention is not confirmed, we can still question the existence of imitation behaviours, as per H8.

Mann-Whitney's test shows that the adopters have a more generalised vision of adoption than others (significance level of below 10%). The link between the observed frequency of adoption and the decision to adopt a cloud system is proven. Yet, this result can be interpreted in two different ways: the agent adopts the innovation because *ex-ante* s/he used to consider it as frequently used; or, inversely, s/he declares it is frequently adopted to justify his/her own choice *a posteriori*. In the first case, it is an imitation effect:

believing in the frequency of cloud computing adoption often leads to adoption. In the second case, decision-makers seek *a posteriori* legitimacy, believing that others have made similar choices. H8 is therefore confirmed: imitation pressures do exist.

While imitation is not generalised, 25% believe that models deserving benchmarking do exist; their influence is therefore considered rather strong. Are chosen as models, the authorities, which are geographically and institutionally closed or the local authorities that seem to be legitimate due to their size or innovative character (cf. Table 10). Notwithstanding this, the influence of these models does not seem to differ from adopters to non-adopters. Similarly, image effect does not significantly affect professional adopters (the significance level of the Mann-Whitney test I is 27%). H3 is not confirmed at this stage of our analysis.

Synthetic adoption phenomenon model. We use an Exact Logit-type regression to explain the adoption of a cloud computing system (dichotomy variable $Y = 1$ if adoption and $Y = 0$ if not) by the variables that we had previously defined and *a priori* explanatory:

- variables that are linked to the technological attributes that slow down the adoption of software (cost and security) or supporting it (advantages);
- variables that are linked to the organisational dimension (size, support from the IT director, support from the general director);
- variables corresponding to the human dimension (IT staff capability to develop new IT projects);
- variables corresponding to the imitation pressures that are able to support adoption (adoption frequency and vicarious learning)¹.

We obtain the logistical regression results using the software SAS, which makes it possible to estimate the stable parameters² from an exact conditional inference method that can be set up using the Hirji, Mehta & Patel (1987) algorithm. The exact logistical regression is used to make a model from binary result variables when the size of the sample is too small for a regular logistical regression (which utilises the Maximum Likelihood Estimation of Logistic Regression).

¹ Given an e_i element from a P statistical population for which the A_j characters (advantage, cloud adoption-based costs and risks, size, support of IT director and general director, staff capability to conduct the project, adoption frequency) have as respective measures $x_j(e_i) = x_{1,i}, x_2(e_i) = x_{2,i}, x_3(e_i) = x_{3,i}, x_4(e_i) = x_{4,i}$ et... $x_9(e_i) = x_{9,i}$ we consider the p_i probability for e_i to hold the studied C character, that is to say having adopted a cloud computing system. We associate e_i with the random variable Y_i that takes the value 1 if e_i holds the C character and the value 0 in the opposite case. In the case of a Logit-system with five explanatory variables, we obtain $\ln[p_i/(1 - p_i)] = +\alpha_1 x_{1,i} + \beta_2 x_{2,i} + \beta_3 x_{3,i} + \beta_4 x_4(e_i) + \dots + \beta_9 x_9(e_i)$, in other words $P(Y=1/(x_1, x_2, x_3, x_4, \dots, x_9)) = (x_{1,i}, x_{2,i}, x_{3,i}, x_{4,i}, \dots, x_{9,i})) = \exp[(\beta + \alpha_1 x_{1,i} + \beta_2 x_{2,i} + \beta_3 x_{3,i} + \beta_4 x_4(e_i) + \dots + \beta_9 x_9(e_i)) / (1 + \exp[(\beta + \alpha_1 x_{1,i} + \beta_2 x_{2,i} + \beta_3 x_{3,i} + \beta_4 x_4(e_i) + \dots + \beta_9 x_9(e_i))])$.

² Amalia Gordóvil-Merino, Joan Guàrdia-Olmos* & Maribel Peró-Cebollero (2012), "Estimation of logistic regression models in small samples. A simulation study using a weakly informative default prior distribution", *Psicológica*.

Criterion	Constant only	Constant and Co-variables
AIC	46.121	36.580
SC	47.882	43.625

Global null hypothesis test: BETA=0

Test	Chi²	DDL	Pr > Chi²	
Score	12.8999	3	0.0049	
Wald	8.7701	3	0.0325	
Exact conditional tests				
Effect	Test	Statistics	p-Value	
			Exact	Mid
Advantages	Score	3.8506	0.0500	0.0471
	Probability	0.00594	0.0572	0.0542
Security	Score	9.0549	0.0018	0.0016
	Probability	0.000256	0.0016	0.0015
Adoption frequency	Score	3.5389	0.0720	0.0508
	Probability	0.0423	0.1087	0.0876

Exact parameters estimated					
Parameter	Estimate	Type error	95% trust interval		Bilateral p-Value
Advantages	0.9319	0.5419	0.0510	2.1794	0.0652
Security	-1.1123	0.4664	-2.3303	-0.3361	0.0014
Adoption frequency	0.9110	0.4707	0.1722	2.0474	0.1117

**Table 12: Logistical regression and cloud computing software adoption
Model adjustment statistics**

Only three variables (data security, adoption frequency, and perceived advantages) explain the decision to adopt. The model correctly adjusts data, as proved by the global model signification tests. The *p* values show that two innovation technological attributes are keys in adoption probability: data security and technology-based

advantages. Other advantages appear to support adoption, such as user service quality, application accessibility (from any office, smartphone, etc.), application execution speed, and quick adaptation of capabilities to needs in terms of hardware and software. Regarding technological attributes, these results are similar to

those of Low *et al.*, (2011). While relative advantages significantly affect choice, neither complexity nor compatibility with the organisation will significantly influence choice.

The search for data security linked with coercive pressure and technology choice slows cloud computing adoption. This highlights the importance of legal factors in a highly institutionalised sector and the importance of coercive fears in the public sector. However, we are not in a forced selection scenario (Abrahamson, 1991) where organisations have no choice and are forced to adopt innovations due to the substantial power of organisations such as government bodies.

Institutional factors, such as imitation, partly explain why local authorities adopt a cloud computing system: legitimacy is obtained by making a choice based on what we believe is the most common approach. In principle, this is one of the easiest ways to be legitimate in the eyes of a hierarchy made up of non-specialists, who can then encounter difficulties to identify surround all the challenges that are linked to such a project. It is also a way to ensure support when the outcome of the project proves to be uncertain.

Once cloud computing adoption factors are highlighted, we try to determine if the adopters' profiles are similar or if they vary according to the system: SaaS, PaaS (usually with a SaaS system adoption too), and IaaS. We want to check to what extent the adoption factors that we have highlighted could be more or less important according to the chosen cloud (SaaS, PaaS, or IaaS).

2.2.3. Adoption factors and cloud computing types

We use the non-parametric Kruskal-Wallis test to compare the distribution of the various attributes among the different populations who have adopted a cloud. We distinguish three adopters' categories: local authorities that only have adopted a SaaS system, and those who have adopted a PaaS or an IaaS system

Technological dimension. The perceived advantages seem greater when local authorities have adopted an IaaS system; in other words, they are more important when they rely on a kind of outsourcing of the infrastructure (significance level of below 5%). Conversely, a project's perceived complexity is a greater problem for local authorities which have adopted IaaS and PaaS systems (Kruskal-Wallis significance level of below 5%). This complexity variable can have a significant and negative effect on the probability of adoption for the two upper layers of cloud. The corollary of the hypothesis H2b is confirmed.

Environmental and institutional dimension. The risk or security dimension, i.e. the problem that is linked to the legal environment, is not significantly higher in one of the three options, in other words the law does not lead to favouring a particular type of cloud. Coercive pressure does not have a different effect on the decision to adopt different types of clouds.

The origin of mimetic pressures varies with the type of cloud. Legitimacy is mainly driven by observing the number of adopters and those geographically close in the case of the

SaaS system, whose adoption is widespread. The reference model for IaaS-type systems requiring significant investments is large organisations, both public and private.

The perception of generalised adoption is a higher choice factor among local authorities that have adopted the simplest system, i.e. the SaaS (significance level of below 1%). A higher spreading of the technology explains this. In other words, there is a cumulative technology diffusion phenomenon. The pressure coming from local authorities that are geographically or institutionally close is higher for those that have only adopted a SaaS-type system (significance level of below 5%). The vicarious learning effect is more important for the adoption of SaaS than IaaS systems (Mann-Whitney significance level of below 5%), for which it is hard to find numerous experiences and to observe the results of projects that require important managerial changes.

A normative pressure links the CIOs of French local authorities to the CIOs of public or private major companies. The institutional pressure from big local authorities' choices and the IT directors of major firms seems higher in local authorities that have adopted an IaaS-type system (significance levels from both tests are below 10%). It shows that local authority IT directors refer to the industrial world, as Boltanski and Thévenot call it, and where technical knowledge prevails. The image effect may exist for the adoption of an IaaS system but is very weak. Using the Kruskal-Wallis test, we observe a significant difference in the case of both adopters and non-

adopters of the two other cloud categories (significance level of below 5%).

These different pressures, depending on the adopted cloud type, seem to be linked to the level of innovation spreading, the importance of the project, and necessary changes. The models used as references for the adoption of the innovation are different according to the degree of diffusion and the fact that it requires internal support.

Organisational dimension. The magnitude of the project related to the adoption of IaaS, and especially the importance of driving change can block the adoption of this innovation. Thus, the compatibility of the cloud with current objectives and processes, the general service director involvement close to IT directors and the large size are factors facilitating the adoption of this type of cloud (significance levels of these tests are below 5%). However, the IT director's influence (bilateral test significance level equals 1%) is not significantly different according to the cloud type.

An IT department's size is crucial when adopting cloud systems, especially when dealing with IaaS and PaaS-type systems (Kruskal-Wallis significance level of below 5%).

Human dimension. Human potential to conduct the project, especially that of IT staff regarding IT development and change management, has a greater impact on IaaS-type systems requiring more management efforts from staff for its implementation. Using the Mann-Whitney test to compare the distribution of the human capabilities to conduct the project-variable on the populations of both IaaS adopters and

SaaS-only adopters, we obtain a significance level of 10% for the unilateral test. In contrast, we do not observe a significant difference in terms of human capabilities between SaaS-system adopters and PaaS-system adopters. H5a is confirmed.

2.2.4. Cloud computing formats and adoption factors

As far as cloud formats are concerned, the authority can choose between a public cloud providing access to a mutualised service, hosted in a provider, a private cloud allowing internal deployment of a private version of the provider's services, and an internal cloud, an internal development of a collective service.

Technological dimension. Perceived implementation costs are highest for internal cloud projects and lowest for public cloud adoption (Kruskal-Wallis significance level of 5%). The cost obstacle to adoption is different depending on the importance of organisational involvement in the project. The highest perceived costs are for local authorities that have adopted a public cloud and the lowest are for those that have chosen an internal cloud (Kruskal-Wallis significance level equals 5%). The private cloud seems more attractive in terms of advantages than the public one (flexibility) but it seems more expensive, too. The differences between the formats mainly concern data safety guarantees.

Organisational dimension. Regarding organisational factors, neither the size nor the involvement of CIOs and DGS will have different influence ac-

cording to the forms of cloud, but opting for an internal cloud (Kruskal-Wallis significance level of 10%) would ensure strong compatibility with the objectives and values of the organisation. Adopting an internal cloud would guarantee this flexibility for the organisation. The adoption of a public cloud seems to be the least compatible with the public organisation's processes and objectives. The public cloud format matches pure service outsourcing, in contrast to other types, where the authority's managerial involvement is higher.

Institutional dimension. We observe that local authorities that have chosen a public cloud are less concerned than others by the risk of confidentiality loss (significance level equals 5%), and that solution is lawful. This coercive pressure may explain why big local authorities choose to implement internal cloud computing. As in Phaphooma *et al.* (2015), we found that security and privacy factors reduce the probability of cloud computing adoption, but going further, we show that in a public context these factors determine the cloud format adopted. This result is consistent with the results of Yigitbasioglu (2015), who emphasizes that the applications containing critical data are retained internally or preserved on a rented dedicated server, while non-critical public data are delocalised.

Organisations that have only adopted a public cloud more often use an economic calculation when making investment choices (the comparison test is significant with a risk below 10%). They adopt a substantive reality approach but also consider the advice of

other local authority IT directors (Kruskal-Wallis significance level of below 5%). Large local authorities are more in a role of benchmarked reference for the authorities that have developed an internal cloud. The latter give more credit to this opinion than private or public cloud adopters (Kruskal-Wallis significance level of below 5%). Internal cloud development requires expertise only found in large organisations.

Local authority IT directors that have adopted an internal cloud admit that they benefit less from the vicarious learning effect than others (Kruskal-Wallis significance level of below 5%). The internal cloud project specificities make the experience of others harder to transfer.

Human dimension. Human capabilities to conduct the project appear to be less important in the case of the public cloud. Yet, the result is not significant since the error risk is slightly above 10%. The IT director's attitude towards new technologies has no significant impact on the adopted cloud format.

Perceived technological attributes and institutional pressures have a different impact depending on the imagined cloud type and format. Data safety fears, blocking cloud adoption, mainly lead to the adoption of an internal cloud. Normative pressures are heterogeneous and different: indeed, if the choices made by close local authorities can be a reference for a SaaS-type system, those made by large public or private organisations are eventually benchmarked for electing an IaaS-type cloud system.

CONCLUSION

Local authorities that are able to adopt cloud-computing systems consider these practices as new. Considering the highly institutionalised public context, we analyse the adoption of this innovation using Rogers' innovation diffusion model, the Technology-Organisation-Environment (TOE), the Human-Organisation-Technology fit (HOT-fit), and the neo-institutional theories, as well as conventions. Based on these analyses, we create a general model with four explanatory dimensions of innovation adoption: technological, human, organisational, and institutional. The proposed original model makes it possible to explain the adoption of cloud computing systems by organisations, but not the use of this innovation within an organisation. The proposed model helps explain the adoption of cloud systems but also the format and type of clouds selected. From a more general perspective, it shows the link between technological choice and institutional environment in the framework of highly institutionalised environments.

Our empirical study is one of the first to be made in the public sector and to deal with public innovation, a central element of the political modernisation of public actions. The survey was conducted with a sample of more than 60 local authority IT directors, representing more than 12% of the original population.

The perceived advantages, data security, and imitation of the most common practices are explanatory factors for the adoption of cloud systems. However, in a highly institutionalised

environment, conformity to the legal framework greatly influences decision-makers' behaviour. Added to this coercive pressure reflecting the public objectives of respect for the law and confidentiality, is imitation-type institutional pressure.

The model largely explains the cloud type and mode that is used. While some dimensions, such as risk, are considered an asset to the adoption of all cloud systems, some attributes, such as perceived advantages, have more weight for some cloud types. Specific attributes, such as the system's complexity, influence specifically the adoption of PaaS and IaaS-type systems, so contrary to prior studies it is useful to distinguish between the different forms of cloud computing when we want to explain its adoption. We also observe that legitimacy sources vary according to cloud type. As far as cloud format is concerned, we observe that the desire to conform with the legal environment justifies the creation of internal clouds. These results are consistent with those obtained by Yigitbasioglu (2015) and Phaphooma *et al.* (2015), who emphasise the security problem in the choice of cloud type. Going further, we show that the perception of non-conformity can also determine cloud computing format adopted.

Through the relevance of its sample, the survey has the advantage of explaining the development of these cloud computing practices within large local authorities. However, certain relationships that appear to be insignificant might appear to be significant in larger samples. The survey originally highlights the various cloud computing

types and formats. From a managerial perspective, it highlights the importance of the IT director's involvement in a cloud project, and it stresses the importance of the IT staff's capabilities and skills in the process of change. It shows the high level of importance of the legal framework when institutionalised organisations make choices, but it also shows that they can disconnect from this framework. Surprisingly, IT directors usually initiate outsourcing practices, such as subcontracting public or hybrid clouds, although such practices can reduce the activity of their department. The fact that IT directors are state employees may explain such behaviour towards this risk of staff reduction. It shows in practical terms that IT directors can, for specific cloud formats and types, benefit from others' experience, and that perceived cost and advantages can explain the decision to adopt SaaS public cloud systems. Participating in fairs targeting local authority IT directors can expand this experience-sharing to other cloud types and formats. Yet, this position is generally linked to private or public IT directors.

The study carries certain limitations. Small local authorities are excluded from our analysis because we wanted to investigate a population of similar sized organisations. We only interviewed IT directors, but it might have been useful to cross their opinions with those of general service directors, elected representatives and even users. Yet, we did not aim to study the degree to which public agents use a technology but a technology adoption by a sector's organisations. Using a widespread TAM model could com-

plete the survey by showing how the use of cloud systems develops within organisations.

An international comparative approach could highlight cultural factors and institutional pressures that vary from one country and one sector to another. This would highlight the results of our survey alongside those from other sectors with both high and low levels of institutionalisation. Ultimately, it could explain the speed differences in innovation adoption processes from one country to another.

REFERENCES

- Abrahamson, E. (1991), "Managerial fads and fashions: the diffusion and rejection of innovations", *Academy Management Review*, Vol. 16, n°3, p.586–612.
- Agarwal, R. & Prasad, J. (1998), "A Conceptual and Operational Definition of Personal Innovativeness in the Domain of IT", *Information Systems Research*, Vol. 9, n° 2, p. 204-215.
- Allen, V.L. & Wilder, D.A. (1977), "Social comparison, self-evaluation and conformity to the group", in J.M. Suls and R.L. Miller (éd.), *Social comparison processes: theoretical and empirical perspectives*, Washington, Dc, Hemisphere.
- Amblard, M. (2003), "Convention et Management", Edition De Boeck, 320 pages.
- Asch, S.E. (1951), "Effects of group pressure on the modification and distortion of judgments", in H.Guetzkow (ed.). *Groups, leadership and men*, Pittsburgh, Carnegie.
- Becker, S. W. & Whisler, T. L. (1967), "The Innovative Organization : A Selective View of Current Theory and Research", *Journal of Business*, Vol. 40, n°4, p. 462-469.
- Benlian, A. & Hess, T. (2011), "Opportunities and risks of Software-as-a-Service: Findings from a survey of IT executives. in: *Decision Support Systems (DSS)*, Jg. 52, H. 1, p. 232-246.
- Besson, P. & Rowe, F. (2011), Perspectives sur le phénomène de la transformation organisationnelle, *Système d'Information et Management*, Vol. 16, n°1, p. 3-34.
- Boltanski, L. & Chiapello, E. (1999), "Le nouvel esprit du capitalisme", Édition Gallimard.
- Boltanski, L & Thévenot, L. (1991), "De la justification des économies de la grandeur", Edition Gallimard.
- Chong, A. Y. L. & Chan, F. T. S. (2012). "Structural equation modeling for multi-stage analysis on Radio Frequency Identification (RFID) diffusion in the health care industry", *Expert Systems with Applications*, Vol. 39, n°10, p. 8645–8654.
- Cloud Security Alliance. (2011) "Security guidance for critical areas of focus in cloud computing" v3.0 Retrieved from. <https://cloudsecurityalliance.org/research/security-guidance>.
- Chou, D. C. (2015), "Cloud computing risk and audit issues", *Computer Standards & Interfaces* Vol. 42, issue C, p. 137–142.
- Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly*, Vol. 13, n° 3, p 319-340.
- DeLone, W. & H., McLean, E. R. (1992), "Information systems success: the quest for the dependent variable", *Information systems research*, Vol. 3, n°1, p. 60-95.
- Delmas, M. A., & Toffel, M. W. (2008), "Organizational responses to environmental demands: Opening the black box", *Strategic Management Journal*, Vol. 29, n°10, p. 1027-1055.
- DiMaggio, P. J. & Powell, W. W. (1983), "The iron cage revisited: Institutional iso-

- morphism and collective rationality in organizational fields, *American Sociological Review*, Vol. 48, n°2, p. 147-160.
- European Network and Information Security Agency, (2009). "Cloud computing: Benefits, risks and recommendations for information Security" Retrieved from <http://www.enisa.europa.eu/activities/risk-management/files/deliverables/cloud-computing-risk-assessment>
- Fishbein, M., & Ajzen, I. (1975), *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*, Reading, MA, Addison-Wesley.
- Garrisona, G., Wakefieldb, R. L. & Sanghyun, K. (2015), "The effects of IT capabilities and delivery model on cloud computing success and firm performance for cloud supported processes and operations", *International Journal of Information Management*, Vol. 35, n°4, p. 377-395.
- Geczy, P., Izymi, N. & Hasida, N. (2012), "Cloudsourcing: Managing cloud adoption", *Global Journal of Business Research*, Vol. 6, n°2, p. 57-70.
- Geczy, P., Izymi, N. & Hasida, N. (2013), "Hybrid Cloud management: Foundations and strategies", *Review of Business and Finances studies*, Vol. 4, n°1, p. 37-50.
- Granovetter, M. (1985), "Economic action and social structure: The problem of embeddedness", *American Journal of Sociology*, Vol. 91, n°3, p. 481-510.
- Hartley, J. (2005), "Innovation in Governance and Public Services: Past and Present, *Public Money and Management*, Vol. 25, n°1, p. 27-34.
- Hecker, A. & Ganter, A. (2013), "The Influence of Product Market Competition on Technological and Management Innovation: Firm-Level Evidence from a Large-Scale Survey", *European Management Review*, Vol. 10, n°1, p.17-33.
- Hofmann, P. & Woods, D. (2010), "Cloud Computing: The Limits of Public Clouds for Business Applications", *Internet Computing, IEEE*, Vol. 14, n°6, p. 90-93
- Kuan, K. K. Y. & Chau, P. Y. K. (2001), "A perception-based model for EDI adoption in small businesses using a technology-organization-environment framework", *Information and Management*, Vol. 38, n°8, p. 507-521.
- Kolodinsky, J. M., Hogarth J. M. & Hilgert, M. A. (2004), "The adoption of electronic banking technologies by US consumers", *International Journal of Bank Marketing*, Vol. 22, n°4, p. 238-259.
- Lachmann J. (1993), "Le financement des stratégies de l'innovation", Economica, Paris, 1993.
- Lacity, M., & Willcokds, L. (2013), "Outsourcing business process for Innovation", *MIT Sloan Management Review*, Vol. 54, n°3, p.63-69.
- Lamb, R., & Kling, R. (2003), "Reconceptualizing users as social Actors in information system research", *MIS Quarterly*, Vol. 27, n°2, p. 197-236.
- Lewis, D.K (1969), "Convention: A philosophical study", Harvard University Press, Boston.
- Lian J-W, Yen D. C., & Wang, Y-T. (2014), "An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital", *International Journal of Information Management*, n°34, n°1, p. 28- 36.
- Lin, A. & Chen N.-C. (2012), "Cloud computing as an innovation: Perception, attitude, and adoption", *International Journal of Information Management*, n°32, n°6, p. 533-540.
- Lin, C. H., Lin, I. C., Roan, J. S. & Yeh, J. S. (2012), "Critical factors influencing hospitals' adoption of HL7 version 2 standards: An empirical investigation", *Jour-*

- nal of Medical Systems*, Vol. 36, n°3, p.1183–1192.
- Liu, C. F. (2011), “Key factors influencing the intention of telecare adoption: An institutional perspective”, *Telemedicine Journal and e-Health*, Vol. 17, n°4, p. 288–293.
- Lippert, S. K., & Govindarajulu, C. (2006), “Technological, Organizational, and Environmental Antecedents to Web Services Adoption”, *Communications of the IIMA*, Vol. 6, n°1.
- Lisa, B. A. (2011), “Hospital uses cloud computing to improve patient care and reduce costs”, Available from <http://www.microsoft.eu/cloud-computing/case-studies/hospital-uses-cloud>
- Low, C., Chen, Y., and Wu, M. (2011), “Understanding the determinants of cloud computing adoption”, *Industrial Management & Data Systems*, Vol. 111, n°7, p. 1006–1023.
- Lyer, B. & Henderson, J. (2010), “Preparing for the future: Understanding the seven capabilities of cloud computing”, *MIS Quarterly Executive*, vol. 9, n°2, p. 117–131.
- March, J. G. & Simon, H. A. (1958), “Organizations”, New York: Wiley, 2nd ed.
- Marston, S., Li, Zh., Bandyopadhyay S., Zhang, J. & Ghalsasi, A. (2011), “Cloud computing - The business perspective”, *Decision Support systems*, n°51, n°1, p.176–189.
- Mazalov, V., Lukyanenko, A. & Luukkainen, S. (2015), “Equilibrium in cloud computing market”, *Performance Evaluation*, n° 92, p. 40–50.
- Meyer, J. W., & Rowan B. (1977), “Institutionalized Organizations: Formal Structures as Myth and Ceremony”, *American Journal of Sociology*, Vol. 83, n°2, p. 340–63.
- Midgley, D. F., & Dowling, G. R. (1978), “Innovativeness: the concept and its measurement”, *Journal of Consumer Research*, Vol. 4, n°4, p. 229–242.
- Moore, G.C. & Benbasat, I. (1991), “Development of an Instrument to Measure the Perceptions of Adopting an Information”, *Information Systems Research*, Vol. 2, n° 3, p. 192–222.
- Oliveira, T., Thomas, M., & Espadanal, M. (2014), “Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors”, *Information & Management*, Vol. 51, n°5, p. 497–510.
- Osborne, S. & Brown, L. (2013), “Risk and innovation: Towards a framework for risk governance in public services”, *Public Management Review*, Vol.15, n°2, p. 186–208.
- Phaphooma, N., Wanga, X., Samuel, S, Helmera, S. & Abrahamssona, P. (2015), “A survey study on major technical barriers affecting the decision to adopt cloud services”, *The Journal of Systems and Software*, n°103, pp 167–181.
- Rogers, E. M. (2003), “Diffusion of Innovations”, 5th Edition, New York, NY: The Free Press.
- Rogers, E. M. (1995), “Diffusion of innovations”, New York.
- Schelling, T. C (1960), “The Strategy of Conflict”, Harvard U Press.
- Scott, W. R. (2008), “Institutions and organizations (3rd ed.). Sage Publications.
- Teo, H.H., Tan, B.C.Y., Wei, K.K. & Woo, L.,Y. (1995), “Reaping EDI benefits through a pro-active approach”, *Information and Management*, Vol. 28, n°3, p. 185–195.
- Thong, J. Y. L. (1999), “An integrated model of information systems adoption in small businesses”, *Journal of Management Information Systems*, Vol.15, n°4, p.187–214.

- Tiers, G., Mourmnan G. & Leclercq-Vandelannoitte, A. (2011), "L'envol vers le Cloud : un phénomène de maturations multiples ", *Systèmes d'information & Management*, Vol 18, n°1, p. 7-42.
- Tornatzky, L.G. & Fleischer, M. (1990), "The Process of Technology Innovation", Lexington: Lexington Books.
- Tingling, P. & Parent, M. (2002) "Mimetic Isomorphism and Technology Evaluation: Does Imitation Transcend Judgment?", *Journal of the Association for Information Systems*, Vol. 3, n°5, p. 113-143.
- Tushman, M. L. & Nadler D. (1986), "Organizing for Innovation", *California Management Review*, Vol. 28, n°5, p.74-92.
- Van de Ven, A. H. (1986), "Central Problems in the Management of Innovation", *Management Science*, Vol. 32, n°5, p.590-607.
- Venkatesh, V., Morris, M. G., Davis, G.B. & Davis, F.D. (2003), "User Acceptance of Information Technology: Toward a Unified View", *MIS Quarterly*, Vol. 27, n° 3, p. 425-478.
- West, M. & Altink, W. (1996), "Innovation at Work: Individual, Group, organizational, and Sociohistorical Perspectives", *European Journal of Work and Organizational Psychology*, Vol. 5, n°5, p. 3-11.
- Windrum, P. (2008), "Innovation and entrepreneurship in public services", in P. Windrum and P. Koch (ed.) (2008), *Innovation in Public Sector Services-Entrepreneurship, Creativity and Management* Cheltenham UK, Northampton MA, USA, Edward Elgar, p. 3-20.
- Yang, Z. Sun, J., Zhang, Y. & Wang, Y. (2015), "Understanding SaaS adoption from the perspective of organizational users: A tripod readiness model", *Computers in Human Behavior*, n°45, p. 254-264.
- Yusof, M., Kuljis, J., Papazafeiropoulou, A. & Stergioulas, L. K. (2008), "An evaluation framework for Health Information Systems: Human, organization and technology-fit factors (HOT-fit)", *International Journal of Medical Informatics*, Vol. 77, n°6, p. 386-398.
- Yigitbasioglu, O. M. (2015), "External auditors' perceptions of cloud computing adoption in Australia", *International Journal of Accounting Information Systems*, Vol. 18, n°3, pp 46-62.
- Zaltman, G., Duncan, R. & Holbek, J. (1973), "Innovations and Organizations", New York : Wiley.