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Digitizing the Public Organization: Information System Architecture as a Key Competency to Foster Innovation Capabilities in Public Administration

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Abstract

The aim of this paper is to focus on the problems encountered in digitizing public administration. It puts emphasis on what is at stake with e-administration and underlines the contrast with the high rate of failure in managing such projects. After a review of why so many projects fail, the paper outlines, through the experience of a pilot project implemented in the Ministry of Finances in France, which key competencies need to be improved in the public sector and what could be an appropriate training program.

Keywords: information system architecture; information technology; eGovernment; innovation; complex systems; design science

1. Introduction

Since the advent of the computer, Information Technology's (IT) promise to radically transform public administration and foster innovation fueled the rhetoric of many reformists. To date, the results are ambivalent: on the one hand, it is clear, thanks both to academic research and practical experiences carried out by governments all over the world, that IT may attain such results. On the other hand, on many occasions, IT projects do not deliver. In the worst cases, they fail, and in the majority of cases, they run over budget and deliver poor results.

Information technology was a central topic in the rhetoric of New Public Management (NPM), as it was supposed to help "reinvent government". In the neoclassical economy and its counterpart in the public sector, NPM, technology appears to be manna from heaven that directs our lives, before which we must bow, and to which we must adapt. As Brian Arthur puts it "we have created a thing, technology, that responds not primarily to human needs but to its own needs" (Arthur 2009). Arthur adds that our relation with technology is ambivalent, since what is at stake is not the technique in itself but our relation with nature. Technology is "nature organized for our purposes", but we forget that we must design these purposes. When we place too much hope on technology, it tends toward closure and self-determination and becomes an end in itself.

This situation is not particular to the public sector, since there is a global problem of systems design – which we call "complex systems architecture" management. This problem is rooted in a misunderstanding of the very nature of technology. Systems Architecture is a generic discipline which aims to handle objects (material or not) in a way that supports reasoning about their structural properties. A system is complex when it aggregates heterogeneous components like humans, hardware and software to perform its mission. The level of complexity is dependent on the number of interrelations between these components and their degree of heterogeneity (Maier 2000; Aiguier, Golden and Krob 2010). Systems architects use models to build abstract representations of the reality that help understand the complexity, and design systems consistently with their purpose. "Complex systems architecture" is, according to the definition coined by Marc Aiguier, Boris Golden and Daniel Krob in 2010, a "generic discipline to handle objects called systems in a way that support reasoning about the structural properties of these objects".

2. The oblivion of the Baconian Legacy

The mainstream trend in technology management, influenced by neoclassical economy, seems to have forgotten the recipe of the industrial revolution that made Europe the richest continent in the world, although all the technology it used was invented somewhere else – mainly in ancient China (Pomeranz 2000). The key to this success is well known to historians of economic development, but not enough to public managers and researchers. This key is the Baconian program in knowledge management. Francis Bacon suggested to use technological progress in order to attain material progress, through a program that "consisted of the application of inductive and experimental method to investigate nature, the creation of a universal natural history, and reorganization of science as a human activity" (Mokyr 2003). In *The Advancement of Learning* (1605), Bacon criticizes the politicians' disdain for knowledge and defines what must be an appropriate use of knowledge: not a "vain philosophy" – as condemned by St Paul – but a means "to give ourselves repose and contentment", keeping us aloof from the temptation to fully understand the very mystery of nature.

Bacon (1620) defines knowledge as a process, both in its social status that must be improved by the state and the king (the Latin translation of "advancement" is "de Dignitate") and as a progress in knowledge. Both are linked, since there can be no progress without a rewarding social status. We can understand today that this status and the alliance between the state and the progress of knowledge is one of the key factors of the "great divergence" (Needham 1969; Pomeranz 2000) between China and the West at the time of the industrial revolution, and of the "long divergence" of the Muslim world (Kuran 2010).

According to Bacon, knowledge is a process that must rely on both theoretical and empirical knowledge. If real knowledge "takes away the wildness and barbarism and fierceness of men's mind", a superficial knowledge "does rather a contrary effect" (Bacon 1605). The real knowledge implies experimentation and a round trip to theory. This process must be guaranteed by the state, as an architect of the numerous initiatives in research activities, through appropriate institutions. Such institutions appeared after Bacon's death, namely the Royal society in England (1660) and the *Académie des sciences* in France.

The advancement of learning was identified with invention (the discovery), then with innovation (practical applications that improve the condition of mankind). Hilaire-Perez (2000) puts an emphasis on the impact this approach had on the modernization of the public administration during the *Ancien régime*. Evaluating and validating inventions to grant the inventors with patents required the development of an expertise within the State that leveraged the modernization of public administration, since departments were obliged to work together. A virtuous circle between institutional renewal (the modernization of public administration) and scientific progress (innovation) was set in motion. Let us point out that this process is exactly what we call today "competitive intelligence" at the government level: breaking the silos in public administration, sharing information and building expertise in order to enhance decision-making and produce strategic knowledge.

Although there is no direct link between the Baconian program and the first industrial revolution since it was mainly the fruit of empirical improvements by craftsmen, it created a cultural- and innovation-friendly institutional climate and triggered an adaptive institutional evolution that was the key to the industrial take-off in the West. The Baconian program reached full bloom with the second industrial revolution, which was based on scientific discovery (chemistry and electricity), in the second half of the 19th century.

It is quite striking that those who, today, wax lyrical about economics and its marvelous achievements are the same who never gave the Baconian program much credit for this development. As Mokyr put it, "technology is knowledge": the word "technology" embeds two concepts: the τέχνη (*techné*) – or the pure craft that makes a taciturn job that alleviates the burden of man and makes things that, unaided, he could not achieve – and λόγος (*logos*) – or knowledge, that is the process of designing what technology must do and for which purpose. This knowledge is built on the one hand on our theoretical knowledge, but mainly on what Mokyr calls "useful knowledge" produced by the interaction of our epistemic knowledge with our inductive experience and our beliefs. By playing with technology, we discover and learn what technology can do, what it may do and what it may not do.

This problem is quite common in the Western world: we have forgotten Francis Bacon, and we confuse technology with technique. By a semantic drift, technology has forgotten the knowledge dimension and has come to be able to define good ends by its own means. This is the reason why our projects escape to our ends.

3. Technology as manna from heaven

In the neoclassical framework, translated in public management in NPM, technology is exogenous and considered to be "manna from heaven", as initially defined by Solow in his approach of economic growth (Solow 1956). Since then, much of the literature envisions technology as a public good that only needs to be applied to reveal its benefits. Endogenous growth theory, on the contrary, reveals that "much of what is involved in mastering a technology is organizational specific investment and learning" (Nelson 1996, 257).

This is not particular to the public sector: until the "dot.com" bubble burst, the world of technology was dominated by the "e-diocy" hype, where any e-something was supposed to solve any kind of modernization problems. The consequences were especially damaging in the public sector. The thorough studies carried out by Dunleavy et al. (2009) at LSE reveal a strong correlation between NPM-enthusiast countries and big failures in IT projects. The rationale was "government is lagging farther and farther behind in adopting state of the art IT" – that was obvious – so the conclusion was drawn by conservatives that the failure of government to keep up with IT confirmed their a-priori idea of privatizing public services (Starr 2010). This gave birth to the hype of outsourcing public IT to the private sector, mixed with another hype of the NPM era: an agencification that fragmented public organizations, impeding any global architecture of the public services.

From the balance of this era, we may draw an ideal picture of the "rules to fail" in managing IT in the public sector with the British case:

- De-emphasis on open competition and segmentation by agencies led the markets to be captured by large firms, with no global competencies to negotiate on the part of the state.
- This conservative (or neo-liberal) view led paradoxically to rising costs due to the emergence of an oligopolistic market, although counterweighted by the Small Business Act (SBA) effect in the US and the small size of the market in New-Zealand.
- The preservation of in-house competencies of the public administration appears to be a key-differentiating factor. Successful countries (such as the Netherlands and Canada) retain more than 50% of their expenses in-house, thus are able to negotiate with the providers. Innovation is produced by these processes of negotiation, which turn into learning processes.

Since innovation and in-house capabilities are key, there is an inverse correlation between expenses in e-government and value creation.

4. Creating strategic capabilities for the public sector

4.1 Lessons from the CHAOS Report for the private and the public sectors

The Standish Group's CHAOS Report is one of the most cited reports when it comes to the management of IT projects (Standish Group 2004). Despite the fact that the definitions for *successful*, *challenged* and *failed* projects adopted by the CHAOS Report are rigid and somewhat overemphasize failure rates, it remains an important measure for the IT industry.

Based on the experiences described in the previous section, we may draw two lessons. The first one is not specific to the public sector. As reported in the CHAOS Report, for the private sector, the probability of failures is a growing function of the project's size, up to 100% above a certain size. Successful projects are a minority, and the majority remains the "challenged projects" which run over budget or take more time than expected. The rate of successful projects rises according to a learning curve, but very slowly. Failed projects diminish, but when a new technological hype appears (e.g. Service-Oriented Architecture, Business Process Modeling Notation), the failure rate rises again. Then a new learning curve begins. According to the Standish Group, the larger the organization, the larger the deficiencies. Table 1 summarizes the project success factors.

Table 1: **Projects success factors**

1. User involvement 15,9%
2. Executive Management Support 13,9 %
3. Clear Statement of Requirements 13,0 %
4. Proper planning 9,6 %
5. Realistic expectations 8,2 %
6. Smaller Project Milestones 7,7 %
7. Competent Staff 7,2 %
8. Ownership 5,3 %
9. Clear vision & Objectives 2,9 %
10. Hard-working, Focused Staff 2,4 %
11. Other 13,9 %

Source: Standish Group (2004)

In the public sector, these trends are amplified by specific constraints:

- The quantity of big projects that are subject to specific constraints and rigidities, implying a large amount of heterogeneous data and a wide range of stakeholders.
- The difficulty of defining a stable perimeter.
- The need to conceive evolutionary systems able to evolve under foreseeable endogenous change linked to politics and unforeseeable exogenous change linked to the environment.

According to our above definition of complex systems, we may say that systems are more complex in the public sector and that they require specific skills in architecture.

In the eyes of the Standish Group's criteria for failing, it appears that the cultural and professional context of the public sector amplifies the risks: Both the "technology as manna from heaven" culture spread by NPM ideology and the lack of architecture-related capacities give to the previous first three causes for failure a significant impact:

- Users are not involved in the projects, since these projects (specifically ERP projects) upset the current organizational arrangements and meet resistance to change from employees. "User involvement" is not part of the administrative culture, either Weberian or neo-Weberian.
- The requirements are not clearly defined: technology is thought to be a problem solver in itself. Projects are driven from a technical standpoint, without rethinking the human and organizational processes. When processes are taken into account, they are merely described and not reengineered, leading to a bureaucratic frenzy, with hundreds of overly detailed diagrams that can hinder the maintainability of the system over the long term.
- Consequently, there is poor management support: Managers see the problem of digitizing the organization as a technical problem only. They consider only the emerged part of the iceberg (Rochet 2010) and not the underwater part, which is the one needing full organizational redesign.
- Another reason may be added: the unrealistic expectation from politicians who favor spectacular big projects that, in the eyes of the CHAOS Report's criteria, are those more prone to failure.

The second lesson from the CHAOS Report concerns a consequence specific to the public sector: whereas in the private sector, failures concern mainly a company and its closest stakeholders, in the public sector, failures harm the society as a whole. Dysfunctions in tax services or unemployment agencies have a socio-economic impact that not only destroys economic value, but most of all undermines the people's confidence in the government. Failure in big projects is seen as a lack of fiscal discipline, and a shocking waste of public funds in a context of scarcity. Moreover, it may reinforce the belief that privatization and/or outsourcing are the solution.

4.2 How to deal with these problems?

First, from a technological viewpoint, we need to identify the temporalities that structure an information system in order to build agile, adaptive and resilient systems. Second, we need to implement a Baconian approach in order to improve the competencies required to deal with these problems. This means that we need first to identify temporalities.

In this context, temporality means two things: speed and evolution. In technology development, not all things go at the same speed. For instance, within the same technological setting, the speed of the microchips (CPU) progresses at the quasi-constant pace of Moore's Law, while the speed of network connections remains largely unchanged (with the exception of optic fibers). The confusion between theses two speeds is an important cause of failure in architectural design. Input/output devices still rely on the classical law of physics: electric signals through copper wires. Technology vendors have their own speed since they have to fulfill commercial objectives that rarely coincide with the real needs of the clients.

Evolution is distinct from speed since it supposes interactions between implementation and the possibility of technological development. The potentialities appear step by step, through an intuitive Baconian process. A first project modifies the environment, and these modifications open new possibilities for future projects.

4.2.1 Business temporalities

IT allows designing new activity models in order to deal with complex public-policy issues: transversal approaches, businesses' interoperability and organizational resilience. These temporalities must integrate the permanency of policies and systems, and their capacity to react to unexpected events. The challenge is to design processes that allow conceiving a resilient organization. This kind of temporality is typically evolutionary and takes place in the medium term. There is a feedback loop between the business strategy and the IT strategy which allows a learning process: a first project will demonstrate that IT may help solving problems or delivering new services, and thereby business becomes aware of new strategic possibilities. That is what is coined by the literature as "strategic alignment". In our context, it is the agility which is being sought, rather than the alignment. Permanent strategic alignment is illusory, as any change in the environment or in the organization's strategy will break the alignment. This is why the system must be flexible (agile) enough to evolve according to these changes.

4.2.2 Technology temporalities

IT apparently evolves fast. However, to catch the evolution of technology as a whole, one has to dig into the layers of technologies. We stressed above that Moore's Law only applies to microchips. The interconnection between computers via networks belongs to the world of telecommunication, which is a specific matter of architecting local-access networks, hubs, commuters and the Internet.

Many failures in system design are the consequence of the confusion between these temporalities. A system that works on one network of desks will prove inappropriate when deployed at a large scale (see Textbox 1).

> Textbox 1: **The Geode Case**
>
> In the case of the new information system ("Geode") of the French employment agency, "Pole Emploi", that aimed to merge the databases of the two agencies previously in charge (The National Agency for Employment and the ASSEDIC), the flow of data has been underestimated. After the project had been tested in three regions, it appeared that the growing amount of data had a negative impact on the application responsiveness and led to a steady increase in the employee's workload. The project, initiated in 1997, was cancelled in 2005 with a total loss of 130 M euros for an initial budget of 26. (Source : Rochet, Chevodian and Tiberghien 2009)

4.2.3 Vendor temporalities

Technological innovation evolves according to the long time of the Schumpeterian business cycles and Kondratiev waves. Very few macro-inventions originate a paradigm shift: most innovations are "new combinations" of existing technologies, as described by Schumpeter. Vendors' strategies, on the contrary, evolve according to the short term of the quarterly results calendar. Employees are stressed out by reporting systems and are incentivized to oversell their products. Their business model fosters a tendency to promote any micro-innovation – not to speak of simple new brandings – as a game-changing breakthrough. For instance, SOA is presented as a sea change, although this concept has existed since the very beginning of computer architecture. It is thus critical that the IS architects be aware of these temporalities to avoid traps and confusions.

4.2.4 Temporalities in project design

The rules of system design have not varied much since Fred Brooks' seminal opus *The Mythical Man Month* (1975) and the rule of tree-structure design defined by Herbert Simon in the 1950s (Simon 1973). Design methods answer to different rules as they apply to hardware or software. The French concept of "urbanization" (city-planning metaphor applied to the design of an information system) allows designing building blocks encapsulated in a bigger system. What is at stake is to avoid the "spaghetti syndrome" that results from sedimentation of layers of software, hardware, human behaviors and organizational policies without any global plan.

The effort must bear on architectural design and interfaces between subsystems:

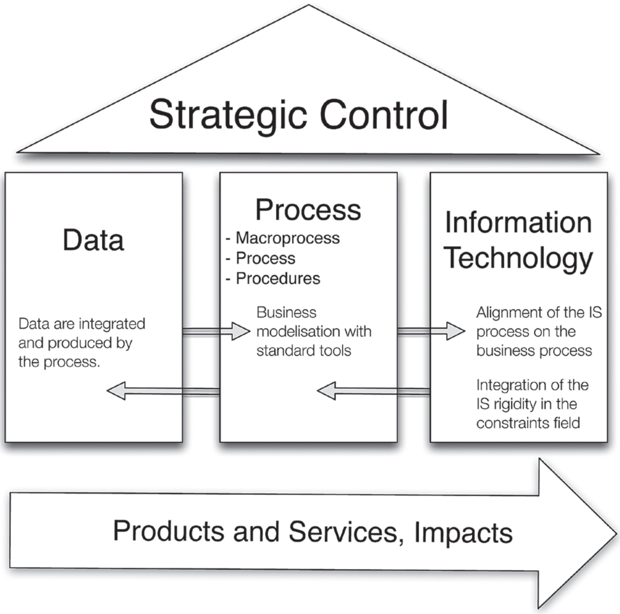
- *Quality of business architectures:* Business architectures must be able to change according to the strategy. The strategy may remain unchanged for a long time (e.g. tax-filling policies and systems) or may change overnight in case of a crisis. It must also be resilient if the administrative business takes place in a permanently changing environment (e.g. disaster-management departments). Therefore, the first questions to be raised before beginning to play with technology are "what is our business model? What are the processes which allow us to reach our goal? How may IT help design new architectures?"
- *Quality of internal software architecture:* Business processes are human processes. Software systems are organic (human) and technical systems. They are the counterparts of the human system. Although legacy systems often pose specific integration problems, modern IT allows connecting almost everything with everything, insofar as the software architect applies agile architecture methodologies that relies on a "what works" approach. Vendors may be reluctant to conform their products to the "urbanized" or architectured approaches, as this may reduce the dependency of their clients on them (vendor lock-in).
- *Quality of interfaces between machines:* This is the "brick & mortar" dimension of the information system. Several generations of devices with

heterogeneous performances cohabit. This is the job of the technical architect to organize this cohabitation, to decide whether a device must be changed, upgraded, and under which conditions it may be interconnected with other hardware. It is of course the interest of vendors to plan the obsolescence of their hardware in order to prevent interoperability with the latest generation one.

- *Quality of incoming and outgoing data:* This point is often neglected: it is of no use to properly design processes if the data is not accurate. Data have their own life cycle that must be managed. An information system obeys to the GIGO principle "Garbage in, Garbage out". With the spreading of Enterprise Resource Planning systems (ERP), workflows and Customer Relationship Management (CRM) applications, software produces a huge amount of data: just as a search on Google delivers N answers among which very few are relevant, data management needs information brokers that have to separate useful from useless information. This is possible by developing a "science of ignorance" (Lurçat 2003) to reset the operational data, get rid of unnecessary data and generate useful data. These must come from the experience following the methodology of the evidence-based management (Pfeffer and Sutton 2006). This "science of ignorance" questions the value of the observations that have generated the data. The ownership of the data (who is responsible for its accuracy; preferably not the IT department) must be clearly defined. Information society does not, contrary to a common hype, mean flattening organizations, decentralization and disaggregating of power: it needs more central architects to define what is relevant information. "Digital agents … are powerful resources for all sorts of human interaction. But to pursue their development needs more cold appraisal and less redefinition or evangelism" (Brown and Duguid 2002, 61).

As a result, digitizing a public service requires three pillars (see Figure 1):

- The central pillar is about human and business processes modeled using standard tools such as Mega®, Casewise® and IDS-Scheer's ARIS® Platform. The key issue is that if these tools help chart the processes, the first step is to design the processes as human processes using pencils and stickers, respecting the principle of tree decomposition: macro-processes, processes and procedures.
- Facing these human processes are the digitized processes. Constant improvement in IT allows more and more flexibility. Nevertheless, the architect has to deal with the set of constraints brought about by the legacy systems. Anyway, even with an agile architecture approach, not everything can be made. There is an evolutionary process between these two pillars: process design defines requirements for software design, and the progresses in software architecture allow new possibilities that trigger innovation in process design.
- The third pillar is data. The current shortcoming of process design is not to take into account the problem of quality of data at the same time. Therefore, systems are locked in a GIGO effect.



Source: Krob and Printz (2010)
Figure 1: **The three pillars of organizational architecture**

But the main temporality is that of the required competencies to conceive, monitor and manage those systems. To date there is significant competence lag in the public sector.

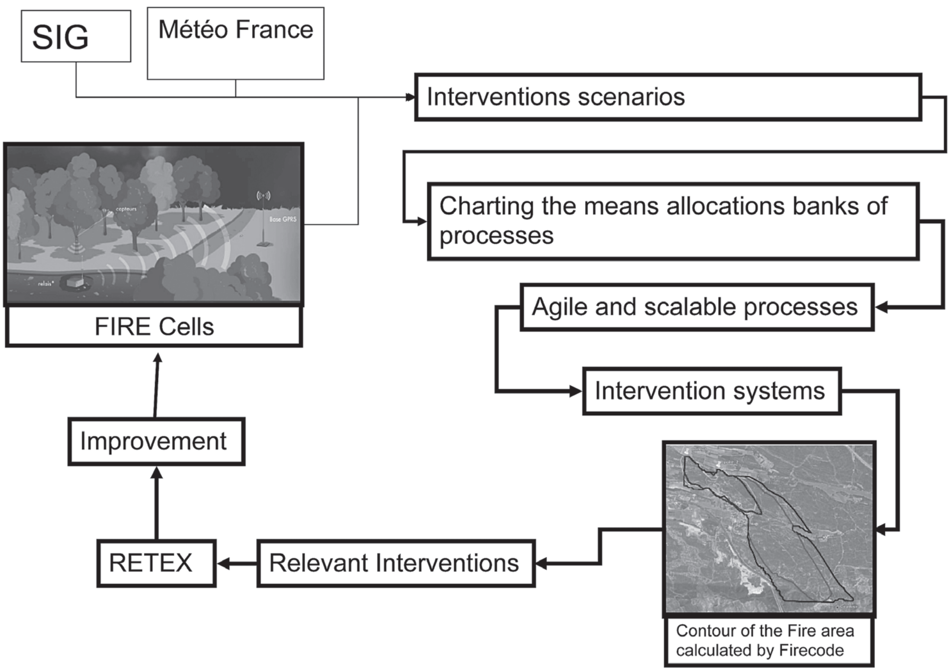
We study the agile architecture of an IS project, "FIRE" (see Figure 2), of a French fire department in the South of the country (Bouches-du-Rhône). This study partnership between the Fire and Rescue Service of the Bouches-du-Rhône Department and the *Institut de Management Public et de Gouvernance Territoriale* (IMPGT). It is an action research that has been conducted during 3 years with the quality manager of the fire department, a PhD candidate and two professors of IMPGT.

The "external innovation" dimension is the adaptation of the chips cards (the same technology that is used for credit-card chips) to the detection of forest fires. Those cards emit signals that give two kinds of information:

- the emission ceases when the air temperature reaches 90°, indicating the ignition of a fire;
- the saturation of terpenes in the air (natural exploding gases widespread in the Mediterranean vegetation), which can produce a flashover that can seriously harm firemen.

The data produced by the FIRE cells is retrieved by a geographic information system and aggregated with weather forecast information, so that a scenario of fire propagation may be instantly generated. A scenario bank is built, allowing an evaluation of the means to be mobilized to answer a given alert.

The “internal innovation” dimension concerns the translation of real-life scenarios into operational processes that will be supported by a business-process-modeling (BPM) approach. This allows the alignment of the information system with the operational processes. It is therefore possible to instantly know the configuration of the disaster, its propagation and to allocate the appropriate resources. The performance of the device relies on the agility of the business-process management, that is, the evolutionary capacity of the architecture. A Lessons Learned (LL) approach fosters organizational learning and helps improve the device.



Source: Rochet, Chevodian and Tiberghien (2009)
Figure 2: **The FIRE project aims to connect external and internal innovation**

4.3 Attempts to develop competencies to deal with the temporalities

This part is empirically based on an innovative experience: the creation of a training program for enterprise architects in the public sector, following an evaluation of a lack of competencies in the French public administration. This training program is, to our knowledge, one of the first in this field in the country. It has been carried out through a partnership between the Ministry of Finance in France and one of the state-of-the-art academic institutions in the field, the famous engineering school École Polytechnique.

In the French state public sector, there was no CIO function till February 2011. Project leaders are either civil servants, who have developed an IT competence on their own, or IT professionals hired on specific contracts, but who do not know administrative processes. In any case, the key concepts of organizational architecture are not taught in the civil-service training schools.

There are several lessons to be learned from this experience on the key competencies to be mastered, and on how to train the architects so as they stay away from the influence of the vendors' propaganda and construct a positive dialogue between IT people and administrative businesses. On the other hand, it is an innovative experience of collaboration between administration and universities to trigger innovation in the public sector by appropriating new knowledge.

This experience allowed it to connect practitioners and academics through an institutional arrangement that triggers on the field-action research. Epistemic knowledge produced by academic research could then be linked to empirical knowledge produced by practitioners. This link is either made by a coaching process between the training sessions or directly by incorporating epistemic inputs in workshops, monitored by academics with a very strong professional background, through concrete and real situation problem-solving workshops.

As a result, the program is intensive (10 two-day sessions over one year). It is aimed at people who are in charge of a project related with architecture, whether they come from IT or business. The program is grounded in professional practice, with individual coaching on the participants' project and case studies. It is aimed to qualify the participants through a process of evaluation under the supervision of the academics.

Designing such a program was a radical breakthrough in the French administration. So, it was decided, from the very beginning, to allow sufficient time to define the problems met, the specificities of information-systems management in public administration in the French context and the relevant learning approach according to the culture of civil servants.

This task has been carried out by a conception committee that brought together high-level sponsors from the main ministries, with a particular impulse from the ministry of finances, top academics and representatives of the French CIO association (CIGREF).

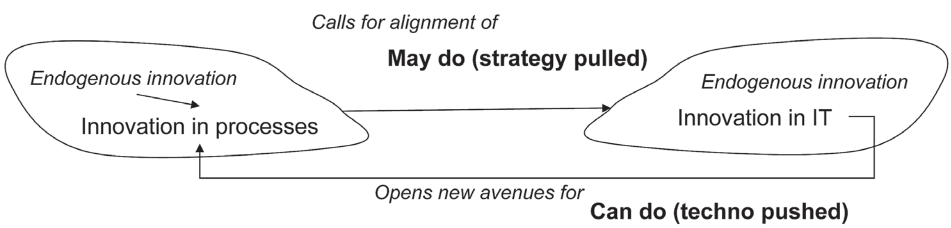
In designing the program, two principles were adopted. First, it was decided that the training had to be "state of the art", and independent from vendors and consultancies. A partnership was formed between the training department of the ministry of finances (IGPDE) and the Thalès Chair of System engineering at École Polytechnique. This partnership implied a shared investment of both parts and a shared ownership of the final product. This way of proceeding is an innovation in itself since, on the one hand, it avoids a call for tenders that would have attracted consultancies and vendors, and, on the other hand, it fosters collaboration between researchers and practitioners.

Second, a "Baconian" approach was chosen, that is to say an intuitive approach of the key concepts through individual experiences of participants, case studies, experimentation and return to experiences. To this end, each session is constructed on a constant scheme: sharing of experience between participants, theoretical contribution, case-study workshop, testimony of major project leaders and back to formal conceptualization. Between each session, each participant has to work on his own project, receives support from a coach and has a particular assignment. Eventually, session after session, each participant builds their own knowledge, that they will present in a memoir they defend in front of a jury of academics and practitioners at École Polytechnique.

Then key concepts are defined as the Information System, and a global architecture is the encounter between two meta systems and goes through the following steps:

- The organization of business processes;
- The technical system that allows digitizing these processes;
- The information system brings together business processes and technical systems. The technical systems are made of two subsystems: hardware (such as servers, computers) and software;
- The evolutionary process of the organization is the result of an interaction between: The top management, which is supposed to define the strategy, and the requirements of what the technical system *must* do …
- … and the IT department, which is in charge of the technology watch and telling the top management what the technical system *can* do.

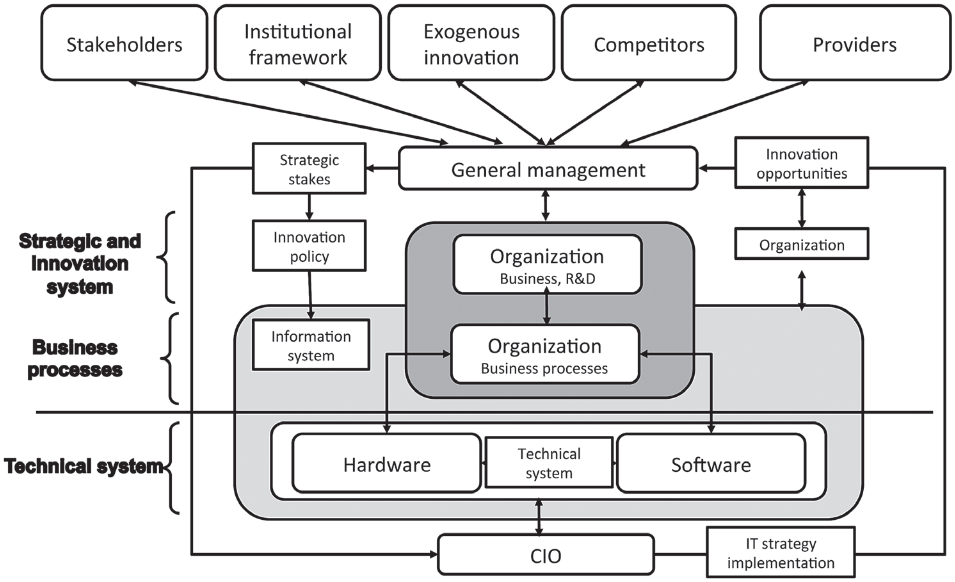
This interaction between the "must do" and the "can do" triggers innovation: what was not possible becomes possible thanks to technology; new strategic avenues open but require an evolution of business, processes and IT (Figure 3).



Source: the authors

Figure 3: **Dialogue between the "can do" and the "must do" to build strategic alignment**

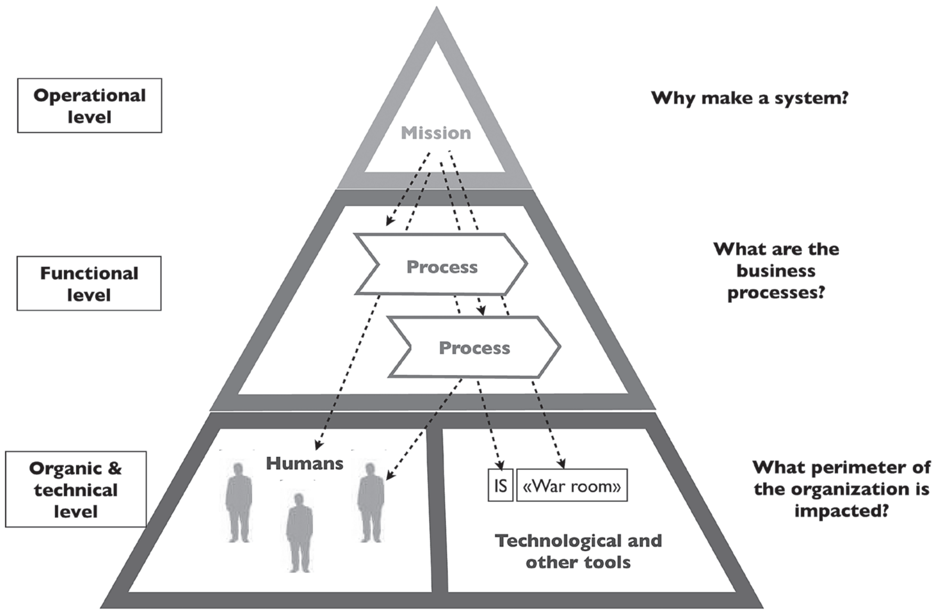
This dialogue between CEO and CIO is the key to this evolutionary engine (Figure 4).



Source: Rochet, Chevodian and Tiberghien (2009), adapted from Krob and Printz 2010
Figure 4: **Enterprise processes and information system**

As the digitized processes are a reflection of human processes, the architect first designs the business processes and the functions to be carried out. These functions define the requirements of the information system, and these human requirements are translated in software requirements. This requires a tree-diagram approach, answering first and foremost the question "why are we building a system?" This allows defining the ends of the system. Then, the architect turns to designing the business processes, defining their life cycle and the functions to be performed, and in the third place (and in the third place only) the relevant subsystems.

In our canonical triangle, *From End to Tool* (Figure 5), the base is composed of two subsets: human systems and computerized systems. The latter are only tools that are meaningless by themselves, since the meaning must be given and driven by the human system. The main discourse and practices of consultancies proceed the wrong way: as they sell their technologies as "solutions", they require people to adapt to their technology. This is what is generally coined as "change management". The underlying assumption is that technology is intelligent and that people are stupid or, at least, too conservative or "reluctant to change". Without user involvement, the ends, the functions to be performed, are not defined. The tool becomes the end.



Source: Krob and Printz (2010)
Figure 5: **From End to Tool**

Having said that, we have to define a methodology to involve all the stakeholders. This is done through collaborative strategic alignment workshops, where all the stakeholders, with very simple tools such as pencils and stickers, map the system. For instance, the workshop can bring together strategists, business-process owners, people in charge of distribution channels and IT people. Note that in the workshop, they stand apart: their role is to listen and to understand. Then, they will draft a solution that will be tested by users and improved through iterations.

5. Best practices

As a result, we have formalized some principles that could become part of the common sense of any architect, because architecture modeling is a key component of any IT project, and this from its very beginning. From this perspective, practice modeling is accurate when it is used to solve a specific problem without using the latest up-to-date tool to build models too general. This way of modeling can be referred to as the *Keep it short and simple* (KISS) principle: do we need that? For what purpose? It does not impede the model to be more sophisticated as the project advances as we found that a big coarse-grained model proves more useful than a complete but unreadable model.

It is also important to keep in mind that an information system is only a representation of the reality, so there will always remain many uncertainties that must be permanently explored by the architect, taking into account the human or technical dimension of a project. This last point was found to be effective only when process modeling fostered iteration between the clients and the architect. If this is not the case, the organization can face the “black box” syndrome when clients do not understand the Information System as they were not involved in every step of the design process.

A model needs to be stable but not unchangeable: it is an ongoing process that may be capable of evolution as we draw near the real of the real, and the condition for a model is to be trustworthy. For that purpose, experience is key: we have estimated that at least ten years of professional practice is necessary to begin architecting. Once designed, a model becomes an asset of the organization, a building block that will facilitate further modeling. An assessment of the training program was made with the participants, which is summarized in Table 2.

Table 2: **Strengths and weaknesses of the training program**

Strengths	Weaknesses
It is crystal clear.	The problem of poor support from top management remains unsolved, in spite of the high price of this training and the immediate and visible impact on the daily performance. Executives were invited to the defense of the memoir by participants to become more aware of the work accomplished. The program reveals this lack of support more strongly since the architecting process needs to present trade-offs. We are thinking about a special short session for top executives, to explain to them what their role is.
The sequence of concepts is natural.	
It is ready to use.	
The triangle is limpid (Figure 5).	
The methodology allows going from the global to the detail.	
Even a beginner in architecture may apply it.	
Case studies and testimonies.	

6. Conclusion, limitations and further research

We define technology as an evolutionary process that structures the dialogue between the world of technology – the “can do” dimension – that tells the business what is now possible that was not at the date of its origin, and the world of business that must reinvent itself through innovation – the “may do” dimension. NPM ideology has hindered this process by promoting an abstract “manna from heaven” conception of technology. This ideology collapsed when the failures in IT systems and the sunk costs made the reality inescapable.

New rules for the game of playing with technology may be invented step by step, based on experimentation. As Bacon put it four centuries ago, the success of a nation does not rely on race, climate, geography or natural resources but on its ability in arts defined as the capability to stimulate the production and selection of useful knowledge through a permanent round trip from epistemic knowledge to empirical practice. Good institutions – rules of the game – for creating value using IT will emerge from this process of digitizing public administration.

“Properly managed” means a clear understanding of the very nature of technology by public managers, so as putting first their strategic objective and defining the appropriate metrics to measure how a system is useful, reliable or not. This supposes an intense interaction between two different disciplines; strategic thinking and technology management, between public customers and vendors. The more intense this interaction, the more useful knowledge is produced.

The updated “three C” of the Baconian program is summarized in Table 3.

Table 3: **The updated “three C” of the Baconian program**

Classical Baconian activities	Description	Digitized Baconian activity
Categorizing	Grouping processes, building blocks, aligning business and IT, architecture, testing	Conceiving
Classifying	Libraries of (on-the-shelves) processes, routines, sub-systems, functions, applications, urbanization plan	Charting
Counting	Gathering the data, tasks, units of works, procedures, software (legacy), lines of code	Computing

The new digitized Baconian program may allow Public CIO to conduct IT projects on the right way by beginning with the reflection on the ends of the tools needed in the conception activity, followed by the charting and the computing steps.

References

Aiguier, M., B. Golden and D. Krob. 2010. “Modeling of Complex Systems II: A Minimalist and Unified Semantics for Heterogeneous Integrated Systems.” *lix.polytechnique.fr*, 1-25. Available at http://www.lix.polytechnique.fr/~-golden/research/amc2010.pdf (last accessed 10/02/2012).

Arthur, W.B. 2009. *The Nature of Technology: What It Is and How It Evolves*. New York: The Free Press.

Bacon, F. 1620. *Novum Organum*. Paris: Hachette.

Bacon, F. 1605. *The Advancement of Learning*. Paris: Hachette.

Brooks, F. 1975. *The Mythical Man-Month: Essays on Software Engineering*. Boston: Addison-Wesley.

Brown, J.S. and P. Duguid. 2002. “The Social Life of Information.” *The Library Quarterly* 71, 94-96.

Deloitte Research. 2007. *Choosing Channels: Optimising the Channel Mix in the UK Public Sector*. London: Deloitte & Touche LLP.

Dunleavy, P., H. Margetts, S. Bastow and J. Tinkler. 2003. “E-government and Policy Innovation in Seven Liberal Democracies.” *Political Studies Association’s Annual Conference 2003*. Leicester: Leicester University Press, 1-34.

Hilaire-Perez, L. 2000. *L’invention technique au Siècle des Lumières*. Paris: Albin Michel.

Krob, D. and J. Printz. 2010. “Urbanisation des systèmes d’information & alignement stratégique." *Formation-action d'architectes urbanistes de systèmes d'information*. CNAM, Paris, 7 and 8 January 2010.

Kuran, T. 2010. *The Long Divergence: How Islamic Law Held Back the Middle East*. Princeton: Princeton University Press.

Lurcat, F. 2003. *De la science à l'ignorance*. Paris: Du Rocher.

Maier, M.W. 2000. *The Art of Systems*. Los Angeles: CRC Press.

Margetts, Helen. 2009. "Public Management Change and e-Government." In Chadwick, A. and P.N. Howard (eds.). *Routledge Handbook of Internet Politics*. Oxon: Routledge.

Mokyr, J. 2003. *The Gifts of Athena: Historical Origins of the Knowledge Economy*. Princeton: Princeton University Press.

Needham, J. and L. Wang. 1956. *Science and Civilisation in China: History of Scientific Thought*. Cambridge: Cambridge University Press.

Nelson, R. 1996. *Technology, Institution and Economic Growth*. Boston: Harvard University Press.

Pfeffer, J. and R.I. Sutton. 2006. *Hard Facts, Dangerous Half-Truths, and Total Nonsense: Profiting from Evidence-Based Management*. Boston: Harvard Business School Press.

Pomeranz, K. 2000. *The Great Divergence: China, Europe, and the Making of the Modern World Economy*. Princeton: Princeton University Press.

Rochet, C. 2010. *Politiques publiques, de la stratégie aux résultats*. Louvain: De Boeck Université.

Rochet, C., L. Chevodian and B. Tiberghien. 2009. "Performance et agilité des processus au Service Départemental d'Incendie et de Secours des Bouches-du-Rhône (France)." *Deuxième Dialogue Euro Méditerranéen de Management Public*. Portoroz-Piran, Slovénie, 7-10 October 2009.

Simon, H.A. 1973. "Applying Information Technology to Organization Design." *Public Administration Review* 33 (3), 268-278.

Solow, R. 1956. "A Contribution to the Theory of Economic Growth." *Quarterly Journal of Economics* 70 (1), 65-94.

Standish Group. 2004. *CHAOS Report Project Success Rate*. Boston: Standish Group.

Starr, P. 2010. "The Liberal State in a Digital World." *Governance*, Vol 23 (1), 1–6.

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