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Vladislav Fomin
GSCM-Montpellier Business School

Francois-Xavier de Vaujany
University Pierre Mendès France

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A NEW THEORETICAL FRAMEWORK FOR ARTIFACT-MEDIATED REGULATION

François-Xavier de Vaujany
CERAG (UMR CNRS 5820)
University of Grenoble 2
150 rue de la Chimie
38040 Grenoble
FRANCE
vaujany@upmf-grenoble.fr

Vladislav V. Fomin
Vytautas Magnus University
Vileikos 8
LT-44404, Kaunas
LITHUANIA
vvfomin@gmail.com

Abstract

In this paper, we attempt to integrate the traditionally disparate concepts of technology design, use and organizational practice in organizational studies. Using Jean-Daniel Reynaud's joint-regulation theory, we demonstrate how these traditionally separate perspectives on ICT-related practice and organizational change process can be brought together under the umbrella of a practice-based view emphasizing rule-setting in organizations. Further, we synthesize existing accounts of practice-based view on organizational processes to introduce the notion of artifact-mediated regulation. It is argued that combined with Reynaud's joint-regulation theory, the proposed notion of artifact-mediated regulation provides a tool for holistic analysis of the dynamics between ICT design and use and organizational practice.

Keywords: Organizational practices, Jean-Daniel Reynaud, joint regulation theory, information and communication technology (ICT), technology artifact.

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Introduction

Contemporary firms experience a growing complexity in the processes leading to design and implementation of Information and Communication Technology (ICT). ICT systems and organizations become more and more distributed, technology design process increasingly intertwined with its use, involving more and more actors, often relying on a vaguely defined role system. This results in fuzzy boundaries between technology-related practices and other organizational practices.

The materiality of ICT artifacts in organizational settings and the continuous interaction of artifact-related and organizational process remains an underdeveloped topic in the IS literature (Béguin and Rabardel, 2000; de Vaujany and Fomin, 2006; Orlikowski, 1992; Orlikowski and Yates, 2006). Nature of contemporary ICT-imblicated work and organizing, however, cannot be understood without considering both technological changes and institutional context that are shaping socio-economic activities (Boddy & Paton, 2005; Sabherwal *et al.*, 2001; Whittington *et al.*, 1999). There is a call to further interaction between Information Systems (IS) and organization studies (OS) research to be more carefully attuned to explaining the nature and consequences of the techno-social phenomena that increasingly pervade our lives_ (Orlikowski & Barley, 2001, p.145).

In this paper, we attempt to integrate the traditionally disparate concepts of technology design, use and organizational practice in organizational studies. In doing so, we suggest to view organizational change process through artifact-mediated rule-setting and rule-maintenance processes, i.e., the regulation process. Current research concerned with the role of technology in organizational change processes shows that technology applications co-evolve with organizational practices, policies and processes. Thus, these emerging types of ICT artifacts appear to be related to organizational regulations processes. This relationship is particularly emphasized in the longer phase implementation processes, such as Enterprise Resource Planning (ERP) projects (Lemaire, 2003) where there is a strong mutual structuring effect between the ICT and organizational practice. Another example calling for further theorizing on the IS-OS interaction is the subtle and continuous relationship between ICT design and use in most e-learning technology or groupware implementation (see Béguin & Rabardel, 2000 or Lin & Cornford, 2000).

Using Jean-Daniel Reynaud's joint-regulation theory (JRT), we demonstrate how traditionally separate perspectives on ICT-related practice and organizational change process can be brought together under the umbrella of practice-based view. Introduction of technology artifact into Reynaud's joint-regulation theory gives IS and OS scholars a valid framework for holistic analysis of the dynamics between ICT design and use and organizational practice.

Practice-based view on ICT in organizations

Over the last 25 years, scholars of IS and OS research have demonstrated an increased interest in practice-based view. Practice-based analyses responded to the increased complexity of ICT design processes and the organizational environment by taking into account such factors, as situatedness, material-boundness and recurrent routine of collective action (Orlikowski, 2002: 256), thus attempting to explain the dynamics between the ICT-related and organizational practice.

Such orchestrated "turn to practice" (Whittington, 2006) in the two disciplines is not surprising. The nominal view of ICT in organization research presents it as the engineered artifact, expected to do what its designers intend it to do_ (Orlikowski & Iacono, 2001, p.123), i.e., technology is seen as a tool *for achieving certain organizational goals*, as a devices that enables organizations to achieve performance benefits in the course of their ongoing socio-economic activities. As failures of ICT development and implementation at virtually any level, from in-house information systems (Ramiller, 2005) to national ones (Hanseth *et al.*, forthcoming), became a commonplace, scholarly inquiry has shifted from asking the question "what technology is?", to studying processes that help yield

the desired organizational change – in other words, asking the question how technology-mediated work is being carried out?”

Attempting to answer the aforementioned question, most practice-based views draw on general sociological or psycho-sociological approaches like: Giddens’ structuration theory (1986), Archer’s critical realistic approach (1995), Bourdieu’s theory of practice (1977), or Emirbayer and Mische’s model (1998). Specifically in the IS domain, practice-based view is presented in numerous intermediary theories, such as Adaptive Structuration Theory (AST) (Desanctis and Poole, 1994), Orlikowski’s structurational model and practice lens (2000, 1992), Barley’s model of technology (1986, 1990) as an opportunity for structuring, Walsham’s interpretive approach (1993, 1995), Actor-Network Theory (ANT) (Callon & Latour, 1990), Jones and Nandhakumar’s (1993) structurational approach of IS, Mingers’ (2004), de Vaujany’s (2003) and Dobson’s (2001) critical realistic approaches, Lin and Cornford’s (2000) or Carroll’s (2004) “in use design” view, and Social Constructivist (SCOT) approach (Bijker et al, 1987) to technology studies.

The aforementioned bodies of literature share the view that there is an important relationship between the technology design and its appropriation and use in organizational (or broader) context. Thus, through the lens of those theories, ICT artifacts are always examined as “technology in practice”.

Within the common importance attributed to the “technology in practice”, there are two competing (or complementary) conceptualizations of the technology-practice relationship, both assuming that there is no ontological difference between design and use, but that both are primarily social practice.

On the one hand, technology is denied any materiality. An ICT is perceived as a “memorial trace” in actors’ mind, a socio-cognitive scheme, resulting from their interactions with a socio-technical environment. This is rather coherent with Orlikowski’s practice lens (2000), Walsham’s interpretative approach (1993, 1995), or Cousins and Robey’s patterns of technology use (2005). From an epistemological stance, this can be related to structuration theory (Giddens, 1979, 1984).

On the other hand, technology is given a material existence, and an exteriority. Technology is socially constructed (and then both enabling and constraining) and physically constraining, in the sense that it can be linked to an opportunity scope. This view is rather coherent with Barley (1986, 1990), Callon and Latour (1992), Desanctis and Poole (1994), or Dobson’s (2001) approaches. More generally, this second practice-based view is coherent with a critical realistic stance (Archer, 1995).

Whether seeing technology in practice as a socio-cognitive scheme, or as an “object in practice”, appropriation of the practice-based view to the problem can be said to be concerned with the continuity and dynamics of design process in organizational settings. Specifically, practice-based view on design is concerned with how the mutual influence of technology and practice unfolds (in the design and post-implementation phases).

Given the theoretical scope of practice-based studies, they bear a promise of providing sufficient theoretical explanations for the dynamics of the unfolding interaction between the technology-related and bureaucracy-related organizational practice. However, only few studies suggest a holistic practice-based view, which encompasses the organizational life *with* ICT from the local design to the use phase (Markus & Robey, 1988; Holmström & Robey, 2005). The linking element between the ICT-related and bureaucracy-related practice in these studies is seen as being established through development and maintenance of rules in organizational settings – what Bowker and Star (1994, p.187) called a “frozen organizational discourse” – the hidden decision processes inscribed into technology during the technology development phase structure the organizational practice at the technology-use stage.

An integrative framework: Jean-Daniel Reynaud’s joint regulation theory

The classical conceptualization of organization, according to Weber (1978) is a system of rules, or bureaucracy. From this perspective, understanding the organizational change process is through instantaneous development and subsequent maintenance of rules. In Weber’s school, rules are issued by the management of the organization, authority of which is not questioned and the rule is assumed to be rational.

With the “turn to practice” in the OS (Whittington, 2006), the emphasis has shifted from the static “organization” as a set of rules, to the process of emergence of the rules, and study of how the rules are followed, maintained or circumvented (see Crozier and Friedberg, 1977). In the newly developed practice-based view of OS, the relationship

between the hierarchy and the rule setting authority is not anymore seen as unilateral. Horizontal, peer-to-peer rule setting becomes an important aspect of organizational change process.

The French sociologist Jean-Daniel Reynaud, as an epitome of the practice-based view, was one of the first OS scholars to systemically differentiate and integrate different kinds of organizational regulations in his joint-regulation theory. We see Reynaud’s (1988) theory of joint-regulation not only as an appealing way to reconcile disparate notions, but also as a meta-theory which can be used in the IS research to move away from a virtual and artifact-free conception of regulation (as described by Crozier and Friedberg (1977) or Whittington (2006)) to that of a sociomaterial one. In order to accomplish the proposed task, we introduce the concept of artifact-mediated regulation in the organizational change process.

Two main social regulations

Jean-Daniel Reynaud is the epitome of the French tradition of sociology of work and labor (Reynaud, 1997), interested in a major issue: “the tensions between the two antagonist or complementary facets of work and labor, namely, human work as personal creation, and labor as pain” (Paradeise, 2003, p.633). This school of thought has gone through three main periods over the last 50 years, from questioning the reduction of creative work to labor disutility, to focusing on exchange values of skills on the labor markets and employment norms, to reconciling work and labor, “by handling the creation of skills, norms of employment and work content in integrated theoretical frameworks” (Paradeise, 2003, p.634). Reynaud’s regulation framework sticks to the third period. Indeed, the sociologist is interested in the emergence or disappearance of social order in organizations through rules. According to Reynaud (1988, 1997), the social dynamic in organizational change process is constituted by two related regulations or rule-setting processes (see Table 1).

Table 1. Two social regulations according to Reynaud (1988, 1997).

	Control regulation	Autonomous regulation
Principle	Exogenous regulation	Endogenous regulation
Logics	Organizational effectiveness, market	Both local effectiveness and group’s autonomy Can be imposed by a minority
Nature of the rule	Partly formal (rules), but may rely on many other resources	Local and group. Linked to local learning or socialization processes

The first one is that of ‘control regulation’ (CR), which consists of formulating and maintaining prescriptions for organizational modus operandi. It is linked to market logic and a broad organizational effectiveness goal. While CR is not solely expressed in official rules (it may thus draw on various sociotechnical rules), “it can only be defined through its strategic orientation: weighing externally on the regulation of a social group” (Reynaud, 1988).

The second process is that of ‘autonomous regulation’ (AR), consisting of local adaptations and drifts in the appropriation of the modus operandi. This form of regulation deals with the development of local practices aimed at making the work both more effective and more autonomous. Autonomous regulation, that of the group managing directly the workflow, is not necessarily contradictory with that of the control regulation. Drawing on the Tavistock Institute study, Reynaud (p.7) suggests: “traditions and professional culture of minors had both an end and productive effectiveness, which the social system of relationship between men, communication, norms and values were directly an element of the productive systems”. Besides, it does not result in a harmonious organizational order as autonomous regulations may be conflicting. There is thus no reason for a sum of local adaptation to result in a broader regulation.

Further Reynaud (1988) explains that an organization could reach an ever-questioned third regulation: the ‘joint regulation’ (JR). When some common interests are identified by both regulations (AR and CR), actors are likely to be involved in a third regulation related to forums where control and local adjustments will work out a fragile

consensus. According to Paradeise (2003, p.640), this concept “theorizes how social compromises between employers, employees and possibly the state may become positive-sum bargaining games”. But in many cases, this necessary (for the survival and the global effectiveness of the organization) alignment will be very hard to reach and extremely provisional.

The influence of Reynaud’s regulation theory has had a deep impact in the French sociology. Nonetheless, three broad limitations are often put forward. First, the excessive verticality of his vision of regulation and thus of the prescription process (Midler, 2003). Then, his view of autonomous regulation as a reaction to control regulation. It is clear that autonomous regulation does not necessarily require a counter-part (i.e., CR) to emerge (Denis, 2006). Lastly, the narrow connection established by Reynaud between CR and management (de Terssac, 1992) has been heavily criticized. Indeed, if Reynaud simply relates CR to an exogenous regulation with regard to a group under study, the control is often de facto combined in his analysis with a managerial, hierarchical action. Besides, Reynaud views control regulation has exerted directly on interaction, whereas it may be relayed by members of the group themselves, or artifacts (e.g., ICT), and so something that will ‘infuse’ within the group.

Despite the criticism, the gist of joint-regulation theory remains a major advance in the sociology of work, in particular the symmetrical view of regulation emphasized by Reynaud (Denis, 2006). Here, we will try to stick to the two categories of regulation (AR and CR), while considering them as independent constructs, involving multiple actors, defining either endogenous or exogenous regulations, and sometimes simply relaying them. Besides, we will introduce artifacts to the framework. Indeed, while Reynaud does not explicitly deal with artifacts in his theory, we can notice that they are often present in his description of work situations (see Reynaud, 1997).

Artifact-mediated regulations

Artifact-mediated regulation (i.e. the regulation of collective action through artifacts) is not a novel concept in the IS domain. Such concepts as *inscription* (Latour, 1995), *stabilization* and *rhetorical closure* (Pinch and Bijker, 1984) or *frozen organizational discourse* (Bowker & Star, 1994), among other, are well established in the IS discipline bridges to OS. Those notions suggest that designers inscribe certain organizational behaviors (rules) into the artifact as well as define users with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways_ (maintenance of the rules) (Akrich, 1992, p. 208). Those concepts pertain to the design domain in the IS-for-OS paradigm, and the way they are defined (through rule setting mechanisms), imply pertinence to the concept of regulation, too.

Another type of artifact-mediated regulation known to the IS scholars is found in the domain of “use” IS-for-OS. The departure point for defining such notions as *interpretive flexibility* (Bijker et al., 1987), *drift* in technological trajectory (Ciborra et al., 2001), *anti-program* (Latour, 1995), *affordance* (Gibson, 1986; Weeks & Fayard, 2006), *appropriation* of technology (DeSanctis & Poole, 1994), and *commodification and innofusion* (Stewart & Williams, 2005) is in acknowledging that the authority of artifacts is not absolute. Artifact-mediated rule imposition can be interpreted and appropriated differently by different organizational members (Akrich, 1992, p.209).

All the aforementioned notions inform us on two important implications of the ICT with regard to associated organizational practices. First, that there are some *desired* ways of regulation pertaining to organizational change and development *inscribed* into the artifacts (rule setting), and the *actual* ones (rule maintenance, re-setting of the rules). Second, that the relationship between the desired and the actual pattern of regulation is established by amenability of rules (in the OS jargon), or a certain *restrictiveness* (in the IS jargon) that ICT artifact imposes on organizational processes. Restrictiveness here is defined as the degree to which and the manner in which a [sociomaterial structure] restricts its users’ decision-making processes to a particular subset of all possible outcomes_ (Silver, 1988, p.52). It is a *constraint*, not a determinism, which means that actors can circumvent or overcome restrictiveness through *innovative practice*.

All aforementioned theoretical concepts (except maybe that of DeSanctis and Poole’s (1994) which emphasizes restrictiveness as an exogenous variable) also acknowledge the emergent, constructed and negotiated nature of socio-material regulation (Boudreau & Robey, 2005; Orlikowski, 1992). Nonetheless, they do not really shed light on different regulations processes. Concepts which are the closest associates to regulation, such as *inscription* in Actor-Network Theory (see Latour, 1995) or *stabilization / closure* in the SCOT approach (see Pinch and Bijker, 1984) both describe only general processes. Moreover, ANT’s “inscription” offers a unilateral view on rule-setting mechanism in artifact-mediated processes, while SCOT’s “closure” assumes unchanging nature of rule-maintenance.

In the following section, we will demonstrate how Jean-Daniel Reynaud’s practice-based view on organizational processes can help make sense of complex organizational change processes involving design and implementation of ICT artifacts in more meaningful ways than the extant IS theories. In doing so, we first will introduce the notion of artifact-mediated regulation into Reynaud’s framework.

Joint-regulation theory and the role of artifacts

While artifacts-mediated regulation is an important aspect of IS research (as we have attempted to argue above), it has not been really dealt with in Reynaud’s theory. We believe that the need for introduction of technology artifacts in his typology is justified by the intricate relationship between the organizational change process and ICT in the contemporary settings (Orlikowski & Barley, 2001). Non-systematic attempts to introduce technology artifacts in Jean-Daniel Reynaud’s theory have already been done. Below, we propose what we believe is a systematic treatment of IS-OS relationship – an integrative framework, which accommodates ICT-related practice in Jean-Daniel Reynaud’s theory. This relies on Norman’s (1991) and Denis (2006) vision of prescription in organizations, described by means of Reynaud’s practice-based view.

In Table 2 below, we demonstrate how ICT artifacts (and artifact-mediated regulation) can be part of Reynaud’s control or autonomous regulation.

Table 2. Artifacts and regulations.

	Control regulation	Autonomous regulation
Status of artifacts	A place of continuous inscription by an exogenous regulatory practice, a “prescriptive artifact” (Denis, 2006)	An object to appropriate, i.e. to make useful for a given purpose (autonomy or local effectiveness), a “cognitive artifact” (Denis, 2006) resulting in emergent endogenous rules
Typical practice related to the artifact	Regulation charts, elaboration of restrictive interfaces, automation of processes, development of compartmentalized IS, moderations on forums	Unexpected uses (from the CR point of view), combination of various artifacts, development of local rules

ICT artifacts can be either related to exogenous closures (in the case of CR) or local appropriations (in the case of AR). Rules can be distributed in organizational practice through “prescriptive artifacts” (Denis, 2006). But artifact will never be prescriptive *per se*. Neither will they embody an expected social structure (Orlikowski, 2000). Some mediators (Hotlines, Webmasters, IS managers, etc.) must maintain and adjust the prescription so as to make it effective (Denis, 2006). A prescriptive artifact will thus rely on a net of material and social constraints maintained by a set of continuous (re-)design activities, accepted by people involved in the final enactment of the tool (Denis, 2006). Thus, prescription is not a prerogative of hierarchical actors, but “a dynamic activity, shared by people with various statuses, who do not all have an official mandate habilitating them to supervise the work of their colleague” (Denis, 2006, p.12). Thus, there is no an a priori association between prescription and a subordinate relationship.

Conversely, some artifacts are simply put at users disposal, without any precise prescriptions. No specific inscription is maintained by designers. This results in various learning processes, bricolages, making ICT a “cognitive artifact” (see Denis, 2006; Norman, 1991).

To summarize, the regulation in the organizational dynamics can be mediated through artifacts, while the organizing modality of artifacts (i.e., their restrictiveness) is practice-dependant, and is neither static nor an a priori construct. Viewing organizational regulation processes through the lens of JRT thus helps overcome the inflexibility and the lack of materiality or technology artifacts in organizational processes. Compared to other popular theories in IS, JRT has thus its specificities (see Table 3 below):

Table 3. The role of technology and rules in popular IS theories and in joint-regulation theory

	Actor Network Theory (ANT)	Structuration Theory (ST)	SCOT	Joint Regulation Theory (JRT)
Main focus	Network elaboration	Social structuring	The closure of a sociotechnical system	The regulation of organization
Status of technology	An actant A place of inscription	A memorial trace	An object which mediates the emergence of a new socio-technological order – a closure	A potential place of regulation
Status of rules	Homogenous and not really at stake. Rules can be inscribed in technology.	Homogenous and a dimension of structural properties	Homogenous and an implicit part of the process of closures	The main focus of the framework, but as a process, something which should always be mobilised. Various kinds of rules and regulation can be distinguished.

JRT's main added value is thus its emphasis on the variety of organizational regulations, and the way they are combined with adaptations in ICT or non ICT-related processes. But in contrast to ANT or SCOT, artifacts do not seem to be in the forefront of organizational structuring in Reynaud's initial framework (they are only implicitly present in his framework). Denis' or Norman's conceptualizations are a way to overcome this relative limitation, for instance by means of their dual conceptualization of technology (cognitive or prescriptive). In continuation to structuration theory, JRT is a good way to stress sociotechnical structuring, but it is primarily focused on regulations. JRT thus offers a more appropriate basis for studying ICT-mediated regulations than ST does, which is a more meta-theoretical and general framework.

In the following section, we present a case study to demonstrate how the proposed concepts allow identifying specific types of organizational change process vis-à-vis ICT artifacts – that is to say relationships between organizational change, and such traditionally disparate perspectives on IS practice as design and use. Reynaud's framework is used as an integrative structure.

Empirical appraisal of theoretical framework

In the following section we present the methodological device used for this research. This work was mainly based on an interpretive version of the case study methodology. Following the methodology section, we present a case about ICT mediated regulations in the implementation of an e-learning technology in a French university.

Research methods

For this research, we used a case-study to illustrate and refine Reynaud's framework.

In terms of our epistemological perspective, this fieldwork can be broadly defined as 'interpretive'. Our aim was to shed light on various stakeholders' interpretations in the course of technology design and use. As suggested by Vaast and Levina (2006, p 190), "an interpretive approach assumed that agents and field researchers subjectively understand and construct social reality".

To gain the necessary in-depth interpretations surrounding the implementation of information systems and broader regulation process, a case study approach was chosen. Yin (1994, p 13) has defined the case-study method as “an empirical enquiry that investigates a contemporary phenomenon within its real life context, which relies on multiple sources of evidence”. In constructing our research, we followed additional guidelines aimed at improving the rigor research. Among such, we draw on work of Walsham (1995), who insisted on the importance of interviews in interpretive studies, for it caters for the “best interpretations that participants have regarding the actions and events that have, or are taking place”. We also took into consideration the seven properties of Klein and Meyer (1999): the principle of the hermeneutic circle (between actors stressed by our participation in the organizational setting and search for actors’ feedbacks about our interpretations), the principle of contextualization (of all agencies illuminated by researchers and emphasized in our narration of the case), the principle of interaction (between researcher and subject, which has been exacerbated by an active data collection through participation in the organizational setting), the principle of abstraction and generalization (in an effort of theorization), the principle of dialogical reasoning (i.e. a sensitivity to contradictions between theories and practices, subsequent revision, for instance in a recurrent confrontation of interpretations between co-authors or stakeholders vision of the process), the principle of multiple interpretations (by means of a stakeholders’ oriented data collection) and lastly, the principle of suspicion (towards the narrative produced by participants).

In continuation with classic semi-structured interviews (focused both on users and designers), we also draw on four other information sources (see de Vaujany 2007 for details of the analysis): (1) internal documents (such as memos); (b) external documents (leaflets, websites, press articles...); (c) participant observations (in steering committees, managerial meetings, etc. as an official members of the organization); and finally (d) a specific monthly questionnaire (to evaluate users’ appropriation of technology) which was applied recurrently during the first year of study. The questionnaire consisted mainly of questions about ICT uses and interpretations, and the perimeter or directions of interaction and its evolution. Three structures of interactions were particularly the focus of the survey: students-students, students-teachers and students-administrative staff

Finally, one of the authors have been involved in the technology implementation process as a manager. This made it possible to gain a deep insight of the process of design and use over the whole duration of the project, while also maintaining the classic data collection processes, as described above. Combined, our observations, questionnaire and interviews made it possible to establish “multiple perspectives” (Klein and Myer, 1999; p 77), and were a way to avoid biases in reconstructing historical accounts of the cases (Kranakis, 1988). Interviews were focused on the story of IS design and use in the organization (and the main phases the process has gone through according to the interviewee).

The case presents design and implementation of an e-learning system in a French university (see Table 4 below).

Table 4. Main features of the case-study

Dimensions	The organization
Organizational setting	An economics and management department in a French university
Technology under study	An e-learning, open source technology, devoted to universities
Period of study	2003-2006
Status of researcher within the organization	Member of the team in charge of the technology
Use of complementary sources of information	Yes (internal documents, external documents, 4 semi-structured interviews and monthly questionnaires)

Case study: the implementation of an e-learning system in a French university

Our case study reports on implementation of an e-learning system within the department of Management and Economics of a French university during 2003-2006. This period corresponded to deep changes in the French academic system. All diplomas were on the verge of being reframed to stick to new European criteria called LMD (“Licence-Master-Doctorat”), a BSc-MSc-Doctorate classification. In this context, the head of the economics and management department was seeking to adopt an e-learning technology for his academic unit. He felt that most of his competitors had already begun to launch such projects and had heard that the university was trying a new tool called the “virtual office” (“bureau virtuel” in French). The software was intended to supplement real-time education. The Virtual Office (VO) was based on an open-source software. The principle of VO was simple: when a student using a web browser was logging on to the system, on the screen there was a list of courses he or she was attending. The personal list of the courses made the appearance of VO likely to be different for different students. The implementation of the software was supported by a commission at the university. The commission (“TICE”) was made of “virtual office delegates” – representatives from each faculty. It is as one of these delegates that the first author took part in the project. Retrospectively, the history of the virtual office at the university can be divided into five main stages (all related to new usage patterns and specific organizational regulations).

Stage 1: Initial installation of the system at the university (2002-2003)

It was within the faculty of Medicine and IUT (“Institut Universitaire Technologique”, i.e., an institute for vocational training) that the experiment truly began. Instigated by two teachers of the university, a first version of the system was implemented in 2002. The support of the Dean of the Faculty of Medicine was as strong as it was official. In a few months, the sheer number of platforms was remarkable. Most teachers of the medicine faculty, sometimes under the pressure of students, used what was then announced as “the virtual office”. In June 2003, more than 300 sites (administration or teaching-oriented) were developed, most of which used many of the advanced functions of the software.

Stage 2: Launch of a first basic model in the Management and Economics faculty of ‘confidential’ software (June-October 2003)

The first attempt at introducing the tool in the Management and Economics faculty dated back to early 2003. After a very short design period (of a couple of weeks, and consisting mainly in a brief adaptation in terms of teaching categories to be created) the system was ready to be implemented. But it was only after a general presentation to faculty members in May 2003 that the head of the department decided to offer a version of the tool to his students. After the initial period of work during the summer and the first two weeks of September, a dozen of sites were launched in a sub-unit of the Faculty (IUP, a post-graduate vocational training in business studies): one

administrative portal (including administrative information such as internal rules, conditional scheduling of reports, daily time schedules, notes, forums, etc) and eleven training platforms. Then, several problems arose. The list of students included in the step-codes was not always accurate. Besides, several errors had been made by teachers in the registration process. Many students did not find their login and password on their student card (the same used for their university e-mail account) required for authentication on the site. Finally, and primarily for political reasons, several teachers chose not to use the new tool. The software thus initially remained rather unknown and unused. The number of business students using the software was very low (less than half); number of log-ins was limited as well (3 to five a day in October).

Basically, the training and communication concerning the new software were insufficient, mainly because of a lack of resources. The commission succeeded in training only ten permanent staff lecturers and three administrative agents in the use of the virtual office. Communication was also unsatisfying. It was limited to a public notice presenting the tool in late September. Therefore, in late October it was decided to distribute an instructional guide for the software within the Faculty of Management.

Stage 3: The initial and increasing use of the software by permanent lecturers of the IUP (November 2003-January 2004)

It was really in late November and December that the virtual office began to take off within the faculty. The bulk of the installation problems with the step-codes (due to unpaid university fees) were resolved. More than 15 sites were set up within a month by permanent lecturers of the IUP. Three community sites were also put at the student's disposal: a "general culture space", a "foreign students' space" and a "research portal" devoted to academics. The problem of the recalcitrant faculty members was also resolved. Students started turning reflexively to the virtual office for administrative information. The first part-time lecturers' sites were also set up after individual presentations of the tool were organized for them.

The number of log-ins skyrocketed. In the case of the administrative portal of the IUP, the number of log-ins increased from 3-5 a day to 30-40 a day on average. This portal alone accounted for half of the online activity at the Faculty of Management. The administrative portal of other units of the Faculty experienced more difficulties (notably the one linked to the Department of Finance). Except for its Master's program, the Economics department offered no administrative portals and almost no courses on-line.

In the IUP, however, lecturers promoted the virtual office during their courses. Concrete uses were nonetheless rather limited to the most basic functions of the software (documents, hyperlinks, course presentation, assignment). But the tool gradually gained adherents among the teachers. In our own courses, we did our utmost by mentioning interesting exchanges on the various forums in order to foster student interest.

As for the students, feedback was rather positive. Interestingly, the number of registered people was not representative of the real number of users. Several students frequently shared the same password and login. In one of commission's surveys, a student wrote that "most of the time, I do not connect with my own login password". On the whole, students appreciated having online much of the information they had previously had to demand from the secretaries (scheduling, grades, addresses, internal rules, etc). Forums received their first contributions and soon many students had signed on. On the whole, the virtual office has been a means for students to achieve a fundamental goal of the IUP: autonomy. In the case of certain decentralized departments, the development of an administrative portal relieved a part of the loneliness they had felt before.

At this stage, administrative agents were also relatively satisfied by the new tool, which seemed to make a part of their job lighter. Students called less to ask for information concerning schedules changes or course information.

Stage 4: Growth of a community of practice and first steps toward institutionalization in the Faculty (February to June 2004)

During this fourth period, the virtual office experienced a progressive 'institutionalization'. Several appraisals of the software's distribution were made during the regular meetings of the steering committee every two weeks. Significant information concerning the IUP department was regularly relayed online with the Announcement tool. The first official participations took place. The director of the faculty committed himself more strongly, and even participated in forums on course features. A procedure to systematize feedback about courses was implemented by an administrative agent of the decentralized department. This was accomplished in the form of a book free to

students, in which they had made their remarks and which were then relayed by the secretary. The first official meeting between the entirety of the faculty and the computer analysts responsible for the software was held. A general evaluation of the virtual office was also made for the annual meeting of the IUP department (in early June 2004) along with the counsel of the institute. A “permanent work group” in charge of the virtual office and e-learning technology within the faculty was established.

During some visits to educational sites, it was noticed that more advanced functions had been appropriated by teachers (such as the group tool and the various types of online exercises). The last permanent teachers not involved in the project finally established sites. Nevertheless, some departments in the faculty (such as Economics and Finance) still displayed very low usage of the technology.

From late March (perhaps because of the positive reports distributed), the number of daily log-ins to the portal has reached approximately 50. Students automatically turned to the virtual office for newer and newer types of information. The number of contributions to forums was so high that we were compelled to delete some old topics in order to better organize the site. The first tensions in discussions concerning education and faculty organization were noticed. Nonetheless, it was decided not to interfere in the discussion between students and to give the exchanges complete freedom.

On the whole, however, the situation was far from ideal. Several students of the IUP, from then on regular users of the tool and increasingly more demanding, voiced their criticisms. They regretted that too many lecturers used their site as a sort of “PowerPoint garage” and wished that they had more sites at their disposal, notably with regards resource management, and more up-to-date information (especially with regards to classroom assignments). Moreover, some regretted the lack of involvement of several lecturers of the institution. All this is clearly illustrated in the drop in satisfaction with the administrative portal and the stagnation of increase in general satisfaction.

For the other departments in the faculty (in particular Economics), this fourth period initially grew rather modestly. Several sites were set up.

Stage 5: Fragmentation of the VO community of practice and development of sub-institutionalization processes (September 2004 to February 2006)

During this fifth period, the software continued to infuse within the department, especially among the economics’ department.

All study programs had from then on their own administrative portals. Some portals were co-managed by teachers, students and administrative agents (in the accounting and finance department).

More and more, managers of faculties used the system to put forward the department rules and broader information.

Three sub-communities co-existed with more or less interactions between them: a managerial one (around the IUP), a finance and accounting one (around the CCAF department) and an economics one, maybe less homogenous than the others.

At the end of this period, more than 185 sites have been set up within the Virtual Office by teachers and administrative staff (101 for the IUP alone which remained the main actor of the BV). This resulted in a lower coherence and visibility from students and teachers point of view. Even a new version of the software (launched in 2005), with a better ergonomics, has only partially solved the problem. Some students of the IUP still had to cope with more than 20 sites on the system.

Case summary and analysis

In this section we reflect on the case study, aiming at grasping the reciprocity of connection between Reynaud’s theory, ICT artifacts, and broader organizational practice (see Table 5). The organizational change process in the case study starts with the decision to implement an e-learning system. There is no specific change pursued by the introduction of this ICT tool. Neither revolutionary changes are expected, nor do they occur. While the usual teacher-students interactions are not modified by the introduction of the ICT artifact, one can clearly see some adaptations in the traditional practice, which results in acceleration of some exogenous pre-existing trends.

Table 5. Case summary

Main reasons for the project	Imitation. Important not to ‘miss the train’ of e-learning technologies. No other specific reason
Evolution of regulatory practice	Dominating AR (CR is even absent at the beginning). More control and joint regulation in the end. Institutionalization of a new field within the department at the end of the period.
Status of ICT artifacts	A cognitive artifact. An attempt to build a more prescriptive object at the end of the case.
Instantiation of a joint regulation	In the end of the case

Using the terminology of Jean-Daniel’s Reynaud theory, the case discourse can be developed in a way, which brings together the role of technology- and bureaucracy-related practice in an intertwined, yet dynamic, continuous fashion, as presented below.

At the Stage 1, the system is an object put forward by the control regulation (i.e. university presidency and IS department), but without any structuring power on broader organizational practice. The first design practice (installation and parameter-setting of the software) is disconnected from broader organizational practice. In spite of the success, both design and use practice doesn’t change usual interactions between students and teachers. Extra-learning is sometimes proposed, through the tool, but without any deep impact on teaching habits.

At the end of Stage 2, we can notice several first “bricolages” and drifts (see Ciborra, 1999). Structuration linked to the system relates to various autonomous regulations. Control regulations are relatively absent from the overall dynamic. The software is a kind of empty shell. No attempt has been noticed to inscribe something in it and to make it a “prescriptive artifact”. Interestingly, we notice that no specific project was related to the technology. The only motivation of the head of department for introducing new ICT tool in organization seems to be “not missing the train” of e-learning technologies.

At the Stage 3, multiple re-invention processes took place. The tool, initially conceived as an educational resource, became an administrative tool, a research support network, and a device devoted to a specific course of the IUP (in this last case, strongly modular and frequently improvised by teachers (“cours de méthode”) devoted to the management of trainees). In particular, at the end of this third period, we can also notice new drifts and a broader autonomous dynamic. Several teachers have adapted the main page of their site (and given up the default parameter-setting). Some of them have also decided to use the student registration facility to register colleagues to their sites, whereas another, more complicated procedure, was intended for that as designed by the IS department.

At the Stage 4, finally, we can notice the same sociotechnical dynamic as suggested by Lin and Cornford (2000, p.9) for the implementation of a groupware technology within their university: “we see an almost casual deployment of technology attracting increasing attention, and slowly developing a profile within the university. The debate around the system moves from the individual to the informal (team), and then into the main management structures.” Gradually, the virtual office became institutionalized within the different departments (especially for the IUP) thanks to the middle tiers of the faculty (particularly the directors of various diploma courses and permanent lecturers). The increase in use of the tool has been progressive (ten sites in December 2003 for the IUP and 65 in late June 2004) and the structure of the system has been both modified and redirected, indeed more towards student-administration interactions (which is a somewhat astonishing result for a system initially made for educational purposes).

Control regulation (the administrative officer in charge of the faculty, the dean of the faculty and the presidency of the university) begins to be more involved in the system they introduced. Delegates – the members of the steering commission – receive their first premium for the work as a “delegate” at the end of the year. The grid proposed to students in order to appraise the courses they attended on various scales begins to include a section about the quality of the animation of the professor evaluated with regard to his/her management of his/her site (in the IUP)... But control practice doesn’t really develop counter-regulations. It only institutionalizes the process and enacts its dynamics to various external stakeholders, i.e. visiting persons of the TICE commission or decision makers of the

Region Rhone-Alpes (a public organization more and more involved in the management and financing of ICT investment).

At the Stage 5, we can notice a more and more active control regulation. The TICE commission, the IS department in charge of the technical management of the software and the presidency of the university are more and more involved in the management of the software. The (previously relatively unknown) IT use chart is more and more put forward. IS actors insist on the necessity to put students aside of the system's administration. During this fifth period, a control regulation becomes more visible and conflictual, in particular at the eve of 2006. Nonetheless, no real inscription can be noticed. The level of restrictiveness remains unchanged.

Theoretical contribution

We see five main theoretical contributions of our work, as follows.

In this paper we have synthesized otherwise disparate notions of artifact-mediated organizational process (i.e., the relationship between ICT and organizational change process), into a single integrative framework of regulation. This framework, based on Jean-Daniel Reynaud's joint regulation theory, distinguished between different rule-setting mechanisms in organizational practice, i.e., it acknowledges different ways how authority in organizational settings can be exerted.

Specifically, from the IS point of view, our contribution is in bringing forth a processual, dynamic view on artifact-mediated process. Our framework allows to overcome limitations of such popular in the IS domain concepts as e.g., ANT's "inscription", which offers a unilateral view on rule-setting mechanism in artifact-mediated processes, and SCOT's "closure", which assumes unchanging nature of rule-maintenance.

While it is commonly acknowledged that the ICT permeates virtually all activities in contemporary organizations, the role of ICT in OS literature is not well covered or understood (Orlikowski & Iacono, 2001). Our framework establishes a novel relationship between the ICT and organizational practice, thus inching towards new theories on artifact-mediated organizational change processes.

By introducing the notion of artifact-mediated regulation we go one step further beyond the notions of "restrictiveness" (see DeSanctis & Poole, 1994) and *interpretive flexibility* (Orlikowski, 1992), both of which offer exogenous views of technical constraints in organizational processes. In contrast to existing theories, our proposed model acknowledges and integrates different types of artifact-mediated regulation, and suggests a more emergent perspective on socio-material constraints and their role in organizational change process.

Last, but not the least, we introduce Jean-Daniel Reynaud's joint-regulation theory – a social theory which is virtually unknown to the IS scholars. The joint-regulation theory, we argue, offers an opportunity for bringing closer the IS and OS studies of organizing by allowing to account for varying roles that technology may take in shaping organizational processes over a chosen period of time.

Limitations and Future research

We see five main limitations in our analysis, as follows, for which a further research is needed.

Our suggested view on organizational change process through rule-setting and rule-maintenance (i.e., the regulation process) is only one aspect of organizational change and social structures in organizations. For example, Giddens (1984) distinguishes three dimensions of social structures (signification, legitimation, and domination), where regulation is only one of the three. Our approach may be thus considered as a limited view of organizational change. Nonetheless, our goal was to make sense of artifact-mediated practice and to combine design, use and broader organizational practices. This has led us to put aside some organizational dimensions.

Another limitation is related to the relationship between the meta-model introduced here, and the well known theoretical frameworks such as structuration theory (see Giddens, 1984) or social critical realism (see Archer, 1995). In this paper we have limited the comparison between popular IS theories to the role of technology (see table 3). However, further questions should be addressed. For example, what is the difference between regulation and structuration? Are Giddens' (1984) ideas about norms that far from Reynaud's ideas of norms?

The way we examined the role of technology introduces another limitation of this work. While we used a generic term “technology artifact”, diverse types of IS applications may affect organizational practices in different ways (e.g. ERP vs. Word processor). In the future, it is necessary to distinguish among different types of technology artifacts.

Lastly, our work has not really drawn on broader societal regulations. We cannot adopt open systems view on organizations without considering deep institutional changes. While we recognize the importance of exogenous regulations, they are not directly incorporated in the original Jean-Daniel Reynaud’s theory, and were also foreshadowed in our model. For example, we haven’t demonstrated the crucial role that such exogenous but important to organizational processes actors as e.g., consultants, journalists, business schools, software vendors (and their marketing campaigns) play in local regulation processes. Call for more explicitly addressing broader sociotechnical regulations beyond a narrow view of ICT use management was already voiced by e.g., Proulx, Massit-Folléa and Conein (2005).

The future development of the framework presented in this paper should exemplify how artifact-mediated regulations in organizational change process can be 1) identified, 2) managed by using the framework, and 3) related to broader extra-organizational dimensions. This, in turn, would require introduction of the temporal dimension to the framework (Davidson, 2006; Wagner and Newell, 2006).

Conclusions

In this article we aimed at answering the recent critique towards the under-theorized relationship between the IS and OS by proposing an integrative framework of artifact-mediated regulation in organizational settings.

In doing so, we synthesized relevant streams of literature on the role of technology artifacts in organizational practice, and introduced the technology artifact into Reynaud’s social theory of joint-regulation.

Our proposed framework brings forth a conceptual toolbox to IS and OS scholars interested in the role of technology in organizational change process. Specifically, we demonstrate how the proposed concept of artifact-mediated regulation makes a contribution to bettering understanding of the mutual impact of work practices and technology, particularly in the longer implementation phases of technology.

The proposed theoretical framework enables IS researchers to gain additional perspectives on the development and implementations of technology and consequently develop valuable insights for management.

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