MANAGING OBSOLETE KNOWLEDGE: TOWARDS A CLARIFIED AND CONTEXTUALIZED CONCEPTION OF UNLEARNING

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Recommended Citation
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MANAGING OBSOLETE KNOWLEDGE: TOWARDS A CLARIFIED AND CONTEXTUALIZED CONCEPTION OF UNLEARNING

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Abstract

The paper aims at clarifying, specifying, and contextualizing the concept of organizational unlearning in the IS literature, through a systematic analysis of the concept. We suggest a definition of unlearning as an intentional practice in order to reduce the possible negative impacts of obsolete knowledge. Reviewing the IS literature based on the suggested definition, we identify four dominant views of unlearning. Using this definition, we empirically explore how organizations apply unlearning in the case of disruptive IT changes. The insight from the empirical study shows a wide range of unlearning practices which are applied to different organizational and technical factors. In addition, we identify six characteristics of the IS context which have direct bearings on applying unlearning practices. Using these empirical insights, we suggest how the concept of unlearning can be clearly defined and specifically operationalized in order to avoid common misunderstanding of this concept. We conclude by commenting on how the dominant views of unlearning in the IS literature can be completed and enriched.

Keywords: Obsolete knowledge, unlearning, IS management, IS implementation, IS change.
1 Introduction

Rapid and radical changes in information technologies (IT) face organizations with two challenges: learning new technologies in a timely manner, and managing the challenges of obsolete technologies. While the former challenge has been in the center of IS scholarship, the latter has been far less explored. Technological obsolescence often triggers obsolescence in portions of organizational knowledge which have been specifically acquired and established for developing and operating such technologies. Given that organizations often have economic, cognitive, structural, and political dependencies on obsolete areas of knowledge, they face serious challenges to let them go, especially in rapidly changing environments.

The importance of managing the consequences of obsolete knowledge (the conceptualization of unlearning of this paper) has been frequently asserted in IS literature. First, unlearning is considered as a crucial imperative for acquiring new knowledge and technologies and be able to explore radically new innovations (Lyytinen & Rose, 2003: 311). For instance, (Robey, Ross, & Boudreau, 2002) in their investigations about the implementation of ERP systems found insights on the importance of unlearning established cognitions and practices to properly understand the complexity of ERP systems. This is, partly because deeply established mentalities can hinder learning process (Wang, Ahmed, & Rafiq, 2008), as established knowledge can have proactive interference (Shaft, Albert, & Jasperson, 2008) with the new knowledge. In this line, the “inability to unlearn old routines” (Volkoff, Elmes, & Strong, 2004: 285) is seen as a critical barrier to absorptive capacity (Szulanski, 1996; Timbrell, Andrews, & Gable, 2001), and slows down the process of learning new knowledge and skills (Carlo, Lyytinen, & Rose, 2011). Unlearning is also suggested as an important factor in establishing and institutionalizing new knowledge, as “unlearning routinised use of prior knowledge” (Timbrell, et al., 2001: 1090) is critical organizations to institutionalize the newly learned knowledge and avoid reversion to the status quo (Zaltman, Duncan, & Holbek, 1973). For instance, the established legacy systems behaviors (Timbrell, et al., 2001) can challenge the institutionalization of new technologies. Thus, unlearning might be needed at a broader scope to be applied to “organizational practices, structures and power relations” (Alvarez, 2008: 206), which have been shaped according to the old technologies and knowledge.

Studies have hypothesized that the need for unlearning is critical in the case of disruptive (Lyytinen & Rose, 2003) and radical (Alvarez, 2008) technological changes, especially when there has been a lot of knowledge and experiences developed around them (Ross & Vitale, 2000). In these cases, organizational members need to depart from “the existing alternatives” (Lyytinen & Rose, 2003: 312), and thus they “must unlearn earlier habits and drop their prevailing cognitive schemata” (Lyytinen & Rose, 2003: 312)

However, few studies have systematically focused on unlearning as a specific organizational dynamics. Although some works have explored the possible negative impacts of obsolete knowledge on learning new knowledge (Shaft, et al., 2008), few works have examined the process through which organizations manage such impacts and deal with their obsolete areas of knowledge, leaving a serious gap in our understanding of the nature of unlearning process (Garud & Kumaraswamy, 2005; Nidumolu, Subramani, & Aldrich, 2001) and the mechanisms through which organizations apply it (Volkoff, et al., 2004). As it is hard to identify a clear conceptualization of unlearning in the IS literature, we would build on the insights from the general management literature to suggest a clear and specific definition of unlearning.

Accordingly, this paper tries to answer two interrelated questions. First, we try to answer “what does unlearning mean” (section 2). Doing so, we build on the recent insights from the literature on organizational learning in order to suggest a definition which captures the main idea of unlearning, while keeping it conceptually distinct from closely related concepts such as learning, unfreezing, and double-loop learning. This conceptual analysis helps us to identify four dominant, and yet incomplete and biased, views of unlearning in the IS literature. Second, we try to answer “how unlearning can be practiced in the context of IS management”. We do so through an in-depth case study research (section 3) which provides us with empirical insights on a wide range of unlearning practices and helps us to contextualize the concept of unlearning in the IS context (section 4). Analyzing these insights allow us to identify six specific characteristics of IS context which affect the process of unlearning. Linking the conceptual analysis with
empirical insights, we comment on three main incomplete understandings of unlearning and we frame them as opportunities to expanding the existing conceptions and inspire further studies (section 5).

2 Literature review

2.1 Unlearning defined: insights from general management literature

In the absence of clear and explicit conceptualization of unlearning in the IS literature, we try to benefit from insights in the general management literature, and more specifically studies in the domain of organizational learning, to clarify this concept. We try to do so by answering three critical questions: “what is the aim of unlearning?”, “is unlearning an intentional practice?”, “what is the object of unlearning?”

Scholars who have studied organizational unlearning focus on the fact that the ultimate aim of unlearning is reducing the possible negative impacts associated with obsolete factors, such as outdated logics, obsolete routines, and wrong theories and methods. For this reason, identifying a series of possible negative impacts of obsolete organizational aspects, such as creating rigidity, limiting the capacity of organizations to explore and understand new alternatives (Hedberg, 1981), and bringing about economic and human damages (Fauchart, 2006; Starbuck, 1996), are all examples of possible negative impacts which justify the need for unlearning. In fact, without such possible negative impacts, it makes no sense that organizations embark on unlearning. This idea has been implicitly accepted in the IS literature, especially when IS scholars have referred to the importance of unlearning in order to reduce the rigidity of organizations in adopting new technologies (Carlo, et al., 2011) or reduce the interfering impact of existing cognitions and routines when new innovations and developments are going to be pursued (Shaft, et al., 2008). Sometimes these ideas have been provoked in terms of positive outcomes such as facilitating the change process, increasing the chance of successful implementation, and enhancing the absorptive capacity of organizations. Regardless of how to present the ultimate aims of unlearning, it is crucial to notice that the presence, dominance, and reliance on the obsolete factors must be accompanied with some possible negative impacts to justify the need for unlearning.

The second conceptual clarification has to do with the intentionality of unlearning. In fact, unlearning is defined in management studies as an intentional action (Martin de Holan & Philiphs, 2005; Tsang & Zahra, 2008) that organizations adopt to deal with the possible negative impacts of obsolete organizational elements. In that respect, unlearning is different from other dynamics such as memory decay (Martin de Holan & Philiphs, 2005) and natural depreciation of knowledge (Darr, Argote, & Epple, 1995). Being intentional, however, does not mean that unlearning is necessarily a pre-planed, formal, and top-down practice. Instead, unlearning can also take place in a variety of emergent, informal, and bottom-up ways.

Finally, the concept of unlearning can be clearly and specifically defined when we specify the focal object of unlearning. More specifically, unlearning can be applied to different organizational and technical issues such as technologies, knowledge, practices, routines, procedures, and even organizational structures and artifacts. Recent developments in the organizational learning literature emphasize on the importance of distinguishing between various factors when studying unlearning, because, first, different objects of unlearning can bring about different sorts of negative impacts in different ways. For instance, insights from previous studies have shown that organizational practices, such as routines, can differently create rigidities on organizational change, than organizational cognition (Yildiz & Fey, 2010). Even more specifically, obsolete tacit knowledge can affect the change process differently from outdated explicit knowledge. Second, they way in which the negative impacts of each obsolete factor can be treated (unlearning) can be different. For instance, while obsolete norms and symbols can be discursively devaluated, informal routines and habits might hardly lend themselves to such a formal and explicit discursive process. This is partly due to the fact that different obsolete objects have different characteristics and organizations have different types of dependencies on them. Although all the various objects of unlearning can be studied, in this paper we only focus on obsolete knowledge as the main object of unlearning. Third, specifying the object of
unlearning helps us to clarify the unit of analysis in studying unlearning and thus, we can clearly identify the units of observations, when we operationalize this concept in our empirical inquiries.

Related to the third point, whatever is regarded as the object of unlearning, it is crucial to notice that unlearning applies to the previously existing factors, rather than the newly coming ones (Martin de Holan & Philiphs, 2005). For instance, unlearning knowledge focuses on obsolete knowledge which already exist in the organizational memory, rather than new knowledge that is going to be learned or is outside the organizations. This is crucial not only to conceptually distinguish between unlearning and learning (as it focuses on new knowledge), but also to the operationalization of this concept for empirical studies. In fact, whereas when studying unlearning, researchers must focus on the existing (obsolete) knowledge, when studying learning, they must concentrate on newly acquired or possibly coming knowledge. Accordingly to the above clarifications, unlearning refers to intentional actions that organizations adopt in order to reduce the possible negative impacts of the obsolete knowledge.

### 2.2 Prior views of unlearning in the IS literature

The conceptualization of unlearning in the IS literature is unspecified and vague as most of the studies often gloss over the overall idea of unlearning, without clearly defining it. However, interpreting the context in which IS scholars have referred to unlearning shows at least four distinct views about unlearning in the literature (Table 1).

In the first view, unlearning involves that individuals forget previously learned knowledge. For instance, (Shaft, et al., 2008) talks about reducing the level of knowledge of system developers about structured programming in order to allow them easily learn object-oriented programming. This view assumes that such a forgetting process not only is possible, but also can be fostered. Another strong assumption of this view is that as far as the obsolete knowledge exists in the mind of individuals, it can interfere with new learning.

The second view of unlearning involves questioning and criticizing the obsolete beliefs, assumptions, and practices (Wang, et al., 2008), mostly through a rational and discursive process. An implicit assumption of this view is that once organizational actors realize the shortcomings and faulty characteristics of obsolete knowledge, they can (and do) properly manage those possible negative consequences. However, this way of understanding unlearning limits its application only to explicit knowledge of and about obsolete issues which can be addressed in the discursive sphere of organizations.

In the third view, unlearning involves stopping the application of the faulty and obsolete elements – i.e. practices, routines, knowledge. For instance, (Timbrell, et al., 2001) talk about the “unlearning routinised use of previous knowledge” (p. 1090), while (Hansen & Nørbjerg, 2005) refers to the idea of breaking the “wrong stimuli-response connections”. In this view, unlearning refers to controlling the negative consequences of obsolete knowledge in the moment of using and practicing them.

Finally, the fourth view of unlearning perceives it as a process of discarding and removing an organizational element, such as a formal procedure (Nidumolu, et al., 2001). Thus, as a result of unlearning, the faulty factor (which can cause some sort of negative impact) will not exist in organization anymore.

<table>
<thead>
<tr>
<th>Perspective of unlearning</th>
<th>Examples of theme in the literature</th>
<th>Exemplary references</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals forgetting</td>
<td>Reducing the level of knowledge of individuals</td>
<td>(Hannon, 2003; Shaft, et al., 2008)</td>
</tr>
<tr>
<td>Questioning and criticizing</td>
<td>Challenging beliefs and assumptions Questioning the validity</td>
<td>(Wang, et al., 2008)</td>
</tr>
<tr>
<td>Stopping the application</td>
<td>Unlearning old routines Breaking the stimuli-response connections</td>
<td>(Alvarez, 2008; Hansen &amp; Nørbjerg, 2005; Robey, et al., 2002; Timbrell, et al., 2001)</td>
</tr>
<tr>
<td>Abandoning or discarding</td>
<td>Discarding obsolete organizational elements</td>
<td>(Nidumolu, et al., 2001)</td>
</tr>
</tbody>
</table>

*Table 1: Four dominant views of unlearning in the IS literature*
Comparing the four dominant views of unlearning in the IS literature (Table 1) with the conceptualization of unlearning in the management literature, we characterize existing IS literature. First, all these views refer to some mechanisms through which unlearning can be applied, rather than capturing the ultimate concern of unlearning, which is managing possible negative impacts of obsolete factors. Thus, chances are great that organizations can unlearn through other mechanisms. Insights from other domains of study have shown this possibility when unlearning is explored in different contexts (Bettis & Prahalad, 1995). Second, these mechanisms are general in the sense that they do not take into account the distinguishing characteristics of IS management context. However, the practices of unlearning can be differently adapted to the context of IS management, than to other contexts. Third, these views are either silent about the object of unlearning or straddle a wide range of factors, without paying attention to the differences between unlearning when applied to different types of organizational factors.

In order to deeply understand the process of unlearning (without limiting it to some specific mechanisms) and contextualize this concept in the context of IS management, we conducted a case study research based on four cases. The case study research method, first, helps us to illustrate a wide range of ways through which unlearning can be applied. Second, it provides us with insights on factors in the IS management context which can affect how organizations apply unlearning.

3 Empirical setting and methodology

In order to explore how organizations manage the possible negative impacts of their obsolete knowledge, we designed a multiple retrospective exploratory case-study (Yin, 2002) in companies that have experienced major technological shifts in last decade. We studied four software companies developing enterprise systems (such as document management and accounting systems); See Table 2 for more detailed information on the companies. The selected technological shifts are: from MS-DOS to Windows technology, from structured programming languages to object-oriented programming languages, and from client-server to web-based technologies. These three technological changes were radical and caused various domains of knowledge became obsolete.

<table>
<thead>
<tr>
<th>Company</th>
<th>Size (No. of Employees)</th>
<th>Product Strategy (No. of products)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMFC</td>
<td>Small (40)</td>
<td>Focused (3)</td>
</tr>
<tr>
<td>MEDFC</td>
<td>Medium (100)</td>
<td>Focused (4)</td>
</tr>
<tr>
<td>LRGDV1</td>
<td>Large (450)</td>
<td>Diversified (31)</td>
</tr>
<tr>
<td>LRGDV2</td>
<td>Large (900)</td>
<td>Diversified (29)</td>
</tr>
</tbody>
</table>

Table 2: Selected companies for the empirical study

We focused on the old technologies (MS-DOS, structured programming, and client-server) and identified what areas of knowledge became obsolete in each technological shift. For instance, the knowledge about the MS-DOS commands became obsolete in the transition from MS-DOS to Windows. We collected data about how organizations managed these obsolete domains in order to reduce their possible negative impacts. The data was collected mainly through 35 interviews with top managers, technical managers, and experts, distributed in different organizational departments. Interviews were done in a semi-structured way, using a pool of questions related to three major issues: 1) the history of technological shifts, 2) the challenges that organizations faced as a result of their reliance on the obsolete technologies, and 3) actions they adopted in order to deal with such challenges All the interviews were voice-recorded and transcribed verbatim. As complementary sources of data, we examined all available documents (around 300 pages) on the change processes such as technical and managerial reports, project management documents, and internal newsletters. All these sources of data were integrated into documents to be analyzed in the next step.

We systematically coded data (using ATLAS.ti software) to identify the obsolete domains of knowledge. Then, for each obsolete domain of knowledge we identified the possible negative impacts that

1 Alphanumeric names are given to conceal the companies’ identity.
organizational actors were recognizing. Accordingly, two parallel researchers coded data to identify the actions that organizations applied to obsolete knowledge areas in order to reduce such negative impacts. We detected 370 quotations (instances of unlearning actions) which we inductively categorized into around 45 codes. For instance, “we facilitated the transfer of old MS-DOS experts to other supporting companies” was a quotation which was initially labelled as “firing old experts”. In addition, 160 memos documented notes on different aspects of these unlearning actions. The codes related to unlearning actions were inductively purified and classified into four categories (see the first column in Table 3) which we report them in the next section.

4 Findings

4.1 Unlearning practices

Companies adopted a wide range of practices in order to manage the possible negative impacts of obsolete knowledge. In our analysis, we could classify these unlearning practices based on their leverage points. In fact, obsolete knowledge areas have been linked to products and technologies, to human resources (practitioners and managers), to communities and organizational units, and to the obsolete knowledge itself (see Table 3).

4.1.1 Applied to products and technologies

A noticeable portion of obsolete knowledge was linked to established technologies, such as CASE-TOOLS, testing software, version control, and platform management systems, which companies were using either as production or process technologies. In addition, various obsolete areas of knowledge were strictly linked with the design, data, and application of old products. For instance, the knowledge of hierarchical database was embedded in a wide range of products sold to the customers. Recognizing this intimate linkage between obsolete knowledge on the one hand and the products and technologies on the other, organizations tried to formulate various practices to reduce their dependencies on these domains of obsolete knowledge. Doing so, organizations first stopped developing new products and R&D activities that were based on obsolete knowledge. For instance, some companies terminated projects for increasing the response time of products which were designed based on structured programming. In the next step, they avoided applying major changes into products which were based on obsolete knowledge, in spite of the frequent and strong requests from their customers. “We tried to prioritize change requests which required no or little new investment in learning about the structured programming and DOS technology”, mentioned a technical deputy. He added, “if it was possible, we would remedy the urgent needs of customers only through minor changes, postponing the fundamental changes to new series of products which are totally based on object-oriented technology”. At a certain point, companies even stopped minor improvements on their old products. This strategy helped them to avoid improving technologies required for improving old products. Thus, they stopped the maintenance and support of obsolete products completely by terminating their existing support contracts, not extending them, and pushing their customers to abandon using the old products. Meanwhile, organizations stopped selling products based on obsolete domains, in order to avoid future dependency on them. As a critical challenge, new products had to support the data (both content and the structure) and functions of the old products. Hence, organizations were somehow dependent on the obsolete knowledge domains, even when designing new systems. In order to reduce this dependency, organizations tried to develop middleware and convert applications in order to reduce the dependency of new products on the obsolete domains. For instance, instead of designing a new database structure (in web-based systems) that supported the tables and relations in the database of client-server applications, they created a convertor which could convert the data from old databases to the database of new applications, without putting serious limitation on the design of new database. As expressed by a technical manager, “if we wanted to keep supporting the same data-structure in new products, we had to keep our team of experts working and even learning on hierarchical database technology”.

6
4.1.2 Applied to human resources

Given that a considerable amount of obsolete knowledge resides in human mind and practices, companies handled this obsolescence by influencing the cognition and behavior of their experts and managers. For instance, they embarked on awareness activities through which they questioned the validity and usefulness of obsolete knowledge. “In a semi-formal meeting with all top and middle managers we clearly discussed the problems of using client-server design and there we convinced them that it should be abandoned”, expressed a technical manager. Accordingly, organizations stopped their training programs on the obsolete domains. As for more tacit areas of knowledge, such as the skills and habits of developers and designers, organizations deployed some organizational and technological mechanisms in order to stop or reduce the occurrence of such practices. “It was normal that the first time our programmers were applying object-oriented designs, they unintentionally were using algorithms and instructions which were more suitable for structured programming. We first forced a “code review” stage to send back such problematic codes. In addition, we asked our experts to create a test program which could detect such mistakes in the codes”, explained a project manager.

At a more aggregate level, organizations avoided hiring experts on the obsolete domains, and facilitated the outward mobility of experts who were dedicatedly specialized on obsolete domains and had little motivation to abandon them. As an interesting dynamics, organizations were facing a class of mostly young and ambitious experts who were eager to move to new technologies. Regarding the fact that organizations had responsibilities to support old products and still they had a noticeable market share on them, these experts had hesitations to keep working on the outdated technologies, in their zeal to learn new methods and technologies. “The challenge here was different. In the time of transition, we had to find some ways to keep at least some of the experts remaining on the old domains of expertise”, described a CEO. To that effect, some organizations tried to diversify the job of experts by putting tasks related to both new and old technologies. “In the mornings, they were working on the client-server systems, this helped us to keep those systems updated, and in the afternoon, they could work on web-based applications, which were quite attractive for them”, explained the same CEO.

4.1.3 Applied to communities and organizational units

As the knowledge of obsolete domains was shared at community levels and organizational unites, some unlearning practices targeted these levels. For instance, some companies realized that the teams of experts who were working on obsolete domains were so integrated that was difficult to apply some of the previously mentioned mechanisms. Thus, they found it useful to reduce the dependency of the company on these communities of experts by encouraging them to create spin-offs and outsourcing the related tasks to them. Therefore, organizations could not only benefit from the support of these externalized partners in short-term, but also they could reduce their institutional dependency on them. While this strategy was functional for knowledge domains which were less critical to the companies, companies had to keep working on some less obsolete, but still critical domains. In these cases, the presence of the obsolete knowledge could be committed to some interfering impacts, such as distracting the attentions of experts who were working on the new knowledge domains. In such cases, organizations adopted an isolation strategy in order to reduce the interactions between the community of obsolete knowledge with other organizational parts. For instance, they located the team of old experts in a geographically separated place and in a distinct organizational unit (such as a separate department). As another interesting, and somehow against the previous mechanisms, organizations integrated the experts on the obsolete domains with the experts on new domains in a single organizational location or unit. Integrating the communities of experts on the old and new knowledge, in some cases helped organizations to reduce the feeling of “being left out” or “discriminated”, among the old communities of experts. As expressed by a project manager, “they had the feeling that they are part of the same development team, both those who were working on DOS and those who were working on Windows systems”.
4.1.4 Applied to obsolete knowledge itself

Finally, some unlearning actions were more directly applied to obsolete knowledge. In some cases, organizations had to go back and learn more about the obsolete domains of knowledge in order to reduce their dependencies on it. This, for instance, happened when organizations were trying to create applications to convert data from DOS systems to Windows systems. For writing such a convertor, they had to learn even more than what they needed to create DOS based systems. “We had to learn the DOS commands and more details about possible conflicts in the hierarchical databases when we wanted to create an automatic convertor”, stated a technical expert. Thus, organizations improved their knowledge about the obsolete domains as a way to reduce their dependency on them. Second, organizations codified and documented their knowledge (whether embedded in the systems and products or in the mind of experts) in order to keep them as backups of their obsolete knowledge, to be used in case of future possible requests. This codification helped organizations to move their experts to work on new domains, without the fear of totally loosing the obsolete domains. Third, and linked to the codification, organizations automated the application of some obsolete knowledge to make it easier to abandon them. For instance, instead of having a team of experts to test the software, they developed testing systems which could be trained based on the experience of test teams. Once the knowledge of the test teams was transferred to the system, the organizations were less dependent on those test teams. Thus, abandoning the testing system was much easier for them than the test team because it required less human and social tensions. This strategy was actively applied to rapidly changing areas of knowledge (such as the knowledge of programming languages) to avoid challenges of unlearning them in future. Table 3 summarizes different unlearning practices.

<table>
<thead>
<tr>
<th>Leverage points</th>
<th>Unlearning practices from the cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technologies and products</td>
<td>1. Stopping the development (New products and new R&amp;D, major and minor improvements)</td>
</tr>
<tr>
<td></td>
<td>2. Stop selling products</td>
</tr>
<tr>
<td></td>
<td>3. Stopping the maintenance and support</td>
</tr>
<tr>
<td></td>
<td>4. Stopping/limiting the operation</td>
</tr>
<tr>
<td></td>
<td>5. Disconnecting new products/technologies from obsolete ones</td>
</tr>
<tr>
<td>Human resources</td>
<td>1. Awareness (both informative and persuasive)</td>
</tr>
<tr>
<td></td>
<td>2. Not training experts on the obsolete domains</td>
</tr>
<tr>
<td></td>
<td>3. Not practicing (development and operation, using both technological and social forces)</td>
</tr>
<tr>
<td></td>
<td>4. Not hiring</td>
</tr>
<tr>
<td></td>
<td>5. Facilitating the mobility of experts on the old knowledge</td>
</tr>
<tr>
<td></td>
<td>6. Job diversification</td>
</tr>
<tr>
<td>Communities and organizational divisions</td>
<td>1. Creating spin-offs</td>
</tr>
<tr>
<td></td>
<td>2. Isolating (physical, institutional)</td>
</tr>
<tr>
<td></td>
<td>3. Integrating experts of the obsolete knowledge with the ones specialized in new knowledge</td>
</tr>
<tr>
<td>The obsolete knowledge itself</td>
<td>1. Improving obsolete knowledge</td>
</tr>
<tr>
<td></td>
<td>2. Codifying / documenting obsolete knowledge</td>
</tr>
<tr>
<td></td>
<td>3. Automating knowledge (embedding in the systems, rather than the experts)</td>
</tr>
</tbody>
</table>

Table 3: Unlearning practices applied to different organizational factors

4.2 Specific characteristics of IS domain and their implications for unlearning

Our analysis of the cases revealed six characteristics of the IS management context which have significant bearings on how organizations apply unlearning in practice. Table 4 presents the six IS contextual factors with the associated challenges that each factor brings about to the process of unlearning. From our analysis of the cases we also identified the learning practices that the organizations adopted to handle these challenges. Due to space constraints, we do not provide detailed data for the unlearning practices.
First, the IS context is characterized by rapid technological changes that cause the organizations have to deal with technological obsolescence frequently. “We expect that each two year, we have a major technological changes”, as expressed a technical manager. On the one hand, this characteristic has increased the challenge of dealing with obsolete knowledge domains. On the other hand, the fact that organizations have got used to this rapid pace of technological changes has made them be more cognitively and practically prepared to manage their obsolete knowledge. For instance, after experiencing several cases of knowledge obsolescence, some organizations proactively reduced the possible negative impacts of obsolete knowledge in the future by automating some frequently changing knowledge domains and avoiding deep and strong dependencies on them. However, rapid technological changes faced organizations with the challenge of too early abandoning the old knowledge, making it important for them to adopt some unlearning practices (such as integrating experts in mixed communities) in order to avoid the possible negative impacts of early detachment (inverted unlearning).

In the IS context, the knowledge related to IT are highly embedded in virtually all business activities. In fact, the embedded nature of IT makes the obsolete domains of knowledge become linked to a wide range of organizational processes, structural factors, and even organizational strategies and policies. The studied companies reported serious challenges in shifting from client-server to web-based systems because the logic of business of many of their clients was shaped based on the interactions within geographically centralized organizations which fitted with the client-server systems. This embedded nature increased the difficulty of applying unlearning to obsolete domains of knowledge (often technical domains) because they were coupled with a wide range of organizational factors which were either still viable or hard to change in a timely manner. This challenge made organizations to adopt practices which could reduce the interdependency of organizational factors on obsolete technologies in order to allow for applying other unlearning practices.

The third contextual factor which surfaced in our analysis was the interdependency of various domains of knowledge through technologies and products. For instance, the knowledge of structured programming was highly attached to the knowledge of hierarchical database because they were both deployed in designing and constructing a series of products. Similarly, the knowledge of structured programming was extensively linked with the knowledge of users in applying the programs that were developed based on structured programming approach. More seriously, the fact that most of the IT products and technologies have to be interoperable makes this situation even more challenging. This interconnected nature of obsolete knowledge has made a situation that applying unlearning actions to a specific domain of obsolete knowledge required considering subsequent modifications (and unlearning practices) in other interrelated domains. Thus, organizations adopted a wide range of disconnecting actions in order to disentangle or loosen the interconnections between the obsolete knowledge and other organizational elements first, and then, apply other unlearning actions. Moreover, this interconnected nature of knowledge made organizations to apply unlearning practices simultaneously to a collection of obsolete knowledge domains, instead of focusing on a specific domain of obsolete knowledge at each time.

The fourth characteristic relates to the common backward compatibility which requires new versions of a product to support the data and functions of the previous versions. Thus, organizations can hardly detach themselves from obsolete knowledge because they need to consider (and perhaps apply) them when using new alternative knowledge domains, in order to satisfy the backward compatibility of their products. In some cases, this implies even further learning on the obsolete domains. Thus, the dependency of organizations on obsolete domains is heightened through the path-dependency of the systems and technologies. Similarly, this makes organizations to apply unlearning actions which first allow them to break such path dependency (for instance through creating convertors to convert old data structure to new one), and then apply other unlearning actions to the detached (or less dependent) knowledge domains.

The high level of knowledge specialization is the fifth factor which characterize the IS context. We found that organizations are highly specialized in different domains of IT knowledge, such as design, development, production, support and sales. Even a single domain, such as design, was specialized into different knowledge domains such as database, algorithm, network, and so forth. For instance, a specific
team of experts in some of the studied companies were exclusively specialized in handling the relations
between the DOS-based applications with the printers. When a specific organizational agent (person, team,
or organizational unit) is highly specialized in a narrow area of knowledge, it is quite challenging for this
agent to apply unlearning to this obsolete area of knowledge because basically it threatens all its knowledge
wealth. “How could I ask a person, who has shaped all his experiences and professional career on
improving the functionality of DOS systems in working with printers, to abandon working on the DOS”,
asked a project manager. Thus, job diversification and using integration actions in order to increase the
diversity of knowledge in the knowledge portfolio of organizational agents were important and common
unlearning practices to alleviate the pains of applying other unlearning practices.

The sixth characteristic of the IS context is the high rate of labor turnover between IT companies and also
IT departments. The experts of organizations that we studied were increasingly interested in moving from
one company to another. This provided a favorable situation for unlearning obsolete knowledge because
organizations could easily get rid of the experts with notoriously obsolete knowledge and expertise by only
facilitating their mobility to other external companies. As expressed by a CEO, “thanks to the natural
interest of IT experts to move to different companies; otherwise we would have serious problems in either
asking them to abandon their dependency on the obsolete technologies, or firing them”.

<table>
<thead>
<tr>
<th>Characteristics of IS context</th>
<th>Implications for the unlearning process</th>
<th>How handled by companies in the cases</th>
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</table>
| Rapid technological changes  | -Making organizations cognitively and practically prepared to apply unlearning  
                              -Unlearning vs. inverted unlearning  
                              -Proactive unlearning through automation of knowledge | Integration approaches  
|                              |                                         | Transformation of knowledge          |
| Embedded nature of IS in all business activities | -Many links (socio-material) that creates obsolete knowledge highly linked to non-technical factors  
                              -The speed of obsolescence for technical and non-technical knowledge domains is different | Proactive unlearning  
|                              |                                         | Radical unlearning                  |
| Interdependency of through systems and technologies | -Inter-operability as a key challenge that links obsolete knowledge domains interconnected | Disconnecting as a key approach  
|                              |                                         | Applying unlearning simultaneously to a series of interconnected knowledge domains |
| Backward compatibility      | -Difficulty of abandoning obsolete knowledge attached to legacy systems  | Developing middleware  
|                              |                                         | Developing intermediate technologies |
| Specialization of knowledge  | -large share of obsolete knowledge in the knowledge portfolio  
                              -Need for diversification with regards to the timing of knowledge obsolescence | Integration and disconnection       |
| High rate of labor turnover | -Natural outflow of embrained and embodied knowledge | Benefiting from this dynamic and facilitating it |

Table4: The characteristics of IS context and its implications for unlearning practices

5 Discussion

Our empirical findings extend prior conceptualizations of unlearning in the IS literature. Although the
existing views of unlearning in the IS literature (summarized in Table 1) refer to some specific mechanisms
of unlearning, they do not take into account the ultimate aim of unlearning which is reducing the possible
negative impacts of obsolete knowledge. These views, also, do not take into account the peculiarities of the
IS context which requires a wide range of other unlearning mechanisms. These mechanism sometimes
might look against the conventional view of unlearning (such as improving the obsolete knowledge or
integrating experts of the old and new knowledge).

More specifically, we did not find any evidence in our cases about the attempt of organizations to make
their experts forget what they have learned about the obsolete domains. Forgetting previous knowledge is
neither necessary for the sake of unlearning, nor it is always feasible as an organizational practice (Howells & Mitev, 2008).

Although formally reflecting on the obsolete knowledge and discussing its possible negative impacts has been used by companies as an unlearning mechanism, in some cases, managers intentionally avoided doing so, as they had the fear of giving more formal recognition to the obsolete knowledge, which in turn could make it more difficult to be unlearned. For instance, in some cases, managers externalized the team of experts who were working on the obsolete knowledge without formally reflecting on the obsolescence of their knowledge.

Similarly, stopping the application of obsolete knowledge has been pursued as a critical unlearning mechanism by companies, though in various cases organizations needed to support it with other mechanisms such as stopping the development of knowledge and disconnecting the obsolete knowledge from products and technologies. However, regarding the novel challenge of managers in the IS context, they had to sometimes deploy mechanisms that keep their experts and teams work on the obsolete knowledge in short term (the challenge of reverse unlearning).

Finally, although we observed a series of unlearning practices which aimed at discarding obsolete knowledge, there were many other unlearning practices, such as isolating the obsolete knowledge, which serve the same purpose but do not discard any organizational factor. These practices were particularly useful when the obsolete knowledge was still viable; though its negative impacts (such as interfering with learning new knowledge) need to be managed through some other practices than discarding. Furthermore, organizations realized that discarding practices though might not be necessary for the aim of unlearning; they can also create turbulences in organizations and cause serious costs and pains to organizations.

Understanding the process of unlearning in the light of IS context, not only can help us to avoid these incomplete views, but also can suggest fresh insights on a wide range of other ways in which unlearning can be applied. More specifically, the fact that IS context makes obsolete knowledge be linked with a various organizational and material factors brings to the for e the importance of mechanisms such as disconnecting and isolating the obsolete knowledge. Similarly, the proactive attitude of experts in moving towards new technologies requires organizations to avoid too early detachment from obsolete domains through mechanisms such as integrating the obsolete knowledge with some organizational factors.

6 Conclusions

We tried to bring the idea of managing obsolete knowledge to the center of analysis. Using the insights from management literature, we suggested a definition of unlearning which helped us to systematically explore a wide range of practices through which organizations try to reduce the possible negative impacts of obsolete knowledge. The empirical insights also helped us to identify a series of factors in the IS context with significant impact on how organizations apply unlearning. These insights not only helped us to empirically enrich the concept of unlearning, but also contextualize it in the IS context.

To the best of our knowledge no previous study systematically focuses on conceptualizing unlearning based on deep understanding of the phenomenon. Most of the previous studies either rely on a tentative, and yet unspecified, understanding of unlearning, or rely on limited and easy-at-hand measures which fail to represent the concept of unlearning in a valid and reliable way. Thus, we hope this paper can put one step forward towards clarifying this concept. Further studies can build on the conceptual clarifications that this paper suggest, though, still much is left to learn about unlearning in practice. More specifically, we invite further studies to explore the theoretical relations between the IS-specific contextual factors and the pattern of applying unlearning practices by organizations. As an important step towards this aim, a theoretical framework that links the characteristics of IS context with the process of unlearning can help future studies to systematically contextualize unlearning process into IS context.

As for practical implications, this study draws the attention of managers towards a wide range of practices that they can adopt to reduce the negative impacts of obsolete knowledge. Thus, managers can leverage
different technical and non-technical factors in order to achieve their unlearning aims. Second, this study warns managers about the importance of taking into account the role of contextual factors, such as the pace of technological shifts and the state of interdependencies between obsolete knowledge and other organizational factors, in adopting unlearning practices.

**Reference**


