
Routinization and memorization of tasks in a workshop: the case of the introduction of ISO norms

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Changing routines and creating new routinization processes are difficult tasks involving both cognitive and political mechanisms. In this paper we use Defial—a French meat-processing firm—in order to illustrate some of the problems involved in creating a new procedural memory in a workshop and in applying the concept of a ‘routine’. We discuss some methodological implications resulting from our various observations and the choices we made. In our case study, the complexity arose partly from the many different factors that affect the production process, such as stress and the overload syndrome. We show that time and hierarchical pressures cannot alone ensure the success of the memorization of a task. The routinization process is only truly successful when a new state of confidence towards management has been established, a confidence that helps overcome the socio-emotional issues arising from the changes that are taking place and that paves the way for the acceptance of change in both declarative and procedural memory.

1. Introduction

This paper addresses the introduction of ISO norms in a French company and illustrates changes in organizational memory and the content of the tasks that were previously performed. The changes offered opportunities for creating new processes of memorization and routinization that encountered important forces of resistance around which bargaining occurred.

The understanding of organizational memory and its expression via routines seems to be essential for the survival and prosperity of firms (Narduzzo, 1998; Nelson and Winter, 2002; Cacciatori, 2003; D’Adderio, 2003). However, knowledge memorized within an organizational context should not be seen as a ‘fixed menu’ (Becker *et al.*, 2005). Knowledge does not exclude a degree of routinization, i.e. a degree of automatism in the activation of a repertoire of knowledge. But even if automatism is observed during a certain time period, the knowledge expressed by individuals could introduce several forms of variation, whether deliberate or unintentional. Consequently, the concept of routines can be tackled operationally or by direct observation in the ‘narrow sense’ of an automatically activated

pattern, taking into account, however, the fact that these patterns have been acquired in specific contexts. In other words, the learning process and its result ('routinization') are two sides of the same coin. In this context, routinization of an activity or process should not be considered as mindless or automatic but as the product of a conscious effort (Feldman, 2000; Becker *et al.*, 2005).

Observing routines and routinization is certainly the most difficult task for scholars of organizational change (see Cohen *et al.*, 1995; Lazaric, 2000) because these routines can be described at different levels (description of a specific and concrete task or a more general/abstract description) (Winter, 1995: 150). A managerial practice such as the implementation of International Standard of Organization (ISO) norms, e.g. Total Quality Management (TQM) or Just in Time (JIT), could encompass both these dimensions. It could simply be an abstract pattern: a rule indicating how quality may be achieved (i.e. a managerial representation, or a normative representation, of the quality). On the other hand, the implementation of this quality standard could be exclusively adapted to the specific context leading to important modifications of the initial project (see Lillrank, 2003). That is one of the reasons why it is important to distinguish between the representation of a managerial practice—a normative standard relating to operating procedures—and its realization in practice: the concrete expression of the managerial practice as it appears in reality.¹ As Pentland and Feldman (2003, 2005) remind us, there is a difference between the representation of the routine (the ostensive part) and its manifestation (the performative dimension) and a permanent interplay between both dimensions (as the 'performative' part may interact with the 'ostensive' one and vice versa).

ISO standards are now widely used in both the service and industrial sectors to articulate knowledge and reduce unpredictability in the production process (Cochoy *et al.*, 1997; Boiral, 2003; Lillrank, 2003). But the application of ISO norms can lead to some ambiguity; indeed the application of these norms can result in increased employee autonomy and in decentralization, and therefore in an enrichment of tasks and improved knowledge dissemination, but this is not necessarily accompanied by a reduction of hierarchical pressure and control (Greenan and Hamon-Cholet, 2000; Valeyre, 2000; Greenan, 2003). In this context the introduction of ISO norms could be considered here as an opportunity to illustrate such an evolution taking place at the cognitive and political levels and to apply the routine concept to a case study.²

¹For a similar discussion see the distinction used by Pentland and Feldman between ostentative and performative (Pentland and Feldman, 2005).

²Our research was sponsored by the Picardie Region in two distinct ways. Blandine Denis benefited from a grant that helped finance her Ph.D. studies. She observed the implementation of the ISO norm in eight firms in the agro-food sector, studying firms such as Bonduel, Belin, Sodeleg and Defial. The result of this study is publicly available in her Ph.D. and in several public reports provided to the Picardie Region (see the final report for an exhaustive presentation: a report written in French and called 'Diffusion des normes ISO dans l'agroalimentaire: quels apprentissages?', N. Lazaric et B. Denis,

The aim of this paper is to focus on the micro dimension of this process in order to scrutinize the changes in recurrent interaction patterns that take place during the implementation of an ISO norm. For this purpose, we shall observe the cognitive change introduced in day-to-day tasks and its motivational dimension in relation to the organizational context within the firm. We shall address the problems related to the application of the concept of 'routines' and 'routinization' and will attempt to solve some concrete methodological problems arising from the existence of a variety of possible areas of observation. We shall try to open the 'organizational black box' in order to understand the degree of unlearning and the creation of new procedural memory at both individual and organizational levels.

In Section 2, we discuss methodological issues that arise when the concept of 'routine' is applied in a case study. In Section 3, we provide some points for discussion about the confusion caused by the emergence of a new declarative memory in Defial. In Section 4, we examine some of the difficulties resulting from the creation of new mechanisms, and in particular the stress affecting the operators under an 'information overload syndrome'. In Section 5, we consider ways in which training and incentives can facilitate the development of procedural memory and can help achieve a smooth transition to a new system. We end with some concluding remarks.

2. How does one observe routinization?

The content of the knowledge memorized in organizations has an impact on routinization. In this section, we shall briefly discuss this dimension by showing that this process is far from being exclusively cognitive and that it is also anchored in the motivational capacity present at individual and organization levels. After discussing this point, we shall address issues concerning our observation method and will present some of the aspects that have led us to select this particular context for our case study.

2.1 *The nature of the knowledge acquired during routinization*

Although routinization is necessary in order to generate coordination, motivation and efficiency within a group (Gersick and Hackman, 1990), it can also be an obstacle to the acquisition of new information or data. In other words, a group may fail to

Février 2000, pôle SHS). A part of this research has benefited from extended interviews particularly with two SMEs called Defial and Sodeleg. A comparison of these two firms from the truce perspective was published in 2001 and the study of the mechanisms of knowledge articulation was published later (Lazaric and Denis, 2003). The present article focuses more specifically on the Defial story and on the emergence of routinized recurrent interaction patterns and is not based on a comparison between two forms of managerial supervision but on the links between the representation of this managerial practice and its expression in Defial through the difficulty for creating a new procedural memory.

recognise new information in what appears to be a familiar situation.³ Indeed, when procedural knowledge is used to encode knowledge, rapid change becomes difficult (Cohen and Bacdayan, 1994). Let us explore this argument more closely. In cognitive science, psychologists argue that our memory's encoding process requires selectivity and a distinctive ability to scan information according to a subjective capacity used to determine whether certain environmental data sets should be taken into consideration or ignored (Reed, 1996). Attention is a scarce resource and should therefore be preserved (Kahneman, 1973). This effect generates different forms of knowledge: some are used to code information, while others are used to memorise it. Episodic and semantic memory is generally described as declarative and is distinguished from procedural memory.⁴ New procedural memory is created when individuals confronted with a problem have to interpret or reconsider existing declarative memory (Cohen and Bacdayan, 1994; Eichenbaum, 1997; Milner *et al.*, 1998). Consequently procedural memory is related to the memorization of knowledge and could be triggered automatically even when declarative memory has been altered. This means that procedural memory stabilizes the existing recurrent interaction patterns and that it could be difficult to change some of their elements without modifying this form of memorization. This also implies that people who have encoded tasks in procedural memory find them very simple (despite their potential complexity) and may have difficulty in articulating and changing them because this would require a certain amount of unlearning (Pentland, 2003a).

We argue here that change in procedural memory operates, not only at individual level but also at organizational level (Cohen and Bacdayan, 1994), and that the ability to cope with changes is related to motivational factors. For this reason, understanding the co-evolution of the social and cognitive dimensions is crucial because the link between the representation and the expression of an organizational practice is interconnected with new forms of supervision (Coriat and Dosi, 1997). This could explain why a firm may face organizational inertia. Organizational inertia has many

³This process is well illustrated by the notorious Air Florida accident of January 1982, where automated behaviours were so deeply entrenched that members of the organization found them difficult to shed even in the face of radically different environmental conditions. The accident was attributed mainly to the application of standard routines in the cockpit, despite the dramatic change in climatic conditions produced by an unexpected snowfall. The crew proved incapable of modifying its habitual procedures and therefore failed to adapt to the new situation. This was a clear case in which routinization led to miscoding, as members of the organization continued to interpret data and new information as they had always done, despite the different circumstances and the blatant need for change.

⁴Cohen (1991) and Cohen and Bacdayan (1994) have shown that declarative memory, which is associated with facts, appears to decay more rapidly than procedural memory, which is related to skills and know-how (both cognitive and motor). Cohen (1991) showed the differences between the two in a study of amnesia patients who, while unable to remember their daily visits to their therapists, were perfectly capable of playing chess quite competently. The reason for this incongruity was that although their declarative memory had been severely impaired, their procedural memory remained intact.

causes. The first, mentioned by Postrel and Rumelt (1992), is the frustration of individuals facing 'unlearning' and a degradation of their short-term performance. A second reason is related to the 'truce problem'. Changing existing recurrent interaction patterns calls the knowledge and social interactions of a firm's members into question. This can reopen the 'black box' of intra-organizational coalitions by creating new conflicts (Lazaric and Denis, 2001, 2003).

Indeed the transformation of recurrent interaction patterns has an impact on the motivation of individuals, who may be reluctant to change their tasks and/or the social interaction surrounding them (Winter, in Cohen *et al.*, 1996). Consequently, different behaviours (e.g. enthusiasm, protest and resistance) towards this new organization practice and towards the process of de-routinization and re-routinization emerge (Boiral, 2003: 722).

2.2 *A methodological presentation of our case study*

Our method rests on the expression of routines and includes the identification of the components of recurring interaction patterns which the motivation-building effort constructed in view of the implementation of this new organizational routine as a whole. In order to do so, we observed different categories of actors that were in charge of diffusing the process to various levels of the hierarchy (technicians, operators, as well as managers). As Pentland (2003b) reminds us, this also implies certain choices with respect to the degree of granularity (which part of the process should be observed and why?) and to boundaries (where does the process begin and where does it end?). In other words, we had to select the areas of the workshop that we believed to be the most significant, i.e. the areas where interdependencies between tasks were present and where observations could be described as an organized sequence of events in time (see also, Pentland, 2003a: 859). Two parts of the workshop were chosen because of their interdependence with other units of the workshop: the quality control department and the boning line. This level of granularity gives some indication of the evolution of the task content, which is crucial when attempting to get a sense of recurrent interaction patterns (past and present ones).

We chose direct observation as a useful and convenient way of gaining knowledge of the nature of the social relations accompanying recurrent interaction patterns. In 1996, we contacted Defial (employees and management) and asked them if they would allow us to observe their process of implementation of ISO standards and the practicalities of data collection. Direct observation took place in the Defial factory in Picardie during 1998 and 1999. During this period an analytical grid to collect the interview data was constructed with several categories (changes in the organizational structure, changes in a particular process, changes of technological tools, changes in the work content, changes concerning a particular task in a selected process, ergonomic changes, changes in informational flows, training and newcomers).

We collected data related to the implementation of the new quality standard (introduced between 1991 and 1995)⁵ with a series of interviews and a collection of documents and archives. This period was chosen to observe some stabilized recurrent interaction patterns and to get a picture of how the representation of this new managerial practice was implemented and assimilated by the firm. We conducted almost 20 semi-direct interviews in March–June 1998 and in May–July 1999. This two-stage approach was crucial in that it gave us the opportunity to determine the elements connecting the recurrent interaction patterns (especially the change within the structure of the organization) and its impact on the content of both the tasks and organizational memory. Interviews were conducted in order to obtain descriptions of the tasks such as they were before and after the implementation of the ISO standards, and of the nature of the changes. Approximately 12 interviews were conducted during the first stage and 8 interviews during the second stage.

In 1998, in-depth interviews were conducted with the management team, the quality manager and the technicians and operators. We then compared the results obtained in 1999 concerning the recurrent interaction patterns with those obtained in 1998. The modification of the tasks was better documented in 1999 because we interviewed people who were in a strategic position and whose roles changed following the introduction of the ISO norm (3 interviews) as well as individuals whose position had remained unchanged (5 interviews).

As the results only provided the subjective representations of the employees during and following the implementation of the ISO standard, they had to be interpreted with caution. The information gave an overview of task changes as perceived by individuals in the firm. These may have differed from the collective representation the management had intended to establish. For this reason, we collected large amounts of data and documents so as to be able to compare the results of our qualitative interviews with what actually took place in the firm, and to be able to describe certain newly implemented procedures (the figures concerning scales, the measurement of documents concerning the quality handbook and its evolution, schematic graphics concerning the organization's chart).⁶ This data is crucial for the acquisition of reliable observations on the sequential variety of the work process (in order to monitor changes).⁷

⁵Implementing the new standard turns out to be a long process, this normally takes three years to complete but took even longer in the case of Defial.

⁶Information obtained from a selection of non strategic documents has been used in this article. For this we received the express authorization of Defial.

⁷As Pentland (*ibid*) reminds us, sometimes the perception of variety in the content of a task and the way it evolves through the implementation of quality standards is only subjective and cannot be quantified objectively. For this reason, interviews have to be cautiously interpreted and complemented with other sources of information in order to see if the subjective representation of employees is reliable or not.

Finally our study—even though it focuses more precisely on the interplay between the expression and the representation of ISO standard—complements, to a certain extent, that of Boiral (2003), who provided extensive information concerning the representation of organizational practices of three groups of employees according to their ability to accept or reject the managerial representation (among the three groups, he found ‘ceremonial integrators’, ‘quality enthusiasts’ and ‘dissidents’). Nevertheless, and taking into account methodological differences between our study and Boiral’s, we found the same ambivalence towards this new managerial tool, one that oscillated between a kind of fascination and rejection (Boiral, 2003: 720).

3. A political dimension hindering change in declarative memory

The ISO implementation process is hindered by the radical reconfiguration of informational flows modifying the organizational structure of the firm. However, the problem does not only concern this stage but the latter is crucial for the creation of a new declarative memory and for encoding data before creating mechanisms for registering it. This technical and cognitive process is supported by the organization’s members who can accept or refuse to reconfigure their mental frames and therefore potentially hinder the implementation of a new collective declarative memory. We shall briefly describe the organizational changes that had to be implemented in order for Defial to reach its goal, as well as the process of negotiation between employees and employers and the role played by the quality handbook for selecting good practices and for paving the way to a new memorization of tasks.

3.1 *Organizational change and change in organizational memory*

Defial is a medium-sized firm with approximately 300 employees (mostly unskilled) and a turnover of 200 million Euros (1998). The company works mainly for larger companies such as McDonald’s, who have had to adopt quality standards in order to improve their credibility *vis-à-vis* their competitors. The food safety crisis of the 1990s led to a drop in consumer confidence in Defial’s products. The firm therefore had little choice but to adopt the ISO 9002 quality standard in order to survive and pushed its suppliers to follow suit. It should be noted that despite their efforts, Defial remains in a critical position.⁸

The introduction of the ISO norm in Defial required a change in the existing interaction patterns in order to generate regular information about the tasks, especially

⁸In 1996, i.e. during the period of the investigation, the firm’s performance lagged behind that of the meat sector as a whole (the firm’s turnover growth was 1% compared to 2% for the sector as a whole and its profitability reached 6% compared to the sector’s overall 7%).

when the different stages of a production process were interdependent. This led to the implementation of a new organizational entity responsible for collecting and centralizing the data gathered about the firm. Consequently Defial's organizational structure changed during the 1990s: new departments were created within the firm and relations with suppliers became more codified so as to better control the quality of the raw materials. An internal laboratory was created in 1991 to cope with the increasing flow of information flows concerning the different aspects of production. The information collected concerns a number of areas including:

- bacteriological analysis and analysis of the chemical and biological quality of the product;
- supervision of the different operations and equipment (centralization of documentation and data analysis);
- fault anticipation;
- knowledge of the production processes to ensure the system works as expected;
- promoting writing as an instrument of communication and facilitate the circulation of information.

Since 1991, Defial has hired a number of technicians and engineers for its laboratory and its quality and maintenance departments. The laboratory has increasingly come to rely on measurement instruments and the compilation of statistics aimed so as to obtain a more accurate picture of the production process and improve it. Over time, a new division of tasks was introduced and the laboratory now interprets measurements, whereas a separate production department deals with day-to-day problems. Quality controls are now decentralized, generating new sources of feedback for other departments.⁹ Overall, more data is produced and more information is collected and measures have been taken to transmit it correctly and promptly to the workshop. In this regard, the new division of labour is extremely 'attention consuming', as different pieces of information have to be simultaneously scanned in order to reach the correct level of management at a later stage. This also implies new declarative knowledge for employees, which can lead to a considerable amount of confusion during the first stage of data selection. This type of confusion occurs both at individual and organizational levels because new people are involved in producing information that has to be transmitted to the right people if it is to be of any value.

These organizational changes, summarized in Table 1, show the importance of an internal laboratory to deal with quality procedures and to distribute internal statistics. The earlier use of an external laboratory gradually ended, thus leaving the tasks of carrying out the preliminary analyses and self-control during production to the production department itself. The maintenance department has declined in its importance and its function is now limited to making repairs when an

⁹Previously, it had been the laboratory's responsibility to do the first analyses.

Table 1 Defial's organizational changes in quality control between 1990 and 1995

Crucial tasks in quality procedure in Defial	Years					
	1990	1991	1992	1993	1994	1995
Preliminary analyses	Internal laboratory	Internal laboratory	Production department	Production department	Production department	Production department
Second level analyses (bacteriological, chemical and chemical)	External laboratory	Internal laboratory with the help of the	Internal laboratory	Internal laboratory	Internal laboratory	Internal laboratory
Completion of statistics and data interpretation	Production department	Production department	Internal laboratory	Internal laboratory	Internal laboratory	Internal laboratory
Production control	Maintenance department	Maintenance department	Maintenance department	Maintenance department	Maintenance department and production department	Production department
Tool maintenance and preventive maintenance	Maintenance department	Maintenance department	Maintenance department	Maintenance department	Maintenance department	Maintenance department
Adjustment of quality procedures	Production department	Quality department	Quality department	Quality department	Quality department	Quality department
Update of quality procedures	Production department	Quality department	Quality department	Quality department	Quality department	Quality department

Source: our research.

unexpected problem arises. In short, new responsibilities were given to the internal laboratory, and the tasks of the quality control and production departments were modified.

3.2 The emergence of an intermediate hierarchy for collecting data and for changing prior declarative memory

The quality control department and the internal laboratory have become crucial in triggering organizational change and generating new recurrent interaction patterns for two reasons. Firstly, as well as gathering information and centralizing data, they are also responsible for ensuring interaction between the subgroups, which had previously ignored the existence of any mutual tasks. Secondly the two departments have been given the power to impose new tasks. Importantly, these included new ways of documenting and improving existing interaction patterns within the workshop. For example, the quality department is now in charge of collecting documents generated at the different stages of production and of verifying whether they can be of use to the laboratory. This has fostered a spirit of 'teamwork', which has proved crucial in the collective selection of good practices (such as the most appropriate metal control practice among the ones in use by workshop operatives). By establishing a suitable review among practices, the quality department has promoted a process of 'de-routinization', thus generating a new representational state and a new organizational memory in the workshop. This process, though difficult, was crucial for the implementation of the ISO standard.

As shown earlier, the reconfiguration of organizational memory is not only technical but also raises the question of who should be involved in the process. For this reason, a quality manager, in charge of registering the procedures with the help of employees, was hired in 1992. His first task was to convince employees that the new way of doing things was important for the firm's prosperity and that documents had to be compiled on a regular basis. This supervisor is also in charge of creating new documents and exploring (with the help of employees) new 'satisfactory' ways of documenting, registering and updating the necessary general procedures. His daily interaction with the staff meant that he was able to solve many minor problems directly by discussing them with blue-collar workers. He reinforced the links between departments by exchanging information flows, especially between the quality, laboratory, supply and production departments, and played an important role in the implementation, transfer and update of procedures within the firm. He had the authority to change recurrent interaction patterns following a collective discussion with operators, thus preserving their autonomy and increasing their potential ability to solve problems. Conversely, he could also demand a more detailed description of a procedure in order to better control the division of labour.

From this point of view ISO is different from the 'Taylorist' tradition whereby the job content is defined by the management, and whereby the work of operators is

rationalized through the implementation of codified procedures drawn up by an appropriate department. Here, operators collate the procedures first and then a quality manager prepares a more or less concise description of the job content for the quality handbook. If the employees refuse a particular articulation of their task, the management finds itself in a difficult position. However, the management may also profit from this process as it can obtain a full articulation of the routines implemented and force co-operation. This can potentially bring about some conflicts but also an opportunity for employees to preserve their autonomy, or for the management to increase their control. In short, firstly the formalization induced by documenting procedures may be interpreted either as an enabling task or as a coercive one depending on the industrial relations prevailing at a particular moment (Adler and Borys, 1996). Secondly, the articulation of the task is correlated to the characteristics of daily operations notably the presence or the absence of procedural knowledge. Moreover, this provides new opportunities to reconfigure organizational memory because, on the one hand, the compilation of the quality handbook centralizes articulated practices that were previously distributed only across a subgroup of operators, and on the other, the introduction of new tools generates a profusion of data that has to be absorbed by employees.

3.3 The discretionary power of employees with regard to the reconfiguration of their declarative memory

The principles of ISO 9000 require organizations to document their quality systems and render them explicit by introducing formal procedures usually laid down in a handbook.¹⁰ The practices associated with a given production process should be identifiable, questioned, documented and thereafter regularly revised and updated. These procedures do not guarantee the quality of a *product*, but they guarantee that of the production process as it forces firms to 'really' do what they claim to be doing according to the managerial principle 'we say what we do, we do what we say'. Thus the purpose of the ISO standard is to reduce the gap between the 'ostensive' and 'performative' aspect of a routine; indeed it describes the 'real' content of what employees are doing. For this reason, the ISO standard cannot be reduced to a purely cognitive or technical system because it requires an internal process of negotiation for its successful implementation. Consequently, it is necessary to develop an incentive system to encourage the production of documents (an essential step for the compilation of a quality handbook) and to negotiate ways of representing work

¹⁰The ISO 9001, 9002 and 9003 norms, initially used as references in client/supplier relations, are used today as quality references. Certification is granted only after tests, checks and audits have been conducted by an autonomous institute, a rule that gives the process more credibility. Firms can choose between diverse referential standards (ISO 9001, 9002, 9003, etc.) depending on the degree of proof required by their clients. ISO 9001 is a model for quality assurance in design, production and final-check tests, 9002 covers production and final-check tests and 9003 covers final-check tests only.

processes exhaustively in those documents so that representations translate into practice (i.e. the performative way of using the handbook). In the case of Defial, negotiation had to take place between employees and between the different departments, especially as a number of departments felt their role in quality control had been diminished.

The maintenance department, whose activities were substantially reduced, was reluctant to provide a comprehensive description of its past and current tasks. Indeed, a stance of this kind left the maintenance department with a certain degree of freedom *vis-à-vis* the management. For example, the maintenance technicians, who had had considerable discretionary powers on the assembly line, hindered the production of documents concerning their activities. They had been asked to describe in writing what they repaired and how and when they did so, but because of their lack of co-operation, the quality manager was forced to constantly check whether or not they fulfilled this requirement.

Before 1991, when a scale broke down, we just repaired it, without taking any notes. Now each scale has its own measurement-book. The latter is regularly checked for recurring breakdowns because they may be due to a manufacturing defect. The system we have now put in place is far more efficient as it consists in gathering information, which in turn enables us to identify problems more easily. However, setting up this measurement book system has hit opposition from maintenance operators, who argue that if they have to write down all the details about what they repair and about the nature of the breakdowns, they will need a secretary. (Quality Manager, Defial)

The change in recurrent interaction patterns also affected operators working in production. Operators had to take charge of a number of quality control tasks that had previously been carried out by maintenance technicians and perceived this change simply as an addition to their workload. The quality manager had to simplify the documents in question, eliminate some of them and create others that were better suited to the production department's rhythms. Nevertheless it was difficult to run the system smoothly. Employees perceived changes as new sources of confusion and stress, especially as the management team wished to implement the ISO procedure quickly. In addition, there was tension between the multitude of sources of information and the managerial aim to improve information flows. In short, this organizational change was accompanied by conflict between the management team, who wished to push the process forward, and the employees who resisted it because of their inability to absorb new informational flows and their lack of motivation to create a new declarative memory. Motivation plays a key role in the construction of new cognitive frames; this is illustrated, in our case study, through the reconfiguration of the declarative memory, which precedes task memorization. Once this stage is completed and collective frameworks have been stabilized, know-how and knowledge can be codified and put into practice smoothly.

3.4 *The quality handbook as a selector: the metal control example*

Beyond the reconfiguration of a declarative memory, the problem is the creation of a new procedural memory via a selection of practices. The quality handbook here is crucial for triggering the unlearning and 'de-routinization' process. Metal control provides an illustration of this dynamic.

In practice, operators and technicians who expressed their subjective perception of the quality guaranteed by the way they carried out daily controls (notably the way they used different detectors) differed radically in their methods. The operators and technicians' subjective perceptions of quality and of how they carry out daily quality checks differ drastically (particularly the way they use the different detectors). The nature of the checks carried out (e.g. making sure that no metal from the manufacturing process had accidentally contaminated the meat) also varied. Consequently, having recognized the existence of variety, a selection of practices took place. Needless to say, the selection process involved long deliberations between the management team and employees.

This difficult change in recurrent interaction patterns in quality control could be interpreted here as the interplay between the performative and the ostensive parts of routines achieved *through* the writing of the quality handbook. There was an wide gap between the practices the quality control department ought to have adopted (or what the management thought it had to adopt) and actual practices; this is well illustrated by the practice that consists in the workers inserting keys in the detector in order to check whether the contamination has increased significantly, and also in order to check whether the detector is working. Discussion and bargaining were also affected by the introduction of new technological tools that revealed recurrent interaction patterns and enabled the employees to adjust them more efficiently. For example, placing a key on the scales was not the most appropriate or effective way of testing for metal contamination.

Following the review of practices through daily controls, a new representation emerged, which was based less on socio-emotional issues and more on task performance. A new co-ordination based on communication between groups of workers rather than on an infinite subdivision of tasks was created. This new division of labour must entail some tradeoffs between the increasing need to communicate and the potential overload syndrome that surfaced at the beginning of the process.

4. The information overload syndrome in Defial or the difficulty of creating procedural knowledge

The difficulty of generating new automatisms came from the increased complexity of the tasks in hand and the increased informational flows to be handled in a context in which new procedures had to be assimilated and new tools mastered. In the short term, the procedures created a cognitive overload syndrome also due to the management's determination to bring the implementation of the ISO norms to a speedy conclusion.

In the longer term, however, the learning process did take place and new interaction patterns gradually emerged, as demonstrated by the reduction in bacteriological contamination.

We shall illustrate some 're-routinization' of the division of labour and the acquisition of new automatisms which are difficult to set up because of conflicts between ancient and new declarative memory, which create tensions that slow down the construction of a new procedural memory.

4.2 *Learning new automatism or paving the way for a new procedural knowledge*

The implementation of ISO norms requires the articulation of tasks, the compilation of documents and a reconsideration of existing recurrent interaction patterns in order to create new ones. Indeed the introduction of new technological artefacts and the redefinition of a task's content also generate local and distributed memory. In principle these external memories help employees in their performance of tasks but they could also be perceived as an additional constraint through the restructuring of the ergonomic configuration of the workshop (such as its visual and spatial design¹¹).

This was the reason why the management team had to help employees get accustomed to the new system. The difficulty for employees was to remain as attentive and vigilant as possible so as not to miss relevant information. The process of selecting the correct information at the right moment did not occur spontaneously. During this early stage, the process required considerable effort and the management team had to stimulate and encourage the employees in order to maintain high levels of attention.

Employees played their role, but the compilation of documents caused a major upheaval. In an effort to increase awareness among employees, we, along with the quality manager, summoned each team in turn and explained the role of the new procedures, why they were implemented, and why it was important for employees to record their actions. Although initially the operators recorded how they operate the controls, they soon stopped focusing and forgot to write down what they were doing. We (the management) had to constantly be there in order to observe them. *Now the practice of taking notes is carried out more automatically. It is becoming an automatism.* (The Management, Defial)

Once a degree of automacity had been achieved, Defial was then faced with an information overload. In practice the staff could not cope with the amount of information generated. This problem had various sources and was also due to the emergence of different memories within the firm.

¹¹See Kirsh (2004) for a conceptual discussion of this aspect.

1. New technological tools such as the measuring instruments located in the laboratory and the scales present on the production line. These tools were physically distributed in different areas of the factory but information concerning these tools had to be collected simultaneously. This created a certain tension and a co-ordination problem for the teams that had to collect the information at appropriate times.
2. The creation of new declarative memory resulting from the new information flows in the documentation system.
3. Building a satisfactory procedural memory is a long process because the performance of a task without deliberation necessitates that a whole series of entrenched habits be changed. This process is time consuming and requires considerable effort from the employees. As one operator aptly stated:

The gradual emergence of a kind of procedural memory and the stabilization of the declarative memory could be interpreted here as a deliberate routinization of tasks. As a production line operator summarizes it:

At the beginning I was constantly wondering who I should receive data from and who I should transfer it to. I was never sure what I should take note of and what I shouldn't. Now I no longer ask myself the question; I just take notes and my colleagues do the same. They found their own adjustments marks for selecting data (for example by using average weekly data instead of daily data).

4.3 *Regularity in the workshop: the example of bacteriological contamination*

In principle the application of each quality standard is very strict. "A standard process can accept only certain inputs since the assessment phase can identify only one type of variety, accept only variation within tolerance limits, and produce only two control states, "go" or "no-go" (Lillrank, 2003: 223). In practice a process could integrate a certain amount of variation, i.e. an *ex ante* deviation from a given target depending on which process variation is tolerated. In Defial, no deviation from the *ex ante* bacteriological control was tolerated, whereas variation in quality control was accepted as long as the quality control in question was articulated and collectively negotiated by the team responsible for the task in question. Within the process itself some critical stages were tightly controlled whereas in other stages of the process, variety (within the content of the task) was accepted if the different targets were functionally equivalent. The task of compiling statistics for example was difficult to formalize. For this reason it was not explicitly described in the quality handbook and variation was significant (from quasi-exhaustive to a minimalist production of data). The compilation of statistics was largely dependent on the subjective judgement of the operators in charge of this particular task. This shows the difficulty of applying a quality standard in each stage of a process and the difficult choice of selecting some critical areas where extreme vigilance and attention ought to be maintained.

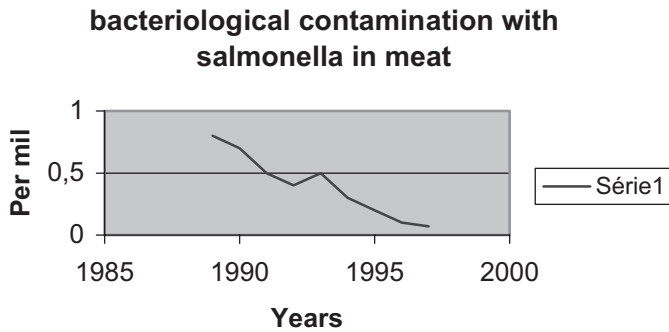


Figure 1 The reduction of bacteriological contamination in Defial from 1989 to 1997.

In order to implement efficient production line quality control, some organizational choices had to be made. These included a simplification of the documentation relating to its distribution. Following a stage of document simplification, the quality control procedure was finally implemented fully. It took two years to reach this stage and quality control had to be regulated (a policy was devised both internally and externally in association with the slaughterhouses). Regularity in quality control was difficult to achieve, but through repetition and the vigilance of the production operators it was eventually achieved.

Bacteriological contamination, notably *Salmonella*, came to be detected and dealt with more rapidly (see Figure 1). The increase in *Salmonella* contamination that occurred between 1992 and 1993 could, however, be interpreted as the by-product of the overload syndrome effect, itself due to of the increasing presence of new high-tech instruments that created confusion in the performance of daily tasks and particularly to the increasing number of control procedures both within and outside the firm. The introduction of microbiological controls and the use of optical tools require the acquisition of a significant amount of knowledge by operators before they can create a new procedural memory. Unsurprisingly, in this context, an increase in bacteriological contamination is observed before measures can be taken to reduce it.

The reduction of bacteriological contamination in meat is a good indicator of a change in the employees' attitude to commonly encountered problems. This new behaviour also had an effect on the division of labour, which gradually became more collective. For example, employees became more involved in quality control and were encouraged to be aware of the clients' requirements and to perform their tasks in a different fashion.¹²

¹²Every month, clients visit the plant and control the quality of the process and products. Some of the clients demand additional analyses. For example, a large distributor asked for proof of *Salmonella* tests. In response to this request, Defial invested in a VIDAS system, which can analyse any *Salmonella* on the production lines within 24 hours. Clients often 'spy' on individual practices and check whether the equipment is controlled, how this is done, whether the hygiene practices are really adhered to and how, and so on. In the new circumstances it seems easier to respond to customer requirements promptly.

They are increasingly called upon to explain their vision of quality—a perception that is usually highly subjective. In sharing their personal knowledge (especially the ‘good’ ways of carrying out a task), they progressively acquired a collective vision of how production should take place. As some employees briefly express in the following sentence:

In terms of bacteriological control, we have become more efficient. Before (the implementation of the quality standard), our assessment of bacteriological quality was not so bad but it was not reliable enough. Now, if there is contamination, we can find out more easily where it came from. We have worked with suppliers and have selected them. The risk still exists and cannot be completely eliminated, but we can evaluate the risk and work with suppliers to reduce it. (Purchase and Quality Control Manager, Defial)

This particular point of view illustrates the political context in which are developed new recurrent interactions and interdependencies between individual and collective frameworks for the construction of a new procedural memory. This political context could be interpreted as a long and laborious routinization established by employees under diverse incentives systems and different pressures. The last section of our paper describes how managerial intervention can play an important role at this stage of the implementation of the ISO standards, by giving a meaning to this memorization of tasks, in order to increase the motivation of employees.

5. Training, incentives: the motivational dimension of the routinization of tasks

Routinization within the workshop was achieved thanks, partly, to the implementation of an intense training policy, which was crucial because most of the employees had few or no formal qualifications and had to be trained in order to carry out their new tasks. This policy was successful because of a combination of on- and off-the-job training and because of the direct involvement of some of the employees in the boning line. It also paved the way for the rotation of tasks, a broadening of individual tasks and a major change in the old division of labour, in which specialized workers could not easily change positions.

5.1 Training for coping with task complexity

In order to cope with this change of rhythm and to motivate employees, the management teams engaged in a process of intense training involving 40% of employees who had been unskilled before the introduction of the ISO 9002. This training was important in that it defined the skills to be acquired and broadened the existing knowledge base.

In view of the importance of this exercise, the management team tried to promote some key employees in the factory so as to encourage them to contribute to the process. Technicians were given training courses, and were then promoted and given

new tasks, including quality control supervision and the compilation of procedural records. Some of the technicians who were promoted (now called ‘the quality representatives’) kept close contacts with the quality manager and the new technicians carrying out bacteriological and chemical analyses. The new job rewarded the empirical skills of ‘the quality representative’ and was accompanied by a pay system that recognized the acquisition of know-how. Similar incentives were set up in the laboratory so that the technicians who had been given new tasks benefited from a wage increase. Those in charge of quality control were also given a role in the decision-making process (they were given a say on future investment issues on the basis of the results of their analyses and their classification of requirements).

On- and off-the-job training played a crucial role in this process by showing the employees involved that having more tasks did not necessarily result in added pressure and stress. Indeed, the main reason for the operators’ and technicians’ reluctance to accept the changes was that they felt the broadening of their task description was an additional duty imposed on them without any extra compensation. In order to create a more co-operative work environment, the management team emphasized the importance of human capital by providing various specialized training courses (communication, quality training and technical training for data processing). This stage proved crucial for most employees:

The employee in charge of the boning process has become a production “leader” so to speak. The staff here used to only do assembly-line work. Now the employee in charge of the boning process is trained to use a computer and knows how to collect and process and trace the information emanating from the boning line. He can fill a card index of faults and knows how to detect and correct these faults. (The Management, Defial)

Table 2 illustrates this process of increasing complexity in daily tasks. From 1990 to 1995 the number of subtasks, for both specialists and operators, increased considerably. The main effect of this process was to broaden the range of tasks and to find an effective way of developing a suitable memorization. The complexity of the new daily tasks also explains the difficulty of learning new automatisms discussed earlier. One way of dealing with this problem was to introduce task rotation in the factory in order to stabilize and regularize the increase of attention that was required of most employees.

5.2 Rotation of tasks and the multi-skill rule in quality control and the boning line

Rotation of tasks was found to be another effective way of improving the attention span and vigilance of the employees. This was implemented in quality control, a time-consuming activity that became increasingly stressful as the various related tasks grew more complex. This realization was the main reason underlying the decision to make quality control operators share their tasks with production operators, thus creating a collective way of defining tasks and manufacturing based on manpower flexibility.

Table 2 Enrichment and complexity of the task in the boning line from 1990 to 1995

Job content according to categories of employees	Years	
	1990	1995
Specialists: the bone leader	Allocates tasks. Stops production in the event of an incident. Restarts production in the event of an incident. Compiles statistics. Liaises with maintenance.	Allocates tasks. Stops production in the event of an incident. Restarts production in the event of an incident. Compiles statistics. Liaises with maintenance. Inspects the quality of supplies and liaises with slaughterhouse. Registers and computerizes. Inspects production quality.
Operatives	Bone process. Liaises with maintenance.	Bone process. Liaises with maintenance. Collects data and communicates it to specialists. Self-control and detection of faults. On the job training for the carving and freezing lines. Occasional duty in carving line.

Source: our research.

Job rotation includes self-control, a process that was not initially accepted despite being introduced at the same time as the compiling of procedures. Consequently, the percentage of breakdowns of scales remained high for a long time. The risk of sabotage and carelessness was present because of the lack of attention paid to incidents that occurred during the production process. The increasing occurrence of breakdowns in the firm during 1992 and 1993 could be interpreted as an external manifestation of resistance among employees. The implementation of ISO norms is demanding and generates different types of behaviour ranging from enthusiasm and dissidence (Boiral, 2003). In our case, the latter type of behaviour was not observed but the risk of sabotage existed and was more or less dormant in the firm.

The percentage of breakdowns decreased drastically a few months after the training programme was implemented, and the increased task burden was finally accepted by employees. During 1995 the detection of faults became automatic and the problems related to tools or bacteriological contamination became part of the job. The increased involvement of employees in the detection of faults in scales is summarized in Figure 2.

One way of facilitating the implementation of task rotation was to adopt the multi-skill rule. In fact, rotation was limited for many years because of the overspecialization of employees, particularly in the boning and carving lines, which required specific skills. Through off- and on-the-job training, rotation was made possible for some employees, a change they welcomed. One-third of the employees from the boning line were allowed to work on the carving or frozen meat line, thus ensuring the diffusion of technical information in the workshop and mutual learning which created a new interdependence among employees who had not initially been used to sharing information. This initiative, which at first was a top-down decision, proved successful over time and was soon permanently instituted. The new rules allowing staff to understand the technical interdependencies existing within the factory and the aims of the ISO norms were also supported by an incentive-based pay system encouraging off- and on-the-job training despite the difficulty of promoting and acquiring certain types of skills, especially those relating to the boning process.

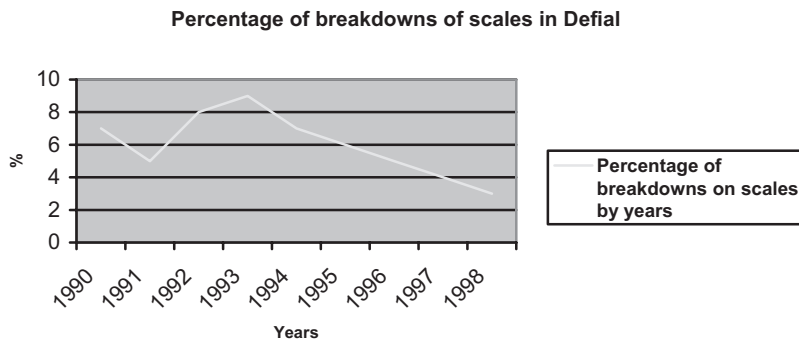


Figure 2 Detection of faults: the percentage of breakdowns of scales in Defial from 1990 to 1998.

6. Conclusion

Our case study is an attempt to describe a difficult process of task routinization. Despite the diffusion of new values and the new incentive system, the stress felt by employees is an important factor when considering the impact of the change in routines and the consequent broadening of their tasks. Another reason accounting for the distress felt by employees is related to their aversion to writing and the associated obligation to record a large part of their tasks (the 'overflowing document syndrome' is a good illustration of this difficult self-fulfilling action pattern). Employees do not accept such new automatisms immediately and a new implicit contract has to be established between them and the management team. This must incorporate the newly created ability to solve problems and the collective co-ordination required to improve the quality of the production process.

The slow pace of routinization is also due to cognitive mechanisms, notably the difficulty of creating new procedural knowledge when changes and difficulties are significant. This confusion results from the introduction of new technological tools and the practice of writing down procedures that provoke new forms of memories and lead to a restructuring of previous declarative memory. Training facilitates the learning process by enhancing selection in declarative knowledge thereby helping create procedural knowledge. Training also helps with the socio-emotional issues of a group when a new collective routine is introduced. It enables operators and technicians to find individual and collective adjustment marks for selecting information and for classifying relevant data (i.e. a satisfactory though not an optimal solution for dealing with increased complexity). Training paves the way to increased work content and to employee motivation as it is perceived to be a signal. In particular, it creates a new state of confidence towards the management. After the difficult period of learning new procedures, routinization leads to a restoration of a certain degree of efficiency and the 'information overload syndrome' decreases. However, this process is not perfect (see, for example, the case of the bacteriological contamination with *Salmonella*) and resistance among employees during 1992–1993 is an illustration of how routinization is difficult and requires effort. Consequently the creation of a new procedural memory does not preclude any control on declarative memory and fossilization of these forms of memory. Knowledge and its carriers are human and alive: the learning of routines is not a stable process but is largely driven by individual and collective willingness to change them creatively. This is why we believe that the political and cognitive mechanisms are inextricably linked.

More generally we have tried to apply the concept of routine in our case study and to make its content operational by showing the nature of change in recurrent interaction patterns: the motivational aspect of this change and its cognitive dimension. First, we have tried to limit our observation, in the workshop, to quality control and the boning line. However we faced some difficulty in precisely delimiting our observation since many changes were related to the evolution of the organizational

structure. As Defial is a medium-sized firm, the level of observation and the granularity meant that some of the interdependency of the global structure inevitably trickled through. This made it difficult to define the boundaries of our case study although we deliberately focused our attention on these two areas. Secondly, we tried to distinguish the political from the cognitive dimension and to separate their potential entanglement although the boundaries remain somewhat blurred. Thus some observations are only based on the political dimension (training and part 4) while others are primarily concern the cognitive dimension ('procedural memory, "cognitive overload' and part 3). Nevertheless, in certain cases the political and cognitive dimensions are clearly connected, as in the case of the socio emotional effects of the creation of a new declarative memory. However, such changes are rooted in the transformation of the organizational memory which could be defined as an evolution in the representation of formal memory and a transformation of daily performance. In this regard, the clear-cut separation of the cognitive and political dimension made by certain observers and researchers, while useful in describing empirical results, could be better depicted as a change in the organizational memory (in its ostensive and performative dimensions). As Pentland (2003b) reminds us, researchers are sometimes forced to select a particular 'point of view' in order to ensure consistency in their observation. We have not managed to escape from this predicament in presenting our results even though we have tried to put forward our own 'point of view' in an explicit way in order to avoid making arbitrary methodological choices.

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