High-reliability organization seen through interstitial activities

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Empirical studies of high-reliability organizations have usually focused on the most visible activities directly related to reliability: flight decks on aircraft carriers, the operation and maintenance of nuclear power stations, hospital emergency services and operating rooms, etc. The findings of fieldwork on heavy handling operations in two firms in the nuclear industry have been used to analyze "interstitial" activities along the boundary with visible "noble tasks". Based on pragmatic theories and communication studies on organizations, this approach proposes an original definition of interstitial activities on four dimensions: organizational, temporal, spatial and symbolic. Owing to their effects on the vigilance of operatives and supervisors and on the decompartmentalization of activities at the plants, these boundary activities in bulk handling reinforce high-reliability organization overall. The concept of "interstitial activity" could prove useful for research on "distributed organizations", where questions of coordination and cooperation are of utmost importance.

An increasing number of studies since the 1990s have focused on the conditions for attaining a high level of reliability in industries that conduct operations with potentially catastrophic effects. According to them, reliability stems from a "collective mindfulness" (WEICK & ROBERTS 1993, WEICK *et al.* 2008) that develops out of interactions between persons during routine activities or in unforeseen problematic situations (JOURNÉ & RAULET-CROSET 2008, TILLEMENT *et al.* 2009). Most empirical studies on high-reliability organizations have concentrated on high-risk installations with activities that are visible and directly related to reliability: flight decks on aircraft carriers (WEICK & ROBERTS 1993), the operation and maintenance of nuclear power stations (ROBERTS 1990, BOURRIER 1999, JOURNÉ 1999) and hospital emergency services and operating rooms (WEICK & SUTCLIFFE 2001, GENTIL 2013). These studies have, however, paid little heed to activities that, though closely related to "noble tasks" (HUGHES 1996), are not a full-fledged part thereof, thus remaining on the boundary, in the interstices of the organization. We shall, therefore, refer to them as "interstitial activities".

To understand the relation between interstitial activities and an organization's reliability, we have analyzed operations for handling and positioning heavy, bulky objects (several tons and several cubic meters) in two companies that produce critical parts (reactor pressure vessels, steam generators, pressurizers) for nuclear power stations and nuclear submarines. With serious industrial, economic and human consequences, these operations correspond to what Bourrier (2009) has described as "organizational risks".

This article[1] intends to show that interstitial activities, though missing in formal texts and discourses about the organization, are crucial to production activities: they compel recognition from the persons working in production. We shall shed light on the processes

whereby handling and porterage activities played a part in high-reliability organization at the plants where we conducted fieldwork. In effect, they aroused "vigilance" with regard to critical risks, which the organization had previously neglected. Furthermore, by generating coordination among persons in workshops, they — and they alone — managed to effect a spatial and functional "decompartmentalization" of the organization.

From a theoretical viewpoint, our definition of interstitial, or boundary, activities is less related to the organization as such than to actual activities. How do such activities fit into a theory of high reliability organization? By proposing a definition grounded on both John Dewey's pragmatic approach to valuation and communication studies of organizations (TAYLOR & VAN EVERY 2009), we raise points for building a theory of interstitial/boundary activities and concretely describe interstitial activities from four key dimensions: organizational, temporal, spatial and symbolic.

Interstitiality as a research topic: The theoretical framework of boundary activities

Research on the reliability of high-risk organizations has usually focused on the most visible and valued activities (even when the intent was to analyze errors and shortcomings) performed by recognized professionals (operatives in control rooms, maintenance technicians, firefighters, airplane pilots, doctors and nurses) (SCHULMAN 1993, ROCHLIN *et al*. 1987, WEICK & SUTCLIFFE 2001, BOURRIER 2009). High-reliability organization refers to *"studying the organizational conditions that enable a complex organized system to maintain a level of reliability compatible with both safety requirements and economic exigencies"* (BOURRIER 2003:200). Reliability involves several aspects, such as efficiency, safety, security, readiness and profit-making (TILLEMENT 2011, LLORY *et al*. 2001).

To study the interstitial activities on the boundary of the "nobler" tasks performed by higher-status occupational groups, we grounded our research on an interactionist approach for three reasons. First of all, this research entailed observing, in symmetry and at the same time, the so-called "noble tasks" and the "dirty work" (HUGHES 1971), since we could not understand the one separately from the other. Secondly, for interactionists (HUGUES 1971, BECKER 1982, STRAUSS 1988), the division of labor is a dynamic process that emerges out of interactions and arrangements between occupational groups with shifting bounds (TILLEMENT 2011). Thirdly, the division of labor is not just a technical matter; it is also a moral question. Zones of competence (BECHKY 2003) and task assignments are continuously (re)negotiated during interactions as a function of the "value" each occupational group assigns to its tasks as a "work well done" or a "real job" (BIDET 2015).

More recent studies (BORZEIX & COCHOY 2008), following up on these classics, share the concern for a detailed analysis of interactions within "communities of practices" and for forms of coordination in real-life situa-tions. They are an extension of pragmatism, in particular of John Dewey's work. In line with them, we have sought to pay special attention to everyday, routine actions that are partly invisible. How do persons at the workplace coordinate "distributed" tasks (LORINO 2014)?

Dewey's (1939) theory of valuation provides an interesting grid for interpreting interstitial activities, since it helps us see how the persons involved determine what is, in their opinion, important. We propose describing interstitial activities as a function of the forms of communication whereby such activities become subject to valuation. For the pragmatist philosophers, thought processes are a form of action; and conversely, forms of action are thought processes. Attention, like any component of an action, involves "beliefs", for instance the belief in safety rules and regulations. For the rules to work, those who make them have to believe that they will be applied as designed; and those who apply them will have to do so in the firm belief that the rules will help avoid risks that they do not even perceive (WILDAVSKY 1979). Dewey studied how beliefs turn "true" by being socially justified. His theory of valuation explains how value is set. Valuation can be formally defined as the making of a value judgement about a past action and the setting of a rule for a future action.

Communication studies see the organization in terms of the interrelation between "texts" and "conversations" (TAYLOR & VAN EVERY 2009). From this perspective, texts — annual reports, evaluation procedures, etc. — constitute the organization and endow it with agency, *i.e*., the capacity for undertaking action (DETCHESSAHAR & JOURNÉ 2007, KUHN 2008, PHILLIPS *et al*. 2004). Studies have also shown the decisive part played by conversations, whether verbal exchanges between directors (COOREN 2004) or operatives at the workplace (MURPHY 2001), in developing the "collective intelligence" that produces high-reliability organization.

Within this theoretical framework, we propose an initial definition of interstitial activities as activities subject to valuation only in conversations, never in texts. In other words, the organization's texts do not refer to them. In this sense, they are invisible. Nevertheless, everyone admits in conversations that they are indispensable.

Methodology

Fieldwork

To empirically describe interstitial activities, we observed handling and porterage activities in two firms that make state-of-the-art heavy equipment for the nuclear energy and weapons industries. The shop described hereafter had a workforce of 450.

The production process in the workshops where fieldwork was conducted involved highly skilled, tightly controlled operations of machining, welding, soldering, boilermaking and assembly. At one of the plants, the time devoted to controlling what was made amounted to a quarter of total production time; at the other plant,

Box 1: Heavy handling operations

The production process observed during fieldwork was organized by project. Each heavy, bulky object to be made was loaded and moved so that workers have access to it. Such bulk handling operations were frequently needed to move the objects being made as well as bins and tools.

These handling operations carry risks. Safety at the plants where these objects will be installed requires that they be manipulated without damage. However the objects might be scratched or bumped while being hoisted. If an object drops, it might not only damage machines in the shop but also injure or kill workers. Another mortal danger for workers is to be hit by an object while it is being moved.

During maintenance work on one of the reactors at the nuclear power station in Paluel (Eure Department, France) on 31 March 2016, a steam generator was dropped. This accident served as a reminder to everyone of the potential economic and human catastrophes related to handling operations. The worst event witnessed during fieldwork occurred when a machinist forgot to unclench a machine's jaw and marks were left on the object being moved. The most frequent mistake made by operatives is to leave slack in the tackle, which causes the hoisted object to be unsteady.

In the workshop where we did fieldwork, the group of handling operatives was made up of ten persons from the principal contractor (who are assigned to five teams) and of five persons from a subcontractor. The technical and material exigencies of heavy handling operations weigh on how they are planned and organized: handling operatives's know-how and skills (CRU and DEJOURS 1983, DODIER 1995), the shapes and characteristics of the object to be moved, the equipment available for performing the operations, etc.

the half. The operations to be performed are well documented. To take soldering as an example, there are detailed designs indicating what to solder and how long the soldered materials should be left to cool.

Despite the quite visible risks, the handling of heavy objects is not the subject of detailed "texts" in these companies. Besides, this activity must adapt to fluctuating demands, a source of pressure. Each workshop has irregular, unexpected needs for bulky, heavy objects to be moved; and the weekly schedule is frequently readjusted to the priorities and contingencies related to these demands. Handling and moving operations are tightly coupled with major production processes (PERROW 1999). For the reliability of bulk handling operations, like the organization's reliability in general, the interactions with other occupational groups have to be made more reliable.

The operations of handling and porterage are planned using demand-management software. In addition, discussions take place on several occasions to schedule operations, those to do right away and those to be done in the coming days (DETCHESSAHAR 2013, LAROCHE 1995).
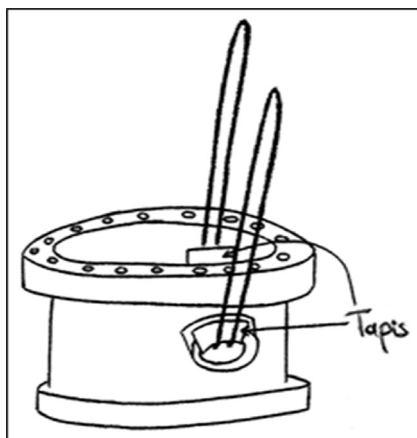

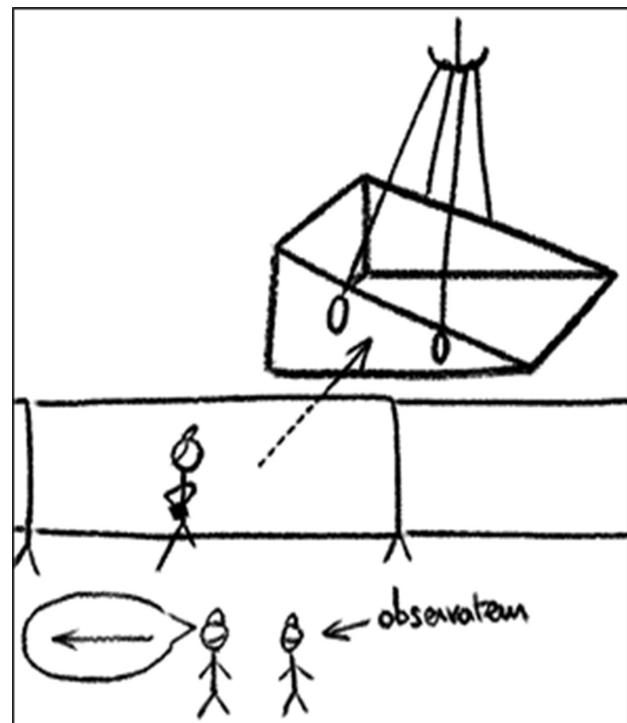Figure 1: Placing slings on a cylinder pipe section to hoist it (drawing made during fieldwork).

Figure 2: Hoisting a bin located behind a partition in relation to the observer (drawing made during fieldwork).

Data collection and analysis

Observations were conducted during fifteen weeks of immersion in fieldwork (FOURNIER 2012, JOURNÉ 2012). We took notes to describe both what workers were actually doing and what they said to each other before, during and after handling operations (VAN MAANEN 1979). Through these observations, we caught sight of the arrangements that handling operatives make to plan and organize their activities. These direct observations along with data collected in other forms enabled us to *"gain access to conversations and texts"* (ARNAUD 2007).
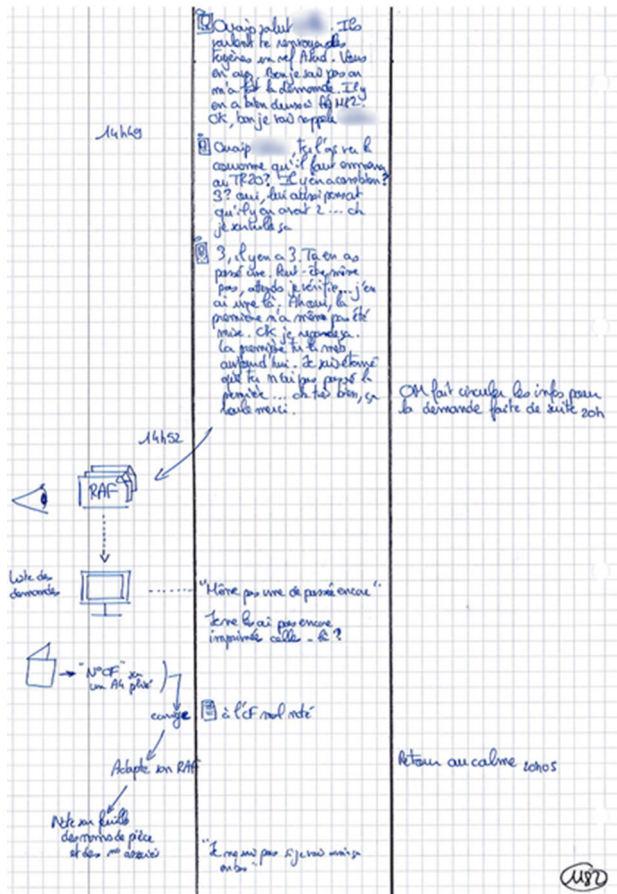

Figure 3: Page from a notebook.

Informal interviews at the workplace helped us understand the meaning these persons assigned to the situations we were observing. We also conducted interviews to detect the subjective experiences of persons working in production, whom we observed during our immersion in the group assigned to heavy handling (BEAUD 1996). Furthermore, we collected copies of documents used for communication purposes.

All this material has undergone a content analysis so as to make visible, for us and for employees, both the contents of the work done by heavy handling operatives and the working conditions (whether routine, disruptive, etc.). To see how handling operations contribute to high-reliability organization, we analyzed both the concrete, material aspects of the work done (tools, gestures, the positioning of operatives in relation both to the object being manipulated and to other workers, etc.) and oral exchanges during operations. We mainly

wanted to understand how the social and material aspects of the work environment were reflected in the language of actors; and vice versa.
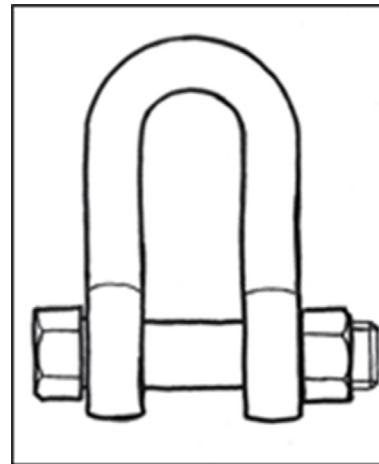

Figure 4: Coupling link used, for instance, to join a sling to an object's handle (drawing made in the field and from a sling operator's notes).

This analysis has brought to light two functions of interstitial activities with respect to high-reliability organization: *a*) they arouse vigilance and *b*) they decompartmentalize activities.
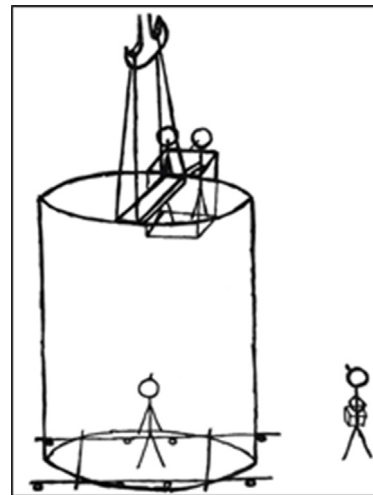

Figure 5: Positioning a lifting beam on a cylinder (drawing made during fieldwork).

Findings

Four dimensions of interstitial activities

With focus set on heavy handling operations and organizational reliability, our research enabled us to refine the initial definition of boundary activities as being invisible and indispensable by taking into account four dimensions: organizational, temporal, spatial and symbolic. The table presents our findings about heavy handling operations. We shall use them to describe interstitial activities and gauge their impact on reliability.

| Dimensions | Characteristics of interstitiality | | Impact on reliability |
	Invisible	Indispensable	
Organizational	— Absence of formal procedures describing the activity. — Absence of quality control and of indicators for measuring performance.	— Impact on production. — Impact on the global performance of workshops at the plant.	— Difficulties of coordination with production. — Difficulties in evaluating and recognizing the work accomplished.
Temporal	— No planning for the time spent on heavy handling operations: the time needed is informally assessed. — The time devoted to such operations is split up as a function of needs in production.	— Dead time is turned into productive time. — When done fast, such operations reduce waiting periods in production.	— Heavy handling operations are seen by the rest of the organization as a waste of time, as a factor disturbing production schedules.
Spatial	— No place reserved for these operations; the place for tools is unused. — These operations are spread out in the workshop as a function of the needs of production.	— The space used for these operations is dangerous. — Space on the shop floor is changed from unproductive into productive.	— An activity at the interstices of the workshop and the organization. — Planning the spatial distribution of handling operations is seen as a waste of time.
Symbolic	— An activity considered to be "dirty work".	— An activity used to promote the organization's products and image (in communication campaigns).	— An activity "looking for its place" in the organization, in time and space.

Table: Interstitial (boundary) activities: Heavy handling operations

The first dimension of interstitiality is organizational. There are no formal procedures describing heavy handling operations as such. The "texts" (guidelines) for conducting or managing such operations, whether at the level of the supervisor or of the workers, are (when they exist) not at all precise or even fail to describe the requirements. There are no indicators for measuring performance, which, as a consequence, cannot be assigned a numerical value. Nor are there specific quality controls for heavy handling operations, unlike for other activities in production. Nonetheless, everyone in the shop said that heavy handling plays a part in production and contributes to reliability and performance. Furthermore, the handling supervisors consider that their activities affect the workshop's global performance. This admission that heavy handling operations contribute to the work process is at odds with their organizational invisibility. The absence of formal texts causes difficulties during interactions with persons in production, problems that might impair the reliability of the organization as a whole. Given that indicators do not exist, it is hard to evaluate the work accomplished during heavy handling operations and, consequently, hard to obtain official recognition for them in the shop.

The second dimension has to do with time. There is no schedule specifying the time to set aside for heavy handling operations. Furthermore, the time needed is seriously underestimated (as compared with the time scheduled for production activities), as both the handling and production managers emphasized. The time to be spent on heavy handling is split up, splintered, as the needs of production evolve. Nonetheless, production supervisors, during interviews, stated that heavy handling operations are, by their very nature, capable of turning dead time into productive time by, for example, reducing waiting periods. This is an argument used by a shop when it insists on having its handling operations done as soon as possible. When done fast, these operations reduce the time that workers in production spend waiting. Given the "temporal invisibility" of heavy handling operations however, this sort of talk is completely disconnected from the actual realization of them. Since handling operations often take much more time than what is allotted, production supervisors ultimately see them as disturbing production schedules. Heavy handling is said to be a preparatory or "lost phase", and thus seen as a waste of time.

The third dimension is spatial. There is no specific place devoted to heavy handling. The places for arranging the tools and material (self-service) are very often ignored. Owing to the very nature of their job, handling operatives temporarily occupy a space normally devoted to production. Even when they are assigned a given place, their job forces them to move about; they are continually scattered and then brought back together. Everyone agrees, once again, that heavy handling

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operations are indispensable for organizing space in the shop. Given the large dimensions of the objects to be manipulated, such operations inevitably take up space. In the words of a production supervisor, the space devoted to such operations *"becomes dangerous when maneuvers are executed; this is the reason production workers are not allowed into certain areas."* Just as heavy handling operations turn dead time into productive time, they can make an unproductive space productive, by helping the production supervisor *"gain room"*. Since handling operations might be scattered all over the workshop, this spatial distribution is a strong reason why production supervisors exert pressure so that "their" request for heavy handling be a priority. This pressure negatively affects the shop's reliability since it tends to compartmentalize handling operations in the shop, disconnecting them from activities in the plant as a whole.

The fourth dimension of boundary activities is symbolic. White- and blue-collars in production consider heavy handling to be "dirty work" (HUGHES-1971). According to a handling operative, this work is seen as *"next to the last job in the shop, just before maintenance"*. Workers are reluctant to help with handling, and supervisors declare that they *"don't have the time to think about handling operations"*. Though little store is set on the job of handling heavy, bulky objects in the shop, this work, paradoxically, draws attention because it is spectacular. Communication campaigns use it to enhance the image of the firm's products and vaunt its "technicity": a classic photograph features a cylinder hoisted by a traveling crane. Heavy handling operations are symbolically invisible but yet spectacular. They are thus continually trying to find "their place".
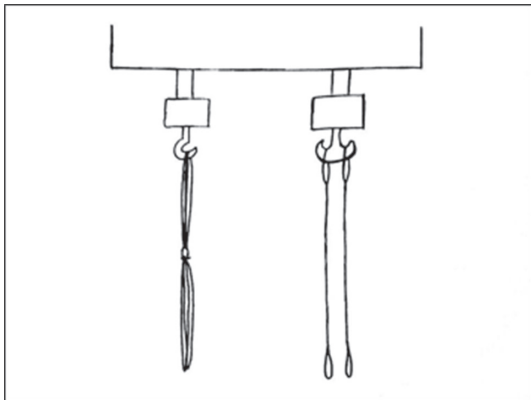

Figure 6: Traveling crane prepared for hoisting (drawing made during fieldwork).
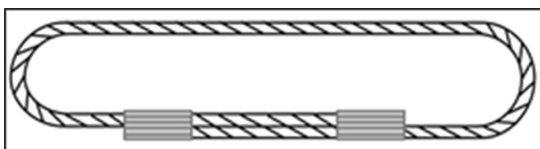

Figure 7: Tackle used for hoisting objects, for example, to be attached to a traveling crane (from a sling operator's notes).

The analysis of interstitial activities along these four dimensions sheds light on the tension between their formal invisibility (which leads to heavy handling being seen as of "little value") and their indispensability (as implicitly recognized in conversations). These boundary activities, which are indispensable for the workshop but more or less invisible, affect the organization's reliability.

High-reliability organization

Heavy handling operations become visible to all whenever an incident affects worker safety, whence the impression that these operations do more harm than good to the organization's reliability. However our research brings to light the positive contribution made by this boundary activity to high-reliability organization. What is said in conversations about handling operations modifies the beliefs and actions of the parties involved and thus contributes to the organization's reliability in two ways: a decompartmentalization of both handling and production that arouses the vigilance of employees in production about heavy handling operations; and a decompartmentalization of jobs in production that also arouses the vigilance of employees there about the workshop as a dynamic whole.

Heavy handling, a factor for increasing vigilance

The work of making heavy handling operations reliable depends on several persons. The handling supervisor, as he coordinates requests coming from all shops in the plant, has to look for information and formulate it for the operations to be performed: date and time, the starting and ending position of the object to be moved, its size and weight, the layout, etc. The production supervisors, who request heavy handling, have access to texts about the operations that are more detailed than those in the hands of the handling supervisor. But when they formulate their request to the handling supervisor, they do not yet have the pertinent information to communicate; and they are not aware, before the handling operations start, of the part that they themselves have in making the operations reliable. When the handling operatives come to the shop to start work, the production supervisors finally realize their part in the reliability of the planned operations. The handling operatives need to fill in the information from their supervisor with information from the production supervisors. Box 2 describes a situation where the handling supervisor helped arouse the vigilance of his colleagues in production.

To plan interventions, the handling supervisor needs to keep his "clients" — the production supervisors — aware of the stakes. In the example reported in Box 2, the handling supervisor frequently reminded his colleagues in production that they had to gather information and pass it on to the handling operatives — information about the precautions to be taken and with technical details about the operations to be performed. The handling supervisor also needs to allay the pressure exerted by production supervisors, lest his operatives be pushed to take risks. In the example cited, the handling supervisor suggested that the production supervisor recheck his information on the handling operations he

Box 2: Arousing a production supervisor's vigilance

Needing to have two objects moved, a production supervisor telephoned the supervisor of heavy handling operations. He had already collected all the information on hand and talked to his workers. The requested operations would not, he thought, take too long. While talking to the handling supervisor, he insisted on the job being done fast. The handling supervisor mentally reviewed the requested operations. He did not tell the production supervisor; but production workers had to prepare the objects to be moved (an activity taking time), and a lifting bar had to be installed (more time…). Taking account of the information from the production supervisor, the handling supervisor thought that going too fast was risky.

Rather than starting an operation that might be risky and cause time to be uselessly wasted, the handling supervisor told his colleague that all his operatives were already busy on other jobs of equal priority that would take time. This was true. He asked him to recheck his information. The production supervisor said he would do so and call back later. Three quarters of an hour later, he called back to say that the two requested operations were not all that urgent. One of the objects was to be shipped the following week, and he gave him the exact date. The other was for much later, but no formal schedule had yet been set.

By advising the production supervisor to recheck his information, the handling supervisor drew on his own expertise, which the shop unanimously recognized. He was asking his colleague to look beyond the information drawn from reading the "texts" and from his "conversations" with his workers; the production supervisor would thus better understand the ins and outs of the requested operations. When the time came, the production supervisor was well enough informed that he could, with his workers, adequately prepare for the operations and satisfactorily coordinate them with the operatives of the handling and lifting equipment. The production workshop thus duly prepared the two operations requested, which were then performed without any rush.

was requesting. In cases when production supervisors are facing an emergency or when they feel that the requested operations cause no difficulty, the handling supervisor tries to arouse their vigilance so as to draw their attention to their part in the handling operations.
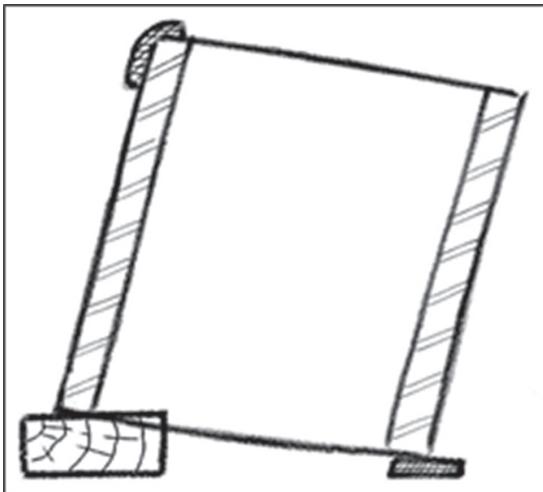

Figure 8: Cylinder prepared for hoisting by a traveling crane (drawing made during fieldwork).

Heavy handling, a factor of decompartmentalization

In the workshop where we conducted fieldwork, there are several specialized job categories (boilermaking, assembly work and tooling), each of them compartmentalized. Given the stakes of their jobs, these occupational groups are organized to attain their own high level of reliability. Each group focuses on its own problems, which are so complicated that, in the words of production supervisors, its members are blind to the "specificities" of the other occupational groups. Given the relative scarcity of resources for bulk handling operations, these "specificities" can spark conflicts between skilled workers in different job categories. For example, welders, who work on very hot materials, might need an object to be moved fast before cooling. This demand is hard to meet when handling operatives are already busy satisfying requests from another job category.

Since production supervisors — unlike the handling supervisor — do not have an overall view of the plant, they are unaware of the general situation. As we noticed, much of the work done by the handling supervisor consisted of telephone contacts with production supervisors to discuss their requests. Production supervisors set store on direct verbal exchanges so as to adjust as fast as possible the schedule of handling operations to their own, local needs. Each production supervisor called the handling supervisor as soon as he wanted a heavy handling operation to be done and negotiated for it to be planned for as soon as possible. Production supervisors expected handling operatives to "function when the whistle blows", in a supervisor's words. These operatives intervened like "firefighters". At the scale of the plant, there were too many requests for handling operations, too much pressure and a "dispersion" of assignments (DATCHARY 2012). The issue was to limit this overbooking through planning.

However this work of planning and thus better preparing heavy handling operations ran up against the aforementioned compartmentalization of occupational

Box 3: Decompartmentalizing a production supervisor's approach

The supervisor of heavy handling operations called a production supervisor to confirm whether a given operation still had to be done in his workshop (for the second object in a pair to be moved during the current shift). The production supervisor said that everything needed had been left nearby. The handling supervisor informed him that there would be a lot of movement in his shop in the coming days. The production supervisor did not know about that. What the handling supervisor did not tell his colleague, however, was that the order of priority assigned to handling operations would very likely keep him from doing the one being requested. After asking the production supervisor to quickly file a request, he suggested that he plan a meeting the next day for their work teams, at the very start of the shift. The production supervisor agreed and assigned him a worker for six o'clock the next day.

The timing made sense: six o'clock is the usual time when the production supervisor meets his workers to discuss the work done during the previous week and to do during the coming week. The handling supervisor's suggestion was clever, since the heavy handling operation would not impede the loading work that the production supervisor had planned for the assigned worker. At the appointed time, this worker and a handling operative performed the operation together without taking any risks.

Afterwards, the other handling operations escalated, as foreseen. The operation that had just been accomplished reduced the pressure that other production supervisors would inevitably try to exert on handling operatives.

By opening a conversation with the production supervisor about the risk of an incident during operations, the handling supervisor managed to win him over by making him aware of the other already planned operations. By accomplishing this operation in advance, conditions were improved for the other operations planned in the shop with leeway for anything unexpected that might crop up.

groups. This impediment could be lifted only if several production supervisors collaborated. Box 3 recounts a series of conversations that sheds light on how the handling supervisor managed to skirt around this compartmentalization, his aim being to pass messages to production supervisors in different shops.

Since handling has the same hierarchical rank as the other occupational groups in the workshop, the handling supervisor was in no position to limit the requests coming from production supervisors. Vulnerable in dealings with these "colleagues", he tried to make them aware of the situation by explaining drawbacks and arousing an awareness of the global situation in the plant, with its interdependencies and incompatibilities. In the case described in Box 3, he managed to construct with the production supervisor a global, less compartmentalized, view and thus bring the latter to an awareness that reached beyond his own shop's problems. In this way, the handling supervisor obtained the cooperation of production supervisors; this, in turn, helped him plan his own work. His "interactional cleverness" during informal exchanges led him to propose adjustments that, as best possible, took account of each party's needs and conditions but without losing sight of the global situation.

Conclusion

Reliability and the organization seen through interstitial activities

We have pointed out how boundary activities play, owing to their very interstitiality, an ambiguous but major role in the reliable performance of an organization, a role of which employees are not fully aware. Contrary to studies of accidents and of high-reliability organizations, this research on everyday work processes has shown that operations such as heavy handling, though insignificant in appearance, play a key part in planning for risks and contingencies.

Through interactions of explanation, translation and negotiation (KELLOG *et al.* 2006), handling operations were performed while arousing the vigilance of production workshops and making them aware of the larger environment, in particular of other job categories and of the plant as a whole — thus moving employees beyond a narrow focus on the shop itself. By doing so, the risks associated with organizational/occupational compartmentalization were reduced; and a global vision of constraints and issues and thus a "collective intelligence" emerged. The planning for heavy handling

operations also led to a cognitive decompartmentalization that stimulated the "requisite variety" (WEICK & SUTCLIFFE 2001) and "slack" (SCHULMAN 1993), both of them necessary for coping with complex, unforeseeable, fluctuating situations.

However the reliability produced through interstitial activities, such as heavy handling operations, is very fragile. This system of reliability is vulnerable owing to what Bourrier (1999) has called "opaque autonomy". It relies on the strong but unrecognized commitments made by first-line operatives and, therefore, depends on their willingness (and acceptance) to commit themselves despite the lack of any recompense, whether financial or symbolic. After all, this very opacity can block the "reflexivity" for which formal procedures allow, such as feedback from experience and the diffusion of learning experiences. Without the backing of the "texts" of safety regulations (DANIELLOU *et al*. 2011), boundary activities are, in this respect, more vulnerable than the "noble" activity described by Bourrier.

A pragmatic, communication-based approach enables us to understand how interstitial activities (herein heavy handling operations) are evaluated through conversations but not in formal texts. Such activities are caught in a permanent state of tension between, on the one hand, this textual invisibility (which keeps them from being assigned a measurable numerical value) and, on the other hand, their usefulness (which is admitted during conversations but is always verbal and more or less informal and contextualized). We have described this interstitiality and the tension accompanying it with reference to four interrelated dimensions: organizational, temporal, spatial and symbolic. An interstitial activity exists in between the activities with boundaries and contents that are clearly set through the organization's practices, occupational groups, territories and formal texts.

Questions of coordination and cooperation in "distributed" organizations" have attracted the attention of researchers and practitioners. They imply investigating interactions along the boundaries, whether organizational, temporal, spatial or occupational. The concepts of "trading zones" (GALISON 1999, KELLOG *et al*. 2006), "boundary-spanning individuals" (TUSHMAN & SCANLAN 1981), or "boundary objects" (STAR 2010, CARLILE 2004) have been formulated to describe boundary activities and the "work of articulation" (STRAUSS 1992), by showing how they depend on an organizational arrangement, an individual or an object.

The originality of our research is that it shows how an interstitial activity — seen in relation to both an occupational group (herein handling operatives) and their practices — serves as the grounds for the emergence of coordination and decomparmentalization. Further research should focus on interstitiality less as a boundary activity of the organization than as a property of the activity itself. In line with studies on the work environment's social and material aspects, it would be worthwhile thoroughly examining how problems of interstitiality crop up on each of the four dimensions (organizational, temporal, spatial and symbolic) and, too, in combinations thereof.

Implications for management

The interstitial activities observed and defined herein raise at least two problems for management. First of all, they are mostly invisible and can, therefore, be easily dismissed as "dead" time in the production process. Secondly, located along the margins, along the boundaries of "real jobs", they are "looking for their place", whence questions about how to define occupations and skills and delimit managerial authority.

A response (observed in both firms where we did fieldwork) to the first problem is to formalize interstitial activities through indicators or other visible, "textual" procedures. In our opinion, this misses the mark, since formal procedures might not find any takers (as we noticed in both firms) and, consequently, might vanish from "conversations" at the workplace. Besides, this response amounts to abolishing the interstitiality of these activities — the very characteristic that allows for their recognition (at least in conversations) and that enables them to be a source of vigilance and decompartmentalization at the workplace. This response by management confuses an activity's "value" with its "visibility".

To handle these two managerial problems, what is necessary is not so much to formalize work processes as to organize a dialog on interstitial activities. By taking account of how such activities reach across boundaries, management can either "dissolve" them in production (by placing them under a single authority with production) or else assert their independence (by bolstering the boundaries with other occupational groups). But either of these solutions risks depriving the interstitial activity of its capacity for stimulating a global vision (COUTAREL *et al*. 2015).

A global vision of the organization depends on an inter-comprehension between handling operations and the so-called "noble" occupations so that the two dialog about their practices and constraints. This necessitates an active management of "spaces" for discussions (DETCHESSAHAR 2001, ROCHA *et al*. 2015) so that the personnel in heavy handling relinquish certain zones of control to oversight by the organization and, too, that the principal activities in the organization attribute more value to these interstitial activities.

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