In this article, I argue that the study of the relationship between organizational design and safety has been largely neglected. Substantial progress has been made in social sciences by considering taking workers' practices and associated social inventions into account.
In this article, I argue that the study of the relationship between organizational design and safety has been largely neglected. Substantial progress has been made in social sciences by considering taking workers’ practices and associated social inventions into account. By and large, the human factor community has also championed the view that for the sake of safety, individuals have regularly reinterpreted rules, procedures and formal organizations. Many studies have underlined the crucial role of the way in which members of an organization adjust to their formal environment, by redefining part of the framework in which they are supposed to operate.

Nevertheless, other studies have also emphasized that some of these adjustments are deviances that can lead to catastrophic consequences. I suggest that this hazard and the on-going debate in which the community seems stuck—i.e. deviation versus deviance and how to allow for deviation while preventing deviance—might benefit from a new look at organizational design.

It is generally accepted that organizational design is a process, mainly concerned with the formal elaboration of work settings, responsibilities, and collaborative frameworks.

Current research suggests that the time is right to assess the broader effects of the costs (human, social, economic...) induced by alternative organizational designs. A new perspective on phenomena like “Normalization of Deviance” or “Necessary Violations” would enable both the human and organizational factor specialists and managers of these organizations to better understand the conditions which generate deviations. This in turn could clarify the contribution of organizational design to safety (and safety failure). Research experience in the civil nuclear industry will be used to develop this approach.

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Introduction

Safety is a Matter of Organization

In high risk industrial environments such as nuclear power plants, chemical factories, railways or the aircraft industry, people in charge of work organization tend to be engineer-technicians of a very homogenous scientific background.

For a number of decades, engineers have structured the organization of high-risk industries. This has been achieved in a highly technical-bureaucratic fashion through successive reforms and as a result of fairly unilateral thinking. The resulting organizational innovations are hardly ever submitted to external criticism, let alone reliability assessments (of the organization itself). No diagnosis is ever attempted. Organizations are generally modified, adjusted, amended, without any prior justification or debate.

Most of these changes are implemented top–down—and yet the way they reach the bottom suggests that there is much variety in the way reforms are received, understood and really implemented. Sustained resistance to change in many places shows how disturbing some of these transformations are.
In addition, many companies have observed differences in actual working practices from one plant to another. This reality suggests there is a limit to homogeneous managerial rhetoric and in reality a great diversity of organizational practices exists, both on paper and on site.

However, there appear to be few analyses and comparisons, or much questioning of this variety, not necessarily to determine the “best model”, but at least to try to assess each individual model in order to better understand its own logic and forecast its possible evolution.

Designing work organization in high-risk industries has rarely been a subject matter for organization science—despite interest in these questions over the years (however, there are some exceptions, as illustrated in this issue). Not only are scholars in this area rarely involved in decision-making, but also they are rarely in a position to share their expertise with the highest level of the organization.

However, criticism should not be too severe as some managers read, consult, and encourage research. That said, once it comes to the planning stage, for example for an “inherently safe” nuclear power plant, technology comes back with a vengeance. For example, the design of a new aircraft is always seen as a technological rather than an organizational matter to begin with (Scardigli, 2001). Although consideration of “human factors” and more recently “organizational factors” are now fashionable, who today would dispute the view that the only way to make things “inherently safe” could be any way other than by technology? The current controversy over the not-so-new European Pressurized Reactor (to be built in Finland and France), with technological characteristics designed to prevent a major accident, reveals again the same rhetoric. The general trend is to neglect the relationship between concrete work settings and technological constraints or more generally the way in which the socio-technical coupling of a given organization is embedded in a political, social, economic context which is constantly in motion.

It is only when performance and reliability are met with growing obstacles: from stubbornness—initially interpreted as “resistance to change”—, strikes—treated as “mostly corporatist”—, incidents—“duly registered and traced in our return on experience database”—, accidents—“hopefully rare”—, crises—“serious, yet of such a radically different nature”—, that social sciences get the house call. By then, it is generally too late (Lagadec, 1988).

Some scholars have voiced their resentment to this “emergency services” type role. They are tired of being invited to provide imperfect recommendations, since these are bound to be over-determined by “hard” technological constraints, themselves the product of a long history over which social scientists have had no control (Bell, 1998; La Porte and Keller, 1995).

Sociologist Charles Perrow goes further. He argues (Perrow, 1984) that so-called “normal accidents” are the price to pay for the failure to jointly design technology and organization. He emphasizes that as long as technology and organization are independently created and viewed as distinct issues, their constant interdependence in real life will remain a source of hazard. Reflection on organizational design remains outside the decision scope in the technical design of plants. From this point of view, Perrow argues that risk cannot be “managed”. Some day, somehow, an accident will occur, resulting from the disastrous encounter of technical complexity with the “structural” shortage of human and organizational capital capable of dealing with it.

To go beyond this problem, some pioneering research has attempted the conception of a surveillance system for high-risk units. This surveillance would be conducted not only from the vantage point of political accountability and transparency, generally only possible after the fact, but also as an issue to be addressed when decisions on technological architecture are being made. For instance, La Porte has discussed recently how to design a high-risk facility in order to facilitate the work of regulators.

This paper rests on the premise that the lack of both debate and cross-fertilization of ideas between managers and engineers who decide on organizational design, and scholars who study high-risk operations, has a high cost in terms of safety. If, as current conventional wisdom suggests, the main reliability gains are to be made on the organizational side, then this situation must be challenged.

The remainder of the paper is organized as follows. The first section discusses the example of the civil nuclear industry to assess the influence of organizational design on behavior. The second section reviews the reasons how and why this situation has come into being. The third section outlines the arguments which lay the foundations for what I suggest calling a “pragmatic management of organizational hazard”.

Transgression and Compliance in the Nuclear Industry: The Contribution of Organizational Design

The procedure of work is part of the strategy of any organizational design. The discussion of the contribution of formal procedures in achieving safety provides insights into the way organizational choices are thought through.
Two Strong Views

In brief, there is a continuing debate on prescriptions and the (associated) corresponding “normal” transgressions, short cuts, arrangements or adaptations. The majority view holds that adjustments are an intrinsic characteristic of work for two reasons. First, because there is a structural inadequacy between the “reality” of actual situations and rules, which are, by definition, incomplete; second, because workers needs create margins of autonomy necessary for the running of high risk systems (Amalberti, 1996; Bourrier, 1999).

This scientific literature is based on a large number of case studies and seems to suggest that safety is derived from the beneficial creativity of personnel, as everyday heroes. It precludes any attention to design, since “one knows” that members of the organization will accept the mode of operation of system, to make it their own.

As a result, many authors have concluded that this situation is not only inescapable but also desirable. Obviously, the cost of this approach is imperfect adjustments, inopportune violations, and non-recoverable errors. These problems would be more than compensated for by the gains in keeping operations going, while satisfying efficiency and safety requirements. A body of literature concurs and has been emphasizing the advantage of adjustments for a long time.

At the other end of the spectrum, managers have emphasized how the adoption of strict rules and regulations will inevitably deliver total safety, as long as workers conform at all times. Obviously, if through neglect, sloppiness, or misunderstanding, people do not adhere to strict compliance—then anything goes.

One could hardly conceive two more incompatible viewpoints.

The dialogue between the two communities has had to reckon with this fault line. The current situation is as follows: It is true that prescriptions do not fix everything and some room must be left for autonomy, initiative, and adjustment. All parties have come to terms with this fact, and it is noticeable that managers no longer get nervous at the mere reference to this reality. At the same time, it is the managers along with the various technical safety bodies, who are in charge of the surveillance of these high-risk systems, and they are understandably NOT ready to give up any reference to rules and procedures.

Yet, how to make choices among the rules? What should be kept and what should be discarded? At this stage neither managers and their regulators, nor scholars, quite know where to go. For example, what is the “optimal” balance between autonomy and procedures? How can the centralization/decentralization struggle be distanced, as Gauthereau and Hollnagel invite us to do? (see article in this issue.)

The only way out, I argue, is to study the implications of alternative organizational choices in detail and to assess their impact on behavior, as this behavior is known to shape overall organizational reliability.

Revisiting the Classic Conventional Wisdom

To begin with I argue that the notion of constant, opaque and beneficial adjustment of rules should be revisited. It is not true that workers dealing with complex systems are bound to drift towards corner-cutting. Close study of the way in which organizational design takes into account the gap between formal procedures and the reality of practical work indicates a vast array of responses. Some designs are more prone than others to transgression.

In fact these designs specifically overlook the influence of the conditions under which rules are created and modified. In other words, as long as the design of working procedures remains out of reach for those who implement them, there will be no other alternative than to break the rules, when conflicts or contradictions emerge. In normal times, these adjustments will reduce some of the pressure and generally help the system to operate smoothly. However, they contain many features, known only to those who implement them, creating opaqueness and pockets of “private knowledge”, leading gradually and naturally to a body of inaccuracy procedures.

Formality Does Matter

My previous research comparing nuclear power plants in France and in the United States, found evidence of this pattern. Whenever the need to modify procedures was not “formally taken into account”, then short cuts and adjustments were observed. “Formally taken into account” implied that the organization officially recognized and dealt with the tension. In other words the organization dealt with the problems either by formally giving workers the responsibility to undertake the modification of procedures when they deemed it necessary, or by providing workers with extra personnel resources for the writing and up-dating of procedures.

Conventional objections to this strategy emphasize that workers on the ground do not possess the requisite expertise to take on a job as important as the writing of procedures. Although this may be the case, it is worth considering the way this was dealt with in one American plant: The foremen and their teams had the authority to suspend their work if they
found they could not perform it without a change of procedure. They collectively thought of possible adjustments. The foreman then attended the daily “Security and Nuclear Safety and Operations Committee”, where he presented the reason why this modification was required to the top management. In the subsequent question- and answer-session, the managers mostly sought to understand the intrinsic logic of the request rather than its technical subtleties. A decision to accept or reject the request was immediately taken and the foreman could start again with his team.

Three ingredients appear to have played a crucial role. First, there was feedback from the lower tiers to the upper tiers, this ensured tight control and supervision of the adjustment. Second, the initiative to undertake the adjustment belonged to those who were directly concerned. Third, the system operated swiftly. Actors did not need to wait for weeks as the committee meets daily.

By contrast, my study of French plants demonstrates that a similar attention to the tension between work and procedures was lacking. In broad terms, the trend is to separate those who design from those who execute procedures, and to prevent those who execute from any initiative to undertake formal modifications. The normal process is that first line actors should warn the management of any problem encountered. The engineers and work planners who may eventually decide on a modification then study the problem. This system privileges analysis over a quick response.

The French system is efficient as long as the pressure on “front line” teams is moderate—which is rarely the case. In practice, it leaves workers and first line supervisors to decide on the course of action to be taken. Only major problems reach the management level. Gradually, first line operators and their proximate supervision choose to muddle through for day-to-day problems, which they deal with through ad hoc, creative, quick and often very effective solutions. These solutions depend on experience, knowledge, but also involve a measure of risk taking. They are of course rarely reintegrated in the loop and do not nurture any kind of formal on-going quality enhancement policy (see on this problem Tucker and Edmondson, 2003).

This “classic” mode of operation involves rewards since it gives room for manoeuvre, and pockets of power but also penalties, which are not usually sufficiently highlighted. It prevents any official recognition of opaque effort, since the adjustments are totally “illegal” (Dejours, 1993). It is a fertile soil for the so-called “normalization of deviance” (Vaughan, 1996), the daughter of all organizational design dead ends.

Adjustments are therefore not a property of human cognition and nature, but highly dependent upon the types of organizational resources members of the organization are able to mobilize. The way the organization is set up formally greatly influences the type of behavior displayed in the end.

Organizational Design: A Neglected Topic

In the past 20 years, organization science has made progress. Its findings ought to have been digested and reprocessed by decision-makers. To date however, progress has been scant for a number of reasons including the following.

A Crucial Lack of Valid Knowledge to Assist in the Taking of Important Decisions

Some have emphasized that scholars in organization science merely describe, shed light on, and invite reflection, rather than provide solutions (De Montmollin, 2001). It is an unfair criticism.

The problems faced by social scientists are compounded by local circumstances. In France it is customary to emphasize the “autism” of managers, nurtured and reinforced by their homogenous training in the Grandes Ecoles. In other countries where more diversity is observed, there is nonetheless a troubling separation between the advances of the social sciences in the field of risk and organization and the way in which the corresponding activities are managed on a day-to-day basis. Yet progress cannot be achieved without a significant change in the relationship between the industrial and the organization science community.

What managers mostly lack is knowledge of the implications of their organizational choices. No attempt is made to determine what the effect would be of a given change on the ecosystem of one specific organization. No advances will occur in mastering organizational sources of reliability (and failure), if we continue to ignore the contribution of the social sciences to provide a perspective on future outcomes.

Sharing Part of the Blame

Scholars share part of the blame. In particular, I believe it is their refusal to pinpoint and question certain social processes as “pathologies”, which is their main weakness. In a sense, a scholar’s “professional ethics” leads him or her never to judge and always just describe. This attitude is unfortunately the source of blindness. Often, they end up explaining how things work “after all”. For example, although the main objective of the sociology of organizations, is to identify the potential flaws of existing systems, it is often reluctant to provide a diagnosis and a
tentative perspective. In the final analysis, it resists assessing the sociological costs induced by alternative set-ups. It prefers to dwell on complex equilibria in the social processes and on transgressions and arrangements designed to achieve efficiency “in spite of” (Clot, 1998). This perspective has too often neglected the study of formal organization, the conditions under which it is produced and finally the conditions under which it is supposed to evolve. The recent work of sociologist Arthur Stinchcombe (2001) offers a dissenting voice on this issue.

“... the unpopularity of formality in social life is due to the fact that it has been understood by its pathologies. When it works properly it achieves the ends it was built for, the substantive ends that people have decided to pursue. When formality pursues the ends alien to us, it is in general because those are the ends of others. It is not the formality that is at fault, but the politics that delivers formal powers to others” (Stinchcombe, 2001, p. 17)

In the end scholars in organization science have rarely ventured into either prospective or scenario construction. They remain clear of extrapolation, sensitivity analysis, or counterfactual assessments, and yet these exercises would be necessary to undertake what might be called a genuine organizational perspective.

Consequently, in the social sciences, organizational design is an under-researched topic (recent exceptions include: Baron and Hannan, 2002; Heimann, 1997; Liedtka, 2000; Roberts and Grabowski, 1999; Stinchcombe, 2001).

This paper argues that organizational design is at the heart of the modern debate on organizational reliability. When organizations are redesigned, through the creation or suppression of services and branches or through outsourcing and other similar developments, the routes to organizational reliability are also modified. (Batteau, 2003; Rousseau and Libuser, 1997; Vandevyver, 1986). To this effect, it is perhaps comforting to note that Proposal 6 of the French Parliamentary Commission report on the AZF accident in Toulouse (September 21, 2001) recommended that in cases of substantial organizational changes, a thorough re-assessment of safety must be accomplished as early as possible. 4

Studying organizational design helps acknowledge that all designs are not equivalent. This does not imply taking a normative view. There is no “best” design. The point is rather to emphasize the costs and benefits of alternative safety designs. Therefore organization science does not promote “safe organizations” as Marc and Amalberti suggest in a recent paper (2002), but rather helps to spell out the implications of certain organizational choices. Organization science could make use of the economist’s concept of “externalities” to analyze social phenomena in technical systems. The only requirement for this is to accept the notion that reliability, as an outcome, is also a matter of organization (Bourrier, 2001).

Consequently, it would be most useful to ask that plant managers get a sense of how reliability is achieved before engaging in any major transformation. Of course, it does not imply that any reform must be blocked, but only that reform should be implemented once there is sufficient understanding of how a given system behaves. To date, this kind of approach—let alone any legal requirement—is yet to be promoted.

Conclusion: Linking Design and Safety

A Robust Research Agenda

Today, there is a better understanding of how the structure of the organization determines performance in terms of reliability. For instance, (Heimann (1997) and in this Management Focus) has demonstrated there is a correlation between organizational design and the type of risk that an organization wants to avoid. Through analysis of the Challenger accident, and of the organizational failure of the Food and Drug Administration, he explains that in these cases, failures occurred at very specific moments of organizational life: namely, when an implicit but unnoticed change of structure was taking place. Careful study of NASA organizational charts led Heimann to conclude that, over time the launch decision structure had shifted from a redundant system in series to a redundant system in parallel. The shift echoes the strategy of cost cutting that took place during the eighties. This design choice increased the “normalization” of deviance, since all redundancies and slack were systematically suppressed, hence limiting the possibility to conduct cross-examinations.

H.R.O. theorists (La Porte, Rochlin, Roberts) have also examined the various design strategies that some high-risk organizations have displayed in their constant search for excellence in risk mitigation (see La Porte and Consolini, 1991; Roberts, 1993; Rochlin et al., 1987).

I have shown in my own work how compliance and transgression are dependent on the kind of official resources to which the personnel have formal access. Some organizations are more prone to deviation than others. As long as it remains difficult for workers to validate a change in an inadequate procedure in a reasonable time, they will try to fix the problem by themselves, usually with success.

In the meantime, research results of this kind cannot lead to recommending the adoption of any specific organizational model in particular. Just as there are

102 European Management Journal Vol. 23, No. 1, pp. 98–104, February 2005
several modes of work structure that can be adopted to successfully effect a maintenance outage, for example, so several organizational designs must also exist to maximize safety. The focus should not be on finding “the” reliable organization, but rather on seriously understanding the positive and negative externalities of alternative existing models.

At a time where major reorganizations are being conducted in many high-risk industries, it can be hoped that organizational choices will be influenced, or at least enlightened by the contribution of current and future research. For this purpose, a certain number of questions must be systematically addressed, in industrial circles as well as in social science research programs.

Pragmatic Management of Organizational Hazards
For example, I believe that the following questions must be systematically addressed if progress is to be made in tackling issues of organizational reliability.

Concurring with Heimann’s analysis, the dilemma between type I risk (loss of installations and life) and type II risk (waste of resources) can be summarized as follows: Which type of risk has the organization chosen to be “acceptable”? Does everybody agree with this choice? Are there any dissenting voices?

Tackling this problem implies communicating the choice in the clearest way possible and stressing its intrinsic problems. It also means engaging in a complete revision of the structures to assess whether the choices made are consistent with the choice of risk to be avoided. It could be useful to set up a system to monitor any unnoticed organizational modifications, because this could suggest that certain members of the organization have chosen another strategy for the organization—either consciously or unconsciously.

The role of whistle-blowers should also be carefully monitored: Are they members of the organization whose opinions are rarely taken into consideration? What are the reasons? Or on the contrary, are they members of the organization who are always listened to?

The involvement of members of the organization in the constant evolution of organizational design should not only be welcomed but also striven towards. At all times managers should be asking themselves about the degree of participation, implication and the real influence of their personnel in the “official” modification of the functioning of their organization? In particular, how are their suggestions and requests integrated in the procedure update loop?

Finally, what kind of relationship is organizational reliability based on? Is there an existing assessment of the strengths and weaknesses of the current organization? Are the decisions to reform the organization based on a systematic assessment of the implications of such changes on the current foundations of organizational reliability? What is known of the positive and negative externalities associated with the organizational choices made?

Today, a better mitigation of organizational risks is dependent upon the managerial will to address these questions, even imperfectly. To date, we do not know of any organization currently engaged in such a process, nor do we know of any research program that seeks to adopt this kind of prospective approach, not after an accident, but before. We believe progress can only be made by the combined effort of researchers and managers.

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Notes
1. According to Perrow however, there is no other way to go—making him a pessimist.
2. One of the problems faced by French nuclear safety authority on the controversial debate around the closure of Superphenix had a lot to do with the issue of “gaining access” to the intricacies of this very complex, almost un-reparable and difficult to audit machine (Bell, 1998).
3. For more details on this work see Bourrier (1996, 1998, 1999).

References


Heumann, L. (1997) *Acceptable Risks, Politics, Policy and Risky Technologies*. The University of Michigan, Ann Arbor, MI.


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