tao Digital Library

An international multidisciplinary paper series devoted to the study of organizational action, organizational change, and organization and well-being. Founded by Bruno Maggi.

TEMPS, AUTONOMIE ET DISCRETION : ANALYSE D'ACTIVITES DANS LA MAINTENANCE FERROVIAIRE

TIME, AUTONOMY AND DISCRETION: ACTIVITY ANALYSIS IN RAILWAY MAINTENANCE*

TEMPO, AUTONOMIA E DISCREZIONALITÀ: ANALISI DI ATTIVITÀ NELLA MANUTENZIONE FERROVIARIA

CECILIA DE LA GARZA•
UNIVERSITÉ PARIS V

BRUNO MAGGI•
UNIVERSITÀ DI BOLOGNA

ANNIE WEILL-FASSINA•
ÉCOLE PRATIQUE DES HAUTES ÉTUDES

Abstract
This paper shows a collaboration between the study of organizational action and ergonomic analysis. The regulation of the processes of work action and the cognitive regulation of operators are jointly studied in the comparison of two real-world case studies focused on the maintenance of railway infrastructure: the maintenance of the line and the repair of electrical signaling installations. The interactions between the affirmation of autonomy or the exercise of discretion and different approaches to the time management of working activities affect in various ways the reliability of the system. In urgent cases, the affirmation of autonomy may promote reliability, while in case of time pressure the exercise of discretion may increase the risk of unreliability.

Keywords
Regulation of social action, Ergonomic analysis, Autonomy, Discretion, Time management.

∗ The original French version of this study was presented at the 33rd SELF Congress, Société d'Ergonomie de Langue Française, Paris, September 16th-18th 1998: v. *Temps et Travail*, *Actes du 33° Congrès de la SELF*: 415-422, Paris 1998. The Italian and English versions have been first published in the journal © Ergonomia 1999, 12: 36-43; 57-60, authorized by the organizing Institutions and Congress Presidents. For this publication of the new versions we are grateful for the autorization to the journal Ergonomia, and also to the SELF.

• The qualifications of the authors refer to the 1998-1999 editions.

Temps, autonomie et discrétion : analyse d'activités dans la maintenance ferroviaire / Time, autonomy and discretion: activity analysis in railway maintenance / Tempo, autonomia e discrezionalità: analisi di attività nella manutenzione ferroviaria. De la Garza Cecilia, Maggi Bruno, Weill-Fassina Annie. Bologna: TAO Digital Library, 2011.

ISBN: 978-88-904979-9-5

tao Digital Library

The TAO Digital Library is part of the activities of the Research Programs based on the Theory of Organizational Action proposed by Bruno Maggi, a theory of the regulation of social action that conceives organization as a process of actions and decisions. Its research approach proposes: a view on organizational change in enterprises and in work processes; an action on relationships between work and well-being; the analysis and the transformation of the social-action processes, centered on the subject; a focus on learning processes.

TAO Digital Library welcomes disciplinary and multi- or inter-disciplinary contributions related to the theoretical framework and the activities of the TAO Research Programs:
- Innovative papers presenting theoretical or empirical analysis, selected after a double peer review process;
- Contributions of particular relevance in the field which are already published but not easily available to the scientific community.

The submitted contributions may share or not the theoretical perspective proposed by the Theory of Organizational Action, however they should refer to this theory in the discussion.

www.taoprograms.org
dl@taoprograms.org

Pubblicato nel mese di Dicembre 2011
da TAO Digital Library – Bologna

Time, autonomy and discretion: activity analysis in railway maintenance*

***Cecilia De la Garza**, Université Paris V•*
***Bruno Maggi**, Università di Bologna•*
***Annie Weill-Fassina**, École Pratique des Hautes Études•*

Introduction

The relationship between the time management of work activities and operators' margin of allowance may impact on system reliability. We intend to discuss this question by comparing two systems of railway maintenance.

The question of system reliability emerged in the course of studies commissioned by SNCF aiming to interpret the dynamics of accidents and injuries. (De la Garza, Weill-Fassina, 1992; 1994; De la Garza, 1995).

A study concerned the safety of the railway workers at risk of being hit by trains during maintenance (replacement of various elements, such as rail splices and ends, sleepers, sleeper screws, or levelling or re-lining, etc.).

Another study concerned system security in relation to maintenance and repair of electric railway signal equipment (level crossing equipment, switching equipment, lights, etc). The operations of the Signaling Department personnel can cause "incidents prejudicing rail traffic security" (such as the inadvertent opening of a level crossing when a train passes by, or a green light instead of red).

The analysis of the work and events brought to light technical and organisational problems and also time management problems, which we would like to emphasize here.

∗ The original French version of this study was presented at the 33rd SELF Congress, Société d'Ergonomie de Langue Française, Paris, September 16th-18th 1998: v. *Temps et Travail*, *Actes du 33° Congrès de la SELF*: 415-422, Paris 1998. The Italian and English versions have been first published in the journal © Ergonomia 1999, 12: 36-43; 57-60, authorized by the organizing Institutions and Congress Presidents. For this publication of the new versions we are grateful for the autorization to the journal Ergonomia, and also to the SELF.
• The qualifications of the authors refer to the 1998-1999 editions.

Time management consists of "programming activities, dividing up time [...] according to principles of efficiency and efficacy [...]. This acts upon interferences, connections and interactions regarding time, on limitation imposed by temporal framework, on their connection to different temporal spaces", combining different temporalities (Grossin, 1996). From this point of view:

- the first situation is characterised by a closely defined temporal framework; this is needed for train announcements to give workers enough time to get off the line before the train reaches them;
- the second situation, especially in case of repairs, is characterised by a lack of precise instructions and a temporal space in which multiple needs exist: reaching a certain position, finding the cause of the problem, repairing it, checking the repair; and this is in relation to the Transport Service, which has its own time constraints and is pushing to restart traffic anyway.

The two situations have in common the need to quickly anticipate risk and to control danger while being conditioned by the degree of *urgency* or *time pressure*. Urgency is typical of unexpected or dangerous situations which require rapid resolution. Time pressure is found in situations in which there is conflict between the time being allowed and the time which the worker considers as necessary for the action. This kind of conflict can be destabilizing.

Margin of allowance is the span of initiative and tolerance which operators have to ensure that the system is working properly (Weill-Fassina, Valot, 1997); this depends on available rules, prescriptions and tools, as well as the precise nature of the situation and the person's responsibilities. The theory concerning the regulation of the process of social action shows the difference between two types of margins of allowance: autonomy and discretion.

Autonomy concerns "the decision-making freedom which an individual or collective subject tries to construct and affirm" in a system regulated externally; "it indicates capacity to produce one's own rules and to manage one's own process of action" (Maggi, 1993; 1996). In the work process, autonomy indicates a capacity to influence the organisation of production and

the affirmation of a certain independence from the hierarchy; it derives from a mobilisation of competences which are not explicitly recognised by the management, while the practical consequences are implicitly accepted to the extent that the expected results are achieved (Terssac, 1992). We shall see that certain activities of railway workers can be interpreted in such a fashion.

Discretion "indicates room for action in a regulated process where the operator is obliged to decide and choose in a context of dependence" (Maggi, 1993; 1996). In the work process, discretion is granted to the operator, delegated by management in the light of the incompleteness of procedures and the difficulty to define them. This can create both advantages and disadvantages to the operator, according to the possibilities and the tools which derive from the organisational choices regarding the *exercise* of such discretion. Repair activities of the Signaling Department operators show these features.

Through reference to the two situations being analysed it will be shown that the interaction between different types of margin of allowance (in terms of either autonomy or discretion) and the modalities of time management (anticipation, precipitation) have specific effects on system reliability: in relation to the time management, the rules and the organisational choices, autonomy appears to be an element conferring reliability, while discretion appears to be an element of unreliability, even though there have been failures in regulating the process because of urgent situations or time pressure.

From the anticipation of danger to the reduction of possibilities to use margins of allowance

An example of autonomy

In small railway line worksites, rigid rules impose two types of protection for personnel: a) stopping traffic on a line on which work is carried out or on an adjacent line by means of communication with the Operating Service, usually in real time; intervention times are a compromise between the needs of the repair work and those regarding the movement of traffic, with

priority given to the movement of traffic; b) the safety of workers is provided by an "announcer" who monitors and signals the arrival of trains by blowing a horn; a table shows precisely the announcement distance in "metres", in relation to the maximum speed of the line and the announcement time in seconds, in relation to the mass and type of tool used. These procedures, derived from a mechanistic representation of work, are based on the notion of "stimulus-response" (announcement signal – immediate clearing of the area).

However, in practice, operators adapt rules on the basis of their experience in order to reduce the situation's uncertainty as much as possible, and to increase their margin of allowance. They therefore attempt to construct their *operational representations* of their environment during the different phases of work.

In practice, the requirement to use "metres" is virtually impossible: it is instead necessary an anticipated identification of the coming train based on audio or visual indicators, plus an evaluation of the time needed for a group of workers to clear the track based on what they are doing, in the light of their experience and the precise nature of their tasks (operations, type and condition of tools and equipment). These evaluations also take into account the possibility for the work group to hear and act on the warning.

During the work process, the role of the announcer is not just to spot the train, but also to contextualize it in relation to indicators such as railway infrastructure (double tracks, straight lines, curves), weather conditions, trains schedule, signals, locations of points and level crossings. Despite their different duties, the group members collaborate on this surveillance activity.

This surveillance may need adjustments, connected on the one hand with the mobility of the site workers and the work group, or in relation to changes in the configuration (such as curves), and on the other hand with weather changes (fog, rain). When announcing the arrival of a train, the announcer goes beyond his strict duties, as he also checks that the signal has been heard and that the workers have successfully got out of the way. According to circumstances, the

group may clear the track immediately or attempt to establish for a few seconds a compromise between safety and productivity.

These different regulations are testimony to a certain autonomy on the part of the work group, which helps to anticipate risks and reduce the risk of being hit by a train. Autonomy in this case constitutes an effective regulation which takes the place of rules that are not always appropriate: the workers have to "look after themselves" to ensure that they work in safety; they are capable of doing so in that they acquire know-how in relation to their work and its environment.

The importance of this anticipatory management is shown in urgent situations. Indeed, when the train is arriving, which includes the announcement and the clearing of the track, the regulations are performed within a very short period of time, such that the situation can rapidly turn into an urgent one. For example, if the interruptions are frequent, the workers try to gain time and finish the work in progress. Therefore they do not clear the track immediately when they hear the announcement. but three to five seconds later: "time to finish tightening a bolt". Such a regulation of production becomes hazardous if the announcement has been slightly delayed. Other cases include situations in which it is difficult or impossible to correctly identify the arrival of a train, because of confusion in the announcement, confusion over the direction it is coming from, or a technical problem. The workers in these cases are "surprised" by the train's arrival. In such circumstances a lack of time to act is the problem, as demonstrated by the failure of many attempts to recuperate time (De la Garza, 1995; De la Garza, Weill- Fassina, 1995).

An example of discretion

Electric Signaling Department workers carry out four types of interventions: preventive maintenance, large scale works, modification or installation, and repairs. They work alone or in pairs. According to the prescriptions, the worker is "solely responsible" for his work. However, he intervenes in a regulated context: from the moment he makes contact with the

electrical installations he has to contact the Operating Department to be given the technical orders regarding security and interventions according to strict rules. He must always repair installations "in time" and "in good condition". A final phase of "personal control" is thus envisaged. In the first three types of maintenance a more or less strict planning procedure and more or less precise operating procedures are defined. In the case of repairs the intervention itself is unforeseen; because of the nature and diversity of failures, and the variability of installations and lines, it is almost impossible to define precise operating methods. Therefore the repairs must be carried out within the safety framework previously described.

Repairing is considered a discretionary task, to the extent that the worker is obliged to take the initiative: he carries out the fault analysis and decides on the appropriate repairs. In order to understand how the installation functions, he must create a representation of the situation by gathering various indicators (either directly observable or not). To put these in context he must also use more or less complex hypothetical-deductive reasoning (Bertrand, Weill-Fassina, 1993; Patrick, 1993; De la Garza, Weill-Fassina, 1994).

However, repairing is carried out within a dynamic system which can generate unpredictable events, usually under time pressure. It is necessary "to bring back the line" to operational status as soon as possible or at a set time (De la Garza, 1995). Time may become an additional element of constraint in the event of an operator not being able to manage his discretion to his advantage: the real environment may in practice reduce his discretion *exercise* (Maggi, 1993; 1996). The efficacy will depend on how the situation evolves. For example, in the course of preventive maintenance (replacement of part of the points) in the personal control phase, the operator notices an anomaly which puts him into a doubly constrained position: his intervention is a failure, and it appears as such only at the end, when he has to return the installation to the Operating Department. His activity is transformed into trouble-shooting and from that moment he is under time pressure. He contacts the Operating Department at 11.30 and "agrees verbally" to continue the search until 12.20. In the course of

the search he overlooks an important symptom and reaches an incorrect diagnosis of the problem. At 12.15 the Operating Service announces the 12.31 train; at 12.20 new tests are carried out; time pressure increases, and the operator reaches a hasty decision to make a repair. He carries out only incomplete tests and completes the work only a few minutes before the train is due, creating a potential risk for the system which will only be verified by the passage of the train itself. It is extremely difficult to make a decision to stop the train "because a fault has not been found".

In more general terms, caught in the conflict between time available and time necessary, the operator may take the risk of behaving hurriedly (Orsini, Fraisse, 1959) in order to complete his work. He focuses only on part of the data and he is not able to gather all the facts pertinent to the situation. This reduction leads to a "tunnel effect" (Rasmussen, 1986): the operators say that they "can no longer see clearly" or that they "are no longer able to reflect". Thus the organisational framework may produce constraints on the operator's discretion exercise and reduced reliability of his actions.

Differentiated effects of time management in situations of autonomy and discretion on system reliability

In conclusion, the autonomy of railway line workers is oriented towards anticipating risk in order to avoid urgent situations. This leads to an improvement in system reliability, failures notwithstanding. For Signaling Department operators, discretion is based on flexible repairing rules, while its exercise is limited by the time pressure connected to the use of the track, and this generates unreliability.

This does not lead to a bi-univocal relationship of autonomy/reliability and discretion/unreliability, but rather to different modalities of *work process regulation*:

- autonomy provides the solution in cases of programme's inadequacy: when rules and procedures turn out to be insufficient for a particular situation, the

operators are able, using their experience, to develop new skills and to define and implement their own rules;

- discretion refers to parts of a programme that are not subject to procedures and whose regulation is delegated to the operators; these are action choices left to their initiative.

Reports of injuries well illustrate how autonomy is not recognised by management, because this implies that rules exist which are not part of the programme. These rules, however, do not conflict with the established ones; they are complementary to them and oriented towards the achievement of production objectives (Reynaud, 1988). This complementary nature ensures, or even increases, the system efficiency and, in the case of railway workers, it increases reliability. For this reason they are implicitly accepted when injuries do not happen.

However, discretion exercise does not systematically constitute a negative situation nor is it necessarily something which operators should not use. According to Thompson (1967) discretion is welcome when the operator can derive an advantage from it. When the system or programme makes it possible for the operator to put his skills to good use, he achieves the expected results and recognition is gained for the work. On the other hand, the operator tries to "refuse" or "avoid" (if we can) discretion when the system or programme place obstacles in its exercise, when his skills are not sufficiently recognised or when he concludes that he is no longer able to deal with the uncertainty, especially if there is a risk of producing unfortunate consequences for the system, and for himself in terms of responsibility and/or health.

The concepts of autonomy and discretion, considered here in relation to ways of managing time (anticipation, rapidity, precipitation) enable us to better understand the work of operators, their strategies and the circumstances which may lead to a failure of regulation and thus give rise to an accident or injury. The problem is not time in itself but time interacting with the dynamics of the work environment. Urgency derives from predictable events arising suddenly in real time; time pressure instead derives from the overlapping of various

temporal frameworks predefined by the needs of different services none of which envisage an incident.

There are, however, no bi-univocal relationships between autonomy/urgency and discretion/time pressure:

- it is possible to have both autonomy and discretion without either urgency or pressure;
- in the examples presented, urgency and pressure regularly appear in specific phases of the work process; in other professional cases (firemen, emergency physicians) these seem almost permanent characteristics;
- autonomy and time pressure may appear together; for example, when railway track workers try to finish fixing a bolt in the seconds preceding the arrival of a train;
- it is possible to have discretion and urgency in other situations; for example, in the "track inspection" of a railway track carried out by a single person. Here, the person is "responsible for his own personal safety": he is given responsibility when, while inspecting "a risky zone", he must carry out three duties which conflict with each other: looking where he is walking to avoid falling over (he is walking on ballast or the sleepers), checking the state of the track and noticing any irregularities (which is the object of the work), and checking for arriving trains in order to avoid having to get out of the way urgently (De la Garza, Weill-Fassina, 1996).

From the point of view of reliability and prevention this analysis illustrates the lack of recognition of the efficacy of operators' autonomy relative to the level of safety that they guarantee. This shows how rules are not sufficient in terms of prevention and, especially, that safety can not be based solely on rules, while the development and use of operators' skills and know-how constitutes a reliability criteria. Discretion illustrates how designers should not give responsibility, including responsibility for errors, to operators without also providing the means to exercise it. Urgency and time pressure require different rules in terms of prevention, this is on the one hand to better anticipate

the danger and on the other to include the anticipation and management of an incident in the regulation of the process.

The complementary nature of the *regulation of the social action* and *cognitive (and physiological) regulation* of the operators raises questions for the decision-makers and managers about what is defined as "overcoming the Taylor-Ford model". The modification of the conditions of work concerns alternatives about technical choices and rules that take into account the reality of the different services and the possible dysfunctions which management and operators must regulate. In the face of these problems, ergonomic research must widen its field of observation to consider the totality of regulation of the work process.

References

BERTRAND L., WEILL-FASSINA A.

1993 Formes de représentations fonctionnelles et contrôles des actions dans le diagnostic de panne, in Weill-Fassina A., Rabardel P., Dubois D. (dir.), *Représentations pour l'action*: 247-270, Toulouse: Octarès Editions.

DE LA GARZA C.

1995 *Gestions individuelles et collectives du danger et du risque dans la maintenance d'infrastructures ferroviaires*, Thèse en Ergonomie, Paris: LEPC-EPHE.

DE LA GARZA C., WEILL-FASSINA A.

1992 *Modalités de gestion et représentations du risque ferroviaire au cours de l'entretien des voies*. Rapport de recherche final n. 3, Contrat LEPC-EPHE/MRE/ SNCF/NEB.

1994 *Modalités et difficultés de gestion des risques ferroviaires dans les activités de travail engageant la sureté des installations de signalisation électrique.* Rapport de recherche final, Contrat LEPC-EPHE/MRES/SNCF/NEB.

1995 Les modalités de gestion collective des risques ferroviaires sur des chantiers d'entretien des voies, *Recherche Transports Sécurité*, 49: 73-84.

1996 *Etude ergonomique sur la Sécurité du personnel de l'Equipement dans les situations de « Déplacement-Travail seul »*, Rapport de recherche final, Contrat LEPC-EPHE/MRES/SNCF/NEB.

GROSSIN W.
1996 *Pour une science des temps. Introduction à l'Ecologie Temporelle*, Toulouse: Octarès Editions.

MAGGI B.
1993 Tradizione e innovazione nello studio interdisciplinare del lavoro, Introduzione a : Terssac, G de, *Come cambia il lavoro* (ed. it. of *Autonomie dans le travail*): 1-28, Milano: Etas Libri (new version in Maggi B., *De l'agir organisationnel*: 95-115, Toulouse : Octarès Editions).
1996 La régulation du processus d'action de travail, in Cazamian P., Hubault F., Noulin M. (dir.), *Traité d'ergonomie*: 637-662, Toulouse : Octarès Editions (new version in Maggi B., *De l'agir organisationnel*: 117-137, Toulouse : Octarès Editions).

PATRICK J.
1993 Cognitive aspects of fault-finding training and transfer, *Le Travail Humain*, 56: 187-209.

ORSINI F., FRAISSE P.
1959 Etudes expérimentales des conduites temporelles, la précipitation, *Psychologie Française*, 4: 117-126.

RASMUSSEN J.
1986 *Information processing and human-machine interaction*, North-Holland : Elsevier Sc. Publisher.

REYNAUD J. -D.
1988 Les régulations dans les organisations : régulation de contrôle et régulation autonome, *Revue française de sociologie*, 29, 1: 5-17.

TERSSAC G. DE
1992 *Autonomie dans le travail*, Paris : PUF.

THOMPSON J.
1967 *Organizations in Action*. New York : McGraw-Hill.

WEILL-FASSINA A., VALOT C.
1997 Le métier ca va, mais le problème, c'est ce qu'y a autour, in *Recherche, Pratique et Formation en Ergonomie,* Actes du 32° Congrès de la SELF: 183-195, Lyon.