

**Trying to measure organizational change: A first look at a matched
employer-employee survey for French manufacturing**

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Introduction

The main purpose of this paper is to find out what are the best variables to address the organizational change and performance issue. Organization, and organizational change is hard to measure. This has been widely acknowledged by structural contingency theory and its multiple attempts to gather statistical, information on a wide scale¹. Moreover, we want to think of measures that do not need the presence of an expert in the field of organization to be implemented. Surveys we are interested in are either postal surveys where the respondent fills up a questionnaire on his own, or telephone or face to face surveys conducted by the usual persons involved in government surveys. One clear cut solution is thus to design a set of questions that uses the vocabulary of managerial practices to interview some firm representatives about the changes implemented in their firm.

According to management, organizational change is correlated with performance improvements. Firms change their organization to gain competitive advantage. However, in France, statistical studies on firm level data relating organizational change and productivity measures (Coutrot, 1996; Greenan, 1997b; Greenan and Guellec, 1998) show rather weak evidence of this relation. At the same time, labor force surveys indicate that between 1984 and 1993, greater pressure has been imposed on employees leading to deteriorated conditions of work (Cézard, Dussert et Gollac, 1992; Gollac and Volkoff, 1996). The increased strain imposed on workers has also been underlined by empirical studies based on data for the US (Cappelli and alii, 1997). But empirical research on productivity impacts of organizational change in the US leads to results that are more positive than in France² (Ichniovsky, Shaw and Prenzushi, 1997; Black et Lynch, 1997; Brynjolfsson and Hitt, 1997; Ashkenazy, 1998). Yet, either data sets are not directly comparable to the ones used in the French studies, or positive results are conditional (on the use of IT, on the presence of a union, on implementation characteristics etc.).

Moreover, the economic rationale behind organizational practices implemented by firm is not clear cut. They implement total quality management and just in time devices, they delayer, reengineer, outsource, focus on their core competencies, downsize, subcontract etc. Are all these changes belonging to a same scale or do they imply different directions of organizational change?

A key element in understanding what firms do when they implement new organizational practices is to identify how workers' effort are affected by these changes. The interactions between the efforts spent by individual workers and the structure of the organization is also a key issue as far as performance is concerned (Harris, 1994).

We are going to explore a French national statistical survey, the C.O.I. survey, that allows to go a little deeper into this rationale of organizational change because it matches a business survey

¹ See Miller and Friesen, 1984 for example.

² The same kind of difference in French/US empirical results on productivity impacts is obtained when IT indicators are used.

measuring changes implemented by firms and a labor force survey, describing the effort spent by employees in every day work³.

The COI survey has been conducted at the end of 1997. It is a group of 3 business surveys matched with one labor force survey⁴. As a matter of fact, the French government surveys organization and technology use topics since the middle the 1980s'. Appendix 1 gives the background and some details about the surveys that preceded the COI survey. The business part of the COI survey in manufacturing is modeled after the 1993 SESSI survey on "organizational change in production" whereas the labor force questionnaire takes on the so called TOTTO survey, carried out in 1993 by the Ministry of labor (DARES). In our empirical work, we focus on the manufacturing sector where the survey benefited from high response rates both on the firm side (88%) and on the workers side (71%).

First, we describe the statistical anatomy of organizational change, using the point of view given by management in the business section of the C.O.I survey. We then turn to the labor force section of the survey where we analyze the pattern of blue collar work organization. Finally we try to better understand management tools used by firms by exploring their relation with the structure of blue collar effort.

1 The words of firm representatives

The most common way to seize organization and organizational change is through interviews of managers. This is so in surveys as well as in case studies. The C.O.I. survey follows this first line of measurement through a self administered firm level questionnaire. In a first section, we outline the main features of the new managerial tool-box used in manufacturing firms over the

³ The idea of the survey originated from a seminar on innovation and performance improvements organized by Dominique Foray and Jacques Mairesse in 1994-1995. A first description of the project was discussed collectively in a group and written up by Michel Gollac and Nathalie Greenan (Caby and alii in Foray and Mairesse, 1999). In the 1990's, in response to the labor market situation, the Ministry of Labor (DARES) became more and more interested in understanding how it related with firm practices. Furthermore, labor force surveys tended to suggest that an increasing share of workers felt high pressure at work. On the other hand, the Ministry of industry (SESSI) wanted to improve knowledge on the skill bias of technological change. As a result both statistical services adopted the project that was to become the COI survey. INSEE got involved because it was interested in the new methodology of the survey and was sub-contracted by DARES to conduct the labor force survey.

⁴ One business survey covers manufacturing and food industries. The Ministry of industry (SESSI) conducted the survey in the former while the Ministry of Agriculture (SCEES) took care of the later, the two others are exploratory surveys in a branch of commerce (home depots type of stores) and in a branch of business services (accountants) carried out by INSEE (National Institute for Statistics and Economic Studies). The labor force survey has been conducted by the Ministry of labor (DARES). 8812 workers have been interviewed, belonging to 4025 firms with more than 50 employees in manufacturing and food industries and with more than 20 employees in the service branches. The conception of the business survey in manufacturing and of the labor force survey and the coordination of the 4 surveys has been directed by Nathalie Greenan at the Centre d'Etudes de l'Emploi.

past decade. In a second section, we discuss the measurement issue. In a third section, we build up synthetic indicators of organizational change.

1.1 The frontier of the new managerial tool-box

Many observers have stressed their impression of an acceleration of technological change since the oil crisis, while growth was slowing down. It is one expression of the widely debated productivity paradox. But as the technologies of information and communication were diffusing among developed countries, managerial concepts also flourished.

As a matter of fact, the simultaneous diffusion of information and communication technologies and managerial tools may be described as a second wave of “Americanization” of European firms (Lanthier, Kervern, Razel, Shröter and Trépo, 1998), the first wave being connected with the Marshall plan and the associated productivity missions. In France, at the beginning of the 1980’s people that were not specialized in management had heard about quality circles and may be matrix organization. During the 1980’s and 1990’s, managerial knowledge spread in many directions (Garcia, 1999). New theories or new versions or old theories were invented by academic and business scholars and marketed rapidly through books and management or professional journals. These ideas were simplified and marketed again by management gurus through best sellers and lectures. At the same time, firms got into the habit of “auditing” while confronted with difficult strategic decisions like growth through mergers and acquisitions, driving the development of the consulting sector. In the end, new words and acronyms stemming from managerial fads and fashions ended up in the current language written in newspapers or spoken on television.

This managerial vocabulary is pervasive and international: the managerial tool box looks very much the same across countries and all the more so when firms are multinationals. It has also a mixed ethnic origin. American engineers have had a very strong influence on management practices in the western world during the first half of the 20th century. In the second half, the principles laid down by these pioneers have been revisited and experimentation has been very active in countries like Japan or Sweden. The new managerial tool-box benefits from all these influences (Applebaum and Batt, 1994). However, a large fraction of the managerial vocabulary used by consultants and management gurus has been “processed” and “calibrated” by American scholars and experts that dominate the market for managerial ideas and concepts (Henry, 1992).

Table 1 gives an example of a list of managerial tools extracted from an American management book by Hall (1987) which French translation has been a best seller at the beginning of the 1990’s. The table describes the set of practices that a manufacturing firm should adopt in order to reach excellence⁵. According to the author, Table 1 displays a consistent system of managerial tools. Just-in-time (JIT) and total quality management (TQM) are viewed as overall

⁵ Of course many books have been written on manufacturing excellence, we choose this one in particular because of its French translation.

process approaches or organizational devices inducing a more thorough management of production flows (resulting from time constraints, inputs and goods in process) and of quality issues. For each organizational device, the table gives a list of items including managerial tools like organization in cells or preventive maintenance for JIT and for TQM, statistical process control or methods for analyzing causes and effects. In order to produce just-in-time, to reach total quality and to promote continuous improvements, firms have to induce a high level of involvement in their employees. This involvement does not only imply a high level of effort. The design of front line jobs entails collective work and diversified tasks in the horizontal as well as in the vertical dimension. Organizational practices such as job rotation, autonomy and team work lead to this type of job design where effort expands in various dimensions involving physical, problem solving and interpersonal abilities.

[Insert table 1]

Hall (1987) proposes a first list of item connected with a general model of manufacturing excellence that stems from the world of management, not from the world of economists. However, economists, from the field of industrial relations mainly, have been attracted by this model and tried to assess its economic performance (Ichniowski and alii, 1996, Godard and Delaney, 2000). One of the reason of this interest lies in the fact that “manufacturing excellence” seems at the same time good for competitive advantage and good for the workers, implying more democracy on the shop floor and more interesting work. In France, “industrial relations” did not become structured in an academic field. This is partly connected with the French history of trade unions. However, in the beginning of the 90s, a model of “skill enhancing organization” (“organisation qualifiante”) has been promoted by scholars close to organization theories and management (Zarifian, 1990). This model has some common features with the “modern manufacturing” model. Before the 1993 recession, it was experimented in big firms like Usinor Sacilor, Pechiney or BSN, and accompanied by scholars doing field work and playing a role of experts. But in the second half of the 1990s, firms became less willing to accept field work and interactions with research. What this model has become remains unclear and recent debates around layoffs in Danone (former BSN) raise the question of the real nature of the new organizational model or of a change in the orientation of organizational change after the recession.

In table2, we are interested in what economists measure when they assess the economic performance of new organizational devices or organizational change. We put together three different lists and give a French translation of the English words used to designate management tools and practices. We focus on items connected with organizational structure, job design and overall process approaches, leaving aside the issues of incentives, training and industrial relations. The first list comes from the overview of Appelbaum and Batt (1994) who summed up the evidence from surveys and case studies. They describe the “piecemeal borrowing” of American firms when they choose a set of practices and thus come to a very large list with items from varied time and geographical origins. The second list is shorter. It gathers together the organizational tools and practices measured in five econometric studies : Osterman (1994) who tries to measure the use of “flexible work organization”, Ichniowski, Shaw and Prenchush

(1997) who investigate the productivity impact of “human resource management practices”, Cappelli and Neumark (1999) who focus on the establishment-level outcomes of “high performance work practices” and Bresnahan, Brynjolfsson and Hitt (1999) and Black and Lynch (2000) who are interested in “workplace innovations”. These papers focus on two aspect of the model of manufacturing excellence described by Hall (1987): employee involvement and quality practices. The justification for such a choice is more implicit than explicit. Three main reasons may play a part: the fact that these practices describe the progressive version of workplace transformations rather than the regressive “low cost” one (Godard and Delaney, 2000), the need for a simple definition of the new “high performance” model and the underlying reference to the Japanese model.

[Insert table 2]

In this paper, we will try not to make any particular assumption on what makes the core of organizational changes. During the period under survey (1994-1997), new words have appeared while old ones were still in use. We assumed that many firms were operating with a set of practices adopted at different moments in time and connected with different “fashions”. Once successfully in use, some managerial tools work like invisible technologies that mould the way people think (Berry, 1983). They have thus a strong inertia that allows them to survive in a context of organizational change. For example, the matrix of the Boston Consulting Group has been long lived in French firms. On the other hand, managers are strongly attracted by simple and standardized tools, especially when they know that some other firms are also using them. In such cases, managerial tools may be very short lived, quickly rejected by “users” after an incomplete adoption. For these reasons, we take a “broad definition” of what new organizational practices are, that is, we try to take into account most of the fashionable managerial tools of the 1990s in manufacturing.

We are more interested in what firms actually do than in what they should do according to the model we have in mind or to the one we want to promote. The example of Hall (1987) suggests that practices tend to form a system with some complementarity relations between them. This idea is developed by Milgrom and Roberts (1990) and Boyer (1998). Complementarity should lead to a small number of best sets of practices. However, practices that often appear bunched together in the professional or management literature do not seem to follow a unique direction of change. Depending on the practice, higher involvement, empowerment, higher formalization, cost reduction or flexibility are favored. Hence, these practices do not necessarily go hand in hand with one another. For example, even though they appear together in table 1, tight deadlines may interfere negatively with a thorough management of quality⁶. Increased formalization may limit empowerment: employee has full responsibility in a tight framework defined by precise procedures. Increased formalization may be also used in ever growing multinational firms to issue measures of relative performances of the production units. In this case, it is an indicator of increased corporate control, and indirectly of restructuring and / or downsizing. Finally

⁶ See for example, the model of Keren and Levhari (1989), based on information processing theory.

downsizing and reengineering may aim at increasing short term profit, an objective that may be in contradiction with employee involvement in the building up of innovative capabilities.

We want to be able to check on these relations between practices. Thus our list of items (grey areas in table 2) is closer to the spirit of the Appelbaum and Batt (1994) list. It has also been adapted to the French context. We augmented it with a set of tools and practices that are often referred to in French management and professional journals like registered quality systems, multi-disciplinary project teams, formal in house customer/supplier contract or organization in profit centers. We also included practices connected with the “low cost route” like “outsourcing” or “sub-contracting” where the firm replaces internal organization by market transactions. We left aside other practices more connected with the American context. As a matter of fact, although the American influence on managerial vocabulary is strong, as witnessed by the use of “reengineering” or “juste-à-temps” (literal translation of “just-in-time”), some practices do not apply or apply differently.

First, “employee involvement practices” is commonly used in the Anglo-Saxon literature to describe the core of the new “high performance” model. The proper translation in French would be “pratiques d’implication de la main d’œuvre”. It is sometimes used in management books translated from the English to the French, but not on a wider scale. “Pratiques participatives” would be closer to the American use of “employee involvement practices”. But its connotation is quite different. Instead of stressing a higher effort of employees, it underlines the sharing of information: “participatif” means that employees participate in decision making, they are consulted or at least informed when the firm is changing its strategy. Furthermore, the extensive use of this expression has its origin in a law taken in 1982 (“Loi Auroux”) at the beginning of Mitterrand’s mandate, that tried to encourage information sharing between employers and employees in a context where the government thought that more democracy in firms would increase collective well being⁷.

Second, it seems to be easy to measure “job rotation” in American surveys. The French translation of “job rotation” would be “polyvalence”. But it is a more ambiguous term that can designate at the same time “job rotation”, “job enlargement” and “job enrichment”. As a result, “polyvalence” never appears as a discriminatory feature of work organization. This could be so because jobs are thought of in reference of a “work post” with detailed characteristics more than in reference with competencies carried by the employee who fulfills the job (Maurice, Sellier and Silvestre, 1982).

Third, firms do not say that they downsize in France. Rather, journalists and executives talk of “restructuration” which is an euphemism. The persistence of high unemployment rates makes it

⁷ This translation problems may be a measure of our ignorance. Nevertheless, the uneasiness with the French translation on some terms that are widely used in the U.S. context can also be found in international comparisons made by institutions like OECD or the European Foundation for the Improvement of Living and Working Conditions. Papers or questionnaires translated in French from the English are often difficult to understand (see for example OECD, 1999, EF, 1998).

unacceptable to display cutting jobs as an objective. It has to be announced like something that is inevitable, in order to secure the survival of the firm. As a result, it is seldom thought of as a choice.

1.2 The measurement issue

The questionnaire of the business section of the C.O.I. survey is built on this list of organizational practices. This survey has been conducted at the end of 1997. A large and representative sample of about 5000 manufacturing firms over 20 employees has been interviewed⁸. It benefited from a 88% response rate (95% in terms of turnover)⁹.

It is a self administered survey. The firm response is given by a firm representative chosen by the headquarters of firm. In fact the statistical office of the Ministry of Industry is in contact with an interlocutor in all firms for the annual survey of manufacture. The C.O.I. questionnaire has been sent to this person with a letter saying that the headquarters, the human resources department, the production department and the IT department were concerned. The letter also informed the firm that some workers randomly selected were being interviewed, but of course it did not give their names. The last question of the survey is about the affiliation of all the persons that participated in building the firm's response. In more than half of the cases, the general manager is the main contributor to the firm's response.

Interviews of firm representative allow to measure the diffusion of the new managerial tool box in French manufacturing firms. They have a clear picture of strategy matters and understand the managerial vocabulary. If they have not just arrived in the firm, they know what kind of organizational devices are being adopted, why, and they also have their own feeling about obstacles and implementation difficulties.

In the business survey questionnaire, we selected 7 sets of questions (118 "primary" questions in total), that deal with innovative work practices. All these questions are reported in box 1 with percentages for each type of answers from the whole sample of interviewed firms with more than 50 employees.

[insert box 1]

⁸ The statistical agency of the Ministry of agriculture (SCEES) administered the survey in the food industries and the statistical agency of the Ministry of industry (SESSI) administered the survey for the rest of manufacturing (excluding the energy sector). Two exploratory surveys have also been conducted in branches of the services and trade industries: accounting activities for the former and DIY or home depots types of stores for the latter. They have been carried out by INSEE (National Institute for Statistics and Economic Studies). So the business section of the C.O.I. survey groups in fact three different surveys. In this paper, we focus on the survey administered by SESSI, that covers manufacturing, excluding the energy sector and the food industries. For more details on the C.O.I. survey, see Greenan and Hamon-Cholet (2000).

⁹ In manufacturing, the C.O.I survey was compulsory, that is firms could be penalized by a fine if they did not answer. The option of making it compulsory has been discussed with representatives of the statistical administration, of trade unions and of employers' federations.

The variables stemming from these questions are of a qualitative type, either dichotomous or with three ordered items. After analyzing their distribution, we decided to build up synthetic indicators in order to deal with a smaller number of them while losing little information. Most of the questions are expressed in terms of the existence of a list of practices in 1997 and either of their existence in 1994 or of the change in their scope within the firm (measured by the share of concerned workers) between 1994 or 1997. It is then possible to analyze separately practices in 1997 and their evolution within firms during 3 years (1994-1997).

We built up 20 synthetic variables describing the situation of the firm in 1997 and 14 others focusing on evolutions between 1994 and 1997. These variables have a varying number of items, summing up to 50 for the first set and to 35 for the second one. They are listed in the first column of table 3 where we keep the same variables names as in box 1. In this table, we break the order of the questionnaire and group the variables into four main categories.

[Insert table 3]

The first category has to do with the way transactions are organized within the firm and with other firms, through market mechanisms. The economic theories that are the most interested in those organizational practices are theories of hierarchies and transaction cost theories that try to understand the determinants of the size and frontier of firms. In a way, we could say that the practices we measure give account of the degree to which the firm uses contracts to organize flows of intermediate goods and services.

The three other categories are directly connected with the model of manufacturing excellence. The first category groups together practices that aim at spurring employee involvement in information processing and decision, when the two others sort practices that respectively aim at optimizing quality objective and a time constraint objective.

We can also note that practices in the first and second category are more closely connected with the organization of the information system of the firm than practices in the third and fourth categories that tend to organize its production system. For the former categories a second type of measure complements measures about the use of a list of organizational devices. We call them organizational “outputs” measures because they should react to the use of organizational devices in a way that we can forecast.

The *decentralization of the organizational structure* is seized through the use of four practices. Two of them influence internal organization: an organization in profit centers (**OPC**) and the use of formal in house customer/supplier contracts (**CSC**). Box 1 shows that 31% of manufacturing firms over 50 employees are organized in profit centers in 1997 and 29% use formal in house customer/supplier contracts. Respectively 10% and 13% of firms have extended the use of these practices. We think here of decentralization in the sense used by traditional theories of hierarchy: a hierarchical structure is more decentralized when its units are more autonomous in their decisions or if mechanisms others than authority contribute to the coordination of activities. This is why we call the organizational tools in this category “pseudo-market” practices. The two other practices we consider shape external organization:

outsourcing of functions (**OUT**) and sub-contracting of production (**SUB**). In 1997 18% of manufacturing firms outsource more than 6 functions from the list of 15 functions given in box1 and 15% have developed outsourcing practices for more than 3 functions between 1994 and 1997. Sub-contracting of production concerns more than half of the firms in 1997. Sub contracting is the only considered practice for which a non negligible fraction of firms moved backward: if 19 % of them have extended its use between 1994 and 1997 and 6% tend to do it less. We group outsourcing and sub-contracting under the heading of “market devices”.

Theories of hierarchy have showed that decentralization through pseudo-market and market devices could have some influence on the number of hierarchical layers within the firm. Thus we consider this number (**HL**) and its evolution (**EVHL**) as an organizational “output” measure of decentralization practices. 18% of firms have declared a reduction in their number of hierarchical layers between 1994 and 1997.

The number of hierarchical layer may also be influenced by managerial tools inducing a higher involvement of employees in information processing and decision. Three practices are considered in this second category: self managed teams (**SMT**), problem solving groups (**PSG**) and multi-disciplinary project teams (**MPT**). As showed in box 1, instead of measuring, the existence of the practices in 1997 and the change in their scope within the firm between 1994 and 1997, C.O.I. gives a more detailed information about the extent of their use in 1997. Three different intensity items are used giving the percentage of concerned direct producers in 1997 (0-10%, 10%-50%, more than 50%). Manufacturing firms with more than 50% of blue collars involved in problem solving groups or multi-disciplinary project teams are scarce: 4% and 2% respectively. This figure reaches 11% for self managed teams which is higher but still low. Thus, we grouped together the medium and high item. The resulting variable measures the existence of such groups on a non negligible scale (more than 10%). Respectively 28%, 19% et 31% of manufacturing firms have more than 10% of their blue collars in problem solving groups, multi-disciplinary project teams and self managed teams.

These three devices favor the *involvement of blue collars in information processing and decision tasks* through the participation in formal teams or groups. In the following, we will speak of “work in teams or groups” practices. They measure a more “modern” definition of decentralization, referring to the Japanese mode of organization and focusing on the autonomy of blue collars rather than on that of the constituent units of the firm. In those teams or groups, blue collars complete cognitive tasks. They are allowed to make operational decisions by themselves or collectively on production matters and/or they exchange information within horizontal networks. Thus, work in teams or groups practices change the allocation of cognitive tasks on the shop floor.

In box 1, the forth set of questions aims at measuring such a change, using a list of 10 “indirect” tasks on the shop floor that have to do with the preparation of work (sharing work, setting machines), information processing (controlling quality, contributing to performance improvement) and with decision (setting machines, stopping and starting production in case of an hitch). Questions are about how the responsibility for each task is shared between the

production worker, the hierarchy and specialists in 1994 and in 1997¹⁰. With this series of questions, we can make up an organizational “output” measure of work in teams or groups practices.

The information embedded in this series of questions is very rich. The division of work between production workers, hierarchy and specialist workers is seized with a set of 60 “primary” questions. We decided to make up three synthetic variables measuring the size of the responsibility sphere of each worker category in 1997 and three other measuring their evolution between 1994 and 1997.

For 1997, management (**MAN**) is responsible for more tasks (in the listed range) than production workers (**PW**) or specialists (**SPE**). However, her prerogatives tend to decrease (**DMAN**) between 1994 and 1997 (12% of firms) whereas those of production workers (**IPW**) and specialists (**ISPE**) increase (respectively 30% and 15% of firms).

Two other groups of questions identifies practices that induce increased horizontal complementarities between workers or units, either because of high quality standards or because of tight time schedule and production flows.

Five practices witness the place taken by *quality management* in the firms’ strategy. Three of them are implemented by the firm herself: ISO or EAQF certification (**ISO**), other certification or total quality management (**TQM**), value analysis, functional analysis or AMDEC methods (**AMD**). Quality certification and total quality management are well diffused practices. 49% of manufacturing firms are certified and 35% declare having implemented total quality management. Value analysis, functional analysis or AMDEC methods are less common (26% of firms). These methods aim at analyzing the consequences of design choices on products and processes. Hall (1987) suggests to consider them as part of a total quality strategy (see table 1). Respectively 30%, 20% and 13% of firms have extended the use of those devices between 1994 and 1997. The two other practices consist in special requirements to the suppliers and / or subcontractors of the firm: to comply with ISO certification or other formal quality approaches (**ISOSU**) and to take part in designing end-products (**DESSU**). A majority of manufacturing firms (66%) declare that they make the first requirement, which drives the diffusion of quality devices. 42% of firms include suppliers and / or subcontractors in design activities. These figures witness the complementarities implied by quality standards along the flow of intermediate goods: there is no point in managing thoroughly quality in a firm if inputs are not spotless.

¹⁰ The questionnaire gave the following indication: Management (“hiérarchie”) groups all the workers with a formal authority on other workers, production workers (“opérateurs”) are the staff that deal with direct production either in an isolated situation or within teams or groups and specialists (“spécialistes”) are employees with a specific technical knowledge (quality or maintenance for example) et which activity is specialized in this domain.

At last, four practices contribute to a thorough *management of time constraint* : just in time delivery (**DJIT**), just in time production (**PJIT**), 5S method or Total productive maintenance (**TPM**) and just in time delivery required to suppliers and / or subcontractors (**JITSU**). In 1997, 39% of firms deliver just in time and 38% produce just in time. 5S method originated in Japan. Like total productive maintenance, it aims at motivating workers in collecting information about all the small hitches into the production process. 5S method insists on tidiness and order in the working environment so that problems are more easily detected. Hall (1987) associates these methods with just in time because small hitches can delay production if they are not identified quickly enough. Only a small number of firms had adopted one of these methods in 1997 (16%). Like for quality devices, manufacturing firms ask they suppliers to deliver just in time more often than what they do themselves: 51% have that type of requirement. Here again, this is an indication of the interdependencies generated by time constraints.

By selecting questions and building up variables, we have tried to manage a rich but not too large information set on organizational change. In the following section, we are going to describe the main directions of changes adopted by manufacturing firms.

1.3 Intensity and orientation of organizational change

Most of the time, empirical studies in economics concentrate on a small number of quantitative variables: IT investment, R&D expenditures etc. The difficulty with organization is that it cannot be summarized with one quantitative variable. Rather, a large set of qualitative variables are potential candidates. Most econometric studies relating organizational changes and performance have focused on a small number of variables in this set, like TQM, job rotation, self-managed teams. Others use “output” indicators like the reduction in the number of hierarchical layers.

We have underlined in section 1.2 that this choice was sometimes guided by the will to promote a virtuous organizational model. In some studies, it also derives from narrowly defined sample of firms also visited through field work, where the richness in implemented practices is smaller than in a national survey. Focusing on one or two practices has another advantage. It makes it easier to present an interpret result and it makes it easier to test additional relations like interaction terms between practices.

However, if we measure organizational change through a national statistical survey, it does not make sense to focus on one specific practice. On a large sample of firms, all types of firms coexist and some of them have adopted multiple devices. Thus, as all implemented practices may interfere with performance improvement, we must take them all into account. And in this case, we have to face the issue of synthesizing parsimoniously information. In the following, we have opted for presenting two different synthesizing method.

The first method consists in defining broad categories of practices: “market devices”, “pseudo market devices”, “work in teams or groups”, “quality management devices”, “just in time

systems". These five categories are directly connected with our analysis in table 3. We leave the requirements to suppliers aside because they are too widely diffused to allow discrimination between firms and we build up a variable indicating if the firm uses at least one device in the retained list within a category. Then we consider the most frequent combinations of categories of devices.

The second method is automatic, based on multiple correspondence analysis. Such a tool is suitable to describe a multi faceted endogenous shock such as organizational change. In France, it is often used in quantitative sociological research (Kramarz, 1986; Gollac, 1989) and economists sometimes recourse to it to describe firm behavior (Salais, 1992, Greenan 1996a, Greenan and Guellec 1998). This tool may show that the heart of information is embedded in a small number of variables highly correlated with all the others. In this case, it helps choosing these variables. Otherwise, it can be used to build up synthetic indexes that are particularly helpful when the variables of interest are latent, indirectly measurable through a large number of qualitative variables.

In the following, we also distinguish between medium term organizational change (fashionable tools used in 1997) and short term organizational change (evolutions in use of new organizational practices between 1994 and 1997). Table 4 and 5 give results about the former and tables 6 and 7 about the latter. Table 4 and 6 are derived from the first method whereas table 5 and 7 are built from correspondence analysis results. We work with the sample of 3286 manufacturing firms with more than 50 employees where employees have been randomly selected for the labor force section of the survey.

Medium term change

In tables 4, the column on the left gives the combinations of practices within the five categories. Market and quality management devices are the most frequent. Then comes just in time, pseudo market devices and work in groups or teams for more than 10 % of blue collar workers. For work in teams, we see that the fact of having no devices (53% of firms) or of having all of them (13%) is relatively more frequent than alternative situations. This type of configuration suggests the presence of complementarities team work practices. For quality management and just in time systems, quality certification on its own and just in time delivery and production are more frequent than the situation where the firm is using all listed devices (20% against 16% for the former, 22% against 13% for the latter). Market devices and pseudo market devices practices seem less dependent on one another within each category.

[Insert table 4]

The column on the right of table 4 gives the most frequent combinations of categories of practices. The 15 retained combinations (out of 32 possibilities) represent 83% of the sample of firms. Only 4% of firms use none of the 13 considered organizational practices and 17% use the five categories of devices. The table suggests that market devices, pseudo market devices and quality devices have a relative autonomy whereas just in time practices and work in groups or teams seem to be "included" in quality devices. But it is difficult to extract from this table a

general information about possible directions of organizational change. Correspondence analysis does this job more efficiently.

Table 5 summarizes results from this second method. The lines in the table give the items of all the active variables in the analysis. The column “total sample” displays the unweighted and weighted¹¹ distribution of these variables. The other columns are variables built from factors 1, 2, 3,4. Box 1 provides elements of appreciation about the associated quality of representation. Firms’ coordinates on these four factors have been transformed into qualitative variables with four items based on quartiles when it could be interpreted as describing an “intensity” and with two items (negative and positive coordinates) when it could be interpreted as expressing a polar opposition. The title given to the columns summarizes our interpretation of the factor, that can be checked through the displayed percentages¹². The first factor measures the intensity in use of new organizational practices. The three others describe orientations in changes: factors 2 and 3 describe tensions within the model of “manufacturing excellence” and factor 4 gives the intensity in use of market and pseudo market devices.

[Insert table 5]

Clearly, practices under examination cluster. Firms are first discriminated by the intensity with which they recourse to new organizational practices. This indicates that all types of practices go hand in hand with one another. Although the C.O.I. survey is much richer than the previous SESSI survey on “organizational change in production” (see appendix 1), the result on the clustering of practices was already observed in 1993 (Greenan, 1996a). What we find here is in line with the idea that new organizational practices are complementary in the sense that the effectiveness of one practice is enhanced by the implementation of others.

If we look more closely at the contribution of the different items to the inertia of the axis we find that the items with the strongest contribution to the factor corresponds to the most “fashionable” practices for its positive part (5S method or TPM, value analysis, functional analysis or AMDEC method, just in time delivery and just in time production) and to the absence of the most diffused practice for its negative part (ISO 9001, ISO 9002 and EAQF certification). In terms of “output variables”, we see that the intensity in use of new organizational practices go together with a higher number of hierarchical layers, expressing a size effect. We also find a higher involvement of production workers and specialists in “indirect” tasks that make the everyday life of the shop floor. This support the idea that new organizational practices are correlated with more responsibilities given to bottom line employees. The increased role played by specialists in a position of “experts” is another interesting result, less discussed in the literature on organizational change than the implication

¹¹ The weights that we use here adjust for sampling rates and non response. We discussed the weighted distribution of variables in section 1.2.

¹² They give the share of firms characterized by the item in the line within each class of the factor variable. For example, the first cell reads: 33% of firms with low intensity in use of new organizational devices do not outsource any task.

on production workers, described as an “empowerment”. It was also found in the 1993 SESSI survey (Greenan, 1996a).

The model of “manufacturing excellence” suggests that total quality, just in time and employee involvement go hand in hand together. Factors 2 and 3 tell us that in practice, things are not as easy, there are some tensions between these three different orientations of organizational change. More precisely, just-in-time carries a conflicting relation with blue collar work in teams and groups on the one hand (factor 2), with quality management devices on the other hand (factor3). The just in time practice that contributes the most to the first opposition is just in time delivery, whereas just in time production and delivery is opposed to quality certification practices on the second factor. As a result, it is more common to find firms using just in time systems and no quality management nor team work devices or firms with team work and / or quality management devices and without any just in time system. These tensions are more clearly identifiable in table 6 than in table 5.

“Output” variable allow to go a little deeper into the understanding of these tensions. Work in group or teams, as opposed to just in time delivery implies a higher involvement of direct producers in indirect tasks and a lighter presence of management. This confirms the fact that our variables about the sharing of responsibilities on the shop floor react to team work practices. When opposed to quality management devices, just in time systems are used by firms with a small number of hierarchical layers (0 to 3), that are less inclined to outsource tasks and to give a lot of responsibilities to specialists. This type of just in time organization has been portrayed by field work studies in sub-contracting firms of the French automobile industry (Gorgeu et Mathieu, 1995). Thus, the tensions registered in factor 3 could discriminate small sub-contracting firm required to deliver just in time from large industrial firms putting emphasis on quality issues.

The intensity in use of “market” and “pseudo market” devices is a second orientation in organizational change. In section 1.2, we have described these practices as contributing to the decentralization of the firm’s hierarchical structure. The fact that they cluster on the fourth factor tends to indicate that they belong to the same class of organizational design variables. Like the preceding “modern manufacturing” orientation, “market” orientation appears partly independent from the intensity of use in organizational practices. Firms with different levels of intensity in use of new organizational practices can experiment tensions within the “modern manufacturing model” or different levels of intensity in use of within or between firms market transactions.

Moreover, these practices interact strongly with “output” variables, but not with the expected ones. There is no simple correlation between the decentralization of the hierarchical structure and the number of hierarchical layers or the involvement of bottom line workers. We can just note that in firms with very high intensity in use of market mechanisms, more frequently have four hierarchical layers and involvement of production workers is more frequently low. On the opposite, low intensity is positively correlated with three hierarchical layer and medium involvement of blue collars. However, the intervention sphere of management and of specialists are clearly and negatively correlated with “market” and “pseudo market” devices. More

decentralization in the hierarchical structure implies a lesser need of management authority and of experts with specialized knowledge.

Short term changes

Do we draw new conclusions from the analysis of changes between 1994 and 1997? As we have already mentioned it in section 1.2, the analysis of short term changes cannot be exactly comparable to the analysis of the 1997 situations because all questions have not been formulated symmetrically for the two years. In particular, we have no information on evolutions for team work and for requirements to the suppliers and /or sub-contractor.

[Insert table 6]

Table 6 shows that about half of the firms have changed their use of “market” devices and of quality management devices, one third have developed just in time systems and a little more than one fifth have adopted or extended “pseudo market” devices. Within each category of devices, we find that next to the situation of stability, the most frequent situation is not the increase in all listed devices. For “market” devices, it is development of outsourcing (31%), for “pseudo-market” devices, it is development of formal in house customer / supplier contract (9%), for “quality management” devices, it is development of ISO or EAQF certification (17%) and for “just in time” devices, it is development of just in time delivery and production (11%). The same applies if we consider combination of increases in categories of devices. 28% of manufacturing firms have kept their organization inert between 1994 and 1997, 10% have developed all four categories of devices, 15% have only developed “market” devices and 10% have developed “market” and “quality management devices”. Here again, decisions about use of “quality management” and “market” devices seem more independent than decisions about “just in time” devices that appear to be “included” in changes in the former domain. In this sense, practices seem to evolve in the medium term and in the short term according to the same laws.

[Insert table 7]

Does correspondence analysis allow to go one step further and to identify different patterns of short term changes? Table 7 summarizes results stemming from this method. We retained the first two factors to describe short term changes¹³. The first one measures the intensity of organizational change between 1994 and 1997, the second one increases in the responsibilities of production workers and specialists.

Like medium term organizational changes, short term changes cluster on the first factor of the correspondence analysis. This indicates that all types of practices go hand in hand with one

¹³ The 3 following factors are also interesting to analyze, especially because they interact with changes in IT equipment (Gollac M., Greenan N. and Hamon-Cholet S., 2000). However, in the following, we have decided to focus on the dimensions that interact with information on work organization from the labor force section of the C.O.I survey.

another and tend to evolve at the same rhythm once adopted. As we have noted earlier, sub-contracting of production is the only practice which evolution entails decrease as well as increase. Table 7 shows that both evolutions are positively correlated with the intensity of organizational change.

Intensity of short term organizational change is significantly correlated with changes in our “output” indicators: with increase in intervention spheres for production workers and specialists and declining managerial intervention and with decreases in the number of hierarchical layers. The second factor measures some of these changes in “output” variables independently from the intensity of organizational change. This tends to show that if short term increases in the use of new organizational practices is positively associated with more responsibilities for production workers and specialists, some firms with stable use of such devices have also modified the sharing of responsibilities on the shop floor.

2 What does organizational change alter in blue collar work?

Until now, we have exploited the same type of information as the one used in most econometric studies about organizational change. That is information given by a firm representative speaking in the name of the whole organization. In this section, we are going to cross check this “firm” level information with information given by randomly selected workers who have precisely described their everyday work. The C.O.I survey allows such a parallel because it is a matched employer / employee survey. In a first section, we explain why we feel that more information is needed to understand the rationale behind the complex strategies of organizational change. In a second section, we examine various labor force indicators of work organization. Finally, we analyze the relations between firm level organizational change variables and blue collar indicators of work organization.

2.1 What do workers can tell that the firm does not know?

Words of the firm and words workers

In business surveys, information on organizational change may be influenced by what they respondent think a modern corporation should be. This may induce a bias towards a positive correlation between organizational devices if this picture is one of a firm with the latest managerial tools. This is a major problem in “organizational design studies” studies that try to measure the complementarities between managerial tools and practices.

But what kind of information can be gathered in a labor force survey? The vocabulary that has been used in the business section of the C.O.I survey can only be understood by a small fraction of the firms’ workforce that is part of the managerial staff. The C.O.I. survey option is to ask workers to describe precisely their every day work, using a very simple and factual vocabulary. While testing different questions on the two types of interlocutors, it appeared that firm representatives could answer more easily to questions on organizational changes than to

questions on the state of organization, while the reverse was true for workers. As a result, most of the questions asked to firms are of a dynamic type (“what has changed between two dates?”) whereas most of the questions asked to workers are of static type (“how do you work at the date of the survey?”). In the labor force survey, one question is an exception because it is expressed in a dynamic way. It is asked in the beginning of the questionnaire and it is about the perception of change over the past three years. Its formulation is the following: has your work environment been deeply on the move during the past three years ? We will analyze the answers to this question in section 2.3.

Second, numerous organization studies have pointed out the discrepancy between formal organization and current practices. Firm representatives generally describe formal organization, whereas workers can be asked about what they really do and how they adapt assignments to the context of their work. Topics like empowerment, worker involvement and greater autonomy on the shop-floor cannot only be investigated through what management knows about it. It is even more true for considerations about work rhythm, stress or all type of adjustment costs caused by organizational change. Thus, the interview of employees allow to measure the various dimensions of effort. As a result, crossed interviews of firms and employees allows to go one step further in the understanding and description of interactions between the efforts spent by individual workers and the structure of the organization. As Harris (1994) underlines it, this is a key issue as far as performance concerned. This is also an important step to understand the economic rationale behind the complex decision set of organizational practices.

In the C.O.I survey, interviewed workers have been randomly sampled in the staff of interviewed firms from a file of government origin that gave the list of all the workers present in the firms on the 31st of December 1996. Workers have been interviewed about one year later. Thus, the sample of workers is representative of workers with at least one year of seniority within interviewed firms. The labor force survey has been carried out by phone or face to face when the selected person could not be reached by phone. In both cases workers have been interviewed in the context of their leisure time. Each respondent has been asked if he or she was willing to meet a researcher later on and 30% accepted the principle of another interview.

Methodological issues

As far as the statistical approach is concerned, a matched employer / employee survey raises methodological issues. The first one is to decide how many workers to interview per firm. It seems difficult to build up serious measures without a large sample of workers within each firm. But this is costly, especially when compared with traditional business survey where the answer of “the firm” is most of the time the answer given by one person allowed to talk in the name of the organization.

The C.O.I. survey took another option: two workers per firm have been interviewed in firms with less than five hundreds employees, three workers in bigger firms. This choice has been backed up by previous empirical work using another labor force survey (the “TOTTO” survey, see appendix 1) to measure the impact of computer use on firm productivity (Greenan, Mairesse, 1996 ; Mairesse and Greenan, 1998). It showed that if workers are randomly

selected within the firm and interviewed at home, away from the influence of the context of their work and knowing that the firm ignores their being interviewed, then the answers given by small samples of workers can be usefully included in a model specified at the firm level. In this case, employee-based variables are subject to important errors. But they are sampling errors that can be assessed, as long as there is a large enough sample of firms with two or more employees selected at random. Moreover, results about the significance of coefficients are robust.

Another methodological problem is related to the fact that the content of work depends strongly on the job and on the position occupied by the worker in the organization. Unlike the indicator on computer use, answers of all types of workers on organization cannot be treated symmetrically. As we have decided to investigate manufacturing industry, we have also chosen to focus on the answers of the largest category of employees: blue-collar workers. With their one year of seniority, they belong the “core” of the shop-floor workforce. The sample of the labor force section of the survey includes 2612 blue collars working in 1710 manufacturing firms with more than 50 employees that have responded to the business section of the survey.

What blue collar workers can tell

As we have already mentioned it, questions asked to workers are about the way everyday work takes place within the firm. We kept all the questions that were connected with the selected business survey variables. For example, blue collar workers are asked they have to meet precise quantifies quality standards like wastage rates or measurable characteristics of the product. We guess that the answer to this question should be connected with the answer of the firm representative about quality registration systems or total quality management practices. Box 2 gives the 41 questions selected from the labor force survey and the percentages of positive answers from the whole sample of interviewed blue collars.

[Insert box 2]

Here again, like with the business survey, we decided to make up a smaller number of synthetic variables. Most of the questions lead to an answer of a “yes or no” type. By summing up the number of positives answers on precise topics, we are able to build up variables that give an idea of the intensity of various dimensions of effort. For example, 4 questions indicate whether the worker communicates with his colleagues on different purposes in the course of his work. With the number of positive answers to these questions, we build up a variable that proxies the intensity of horizontal communication. In box 2, questions that are grouped together under one heading are used to make up one synthetic variable which name and number of items is given in between brackets (14 variables in total). Table 3 gives a tentative classification we made between firm level variables and employee level variables, making assumptions about how each category of new organizational practices influences the content of jobs.

The *decentralization of the hierarchical structure* of the firm is difficult to address through the interview of blue collar workers. Thus, there is no question that *a priori* corroborates the answers given by firm representatives.

Involvement in information processing and decision is seized through a group of 9 variables. A first set of 5 variables give some indications on communication: vertical and horizontal communication (**CVER** and **CHOR**), communication with other services (**CWITH**), communication with outside the firm (**CBETW**) and contact with the customer (**CUS**). On the shop floor, a majority of blue collar workers communicate with their boss and their colleagues in one way or in another. Communication with other departments in the firm is rarer: nearly half of blue collar workers attached to the core of firms' workforce do not discuss, nor are helped, nor exchange indications with other departments. Finally, 80% of blue collar workers are not involved in information exchanges about their work with persons from outside the firm and 87% are never in direct contact with the customer. This leaves 20% of them involved in such exchanges, 6% of them doing it for multiple purposes and 2% being in constant contact with the customer.

The number of meeting per year attended by blue-collar workers (**MEET**) measures institutionalized or formal ways to communicate. In a meeting, communication takes place between a group of people whereas the other forms of communication that we mentioned are more bilateral. On the whole, 43% of blue collars never participate into meetings in the context of their work and 26% attend one or more meetings a year.

The synthetic variable on the scope of initiative (**SCOPI**) sums up different types of hierarchical constraints: do supervisors give precise instructions about how to do the work? Does the employee follow instructions to the letter? Is he frequently checked? When unforeseen contingencies occur, does he call on other people to fix the problem? About 20% of blue collars have to comply with 3 or more of these hierarchical constraints. On the other extreme, 35% of blue collar workers have some scope to adapt assignments to their need or to define themselves the content of their work. The remaining 45% experiment moderate hierarchical constraint: they have no scope for changing things, but direct supervision is not very strong.

Employees are also asked if they make propositions for process improvement (**PPIM**) measuring the participation to the building up of a collective knowledge on how to improve processes. 61% of blue collar workers declare such propositions, which is rather high.

The last question that we have classified the employee involvement category is about collective work. Does the employee work in group or collectively (**GROU**)? 45% of interviewed blue collar workers never work within a group or collectively, but 29% do it all the time.

Two questions seem to be connected with *quality management* practices. Does the worker has to respect some precise quality norm (**QUAL**) or to participate in product testing (**TEST**)? 46% of direct producers are concerned by the former and 48% by the latter.

A last set of three variables have some connections with the *management of time constraint*. They describe different heavy constraints on the work rhythm of blue collars. Is work rhythm constrained by quantitative norms or deadlines (**RXX**) or by horizontal linkages with his colleagues or with the customer (**RCXXX**) ? or is it constrained by machines or by the design of the work process (**RTEC**)? We consider that all these variable measure some sources of complementarities between workers in the work done: due to time schedule, production flows, equipment or to the production process itself

Very tight time constraints are declared by about one third of blue collar workers: in this case work rhythm is defined by an external demand needing an immediate response. This complements information on contacts with customers. If only 13% of blue collar workers have direct contact with customers, they impose tight work rhythm on 30% of them. Another 44 of direct producers have production norms or deadlines to meet between 1 hour and one day. The remaining 26% work with slack deadlines.

The identity of the person who influences the production flow gives another information. It can either be a colleague or the customer. We have already measured whether customer was imposing a tight time constraint. But external demand may not always require immediate response. We find that 36% of interviewed workers do not have their work rhythm imposed by either customers or colleagues. On the opposite side of the scale, 19% refer both to the influence of customers and colleagues on their work rhythm. The remaining half is shared evenly between situations where only colleagues are a source of pressure and situations where only customers are so. We can derive a third information on the influence of customers on production work from this variable: it concerns 41% of blue collars if we take into account both tight and slack pressures on work rhythm.

Technology itself is another, more traditional, source of horizontal pressure on work rhythm. The conveyor belt is the best example. We built a synthetic indicator on technological constraints summing up a variable on rhythm imposed by automatic moving of a product or a part, a variable of rhythm imposed by automatic pace of a machine and a variable on repetitive work. 34% of blue collars are not concerned by those constraints and 43% are concerned by 2 or all of them. Thus, more traditional ways of constraining direct production work are not out of date in manufacturing.

2.2 Perception of change and patterns of blue collar work

Before considering the rich set of variables which construction has just been presented, we are going to analyze answers to the only dynamic question in the labor force section of the C.O.I survey. As already mentioned, it is about the perception of change.

Perception of change

It is interesting to examine the question about the perception of change for the whole sample of employees, not only for blue collars. In doing so, we are able to check differences between

various job occupation. This question has been asked only to employees with at least three years of seniority in the firm. 3991 employees are concerned, attached to 2376 manufacturing firms with more than 50 employees and having responded to the business section of the C.O.I survey. This sample includes 2200 blue collars affiliated to 1308 firms. The question about the perception of change was followed, for employees who responded positively by a question about the reasons of this perception: a change in job, technological change, financial restructuring of the firm, organizational change implemented within the firm. We group the last two items in order to build up a variable about the perception of organizational change.

[Insert figure 1]

In figure 1, we compute for different occupations, the share of employees that have perceived some organizational change during the past three years according to the number of new organizational practices used by the firm in 1997. We have retained this variable after checking that the perception of change was not significantly correlated to any new organizational practice taken on its own. It is not the nature of the practice that influences perception of change but the fact that they are numerous.

We observe that when the firm uses no or just one new organizational practice, 70% of workers do not perceive any organizational change and 41% perceive a change when nine to thirteen new organizational practices are used. Perception of change thus increases in the number or managerial tools used by the firm. However, in firm with no or little use of new organizational devices, 30% of workers perceive some organizational changes and 59% of workers do not perceive anything when the firm is very active in her use of organizational devices. This may have two main explanations. The first one is that the use of the practice mentioned by the firm is formal but not real. It has been decided by the management but workers do not apply it. The second one is that the worker is not concerned by the practices declared by the firm. As a matter of fact, in the business survey, we have no information at all about the degree of diffusion of the practice within the firm: is it experimental, or does it concern just one production site or has it been extended to the whole firm?

If we now consider different occupations, we see that the discrepancy about the perception of change when the firm is not innovative and when it is very innovative is smaller for blue collars than for clerks or middle management. Compared with blue collars, a smaller fraction of clerks perceive change when the firm is not innovative. For middle management, the jump in perception is when the firm uses four to five practices and it then decreases. The pattern for executives is less clear cut.

[Insert Figure 2]

In figure 2, we do the same as in figure 1, except that we consider evolutions in use of new organizational practices between 1994 and 1997. We see that the perception of change increases strongly when firms develop more than seven new organizational devices. Here again, this is especially the case for middle management, confirming that this occupation

occupies a key position in changes. We are now going to look more deeply into patterns of blue collars work organization.

Intensity of communication, intensity of industrial constraints, customers and colleagues

We will do so through correspondence analysis which seems to be the best synthesizing method for the kind of set of qualitative variable that we have to deal with. Variables built on the answers given by blue collar workers are less correlated with one another than firm level variables: to reach a proportion close to 20% of total inertia, 3 axis have to be considered in the worker level analysis, whereas 2 were sufficient in the firm level analysis. This happens even though some of the respondents belong to the same firm. If organizational practices cluster, profiles of blue collar jobs are quite varied. We chose to retain factors 1, 2 and 3 to describe parsimoniously blue collar work organization. We interpret them as describing respectively the intensity of communication on the shop floor, the intensity of industrial constraints and the opposition between work pulled by the market or work pushed by colleagues. Table 8 presents results of this analysis. It is built with the same method as tables 4 and 6.

[Insert table 8]

Vertical, horizontal, within firm, between firm and group communication in meetings come together on the first factor. Like new organizational practices, different types of communication cluster. Blue collar workers are either part of a large communication network where they share information with various interlocutors or they do not discuss at all about their work. But there is one exception : a regular or permanent contact with the customer. Although it implies communication, it does not favor a very large communication network. One reason could be that blue collars in such situations have jobs where they are more isolated, like in storehouses.

Three other variables have a strong contribution to the first factor: scope of initiative, proposition for process improvements and work rhythm fixed by external demand needing an immediate response. The first two variables are directly connected with employee involvement. Workers with low intensity of communication experiment high hierarchical constraints whereas numerous information exchanges is correlated with some scope of initiative. This does not imply that horizontal and vertical communication are substitutes: workers with more initiative also communicate more intensively with their boss. Besides, they are more prone to proposing process improvements whereas workers under tight hierarchical supervision seldom do it. Thus, it seems that if some blue collar workers communicate more intensively than others, it is because they are more autonomous and have to find their own ways when they face problems in the course of production.

The third variable is an indicator of high time pressure weighing on work. We are a little surprised to find it on the first factor rather than on the second one. We interpret it in the following manner: in order to cope with external demand needing immediate response, blue collars have to be autonomous and to have the scope to interact directly with those that will help them fulfilling their task. Thus, some blue collar workers have a complex structure of

effort where, at the same time, they have to produce intensively to reach tight deadlines and to think about what they do. Another consequence is that high hierarchical constraint and high time pressure (immediate response) are antagonistic.

Thus communication and low supervision does not mean no constraints on work. The second factor adds constraints other than high time pressure and hierarchical constraints to the description of blue collar effort. These additional constraints can coexist with different levels in intensity of communication. We group them under the heading of industrial constraints: like different types of communication, high technical constraints (work rhythm fixed by the pace of a machine), medium time pressure (deadlines to meet in one hour at most), quality norms and permanent production work within a group are correlated with one another. Vice versa, some blue collar workers do not experiment any of those constraint. Workers that have a regular or permanent contact with the customer are more frequently in this situation. The same interpretation as the previous one for this variable holds. These workers are isolated on the shop-floor, they do not interact with other workers either through information flows or through production flows.

The first panel of table 8 also shows a negative relation between very high levels of communication, high scope of initiative and the intensity of industrial constraints and no significant relation with very high time pressure. This tends to show that workers cannot develop a high involvement in information processing and decision and have at the same time their work rhythm fixed by heavy industrial constraints. There is a kind of physical and / or organizational limit to some structures of effort.

These results are in line with the ones obtained in a similar analysis using the 1987 TOTTO survey (Greenan and Guellec, 1998). Intensity of communication and intensity of constraints appeared to be two strong dimensions structuring blue collar jobs. However hierarchical constraints were correlated with both axis whereas here, they are clearly isolated from the other types of constraints. This can be interpreted as a piece of evidence showing that constraints tend to shift in time with the diffusion of organizational changes.

The third factor separates jobs that are “pushed” or influenced by colleagues from jobs that are “pulled” or close to the market. On one side, workers are in contact with the customer or have their work rhythm constrained by them within very tight deadlines, on the other one workers communicate with colleagues or have their work rhythm influenced by immediate dependence on them in the work done.

When production flows are pushed by colleagues and technical constraints are high, then colleagues impose a time constraint on work. If, on the contrary, technical constraints are low, time constraints are also weak and information exchanges are dense between colleagues. The same kind of association is observed with the influence of the market. When production flows are pulled by the market and technical constraints are high, then the customer imposes time pressure on production flows. On the opposite, with low technical constraints the proximity of the market does not mean increased time pressure for the worker, but rather information exchanges and direct contact with the customer.

If we cross the intensity of industrial constraints with the opposition between work “pushed” by colleagues or “pushed” by customers, we determine four different types of working environment. Two of them have already been described with other surveys (Kramarz, 1986; Gollac 1989): the “industrial” environment and the “craft” environment.

An industrial type of environment has strong technical constraints and quantitative norms. Here we find it enriched with quality standards. A craft environment has low technical constraints and time pressure, production work is more isolated than collective and direct contacts with the customer are frequent to define the characteristics of the products.

The two others types of working environment are less easily identifiable. On one hand, we have workers that experiment low industrial constraints and high horizontal communication, on the other one, high intensity of industrial constraints is associated with an influence of customer on the work rhythm.

2.3 Organizational change and blue collar structure of effort

We have now two pictures. The first one is built of managerial representations and it shows patterns of medium term and short term organizational change in French manufacturing firm. The second one is made out of a description given by blue collars of how their day to day work take place. In this section, we are going to put these two pictures together thanks to the matching possibilities between the two sections of the C.O.I. survey. This linkage is important both because it defines the size of potential productivity gains and because it is a source of tensions that may impede performance. In the following, we do so, choosing randomly one unique blue collar worker per firm. Thus, the size of our blue collar sample shrinks to 1710, which is also the number of affiliated firms.

Correlations between synthetic variables

A first and simple way to do it consist in computing simple correlations between factors from our three correspondence analysis. We do it in table 9 (column “simple”) where we also compute correlations controlled for the size and sector of the firm (column “sector x size”).

[Insert table 9]

We find that firms with an intense use of new organizational have their blue collar workers who communicate more intensively and who experiment higher industrial constraints. Furthermore, work is influenced by colleagues rather than by the customer. Symmetrically in firms with no organizational changes blue collar workers communicate less with other people in or outside the firm and they work under hierarchical pressure rather than formalized quantitative or qualitative pressure. This result holds when short term rather than medium term organizational change is considered. Thus, an intense use of new organizational practices and an increasing use of such devices are correlated both with higher autonomy or more decentralized information processing and with higher constraints on work due to automated technology, repetitive tasks and quality standards.

The orientation of medium term organizational changes towards just-in-time systems is negatively correlated with the intensity of blue collar communication. Thus we may assume that such orientation is not closely connected with very high time pressure on work rhythm which is rather counter intuitive.

The orientation of medium term organizational changes towards market and pseudo-market devices are negatively correlated with the intensity of industrial constraints on blue collar work.

The orientation of short term organizational change towards increased responsibilities to production workers and specialists is positively correlated with the intensity of blue collar communications.

An interpretation of this result is that organizational change drives a transformation in the structure of blue collars effort. The main direction is that of an increase both in the intensity of blue collar communication and in the intensity of industrial constraints. The linkage we find here between a high intensity of communication and organizational change is consistent with what Shaw, Gant and Ichniowski (1999) found in the steel industry. They argue that “a move to a high-performance workplace requires a reconfiguration of the entire system of inter-personal interactions in the workplace” (p.2). The correlation of organizational change with the intensity of industrial constraints and with the influence of colleagues (though weaker) tends to show that it takes place more frequently in environments with heavy equipment. As a result, the structure of blue collar effort tends to become more complex as they are required to participate intensively both in information and production flows. But we have not tested the causality of this relation. Furthermore, we have seen that at the level of the worker, high involvement in information processing and decision was negatively correlated with high industrial constraint. Thus, firms that implement organizational change have to deal with this internal contradiction.

The orientation of organizational change also influences the structure of effort. Firms that use of new organizational practices is oriented towards just in time system are characterized by less communication on the shop floor than firms that favor teamwork and quality management devices. Firms that choose to use intensively internal and external market transactions are characterized by less industrial constraints on blue collar work.

Size could explain part of the observed correlation between firm and worker level variables. Firm level variables are all strongly correlated with size. Bigger firms have a more dynamic organization than smaller ones. In the firm level correspondence analysis, we checked, using size as a supplementary variable that the “no firms” were smaller than those with an increasing use of new organizational practices. However, worker level variables are much less sensitive to the size of the firm. It seems that the variables that structure the most strongly the space of blue collar job characteristics are independent from size. But looking more closely, we find that the employee level items that are significantly correlated with size are also correlated with organizational change: technical constraints, number of meetings, propositions for process improvement, quality norms and product testing. Furthermore “industrial” type of environments correspond to bigger firms where work is pulled by the market or influenced by it.

What are the different explanations for the strong correlation with size in our firm level variables? A first one is mechanical: the probability of adopting a new organizational device is larger in a bigger firm as it would be larger in a firm made out of a collection of smaller ones. If this was true, it would be sounder to interview the plant rather than the firm. Second managerial vocabulary is better understood in bigger firms where managers have more often been educated in schools where management research was going on. Third, organizational changes are responses to increased complexity either originating from inside the firm (introduction of new technologies, product differentiation, higher quality standards, etc.) or from outside (distant markets, customer with changing tastes etc.). In both cases, size makes increased complexity more complex, because coordination problems are bigger to solve.

To check if our firm / worker correlation may be explained by a pure size effect, we computed the correlation in table 4 again using data centered on the size/sector mean crossing 4 size categories and 15 sector ones. Results are still significant with the same sign, but they are a little weaker. Thus size and sector explains part of the observed correlation between firm and workers coordinates, but not all of it.

Finally, we find that the firms that are more prone to organizational change have a bigger size, are “industrial” in the traditional sense of it (repetitive work, high capital intensity) and have developed dense internal communication network. On the whole, firms which use of organizational devices result from choices taken in the beginning of the nineties seems to search a way of better mastering quality rather than a way to give quicker response market demand.

Correlations between “primary” variables

Do we find the same results when we turn back to the “primary” variables of the survey? To answer this question, we estimated multiple correlations between each new organizational practice (explained variable) and variables about blue collar work (explanatory variable). We also included crossed effect of blue collar variables with the perception of change. Results are given in table 10. Panel one gives correlations between work organization variables and new organizational practices for an average blue collar worker while panel two gives correlation for a blue collar worker who has perceived organizational change. This allows to check if the level of correlations react to the fact that the worker seems directly concerned by the change.

[Insert table 10]

In table 10, each column gives the result of a regression for one special new organizational practice. Practices are grouped according to the same categories as the ones we used in section 1. We discuss the main results in this table.

First, two variables reacts to nearly every new organizational practices : the number of meeting attended by blue collars per year and the fact of making propositions for process improvements. Meeting and propositions for process improvement are both more frequent when firms use new organizational practices.

Second, another variable reacts, this time negatively, but in a less systematic way: vertical communication. Blue collars seem to discuss less frequently of work with their bosses when new organizational practices are implemented.

Third, some expected correlations are not very significant nor have the wrong sign, like the one between quality management devices, quality norms and product testing, or the one between just in time systems and work rhythm imposed by customers, or the one between work in teams or groups and intensity of production work within a group.

Third, panel two shows that, rather than being more concerned by organizational change, blue collar who perceive change seem to occupy a special position in the organization of work. They participate less often than on average to meetings, they have a smaller scope of initiative, they more often spend some time doing production work within a group.

These results corroborate the preceding one on the correlation between intensity of communication and organizational change, but it is more precise. It seems that the common ingredient to all new organizational devices has to do with the production of a collective knowledge on the shop floor allowing to improve continuously production process. In other words, organizational change would be connected with a new way of rationalizing knowledge making where all workers are asked to explicitly contribute to technological progress.

Here again, this is only a possible interpretation of our results. More meetings and more suggestions could also be an indirect measure of the adjustment cost associated with organizational change. When ways of doing things change in an organization, people have to meet to find agreements and to work out solutions to unforeseen problems.

If the first interpretation holds then the structure of blue collar effort in manufacturing will durably be altered by organizational change. But if the second interpretation is right then the structure of blue collar effort may move back to another equilibrium.

Temporary conclusion: summary of main results

Main results:

In the words of firm representatives:

- 1) In the words of firm representative, new organizational practices cluster
- 2) There are some tensions within the “model of manufacturing excellence” between quality management and teamwork devices on one hand and just in time systems on the other hand.
- 3) The intensity in use of “pseudo market” and “market” is relatively independent from the intensity in use of new organizational practice and from the orientation towards the “model of manufacturing excellence”.

- 4) Practices seem to evolve in the medium term and in the short term according to the same laws and at the same rhythm once adopted.

In the words of workers:

- 4) The perception of organizational change is positively correlated with the number of new organizational devices used by the firm. This correlation is at the same time weak and significant. There is a gap between what the firm declares doing and what the worker perceives.

In the words of blue collars

- 5) The intensity of communication on the shop floor is a discriminatory feature of work organization.
- 6) The intensity of communication is positively correlated with high time constraint on the work rhythm and with low hierarchical constraint. Thus high hierarchical constraints and high time pressure on work are antagonistic.
- 7) The intensity of technical constraints, positively correlated with medium time pressure, quality standard and permanent production work within a group and negatively correlated with regular or permanent contact with the public is a second prominent characteristic of blue collar work.
- 8) Workers cannot develop a high involvement in information processing and decision and have at the same time their work rhythm fixed by heavy industrial constraints. There is a kind of physical and / or organizational limit to some structures of effort
- 9) Whether production and information flows are pushed by colleagues or pulled by the customer is a third discriminatory feature of blue collar work organization.

Organizational change and structure of blue collar effort

- 10) A higher use and an increasing use of new organizational devices are positively correlated with a higher intensity of blue collar communication, with a higher intensity of industrial constraints and with production flows that are pushed by colleagues rather than pulled by the market. Thus the structure of blue collar effort reacts to medium term and short term organizational change.
- 11) The orientation of organizational change also influences the structure of effort. Firms that use of new organizational practices is oriented towards just in time system are characterized by less communication on the shop floor than firms that favor teamwork and quality management devices. Firms that choose to use intensively internal and external market transactions are characterized by less industrial constraints on blue collar work.

- 12) It seems that the common ingredient to all new organizational devices has to do with the production of a collective knowledge on the shop floor allowing to improve continuously production process. In other words, organizational change would be connected with a new way of rationalizing knowledge making where all workers are asked to explicitly contribute to technological progress

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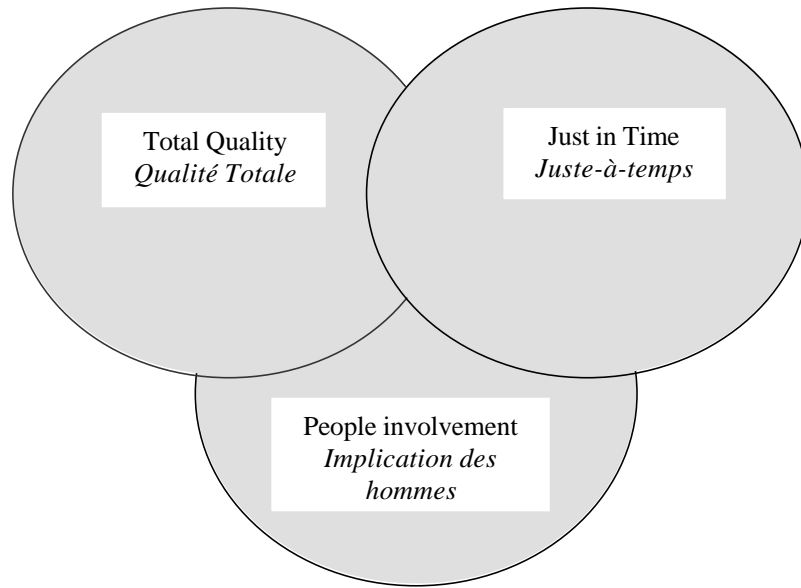
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Table 1 : General view of manufacturing excellence

Total quality	<i>Qualité total</i>	People involvement	<i>Implication des hommes</i>	Just in time	<i>Juste-à-temps</i>
Defined quality to customers	<i>Qualité définie selon les besoins du client</i>	Survival perspective	<i>Objectif de survie</i>	Workplace organization	<i>Organisation du poste de travail</i>
Total company effort	<i>Effort de l'ensemble de l'entreprise</i>	Total organization reform	<i>Changement complet de l'organisation</i>	Visibility	<i>Visibilité</i>
Targets for improvement	<i>Objectifs / cibles d'amélioration</i>	Responsibility at the source	<i>Responsabilité à la source</i>	Limited inventory	<i>Stocks limités</i>
Quality process ; quality product	<i>Qualité du processus : qualité du produit</i>	More skills, less effort	<i>Plus de qualification, moins d'effort</i>	Reduced setup times	<i>Temps de changement de série réduits</i>
Responsibility at the source	<i>Responsabilité à la source</i>	Flexible workers	<i>Personnel souple et polyvalent</i>	Small lot sizes	<i>Faible taille des lots</i>
Statistical process control	<i>Contrôle statistique de processus</i>	Broad perspective	<i>Recherche d'une vision globale</i>	Reduced lead times	<i>Cycles de production réduits</i>
Immediate feedback	<i>Correction immédiate</i>	Full work	<i>Plein-emploi</i>	Reduced space : Group technology, Standard routings, Cell layouts	<i>Réduction de la surface : Technologie de groupe, Gamme, Implantation en cellules</i>
Cause and effect methods	<i>Méthode d'analyse de causes et d'effets</i>	People	<i>Enrichissement des compétences</i>	Producibile designs	<i>Conception « manufacturable »</i>
Reduced variance in process	<i>Réduction de la variabilité dans le processus</i>	development	<i>Atmosphère de résolution des problèmes</i>	Stable, repeating schedule	<i>Charge stable et renouvelée</i>
Failsafe operations	<i>Opérations conçues pour empêcher les défauts</i>	Problem solving atmosphere	<i>Mesure des performances</i>	Preventive maintenance	<i>Maintenance préventive</i>
Standardization	<i>Standardisation</i>	Performance measurement	<i>Améliorations continues</i>	Cycle time analysis	<i>Analyse des temps de cycle</i>
		Continuous improvement			

After Hall (1987, p.25) and its French translation (1989, p. 43.)

Table 2 : French and Anglo-saxon organizational tools: vocabulary issues

Practices often referred to in the US literature		References	
English term	French term	Appelbaum and Batt	5 US papers
Employee involvement	“implication des salariés” “pratiques participatives”	Swedish Japanese	BBH, ISP
Total quality management	“démarche de qualité totale”	Japanese	O, CN
Quality circle	“cercle de qualité”	Japanese	O, CN
Job rotation flexible job assignment broad job assignment	“polyvalence”	Swedish Japanese Italian	O, ISP, BBH, CN
Self directed work teams Self managed team Self managing team Autonomous work groups	“équipes de travail autonomes”	Swedish	O, BL, BBH, CN
Problem solving groups	“groupes de résolution de problèmes”	Swedish Japanese	O, ISP
Benchmarking	“Benchmarking”	American LP	CN, BL
Business process reengineering	“Reengineering”	American LP	BL
Delaying	“Suppression de niveaux hiérarchiques”	American LP	
Just-in-time in production / delivery	“juste-à-temps”, “flux tendus” “production” / “livraison”	Japanese	
Lean production	“production maigre”	Japanese	
Downsizing	“restructuration”	Low cost route	
outsourcing	“externaliser”	Low cost route	
sub-contracting	“sous-traiter”	Low cost route	
Other tools		<p>Grey areas underline practices that are measured in the COI survey.</p> <p>“Appelbaum and Batt” refers to their 1994 book titled “The New American Workplace”. LP means lean production.</p> <p>O refers to Osterman, 1994. ISP to Ichniowski, Shaw and Prensushi, 1997. BBH to Bresnahan, Brynjolfsson and Hitt, 1999. CN to Cappelli and Neumark, 1999. BL to Black and Lynch, 2000.</p>	
ISO certification Registered quality systems	certification ISO, EAQF		
Value analysis, value engineering	“analyse de la valeur”, “analyse fonctionnelle”, “AMDEC”		
Total Productive Maintenance	“TPM”		
5S method	“méthode 5S”		
Organization in cells	“îlots de production”		
Multi-disciplinary project teams	“équipes de projet”		
Organization in profit centers	“organisation en centres de profit”		
Formal in-house customer / suppliers contracts	“contrats clients / fournisseurs internes”		

Table 3: What is measured through the answers of firm representatives and blue-collar workers in the C.O.I. survey?

Firm representative Situation of the firm in 1997 and change over the 1994-1997 period	Blue-collar worker Description of work content en 1997
Decentralization of the hierarchical structure	
<p>Existence (Y/N) or evolution in use (I/S) oforganization in profit centers (OPC) ...formal in house customer / supplier contracts (CSC)</p> <p>Number of functions outsourced (OUT) Subcontracting of production (SUB)</p> <p>Number of hierarchical layers (HL) Change in HL (EVHL)</p>	<p>Cannot be measured through questions addressed to blue collar workers</p>
Involvement of employees in information processing and decision	
<p>Extent (M/L) of the involvement of direct producers in... ...problem solving groups (PSG) ...multi-disciplinary project teams(MPT) ...self managed teams (SMT)</p> <p>Number of operating tasks the management (MANN_N), production workers (PWN_N) and specialists (SPEN_N) are respectively responsible for and change in this number (DMANN_N, IPWN_N et ISPEN_N)</p>	<p>Intensity of... ...vertical communication (CVER) ...horizontal communication (CHOR) ...communication with other departments (CWITH) ...communication with outside the firm (CBETW) ... contact with the customer (CUS) Number of meetings (MEET) Scope of initiative (SCOPI) Propositions for process improvements (PPIM) Intensity of production work within a group (GROU)</p>
Complementarities due to quality standards	
<p>Existence (Y/N) or evolution in use (I/S) of... ...ISO 9001, ISO 9002, EAQF (ISO) ...TQM or other quality norms (TQM) ...Value analysis or AMDEC method (AMD) Suppliers or subcontractors are required to... ...comply with ISO standards (ISOSU) ...take part in designing end-products (DESSU)</p>	<p>Prescription of precise quality norms (QUAL) Product testing (TEST)</p>
Complementarities due to time schedule, production flows and equipment	
<p>Existence (Y/N) or evolution in use (I/S) of... ...a just in time delivery system (DJIT) ...a just in time production system (PJIT) ...5S method or TPM (TPM) Suppliers or subcontractors are required to... ...make just-in-time deliveries (JITSU)</p>	<p>Work rhythm fixedby prescribed times (RXXX) ...by horizontal linkages (RCXXX) ...by technical constraints (RTEC)</p>

Table 4: Combinations of organizational devices used by manufacturing firms in 1997

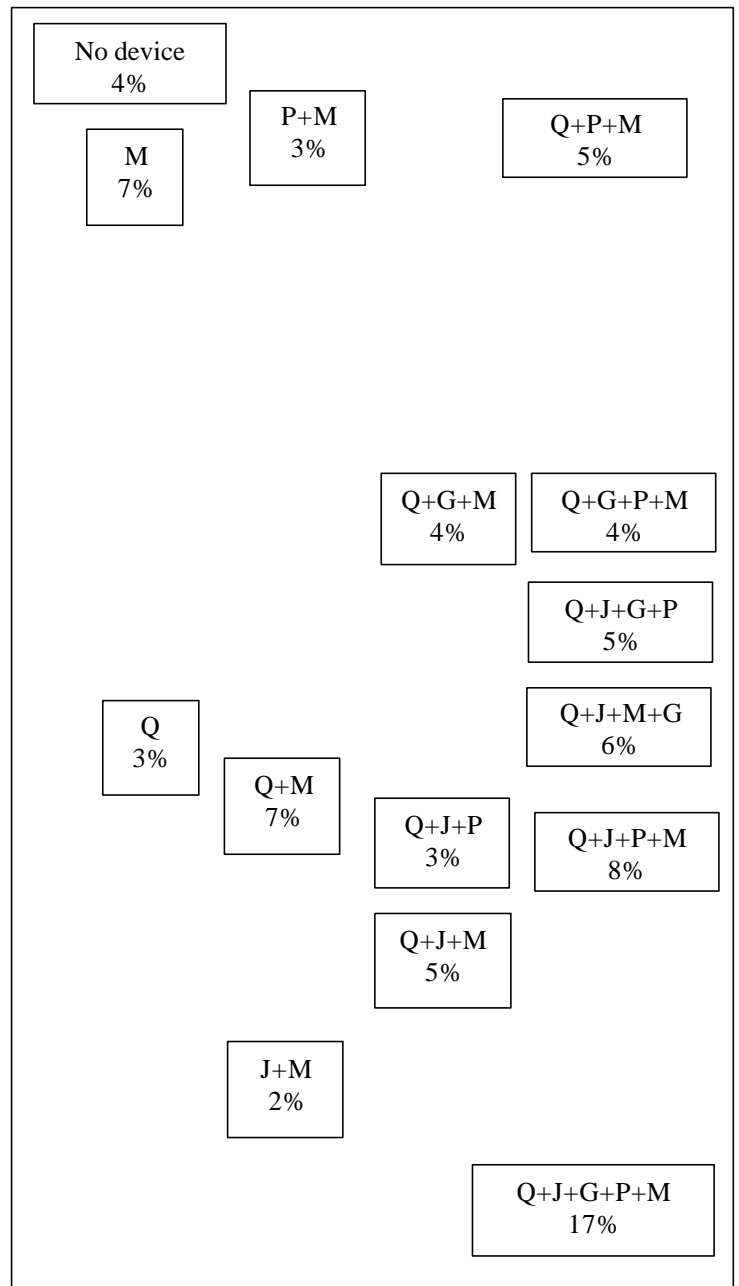
M: Market devices	
Outsourcing of more than 3 tasks (OUT)	19%
Subcontracting of production (SUB)	29%
OUT+SUB	26%
No market devices	26%

P : Pseudo-market devices	
Organization in profit centers (OPC)	19%
Formal in-house customer / supplier contracts (CSC)	14%
OPC+CSC	19%
No pseudo market devices	48%

G: Work in teams or groups for more than 10% of production workers	
Self managed teams (SMT)	10%
Problem solving groups (PSG)	7%
Project teams (PRT)	3%
SMT+PSG	8%
SMT+PRT	1%
PSG+PRT	5%
SMT+PSG+PRT	13%
No work in teams or groups for production workers	53%

Q : Quality management devices	
ISO 9001, ISO 9002 or EAQF certification (ISO)	20%
Other certification or Total Quality Management (TQM)	11%
Value analysis, functional analysis or AMDEC method (AMD)	2%
ISO+TQM	10%
ISO+AMD	11%
TQM+AMD	4%
ISO+TQM+AMD	16%
No quality management device	26%

J : Just in time systems	
System of just in time delivery (DJIT)	6%
System of just in time production (PJIT)	5%
5S Method or Total Productive Maintenance (TPM)	6%
DJIT+PJIT	22%
DJIT+TPM	2%
PJIT+TPM	1%
DJIT+PJIT+TPM	13%
No just in time systems	45%

**Selection of combinations within categories of devices**

When a device appears on its own, it means that the firm only uses this device in the considered category.

Selection of combinations of categories of devices

Each letter indicates the presence in the firm in 1997 of at least one of the devices represented by the letter.

The 15 retained combinations (out of 32) group 83% of the firms

Source: C.O.I survey, 1997, business section, MEFI-SESSI, MAP-SCEES

Note: This table gives the percents computed on the sample of 3286 manufacturing firms with more than 50 employees where at least one employee responded to the labor force section of the C.O.I. survey.

Table 5 : Synthetic indicators of the use of new organizational devices in 1997

% of firms unweighted, (weighted) N=3286	Intensity in use of new organizational devices				Teamwork versus just-in-time		Just-in-time versus quality devices		Intensity in use of market and pseudo-market devices				Total sample
	Low	Medium	High	Very high	Team	JIT	JIT	Quality	Low	Medium	High	Very high	
Market devices													
No outsourced tasks (OUTS0)	33	25	22	24	30	23	32	20	18	24	32	31	26 (27)
1 or 2 outsourced task (OUTS1_2)	29	30	30	26	27	30	26	32	33	29	27	26	29 (28)
3 to 5 outsourced task (OUTS3_5)	25	26	28	25	24	28	26	26	33	29	23	20	26 (27)
6 to 15 outsourced task (OUTS6_15)	13	19	20	25	19	19	16	22	16	19	19	23	19 (18)
Subcontracting of production (SUBCY)	48	50	56	67	48	62	51	59	29	51	68	75	55 (54)
Pseudo-market devices													
Organization in profit centers (OPCY)	13	31	46	66	38	39	34	43	23	36	39	56	38 (31)
Formal in-house customer / supplier contracts (CSCY)	9	24	41	61	32	34	35	32	17	30	36	51	33 (29)
Number or hierarchical layers between production workers and the head of the company													
0 to 2 (HL2)	38	20	15	8	24	18	32	9	13	24	22	25	21 (28)
3 (HL3)	32	27	29	21	28	26	31	23	42	29	21	14	27 (30)
4 (HL4)	19	33	26	34	25	31	25	31	14	20	34	44	28 (25)
5 and more (HL5)	11	20	30	37	23	25	12	37	31	27	22	17	24 (17)
Involvement of more than 10% of direct producers in...													
Self managed teams (SMTM)	10	25	37	61	52	16	42	23	32	32	31	35	32 (31)
Problem solving groups (PSGM)	6	19	39	73	58	13	38	29	43	35	30	26	34 (28)
Project teams (MPY)	4	14	27	45	45	3	26	18	27	22	20	19	22 (19)
Responsibilities of management for 10 indirect shop-floor tasks													
0 to 3 tasks (MAN0_3)	23	21	17	16	28	12	25	13	1	5	17	56	19 (20)
4 to 5 tasks (MAN4_5)	18	25	25	31	21	27	22	28	22	28	31	19	25 (23)
6 or 7 tasks (MAN6_7)	33	31	35	35	28	39	26	41	32	40	41	22	34 (33)
8 to 10 tasks (MAN8_10)	26	23	23	18	23	22	27	18	45	27	12	4	22 (24)
Responsibilities of production workers for 10 indirect shop-floor tasks													
0 to 2 tasks (PW0_2)	48	26	13	5	25	22	28	19	9	19	27	39	23 (28)
3 to 4 tasks (PW3_4)	25	29	26	15	17	30	21	27	31	27	22	14	24 (25)
5 to 6 tasks (PW5_6)	18	26	30	30	23	29	22	30	34	27	24	19	26 (25)
7 to 10 tasks (PW7_10)	9	18	31	51	35	19	29	25	26	27	27	28	27 (22)
Responsibilities of specialists for 10 indirect shop-floor tasks													
0 or 1 task (SPE0_1)	49	25	16	12	35	19	36	15	17	25	25	37	26 (31)
2 or 3 tasks (SPE2_3)	27	24	20	14	18	25	21	22	17	22	26	21	22 (23)
4 to 6 tasks (SPE4_6)	17	35	38	36	27	34	26	37	23	32	36	35	31 (28)
7 to 10 tasks (SPE7_10)	7	17	26	38	20	22	18	25	43	21	13	7	22 (18)
Quality management devices													
ISO 9001, ISO 9002 or EAQF certification (ISOY)	17	56	69	89	54	59	44	71	59	54	57	58	57 (49)
Other certification or Total Quality Management (TQMY)	14	33	50	68	43	38	36	46	39	40	40	43	41 (35)
Value analysis, functional analysis or AMDEC method (AMDY)s	2	15	40	79	31	34	28	38	33	33	31	34	33 (26)
Suppliers / subc. comply with ISO or other standards (ISOSUY)	27	75	90	98	66	76	60	84	70	71	73	73	72 (66)
Suppliers / subc. take part in designing end products (DESSUY)	21	42	51	67	40	49	43	47	22	40	49	70	45 (42)
Just in time systems													
System of just in time delivery (DJITY)	7	31	55	84	29	55	63	23	50	44	38	40	43 (39)
System of just in time production (PJITY)	9	26	52	81	29	52	62	19	45	43	40	37	41 (38)
5S method or Total Productive Maintenance (TPMY)	0	5	22	63	23	21	22	23	25	23	21	19	22 (16)
Suppliers / subc. are asked to make JIT deliveries (JITSUY)	23	45	64	87	40	67	70	38	50	55	57	55	54 (51)
Total sample	24 (33)	24 (28)	26 (23)	26 (16)	46 (46)	54 (54)	51 (57)	49 (43)	26 (25)	25(26)	24 (25)	25 (24)	

Source: C.O.I survey, 1997, business section, MEFI-SESSI, MAP-SCEES

Note: This table gives the percents computed on the sample of 3286 manufacturing firms with more than 50 employees where at least one employee responded to the labor force section of the C.O.I. survey.

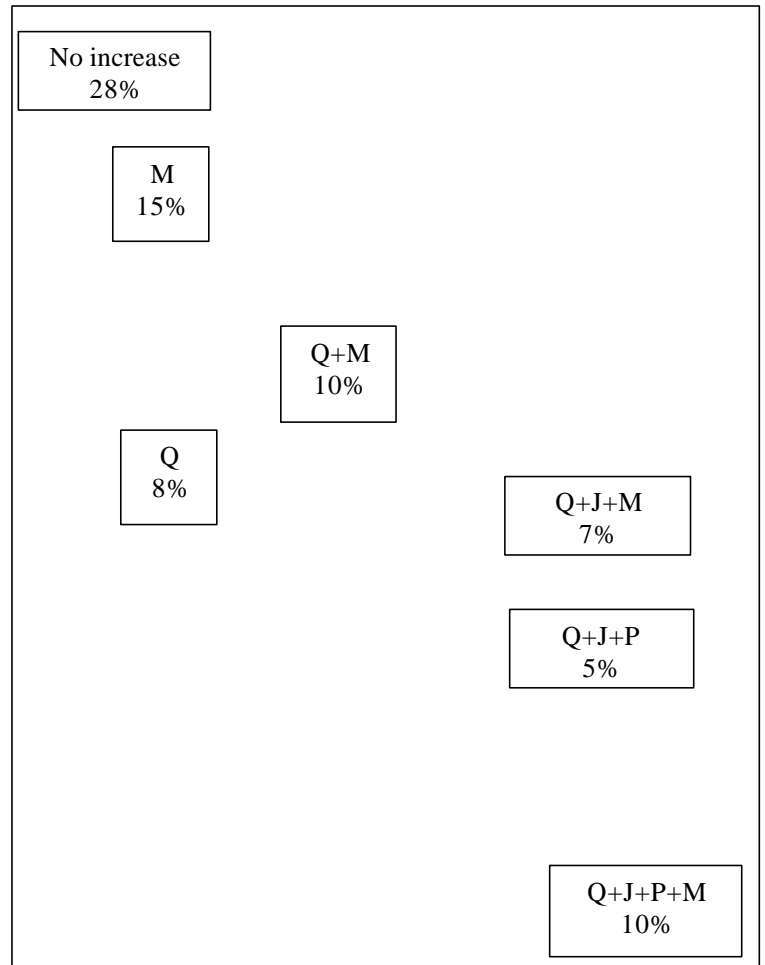
Table 6 : Combinations of increases in the use of organizational devices 1994-1997

M: market devices	
Outsourcing (OUT)	31%
Subcontracting of production (SUB)	9%
OUT+SUB	11%
No increase in the use of market devices	49%

P: pseudo-market devices	
Organization in profit centers (OPC)	8%
Formal in-house customer / supplier contracts (CSC)	9%
OPC+CSC	7%
No increase in the use of pseudo market devices	76%

Q: quality management devices	
ISO 9001, ISO 9002 or EAQF certification (ISO)	17%
Other certification or Total Quality Management (TQM)	8%
Value analysis, functional analysis or AMDEC method (AMD)	2%
ISO+TQM	7%
ISO+AMD	6%
TQM+AMD	2%
ISO+TQM+AMD	7%
No increase in the use of quality management devices	51%

J : Just in time systems	
System of just in time delivery (DJIT)	3%
System of just in time production (PJIT)	3%
5S Method or Total Productive Maintenance (TPM)	6%
DJIT+PJIT	11%
DJIT+TPM	1%
PJIT+TPM	1%
DJIT+PJIT+TPM	7%
No increase in the use of just in time systems	68%



Selection of combinations of increases in use within categories of devices

When a device appears on its own, it means that the firm only increases the use of this device in the considered category.

Selection of combinations of increases in the use of categories of devices

Each letter indicates the increase in use between 1994 and 1997 of at least one of the devices represented by the letter.
The 7 retained combinations (out of 16) group 83% of the firms

Source: C.O.I survey, 1997, business section, MEFI-SESSI, MAP-SCEES

Note: This table gives the percents computed on the sample of 3286 manufacturing firms with more than 50 employees where at least one employee responded to the labor force section of the C.O.I. survey.

Table 7 : Synthetic indicators of organizational change 1994-1997

% of firms unweighted, (weighted) N=3286	Intensity of organizational change 1994-1997				Increase in the responsibilities of production workers and specialists			Total sample
	Low	Medium	High	Very high	Stable	Medium	High	
Change in use of market devices								
Stability in outsourcing practices (IOUTS)	83	54	46	35	61	57	48	58 (60)
Development in outsourcing practices for 1 or 2 tasks (IOUT1_2)	12	29	28	29	22	25	28	23 (22)
Development in outsourcing practices for 3 to 15 tasks (IOUT3_15)	5	17	26	36	17	18	24	19 (17)
Stability in production sub-contracting practices (SUBES)	90	72	68	58	77	74	66	74 (76)
Increase in production sub-contracting practices (SUBEI)	8	22	24	31	19	20	22	20 (19)
Decrease in production sub-contracting practices (SUBED)	2	6	8	11	4	6	12	6 (6)
Increase in use of pseudo-market devices								
Organization in profit centers (OPCI)	0	6	18	45	16	11	11	14 (10)
Formal in-house customer / supplier contracts (CSCI)	0	4	21	53	18	12	13	16 (13)
Change in the number of hierarchical layers								
Stability (EVHLS)	89	73	59	45	86	36	42	70 (73)
Increase by 1 level or more (EVHLI)	6	9	10	6	4	19	10	7 (9)
Decrease of 1 level (EVHLD1)	5	15	27	34	8	38	37	18 (15)
Decrease of 2 or more levels (EVHLD2)	0	3	4	14	2	7	11	5 (3)
Decrease in responsibilities of management for 10 indirect shop-floor tasks								
...no decrease in the number tasks (DMAN0)	100	91	79	67	99	91	40	87 (88)
...decrease by 1 or 2 tasks (DMAN1_2)	0	7	15	22	1	9	39	9 (8)
... decreased by 3 or more tasks (DMAN3_10)	0	2	6	11	0	0	21	4 (4)
Increase in responsibilities of production workers for 10 indirect shop-floor tasks								
...no increase in the number of tasks (APW0)	97	68	45	25	84	47	9	64 (70)
...increase by 1 to 3 tasks (APW1_3)	3	25	34	34	13	39	36	22 (19)
...increase by 4 or more tasks (APW4_10)	0	7	21	41	3	14	55	14 (11)
Increase in responsibilities of specialists for 10 indirect shop-floor tasks								
...no increase in the number of tasks (ASPE0)	99	85	76	67	98	78	39	84 (85)
...increase by 1 to 2 tasks (ASPE1_2)	1	11	17	24	2	20	39	12 (11)
...increase by 3 or more tasks (ASPE3_10)	0	4	7	9	0	2	22	4 (4)
Increase in use of quality management devices								
ISO 9001, ISO 9002 or EAQF certification (ISOI)	0	39	54	76	38	33	34	37 (30)
Other certification or Total Quality Management (TQMI)	0	19	36	57	23	22	29	24 (20)
Value analysis, functional analysis or AMDEC methods (AMDI)	0	4	19	61	17	17	20	17 (13)
Increase in use of just in time system								
System of just in time delivery (DJITI)	0	4	32	71	24	15	20	22 (18)
System of just in time production (PJITI)	0	3	32	68	24	13	19	21 (18)
5S method of Total Productive Maintenance (TPMI)	0	4	16	52	14	15	18	15 (9)
Total sample	32 (38)	28 (29)	20 (18)	20 (15)	65 (67)	17 (17)	18 (16)	

Source: C.O.I survey, 1997, business section, MEFI-SESSI, MAP-SCEES

Note: This table gives the percents computed on the sample of 3286 manufacturing firms with more than 50 employees where at least one employee responded to the labor force section of the C.O.I. survey.

Figure 1 : Perception of change and new organizational devices in 1997

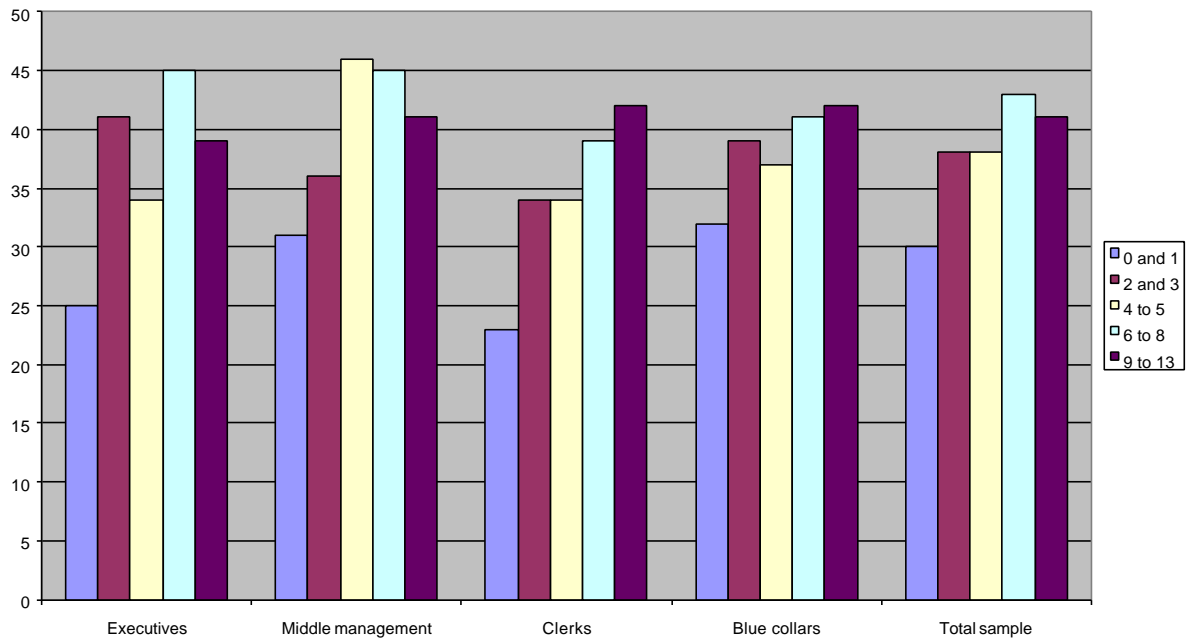
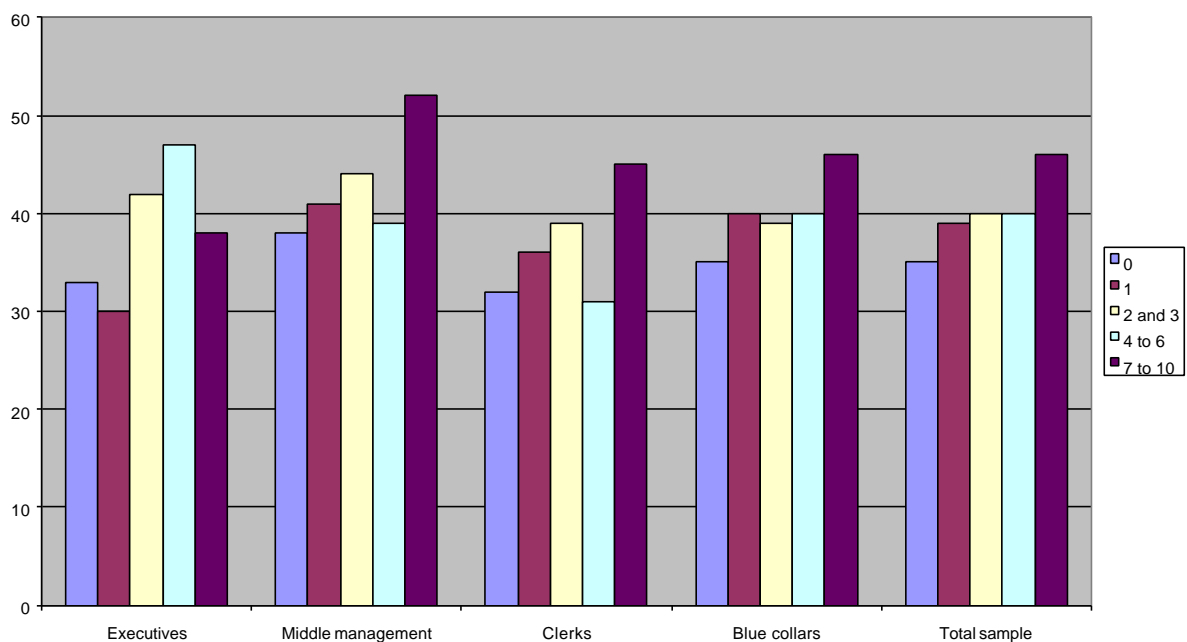


Figure 2 : Perception of change and organizational change 1994-1997



Source: C.O.I survey, 1997, business and labor force sections, MEFI-SESSI, MAP-SCEES, MES-DARES

Note: These figures give the percents of workers from each category and with at least three years of seniority, that have answered “yes” to the following question “Has your work environment been deeply on the move during the past three years ?” and “yes” to at least one of the following questions “Is it because of some financial restructuring of the firm you work for?” or “Is it because of organizational changes implemented within the firm?”. This percentage is computed according to the number of new organizational devices used by the firm in 1997 (figure 1) and according to the number of devices which have been adopted or which use has been extended between 1994 and 1997 (figure 2). The number of employees (firms) used to compute these statistics are the following: executives 506 (321), middle management 986 (608), employees 299 (139), blue collars 2200 (1308), total sample 3991 (2376).

Table 8 : Synthetic indicators of blue collar work organization (panel 1)

% of blue collars unweighted, (weighted) N=2612	Intensity of communication				Intensity of constraints				Customer and colleague		Total sample
	Low	Medium	High	Very high	Low	Medium	High	Very high	Customer	colleague	
Intensity of vertical communication (with the boss)											
VERY LOW (CVER0)	35	24	17	6	28	24	20	11	24	18	21 (19)
LOW (CVER1)	36	28	17	9	16	22	23	29	23	22	22 (22)
MEDIUM (CVER2)	19	25	24	16	20	21	22	21	20	21	21 (21)
HIGH (CVER3)	9	17	25	21	11	14	19	28	19	18	18 (20)
VERY HIGH (CVER4)	1	6	17	48	25	19	16	11	14	21	18 (18)
Intensity of horizontal communication (with colleagues)											
VERY LOW (CHOR0)	58	28	15	7	39	32	23	13	35	21	27 (26)
LOW (CHOR1)	27	35	28	18	21	31	28	29	25	29	27 (28)
MEDIUM (CHOR2)	15	35	48	41	20	27	38	53	34	35	35 (34)
HIGH (CHOR3)	0	2	9	34	20	10	11	5	6	15	11 (12)
Intensity of communication with other departments											
NO (CWITH0)	81	54	39	15	50	53	47	38	50	46	47 (47)
LOW (CWITH1)	14	27	35	28	17	25	27	34	27	25	26 (26)
MEDIUM (CWITH2)	5	18	20	28	16	14	18	23	17	18	18 (17)
HIGH (CWITH3)	0	1	6	29	17	8	8	5	6	11	9 (10)
Intensity of communication with outside the firm											
NO (CBETW0)	97	90	84	51	67	83	84	88	78	83	81 (80)
LOW (CBETW1)	3	9	14	30	17	14	14	11	18	11	14 (14)
MEDIUM-HIGH (CBETW2)	0	1	2	19	16	3	2	1	4	6	5 (6)
Intensity of contact with the customer											
NEVER (CUS0)	98	94	89	67	67	88	95	97	80	92	87 (87)
OCCASIONALLY (CUS1)	1	3	6	19	14	9	4	3	10	6	7 (8)
REGULARLY (CUS2)	1	3	5	14	19	3	1	0	10	2	6 (5)
Number of meetings per year											
0 (MEET0)	73	54	41	27	63	59	43	29	54	45	49 (43)
1 OR 2 (MEET1)	14	17	15	13	11	13	18	19	12	17	15 (15)
BETWEEN 3 & 9 (MEET2)	8	14	18	18	9	10	16	21	11	16	14 (16)
BETWEEN 10 & 16 (MEET3)	5	10	16	21	8	11	14	19	13	14	13 (14)
17 AND MORE (MEET4)	0	5	10	21	9	7	9	12	10	8	9 (12)
Scope of initiative											
VERY LOW (SCOPI0)	37	25	12	4	8	18	22	29	24	15	19 (20)
LOW (SCOPI1)	34	28	25	10	16	25	25	31	22	26	24 (23)
MEDIUM (SCOPI2)	21	26	23	17	24	21	21	22	21	23	22 (22)
HIGH (SCOPI3)	7	16	28	33	27	23	21	14	21	21	21 (21)
VERY HIGH (SCOPI4)	1	5	12	36	25	13	11	4	12	15	14 (14)
Propositions for process improvement											
Yes (PPIMY)	19	54	74	87	45	51	61	76	54	62	59 (61)

Source: C.O.I survey, 1997 labor force section, MES-DARES

Note: This table gives the percents computed on the sample of 2612 blue collar workers with at least one year of seniority in a firm with more than 50 employees that has responded to the business section of the C.O.I. survey.

Table 8 : Synthetic indicators of blue collar work organization (panel 2)

% of blue collars unweighted, (weighted) N=2612	Intensity of communication				Intensity of constraints				Customer and colleague		Total sample
	Low	Medium	High	Very high	Low	Medium	High	Very high	Customer	colleague	
Intensity of production work within a group											
NEVER (GROU0)	71	52	38	25	60	53	45	28	43	49	46 (45)
LESS THAN 1/4 OF TIME (GROU1)	4	14	19	28	19	17	16	12	16	16	16 (16)
1/4 OF TIME OR MORE (GROU2)	4	7	12	19	11	10	10	13	10	11	11 (10)
ALL THE TIME (GROU3)	21	27	31	28	10	20	29	47	31	24	27 (29)
Prescription of precise quality norms											
YES (QUALY)	23	44	51	61	16	35	54	74	42	46	45 (46)
Product testing											
YES (TESTY)	16	45	57	68	22	39	51	73	44	49	47 (48)
Work rhythm fixed by prescribed times											
NO PRESCRIBED TIME (RYEAR)	40	26	22	14	50	29	15	8	15	33	25 (26)
1 DAY (RDAY)	28	27	20	12	18	24	24	21	11	30	22 (22)
1 HOUR (RHOU)	30	27	19	10	5	17	27	37	7	33	21 (22)
IMMEDIATELY (RIMM)	2	20	39	64	27	30	34	34	67	4	32 (30)
Work rhythm fixed by horizontal linkages											
NONE (RCUCN)	56	42	27	15	55	40	30	16	9	21	35 (36)
COLLEAGUES ONLY (RCOL)	34	27	19	9	6	19	25	38	5	29	22 (23)
CUSTOMER ONLY (RCUS)	6	18	29	42	32	28	21	14	48	35	24 (22)
CUSTOMER AND COLLEAGUES (RCUCO)	4	13	25	34	7	13	24	32	38	15	19 (19)
Work rhythm fixed by technical constraints											
NONE (RTEC0)	39	40	46	52	83	53	30	11	45	44	32 (34)
LOW (RTEC1)	22	26	26	23	12	28	32	26	22	26	24 (23)
MEDIUM-HIGH (RTEC2)	39	34	28	25	5	19	38	63	33	30	44 (43)
Total sample	25 (26)	25 (25)	25 (25)	25 (24)	25 (28)	25 (25)	25 (23)	25 (24)	44 (41)	57 (59)	

Source: C.O.I survey, 1997 labor force section, MES-DARES

Note: This table gives the percents computed on the sample of 2612 blue collar workers with at least one year of seniority in a firm with more than 50 employees that has responded to the business section of the C.O.I. survey.

Table 9 : Blue collar workers and firm representatives: how do answers correlate ?

N = 1710 Coordinates of firm representatives	Coordinates of blue-collar workers 1 blue-collar worker randomly chosen by firm					
	Intensity of communication factor 1		Intensity of constraints factor 2		Customers and colleagues factor3	
<i>Correlations on coordinates (simple) and on coordinates centered on sector x size mean (sector x size)</i>	Simple	Sector x size	Simple	Sector x size	Simple	Sector x size
LEVELS IN 1997						
Intensity in use of new organizational devices factor 1	0.14 (0.00)	0.09 (0.00)	0.12 (0.00)	0.09 (0.00)	-0.08 (0.00)	-0.04 (0.08)
Use of teamwork versus just in time factor 2	0.07 (0.00)	0.06 (0.01)	-	-	-	-
Use of just in time versus quality devices factor 3	-0.07 (0.00)	-	-	-	-	-
Intensity in use of market / pseudo market devices factor 4	-	-	-0.11 (0.00)	-0.10 (0.00)	-	-
EVOLUTIONS 1994-1997						
Increase in use of organizational devices factor 1	0.12 (0.00)	0.09 (0.00)	0.10 (0.00)	0.07 (0.00)	-0.05 (0.02)	-
Increase in the responsibilities of production workers and specialists, factor 2	0.04 (0.08)	0.05 (0.04)	-	-	-	-

Source: C.O.I survey, 1997 business and labor force section, MEFI-SESSI, MAP-SCEES and MES-DARES

Note : Pearson correlation coefficients between factors have been computed on the sub-sample of firms with at least one responding blue collar worker. When firms had more than one blue collar response, one of them was chosen at random. In between brackets critical probabilities are given.

**Table 10 : regression of firm level variables (organization in 1997) on blue collar level variables
panel 1: direct effect of blue collars' responses**

N=1710	Quality			Just in Time			Work in teams or groups			Pseudo-market		Market	
	ISOY	TQMY	AMDY	DJITY	PJITY	TPMY	SMTM	PSGM	MPTM	OPCY	CSCY	OUT3+	SUBY
Intensity of vertical communication – reference: CVER0													
CVER1	-0.36#				-0.32#								-0.40*
CVER2						-0.42#					0.32		-0.37#
CVER3													-0.30
CVER4	-0.35		-0.78**	-0.42*		-0.73**						-0.42#	-0.43#
Intensity of horizontal communication – reference: CHOR0 - no significant result for CHOR3													
CHOR1							0.34#						0.43*
CHOR2	0.26#												
CHOR3													0.48#
Intensity of communication with other departments – reference CWITH0													
CWITH1							-0.35*		-0.34#				
CWITH2						0.36#							
CWITH3									0.73**			-0.46#	-0.66**
Intensity of communication with outside the firm – reference CBETW0													
CBETW1						-0.38							
CBETW2					-0.66#			-0.56	-0.68				
Intensity of contact with the customer – reference CUS0													
CUS1		-0.40		-0.37		-0.64*						-0.44#	
CUS2				-0.52#	-0.60#								
Number of meetings per year – reference MEET0													
MEET1	0.55**	0.37*	0.30	0.31#				0.29			0.39*		0.29
MEET2	0.35#					0.54*		0.58**	0.52*	0.35#			
MEET3	0.75**	0.60**	0.47*	0.57**	0.49**	1.05**	0.36#	0.73**	0.57**	0.61**	0.35#	0.34#	
MEET4	0.94**		0.86**	0.82**	0.84**	1.01**	0.41#	1.31**	0.75**	0.63**		0.73**	0.42#
Scope of initiative – reference SCOPI0													
SCOPI1			-0.33#				0.40*	0.30					
SCOPI2		0.30					0.54**	0.32	0.39#				
SCOPI3			-0.35										
SCOPI4							0.38#						
Propositions for process improvement – reference PPIMN													
PPIMY	0.47**	0.27*	0.41**	0.21		0.59**	0.26#	0.29#		0.23	0.42**		-0.36
Intensity of production work within a group – reference GROU0													
GROU1	-0.30#		-0.38#			-0.39#				-0.53**		-0.31#	
GROU2	-0.37#			-0.34									
GROU3	-0.25												
Prescription of precise quality norms – reference QUALN													
QUALY	0.25#		0.24#	0.21			-0.26#					0.29*	
Product testing – reference TESTN													
TESTY	0.31*						0.33*	0.24	0.50**	0.24			
Work rhythm fixed by prescribed times – reference RYEAR – no significant result for RDAY													
RHOU										-0.38#		-0.43*	0.43*
RIMM			0.57*	0.45#	0.40	0.47				-0.37			0.39#
Work rhythm fixed by horizontal linkages – reference RCUCN													
RCOL								-0.32#					
RCUS				-0.39#	-0.52*			-0.76**				-0.45#	
RCUCO	-0.49#			-0.44#	-0.55*			-0.80**					
Work rhythm fixed by technical constraints – reference RTEC0													
RTEC1	-0.29#												-0.43**
RTEC2						0.45*							-0.44**

Source: C.O.I survey, 1997 business and labor force section, MEFI-SESSI, MAP-SCEES and MES-DARES

Note: OUT3+ corresponds to situations where more than 3 and more functions are outsourced. Displayed coefficients are significant at a 1% (**), 5% (*), 10% (#) and 15% (no added sign).

**Table 10: regression of firm level variables (organization in 1997) on blue collar level variables,
panel 2: crossed effect with the perception of change**

N=1710	Quality			Just in Time			Work in teams or groups			Pseudo-market		Market	
	ISOY	TQMY	AMDY	DJITY	PJITY	TPMY	SMTM	PSGM	MPTM	OPCY	CSCY	OUT3+	SUBY
Intensity of vertical communication – reference: CVER0													
CVER1			0.61#										0.70*
CVER2							0.62#					0.52	0.73*
CVER3													0.75*
CVER4	0.89*		0.85*							-1.09*		0.60	0.73#
Intensity of horizontal communication – reference: CHOR0 - no significant result for CHOR3													
CHOR1						0.64#				-0.68*			
CHOR2													
Intensity of communication with other departments – reference CWITH0													
CWITH1		0.43					0.60*		0.66*				
CWITH2						-0.68#	0.77*			-0.50			
CWITH3		0.71#							-0.67	-0.76	-1.21**		0.93*
Intensity of communication with outside the firm – reference CBETW0													
CBETW1					0.47				0.65#				
CBETW2	-0.90#								1.01#		-1.24*	0.66*	
Intensity of contact with the customer – reference CUS0													
CUS1						1.50**				0.80#	1.08**		
CUS2	1.10*	0.91*		1.19*	0.92#	0.91	0.82	0.60			2.06**		
Number of meetings per year – reference MEET0 – no significant result for MEET1													
MEET2	0.69*	0.58#	0.85*	0.54#		0.60			-0.60	0.69*			
MEET3													-0.68*
MEET4							0.64#	-0.82*					-1.23**
Scope of initiative – reference SCOPI0 – no significant result for SCOPI3													
SCOPI1			-0.59#	-0.56#			-0.54#	-0.84**			-0.86**	-0.52#	-0.76**
SCOPI2		-0.53#		-0.64*	-0.51		-0.77*	-0.73*			-0.64#		
SCOPI4	0.69	-0.90*					-0.69#						
Propositions for process improvement – reference PPIMN													
PPIMY	-0.37										-0.40		
Intensity of production work within a group – reference GROU0													
GROU1					0.50	0.71*	0.46	0.77*	1.22**	0.65*			-0.62*
GROU2	0.95*											0.59#	
GROU3										0.79**			
Prescription of precise quality norms – reference QUALN													
QUALY						-0.39	0.49*						
Product testing – reference TESTN													
TESTY							-0.56*		-0.62*	-0.52*			
Work rhythm fixed by prescribed times – reference RYEAR – no significant result for RDAY													
RDAY													
RHOU													-0.63*
RIMM	-1.04*		-0.70			-0.98*				0.73#			-0.66#
Work rhythm fixed by horizontal linkages – reference RCUCN													
RCOL								0.51					
RCUS	0.85*												
RCUCO	0.69#			0.65#	0.90*					-0.65			
Work rhythm fixed by technical constraints – reference RTEC0													
RTEC1													0.40
RTEC2		-0.38						-0.43	-0.90**				0.79**
% Concorda nt	68.2	62.0	66.6	63.7	63.9	69.9	63.2	67.3	68.0	64.4	63.9	62.2	63.1

Source: C.O.I survey, 1997 business and labor force section, MEFI-SESSI, MAP-SCEES and MES-DARES

Note: OUT3+ corresponds to situations where 3 and more functions are outsourced. Displayed coefficients are significant at a 1% (**), 5% (*), 10% (#) and 15% (no added sign).

Table 11: regression of firm level variables on blue collar level variables (evolutions)
panel 1: direct effect of blue collars' responses

N=1710	Quality			Just in Time			Pseudo-market		Market		
	ISOI	TQMI	AMDI	DJITI	PJITI	TPMI	OPCI	CSCI	IOUT1 +	SUBEI	SUBED
Intensity of vertical communication – reference: CVER0											
CVER1	-0.34#							-0.51			
CVER2						-0.42					
CVER3			-0.51#							-0.22	
CVER4			-0.87**	-0.63*	-0.77**	-0.66*					
Intensity of horizontal communication – reference: CHOR0 - no significant result for CHOR3											
CHOR1									-0.27		
CHOR2					0.38#		0.44#	0.48*			
CHOR3										0.29#	
Intensity of communication with other departments – reference CWITH0											
CWITH1					-0.33#				0.26	-0.19*	-0.41*
CWITH2								-0.32		-0.16	-0.32
CWITH3								-0.50#	0.77**	-0.37*	-0.64#
Intensity of communication with outside the firm – reference CBETW0 - no significant result for CBETW1											
CBETW2					-0.77#						
Intensity of contact with the customer – reference CUS0 - no significant result for CUS2											
CUS1		-0.73*									
Number of meetings per year – reference MEET0											
MEET1			0.42#			0.47#	0.47#				0.28
MEET2						0.53#				-0.22	
MEET3	0.61**	0.58**	0.64*	0.55*		1.10**	0.67*	0.44#			
MEET4	0.59*	0.49#	0.87**	0.82**	0.95**	1.12**				-0.36	0.64**
Scope of initiative – reference SCOP0 – no significant result for SCOP1 and SCOP3											
SCOP2											-0.32
SCOP4											-0.43
Propositions for process improvement – reference PPIMN											
PPIMY	0.51**	0.38*	0.55**	0.33*	0.26	0.77**	0.43*	0.46*	-0.41**		0.28#
Intensity of production work within a group – reference GROU0 – no significant result for GROU3											
GROU1				-0.53*	-0.51*					0.18#	
GROU2	-0.61**			-0.44						0.21#	0.34#
Prescription of precise quality norms – reference QUALN											
QUALY	0.20	0.23									
Product testing – reference TESTN											
TESTY					-0.28					-0.22#	
Work rhythm fixed by prescribed times – reference RYEAR – no significant result for RDAY											
RHOY						-0.43				0.27**	
RIMM			0.97**	0.71*	1.03**	0.55					
Work rhythm fixed by horizontal linkages – reference RCUCN											
RCOL										-0.17	
RCUS				-0.66*	-0.74*	-0.64#					
RCUCO	-0.38		-0.64	-0.55#	-0.67*				0.38		
Work rhythm fixed by technical constraints – reference RTEC0											
RTEC1				-0.36#	-0.40*			-0.41#	0.29#		
RTEC2			0.34							-0.22*	-0.26

Source: C.O.I survey, 1997 business and labor force section, MEFI-SESSI, MAP-SCEES and MES-DARES

Note: The use of new organizational devices is always increasing except for subcontracting practices. Thus, the endogenous variable as far as this practice is concerned takes three modalities: increase (SUBEI), decrease (SUBD) and stability (reference situation). OUS1+ corresponds where an additional function is outsourced. Displayed coefficients are significant at a 1% (**), 5% (*), 10% (#) and 15% (no added sign).

Table 11: regression of firm level variables on blue collar level variables (evolutions)
panel 2: crossed effect with the perception of change

N=1710	Quality			Just in Time			Pseudo-market		Market		
	ISOI	TQMI	AMDI	DJITI	PJITI	TPMI	OPCI	CSCI	IOUT1 +	SUBEI	SUBED
Intensity of vertical communication – reference: CVER0 – no significant result for CVER2											
CVER1			0.61								
CVER3			1.22**			0.68					
CVER4	0.74		1.15*		0.73					0.41#	
Intensity of horizontal communication – reference: CHOR0 - no significant result for CHOR3											
CHOR1						0.86*					
CHOR2							-0.69#				
Intensity of communication with other departments – reference CWITH0											
CWITH1		0.47			0.63#			0.69#	-0.45#		0.51#
CWITH2		0.61#						0.76#			
CWITH3		0.76								0.84**	0.99*
Intensity of communication with outside the firm – reference CBETW0											
CBETW1									-0.82**		
CBETW2								-1.13	-0.76		
Intensity of contact with the customer – reference CUS0											
CUS1					-1.00*						
CUS2		0.89	1.17#	0.93				1.53*		-0.50#	
Number of meetings per year – reference MEET0 – No significant result for MEET1											
MEET2				0.59	0.93*		0.72				
MEET3					0.91*						
MEET4									0.58		
Scope of initiative – reference SCOP0											
SCOP1				-0.63#				-0.87*			
SCOP2				-0.72#	-0.96**			-0.71			
SCOP3	-0.62#			-0.75#	-0.63	-0.69		-0.90*			
SCOP4									-0.71#		
Propositions for process improvement – reference PPIMN											
PPIMY				-0.47						-0.29#	-0.53*
Intensity of production work within a group – reference GROU0											
GROU1	-0.54#				0.69#					-0.70**	
GROU2	1.04**	-0.90*						0.74		-0.41#	-0.76#
GROU3							0.60				
Prescription of precise quality norms – reference QUALN											
QUALY					-0.44						
Product testing – reference TESTN											
TESTY								0.61#			
Work rhythm fixed by prescribed times – reference RYEAR – no significant result for RDAY											
RDAY											
RHOU		0.55	0.78#								
RIMM		0.64#		-0.90#		-1.23*			0.64		
Work rhythm fixed by horizontal linkages – reference RCUCN – no significant result for RCOL and RCUS											
RCUCO					0.77						
Work rhythm fixed by technical constraints – reference RTEC0											
RTEC1										0.32#	
RTEC2		-0.87**	-0.61#		-0.67*						
% Concordant	66.9	63.8	68.5	67.2	68.9	71.4	68.1	67.5	61.6		

Source: C.O.I survey, 1997 business and labor force section, MEFI-SESSI, MAP-SCEES and MES-DARES

Note: The use of new organizational devices is always increasing except for subcontracting practices. Thus, the endogenous variable as far as this practice is concerned takes three modalities: increase (SUBEI), decrease (SUBD) and stability (reference situation). OUS1+ corresponds where an additional function is outsourced. Displayed coefficients are significant at a 1% (**), 5% (*), 10% (#) and 15% (no added sign).

**BOX 1 : The business section of the COI survey:
from the questions to synthetic indicators**

1) Selected questions from the COI questionnaire

We selected seven sets of questions that follow each other in the COI questionnaire (118 questions in total). We give the corresponding questions, keeping the same presentation as in the questionnaire except that we have replaced the original numbers given to the questions (3.1 to 3.15, 4.1 to 4.8, 5.1 to 5.3, 6.1 to 6.10, 7, 10.1 to 10.3 and 14.8) by names (in between brackets and in capital letters) corresponding to those that we use in the tables and figures.

For each set of questions, we give the percents of manufacturing firms (excluding energy and food industries) with more than 50 employees that ticked each cell computed from the sample of respondents (3286 firms) and using weights to adjust for sampling rates and non response. Frequency counts from the business part of the COI survey are published in Favre, François and Greenan (1998). The whole questionnaire and some descriptive results have been translated in English. They are available upon request.

3. Does your company outsource any of the following tasks ? (OUT)

	In 1997		Change since 1994		
	Yes	No	+	=	-
Research / development / design	28.0	72.0	12.2	85.6	2.2
Purchasing	7.8	95.2	1.6	97.5	1.0
Production engineering / production management / scheduling	5.4	94.6	2.3	96.5	1.2
Manufacturing / production	9.5	90.5	4.1	94.4	1.5
Quality assurance	13.6	86.4	7.5	90.6	1.9
Maintenance	23.2	76.8	7.9	90.7	1.4
Sales	10.3	89.7	3.5	95.2	1.2
Marketing / advertising	23.9	76.1	7.9	90.3	1.8
IT	40.3	59.7	17.4	80.2	2.4
Telephony / networks	17.1	82.9	9.4	89.7	1.0
Human resources / staff training	19.9	80.1	7.3	91.4	1.3
Accounting / management control	17.1	82.9	3.6	94.5	1.9
Finance / cash management	11.3	88.7	2.3	96.3	1.4
Legal affairs	48.8	51.2	12.9	85.4	1.7
Environment / health and safety	16.0	84.0	6.9	92.3	0.8

4. Does your company use the following organizational device ?

		In 1997		Change in the % of employees affected since 1994		
		Yes	No	+	=	-
(ISO)	ISO 9001, ISO 9002, EAQF certification	78.8	51.2	30.4	68.7	0.8
(TQM)	Other certification or total quality management	34.7	65.3	19.6	79.7	0.7
(AMD)	Value analysis, functional analysis or "AMDEC" method	25.9	74.1	12.8	86.6	0.5
(TPM)	5S method or TPM (Total Productive Maintenance)	15.7	84.3	9.4	90.1	0.5
(OPC)	Organization in profit centers	30.5	69.5	10.4	89.0	0.6
(CSC)	Formal in-house customer / supplier contracts	29.1	70.9	12.9	86.7	0.4
(DJIT)	System of just in time delivery	39.1	60.9	18.5	81.0	0.5
(PJIT)	System of just in time production	37.7	62.3	17.9	81.7	0.4

5. In 1997, what percentage of company employees took part in the following types of teams or groups of

...

		Production workers			Other workers		
		0%-10%	10%-50%	50% +	0%-10%	10%-50%	50% +
(SMT)	Self managed teams	69.4	20.0	10.5	70.8	22.2	7.1
(PSG)	Problem solving groups	71.5	24.8	3.6	66.0	28.1	5.9
(MPT)	Multi-disciplinary project teams	81.0	16.8	2.2	66.8	27.6	5.6

**6. In general, who is/was authorized to do the following in your company workshops?
(more than one answer possible)**

	In 1997			In 1994		
	Management (MAN)	Production worker (PW)	Specialist (SPE)	Management (MAN)	Production worker (PW)	Specialist (SPE)
Adjust installations	23.3	56.8	50.4	24.4	48.8	51.0
Perform 1 st level maintenance	11.3	63.6	42.2	13.4	50.8	48.7
Allocate tasks to production workers	15.4	9.5	7.6	85.4	6.6	7.2
Inspect quality of supplies	38.8	36.5	41.5	40.4	31.8	40.4
Inspect quality of production	48.1	52.3	40.4	50.5	40.5	41.0
Participate in performance improvements	79.0	53.7	36.5	80.5	39.7	33.3
Participate in projects teams	70.8	39.3	36.8	71.1	28.5	33.1
Stop production in case of an incident	72.6	45.9	25.9	74.8	37.6	23.5
Troubleshoot in case of an incident	54.7	46.1	42.0	57.6	36.9	40.5
Start production again in case of an incident	75.0	24.9	28.1	76.9	19.8	25.0

7. How many hierarchical layers are /were there between production workers (level 0) and the head of the company (level N) ? (HL) and (EVHL)

In 1997, N=1	7.2	In 1994, N=1	8.0
N=2	20.5	N=2	18.4
N=3	30.1	N=3	28.4
N=4	25.1	N=4	23.8
N=5	11.6	N=5	13.4
N=6 and +	5.5	N=6 and +	8.0

10. Did your compagny ask suppliers or subcontractors to do any of the following in 1997?

	Yes	No
(DESSU) ...take part in designing end-products	41.8	58.2
(JITSU) ...make just-in-time deliveries	51.4	48.6
(ISOSU) ...comply with ISO standards or other formal quality approaches	65.5	34.5

14. Does your company use any of the following means to adjust output to demand ?

	In 1997		Change since 1994		
	Yes	No	+	=	-
(SUB) Subcontracting	54.3	45.7	19.2	75.4	5.5

2) From questions to variables about organization and its evolution

Using the answers to these 118 questions, we built up 34 qualitative variables: 20 describing the state of the organization in 1997 (50 items or modalities in total) and 14 others describing its evolution (35 items or modalities in total).

With the first set of question, we built an indicator of the number of tasks outsourced (**OUT**), taking 4 modalities, **OUT0** for no function, **OUT1_2** for 1 or 2 functions, **OUT3_5** for 3 to 5 functions and **OUT6_15** for 6 to 15 functions. We also computed an indicator of change in the use of outsourcing, summing up the tasks with increasing use of it. The indicator is called **IOUT** and takes 3 modalities : stability in outsourcing practices (**IOUTS**), development in outsourcing practices for 1 or 2 tasks (**IOUT1_2**), development in outsourcing practices for more than 3 tasks (**IOUT3_15**).

The way the second set of questions has been formulated has a drawback as we cannot distinguish firms that have adopted a new organizational tool (noted **ISO, TQM, AMD, TPM, OPC, CSC, DJIT** and **PJIT**) between 1994 and 1997 from those that had it already in 1994 and that have extended its use. Thus we chose to build up two sets of 8 variables indicating, for the first set, whether the firm is using (**Y**) or not (**N**) a special organizational tool and for the second set, whether the firm has extended its use (**I**) or has kept it stable (**S**).

From the third set of questions, we built 3 dichotomous variables, using the answers given about the participation of production workers to teams or groups (**SMT, PSG** or **MPT**). They indicate weather more (**M**) or less (**L**) than 10% of the production workers participate in the group in 1997. The questionnaire does not ask any question about the evolution of this distribution between 1994 and 1997.

Six variables have been constructed from the forth set of questions, which is very rich in terms of information. First, we computed three variables describing the number of tasks (in the list of 10 tasks given by the questionnaire) each type of

worker is responsible for in 1997. Each variable takes four modalities depending on its distribution: from 0 to 3 tasks, 4 or 5 tasks, 6 or 7 tasks and from 8 to 10 tasks for the hierarchy (noted **MAN0_3**, **MAN4_5**, **MAN6_7** and **MAN8_10**); from 0 to 2 tasks, 3 or 4 tasks, 5 or 6 tasks and from 7 to 10 tasks for production workers (noted **PW0_2**, **PW3_4**, **PW5_6** and **PW7_10**); 0 or 1 task, 2 or 3 tasks, from 4 to 6 tasks and from 7 to 10 tasks for specialists (noted **SPE0_1**, **SPE2_3**, **SPE4_6** and **SPE7_10**). Second, we computed indicators of the evolution in the number of tasks between 1994 and 1997. Three variables taking three modalities measure respectively the number of tasks production workers (noted **APWO**, **APW1_3** and **APW4_10** for stability or decrease in the number of tasks, increase of 1 to 3 tasks and increase of 4 and more tasks) and specialists have become responsible for (noted **ASPEO**, **ASPE1_2** and **ASPE3_10** for stability or decrease in the number of tasks, increase of 1 or 2 tasks and increase of 3 and more tasks) and the number of tasks for which hierarchy lost responsibility (noted **DMANO**, **DMAN1_2** and **DMAN3_10** for stability or increase in the number of tasks, decrease of 1 or 2 tasks and decrease of 3 and more tasks).

Two variables have been constructed from the question on the number of hierarchical layers. The first one gives the number of hierarchical layers in 1997 (**HL**), grouped in four items 0 to 2 noted **HL2**, 3 noted **HL3**, 4 noted **HL4** and 5 and more noted **HL5**. The second one gives a measure of the change in the number of hierarchical layers between 1994 and 1997 (**EVHL**) in four items: increase (**EVHLL**), stability (**EVHLS**), loss of 1 layer (**EVHLD1**) and loss of 2 and more layers (**EVHLD2**).

The sixth set of questions gives some further information about the requirements of the firm towards its suppliers and sub-contractors. The information is only available for 1997. Three variables have been built from it (noted **DESSU**, **JITSU** and **ISOSU**), indicating whether the firm requires (**Y**) or not (**N**) each of the devices.

The last question used is about subcontracting of production. It has been isolated from the set it belongs to, dedicated to the issue of quantitative flexibility. Two variables have been built from it: **SUB** indicating whether the firm subcontracts (**Y**) or not (**N**), and **SUBE** indicating the evolution of this practice between 1994 and 1997 (increase-**I**, stability-**S** or decrease-**D**).

3) Building up synthetic indicators with multiple correspondence analysis

We conducted a first multiple correspondence analysis with the variables indicating levels in 1997: **OUT0**, **OUT1_2**, **OUT3_5**, **OUT6_15**, **ISOY**, **ISON**, **TQMY**, **TQMN**, **AMDY**, **AMDN**, **TPMY**, **TPMN**, **OPCY**, **OPCN**, **CSCY**, **CSCN**, **DJITY**, **DJITN**, **PJITY**, **PJITN**, **SMTL**, **SMTM**, **PSGL**, **PSGM**, **MPTL**, **MPTM**, **MAN0_3**, **MAN4_5**, **MAN6_7**, **MAN8_10**, **OPE0_2**, **OPE3_4**, **OPE5_6**, **OPE7_10**, **SPE0_1**, **SPE2_3**, **SPE4_6**, **SPE7_10**, **HL2**, **HL3**, **HL4**, **HL5**, **DESSUY**, **DESSUN**, **JITSUY**, **JITSUN**, **ISOSUY**, **ISOSUN**, **SUBY**, **SUBN**. We use the four first factors as synthetic indicators of the use of new organizational devices in 1997. The following table describe the factors, in terms of interpretation and quality.

Correspondence analysis, levels in 1997 20 variables, 50 items	Singular value	% of inertia explained by the factor
Factor 1 : intensity in use of organizational devices	0.46	14.14
Factor 2 : use of teamwork versus just in time	0.29	5.47
Factor 3 : use of just in time versus quality devices	0.28	5.12
Factor 4 : increase in use of market / pseudo market devices	0.25	4.00

The second correspondence analysis uses the variables expressing an evolution between 1994 and 1997: **IOUTS**, **IOUT1_2**, **IOUT3_15**, **ISOI**, **ISOS**, **TQMI**, **TQMS**, **AMDI**, **AMDS**, **TPMI**, **TPMS**, **OPCI**, **OPCS**, **CSCI**, **CSCS**, **DJITI**, **DJITS**, **PJITI**, **PJITS**, **AOPE0**, **AOPE1_3**, **AOPE4_10**, **ASPE0**, **ASPE1_2**, **ASPE3_10**, **DMAN0**, **DMAN1_2**, **DMAN3_10**, **EVHL1**, **EVHLS**, **EVHLD1**, **EVHLD2**, **SUBEI**, **SUBES**, **SUBED**. The following table describe the factors, in terms of interpretation and quality.

Correspondence analysis, evolutions between 1994 and 1997 14 variables, 35 items	Singular value	% of inertia explained by the factor
Factor 1 : increase in use of organizational devices	0.52	17.96
Factor 2 : increase in the responsibilities of production workers and specialists	0.35	7.92

**BOX 2: The labor force section of the COI survey:
from the questions to the synthetic variables**

1) Selected questions from the COI questionnaire

First, we give all the “primary” questions from the labor force questionnaire that we used for the purpose of this study (41 questions in total). They are grouped together according to the different topics we want to measure. Thus, we do not follow the order of the questionnaire, but all the questions starting with the same letter come together in the questionnaire.

In capital letters we give the names of the synthetic variables that are reported in tables and figures and the corresponding number of items. Most of the variables lead to a yes/no type of answer. When it is different, we mention it and “(if it applies)” indicates that there is also an item “does not apply”. In between brackets, we give the percents of blue collars belonging to manufacturing firms with more than 50 employees that gave a positive answer, using weights to adjust for sampling rates and non response (sample of 2612 blue collars).

1- Intensity of vertical communication (CVER, 5 items)

(a) Do you have occasion to modify the nature and quantity of the work which you will have to do, or the manner of proceeding ? If yes, is it...

- (a₁) while discussing with your superiors alone (if it applies)? (26.6%)
- (a₂) while discussing with your superiors in the presence of your colleagues (if it applies)? (25.5%)
- (b) If you have a temporary excess workload or if you are uneasy with a difficult or tricky task are you helped by...
 - (b₁) your superiors? (if it applies) (46.4%)
- (c) In general, does your superior intervene...
 - (c₁) to show you how to do the work? (34.7%)
 - (c₂) to share the work between you and your colleagues? (if it applies) (65.0%)
 - (c₃) when you have a problem with a customer? (if it applies) (8.8%)
 - (c₄) when you have a technical problem? (if it applies) (74.7%)
 - (c₅) when you have relations problem with colleagues from the same department? (if it applies) (58.9%)
 - (c₆) when you have relation problem with other departments (if it applies) (49.0%)

2- Intensity of horizontal communication (CHOR, 4 items)

(a) Do you have occasion to modify the nature and quantity of the work which you will have to do, or the manner of proceeding ? If yes, is it...

- (a₃) while discussing between colleagues, without your superiors being present (if it applies) ? (22.1%)
- (b) If you have a temporary excess workload or if you are uneasy with a difficult or tricky task are you helped by...
 - (b₂) colleagues you usually work with? (if it applies) (80.4%)
- (d) Do you give indications to other persons on what they have to do...
 - (d₁) to colleagues you usually work with? (if it applies) (67.9%)
- (e) Apart from your superiors, are there other persons that give you indications on what you have to do:
 - (e₁) colleagues you usually work with? (if it applies) (53.9%)

3- Intensity of communication with other departments (CWITH, 4 items)

(a) Do you have occasion to modify the nature and quantity of the work which you will have to do, or the manner of proceeding ? If yes, is it...

- (a₄) while discussing with colleagues from other departments? (if it applies) (6.3%)
- (b) If you have a temporary excess workload or if you are uneasy with a difficult or tricky task are you helped by...
 - (b₃) persons in the firm other than the colleagues you usually work with? (if it applies) (18.9%)
- (d) Do you give indications to other persons on what they have to do...
 - (d₂) other persons or departments in the firm? (if it applies) (27.9%)
- (e) Apart from your superiors, are there other persons that give you indications on what you have to do...
 - (e₂) other persons or departments in the firm? (if it applies) (33.8%)

4- Intensity communication with outside the firm (CBETW, 3 items)

(b) If you have a temporary excess workload or if you are uneasy with a difficult or tricky task are you helped by...

- (b₄) persons from outside the firm? (if it applies) (9.5%)
- (d) Do you give indications to other persons on what they have to do...
 - (d₃) persons from outside the firm (customers, suppliers, order-givers...)? (10.5%)
- (e) Apart from your superiors, are there other persons that give you indications on what you have to do...
 - (e₃) persons from outside the firm (customers, suppliers, order-givers...)? (7.1%)

5- Intensity of contact with the customer (CUS, 3 items)

(m) Are you in direct contact (face to face or by phone) with customers? All the time (1.7%), regularly (2.4%), occasionally (5.7%) or never (90.1%).

6- Number of meetings per year (MEET, 5 items)

(f) How frequently do you participate into meetings in the context of your work? (at least once a year: 66.2%)

7- Scope of initiative left by hierarchy (SCOPI, 5 items)

(a) Do you have occasion to modify the nature and quantity of the work which you will have to do, or the manner of proceeding ? (42.2%)

(g) Instructions given by your superiors in the company tell you what must be done. In general do they also tell you how to do the work? (35.3%) or do they tell you the objective of your work, but leave you to decide how to achieve this objective? (64.5%)

(h) You receive orders, assignments, instructions. In order to perform your work correctly, which of the following applies (if it applies) ? You carry the assignments to the letter (63.7%). In certain cases, you act differently (31.2%). You act differently most of the time (1.6%).

(i) In general, when in the course of your work, something unforeseen occurs, what happens ? You fix the problem on your own (39.4%). You manage it with the colleagues around you (26.9%). You call on other people (a superior, a colleague, a specialist department) (33.7%).

(j) Is your work rhythm imposed by the following?

(j₁) Permanent (or at least daily) checks or supervision by the hierarchy? (40.9%)

8- Propositions for process improvement (PPIM, 2 items)

(k) In the context of your work, do you make propositions in order to improve your post, processes or equipment? (62.9%)

9- Intensity of production work within a group (GROU, 4 items)

(l) Do you sometimes do your work in group or collectively? (56.3%)

(l₁) If yes, how much of your working time does it take? Almost all the time (30.8%), more than ¼ of your time (10.0%), less than ¼ of your time (15.4%).

10- Work rhythm fixed by prescribed times (RXXX, 4 items)

(j) Is your work rhythm imposed by the following?

(j₂) Production norms or deadline to meet in an hour at most? (38.7%)

(j₃) Production norms or deadlines to meet in a day at most? (64.4%)

(j₄) External demand (customers) needing an immediate response? (26.4%)

(j₆) Immediate dependence of one or more colleagues in the work done? (47.4%)

11- Work rhythm fixed by horizontal linkages (RCXXX, 4 items)

(j) Is your work rhythm imposed by the following?

(j₄) External demand (customers) needing an immediate response? (26.4%)

(j₅) External demand (customers) not needing an immediate response? (28.6%)

(j₆) Immediate dependence of one or more colleagues in the work done? (47.4%)

12- Work rhythm fixed by technical constraints (RTEC, 3 items)

(j) Is your work rhythm imposed by the following?

(j₇) Automatic moving of a product or a part? (38.9%)

(j₈) Automatic pace of a machine (50.1%)

(n) Do your work consist in continually repeating the same series of actions or operations?

(n₁) If yes, does each series last for less than a minute? (24.5%)

13- Precise quality norms prescribed (QUAL, 2 items)

(o) Do you personally have to meet precise quantified quality standards (for example: wastage rates, measurable characteristics of the product) ? (48.6%)

14- Participation in product testing (TEST, 2 items)

(p) In the context of your work, do you sometimes get to test the quality of products or try them? (49.2%)

2) From questions to variables about blue collars' work organization

The preceding questions are used to build up 14 qualitative variables (50 items or modalities in total). We explain how the variables are built from the questions keeping in line with the notations in the previous section. In between

brackets, we give the percentage of blue collar workers from manufacturing firms with more than 50 employees in each category, using weights to adjust for sampling rates and non response (sample of 2612 blue collars).

1- Intensity of vertical communication (CVER, 5 items)

With (c), a synthetic variable, taking its values between 0 and 1 indicates the size of the intervention sphere of the superiors:

$ISPHERE = (\text{number of answers "yes" at questions } c_1 \text{ to } c_6) / (1 + \text{number of questions that apply})$

The intensity of vertical communication is measured by the following variable:

$CVER = [ISPHERE + (a_1 = \text{yes}) + (a_2 = \text{yes}) + (b_1 = \text{yes})] / (1 + \text{number of questions that apply})$

From which a variable with 5 items (representing respectively 17%, 25%, 21% and 17% of the sample), is constructed: **CVER0**=(CVER≤0.125), **CVER1**=(0.125<CVER≤0.25), **CVER2**=(0.25<CVER≤0.4375), **CVER3**=(0.4375<CVER≤0.625), **CVER4**=(CVER>0.625)

2- Intensity of horizontal communication (CHOR, 4 items)

The intensity of horizontal communication is measured by the following variable (varying from 0 to 1):

$CHOR = (\text{number of answers "yes" to questions } a_3, b_2, d_1 \text{ and } e_1) / (\text{number of questions that apply})$

From which a variable taking 4 items (representing respectively 26%, 25%, 36% and 13% of the sample) is constructed: **CHOR0**=(CHOR≤0.25), **CHOR1**=(0.25<CHOR≤0.67), **CHOR2**=(CHOR=0.751), **CHOR3**=(CHOR=1)

3- Intensity of communication with other departments (CWITH, 4 items)

The intensity of communication with other departments is measured by the following variable (varying from 0 to 1):

$CWITH = (\text{number of answers "yes" to questions } a_4, b_3, d_2 \text{ and } e_2) / (\text{number of questions that apply})$

From which a variable taking 4 items (representing respectively 50%, 23%, 17% and 10% of the sample) is constructed: **CWITH0**=(CWITH=0), **CWITH1**=(CWITH=0.25), **CWITH2**=(0.25<CWITH<0.75), **CWITH3**=(CWITH≥0.75)

4- Intensity of communication with outside the firm (CBETW, 3 items)

The intensity of communication with outside the firm is measured by the following variable (varying from 0 to 1):

$CBETW = (\text{number of answers "yes" to questions } b_4, d_3 \text{ and } e_3) / (\text{number of questions that apply})$

From which a variable taking 3 items (representing respectively 80%, 14% and 6% of the sample) is constructed: **CBETW0**=(CBETW=0), **CBETW1**=(0<CBETW≤0.5), **CBETW2**=(0.5<CBETW<1)

5- Intensity of contact with the customer (CUS, 2 items)

A variable with 3 items (representing respectively 90%, 6% and 4% of the sample) is built from the answers to question I: **CUS0**=(m=never), **CUS1**=(m=occasionally), **CUS2**=(m=regularly or all the time)

6- Number of meetings per year (MEET, 5 items)

A variable measuring the number of meetings per year with 5 items is constructed from this question (representing respectively 43%, 15%, 16%, 12% and 14% of the sample):

MEET0=(f=0), **MEET1**=(f=1 or 2), **MEET2**=(3≤f≤10),

MEET3=(11≤f≤16), **MEET4**=(f≥17)

7- Scope of initiative left by hierarchy (SCOPI, 5 items)

To compute the scope of initiative left by the hierarchy, we codify the answers with -1 if the worker has no scope of initiative, 0.5 if the scope of initiative is bounded and 1 if it is unbounded. A missing response or a response "does not apply" is coded with a 0. The overall scope of initiative is thus given by: $SCOPI = (a) + (g) + (h) + (i) + (j)$, which varies between -5 and 4. From this variable, we build a variable with 5 items (representing respectively 23%, 23%, 22%, 17% and 15% of the sample): **SCOPI0**=(SCOPI≤-3), **SCOPI1**=($-3 < SCOPI \leq -1$), **SCOPI2**=($-1 < SCOPI \leq 0.5$), **SCOPI3**=($0.5 < SCOPI \leq 2$), **SCOPI4**=(SCOPI>2)

8- Propositions for process improvement (PPIM, 2 items)

A variable with two items (representing respectively 63% and 37% of the sample) has been constructed: **PPIMY**=(k=yes) and **PPIMN**=(k=no).

9- Intensity of production work within a group (GROU, 4 items)

A variable with 4 items (representing respectively 44%, 15%, 10% and 31% of the sample) is built from the answers to questions I and I₁: **GROU0**=(I=no), **GROU1**=(I=yes and (I₁)=less than ¼), **GROU2**=(I=yes and (I₁)=more than ¼), **GROU3**=(I=yes and (I₁)=almost all the time).

10- Work rhythm fixed by prescribed times (RXXX, 4 items)

A variable with 4 items has been computed to measure the tightness of quantitative norms and deadlines (representing respectively 26%, 24%, 24% and 26% of the sample):

RNOP=(negative answers to j_2 , j_3 , and j_4), **RDAY**=($(j_3)=\text{yes}$ and $(j_2)=\text{no}$ and $(j_4)=\text{no}$), **RHOU**=($(j_2)=\text{yes}$ and $(j_4)=\text{no}$), **RIMM**=($(j_4)=\text{yes}$).

11- Work rhythm fixed by horizontal linkages (RCXXX, 4 items)

A variable with 4 items (representing respectively 34%, 18%, 28% and 20% of the sample) measures if work rhythm is fixed by horizontal linkages:

RCUCN=(negative answers to j_4 , j_5 and j_6), **RCUS**=($(j_4)=\text{yes}$ or $(j_5)=\text{yes}$ and $(j_6)=\text{no}$), **RCOL**=($(j_6)=\text{yes}$ and $(j_4)=\text{no}$ and $(j_5)=\text{no}$), **RCUCO**=($(j_4)=\text{yes}$ or $(j_5)=\text{yes}$ and $j_6=\text{yes}$).

12- Work rhythm fixed by technical constraints (RTEC, 3 items)

A variable with 3 items (representing respectively 37%, 23% and 40%) measures the intensity of technical constraints: **RTEC0**=(negative answers to j_7 , j_8 and n_1), **RTEC1**=(one positive answer), **RTEC2**=(more than one positive answers).

13- Precise quality norms prescribed (QUAL, 2 items)

A variable with two items (representing respectively 49% and 51% of the sample) has been constructed: **QUALY**=($(o)=\text{yes}$) and **QUALN**=($(o)=\text{no}$).

14- Participation in product testing (TEST, 2 items)

A variable with two items (representing respectively 49% and 51% of the sample) has been constructed: **TESTY**=($(p)=\text{yes}$) and **TESTN**=($(p)=\text{no}$).

3) Building up synthetic indicators with multiple correspondence analysis

We conducted a multiple correspondence analysis involving the preceding variables : **CVER0**, **CVER1**, **CVER2**, **CVER3**, **CVER4**, **CHOR0**, **CHOR1**, **CHOR2**, **CHOR3**, **CWITH0**, **CWITH1**, **CWITH2**, **CWITH3**, **CBETW0**, **CBETW1**, **CBETW2**, **CUS0**, **CUS1**, **CUS2**, **MEET0**, **MEET1**, **MEET2**, **MEET3**, **MEET4**, **SCOPI0**, **SCOPI1**, **SCOPI2**, **SCOPI3**, **SCOPI4**, **PPIMY**, **PPIMN**, **GROU0**, **GROU1**, **GROU2**, **GROU3**, **RNOP**, **RDAY**, **RHOU**, **RIMM**, **RCUCN**, **RCUS**, **RCOL**, **RCUCO**, **RTEC0**, **RTEC1**, **RTEC2**, **QUALY**, **QUALN**, **TESTY**, **TESTN**. We use the three first factors as synthetic indicators of the organization of blue collars work. The following table describes the factors, in terms of interpretation and quality.

Correspondence analysis, blue collars 14 variables, 50 items	Singular value	% of inertia explained by the factor
Factor 1 : intensity of communication	0.47	8.60
Factor 2 : intensity of constraints	0.37	5.35
Factor 3 : Customers versus colleagues	0.33	4.42

Appendix 1 : French government surveys on technological and organizational change: ancestors the COI survey

1) Background

The French government surveys organization topics since the middle of the 1980s'. Traditionally, the Ministry of labor has two domains of competence : work ("travail") and employment ("emploi"). The first has to do with industrial legislation, the second with labor market regulations. Surveys on organization originated from the "work" department. Interest in work organization came from the need to complement the information gathered through the national surveys on working conditions.

A first labor force survey was designed in 1987, under the acronym TOTTO ("enquête sur les Techniques et l'Organisation du Travail auprès des Travailleurs Occupés"), by a team under the direction of Michel Gollac. Its aim was to better understand how working conditions were related with work (task and technology) and worker (gender, age, social origin) characteristics. The TOTTO survey has been conducted again in 1993.

At the same time, the Ministry of labor launched a new business survey inspired by the British Workplace and Industrial Relations Survey (REPONSE survey), in order to improve knowledge about industrial relations in French firms. The conception of the REPONSE survey has been coordinated by Thomas Coutrot and Anna Malan.

At the end of the 1980's, the Ministry of industry designed, a system of annual surveys aiming at measuring the innovative behavior of firms. This took place in the context of the public debate on the productivity paradox. At the beginning of the 90s, most OECD countries had data bases on R&D expenditures built according to the Frascati manual and they were implementing their innovation surveys along the lines of the OSLO manual. In 1991, Ministry of Industry conducted a first innovation survey. In 1993, a smaller survey on organizational change (the survey on "organizational change in production") was conducted to better understand the relations between technological innovation and organizational innovation. The design of this survey has been directed by Nathalie Greenan and Dominique Guellec.

1) The "TOTTO" surveys (INSEE, 1987; DARES 1993)

The "TOTTO" ("enquête sur les Techniques et l'Organisation du Travail auprès des Travailleurs Occupés") survey has been financed and conducted by the National Institute of Statistics and Economic Studies (INSEE) in 1987, financed by the Ministry of labor (DARES) and conducted by INSEE in 1993. Researchers from the fields of ergonomic, industrial medicine, psychology, sociology and economics contributed to the design of the questionnaire. Both in 1987 and in 1993, the survey was a supplement to the annual labor force survey and a sample of about 20 000 occupied workers from all industries were interviewed.

Workers were asked about their perception of the way they work. The main topics of the questionnaire are the nature of tasks performed, timetables, hierarchical relation, autonomy, communication, work rhythm, deadlines and technology use. Information was gathered through face-to-face interviews of about 45 minutes, completed at the workers' home.

Workers also gave the name and address of their establishment, which allows to trace the firm identification number. This number is used in all the official surveys conducted at the firm level and in data files of government origin. Thus, matched employer/employee data sets can be generated from this type of surveys.

2) The "REPONSE" survey (DARES, 1993)

Financed by the Ministry of labor (DARES), this survey aims at measuring the social climate and the state of industrial relations. Researchers in economics and industrial relations, statisticians and firm representatives participated in the design of the questionnaire. Firm and trade union representatives of about 3000 establishments of firms over 50 employees from all industries were interviewed.

The employer was asked about social climate within the firms and about participatory devices ("pratiques participatives"): negotiation with trade union representatives, incentive strategy, conflicts, employee involvement schemes, technological and organizational innovations. Questions on technology and organization were asked to better understand the context of information sharing and to measure whether these topics were discussed directly or indirectly (through trade unions) with employees. A set of questions on the same topics (sometimes the same questions) were asked to trade union representatives, allowing to measure some the convergence or divergence in points of view. This survey has been carried out once again in 1998.

3) The survey on organizational change in production (SESSI, 1993)

Financed by the Ministry of industry (SESSI), the aim of this survey was to measure aspects of the firm's behavior that could influence its capacity to innovate and its competitiveness. The group of experts that participated in the design of the questionnaire, was mainly composed of economists. 2600 manufacturing firms over 50 employees were interviewed.

The focus of the questionnaire is on the organization of the production department of the firm and on the use of advanced manufacturing technologies. The main topics are the objectives of organizational change, technology use, sharing of responsibilities for operating activities on the shopfloor between operators, the supervisors and specialists, timetables, teamwork, change in competencies, quality norms, changes in formal relations between departments, impacts of organizational change on various indicators. As this survey was a postal survey, this questionnaire is a very short one (two pages), with mainly qualitative questions addressed to the production manager of the firm.

Whereas in the TOTTO survey, questions aim at measuring the main characteristics of jobs in terms of organization and technology use, in this firm level survey, most questions are on changes on a 5 years period. As a matter of fact, this is an output of the discussions about the design of both questionnaires. For the TOTTO survey, the group of experts felt that workers had to be asked some very simple questions about their everyday work, trying to formulate questions in the most "objective way". At the firm level, the interviewed person is expected to give an answer concerning the whole firm or part of it. Here, the "pilot" group felt that it was easier to respond about the change that occurred within the firm during a given period of time than about the state at a given date. In a way, it is assumed that there is much more heterogeneity within the firm in the state of organization than in organizational changes.