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ORGANISATIONAL AND TECHNOLOGICAL INNOVATIONS IN MANUFACTURING FIRMS IN THE PROVINCE OF REGGIO EMILIA: PRELIMINARY RESULTS

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ORGANISATIONAL AND TECHNOLOGICAL INNOVATIONS IN MANUFACTURING FIRMS IN THE PROVINCE OF REGGIO EMILIA: PRELIMINARY RESULTS

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Abstract

This paper presents some results of the project carried out by the research team of the University of Ferrara on *Organisational Innovations, Industrial Relations, and Economic Performances.* The core of the program is the analysis of the interactions between various forms of flexibility that characterise both managerial styles and industrial relations within a large sample of manufacturing firms, with 50 employees and more, located in the province of Reggio Emilia, Emilia-Romagna.

The main objective of the study is to highlight the organisational features and the models of human resources management accompanying direct and indirect worker participation and leading to improved economic performances. Within this framework, the aim is to investigate the role of industrial relations in affecting the organisational configuration of the firm. Moreover, the work enquires the relationship between quality of industrial relations, particularly in the field of workers and representatives participation, and innovative processes within the firm.

Key words: human resources management, industrial relations, competitiveness.

J.E.L.: J51, L60, M54

Introduction

The economic and managerial literature[1], no more than the operators' positions, emphasise the role of innovative managerial models coupled with innovative technological paths in improving firm performance. Both aspects of innovations have been widely studied often in distinct theoretical and empirical streams. Since technology and organisation, as it will be more extensively explained below, are likely to co-evolve and to mutually influence each other, the empirical analysis should consider toghether these aspects, though the work addresses primarily organisational themes in the field of labour participation and human resources management (HRM hereafter) practices.

The core of the paper examines the innovations adopted by management, their characteristics in terms of organisational change *versus* technological innovation, and the related degree of employees' involvement. Of course, the theme of worker participation in organisational models evokes the role of worker representatives and unions and the distinction between direct and indirect participation in the domain of industrial relations.

The analysis is based on the information collected with a structured questionnaire addressed, with the method of direct interview, to managers for a sample of about 200 manufacturing firms with at least 50 employees, located in the province of Reggio Emilia, Emilia-Romagna[2].

The structure of the paper is as follows. The theoretical background underpinning the empirical analysis is presented in section 1. After a brief description of the methodogical features of the survey, with the related response rates (section 2), a closer attention is paid to the firm economic performance between 1998 and 2001 reported by managers (section 3) and to the organisational structure of the firm: the general macro-structure in terms of hierarchy, production organization, and working hours is described in section 4. Section 5 constitutes the core of the paper and deal with technological and organisational innovations, focussing on types and proponents of innovations. Section 6 presents some relevant results of the analysis based on simple correlation coefficients between structural features of the firms, various aspects of

[1]Some of the most relevant articles in this wide and populated research field are Fernie and Metcalf (1995), Machin and Stewart (1996), Addison and Belfield (2001), Black and Lynch (2001), Ichiniowski and Shaw (2003). See Section 1 of this paper for a discussion of the theoretical framework. For a comprehensive survey dealing with payment systems, the reader can consult European Parliament (2003).

innovation processes, and firm performance. Sections 7 and 8 are devoted to a closer look to industrial relations and workers participation. The former describes the way in firm managers, union delegates, and workers interact with each other, while the latter explores the dilemma of complementarity versus substitution of direct and indirect participation within the firm. Some final remarks conclude the paper.

1. Theoretical background

The European Commission (E.C., 1997) underlines the role of changes in firm organisation in developed countries. An evolutionary process characterised by the transformation of the Fordist-Taylorist organisation in knowledge economy has taken place in the last decades. Firms can be described as *learning organisations*, characterised by a flat and decentralised organisational structure (Lundvall and Nielsen, 2002). Organisational decentralisation is necessarily connected with some degree of decisional decentralisation. Individual workers, groups of workers, and their representatives participate in decisional processes, at least at the operative and, to a lesser extent, organisational level. Such kind of participation can be mutually advantageous for firms and workers. While the former are able to exploit workers' competencies, that can be generated and developed at the workplace through *empowerment and job enrichment* (Foss and Foss 2002; Foss and Laursen 2002; Ichiniowski and Shaw 2003; Leoni *et al.* 2003), the latter benefit of a more involving and participatory working environment, and at the same time obtain a credit with the management at the bargaining table and an economic reward trough negotiations.

Recent studies (Black and Lynch 2001) show that worker participation has a crucial role in making new technologies work within new organisational settings. New practices (often labelled "best work practices") are often introduced by the initiative of managers. However, they appear to be more efficacious the more they actively involve employees in the production process, even if only at the operative level, with or without worker representatives' intervention. On the other hand, the introduction of new work practices is related to the utilisation of "knowledge intensive" technologies.

The mere introduction of new technologies, without organisational innovation and new human resources management practices, does not seem to support better performances (Arnal

[2] The interviews were carried out directly during the first half of the year 2002 by the research group coordinated by prof. Paolo Pini at the University of Ferrara, Department of Economics Institutions Territory. This paper will present only part of the results emerging from the information collected during the interviews.

et al. 2001). On the other hand, knowledge intensive practices, which appear to be adopted in bundles (OECD, 1998), are likely to require new and more flexible technologies, able to trespass the old Fordist-Taylorist scheme and to underpin a more integrated and inclusive working environment. It should be noticed that the direction of innovation *(technology driven* or *organisational driven)* is not easy to enquire. At any rate, it seems fair to state that (as, for example, in Leoni *et al.* 2001) the two components (organisational and technological innovation) are likely to co-evolve, and, when separated, do not lead to remarkable results.

The European Commission (E.C. 1997) underlines the impact of organisational innovation and new work practices on industrial relations too. In turn, industrial relations can have an active role in favouring or halting innovation. New organisational models necessarily influence information, consultation and bargaining procedures between managements and worker representatives, at times in a way similar to the model of partnership (Appelbaum and Hunter 2003). The old scheme requiring the definition and measurement of simplified and predetermined tasks is progressively overcome. Union intervention cannot be limited any more to the mere control over the measurements carried of by supervisors. It needs to become wider and more complex. Bi-directional information sharing, consultation, and negotiation concerning organisational settings and economic results are added to traditional bargaining procedures at the local level. In a context where it becomes impossible to precisely measures workers' output, it is necessary to device new patterns of interaction between managers and worker representatives. The sharing of procedures seems to be a particularly promising direction to follow, for example in the field of worker formal evaluation. Just the management of internal labour markets would constitute an especially promising field of interaction for social parties (managers, union delegates, and workers). The presence of largely diverging opinions on the issue notwithstanding, an active role of union guaranteeing the respect of procedures and supporting the development of workers' competencies would represent a privileged field of increased participation and involvement.

The contributions present in the literature, which address the description and assessment of unions' role in the new economy in a milieu where new organisational schemes are adopted, highlight the fact that the impact of unions' presence cannot be predicted in advance. It crucially depends on the attitudes of both worker representatives and firm managers. The result is confirmed by the non- unequivocal empirical results concerning union impact on worker productivity and firm performance (Deery *et al.* 1999; Addison *et al.* 2000; Addison and Belfield

2001) Given the clear distinction between differing roles, the presence of unions devoted to collaboration and non-antagonistic participation seems to favour both organisational innovation and better economic performance (Black and Lynch 2001; Leoni *et al.* 2001; Pini 2002).

Participation becomes the area where firm modernisation and development possibilities intersect. Right choices are not granted and the risk to follow wrong directions is always present. While many firms choose a more conservative attitude and retain traditional organisational settings, the connection between participation, that can take the form of collaborative industrial relations, and organisational innovation, for example in the field of human resources management, constitutes a new frontier characterised by opportunities and risks. At the level of scientific enquire there is no doubt about the interest created by the exploration of the potentialities of participation. However, it should not be forgotten that participation cannot interfere with fundamental institutional barriers. For example, property rights and the connected governance structure of the firm keep on being underpinned by managerial initiative that, in turn, is accountable to the firm owners (Godard 2001).

2. Firm population and response rate to the survey

The firms included in the universe are drawn from national[3] and local[4] data bases and are classified on the basis of the codex ISTAT-ATECO 91. They are all the manufacturing firms (257) with at least 50 employees located in the province of Reggio Emilia in the year 2001. The survey is made up of a questionnaire addressed to the management, on three main topics: (a) organisational innovations and human resources management practices; (b) industrial relations; (c) payment systems. The firms responding to the survey are 199, with a reply ratio of 77,4% of the entire population[5]. Firm distribution by sector and dimension is characterised by limited bias. The textile sector and small firms (50 to 99 employees) are under-represented. However, no significant distortion emerges in all other sectors and dimensions, with the number of interviewed firms approaching or reaching 100% of the total in many of them *(Tab. 1a-1b).*

After a first phone contact, the introductory part of the questionnaires was sent by fax directly to each firm in February 2002, asking to answer the questions concerning the structural features of the firm and ascertaining the willingness to answer the whole questionnaire during a

[3] Intermediate census 1996 of the National Institute of Statistics (ISTAT 1999).

[4] *Camera di Commercio* in Reggio Emilia (Infocamere 2001).

[5] For details on the structures of the database see Pini *et al.* (2003a).

direct interview. Interviewers were sent to accepting firms between May and July 2002. Interviewees are generally top manageres and human resources directors. Where necessary, firms were contacted again to solve problems pertaining their answers or to complete the questionnaire (autumn 2002).

3. Economic performance between 1998 and 2001

On the basis of firm managers' subjective evaluation, the economic performance accomplished between 1998 and 2001 are positive. Six dimensions of performance were taken into consideration (production, sales, investments, employment, profitability, and liabilities). Respondents indicated for all six dimensions if their firm had improved or worsened its results over the past four years. An additive index varying between -1 and +1 was build over the six dimensions. Its total value is 0,52, indicating a clear tendency toward positive results. The individual values for each of the six dimensions highlight a notable degree of variation. The index values for production, sales and investments are near to 0,7, indicating that the greatest part of firms had improved over these dimensions. The value of the index for employment is equal to 0,51, while for profitability it is equal to 0,3. It is clear that increase in sales and production do not entail increased profitability, though firms' result are positive in the latter respect too. Finally, the level of debts decreased in 28% of the enquired firms, and increased in 15%. Hence a slight tendency to liability reduction is detected. *Tables 2.*

4. Macrostructure of the firms: hierarchy, production organization, and working hours

The core of the survey is constituted by the enquiry on technological and organisational innovation. Besides, some more general organisational futures, to be intended as structural variables, are enquired. Among these, the hierarchical structure, the number of functional divisions within the firm, the organisation of production in terms of flexibility of the production process and of labour services, and the management of working hours constitute part of the framework within which techno-organisational innovation is expected to flourish.

As long as formalised divisions and hierarchical structure are concerned, the results emerging from the research describe firms that do not show a particularly hierarchical structure. While the number of formalised divisions[6] is quite high, they are distributed over a reduced

[6] The questionnaire identified fifteen distinct formalised divisions. The average number of divisions is 10,5, and the standard deviation is 2,9.

number of hierarchical ladders. The result is that the hierarchical intensity[7] is not particularly high (the overall value is 0,29, in the range 0-1). This is mainly true just in firms where a more complex and articulated organisational structure is present. Furthermore, there is a tendency to increase the number of formalised functions without strengthening the pyramidal structure of the firm. Important differences are found by sector and dimension. In particular, little and medium sized firms, though they are characterised by a simpler organisational structure, show a higher hierarchical intensity, while in larger firms, due to the presence of many distinct functions with horizontal relations, hierarchy is less pronounced *(Tab. 3-3.3)*.

The organisation of production is characterised by a high level of flexibility both in the utilisation of the plants technologies, and in the utilisation of labour services. In more than a half (55%) of the total number of enterprises the two features are coupled together, though it must be said that 30% of enterprises show both rigid plant technologies and rigid labour services[8].

Working hours are a third general organisational feature that received close inspection by the survey. Since 1998, 36% of the firms introduced innovations in working time regimes. The accomplishment of innovations in working hours regimes is likely to be connected to the preceding organisational item, i.e. the degree of flexibility of plant technologies and labour services. Changes in working time regimes are more widespread in firms showing lower levels of flexibility. The reason may be that firms characterised by low flexibility are prone to introduce flexibility in working hours in order to recoup the underlying rigidities.

Innovations introduced in working hours regimes constitute a first field where to compare managerial initiatives with the initiatives taken by worker representatives, joint committees and workers themselves. As it will become evident in the following sections, managerial leadership in steering the innovation process emerge as a clear feature with respect to both technology and organisation. However, throughout the analysis of innovative processes, a significant role of worker representatives, unions, and workers is found. These results are well aligned with the theoretical viewpoint of authors like Aoki (1980, 1984, and 1988). A complex picture of the firm emerges, where a hierarchical structure which is fundamentally top-down is completed by initiatives and information fluxes which run in the opposite direction.

[7] Hierarchical intensity is defined as the ratio of number of hierarchical ladders to the number formalised divisions.

[8] See for details Pini *et al.* (2003b).

These systemic features may allow the firm to exploit the disperse operative knowledge formed at lower hierarchical layers *(Tables 4.1-4.2)*.

5. Technological and organisational innovations

The core of the paper concerns technological and organisational innovation carried at the plant level. The first step is to examine the presence of some organisational practices (*total quality management, job rotation, team work, quality circles, and just in time*), often labelled "high performance" (Godard 2001) or "best work organizational practices" (OECD, 1998) because they imply employee involvement at the operative and organisational level. Particular attention will be devoted to the characteristics of team work. The second step is the analysis of other innovations introduced at the organisational level and in the field of new technologies and product quality, with special focus on its employee involvement content and on proponents (management, union delegates, joint committees or workers themselves).

The analysis depicts an entrepreneurial reality which is dynamic and open to change at the organisational and technological level. However, decisional decentralisation intervenes at a slow pace. While standard innovations are widespread, the ones implying employee involvement and pattern of decisional decentralisation characterise a restricted set of firms. In this group of firms, the relevance of proposals by union delegates, production workers, and joint committee emerges - in relative terms- with respect to managerial proposals. Though the decisions taken by management remain dominant, worker representatives accomplish an important role just in the adoption of participatory innovations.

At least one out of the five organisational practices studied by the literature on human resources management *(total quality management, job rotation, team work, quality circles, and just in time)* is present in 67,3% of the total firms[9]. Among these five practices, total quality management, job rotation, and team work are the most widespread, being present in a percentage of firms equal or superior to 30%. The remaining two practices (quality circles and job rotation) are not common since they were found in slightly more than 10% of firms. The percentage of workers involved, in firms where such practices are present, is superior to 50% in the case of just in time, total quality management, and team work, whilst it is inferior to 50% in the other cases.

Among the various human resources management practices (HRM practices hereafter) particular attention was gives to the organisational features of team work, as it potentially implies a high degree of worker involvement at the operative level. Team work is found in 30% of the firms. In the vast majority of these firms (85%), worker in team are responsible for specific product and/or services. This result is confirmed by the fact that in 60% of total firm where teamwork is found, team members decide together how operations should be performed, even if workers generally do not decide the group leader. Team work activity is rewarded in some way in 83% of the firms adopting it; the main typologies of reward are career advancement and economic rewards[10] *(Tables 5.a-5.b)*.

5.1. Organisational and technological innovations introduced since 1998

Since 1998 the most part of firms decided to introduce organisational and technological innovations. It is possible to distinguish five main categories of changes:

a) new products and services;

b) new technologies at the plant level;

c) changes in remuneration systems;

d) standard innovation in work organisations;

e) various typologies of organisational innovations which implies workers involvement and participation with possible sharing of procedures.

The most frequent changes (recorded in a percentage of enterprises equal or superior to 70%) are the ones comprehended in categories (a), (b) e (d): new product and services, new technologies, and standard innovations in work organisation. Innovations in category (e) (participatory work organisational innovations) are present in a percentage of firms near to 50%: job rotation, total quality management, life-long training processes connected with new organisational requirements.

Other changes were recorded in a percentage of enterprises comprehended between 20% and 40% of the total. They are changes in remuneration systems (category c), and other innovations concerning the participation of employees, hence to be enclosed in category (e). This group comprehends higher level of employee autonomy in problem solving, and creation of

[9] Their introduction usually occurred during the nineties, though in some cases it took place during the eighties, and, in rare cases, during the seventies.

structured channels for employee suggestions to the management about organisation and product quality[11] *(Table 6a).*

Worker training deserves a special place in the analysis of techno-organisational innovation. In 85,4% of firms techno-organisational change entailed interventions on worker skills within the firm, while 61,3% of firms employed new workers for the same reason. In the latter case, 54% of firms employed workers with new competencies. The upgrading of employee skills associated with innovation depends primarily on the introduction of new technologies (77% of cases), but also on new competencies (58%) of cases. Finally, it is interesting to note that in 46% of firms processes life-long worker training were detected, an in 35% of firms a formalised function concerning worker training is *present (Table 6b).*

5.2. The proponents of technological and organisational innovations

A precise knowledge concerning who took the initiative in the introduction of technological and organisational innovations is important for the study of industrial relations and worker participation within the firm. Various models can be envisaged in this field, ranging from purely uni-directional and hierarchical ones, to more democratic models where initiatives for changes come from all hierarchical ladders, or from worker representatives and joint committees.

The evidence concerning manufacturing firms in the local system of Reggio Emilia highlight a clear prevalence of managerial initiatives[12] over the initiatives of workers or their representatives. This broad result is not at all surprising and it is in line with many theoretical streams, ranging from the property rights school, to the principal-agent model, to the managerial theories of the firm. The interesting aspect that comes into light concerns the role of the social parties other than management.

The exceptions to this rule are constituted most of all by changes enclosed in category (e), innovations in worker participation at the operative and organisational level. For example, the introduction of structural channels for employee suggestions concerning product quality and

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[10] Beyond teamwork and decisional decentralisation at the operative level, other channels of workers involvement is employee suggestions to the management on problem solving, practice that is recorded in 77% of total firms. These workers need not be members of team and they are economically rewarded in 38% of cases.

[11] One of the least adopted innovation is the introduction of innovations in working hours systems (about 30% of firms), that were already dealt with.

[12] The management takes the initiative for the introduction of innovations in at least 85% of firms for the vast majority of innovation typologies.

organisational settings are proposed by management only in 50% of cases. Other changes comprised in category (e), together with changes in remuneration systems, are characterised by the active intervention of management in a percentage of firms ranging from 65% to 80%. It seems that organisational changes implying worker involvement are characterised by the lowest degree of managerial intervention.

Conversely, the same category of changes, plus the introduction of remuneration system, is characterised by the active intervention of actors other than managers at times in more than 50% of the total number of firms. For example, the proposals of union delegates, joint committees and workers happened to be relevant for the introduction of job rotation, team work, life-long training programmes, and for greater employee autonomy in problem solving.

Overall, it seems that the data recorded highlight a polarisation of the typologies of innovation on the basis of the proposing actors. The management intervenes actively in the vast majority of cases as far as the realisation of changes addressed to improve internal efficiency and firm performance, such as product and process innovation, product quality and innovations in work organisation of a more traditional kind are concerned. On the other hand, worker representatives, joint committees and workers perform an active role in organisational fields which implies some kind of worker involvement.

5.3. Synthetic indexes for technological and organisational innovations

With the aim of synthesising and sorting off the diffusion of various typologies of technological and organisational innovations, a series of additive indexes able to incorporate all the information collected were built[13]. As long as the topics just dealt with are concerned, two groups of indexes were built, the former representing innovation intensity and the latter representing the proponents of innovations.

The first group of indexes comprises 5 items, ranging between 0 and 1. The first index (INNO 1) synthesises all innovation categories, both technological and organisational, in terms of dimension and intensity. Its value (0,461) represents a benchmark for the other indexes. The second represents product and process innovation. Its value (0,744) is the highest

[13] The most part of the indexes built in the study are additive as average value of dichotomous (0-1) variables representing the various typologies of technological and organisational innovations. Hence they vary between 0 and 1. Alternatively, they can be standardised to the interval 0-1. There are exceptions: not all questions have dichotomous answers (e.g.: "yes/no", "present/absent" etc…). However, in such case, variables are most often categorical and their value ranges over a limited scale like the corresponding indexes. In other cases, the indexes can be termed "qualitative" insofar as different weights were assigned to different answers on the basis of a subjective evaluation of their significance. Since the most part of indexes are of the first kind, only the qualitative nature of indexes will be specified in the text.

and testimony the fact the technological innovations are, on average, realised at a higher pace than organisational ones. The third index (INNO 3) represents the commonest organisational innovations (e.g. total quality management, job rotation, team work). Its value is 0,468. The fourth index (INNO 4) is again related to organisation, but it comprises all innovations, not only the commonest, but also the participatory ones (e.g. employee autonomy in problem solving, structured channels for employee suggestions to the management, life-long training). Its value is 0,409. The fifth index (INNO 5) encloses only the innovations that have a more pronounced participatory characterisation and its value is 0,362. The value of the three organisational indexes shows a clear tendency toward a more cautious implementation of participatory schemes than common schemes. Putting it differently, it seems that the enquired firms assume a quite bold attitude in innovating at the technological and organisational level, though employee's participation finds more difficulties and obstacles and would require stronger effort.

The second group of indexes represents the intensity of initiatives taken by the social actors. As it may have been easily predicted, the index representing the intensity of managerial initiatives is much higher than the one representing the initiatives taken by the other social parties (union delegates, joint committees, and workers)[14]. The former scores 0,338, while the latter scores 0,134. The intensity of initiatives by union delegates, joint committees, and workers is less than a half of managerial intensity. However, it should be noted that it is not irrelevant. Quite the contrary, it appears to be important in specific field of organisational innovation, as it will be underlined in the following sections *(Table 6c)*.

6. Some relationship between innovations and characteristics of the firms

A first test to identify some relationships emerging out the set of data collected and illustrated so far is constituted by a simple statistical correlations analysis. Though the empirical analysis cannot be limited to the exploration of simple correlation coefficients this description is a first useful step highlighting possible structures of linkages between variables.

On the basis of this first exploration of the data, the analysis reveals important relationships that often are quite strong from a statistical point of view. Such connections will be summarised in the present section[15].

[14] See INNO 7 vs. INNO 8-9-10-11.

[15] In this section not all the tables are included. However, they can be requested from the authors.

A first result that clearly emerges from data exploration is the strongly complementary character of the introduction and presence of innovations. Technological and organisational innovations are seldom introduced alone. Most often, they appear in clusters and are introduced following a path that calls to mind increasing returns to innovations, at least up to a minimum number of innovations necessary to accomplish sufficient cost reduction and productivity increasing effects. This result is underlined by various works, and it is confirmed by the present analysis.

Second, innovative intensity seems to be a growing function of dimension, mainly in terms of plant dimension more than in terms of firm dimension. Innovative processes are particularly intense in medium and medium-large firms (between 250 and 999 employees), while it is less pronounced in firms below 250 employees.

Third, hierarchy does not seem to help innovation. Innovation is more intense in firms characterised by a low ratio of hierarchical ladders to the number of formalised functions existing within the organisation. Among the others, the presence of formalised functions addressing industrial relations, training, and human resources management seems to be more conducive to innovative processes.

Fourth, the flexibility of labour relations is associated with the intensity of innovative processes. The utilisation of short term contracts is positively correlated with innovation. The same is true in the case of[16]. One of the main functions performed by the utilisation of short term contracts is screening. Such contracts are interpreted by firms as trial periods during which managers have the possibility to assess worker fitness for the tasks assigned and to select personnel with adequate characteristics. The analysis of this result in terms of worker functional position within the firm adds further important information. *Skilled craft workers* seem to constitute integral part of core business and are only marginally influenced by the diffusion of short term contract. Furthermore, the percentage of skilled workers on short term contract is *negatively* associated with the intensity of innovation processes. One of the main functions of the presence of *unskilled craft workers* seems to be to increase the flexibility of the production process and to easy innovation processes without being an integral part of it. In fact, the percentage of unskilled worker on short term contracts is *positively* associated with the intensity of innovation[17].

[16] Labelled "atypical" contract in the Italian jargon.

[17] An indirect confirmation of these results comes from the association between innovation processes and the degree of education of the workforce. Indexes of correlation between education and the degree of innovation are positive and signifi-

Fifth, economic performances, mainly in terms of liability position and profitability, but also in terms of other performance indicators, are strictly associated with innovative processes. Liabilities, in absolute terms, are lower in more innovative firms, though it seems that the rate of growth of liabilities is *positively associated* with innovative processes. This apparently contrasting results can be explained, on the one hand, by the necessity of innovative firms to expand investments and, consequently, financial exposition, and, on the other hand, by the better ability of innovative firms to self-finance themselves and reduce financial exposition in relative terms by means of increased profitability.

Sixth, in the domain of labour organisation, innovations that show the strongest statistical association with profitability are what were defined as participatory arrangements (e.g. increased autonomy in problem solving, life-long training, and structured channels for employee suggestions to management). The introduction of such typologies of organisational innovations is characterised by a more intense initiative by non managerial actors (mainly worker representatives). An increased interaction between management and other social parties (*social dialogue*) is associated with a growing intensity of innovative processes and with improved economic performances.

Finally, internationalisation of the firm is positively related to innovation. Though the elements to test causality are insufficient, it is cler that firms operating more intensely on foreign markets are more innovative. The percentage of foreign sales is positively associated with innovation, whilst the contrary is true for the percentage of domestic sales. Competition on international markets seems to require (and maybe favour) more intense techno-organisational innovations. Firms adopting a defensive policy may be able to survive on domestic markets, while innovation is likely to be a necessary condition for survival on international markets *(Tables 6c, 7a-7d).*

cant in the field of innovation in labour organisation and they grow as the degree of participation incorporated in organisational innovation increases. Hence education seems to favour participation, while it is negatively related (though not strongly) to process and product innovation. Overall, a picture of the role of labour in innovative processes is obtained where innovation in labour organisations is favoured by higher educational levels, long term employment of skilled workers and short term employment of unskilled workers.

7. Information, consultation and bargaining between management and worker representatives on technological and organisational innovations

Different schools of thought tend to see in the presence of unions at the firm level a danger for the efficiency of production processes, or an element of stimulus, pressure, and active interaction with the management. At the empirical level, contrasting results have been reached about the role of unions (see, for example, Fernie and Metcalf 1995; Machin and Stewart 1996; Addison and Belfield 2001) and their generalisation would not be granted.

In our survey, on the basis of the answers provided by managers it results that unions and firms interact first of all on the basis of information flows: this is so in the 64% of total firms. In the 29% of the firms consultive procedures between managers and unions were recorded, while processes of negotiation concerning innovations are present in the 11,3% of the firms.

In the following paragraphs the general result of the analysis will be highlighted without going into the detail of all the empirical elaborations. In broad terms, firm policies aiming at discussion and bi-directional interaction between managers and worker representatives are not in contrast with innovation processes. Quite the contrary, it seems that an interaction characterised by high information flows is able to support the introduction and management of innovative practices. This result emerges also from the analysis of correlation coefficients between indexes of techno-organisational innovations and indexes representing the interaction between managers and worker representatives.

It should be noted that mainly information flows and, to a lesser extent, consultive interaction do appear to support innovation[18]. Consultation appears significant in the field of labour organisation and employee participation, while it is less so as long as product/process innovation and product quality are concerned.

The interesting result is that social interaction, though mainly at the level of information flows and consultation, is most relevant just in the areas of participatory practices. The initiative for the introduction of new practices is taken by managers in the most part of cases, but this attitude does not foreclose a more open interaction with worker representatives *(Tables 8a-8b).*

[18] Correlation coefficients between information flows and innovation processes are almost always positive and statistically significant.

8. Complementarily and antagonism of direct versus indirect participation

The analysis of the relationship between management, union delegates and workers is of crucial importance in the study of industrial relations. A topic much debated in the literature (Addison *et al.* 2000) concerns the comparison between *direct* and *indirect* interaction between managers and workers. Some authors (Fenton-O'Creevy *et al.* 1998) maintain that the two typologies of interaction exclude each other. Where direct interaction prevails, the role of unions necessarily fades away, as it can be observed, for example, in important parts of the American and British industrial systems. On the other hand, a strong diffusion and relevance of unions induces firm managers to interact with worker representatives, penalising if not excluding direct interaction with individual or group of workers (in this case the German industrial system can be recalled). The co-presence of the two typologies of interaction is sometimes considered superfluous, or inefficient, or likely to favour overlapping and contrasts between social parties.

The results of this study on manufacturing firms in Reggio Emilia point to a different direction. Two indexes sythesising industrial relations were used: the first describes the interaction between managers, workers and union delegates in terms of information, consultation and negotiation in the field of techno-organisational innovation[19]. The second describes the complex of industrial relations enclosing other aspects of the interaction between social parties[20]. The analysis clearly highlights the fact that the interaction between managers and worker representatives is more intense where more practices of direct employee involvement are found[21]. There is no evidence of some form of antagonism or substitution between direct and indirect participation. Quite the contrary, the two phenomena are likely to coexist and reinforce each other.

In other words, more participatory firms are characterised by various practices of worker

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[19] The interaction between management and unions in Reggio Emilia was studied on the basis of a list of 22 discussion themes. Some examples of themes enclosed in the list are "product quality", "market evolution", "production" , "decentralisation of non-core activities", "labour contracts", "career advancements", etc… The same list was used for the study of industrial relations both in the survey addressed to management and in a second the survey addressed to worker representatives that is not considered in this work. Various additive indexes (both quantitative and qualitative) of the type described in footnote 13 were built. The results illustrated in the following sections are based on this technique for empirical analysis.

[20] For example, it takes into consideration elements such as the organisation of joint work groups comprising both managers and workers, employee participation in formal organisms with decisional powers at the operative and organisational level, etc…

[21] See tables 9a-9d and Pini *et al.* (2003b) for details. There, it emerges a strongly positive relation between the intensity of the interaction between managers and worker representatives on the one hand, and the various modalities and intensity of direct involvement (consultation and delegation) of workers by the management. The most striking feature of the results is that both the indexes of industrial relations and interactions between managers and union delegates grow monotonically with the number of practices of direct involvement of workers.

involvement in terms of consultation and delegation (Coriat, 2002)[22] at the individual and team work level. In this group of firms the interaction between managers and union delegates is likely to be more intense in terms of information, consultation, and negotiation concerning the various themes under discussion and the various typologies of techno-organisational innovation *(Tables 9a-9d).*

9. Concluding remarks

The analysis highlights a series of interesting results concerning the relationships between techno-organisational innovations on the one hand, industrial relations and firm performance on the other hand.

Though these results, needing deeper future enquire, should not be overstated, it seems reasonable to state that an high level and quality of social dialogue is an important condition for the implementation of new technologies and organisational practices.

The industrial local system of Reggio Emilia emerged as a complex one, primarily characterised by a high degree of dynamicity of the system, with important variations and exceptions to this general feature. Innovation intensity is high, driven by managerial initiatives, with an important role played by union delegates and workers in the field of innovative labour organisation. Just the organisational realm is likely to constitute the most suitable field for further fruitful experimentation in the field of worker participation.

The role of industrial relations, together with worker training and orther relevant features of the workforce, do have a relevant impact on the organisational structure of the firm, the intensity of its innovative efforts, its ability to benefit from the flexibility of labour services and labour contracts, and, eventually, to accomplish better economic performance[23].

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[22] A more in depth analysis, in line with what is presented in Coriat (2002), distinguishes between individual and group delegation and consultation. Very briefly, the results of the analysis highlight that the most effective forms of decisional decentralisation are individual consultation and group delegation. In other words, managers testimony better results in cases where they have consulted individual workers about operational and organisational issues. Good results are also recorded in firms where a certain degree of delegation of responsibilities and decision making power was conceded to groups of employees, often working in teams. Individual delegation and group consultation are less widespread and do not seem to be associated with improved performance and good effects on innovation processes. See Pini *et al*. (2003b) for details.

[23] A further extension of the analysis takes into consideration the categorisation introduced by Pavitt, and employed in OECD (1994) which distinguishes firms on the basis of their productive orientation. Firms are sorted in five categories: (a) labour intensive; (b) resources intensive; (c) scale intensive; (d) specialised suppliers; (e) science based. In the present study concerning Reggio Emilia, the number of categories reduces to four since firms characterised as science based were not detected. The summary results in the fields of innovation intensity, performance, and industrial relations concerning the various groups of firms highlight clear and distinctive results. Labour intensive firms show a poor record in all three fields: weak performance, weak innovation intensity, and weak interaction between managers and worker representatives. At the other end of the spectrum, specialised suppliers are found: they associate good performance, high innovation pace, and close interaction between managers and unions at various levels. Resources intensive and scale intensive firms show a more articulated posi-

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tion. The former are characterised by low innovation pace, though good industrial relations seem to result in good performances connected with the limited innovative processes. On the other hand, scale intensive firms show high innovation pace and good performance, though industrial relations are not as good as in other categories.

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APPENDIX

Tab.1a: Total firms

	SIZE: no. of employees						
SECTOR	A 50-99	B 100-249	C 250-499	D 500-999	E > 999	Total (%)	*Total (Absolute value)*
FOOD (DA)	0,78	1,95	1,17	0,78	0,78	5,45	*14*
OTHER INDUSTRIES (DN)	0,78	0,00	0,00	0,00	0,00	0,78	*2*
PAPER-PUBLISHING (DE)	1,56	0,00	1,17	0,00	0,00	2,72	*7*
CHEMICAL (DG-DH)	3,11	2,72	0,78	0,00	0,39	7,00	*18*
WOOD (DD)	0,00	0,78	0,00	0,00	0,00	0,78	*2*
MACHINERIES (DJ-DM)	28,02	15,95	5,06	2,72	3,50	55,25	*142*
NON-METAL MINERALS (DI)	9,73	6,61	1,95	2,72	0,78	21,79	*56*
TEXTILE (DB-DC)	1,56	1,56	2,72	0,00	0,39	6,23	*16*
Total (%)	45,53	29,57	12,84	6,23	5,84	100,00	
Total (absolute value.)	*117*	*76*	*33*	*16*	*15*		*257*

Tab.1b: Interviewed firms

	SIZE: no. of employees						
SECTOR	A 50-99	B 100-249	C 250-499	D 500-999	E > 999	Total (%)	*Total (Absolute value)*
FOOD (DA)	0,00	60,00	100,00	100,00	100,00	71,43	10
OTHER INDUSTRIES (DN)	100,00	-	-	-	-	100,00	2
PAPER-PUBLISHING (DE)	75,00	-	100,00	-	-	85,71	6
CHEMICAL (DG-DH)	100,00	71,43	100,00	-	100,00	88,89	16
WOOD (DD)	-	50,00	-	-	-	50,00	1
MACHINERIES (DJ-DM)	73,61	73,17	84,62	85,71	100,00	76,76	109
NON-METAL MINERALS (DI)	68,00	88,24	100,00	100,00	100,00	82,14	46
TEXTILE (DB-DC)	75,00	75,00	28,57	-	100,00	56,25	9
Total (%)	73,50	75,00	78,79	93,75	100,00	77,43	
Total (absolute value.)	86	57	26	15	15		199

Tab.2: Economic performance since 1998

	Percent				Synthetic Index
Indicators	decrease	stable	increase	Na	[-1, +1]
- Production	7,54	17,09	75,38	0,00	0,678
- Sales	8,54	11,06	79,40	1,01	0,716
- Investments	3,02	17,09	79,40	0,50	0,768
- Employment	14,57	19,60	65,33	0,50	0,510
- Profits	14,57	40,20	43,72	1,51	0,296
- Liabilities	27,64	55,28	14,57	2,51	0,134
Total	***10,05***	***7,54***	***81,91***	***0,50***	***0,518***

Tab.3: Formalised division and hierarchical structure

Firm structure	average		st. dev.	
Formalised firm divisions	10,49		2,894	
Hierarchic structure	decrease	stable	increase	index
Changes in the number of divisions since 1998	3,02	38,69	58,29	0,553
	no		yes	
Hierarchy among division (firm direction excluded)	51,76		48,24	
	average		st. dev.	
No. of hierarchical layers	2,834		1,077	
No. of hierarchical layers (only firms with at least three layers)	3,729		0,923	
Ratio of number of hierarchical layers to number of formalised divisions (hierarchy ratio)	0,289		0,137	
	decrease	stable	increase	index
Change in the no. of hierarchical layers	4,02	79,40	16,58	0,126
Change in hierarchy ratio	12,56	66,83	20,60	0,080

Tab.3.1: No. of formalised divisions and hierarchic layers (%)

	Change in the no. of divisions				
Change in the no. of hierarchical layers	Decrease	Stable	Increase	Total	*No of firms*
Decrease	1,01	2,51	0,50	4,02	*8*
Stable	2,01	36,18	41,27	79,40	*158*
Increase	0,00	0,00	16,58	16,58	*33*
Total	3,02	38,69	58,29	100,00	
No of firms	*6*	*77*	*116*		*199*

Tab. 3.2: Hierarchic structure and hierarchic kevel (%)

	Change in hierarchic structure				
Change in the no. of hierarchical layers	Decrease	Stable	Increase	Total	*No of firms*
Decrease	3,52	0,50	0,00	4,02	*8*
Stable	8,04	65,32	6,03	79,40	*158*
Increase	1,01	1,01	14,57	16,58	*33*
Total	12,56	66,83	20,60	100,00	
No of firms	*25*	*133*	*41*		*199*

Tab.3.3: Number of divisions and hierarchic structure (%)

	Change in hierarchic structure				
Change in the no. of divisions	Decrease	Stable	Increase	Total	*No. of firms*
Decrease	1,51	1,51	0,00	3,02	*7*
Stable	4,02	33,67	1,01	38,69	*77*
Increase	7,04	31,66	19,60	58,29	*116*
Total	12,56	66,83	20,60	100,000	
No. of firms	*25*	*133*	*41*		*199*

Tab.4.1: Innovations in working hours regimes

Flexibility in working hours regimes	Yes	No
Innovations since 1998	36,18	63,82
Innovative modalities	Yes	No
Work shift (double, triple, etc…)	70,83	29,17
Annual "bank" of work hours	20,83	79,17
Working time reduction	34,72	65,28
Flexibility regimes (weekly, annual, etc…)	23,61	76,39
Work on Saturday and Sunday	23,61	76,39
Time entry/exit flexibility	31,94	68,06
Worker availability on request	26,39	73,61
Horizontal and/or vertical part time	29,17	70,83
Other	1,39	98,61
	index (0-1)	stand. dev.
Index, introduction of work hours flexibility	0,106	0,171
Index, introduction of work hours flexibility (only innovative firms)	0,292	0,164
Proposing party	Yes	no
Firm managers	86,11	13,89
Worker representatives	31,94	68,06
Joint committees	11,11	88,89
Groups of workers	11,11	88,89
Total of non managerial parties	50,00	50,00

Tab.4.2: Innovation in working hours regimes and flexibility

Indexes	Index of flexibility		*Total of firms (abs. val.)*
Innovations in working hours regimes	Plant technologies	Labour services	
No	0,382	0,413	*127*
Yes	0,326	0,403	*72*
Total of firms	0,362	0,410	*199*

Tab.5a: Organisational Practices

Organisational practices: present or adopted	Yes	No	Year of introductions (average)	% of involved workers in firms with organisational practices	Stand. Dev.
Team work	29,65	70,35	1993	50,85	33,375
Quality circles	12,06	87,94	1994	35,68	34,630
Just in time	13,07	86,93	1991	63,46	34,548
Job rotation	32,16	67,84	1991	35,70	23,798
Total quality management	45,73	54,27	1995	59,74	40,976
Other	1,52	98,48	2001	26,67	16,073
No organisational practices present or adopted	32,66	67,34			

Tab.5b: Modalities of team work

Operative modalities of teams	Yes	No
Team members appoint their chief	8,47	91,53
Team members decide together how their tasks should be performed	57,63	42,37
Teams are responsible for specific products or services	84,75	15,25
Individual team members are responsible for specific products or services	59,32	40,68
Index: operative modalities of team work (index, stand. dev.)	*0,525*	*0,231*
Team work rewards	Yes	No
No reward	16,67	83,33
Economic reward	53,33	46,67
Career advancement	55,00	45,00
Training	23,33	76,67
Other	1,67	98,33
Index: team work reward (index, stand. dev.)	*0,439*	*0,285*
Employee suggestions	Yes	No
The existence of team work notwithstanding, are there channels tapping suggestions concerning work methods?	76,88	23,12
If the answer is yes, are there economic rewards?	37,91	62,09

Tab.6a: Changes since 1998 and their proponents

Changes introduced	Introduced	Top management	Worker representatives	Joint committes	Employees	Total non managerial
1. Remuneration systems	41,71	66,27	24,10	16,87	7,23	48,19
2. New technologies	73,37	94,52	2,05	4,79	7,53	13,01
3. Innovation in work hours regimes	36,18	86,11	31,94	11,11	11,11	50,00
4. Work organisation	69,35	89,13	5,80	13,77	16,67	34,78
5. New products and services	75,38	94,67	1,33	5,33	6,00	12,67
6. Introduction of team work	28,64	77,19	5,26	19,30	14,04	36,84
7. Total quality management	50,00	94,95	7,07	6,06	5,05	18,18
8. Job rotation	50,25	73,00	16,00	15,00	14,00	45,00
9.Increased individual and group autonomy in problem solving	39,20	75,64	6,41	12,82	26,92	44,87
10. Structured channel for suggestions from workers to managers on organisational themes	23,62	57,45	23,40	23,40	23,40	65,96
11. Structured channel for suggestions from workers to managers on product quality	30,15	55,00	10,00	26,67	26,67	58,33
12. Life-long training programmes	45,73	82,42	8,79	14,29	14,29	35,16
13. Definition of objectives for teams of workers and individual workers	35,68	90,14	8,45	7,04	11,27	26,76
14. Increase in the number of and distance between hierarchical ladders	9,55	100,00	0,00	0,00	5,26	5,26
15. Other	1,01	100,00	0,00	50,00	0,00	50,00
Total	97,99	97,95	32,31	31,79	33,85	68,21

Tab.6b: Worker training and techno-organisational change

As a consequence of techno-organisational change, did you need to intervene on workers' skills by means of training or new enrolment?	Yes	No
Training		
Realised training activity	85,43	14,57
Work side by side	47,74	52,26
On-the-job training	66,33	33,67
Off-the-job training	47,74	52,26
Hiring of new personnel		
Hiring	61,31	38,69
Hiring of personnel with new competencies	53,77	46,23
If training level for employees increased since 1998, what have been the reasons?	Technical reasons (technological change)	Functional reasons (change in required competencies)
Top managers	24,20	31,21
Executives	34,72	39,58
Clerks	58,29	41,71
Skilled workers	66,30	28,80
Unskilled workers	49,43	22,16
Total	76,88	57,79

Tab.6c: Innovation indexes

Innovation vs. firm size	50-99	100-249	250-499	500-999	>999	Total	% firm without innovations
INNO Team work	0,326	0,246	0,269	0,267	0,400	0,296	70,35
INNO Quality circles	0,093	0,105	0,192	0,067	0,267	0,121	87,94
INNO Just in time	0,105	0,105	0,192	0,200	0,200	0,131	86,93
INNO Job rotation	0,267	0,316	0,423	0,400	0,400	0,322	67,84
INNO Total quality management	0,442	0,456	0,500	0,467	0,467	0,457	54,27
INNO NO organisational practices	0,291	0,368	0,346	0,333	0,333	0,327	32,66
INNO 1 Total innovations	0,393	0,463	0,586	0,513	0,574	0,461	2,01
INNO 2 Product/services	0,680	0,763	0,904	0,667	0,833	0,744	11,06
INNO 3 Work organisation	0,412	0,456	0,577	0,533	0,587	0,468	6,53
INNO 4 Work organisation and worker participation	0,343	0,398	0,535	0,500	0,513	0,409	4,02
INNO 5 Innovations only with worker participation	0,292	0,341	0,489	0,495	0,486	0,362	18,09
INNO 6 Payment systems	0,314	0,509	0,462	0,333	0,667	0,417	58,29
INNO 7 (managerial proposals)	0,286	0,352	0,472	0,316	0,382	0,338	4,02
INNO 8 (worker representatives proposals)	0,022	0,049	0,056	0,071	0,044	0,040	63,34
INNO 9 (joint committees)	0,034	0,028	0,064	0,120	0,102	0,048	68,84
INNO 10 (worker proposals)	0,065	0,043	0,059	0,031	0,031	0,052	66,83
INNO 11 (proposals without managerial intervention)	0,112	0,117	0,172	0,218	0,173	0,134	33,17

Tab.7a: Correlations, innovation indexes and firm characteristics

	Index formal division HRM	Index formal division HRM (qualitative)	No. Hierarchical levels	Ratio hierarchical levels to no. of divisions	Change in hierarchic structure	Index: flexibility of plant technology	Index: flexibility of labour services
INNO Team work	0,156	0,168	-0,233	-0,070	-0,020	0,063	0,048
INNO Quality circles	0,132	0,128	0,063	-0,139	-0,216	0,097	-0,016
INNO Just in time	0,147	0,163	-0,233	-0,082	-0,058	0,134	-0,031
INNO Job rotation	0,188	0,174	-0,128	-0,132	-0,140	0,050	-0,007
INNO Total quality management	0,143	0,127	-0,203	-0,111	-0,031	0,125	0,040
INNO NO organisational practices	-0,112	-0,111	0,285	0,147	0,083	-0,075	-0,022
INNO 1 Total innovations	0,315	0,298	-0,152	-0,167	-0,002	0,162	0,024
INNO 2 Product/services	0,005	-0,010	-0,039	-0,164	0,035	0,099	0,030
INNO 3 Work organisation	0,268	0,276	-0,263	-0,161	-0,035	0,177	0,085
INNO 4 Work organisation and worker participation	0,316	0,304	-0,149	-0,137	-0,108	0,212	0,074
INNO 5 Innovations only with worker participation	0,329	0,316	-0,127	-0,118	-0,118	0,164	0,061
INNO 6 Payment systems	0,175	0,164	-0,122	-0,130	0,123	-0,001	-0,198
INNO 7 (managerial proposals)	0,278	0,256	-0,079	-0,171	0,041	0,177	0,005
INNO 8 (worker representatives proposals)	0,169	0,149	-0,079	0,050	-0,036	0,032	0,074
INNO 9 (joint committees)	0,106	0,126	-0,070	-0,070	-0,167	-0,009	0,056
INNO 10 (worker proposals)	-0,059	-0,068	-0,044	-0,046	0,030	0,074	0,124
INNO 11 (proposals without managerial intervention)	0,124	0,119	-0,102	-0,053	-0,113	0,068	0,181

Tab.7b: Correlations, innovation indexes

	INNO teamwork	INNO quality circles	INNO just in time	INNO job rotation	INNO total quality management	INNO NO innovation	INNO 1 Total innovations	INNO 2 Product/services	INNO 3 Work organisation	INNO 4 Work organisation and worker participation	INNO 5 Innovations only with worker participation	INNO 6 Payment systems	INNO 7 (managerial proposals)	INNO 8 (worker representatives proposals)	INNO 9 (joint committees)	INNO 10 (worker proposals)	INNO 11 (proposals without managerial intervention)
INNO Teamwork	1,000	0,131	0,173	0,236	0,133	-0,452	0,356	0,148	0,534	0,416	0,382	0,031	0,278	0,202	0,151	0,117	0,269
INNO Quality circles		1,000	0,085	0,208	0,218	-0,258	0,209	0,074	0,177	0,242	0,198	0,062	0,253	0,108	0,008	-0,039	0,053
INNO Just in time			1,000	0,244	0,273	-0,270	0,191	-0,015	0,197	0,163	0,144	0,126	0,213	0,138	0,003	-0,089	0,025
INNO Job rotation				1,000	0,318	-0,480	0,343	0,122	0,450	0,381	0,326	0,029	0,318	0,155	0,060	0,155	0,244
INNO Total quality management					1,000	-0,639	0,345	0,201	0,427	0,320	0,199	0,062	0,367	0,129	-0,059	0,042	0,081
INNO NO organisational practices						1,000	-0,284	-0,136	-0,525	-0,335	-0,228	0,019	-0,278	-0,073	-0,043	-0,137	-0,159
INNO 1 Total innovations							1,000	0,533	0,752	0,893	0,782	0,472	0,867	0,327	0,224	0,233	0,481
INNO 2 Product/services								1,000	0,410	0,311	0,169	0,112	0,557	0,073	0,002	0,123	0,149
INNO 3 Work organisation									1,000	0,779	0,598	0,188	0,669	0,178	0,185	0,170	0,337
INNO 4 Work organisation and worker participation										1,000	0,924	0,267	0,733	0,324	0,269	0,273	0,524
INNO 5 Innovations only with worker participation											1,000	0,227	0,587	0,340	0,318	0,253	0,545
INNO 6 Payment systems												1,000	0,418	0,251	0,053	-0,037	0,145
INNO 7 (managerial proposals)													1,000	0,259	-0,138	0,189	0,206
INNO 8 (worker representatives proposals)														1,000	-0,036	-0,091	0,452
INNO 9 (joint committees)															1,000	0,025	0,579
INNO 10 (worker proposals)																1,000	0,615
INNO 11 (proposals without managerial intervention)																	1,000

Tab.7c: Correlations, innovation indexes and some firm features

	Employees, firm	Employees, plant	Sales	Percent national sales	Percent foreign sales	Firm typology	Performance production 98-01	Performance sales 98-01	Performance investments 98-01	Performance employment 98-01	Performance profits 98-01	Performance liabilities 98-01
INNO Teamwork	-0,036	0,096	0,024	-0,201	0,189	0,126	-0,019	-0,046	-0,007	-0,031	0,045	-0,138
INNO Quality circles	0,123	0,172	0,155	-0,004	0,014	0,216	0,120	0,117	0,082	-0,026	0,042	-0,127
INNO Just in time	0,049	0,148	0,016	-0,011	0,021	0,083	0,033	0,034	0,062	0,015	0,112	-0,176
INNO Job rotation	0,003	0,164	0,072	-0,098	0,084	0,143	0,046	0,047	0,058	-0,046	0,041	-0,108
INNO Total quality management	-0,025	0,131	0,024	-0,047	0,045	0,008	-0,012	0,010	0,148	0,091	0,077	-0,129
INNO NO Organisational practices	0,028	-0,040	0,033	0,160	-0,166	-0,066	0,034	0,008	-0,042	-0,017	-0,034	0,183
INNO 1 Total innovations	0,178	0,352	0,245	-0,101	0,103	0,168	0,089	0,031	0,104	0,024	0,191	-0,107
INNO 2 Product/services	0,076	0,190	0,001	-0,109	0,125	0,110	0,014	-0,038	0,088	0,020	0,066	-0,209
INNO 3 Work organisation	0,083	0,268	0,160	-0,154	0,150	0,143	0,019	-0,020	-0,022	-0,047	0,083	-0,115
INNO 4 Work organisation and worker participation	0,158	0,332	0,257	-0,125	0,117	0,190	0,073	0,015	0,061	-0,036	0,161	-0,086
INNO 5 Innovations only with worker participation	0,273	0,315	0,285	-0,131	0,121	0,212	0,031	-0,029	0,045	-0,072	0,108	-0,034
INNO 6 Payment systems	0,170	0,182	0,073	-0,023	0,019	-0,009	-0,005	0,039	0,069	-0,019	0,108	0,030
INNO 7 (managerial proposals)	0,078	0,306	0,073	-0,101	0,099	0,173	0,108	0,103	0,148	0,038	0,204	-0,115
INNO 8 (worker representatives proposals)	0,100	0,164	0,086	-0,155	0,156	0,081	0,039	-0,043	0,069	-0,072	0,025	-0,024
INNO 9 (joint committees)	0,215	0,247	0,393	-0,019	0,032	0,101	0,041	-0,043	0,002	0,053	0,039	0,027
INNO 10 (worker proposals)	-0,043	-0,027	-0,037	0,005	-0,003	-0,049	0,076	0,056	0,043	0,146	0,113	-0,040
INNO 11 (proposals without managerial intervention)	0,162	0,231	0,275	-0,074	0,083	0,073	0,097	-0,005	0,077	0,091	0,108	-0,016

Tab.7d: Correlations, innovation indexes and some features of employment

	Employment and labour contracts, index	Employment and education level, index	Change in total employment	Change in 'atypical' employment
INNO Teamwork	0,034	0,085	-0,037	0,042
INNO Quality circles	-0,191	0,093	0,015	0,081
INNO Just in time	-0,091	0,190	0,030	0,022
INNO Job rotation	-0,084	-0,089	0,011	0,160
INNO Total quality management	-0,223	0,028	0,061	0,143
INNO NO Organisational practices	0,158	-0,037	0,008	-0,144
INNO 1 Total innovations	-0,044	0,108	0,043	0,262
INNO 2 Product/services	0,041	-0,109	0,100	0,047
INNO 3 Work organisation	-0,023	-0,004	0,018	0,174
INNO 4 Work organisation and worker participation	0,007	0,125	-0,007	0,271
INNO 5 Innovations only with worker participation	0,046	0,126	-0,059	0,252
INNO 6 Payment systems	-0,092	0,122	-0,050	0,183
INNO 7 (managerial proposals)	-0,054	0,050	0,086	0,152
INNO 8 (worker representatives proposals)	0,053	0,068	0,017	0,142
INNO 9 (joint committees)	-0,022	0,075	-0,012	0,130
INNO 10 (worker proposals)	-0,011	0,027	0,127	-0,004
INNO 11 (proposals without managerial intervention)	0,004	0,100	0,102	0,131

Tab.8a: Correlations, innovation indexes and industrial relations

Innovations vs. Information, consultation and negotiation on organizational innovations	Index interaction management/ worker representatives	Management / worker representatives (qualitative)	Information	Consultation	Negotiation
INNO Team work	0,138	0,141	0,108	0,091	0,128
INNO Quality circles	0,036	0,029	0,065	-0,013	0,028
INNO Just in time	-0,002	0,000	-0,003	-0,007	0,009
INNO Job rotation	0,069	0,055	0,100	0,023	0,026
INNO Total quality management	0,050	0,035	0,107	-0,023	0,022
INNO NO Organisational practices	-0,045	-0,047	-0,094	0,069	-0,093
INNO 1 Total innovations	0,279	0,232	0,330	0,183	0,090
INNO 2 Product/services	0,094	0,075	0,141	0,027	0,036
INNO 3 Work organisation	0,229	0,202	0,263	0,125	0,122
INNO 4 Work organisation and worker participation	0,280	0,229	0,336	0,190	0,075
INNO 5 Innovations only with worker participation	0,289	0,241	0,324	0,215	0,085
INNO 6 Payment systems	0,076	0,056	0,113	0,038	0,007
INNO 7 (managerial proposals)	0,224	0,184	0,264	0,158	0,060
INNO 8 (worker representatives proposals)	0,106	0,095	0,063	0,143	0,023
INNO 9 (joint committees)	0,120	0,105	0,156	0,039	0,074
INNO 10 (worker proposals)	-0,107	-0,106	-0,063	-0,114	-0,067
INNO 11 (proposals without managerial intervention)	0,093	0,074	0,119	0,056	0,022

Tab.8b: Interaction between management and worker representatives on techno-organisational innovation, and indexes of techno-organisational innovation

Indexes: techno-organisational innovations	Index industrial relations less than the average	Index industrial relations more than the average
INNO 1 Total innovations	0,432	0,534
INNO 2 Product/services	0,734	0,755
INNO 3 Work organisation	0,430	0,541
INNO 4 Work organisation and worker participation	0,372	0,496
INNO 5 Innovations only with worker participation	0,321	0,471
INNO 6 Payment systems	0,429	0,471
INNO 7 Innovation introduced by managerial initiative	0,319	0,384
INNO 11 Innovation introduced by initiative of subjects different from management	0,122	0,153

Tab.9a: Forms of consultation and delegation in production

	CONSULTATION IN DECISIONAL PROCESSES	**DECISIONAL DELEGATION**
INDIVIDUAL LEVEL	*6 ITEMS*	*4 ITEMS*
	Channels for employee suggestions	
	Structured modalities of suggestions on production	Non-hierarchical characteristics in team work
	Structured modalities of suggestions on quality	Presence of job rotation
	Initiatives of individual involvement	Introduction of job rotation
	Enquires on organisational climate	Non-hierarchical employee evaluation
	Formal evaluation of employees	
GROUP LEVEL	*5 ITEMS*	*10 ITEMS*
		Subject involved in quality control
		Presence of team work
	Initiatives for involvement of teams	Non-hierarchical features of team work
	Presence of quality circles	Presence of total quality management
	Presence of team work	Introduction of team work
	Hierarchical features of team work	Introduction of total quality management
	Introduction of team work	Increased autonomy for work teams
		Objectives of team work
		Certification of quality control
		Initiatives of work teams involvement

Tab.9b: Consultation and delegation in decisional processes: employee direct participation

Typologies of direct participation	Yes	No	No. of practices	Maximum no. of adopted practices	Maximum percentage of practices	Synthetic index of diffusion (0-1)	Stand. Dev.
Individual consultation	92,46	7,54	6	4	66,67	0,289	0,162
Group consultation	53,77	46,23	5	4	80,00	0,201	0,223
Individual delegation	59,80	40,20	4	3	75,00	0,232	0,233
Group delegation	95,98	4,02	10	6	60,00	0,303	0,155

Tab.9c: Interaction between management and worker representatives on innovation versus consultation and delegation practices

Index	Consultation		Delegation	
Item	individual	group	individual	group
0	0,231	0,296	0,306	0,333
1	0,323	0,376	0,389	0,333
2	0,367	0,352	0,365	0,333
3	0,368	0,467	0,361	0,314
4	0,542	0,667	Absent	0,357
5	Absent	Absent		0,406
6	Absent			0,400
7				Absent
8				Absent
9				Absent
10				Absent
Average	0,348	0,348	0,348	0,348

Tab.9d: Index of industrial relations versus consultation and delegation practices

Index	Consultation		Delegation	
Item	individual	group	Item	individual
0	0,274	0,348	0,323	0,306
1	0,361	0,361	0,391	0,357
2	0,353	0,353	0,397	0,335
3	0,393	0,428	0,412	0,335
4	0,540	0,727	Absent	0,391
5	Absent	Absent		0,407
6	Absent			0,440
7				Absent
8				Absent
9				Absent
10				Absent
Average	0,365	0,365	0,365	0,365