

# WORKING CONDITIONS ‘DETERMINANTS’: THE ROLE OF INNOVATIONS AND INDUSTRIAL RELATIONS. EVIDENCE FOR A LOCAL PRODUCTION SYSTEM

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## **Abstract**

Changes in organization of work and production certainly impact on the workers well being. Whether such an influence is positive or negative is an empirical matter, upon which the present work tries to shed light for a local production system located in Northern Italy.

During the 1990s several economists and managerial scholars pointed to the positive effects on workers from the introduction of new forms of work and production organization; however, some more recent studies highlight its potential negative effects. In addition to the organizational innovations it is important not to overlooking other aspects of firms’ innovation activity and industrial relations that may influence the working conditions. Cooperative relationships at firm level between union delegates and management are likely to be linked with good quality working conditions.

Our empirical aim is twofold. First, we disentangle the role of innovation intensity in four different innovation areas (technology, organization, training and ICT), on working conditions. The evidence is mixed. On the one hand, innovations have an overall positive effect on working conditions. However, this effect is weak and for specific organizational aspects, is negative. Second, we confirm the relationship between cooperative industrial relations, at firm level, and working conditions.

**Keywords:** organizational innovations, working conditions, industrial relations, local production system.

**JEL:** L60, M54, O33, J51, J81

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## 1. Introduction

In this present work we intend to complement the widespread literature that investigates the effects of innovation on firms' economic outcomes, providing some evidence on the effects of innovation, conceived as technological and organizational innovation, on working conditions.

The subject is not new, but is under-researched. The economics and sociology literatures have investigated the detrimental effects generated by the adoption of a Fordist-Taylorist production organization on the workers well being, in the second half of the past century: "the reduction of the skill content of work task and an ever-finer division of labor, it was argued, were designed to allow an intensification of work through the weakening workforce's capacity of resistance, more precise measurement of tasks activities and a tighter linking of financial incentives to output" (Gallie, 2005, p.352). More recently, the increasing diffusion of so called High Performance Work Practices (HPWP henceforth) and the contraction of the traditional Fordist-Taylorist organization of production have spurred a renewed interest in the consequences of 'new' forms of production organization for workers' conditions. A widespread endorsement of the HPWP benefits on workers emerged during the '90s, especially in the US context: wider discretion, greater opportunity for using their skills thorough job redesign, decreased level of control by management and greater worker involvement in decision making processes were perceived as aspects that increased working conditions (Handel, Levine, 2004). However, some scholars (Gallie, 2005; Green, 2004; Brenner, Fairris, Ruser, 2004; Askenazy, Caroli, 2006) have highlighted that there are costs to workers associated with organizational changes: intensification of the working activity, reduction in working dead-times, psychological and physical pressures. The evidence that in several OECD countries work intensity increased during the '90s has been consolidated<sup>1</sup> (Green, 2004).

In addition to organizational changes there are innovation activities that may influence jobs and the way job tasks are managed, which may have an impact on workers' well being, including diffusion of information and communication technology (ICT), technological<sup>2</sup> innovations and training activities.

Coupled with the potential effects of these innovation activities on the working conditions we also analyze the way cooperative aspects of industrial relations are related to the changes in workers' well being. Unions are clearly concerned about the welfare of their members, but management may be less sensitive to workers' interests and more focused on workers' efforts.

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<sup>1</sup> See also the works of the symposium of the Eastern Economic Journal (2004).

<sup>2</sup> In this paper the term technological innovation encompasses product and process innovations, both incremental and radical, quality control innovation, formal Research and Development (R&D) division, resources and employees involved in R&D activities, collaborations with other firms on R&D (Tab.A.2 in Appendix).

Thus, the presence of cooperative relations between management and union delegates may help to resolve in a non-conflictual way, the partially divergent objectives of the two parties.

The empirical work is grounded on the above consideration. Two sources of data are used: a unique data set of 192 manufacturing firms located in a Northern Italy province, Reggio Emilia in Emilia Romagna, which specifically focuses on industrial relations characteristics and firm innovative behavior; a panel of official balance sheet data for the period 1998-2004. To our knowledge, very few empirical works on small and medium sized enterprises (SME), use official balance sheet data.

The paper is structured as follows. Section 2 reviews the existing literature in order to contextualize the present work. Section 3 outlines the Reggio Emilia local production system, and describes the data and some methodological issues. Section 4 provides the results of the analysis. Section 5 concludes.

## **2. Literature Review**

The conceptual framework of this work is drawn from the literature that aims at disentangling the effects of innovation activities, with a particular focus on organizational change, on working conditions. It also takes account of the nexus between cooperative industrial relations and working conditions, which can be thought of as being complementary to the literature on the effects of innovation activities.

Since the '90s a huge number of works in the international literature has focused on the rapid diffusion of 'new'<sup>3</sup> organizational practices in a variety of workplaces (Osterman, 1994, 2000; Gittleman, Horrigan, Joyce, 1998; Cristini, Leoni, 2005; Antonioli, Mazzanti, Pini, Tortia, 2004; Antonioli, Pini, 2004). In parallel, another stream of works has addressed the issue of the impact of 'new' organizational practices on firms' economic outcomes (Black, Lynch, 2001; Caroli, Van Reenen, 2001; Janod, Saint-Martin, 2004; Huselid, 1995; Huselid, Becker, 1996; Cappelli, Neumark, 2001; Ichniowski, Shaw, Prennushi, 1997; Ichniowski, 1990; Zwick, 2004; Antonioli, Mazzanti, Pini, 2007; Leoni, 2008). This body of influential quantitative studies provides evidence of positive linkages between the introduction of 'new' work practices and the economic performance of firms. It is mainly for this reason that such work practices have been described as High Performance Work Practices. The latter definition is not always adopted. The terminological blurriness that still surrounds the world of the HPWP has been highlighted by several scholars (Belanger et al., 2002; Butler et al., 2004). As put forward by Wood (1999), the two main

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<sup>3</sup> As suggested by some authors it is difficult to identify what is really new in the organizational changes introduced by firms (Askenazy, Caroli, 2006).

conceptualizations that emerged during the 80s stressed the accent on the presumed capacity of “new work practices” to induce a high level of workforce commitment: *high commitment model* (HCM) and *high involvement management* (HIM). The interesting point to be stressed is the subject of the two definitions of the early phase of “new work practices” diffusion: the focus was on employees. The priority given to gains in economic performances, in the definition(s) of “new work practices”, emerged during the 90s and it has pervaded the literature, both theoretical and empirical, since now. A bundle of the most cited and empirically used HPWP is given by team works, quality circles, total quality management, job rotation, self-managed teams (Osterman, 2000; Lynch, 2007). The joint adoption of the latter practices coupled with other ones, such as supporting HRM policies (e.g. investment in training covering both specific and general skills), connotes what can be defined a High Performance Work System (HPWS) according to the interpretation provided by the European Commission (EC, 2002) on the basis of several studies on European countries.

Although the introduction of HPWP may improve productivity, this is only one side of the coin. The other is related to the impact of such reorganization on workers’ well being. However, this latter issue, notwithstanding its importance, is rather under-researched<sup>4</sup>.

There are two main views. One maintains that the adoption of HPWP has a positive impact on workers’ well being (*empowerment thesis*) through a multiplicity of channels (Handel, Levine, 2004). In this perspective both management and workers gain from the introduction of organizational changes: the former obtain higher levels of productivity; the latter receive economic benefits (e.g. higher wages), enjoy higher levels of job satisfaction, are better trained, more motivated and capable of implementing and using their skills. The other view is less positive and lists a series of potential detrimental effects of HPWP on workers conditions. In this view (*intensification thesis*) the management uses the ‘new’ organizational practices to strengthen control over workers’ efforts and to intensify the pace of work. The work intensification that several economies have experienced in recent years (Green, McIntosh, 2001; Green, 2004; Askenazy, 2004; Fairris, 2004) can be understood as a result of technological changes in addition to reorganization. In particular, the increasing diffusion of ICT (Brynjolfsson, Hitt, 2000; Bresnahan, Brynjolfsson, Hitt, 2002) has been identified as a cause of stress among workers because of the possibility they provide to management to monitor and control workers more intensively (Green, 2004). The skills upgrades necessitated by the increased degree of worker autonomy implied by the introduction of HPWP, the introduction of ICT that can be used by the management to intensify the pace of work and control over workers, the shifting of responsibility from management to shop floor levels, are all elements that potentially cause psychological and physical stress (*cumulative trauma disorders*).

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<sup>4</sup> Most of this work is focused on the relation between changes in organizational practices and workers’ wages (Black, Lynch, Krivelyova, 2004; Handel, Gittleman, 2004; Forth, Milward, 2004)

However, ICT may alter the working environment for workers in positive ways. The possibility provided by the ICT of improving information sharing may help to spread information about best safety practices, for example, and provide workers with greater degrees of autonomy in their jobs. This same reasoning may hold for innovation in processes or quality control. On the one hand, their introduction can increase mental strain for workers and reduce safety because the ‘ever’ changing production environment reduces the possibility of setting and learning safety procedures; on the other hand, the focus on quality, and especially in the processes implemented, can be thought of as improving occupational safety (Askenazy, Caroli, 2006). Conceptually, training activities are the less ambiguous innovation aspects potentially influencing working conditions: the better trained the employees the better should be their working conditions<sup>5</sup>.

The changes in the workplace also affect the relations between the firm constituencies. If high commitment workplace practices are seen as instruments to align management and workers’ objectives, spurring a more intense direct dialogue between the parties, the role of a cooperative and participative industrial relations climate in influencing the workers well being cannot be neglected. Participatory industrial relations may be legitimately thought of as complementary aspects of innovation activities in influencing working conditions<sup>6</sup> and not only firm economic performance (Menezes Filho, Van Reenen, 2003; Metcalf, 2003). Unions are clearly concerned about the well being of their members, but management may be less sensible towards workers’ well being and more focused on workers’ efforts. The presence of unions in the workplace, their recognition by and, more importantly, their cooperative relations with management, and the inclination of the latter to listen to them, may contribute to non-conflictual resolution of the partially divergent objectives of the two parties. It is worth remarking that such a reasoning holds if industrial relations are not poor, but driven by union/management cooperation<sup>7</sup>. In fact, it may be argued that within a cooperative environment unions are able to influence management decisions on innovation implementation, leading to the choice of configurations that produce higher efficiency and have a positive or at least not detrimental impact on workers’ conditions.

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<sup>5</sup> E.g., it can hardly be argued that training in safety and security issues does not positively affect workers well being.

<sup>6</sup> Within this line of empirical research the issue of reverse causality emerges (Renaud, 2002): the good quality of the dialogue between union delegates and management spurs workers well being, because management is more receptive to the union voice and consequently to the workers’ needs, or instead, better quality working conditions promote less adversarial industrial relations?

<sup>7</sup> As interestingly highlighted by an anonymous referee, if unions are conservative (and likely operating in a poor industrial relations environment) they may be prone to adopt behaviours that hinder the introduction of innovations, both technological and organizational, independently by the interest of their members. Some empirical studies have pointed out that union power, usually “proxied” by union density variable, may exert a hindering effect on R&D expenditure and on profitability (Menezes-Filho, Ulph, Van Reenen, 1998; Betts, Odgers and Wilson, 2001)

### 3. Empirical framework and methodology

The local production system of Reggio Emilia, a Northern Italy province in Emilia-Romagna, is the geographical location of the manufacturing firms analysed in the present work. This local system (Seravalli, 2001) is characterized by a predominant presence of SME<sup>8</sup>. A particular characteristic of the Reggio Emilia manufacturing context, which is linked to the prevalence of SME, is the existence of two districts: the first includes non-electrical machinery and equipment - machinery for mechanical energy and agriculture in particular; the second includes non metallic mineral products - ceramic tiles in particular (Brusco, 1982; Brusco, Cainelli, Forni, Franchi, Malusardi, Righetti, 1997). From the firm distribution by sectors and size (Tab.A.1), we can see that about half of the surveyed firms operate in a district-like environment, usually constituted by networks of SME. As a result of its features, the Reggio Emilia local production system can be considered to be a paradigmatic version of the so called '*Emilian model*' (Amin, 1999; Brusco, 1982), in which a well marked entrepreneurship spirit and an equally strong, deep-rooted unionism coexists with a productive apparatus characterized by the presence of a district-like production system<sup>9</sup>.

The empirical analysis is conducted using two different datasets. The first data source is a firm level survey conducted on the manufacturing firms located in Reggio Emilia<sup>10</sup>. The criteria we adopted for the identification of the population of 634 firms are: (a) firms with at least 20 employees<sup>11</sup>; and (b) firms belonging to manufacturing sectors according to the ISTAT ATECO 2002<sup>12</sup> classification. The data for 2004 were provided by union representatives, through face-to-face interviews. On the basis of a representative sample (250 firms) of the 376 firms with union delegates the interviews led to 192 respondents, which constituted 51% of firms with union representation (UR). The survey is a unique source of information about firms' structural characteristics, workforce composition, innovation activities, working conditions and industrial relations.

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<sup>8</sup> According to the European Commission (Official Journal of the European Union, L 124, May 2003) a SME is defined as a firm with less than 250 employees. Table A.1 shows that in our local production system about 85% of the firms with union representatives are below this threshold.

<sup>9</sup> We especially refer to the role of CGIL, the left wing union. For an overview of the union history and the linkages with political parties we refer the interested reader to Baglioni (1998).

<sup>10</sup> Several official sources were used to construct the firm population: Reggio Emilia Chamber of Commerce, Istat Census, Aida data bank, "Impero" data bank, balance sheets data bank of the Reggio Emilia "Camera del Lavoro Territoriale". For reasons of homogeneity and information availability the population refers to the year 2001.

<sup>11</sup> Five size classes in terms of employees were constructed: 20-49, 50-99, 100-249, 250-499, more than 499.

<sup>12</sup> The sectors are: food, textiles, wood, chemicals, non-metallic mineral products, machinery, other industries. The ISTAT ATECO classification coincides with the NACE Rev1.1 and thus with ISIC Rev3.1.

The remaining data came from official balance sheet information for the period 1998-2004<sup>13</sup>. The number of firms for which we have balance sheet data is 156.

Table A.1 shows the distribution for the 376 firms with union representatives, of the interviewed firms in terms of size and sector. Some minor distortions emerge: the only evident bias in terms of different percentage distribution of the sample interviewed with respect to the population with union representation is in the '20-49 employees' size category and the machinery sector, which are under represented. Similar weak distortions emerge for the sample obtained by merging the firms interviewed with balance sheet data: 156 firms. A version of the Cochran Test (Cochran, 1977) for sample distortions shows acceptable results (Tab.A.1.Appendix)<sup>14</sup>.

The empirical model is based on the following regression function:

$$(1) \text{ Working Condition (WC}_i) = \beta_{0i} + \beta_{1i}[\text{structural variables}] + \beta_{2i}[\text{innovation activities}] + \beta_{3i}[\text{industrial relations}] + \beta_{4i}[\text{flexibilities}] + \beta_{5i}[\text{balance sheets variables}] + \varepsilon_i$$

where the dependent variable is defined according to two specifications: WC\_1 and WC\_2 (i = 1; 2). The index WC\_1 concerns the trend in working conditions more akin to job content and potentially explains *job empowerment*: the higher (lower) the index, the higher (lower) is the intensity of job enrichment and empowerment. The index WC\_2 was constructed using the variables *stress* and *safety/security*: the maximum (minimum) value of the index shows improvement (worsening) of the *safety/security* and a reduction (increasing) of the *stress* variable<sup>15</sup>. Hence, the higher (lower) the index WC\_2 the better (worse) is the trend in working conditions in terms of *stress* and *safety/security* (see Tab.A.2 in Appendix for a detailed description of variables construction).

Thus, the separate utilization of the two dependent variables is aimed at verifying the impact of the innovation and industrial relations variables on two 'typologies' of working conditions: using WC\_1 we investigate the relations between positive changes in working conditions (e.g. worker autonomy in performing job tasks, competences, economic advantages, etc...), innovation and industrial relations; using WC\_2 we aim at verifying the existence of relations between 'critical'

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<sup>13</sup> Information on balance sheet data are mainly based on firm balance sheets registered with the Reggio Emilia Chamber of Commerce and reclassified by the balance sheet unit of the Reggio Emilia "Camera del Lavoro Territoriale".

<sup>14</sup> For details of the data see Antonioli, Delsoldato, Mazzanti, Pini (2007).

<sup>15</sup> The respondents to the questionnaire (union representatives) were asked to indicate the trend for ten items (effort, security and job stability, employees competences, information disposable to the employees, autonomy in accomplish the job tasks, influence over the managerial decisions, monetary incentives, non-monetary incentives, stress, safety/security) concerning the working conditions on a scale from 1 (decreased) to 3 (increased). Only for the stress item the number 1 means increased and 3 decreased, so that the higher is WC\_2 the better is for workers.

aspects of the working conditions, which can be considered as proxies for psychological and physical strain, innovation and industrial relations.

It is important to note that there may be a lack of simultaneity between the dependent variables and the innovation variables, which derives from how the question was framed: “*In 2004, also subsequently to the introduction of changes by the management, how did the working conditions change?*”. The generic term ‘changes’ without other specifications, in the context of the questionnaire, refers both to changes in innovation areas (technology, organization, training and ICT), and also in the flexibility, both internal (e.g. variation in functional flexibility) and external (e.g. adoption of short term contractual forms), of the firm.

Among the covariates we can distinguish: the structural variables, which capture as much as possible the firm specific heterogeneity in our cross sectional environment; innovation indexes; three main indexes of internal and external flexibility; cooperative aspects of the industrial relations system, mainly capturing union delegates/management relations; past/present performance variables from balance sheet information and questionnaire responses. It is worth stressing the accent on the fact that innovation activities are thought to encompass several spheres. In fact, the administered questionnaire allowed collecting information not only on product and process innovations (with a wealth of information on R&D activities), but also on organizational changes, training activities and ICT adoption (see Tab.A.2 in Appendix for a detailed description of the explanatory variables)

The use of past performance variables helps to mitigate potential problems of simultaneity in our context (Michie, Sheean, 2003), while the richness of the data reduces to some extent the likelihood of relevant variables being omitted.

The above short literature review and the availability of the data are the basis for the two main research questions:

1. Is there an indication of a positive or negative impact of techno-organizational changes on working conditions?
2. Is a cooperative industrial relations climate positively related to working conditions?

The impact of the factors potentially influencing workers’ conditions are reported in table 1:

*TABLE 1- Hypothesized signs of influencing variables on the working conditions.*

Influencing factors	WC_1	WC_2
<i>Hypothesized causality directions:</i>		
<i>Innovations → Working Conditions</i>		
<i>1998-2003 Performances → Working Conditions</i>		
Technological innovation	(+,-)	(+,-)
Organizational innovation	(+,-)	(+,-)
Training	(+)	(+)

ICT	(+,-)	(+,-)
1998-2003 Economic performance (balance sheets variables)	(+,-)	(+,-)
<i>Hypothesized relations:</i>		
<i>Industrial relations <math>\beta</math> à Working Conditions</i>		
<i>Flexibilities <math>\beta</math> à Working Conditions</i>		
<i>2004 Performances <math>\beta</math> à Working Conditions</i>		
<i>Perceived Performances <math>\beta</math> à Working Conditions</i>		
Cooperative Industrial relations	(+)	(+)
Flexibilities	(+,-)	(+,-)
2004 Economic performance	(+,-)	(+,-)
Perceived performances (questionnaire variables)	(+,-)	(+,-)

#### 4. Results of the econometric analysis

The results of the econometric exercise are reported in tables 2a,b.

First, we should draw attention to the robustness of the results for all the specifications adopted, which indirectly confirms the robustness of the estimates, despite the use of the full dataset with 192 observations (interviewed firms), and the use of a restricted dataset with 156 observations (interviewed firms merged with balance sheet data). Second, it should be stressed that because of the importance of organizational changes in influencing working conditions, we estimate both a specification with only the synthetic index of organizational innovation (INNO\_ORG) and a specification with the disaggregated variables used to construct INNO\_ORG. The regressions for each specification are conducted using performance measures as perceived by the respondents, or inserting the economic performance variables extracted from balance sheets. This yields four specifications for each of the two dependent variables.

From the analysis results for the set of *structural variables* we note that sector and size do not influence the degree of empowerment (WC\_1) and only two sectors (textile and non-metallic mineral products) are negatively associated with critical aspects of the working conditions (WC\_2). The choice to delocalize and to implement a social responsibility balance shows opposite and significant signs only for WC\_1. We can argue that when management is concerned and aware of its social responsibility it is also more sensitive to the working conditions of employees. A delocalization strategy, especially if it is pursued for mere cost reduction reasons, may imply workforce re-composition and reorganization processes that are negatively related to workers' empowerment. The strategic orientations of management are weakly related to WC\_1, but quite strongly correlated with WC\_2. Both the search for cost/price reduction and improved technology/quality to remain competitive and prosper on the market, although contrasting

management behaviours, seem to increase the psychological and physical stress and reduce safety/security for workers<sup>16</sup>.

TABLE 2a – Results of the econometric exercise with WC\_1 as dependent variable<sup>^</sup>.

Dependent variable	WC_1♥			
	1	2	3	4
Cons.	***	**	*	*
<i>Structural variables</i>				
SRB	*	**		*
DELOC	** (-)	* (-)	*** (-)	** (-)
INT_TURN		* (-)		
VA_STR		* (-)	* (-)	* (-)
<i>Synthetic Innovation Indexes</i>				
INNO_ICT	*		**	*
<i>Organizational changes</i>				
ORG_LAB	/	***	/	*
<i>Industrial Relations</i>				
INTERAC_ISSUES	**		**	
INDREL_TREND	**	***	**	**
<i>Flexibility</i>				
LCF		* (-)		
FLEX_VAR	***	***	**	**
<i>Economic Performance</i>				
PROD_QUEST		*	/	/
Adj R <sup>2</sup>	0.26	0.29	0.27	0.26
F test prob.	0	0	0	0
N	191	191	156	156

Notes:

<sup>^</sup> only the level of significance of the coefficients and their signs, when negative, are reported (10% \*, 5% \*\*, 1% \*\*\*); the coefficients are not reported for brevity but full results are available upon request; empty cells mean the variable is not significant at least at 10%; / represents variables not included in the estimation.

♥ List of variables included in the estimations but not reported because not significant in any of the specifications for WC\_1: (*structural variables*) size dummies, firm typology dummies, WC/BC, BR\_STR, sector dummies, CP\_STR, TQ\_STR; (*innovation variables*) ORG\_PROD, OUT, INS, REL\_SUPPLCLI, INNO\_TRAIN, INNO\_TECH; INNO\_ORG, REW; (*industrial relations*) formal aspects of industrial relations, BTC and FL\_BARG, and informal aspects, INTERAC\_FLEX, INDREL\_EVAL; (*flexibility*) CONV\_LCF; (*economic performance*) PROF\_QUEST, ROE 2004, M\_ROE98-03, VA/EMP 2004; M\_VA/EMP98-03.

The results for the second set of explanatory variables (*Innovations*) are as follows.

Looking at the innovation indexes we observe that the introduction of ICT is mainly connected with aspects that are more akin to the characteristics of the job and its content and less to psychological and physical stress. Thus, ICT can be seen as innovation activities that spur an increasing degree of workforce empowerment, without undermining safety/security or increasing stress levels. The role of training activities and technological innovation appears to be neutral with respect to the degree of empowerment of workers, but it emerges as significant, to different extents,

<sup>16</sup> If we assume the cost reduction affects training programs, worker awareness about safety/security themes and measures to improve the quality of the working environment, then safety/security conditions deteriorate and stress is increased. However, it could be argued that when technological/quality strategy is management driven and is mainly directed towards increasing managerial control over workers then this will increase stress levels among workers.

on the index for potentially critical aspects of the workers well being. In particular, the positive signs for technological innovations and training activities show that these types of innovation actually help to reduce stress levels and/or augment the safety/security of workers<sup>17</sup>. The only innovation synthetic index that shows a negative effect on worker conditions, specifically on WC\_2, is the overall index for organizational changes. The overall effect of organizational changes is one of undermining safety/security and/or increasing workers' stress levels. This result is in line with the recent empirical literature on the relations between organizational changes and working conditions (Green, 2004; Brenner, Fairris, Ruser, 2004; Askenazy, Caroli, 2006). The third set of explanatory variables (*Organizational changes*) helps us to identify the specific organizational aspects that negatively impact on WC\_2. Our results show that it is the presence of individual/collective reward systems (REW) that negatively affects the level of stress and safety/security, probably because of the intensification in working pace due to the linkages between the reward system and performance indicators. The disaggregation of the synthetic index of organizational changes (INNO\_ORG) produces another interesting result concerning WC\_1: the positive impact of ORG\_LAB, that is to say changes in organizational practices related to labour services (e.g. job rotation, evaluation systems, etc...). This result is not unexpected because those organizational changes clustered in ORG\_LAB variable are usually interpreted as ameliorative elements of the job content. In conclusion, we can state that overall there is an absence of innovation variables that affect both the working conditions indexes: the impact of some kind of innovation activity on the empowerment index excludes a relation between the same innovation activity and the index that clusters critical aspects of the workers' conditions. Innovations affect working conditions in a fairly focused and narrow way.

The fourth set of variables clusters the cooperative *industrial relations* aspects. As expected, the relations between working conditions and high quality, non-adversarial relations between union delegates and management, are positive and significant. Where processes of consultation and negotiation, between management and union representatives, are implemented, employees enjoy good working environments and their jobs are enriched and empowered. The significance level of union delegates/management interaction on the firm issues<sup>18</sup> variable (INTERAC\_ISSUES) is sensitive to the disaggregation of the INNO\_ORG index, while the other industrial relations variables are not. In particular, the signs of the trend in the industrial relations variable (INDREL\_TREND) show strong robustness across specifications and samples: a perceived good

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<sup>17</sup> It should be noted that INNO\_TECH loses significance when balance sheet data are used and the number of observations drops to 156. The opposite holds for INNO\_TRAIN, which is significant only in the specifications based on balance sheet data. The change in the significance of these two indexes may be dependent on the use of balance sheet rather than perceived performance and on the samples used for the estimation.

<sup>18</sup> Some of these are included in table A.2, which presents the variables used in the analysis.

trend in the firm level industrial relations climate is positively associated with both the dependent variables.

TABLE 2b – Results of the econometric exercise with WC\_2 as dependent variable<sup>^</sup>.

Dependent variable	WC_2 <sup>♦</sup>			
	1	2	3	4
Cons.	***	**	**	**
<i>Structural variables</i>				
Sector dummies <sup>§</sup>	Textile**(-); Non metallic mineral products**(-)	Textile**(-); Non metallic mineral products*(-)	Textile **(-); Non metallic mineral products **(-)	Textile*(-); Non metallic mineral products*(-)
CP_STR	* (-)	** (-)	** (-)	*** (-)
TQ_STR	** (-)	*** (-)	***(-)	*** (-)
<i>Synthetic Innovation Indexes</i>				
INNO_TRAIN	**	**		
INNO_TECH			*	*
INNO_ORG	** (-)	/	** (-)	/
<i>Organizational changes</i>				
REW	/	** (-)	/	** (-)
<i>Industrial Relations</i>				
INDREL_EVAL	***	***	***	**
INDREL_TREND	**	**	*	*
<i>Flexibility</i>				
FLEX_VAR	***	***	*	*
<i>Economic Performance</i>				
VA/EMP 2004	/	/	*	*
M_VA/EMP98-03	/	/		* (-)
Adj R <sup>2</sup>	0.26	0.26	0.25	0.25
F test prob.	0	0	0	0
N	191	191	156	156

Notes:

<sup>^</sup> only the level of significance of the coefficients and their signs, when negative, are reported (10% \*, 5%\*\* , 1%\*\*\*); the coefficients are not reported for brevity but full results are available upon request; empty cells mean the variable is not significant at least at 10%; / represents variables not included in the estimation; § only significant sectors are reported.

<sup>♦</sup> List of variables included in the estimations but not reported because not significant in any of the specifications for WC\_2: (structural variables) size dummies, firm typology dummies, WC/BC, BR\_STR, SRB, DELOC, INT\_TURN, VA\_STR; (innovation variables) ORG\_PROD, OUT, INS, REL\_SUPPLCLI, INNO\_ICT, ORG\_LAB; (industrial relations) formal aspects of industrial relations, BTC and FL\_BARG, and informal aspects, INTERAC\_FLEX, INTERAC\_ISSUES; (flexibility) CONV\_LCF, LCF; (economic performance) PROF\_QUEST, ROE 2004, M\_ROE98-03, PROD\_QUEST.

The last two sets of explanatory variables concern the *flexibility* and *past/present economic performance* of the firm. The results show that external flexibility is only marginally associated (with a negative sign) to the dependent variable capturing the intensity of empowerment (WC\_1). The reverse is true for the variation in internal forms of flexibility (FLEX\_VAR), which is positively associated with both the working conditions indexes. These associations are not surprising, because functional flexibility or organizational flexibility are instruments to increase both the degree of autonomy/responsibility of the workers and the possibility of fully exploiting and implementing workers' skills and competences.

Economic performance, based on balance sheets (1998-2004) and survey responses, shows a marginal relationship with working conditions. Only productivity variables for 2004, both from questionnaire responses and balance sheet data, are linked, with a positive sign, to working conditions; profitability variables are not. There seems to be a general positive, although marginal, relation between productivity and workers' well being, but we cannot disentangle a causal nexus.

TABLE 3 – Synthesis of the results.

<i>Influencing factors</i>	<i>WC_1</i>	<i>WC_2</i>
Technological innovation	Not significant	Positive but weakly significant
Organizational innovation....	Not significant	Negative and significant
....Changes in Labour Organization	Positive and significant	Not significant
....Reward System	Not significant	Negative and significant
Training	Not significant	Positive and significant
ICT	Positive and significant	Not significant
Cooperative Industrial relations	Positive and significant	Positive and significant
Flexibilities	Positive and significant	Positive and significant
Economic performance (balance sheets variables)	Not significant	Positive but weakly significant
Perceived performances (questionnaire variables)	Positive but weakly significant	Not significant

To conclude the analysis of results, table 3 shows that there is evidence of a relation between the indexes for working conditions and the principal explanatory factors. The index WC\_1 always shows positive linkages with the main influencing factors, when these linkages are significant. Innovations, non-adversarial relations between managements and employees, flexibilities and, to a lesser extent, economic performance impact in the same direction on the index of job empowerment (WC\_1). The index synthesizing the trend of safety/security and workers' stress (WC\_2), on the other hand, shows more ambiguous relations. In particular, the impact of innovations activities does not always go in the same direction: organizational changes may negatively influence the levels of stress of workers and also their safety/security.

## 5. Conclusions

The intensification of work in Europe during the '90s and the simultaneous diffusion of ICT and organizational changes have raised concerns about the effects of innovations as widely conceived, on workers' well being. The outcome of innovation activities is not confined only to the firm, it also affects the workers. Similarly, the effect of cooperative relationships between union delegates and management cannot be thought to be neutral in terms of the quality of work. The main hypothesis underlying the present work is that techno-organizational changes and the industrial relations climate are both factors that influence workers' well being.

Our empirical results support the hypothesis that working conditions are an outcome of techno-organizational changes. When we look at the effects on those aspects more closely related to the definition of job empowerment, we note the positive impact of ICT introduction and of organizational changes introduced to modify the organization of labor. The innovation activities seem to positively influence the degree of workers' autonomy, job stability, amount of information that workers have access to, and so on. When we consider the other aspects of the job, namely stress and safety/security issues, the positive impact of training activities and the negative impact of the organizational innovation should be highlighted. Training is likely to be related to safety/security issues because it can explicitly address these aspects, making workers more aware of the risks inherent in their jobs. The sign on organizational innovation is mainly driven by the negative impact of employees' reward systems. This result may be interpreted as being due to such organizational aspects being introduced by management alongside other organizational practices with the intent not to construct a high performance work system, but rather to increase efficiency, that is, to increase workers' productivity within a short-run strategic orientation aimed at reducing labour costs ('low road' to competitiveness).

In terms of industrial relations, we note that they are positively related to a favourable trend in working conditions: this result holds for both indexes for working conditions. In other words, the less formal aspects of firm level industrial relations show a positive linkage with working conditions, while the more formal ones are neutral in determining workers' well being. Thus, the more intense the cooperation between management and union delegates, the higher the quality of the workers' life.

The rather different results for the two indexes of working conditions highlight the importance in the empirical analysis of considering specific aspects of workers' lives as outcomes of innovation and industrial relations. Indeed, the definition of workers' well being encompasses several components and dimensions, and calls for further empirical evidence.

## Appendix

TABLE A.1 – Firms percentage distribution: firms population with Union Representatives (UR) and interviewed firms.

Population with UR (376)						
Sectors	Size classes 31.12.2004					Total
	20-49	50-99	100-249	250-499	>499	
Food	1.60	1.33	1.86	0.27	0.53	5.59
Other Industries	1.60	0.27	0.00	0.00	0.27	2.13
Chemical	4.52	1.86	2.39	0.00	0.27	9.04
Wood	1.06	1.33	1.06	1.06	0.00	4.52
Machineries	23.14	16.49	12.23	3.46	2.39	57.71
Non-metallic mineral	3.72	4.26	4.52	2.66	1.86	17.02
Textile	1.06	1.60	0.53	0.80	0.00	3.99
Total	36.70	27.13	22.61	8.24	5.32	100.00
Interviewed Units (192)						
Sectors	Size classes 31.12.2004					Total
	20-49	50-99	100-249	250-499	>499	
Food	1.56	2.08	3.13	0.52	0.52	7.81
Other Industries	2.08	0.00	0.00	0.00	0.52	2.60
Chemical	4.69	1.56	3.13	0.00	0.52	9.90
Wood	1.04	1.04	1.56	1.56	0.00	5.21
Machineries	15.10	13.54	14.06	3.65	3.65	50.00
Non-metallic mineral	4.69	3.13	5.21	4.17	2.08	19.27
Textile	1.04	2.08	1.04	1.04	0.00	5.21
Total	30.21	23.44	28.13	10.94	7.29	100.00

Cochran Test  
Margin of error  $q$  \*

Interviewed firms vs. Population  
with RSU

Interviewed firms with balance  
sheets 1998-2003 (156 obs.) vs.  
Population with RSU

$$q = \sqrt{\frac{N}{(N-1)n} - \frac{1}{N-1}}$$

0.05

0.05

\* Margin of error  $q$  “usually” tolerated: 0.05. Restrictive test for small population: the smaller is N, the lesser the distance between N and  $n$  has to be in order to generate an acceptable  $q$ .

TABLE A.2 – Descriptive statistics for the 192 respondents

Variables	Description	Min	Max	Mean
<b>Dependent Variables</b>				
<b>Working Conditions</b>				
WC_1	Index capturing the trend of 8 job items (effort, security and job stability, employees competences, information disposable to the employees, autonomy in accomplish the job tasks, influence over the managerial decisions, monetary incentives, non-monetary incentives) on a scale from 1 to 3 (decreased, stable, increased)	1	3	2.04
	Index capturing the trend of two job items, safety/security and stress, on a scale from 1 to 3 (decreased, stable, increased)	1	3	1.74
<b>Controls and Explanatory Variables</b>				
<b>Structural Variables</b>				
Sectors Dummies (Food , Other Industries, Chemical, Wood, Machineries, Non-metallic minerals)	Binary variables (0,1)	0	1	/
Size Dummies (20-49, 50-99, 100- 249, 250-499, >499; and 20-99, >99)	Binary variables (0,1)	0	1	/

Firm Typology Dummies (private firm, industrial group, cooperative firm, cooperative group; private firm/group, cooperative firm/group)	Binary variables (0,1)	0	1	/
Employees (log)	Logarithms of the number of employees at 2004	2.99	7.49	4.55
Percent of International Turnover ( <b>INT_TURN</b> )*	Percentage of turnover made on international markets. Rescaled on interval (0-1)	0	0.9	0.42
White Collar/Blue Collar ( <b>WC/BC</b> )	White collar workers (managers and clerks) over blue collar workers	0.05	71	0.99
Social Responsibility Balance (d) ( <b>SRB</b> )	Binary variable (0,1)	0	1	0.21
Delocalization (d) ( <b>DELOC</b> )	Binary variable (0,1)	0	1	0.17
Cost-Price Strategy (d) ( <b>CP_STR</b> )	Binary variable (0,1)	0	1	0.62
Technology-Quality Strategy (d) ( <b>TQ_STR</b> )	Binary variable (0,1)	0	1	0.87
Brand Strategy (d) ( <b>BR_STR</b> )	Binary variable (0,1)	0	1	0.3
Variety Strategy (d) ( <b>VA_STR</b> )	Binary variable (0,1)	0	1	0.45
Performance Indicators from questionnaire: Productivity ( <b>PROD_QUESTION</b> ), Revenue ( <b>TURN_QUESTION</b> ), Profit ( <b>PROF_QUESTION</b> ), Investment ( <b>INV_QUESTION</b> )	Indexes: each type of performance is ranked on a -5 (worse than the preceding year)+5 (better than the preceding year) scale	-5	5	/
<b>Balance Sheets Variables</b>				
Value Added per employee 2004 ( <b>VA/EMP2004</b> )	Value added per employee	2.81	126.95	48.49
<b>ROE2004</b>	Returns on equity	-158.9	122.51	3.54
Average Value Added per employee 98-03 ( <b>M_VA/EMP98-03</b> )	Average value of value added per employee on the period 1998-2003	19.1	265.28	23.39
Average ROE98-03 ( <b>M_ROE98-03</b> )	Average value of return on equity on the period 1998-2003	-5.09	82.18	5.44
<b>Training</b>				
<b>INNO_TRAIN.... (interval 0-1)</b>	Composite index capturing the intensity in training activities ù Mean of the following indexes:	0	0.97	0.31
....Training Coverage	Index: percentage of employees involved in training programmes (0 nobody; 1=1-24%; 2=25-49%; 3=50-74%; 4=75-100%)	0	4	1.02
Training Modalities	Index: modalities of training (side-by-side training with structured programmes, internal and external to the firm programmes). Interval (0-1).	0	0.76	0.17
Training Advantages	Index: advantages for employees involved in training activities Interval (0-1).	0	1	0.19
Total Index of Training Competencies	Index: based on the whole competencies the training programmes aim to develop. Interval (0-1).	0	1	0.2
Informatics Competencies	Index: based on the competencies in informatics training programmes aim to develop. Interval (0-1).	0	1	0.17
Techno-specialist Competencies	Index: based on the technical competencies training programmes aim to develop. Interval (0-1).	0	1	0.39
Juridical-economics Competencies	Index: based on the juridical and economic competencies training programmes aim to develop. Interval (0-1).	0	1	0.09
Relational-organizational Competencies	Index: based on the organizational and relational competencies training programmes aim to develop. Interval (0-1).	0	1	0.17
<b>Technological Innovation</b>				
<b>INNO_TECH.... (interval 0-1)</b>	Composite index capturing the intensity in technological innovations Mean of the following indexes:	0	1	0.39
....Process Innovation (d)	Binary variable (0,1)	0	1	0.49
Product Innovation (d)	Binary variable (0,1)	0	1	0.55
Quality Control Innovation (d)	Binary variable (0,1)	0	1	0.61
Radical Innovation (d)	Binary variable (0,1)	0	1	0.27
Incremental Innovation (d)	Binary variable (0,1)	0	1	0.61
R&D activities	Index: it synthesizes the information about innovation input (formal R&D division, R&D activities, resources and employees involved in R&D activities, collaborations with other firms on R&D ). Interval (0-1).	0	1	0.49
<b>Organizational Innovation</b>				
<b>INNO_ORG.....</b>	Composite index capturing the intensity in organizational	0.05	0.62	0.24

<b>(interval 0-1)</b>		innovations			
		Mean of the following indexes:			
.....Organizational practices in production ( <b>ORG_PROD</b> )	Index: Changes in organizational practices in production (quality circles, team working, just in time, total quality management). Interval (0-1).	0	0.8	0.19	
Organizational practices in labor services ( <b>ORG_LAB</b> )	Index: Changes in organizational practices in labour services (job rotation, delegation, continuous training, etc...). Interval (0-1).	0	0.83	0.26	
Reward System ( <b>REW</b> )	Index: Individual and collective reward in 2004. Interval (0-1).	0	1	0.4	
Out-sourcing ( <b>OUT</b> )	Index: intensity of out-sourcing in ancillary activities, production support activities and production activities. Interval (0-4).	0	3.53	1.16	
In-sourcing ( <b>INS</b> )	Index: intensity of in-sourcing in ancillary activities, production support activities and production activities. Interval (0-4).	0	2.53	0.29	
Relations with Client and Suppliers ( <b>REL_SUPPCLI</b> )	Index: relations with clients and/or suppliers on furniture, assistance, changing technological equipment, exchange of technical and commercial knowledge/information etc.... Interval (0-1).	0	0.78	0.25	
<b>ICT</b>					
<b>INNO_ICT...</b> <b>(interval 0-1)</b>	Composite index capturing the intensity in ICT adoption	0.08	1	0.64	
		Mean of the following indexes:			
....ICT in Production	Index: introduction of ICT in production. Interval (0-1).	0	1	0.57	
ICT in Communication	Index: introduction of ICT for communication purposes. Interval (0-1).	0	1	0.82	
ICT in Management-Integration	Index: introduction of systems that use ICT such as EDI, Electronic Data Interchange, EDI (Electronic Data Interchange); MRP (Material Requirements Planning) etc... Interval (0-1).	0	1	0.52	
<b>Flexibility</b>					
Labor Contract Flexibility ( <b>LCF</b> )	Index: captures the characteristics of the contractual flexibility (number of contracts, typology of contracts, trend of the flexible contracts diffusion etc...). Interval (0-1).	0	1	0.66	
Conversion of Flexible Labor Contracts in Long-lasting Ones ( <b>CONV_LCF</b> )	Index: percentage of workers who are hired permanently after the flexible contract expires. Rescaled on interval (0-1).	0	1	0.39	
Variation in Internal Flexibility ( <b>FLEX_VAR</b> )	Composite index capturing the variation (decreased, stable, increased) in several forms of flexibility: Temporal, Functional, Wage, Organizational. Interval (1-3).	1.25	2.88	2.15	
<b>Industrial Relations</b>					
Firm Level Bargaining (d) ( <b>FL_BARG</b> )	Binary variable (0,1): 1 if a second level formal agreement has been signed in 2004	0	1	0.68	
Bilateral Technical Commissions (d) ( <b>BTC</b> )	Binary variable (0,1): 1 if a BTC exists	0	1	0.32	
Trend in Industrial Relations ( <b>INDREL_TREND</b> )	Index: trend of the industrial relations compared to the preceding year (worsened, stable, improved). Interval (1-3)	1	3	2.03	
Evaluation of Industrial Relations ( <b>INDREL_EVAL</b> )	Index: evaluation of the industrial relations system (from very poor to excellent). Interval (1-5)	1	5	2.81	
Management/Union Interaction on Issues ( <b>INTERAC_ISSUES</b> )	Index: interaction between management and union representatives (no interaction, information, consultation, negotiation) on several issues (e.g. production, quality, employment, working hours, etc...). Interval (1-4)	1	3.43	1.92	
Management/Union Interaction on Flexibility ( <b>INTERAC_FLEX</b> )	Index: interaction between management and union representatives (no interaction, information, consultation, negotiation) on the different types of flexibility. Interval (0-1)	0.12	0.87	0.47	

Notes: The descriptive refers to the 192 interviewed firms but for balance sheets variables the numbers of observations are 171 for 2004 and 156 for 1998-2003; the descriptive statistics for the two sub-sample of interviewed firms with balance sheets are not reported but they are available upon request and they almost do not differ from those reported in the table; "(d)" stands for a binary variable (dummy); \* 191 observations.

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