International Journal of Occupational Safety and Ergonomics
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tose20

Macroergonomics and Total Quality Management: How to Improve Quality of Working Life?

Pascale Carayon[a], François Sainfort[a] & Michael J. Smith[a]
[a] University of Wisconsin-Madison, USA
Published online: 08 Jan 2015.

To cite this article: Pascale Carayon, François Sainfort & Michael J. Smith (1999) Macroergonomics and Total Quality Management: How to Improve Quality of Working Life?, International Journal of Occupational Safety and Ergonomics, 5:2, 303-334

To link to this article: http://dx.doi.org/10.1080/10803548.1999.11076423

INTERNATIONAL JOURNAL OF
OCCUPATIONAL SAFETY AND ERGONOMICS 1999, VOL. 5, NO. 2, 303–334

Macroergonomics and Total Quality Management: How to Improve Quality of Working Life?

Pascale Carayon

Ecole des Mines de Nancy, France
University of Wisconsin-Madison, USA

François Sainfort
Michael J. Smith

University of Wisconsin-Madison, USA

In this paper, we present a macroergonomic model of work design that is applied and tested to examine Total Quality Management (TQM) in the public sector. According to the model, TQM can influence different aspects of work design and quality of working life (QWL). Questionnaire data collected in 2 public sector organizations in the USA show that TQM can have both positive and negative impact on work design and QWL. The main positive impact of TQM was found on job content, job control and participation, and social relationships. The main negative impact of TQM was on workload, uncertainty, and clarity of job duties. The impact of TQM on QWL was mixed. Our results show that the impact of TQM on work design and QWL varied very much across the 6 participating departments, as well as within the departments. Further research is warranted to assess the human impact of TQM, in particular research on the linkage between various aspects of TQM, on one hand, and work design and QWL, on the other hand.

Total Quality Management quality of working life design of work public sector

1. INTRODUCTION

Ergonomics has traditionally focused on the design of specific tasks, jobs, and related human-machine interfaces. Shakel (1991) and Helander (1997) characterize the development of ergonomics as follows:

Correspondence and requests for reprints should be sent to Pascale Carayon, University of Wisconsin-Madison, Department of Industrial Engineering, 1513 University Avenue, Madison, WI 53706, USA. E-mail: <carayon@engr.wisc.edu>.

- 1950s: military ergonomics,
- 1960s: industrial ergonomics,
- 1970s: consumer products ergonomics,
- 1980s: human-computer interaction and software ergonomics,
- 1990s: cognitive ergonomics and organization ergonomics,
- 2000–2010: eco-ergonomics.

Over the years, the discipline of ergonomics has studied more and more complex systems and has encompassed larger (macro) factors. In the 1990s, the development of macroergonomics, or organization ergonomics, has largely contributed to an improved understanding of the role of ergonomics with regard to environmental changes, in particular changes in the business world (Hendrick, 1997). One of the major developments in the field of organizational design and management has been the development and implementation of Total Quality Management (TQM). Understanding the linkages between ergonomics (and macroergonomics) and TQM is crucial. Drury (1997) lists several interactions between ergonomics and TQM:

1. the use of ergonomics to improve the performance of quality control inspectors;
2. applications of TQM to safety aspects of ergonomics;
3. linkages between TQM and macroergonomics or Sociotechnical Systems;
4. open systems strategic issues;
5. systems approaches to organization design and leadership;
6. measurement-based operations;
7. appropriate use of technology;
8. individuals, teams, and the change process.

Our paper falls in categories 3, 5, and 8. We present a macroergonomic model of work design that is used to examine TQM in the public sector. Our model discusses linkages between TQM and macroergonomics, in particular work design. The work design approach used to examine these linkages is a systems approach. Finally, we also discuss issues related to teams in the context of TQM and work design.

The most important outcome of our macroergonomic model is quality of working life (QWL). Drury (1997) and Hackman and Wageman (1995) emphasize the lack of data on whether "TQM works," in particular with regard to human outcomes. Our paper focuses on those aspects of work which, in the context of TQM, can impact people, in particular

their quality of working life. Aspects of work are identified that can contribute to quality of working life and the linkages between quality of working life and TQM efforts are discussed.

Quality of working life has been defined by many researchers in a variety of ways. Terms that have been used in place of QWL include quality of work (Attewell & Rule, 1984) and employment quality (Kraut, Dumais, & Koch, 1989). The concept of QWL was first introduced by social scientists at the Tavistock Institute of Human Relations (Trist, 1981). They defined QWL as "what people do, how they can contribute their skills and knowledge to their work organizations, what control they have over their own work, how they can deal with the difficulties and frustrations in the work process, what freedom and autonomy they can exercise, and how they can relate what they do to their future and to society at large" (Davis, Cherns, & Associates, 1975, p. 4). More recently, Davis (1983) has defined QWL as "the quality of the relationship between employees and the total working environment, with human dimensions added to the usual technical and economic considerations" (p. 80). Using this definition, we propose a model of the characteristics of work that contribute to high quality of working life. Based on the literature on job design, occupational stress, and ergonomics, one can define aspects of work which contribute to positive quality of working life. We, then, link TQM principles to these aspects of work and QWL.

2. MACROERGONOMIC MODEL OF TQM AND QWL

According to our model, a good quality improvement program needs to take into account not only the quality of products and processes, but also the quality of the working environment and human outcomes, such as job satisfaction, stress, and health (Smith, Sainfort, Carayon-Sainfort, & Fung, 1989). Modern quality improvement philosophy is based on involvement and participation from top management to the shop floor, customer orientation, comprehensive quality monitoring systems, supportive management and organizational systems, and a continuous improvement philosophy (Dean & Bowen, 1994; Dotchin & Oakland, 1992; Smith et al., 1989). The management of quality pervades all aspects of management and should be approached from a "total system" perspective (Smith et al., 1989). In particular, the importance of the role of people in quality has

been recognized by the theorists and by most companies that have quality management programs (see, e.g., Deming, 1986). Quality improvement efforts have at least three separate, yet interrelated, aspects (Smith et al., 1989):

- the quality of products and services produced,
- the quality of the workforce,
- the quality of working life.

High quality products and services cannot be produced unless there is a high quality workforce working with a high quality production process; and a high quality workforce can only be maintained when there is a high quality of working life (see Figure 1). A few empirical research studies have shown the links between these three elements (Ball & Procter, 1994; Eklund, 1995; Rooney, Morency, & Herrick, 1993). Each element complements the other and each is necessary for the other. Within this framework, the pursuit of quality depends on using each of these aspects to enhance and reinforce the others.

From a macroergonomic point of view, two questions arise:

- How do TQM programs contribute to high quality workforce and high quality of working life?
- How to manage change when implementing a TQM program?

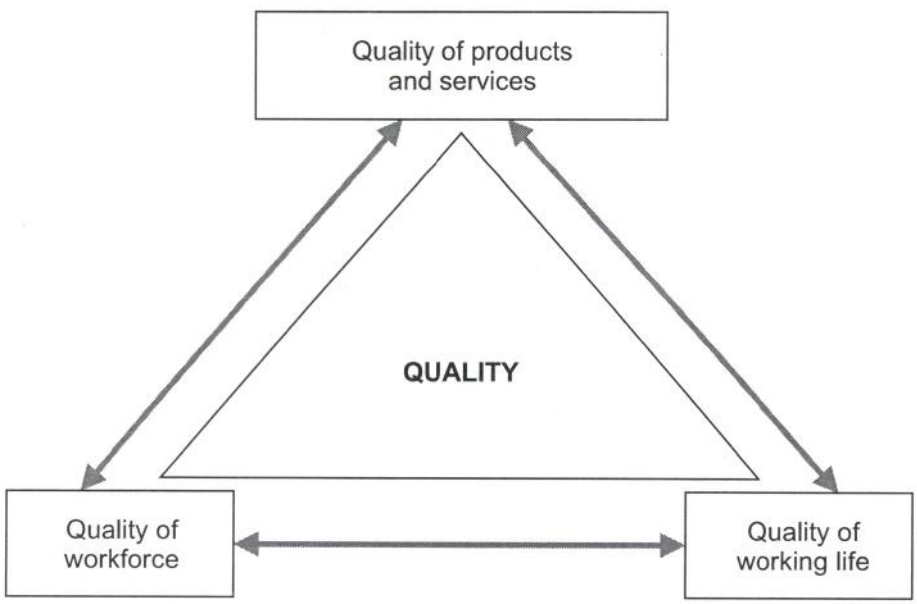

Figure 1. Three interrelated aspects of quality.

The first question refers to a static view of work systems and organizations (how to design a system?), whereas the second question refers to a dynamic view of work systems and organizations (how to change a system?). In this paper, we focus on the design of work. For a discussion on the management of change in the context of TQM programs or other participatory programs, see, for example, Carayon, Coujard, and Sainfort (1997); Haims and Carayon (1998); Sainfort, James, Yeh, Carayon, Lund, and Smith (1998b); Smith and Carayon (1995); and Wilson and Haines (1997).

2.1. Background Literature on TQM, Design of Work, and QWL

Various aspects of work can influence the workforce and QWL in positive or negative ways. The objective for the design of work systems is to enhance the positive impact on the workforce and QWL, and to eliminate or reduce the negative impact (Smith & Carayon-Sainfort, 1989). Various bodies of literature have identified characteristics of work that can influence the workforce and QWL:

- literature on job design,
- literature on occupational stress,
- ergonomics literature.

In the 1970s and 1980s, job design literature focused on aspects of work that can influence human outcomes, such as satisfaction, motivation, absenteeism, and performance. For instance, the Job Characteristics model emphasizes five job characteristics: variety, autonomy, feedback, significance, and identity (Hackman & Oldham, 1976). Herzberg (1974) also listed key job characteristics. According to his Job Enrichment theory, job characteristics can be categorized into (a) hygiene factors and (b) motivators. Improving work through hygiene factors can only reduce job dissatisfaction, whereas building up the content of jobs through motivators can increase job satisfaction. According to the Sociotechnical Systems Theory, the positive characteristics of work are skill utilization and development, job control and autonomy, identity and social relationships (Davis, 1983; Trist, 1981).

Occupational stress literature also provides important information on the characteristics of work that can influence the workforce and QWL. Cooper and Marshall (1976) list the following factors as potential

sources of stress: factors intrinsic to work, role in the organization, career development, relationships at work, and organizational structure and culture. Karasek (1979) emphasizes the role of job decision latitude as a means for dealing with workload problems. Johnson (1989) added social support to the job factors of decision latitude and workload included in Karasek's (1979) model. Recently, a review of occupational stress literature by Kalimo Lindstrom, and Smith (1997) listed various characteristics in work, work organization, and environment that are potential contributors to the health and well-being of individual workers, groups, and the whole organization: factors intrinsic to the job (i.e., physical working conditions, job demands, responsibilities, job content, decision-making, and perceived control), organizational structure and climate, management and supervisory systems, job design characteristics, and roles and interpersonal relations.

According to ergonomics literature, factors such as poor postures, physical load, and poor physical environment can affect worker health (Kroemer, Kroemer, & Kroemer-Elbert, 1994) and also quality of performance. A study by Eklund (1995) showed that tasks that are poorly designed from an ergonomic point of view have more quality deficiencies. More recently, development in the ergonomics field has taken into account the larger (macro) aspects of work. The macroergonomics approach encompasses the microergonomic aspects of work and the organizational aspects of work (Hendrick, 1991).

The macroergonomic model of work proposed by Smith and Carayon-Sainfort (1989) is a systems approach based on job design, occupational stress, and ergonomics literature. According to the Balance Theory, a work system is comprised of five elements: the individual, tasks, technologies and tools, the environment, and organizational conditions. Each element of the work system as well as the interactions between those elements can influence the "stress load" on the individual. The stress load has a physical component and a psychological component. Over time, the stress load can have positive or negative consequences on the individual in terms of health and well-being, as well as in terms of attitudes and performance (i.e., quantity and quality of work). The Balance Theory emphasizes the multiple aspects of work that are important to the individual and his or her health and well-being. These factors can be positive or negative depending on their effects on the individual. For instance, job design literature has defined a number of positive work factors, such as variety, autonomy, and feedback that

influence satisfaction, motivation, and performance. Occupational stress literature has defined negative factors, that is, job stressors, such as quantitative workload and job future concerns that have been shown to influence strain and health. Ergonomics literature has also defined a range of positive and negative factors. Negative ergonomic aspects of work include high force, poor postures, and stressful physical environment.

A work system has multiple aspects that are of importance to the individual (Smith & Carayon-Sainfort, 1989). Therefore, a management effort, such as TQM, can impact a variety of factors in positive or negative ways (Smith & Carayon-Sainfort, 1989). The work factors of importance in job design, occupational stress, and ergonomics literature can be categorized as follows:

- job content: variety, challenge, skill utilization, skill development;
- job control: control over different facets of work, for example, pace, order, content, methods, people;
- job demands: workload, work pressure, cognitive demands, attention;
- job future and career: uncertainty, job loss, career growth, and opportunities;
- social and organizational aspects: social support, socialization, role ambiguity and conflict, resources;
- ergonomics: physical environment, force, postures, and so forth.

2.2. TQM, Work Design, and QWL

Total Quality Management (TQM) is an approach for continuously improving the quality of goods and services delivered and, therefore, meeting or exceeding the needs and expectations of customers through the participation of all levels and functions of the organization (Miller, 1996; Pfau, 1989). TQM requires a philosophy based on problem solving using data; it builds upon involvement and participation from top management to the shop floor; it focuses on customer orientation, comprehensive quality monitoring, and supportive management systems (Smith et al., 1989). TQM has been conceptualized as an approach to management that can be characterized by its principles, practices, and techniques (Dean & Bowen, 1994). TQM principles are customer focus, continuous improvement, and teamwork. These principles are implemented through practices or activities, such as data collection, process analysis, and group skills training. The practices are supported by a range of

techniques, that is, methods intended to make the practices effective. TQM techniques include customer surveys, flowcharts, and team-building methods. Our model incorporates the TQM principles defined by Dean and Bowen (1994):

- customer focus: providing products and services that fulfill customer needs; organization-wide focus on customers;
- continuous improvement and learning: relentless improvement of processes that create products and services;
- teamwork and organizational system: collaboration throughout an organization as well as with customers and suppliers;

TQM represents an organizational change that can have much impact on the different elements of the work system, therefore, on work design and quality of working life (Smith & Carayon-Sainfort, 1989). Figure 2 shows the hypothesized relationship between TQM, work design, and QWL. This model is similar to the process model of quality management proposed by Gatewood and Riordan (1997). In previous research, we have developed and tested models of the effects of different forms of technology on people, such as computer system performance (Carayon-Sainfort, 1992), and electronic performance monitoring (Carayon, 1994; Smith, Carayon, Sanders, Lim, & LeGrande, 1992). These models are based on the assumption that technology has a direct effect on people, but also an indirect effect through changes in work design (Smith & Carayon-Sainfort, 1989). The TQM, work design, and

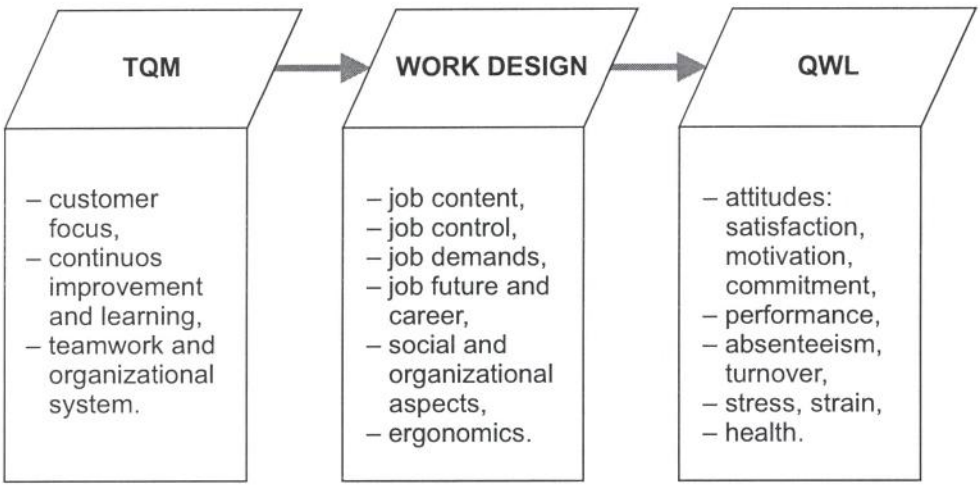

Figure 2. Relationships between Total Quality Management (TQM), work design, and quality of working life (QWL).

QWL model shown in Figure 2 is based on a similar assumption that TQM can have a direct effect on QWL, but also an indirect effect through changes in work design.

The principles of continuous improvement, and teamwork and organizational system are often implemented through cross-functional quality teams, and the work content of such teams is usually quite well designed and rich (Hackman & Wageman, 1995). Therefore, one can predict that TQM will have positive effects on job content. Hackman and Wageman (1995) assert that the distribution of authority typically does not change much when TQM is implemented. However, the TQM principle of continuous improvement often means that employees are given opportunities for learning (Hackman & Wageman, 1995) and the TQM principle of customer focus means that employees are given direct customer contact and, therefore, some latitude on how to deal with the customers (Dean & Bowen, 1994). Therefore, TQM could have either no effect or a positive effect on job control. The implementation of TQM principles requires the creation of various task forces, focus groups, and problem-solving teams, therefore adding to the workload of employees. Therefore, TQM could increase the job demands. With the opportunities for learning offered through TQM (Hackman & Wageman, 1995), employees may perceive improvements in their job future and career. The teamwork principle of TQM involves collaboration between managers and nonmanagers, and between functions (Dean & Bowen, 1994), therefore leading to improvement in the social relationships. The implementation of the TQM principle of continuous improvement may involve the clarification of job duties within the organization, therefore reducing role ambiguity and role conflict. Finally, the implementation of TQM could lead to the improvement in ergonomics (see, e.g., the case study described by Rooney et al., 1993). This short discussion of the impact of TQM implementation shows that TQM can have positive effects, negative effects, or no effects on different aspects of work design, and, therefore, on quality of working life.

Empirical research, in particular in the public sector, shows that the implementation of TQM can have some positive impact on various indicators of QWL, job satisfaction, commitment, and absenteeism (Morrow, 1997; Poister & Harris, 1996), but also some negative impact (Connor, 1997). A case study of the implementation of TQM in an Australian organization showed that TQM can have both positive and negative impact on employees, even after 7 years (Fisher & Davis, 1992). The impact of TQM on work design and QWL may depend on

the content of the TQM approach used by the organization, as well as on the way TQM is implemented (Ahire, Waller, & Golhar, 1996; Sitkin, Sutcliffe, & Schroeder, 1994). In this paper, we examine the impact of TQM on work design and QWL in six departments of two different organizations. This allows us to examine the possible variation of the impact of TQM in different organizational contexts.

3. METHODOLOGY

The empirical research reported in this paper was conducted in the public sector. In recent years, there has been increasing interest from practitioners, consultants, managers, engineers, and academicians for the public sector. Peter Drucker recently advocated management researchers and consultants to focus their attention on the public sector (Drucker, 1998). In industrialized countries, the public sector represents a large part of the Gross National Product. Understanding how one can improve the effectiveness and efficiency of the public sector is a very important goal, given the significance of the public sector. Total Quality Management has been seen by some as a way to improve the effectiveness and efficiency of the public sector (Milakovich, 1991; Rago, 1994). However, this opinion is not shared by everyone, and limits of the application of TQM in the public sector have been highlighted (Swiss, 1992; Younis, 1997). Others have proposed mixed views on TQM in the public sector. For instance, Durant and Wilson (1993) proposed a contingency theory of TQM applications in government organizations; and Hyde (1993) highlighted the steps a public sector organization can follow in implementing a TQM program, and the associated difficulties. In any case, any program or strategy aimed at improving quality and effectiveness within the public sector should consider its organizational and human characteristics (Dale, 1994; Smith et al., 1989). In this paper, we report on empirical research conducted in the public sector. Data regarding the impact of TQM on work design and QWL is discussed.

3.1. Sample

Data were collected in two public sector organizations in the midwest of the USA. The first organization is a local government organization, which is known as a pioneer among American public sector organizations in adopting and implementing TQM principles. The quality program

started in 1983 in the form of a collaboration between the Mayor's office and the Center for Quality and Productivity Improvement of the University of Wisconsin-Madison (Box, Joiner, Rohan, & Sensenbrenner, 1989). Over the last 15 years, the quality improvement program has expanded in three different directions: (a) team-based quality improvement projects, (b) quality in daily work, and (c) strategic management system (Carayon & Sainfort, 1997). The different data-collection methods used in this organization include archival data analysis, face-to-face interviews, focus groups, and surveys[1]. The data reported in this paper rely on the survey results. Four departments were chosen for the questionnaire survey. These departments were chosen for their various levels of involvement in quality initiatives and their varied structures and missions. Response rates varied from 37 to 87% across agencies with an overall response rate of 58%, that is, giving us a useable sample of 424 respondents. There were 117 study participants in department 1, 146 in department 2, 26 in department 3, and 134 in department 4[2].

The second organization has been involved with quality improvement efforts since the beginning of the 1990s. Recently, there has been a renewed effort for a more efficient application of TQM. In the fall of 1996, all employees of two departments were trained in Quality-Based Leadership (QBL). QBL training included: (a) Introduction: The Road to Total Quality, (b) The Essentials of Managing Total Quality, (c) Personal Quality, (d) Understanding the Elements, (e) Case Study, (f) The Elements in Practice, (g) Annual Quality Improvement Plan, (h) From Vision to Action, and (i) Case Study. The implementation of the QBL training gave us the opportunity to conduct a longitudinal before-after study of the effects and effectiveness of the QBL training program. In this organization, we used two data-collection methods: a questionnaire survey and document analysis[3]. A major part of the questionnaire survey used in the two participating organizations was common, therefore allowing comparisons between the two organizations. A total of 70 people participated in the questionnaire survey. There were 41 study participants in department 5 and 29 study participants in department 6.

[1] Funding for this research study was provided by the National Science Foundation "Total Quality Organizations" program (Principal Investigator: François Sainfort, Grant No. SBR-9529900).

[2] One respondent did not specify his or her department, and was, therefore, excluded from any data analyses.

[3] Funding for this research study was provided by the Center for VDT and Health Research of the Johns Hopkins University (Principal Investigator: Pascale Carayon, contract No. 95-0004).

3.2. Study Procedures

In both organizations, commitment was obtained from management and union representatives for the study. Partnerships were built between the management, union representatives, and the researchers to conduct and organize the study. Participation in the questionnaire survey was on a voluntary basis. Both organizations provided on-the-job time to employees for participating in the study. In the first organization, questionnaires were anonymous. In the second organization, questionnaires were not anonymous. In this organization, two rounds of questionnaire were conducted, one round 1 month before the QBL training, and a second round 8 months after the QBL training. In order to keep track of individual employees' responses, we asked study participants to write down the last four digits of their Social Security number on the questionnaire. The longitudinal data were used to examine the over-time impact of QBL on work design.

3.3. Questionnaire Survey

The questionnaire surveys used in the two organizations had the same structure. They basically consisted of four sections:

- general job information and demographic information,
- implementation and characteristics of TQM,
- job and organizational characteristics,
- quality of working life.

More details on the questionnaire survey used in the first organization are provided in Sainfort et al. (1998a). For additional information on the questionnaire survey used in the second organization, see Carayon, Schmitz, and Newman (1998).

4. RESULTS

According to Hackman and Wageman (1995), the evaluation of a TQM program can involve three types of assessment: (a) empirical demonstration that TQM has, in fact, been implemented, (b) determination of whether TQM alters how people work, and (c) the degree to which improvements in organizational functioning are observed. Our data covers all three

types of assessment. We will, first, present data on the implementation of TQM in the two organizations. In the second and third parts of the Results section, we report data on the impact of TQM on work design and QWL. People were asked to report changes in their work and their quality of working life due to TQM. Only a small part of the data relates to improvements in organizational functioning as perceived by the employees.

4.1. Implementation of TQM in the Two Organizations

Organization 1 has a long experience with TQM: the first quality improvement project started in 1984. For more details on the development of TQM in organization 1, see Box et al. (1989) and Sainfort et al. (1998a). Several questions in the questionnaire survey asked about the implementation of TQM within the organization. These questions are used to describe the degree to which TQM is implemented in the two organizations. Table 1 displays the results for each of the six departments of the two organizations. In general, department 5 in organization 2 tends to have a lower level of TQM implementation, whereas departments 3 and 4 tend to have the highest level of TQM implementation.

4.2. Effects of TQM on Work Design and QWL

Study participants in both organizations were asked about the impact of TQM on QWL and on various aspects of their work. A series of six questions asked study participants their degree of agreement-disagreement regarding the impact of TQM on QWL and various aspects of work:

- QWL-attitudes: increased satisfaction, increased loyalty to the organization;
- QWL-performance: little improvement to one's job, help in daily work, improved access to information;
- work design-job demands: additional work.

Figure 3 shows the results for the four departments of the first organization and the two departments of the second organization on the impact of TQM on QWL and various aspects of work. The results are displayed as means within each department on a 1–5 scale (1—strongly disagree, 2—disagree, 3—neither agree nor disagree, 4—agree, 5—strongly

TABLE 1. Implementation of Total Quality Management (TQM) Within the Two Organizations

	Organization 1				Organization 2	
	Department 1	Department 2	Department 3	Department 4	Department 5	Department 6
Employees ever involved in TQM team effort	31%	36%	58%	48%	29%	50%
Employees currently involved in TQM team effort	26%	27%	29%	44%	15%	92%
Number of team efforts (median)	2	3	4	2	2	1
Employees volunteer in TQM team effort	59%	74%	82%	48%	67%	62%
Degree of TQM implementation within one's department (1—not at all implemented, 10—completely implemented; mean, *SD*)	4.04 (2.04)	4.60 (2.15)	5.23 (2.52)	5.55 (2.23)	3.36 (1.85)	4.92 (2.61)
Degree of personal use of TQM (1—not at all applied, 10—completely applied; mean, *SD*)	4.05 (2.70)	5.00 (2.43)	4.84 (2.08)	5.43 (2.35)	5.19 (2.24)	5.23 (2.47)

disagree) for each of the six statements. Data collected in the second round of survey was used for organization 2. Overall, the means for the six questions were around the value coded as 3, indicating a rather neutral position on average, except for department 5. The results for department 5 indicate that TQM did not have much impact on QWL and work. A closer look at the distribution of answers to these questions showed much disagreement within the departments on the impact of TQM on QWL and work design. In five of the six departments, about one-quarter to one-third of the study participants thought that TQM had increased their satisfaction and loyalty to the organization, and about the same percentage of study participants thought that TQM had not increased their satisfaction and loyalty to the organization. In these same departments, about one-quarter to half of the study participants thought that TQM had positive impact on their performance, that is, improved one's job, helped in daily work and improved access to information. A smaller proportion, but still significant, thought that TQM had not improved their performance. The opinion regarding TQM being additional work was very uneven across the departments: from 40% in department 6 to 9% in department 2.

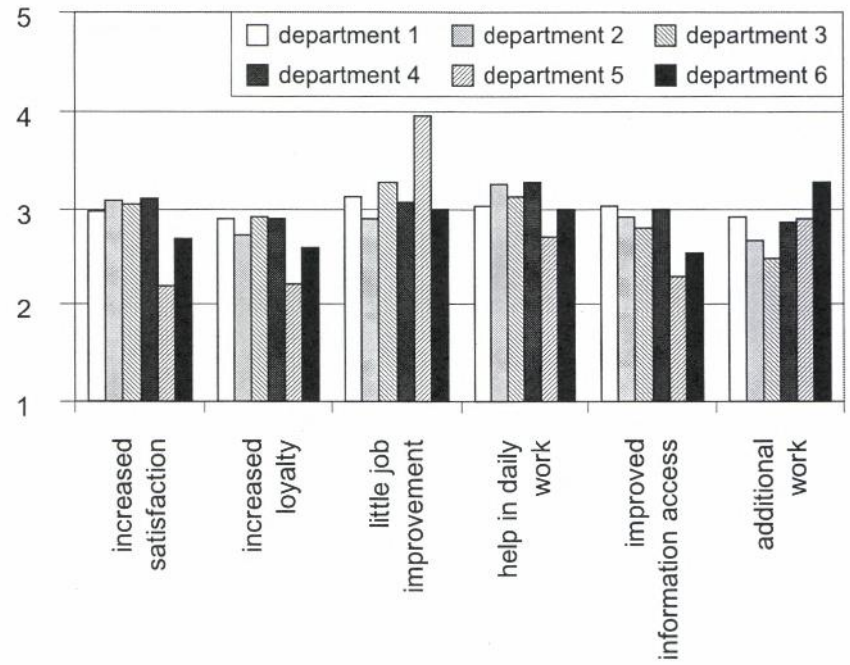

Figure 3. Impact of Total Quality Management (TQM) on quality of working life (QWL) and work. *Notes.* Response scale: 1—strongly disagree, 2—disagree, 3—neither agree nor disagree, 4—agree, 5—strongly agree.

Statistical analyses were performed to compare the six departments on the six questions regarding the impact of TQM on QWL and work design. For each question, an analysis of variance was performed with department as the group variable. The six questions were considered as continuous variables with 5 response categories (1—strongly agree to 5—strongly disagree). ANOVA's achieved a significant level ($p < .05$) for all six questions. Post-hoc Scheffé tests were conducted to examine the differences between the departments. Results of post-hoc tests were as follows:

- department 5 reported less increased satisfaction due to TQM than departments 1–4;
- department 5 reported less increased loyalty to the organization due to TQM than departments 1, 3, and 4;
- department 5 reported less improvement to one's job due to TQM than departments 1–4;
- department 5 reported less help in daily work due to TQM than departments 1–4;
- department 5 reported less improved access to information due to TQM than departments 1 and 3;
- department 6 reported more additional work due to TQM than departments 2 and 3.

Figure 4 shows the results about the effects of TQM on various aspects of work. Study participants were asked whether TQM had increased (coded as +1), had no effect on (coded as 0) or had decreased (coded as −1) the following 12 different aspects of work:

- QWL-performance: response time to customers;
- work design-job content: opportunity for personal growth, variety, feedback;
- work design-job control: participation in decisions;
- work design-job demands: workload;
- work design-job future and career: opportunity for advancement;
- work design-social and organizational aspects: conflicting job duties, clarity of job duties, recognition, relationships with co-workers, relationships with one's supervisor.

The results are reported as means using the −1/0/+1 scale for each of the 12 aspects of work. Overall, the highest means are obtained for workload, participation, opportunity for growth, variety, and relationships with co-workers. The means for opportunity for advancement and

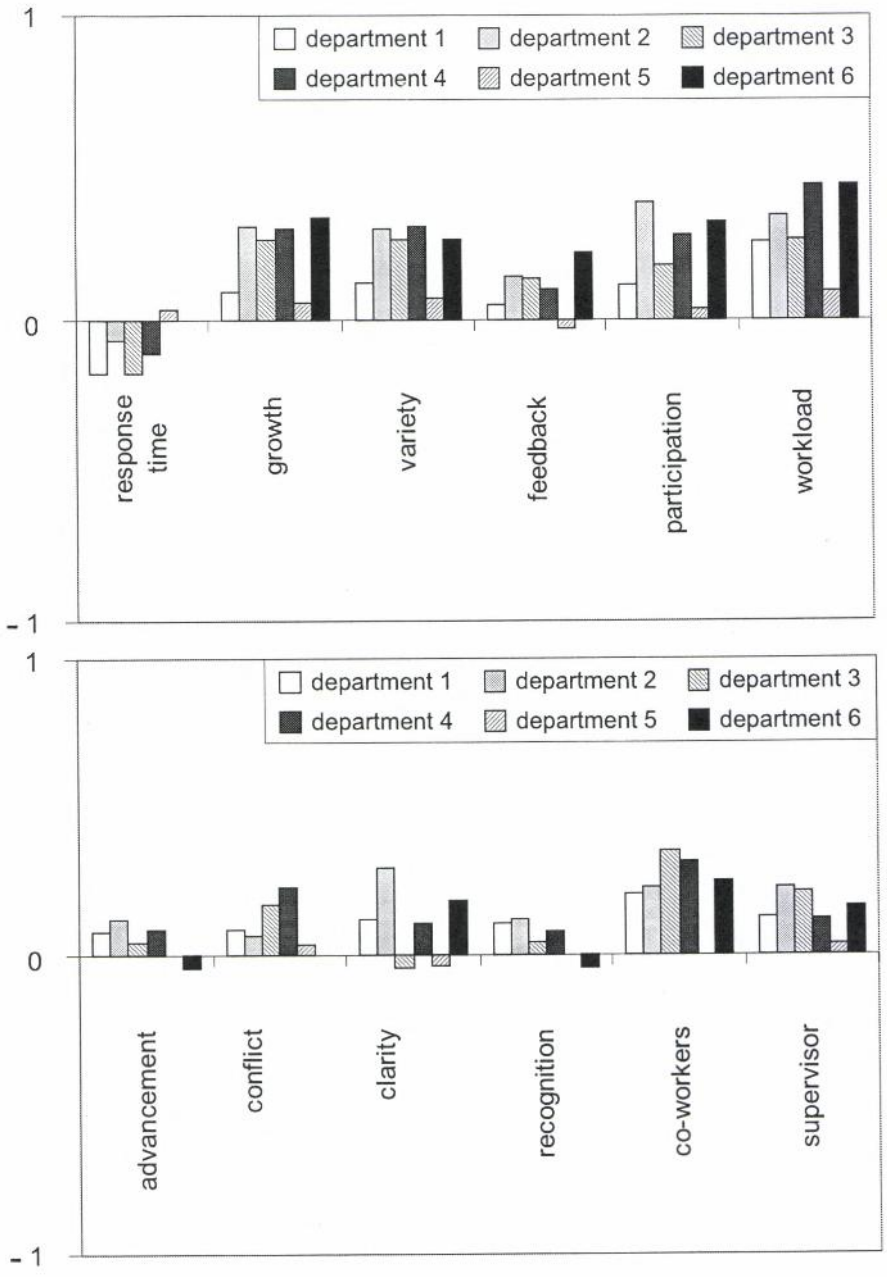

Figure 4. Effects of Total Quality Management (TQM) on various aspects of work. *Notes.* Response scale: 1—decrease, 0—no change, 1—increase; growth—opportunity for growth, advancement—opportunity for advancement, conflict—conflicting job duties, clarity—clarity of job duties, co-workers—relationship with co-workers, supervisor —relationship with one's supervisor.

recognition are close to 0. These results indicate that TQM had much negative impact on workload; much positive impact on participation, opportunity for growth, variety, and relationships with co-workers; and little effect on opportunity for advancement and recognition.

Nonparametric analyses of variance (Kruskal-Wallis test) were performed to examine differences across the six departments for each of the 12 questions. Five of the 12 tests achieved statistical significance ($p < .05$): opportunity for personal growth, variety, participation in decisions, workload, and relationships with co-workers. TQM tended to increase opportunity for personal growth more in departments 2, 3, 4, and 6, and less in department 5. TQM tended to increase variety more in departments 2, 3, 4, and 6, and less in department 5. TQM tended to increase participation in decision-making more in departments 2, 3, 4, and 6, and less in department 5. TQM tended to increase workload more in departments 4 and 6, and less in department 5. TQM tended to increase relationships with co-workers more in departments 1, 2, 3, 4, and 6, and less in department 5.

4.3. Effects of QBL Over Time in the Second Organization

In order to examine the effects of QBL over time, we examined changes in 19 selected work factors between the two rounds of surveys in the second organization[4]:

- work design-job content: boredom, challenge, task uncertainty, required skill;
- work design-job control: task control, decision control, resource control, pace control, participation;
- work design-job demands: quantitative workload, work pressure, attention, mental demands, computer-system performance;
- work design-job future and career: job future concerns;
- work design-social and organizational aspects: supervisor social support, colleague social support, interaction with difficult clients, role ambiguity.

We expected that employees involved in QBL would report changes in work factors over time. We used two indicators of QBL involvement:

- personal use of QBL,
- involvement in QBL team effort.

[4] For more details on the scales and their characteristics, see Carayon et al. (1998).

TABLE 2. Comparison of Low Versus High Personal Use of Quality-Based Leadership (QBL, GROUP variable)

	Within-Subjects Effects			
Work Factors	**Round**	**Interaction Round * Group**	**Between-Subjects Effects**	**Comments**
Boredom	*ns*	*ns*	$F = 6.68,\ p < .05$	People with high QBL personal use report less boredom than people with low QBL personal use (average rounds 1 and 2 mean—1.74 vs. 2.45).
Challenge	*ns*	*ns*	$F = 6.84,\ p < .05$	People with high QBL personal use report more challenge than people with low QBL personal use (average rounds 1 and 2 mean—5.43 vs. 4.66).
Task uncertainty	*ns*	*ns*	$F = 6.99,\ p < .05$	People with high QBL personal use report more task uncertainty than people with low QBL personal use (average rounds 1 and 2 mean—5.40 vs. 4.63).
Task control	*ns*	*ns*	$F = 5.53,\ p < .05$	People with high QBL personal use report more task control than people with low QBL personal use (average rounds 1 and 2 mean—3.54 vs. 3.26).
Decision control	*ns*	$F = 3.98,\ p = .051$	$F = 7.27,\ p < .01$	Decision control increases from round 1 to round 2 for people with high QBL personal use (mean at round 1—2.98, mean at round 2—3.23), but does not increase for people with low QBL personal use (mean at round 1—2.34, mean at round 2—2.30). People with high QBL personal use report more decision control than people with low QBL personal use (average rounds 1 and 2 mean—3.11 vs. 2.32).
Resource control	*ns*	*ns*	$F = 8.34,\ p < .01$	People with high QBL personal use report more resource control than people with low QBL personal use (average rounds 1 and 2 mean—3.53 vs. 2.84).
Participation	*ns*	*ns*	$F = 5.17,\ p < .05$	People with high QBL personal use report more participation than people with low QBL personal use (average rounds 1 and 2 mean-3.24 vs. 2.82)

Notes. In this table, only significant results are reported. Nonsignificant results were obtained for the following variables: required skill, pace control, workload, work pressure, attention, mental demands, computer-related problems, job future ambiguity, supervisor social support, colleague social support, interaction with difficult clients, and role ambiguity.

For the first comparison, we used the question on the degree of personal use of QBL. The response categories varied from 1 (not at all applied) to 10 (completely applied). The middle response category was "moderately applied." We split the sample into two groups: low personal use of QBL (response categories ranging from 1 to 5, $N = 30$) and high personal use of QBL (response categories ranging from 6 to 10, $N = 33$). We then compared employees involved in at least one QBL team effort ($N = 24$) to employees not involved in any QBL team effort ($N = 40$). A comparison was performed of the two indicators of QBL involvement. Of those who reported a low level of personal use of QBL, only 23% were involved in a QBL team effort. Of those who reported a high level of QBL personal use, 50% were also involved in a QBL team effort.

We used the general linear model (GLM) with repeated measures to examine the differences in work factors over time between the groups. The groups were defined according to the QBL involvement indicator. The round was a within-subjects factor, whereas the group was a between-subjects factor.

Table 2 shows the results of the GLM repeated measures analysis performed to compare people who are heavy personal users of QBL to people who do not use QBL much. Out of the 19 work factors, we found one significant interaction term for decision control. Decision control increases from the first round to the second round for people who personally use QBL, but does not change for people who do not personally use QBL (see Figure 5). There is a significant between-subjects effect for seven work factors: boredom, challenge, task uncertainty, task control, decision control, resource control, and participation. Overall,

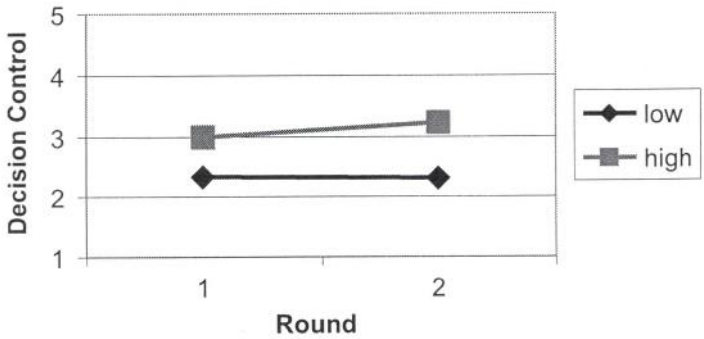

Figure 5. Effects of (low vs. high) personal use of Quality-Based Leadership (QBL) on decision control. *Notes.* A high score on the vertical axis represents high decision control, and a low score represents low decision control.

TABLE 3. Comparison of Employees Involved in at Least One Quality-Based Leadership (QBL) Team Effort and Employees Not Involved in Any QBL Team Effort (Group Variable)

	Within-Subjects Effects			
Work Factors	**Round**	**Interaction Round * Group**	**Between-Subjects Effects**	**Comments**
Boredom	*ns*	*ns*	$F = 4.40,\ p < .05$	People involved in QBL team effort report less boredom than people not involved QBL team effort (average rounds 1 and 2 mean—1.72 vs. 2.18).
Challenge	*ns*	*ns*	$F = 2.87,\ p = .10$	People involved in QBL team effort report more challenge than people not involved in QBL team effort (average rounds 1 and 2 mean—5.40 vs. 4.86).
Task uncertainty	*ns*	*ns*	$F = 4.12,\ p < .05$	People involved in QBL team effort report more task uncertainty than people not involved in QBL team effort (average rounds 1 and 2 mean—5.45 vs. 4.81).
Required skill	*ns*	*ns*	$F = 4.26,\ p < .05$	People involved in QBL team effort report more required skill than people not involved in QBL team effort (average rounds 1 and 2 mean—5.89 vs. 5.47).
Task control	*ns*	$F = 9.29,\ p < .01$	$F = 12.06,\ p < .001$	Task control increases for people involved in QBL team effort (mean at round 1—3.68, mean at round 2—3.94), but task control decreases for those not involved in QBL team effort (mean at round 1—3.26, mean at round 2—3.16). People involved in QBL team effort report more task control than people not involved in QBL team effort (average rounds 1 and 2 mean—3.81 vs. 3.22).
Decision control	*ns*	$F = 3.24,\ p = .077$	$F = 34.77,\ p < .001$	Decision control decreases from round 1 to round 2 for people involved in QBL team effort (mean at round 1—3.73, mean at round 2—3.65), but increases for people not involved in QBL team effort (mean at round 1—2.08, mean at round 2—2.29). People involved in QBL team effort report more decision control than people not involved in QBL team effort (average rounds 1 and 2 mean—3.11 vs. 2.32).
Resource control	*ns*	*ns*	$F = 8.51,\ p < .01$	People involved in QBL team effort report more resource control than people not involved in QBL team effort (average rounds 1 and 2 mean—3.63 vs. 2.92).

TABLE 3. (cont.) Comparison of Employees Involved in at Least One Quality-Based Leadership (QBL) Team Effort and Employees Not Involved in Any QBL Team Effort (Group Variable)

	Within-Subjects Effects			
Work Factors	Round	Interaction Round * Group	Between-Subjects Effects	Comments
Pace control	*ns*	$F = 2.66$, $p = .11$	$F = 6.37$, $p < .05$	People involved in QBL team effort report more pace control at round 2 than at round 1 (mean at round 1—5.49, mean at round 2—5.81); however, there is a decrease in pace control for people not involved in QBL team effort (mean at round 1—4.89, mean at round 2—4.78). People involved in QBL team effort report more pace control than people not involved in QBL team effort (average rounds 1 and 2 mean—5.65 vs. 4.84).
Participation	*ns*	*ns*	$F = 12.64$, $p < .001$	People involved in QBL team effort report more participation than people not involved in QBL team effort (average rounds 1 and 2 mean—3.59 vs. 2.80).
Interaction with difficult clients	*ns*	*ns*	$F = 9.61$, $p < .01$	People involved in QBL team effort report more interaction with difficult clients than people not involved in QBL team effort (average rounds 1 and 2 mean—3.30 vs. 2.79).
Role ambiguity	*ns*	*ns*	$F = 4.25$, $p < .05$	People involved in QBL team effort report less role ambiguity than people not involved in QBL team effort (average rounds 1 and 2 mean—1.69 vs. 2.01).

Notes. In this table, only significant results are reported. Nonsignificant results were obtained for the following variables: workload, work pressure, attention, mental demands, computer-related problems, job future ambiguity, supervisor social support, and colleague social support.

people who personally use QBL report less boredom and more challenge, uncertainty, task control, decision control, resource control, and participation than people who do not use QBL.

Table 3 shows the results of the GLM repeated measures analysis performed to compare people involved in QBL team effort to people not involved in QBL team effort. Out of the 19 work factors, we found one significant interaction term for task control, and two borderline significant interaction terms for decision control and pace control. Task control increases from the first round to the second round for people

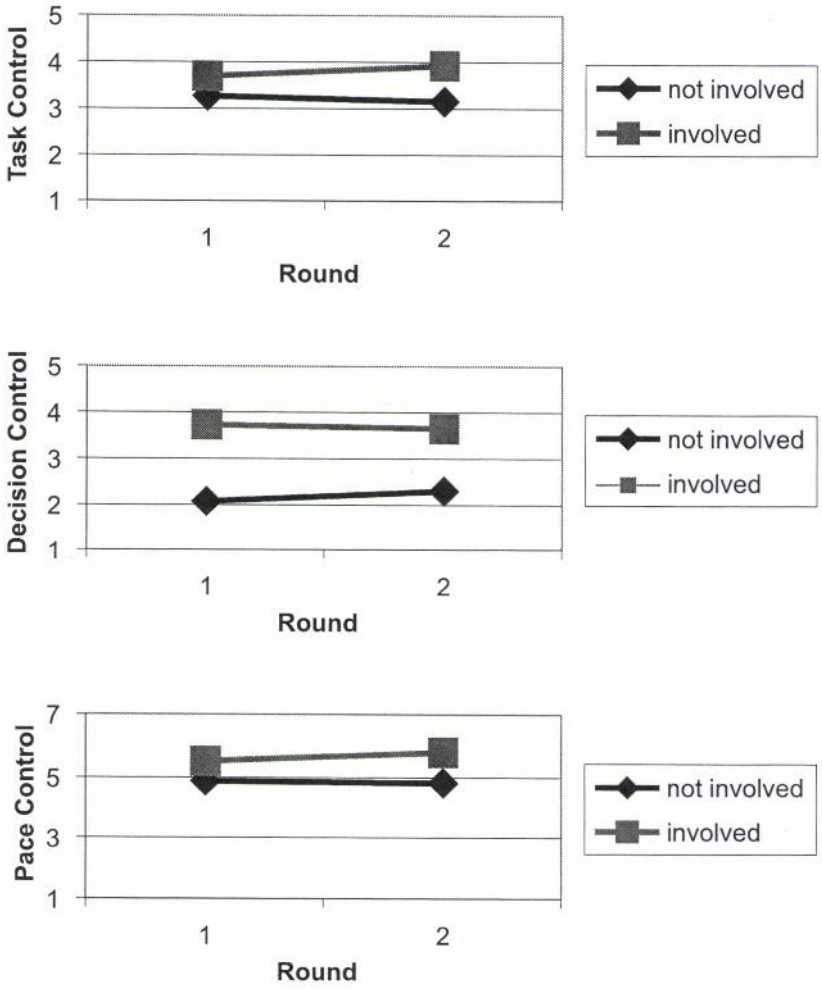

Figure 6. Effects of involvement in Quality-Based Leadership (QBL) team effort on task control, decision control, and pace control. *Notes.* A high score on the vertical axis represents high task control, decision control, and pace control, and a low score represents low task control, decision control, and pace control.

involved in QBL team effort, but decreases for people not involved in QBL team effort (see Figure 6). This result is confirmed by the borderline significant level of the interaction term for pace. People involved in QBL team effort report a higher level of pace control at the second round than at the first round, whereas people not involved in QBL team effort report less pace control at the second round than at the first round (see Figure 6). On the other hand, the trend for decision control is unexpected: decision control decreases from the first round to the second round for people involved in QBL team effort, but increases for people not involved in QBL team effort (see Figure 6). However, the level of decision control at the second round is higher for people involved in QBL team effort than for people not involved.

There is a significant between-subjects effect for nine work factors: boredom, challenge, task uncertainty, required skill, task control, decision control, resource control, pace control, and participation. Overall, people involved in QBL team effort report less boredom and more challenge, uncertainty, required skill, task control, decision control, resource control, pace control, and participation than people not involved in QBL team effort.

5. DISCUSSION

In this paper, we have examined the links between TQM, work design and quality of working life. It was hypothesized that TQM could have much (positive or negative) impact on work design and quality of working life. Data were collected in two public sector organizations that have implemented TQM. Six departments, four in the first organization and two in the second organization, participated in the study. These six departments have varying degree of TQM implementation. One department had a relatively low level of TQM implementation (department 5), and two departments (3 and 4) tended to have a higher level of TQM implementation.

Questionnaire data collected in the two organizations allowed us to assess the impact of TQM on various aspects of work design and QWL. The first set of questions showed much disagreement across departments and also within departments on the impact of TQM on QWL and work design. In the department with the lowest degree of TQM implementation (i.e., department 5), respondents indicated that TQM had very little

impact on QWL and work design. The second set of questions showed positive impact of TQM on the following aspects of work (see Figure 4):

- participation in decisions,
- opportunity for personal growth,
- task variety,
- relationships with co-workers.

A negative impact of TQM was found for the following aspect of work:

- workload.

The impact of TQM on clarity of job duties was mixed: both positive and negative influences of TQM were found. The largest impact of TQM was found on participation in decision-making, workload, opportunity for growth, variety, and relationships with co-workers.

In organization 2, data were collected before and after the implementation of a Quality-Based Leadership training program. This allowed us to assess the impact of QBL on various aspects of work design. We, first, compared people who personally use QBL a lot to those who do not use it very much. Decision control tended to increase only for people with high QBL personal use (see Figure 5). People with high QBL personal use tended to report better job content (i.e., less boredom, more challenge), more job control and more participation, but also more task uncertainty than people with low QBL personal use. The personal use of QBL seems to be related to many positive characteristics of work, except for high task uncertainty. In the second analysis, we compared people involved in at least one QBL team effort and people not involved in any QBL team effort. Task control and pace control tended to increase for people involved in QBL team effort (see Figure 6). However, these same people experienced a drop in decision control, whereas people not involved in QBL team effort perceived an increase in decision control (see Figure 6). People involved in QBL team effort tended to report better job content (i.e., less boredom, more challenge, more required skill), more job control and more participation, but also more task uncertainty than people not involved in QBL team effort. Involvement in QBL team effort seemed to be related to many positive characteristics of work, except for high task uncertainty. In addition, people involved in QBL team effort tend to report less decision control over time.

These results show that the impact of TQM on work design and QWL can be both positive and negative. In general, TQM has a positive

impact on job content, participation and job control, and social relationships, and a negative impact on workload and uncertainty. The impact of TQM on various indicators of QWL was both positive and negative. Therefore, in designing and implementing a TQM program, it is important to take into account a range of work factors that are of importance for QWL. The potential negative impact of TQM on work factors, in particular on workload and uncertainty, should be considered. The implementation of TQM involves additional tasks and activities for the employees and their managers. This additional workload can be a potent source of stress, and, therefore, consequences in terms of health and well-being. As suggested by the Job Strain model of Karasek (1979), the positive impact of TQM on job control and participation may moderate the negative effect of increased workload, however. TQM was also found to increase uncertainty. It is interesting to observe that Quality Assurance programs tend to specify tasks and activities, whereas TQM programs may have the opposite effect of creating or increasing uncertainty. The increased uncertainty may be due to the double activities that people involved in TQM perform: (a) their regular job duties, and (b) the TQM-related activities, for example, membership on a project team. This problem has also been found in matrix organizations where employees have actually two bosses, their functional supervisor and their project manager.

In our study, we found that TQM tended to have much positive impact on job control, participation, job content, and social relationships. TQM allowed employees to participate in project teams, to improve work processes, and to assess their customers' needs and satisfaction. These activities may lead to increased job control and participation, as well as to improvement in the content of the jobs performed and increased skills utilization and development. In addition, the social climate and relationships within the organization can improve too. The longitudinal data in the second organization shows some mixed effect of TQM on decision control. Employees reporting high in the personal use of TQM reported more decision control over time, but employees involved in a TQM team effort reported less decision control over time. Participation in TQM group activities may lead to a loss of decision control, whereas personal use of TQM may lead to a gain in decision control. Study participants in the second organization were professionals and managers. Therefore, for these job categories, TQM group activities where decisions are made by the group may actually lead to a loss of

decision control. In both organizations participating in this study, the TQM program was largely based on team efforts, that is, problem-solving teams (see Table 1). In addition, training was given to many employees in order to sustain the team approach and the problem-solving processes. These characteristics may have influenced our results, in particular the positive impact on job control, participation, job content, and social relationships, and the negative impact on workload. Team-based efforts can provide interesting opportunities for employees and enrich their jobs and their environment, but apparently at a cost, that is, increased workload.

It is important to recognize that our data shows that the impact of TQM varies not only across departments, but also within departments. For instance, whereas a large majority of study participants across departments reported a positive impact of TQM on participation in decision-making, 20% of employees in department 3 reported a decrease in participation and 36% employees of that same department reported an increase in participation. Overall, the impact of TQM was very small on department 5. This is quite understandable given the low level of TQM implementation in this department (see Table 1). Only 29% of employees in this department have ever been involved in a TQM team effort. At the time of the survey, only 15% of the employees in this department were currently involved in a TQM team effort. On the other hand, the impact of TQM tended to be much stronger on departments 2, 3, and 4. These three departments, in particular departments 3 and 4, tended to have a high level of TQM implementation. Therefore, when examining the impact of TQM on work design and QWL, it is important to assess the type and the deployment of the TQM program implemented.

When evaluating a TQM program, Hackman and Wageman (1995) have recommended three types of assessment: (a) TQM implementation, (b) impact of TQM on work, and (c) improvements in organizational functioning. In our study, the implementation of TQM varied across departments, therefore leading to various effects on work and organizational functioning. Overall, TQM had both positive and negative impact on work design, and mixed effects on organizational functioning. Our results tend to show that TQM does not have a uniform (positive) impact on work design and QWL. Our results do not confirm the results of previous studies that have found a positive impact on various indicators of QWL, such as job satisfaction, commitment and absenteeism

(Morrow, 1997; Poister & Harris, 1996). In addition, it is important to understand the multiple work factors that can be impacted by TQM. In particular, the impact of TQM on workload and other types of job demands has not been studied very much. Whether the impact of TQM on these various work factors can be balanced out in order to avoid negative consequences on the individual and the organization needs to be demonstrated (Smith & Carayon-Sainfort, 1989). Therefore, it is important to examine the three interrelated aspects of quality: quality of products and processes, quality of workforce, and quality of working life (see Figure 1).

Our study involved two public service organizations in the USA, therefore limiting the generalizability of the results to other organizations in other countries. In addition, the data reported in this study is based solely on employee questionnaire surveys. This is another potential weakness of our study. However, our interest is to understand the impact of TQM on individual employees. Therefore, asking these people for their opinion is important.

Further research is necessary to understand the impact of TQM on work design and QWL. In particular, we need to untangle the impact of different aspects of TQM on work design and QWL. Dean and Bowen (1994) listed three TQM principles, that is, customer focus, continuous improvement and learning, and teamwork and organizational system. For each TQM principle, Dean and Bowen described practices and activities, as well as techniques and methods. An evaluation of the relationships between the TQM principles and their associated practices and techniques, on one hand, and work design and QWL, on the other hand, would give us valuable information on which aspects of TQM are potentially positive or negative. This evaluation will help TQM practitioners avoid the problems related to the implementation of TQM, in particular the negative impact on the workforce.

6. CONCLUSION

In this paper, we have examined the macroergonomic impact of TQM on work design and QWL. Our data show that TQM can have both positive and negative impact on work design and QWL. The main positive effects of TQM were found on job content, job control and participation, and social relationships. The main negative impact of TQM was on workload, uncertainty, and clarity of job duties.

Recently, there has been an increased interest in TQM literature on the role of humans (Connor, 1997; Russell, 1993). Our study contributes to the empirical data base on the human impact of TQM, in particular in the public sector. Further understanding the linkage between TQM and its various components, and work design and QWL is warranted.

REFERENCES

Ahire, S.L., Waller, M.A., & Golhar, D.Y. (1996). Quality management in TQM versus non-TQM firms: An empirical investigation. *International Journal of Quality and Reliability Management*, 13, 8–27.

Attewell, P., & Rule, J. (1984). Computing and organizations: What we know and what we don't know. *Communications of the ACM*, 27, 1184–1192.

Ball, J., & Procter, D. (1994). Zero-accident approach at British Steel, Teesside Works. *Total Quality Management, 5*, 97–104.

Box, G.E.P., Joiner, L.W., Rohan, S., & Sensenbrenner, F.J. (1989). *Quality in the community: One city's experience.* Madison, WI: Center for Quality and Productivity Improvement of the University of Wisconsin-Madison.

Carayon, P. (1994). Effects of electronic performance monitoring on job design and worker stress: Results of two studies. *International Journal of Human Computer Interaction, 6*, 177–190.

Carayon, P., Coujard, J.-L., & Sainfort, F. (1997). Implementation of a quality management program in the public sector. In P. Vink (Ed.), *Human factors in organizational design and management—VI* (pp. 147–152). Amsterdam: Elsevier Science.

Carayon, P., & Sainfort, F. (1997). *Management Total de la Qualité dans le secteur public—L'expérience de la ville de Madison, capitale de l'Etat du Wisconsin aux Etats-Unis* [Total Quality Management in the public sector—Experience of the city of Madison, capital of the state of Wisconsin in the US]. Nancy, France: Ecole des Mines de Nancy.

Carayon, P., Schmitz, W., & Newman, L. (1998). Evaluation of an assessment tool for measuring psychosocial work factors and health in office/computer work. In P. Vink (Ed.), *Human factors in organizational design and management—VI* (pp. 661–666). Amsterdam: Elsevier Science.

Carayon-Sainfort, P. (1992). The use of computers in offices: Impact on task characteristics and worker stress. *International Journal of Human Computer Interaction, 4*, 245–261.

Connor, P.E. (1997). Total Quality Management: A selective commentary on its human dimension, with special attention to its downside. *Public Administration Review, 57*, 501–509.

Cooper, C.L., & Marshall, J. (1976). Occupational sources of stress: A review of the literature relating to coronary heart disease and mental ill health. *Journal of Occupational Psychology, 49*, 11–25.

Dale, B.G. (1994, April–June). A framework for quality improvement in public sector organizations: A study in Hong Kong. *Public Money & Management*, 31–36.

Davis, L.E. (1983). Design of new organizations. In H. Kolodny & H.V. Beinum (Eds.), *The quality of working life and the 1980s* (pp. 65–86). New York: Praeger.

Davis, L.E., Cherns, A.B., & Associates. (1975). *The quality of working life*. New York: Free Press.

Dean, J.W., Jr., & Bowen, D.E. (1994). Management theory and Total Quality Management: Improving research and practice through theory development. *Academy of Management Review*, 19, 392–418.

Deming, W.E. (1986). *Out of the crisis* Cambridge, MA: Massachusetts Institute of Technology.

Dotchin, J.A., & Oakland, J.S. (1992). Theories and concepts in total quality management. *Total Quality Management, 3*, 133–145.

Drucker, P.F. (1998, October 5). Management's new paradigms. *Forbes*, 152–177.

Drury, C.G. (1997). Ergonomics and the quality movement. *Ergonomics, 40*, 249–264.

Durant, R.F., & Wilson, L.A. (1993). Public management, TQM, and quality improvement: Toward a contingency strategy. *American Review of Public Administration, 23*, 215–245.

Eklund, J.A.E. (1995). Relationships between ergonomics and quality in assembly work. *Applied Ergonomics, 26*, 15–20.

Fisher, T.J., & Davis, D. (1992). An application of the Deming philosophy in an Australian company. *Total Quality Management, 3*, 107–114.

Gatewood, R.D., & Riordan, C.M. (1997. The development and test of a model of Total Quality: Organizational practices, TQ principles, employee attitudes and customer satisfaction. *Journal of Quality Management, 2*, 41–65.

Hackman, J.R., & Oldham, G.R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance, 16*, 250–279.

Hackman, J.R., & Wageman, R. (1995). Total Quality Management: Empirical, conceptual and practical issues. *Administrative Science Quarterly, 40*, 309–342.

Haims, M.C., & Carayon, P. (1998). Theory and practice for the implementation of "in-house" continuous improvement participatory ergonomic programs. *Applied Ergonomics, 29*, 461–472.

Helander, M.G. (1997). The human factors profession. In G. Salvendy (Ed.), *Handbook of human factors and ergonomics* (pp. 3–16). New York: Wiley.

Hendrick, H.W. (1991). Human factors in organizational design and management. *Ergonomics, 34*, 743–756.

Hendrick, H.W. (1997). Organizational design and macroergonomics. In G. Salvendy (Ed.), *Handbook of human factors and ergonomics* (pp. 594–636). New York: Wiley.

Herzberg, F. (1974). The wise old Turk. *Harvard Business Review*, 70–80.

Hyde, A.C. (1993). The proverbs of Total Quality Management: Recharting the path to quality improvement in the public sector. *Public Productivity and Management Review*, 25–37.

Johnson, J.V. (1989). Control, collectivity and the psychosocial work environment. In S.L. Sauter, J.J. Hurrell, & C.L. Cooper (Eds.), *Job control and worker health*, (pp. 55–74). New York: Wiley.

Kalimo, R., Lindstrom, K., & Smith, M.J. (1997). Psychosocial approach in occupational health. In G. Salvendy (Ed.), *Handbook of human factors and ergonomics* (pp. 1059–1084). New York: Wiley.

Karasek, R.A. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly, 24*, 285–308.

Kraut, R., Dumais, S., & Koch, S. (1989). Computerization, productivity, and quality of work life. *Communications of the ACM, 32*, 220–238.

Kroemer, K., Kroemer, H., & Kroemer-Elbert, K. (1994). *Ergonomics. How to design for ease and efficiency*. Englewood Cliffs, NJ: Prentice Hall.

Milakovich, M.E. (1991, Spring). Total Quality Management in the public sector. *National Productivity Review*, 195–213.

Miller, W.J. (1996). A working definition for Total Quality Management (TQM) researchers. *Journal of Quality Management, 1*, 149–160.

Morrow, P.C. (1997). The measurement of TQM principles and work-related outcomes. *Journal of Organizational Behavior, 18*, 363–376.

Pfau, L.D. (1989). Total Quality Management gives companies a way to enhance position in global marketplace. *Industrial Engineering, 21*, 17–21.

Poister, T.H., & Harris, R.H. (1996). Service delivery impacts of TQM-A preliminary investigation. *Public Productivity and Management Review, 20*, 84–100.

Rago, W.V. (1994). Adapting Total Quality Management (TQM) to government: Another point of view. *Public Administration Review, 54*, 61–64.

Rooney, E.F., Morency, R.R., & Herrick, D.R. (1993). Macroergonomics and Total Quality Management at L.L. Bean: A case study. In R. Nielsen & K. Jorgensen (Eds.), *Advances in industrial ergonomics and safety—V* (pp. 493–497). London: Taylor & Francis.

Russell, T.R. (1993). How do human characteristics fit into total quality management? *Total Quality Management, 4*, 313–323.

Sainfort, F., James, C., Taveira, A., Bisgaard, S., Carayon, P., Haims, M.C., Lund, J., Mosgaller, T., Smith, M.J., & VanRensselaer, G. (1998a). Quality management in the public sector: Methodology and preliminary findings from the City of Madison study. Manuscript submitted for publication.

Sainfort, F., James, C., Yeh, Y.J., Carayon, P., Lund, J., & Smith, M.J. (1998b). Impact of quality management on job characteristics. In P. Vink (Ed.), *Human factors in organizational design and management—VI* (pp. 135–140). Amsterdam: Elsevier Science.

Shakel, B. (1991). Ergonomics from past to future: An overview. In M. Kumashiro & E.D. Megaw (Eds.), *Towards human work: Solutions to problems in occupational health and safety*. London: Taylor & Francis.

Sitkin, S.B., Sutcliffe, K.M., & Schroeder, R.G. (1994). Distinguishing control from learning in Total Quality Management: A contingency approach. *Academy of Management Review, 19*, 537–564.

Smith, M.J., & Carayon, P. (1995). New technology, automation, and work organization: Stress problems and improved technology implementation strategies. *International Journal of Human Factors in Manufacturing, 5*, 99–116.

Smith, M.J., Carayon, P., Sanders, K.J., Lim, S.Y., & LeGrande, D. (1992). Employee stress and health complaints in jobs with and without electronic performance monitoring. *Applied Ergonomics, 23*, 17–27.

Smith, M.J., & Carayon-Sainfort, P. (1989). A balance theory of job design for stress reduction. *International Journal of Industrial Ergonomics, 4*, 67–79.

Smith, M.J., Sainfort, F., Carayon-Sainfort, P., & Fung, C. (1989). *Efforts to solve quality problems*. Washington, D.C.: Secretary's Commission on Workforce Quality and Labor Market Efficiency, U.S. Department of Labor.

Swiss, J.E. (1992). Adapting Total Quality Management (TQM) to government. *Public Administration Review, 52*, 356–362.

Trist, E. (1981). *The evaluation of sociotechnical systems*. Toronto, Ont.: Quality of Working Life Center.

Wilson, J.R., & Haines, H.M. (1997). Participatory ergonomics. In G. Salvendy (Ed.), *Handbook of human factors and ergonomics* (pp. 490–513). New York: Wiley.

Younis, T. (1997). Customers' expectations of public sector services: Does quality have its limits? *Total Quality Management, 8*, 115–129.

* * * * *