

Utilization of group project methodology such as Quality Control Circles for solving problems in the Brazilian factory of a multinational industrial organization

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Abstract

An adequate environment and good working conditions produce satisfied employees and bring positive results to various sectors of the organizations. As a methodology to create and sustain these conditions, for more than 40 years the Quality Control Circle (QCC) has been the preferred structure to ensure that product quality and processes are constantly improved, that costs are kept to budgeted levels, and that a favorable working environment is maintained. The objective of this present study is to analyze the results of the use of the QCC methodology in a Brazilian manufacturing unit which forms part of a multinational Company. The performance results recorded were positive and justified the permanence of this methodology in the company.

Key words: Quality Control Circles (QCCs), Improvement of the working environment, Participation Programs.

1 Introduction

The Quality Control Circles (QCC) were first implemented by Ishikawa in 1962 with the intention of encouraging their Japanese employees to participate in decisions and changes within organizations (Ishikawa, 1985). Zetie (2002), in turn, states that there are many definitions for QCC, but synthesizing the information, it can be said that it is the meeting of a group of employees in order to solve problems of mutual interest. They are stimulated and encouraged by management and given the power to make any changes or alterations required. Strachan (1996) points out that, via a systematic of participative activities the QCC's make it possible for managers to access the energy, ideas and knowledge of their subordinates.

Numerous operational gains result from the QCC activities in user organizations. In addition, as Salaheldin (2009) points out, academicians and practitioners agree that the system can provide increased productivity, improve the quality of the product, decrease the distance between workers and managers, valorize the employees and create an atmosphere where subordinate employees can voice their ideas about their working conditions, introducing therefore a more democratic spirit. Because of the success obtained, the method has spread throughout the world. Although critics hold that the methodology is out of date (in use for over 40 years) the alterations that organizations have introduced over the years, and the relative similarity of gains made with the more recent methodologies now available, still leads many organizations to adopt, implement and maintain Japanese practices based on QCC.

The objective of this study is to analyze the results of the use obtained from the QCC in a Brazilian factory that is part of a multinational organization. To evaluate the success of the QCC methodology, the following performance indicators were used: financial gains obtained; improvements in environmental protection, health and safety; product quality; client satisfaction; advances in the quality management system over the last three years of the company operations. Modern systems and instruments were utilized to obtain more detailed data so as to identify any variables which might contaminate the final results. Herein Section Two is a review of the QCC and its origins, definition, critical success factors in the implementation and results obtained from the its application. Section Three presents the methodological procedures, while Section Four presents the case study, and finally, Section 5 the conclusions.

2 Theoretical foundation

The theoretical base for the present study includes the concepts described by the many principal authors who have written on the theme of Quality Control Circles (QCC). Initially the origin of the methodology will be reviewed. After the Second World War, with its economy in crisis, Japan sought, amongst many other things, a means of reconstructing its factories and making them more competitive in the difficult post-war market - mainly by getting increased reliability in the manufacturing processes, and optimization of the relationships between man, machine and material.

With this initiative, Japanese think-tanks created effective process management tools, such as “The Lean Production System” (reduces setup time, introduces Productive Total Maintenance – TPM and others) the “Total Quality Control (TQC)”; (tools for blocking or non-generation of defects); “Just-in-time (JIT)” (supplies parts and components only as required by the production line) and the “QCC”, with work carried out in small groups (Strap; Ribas; Guinato, 2001; Metri, 2006).

By 1975, Japanese industry was a benchmark in quality and productivity, leading managers from around the world to visit the country to see how such positive results had been obtained so quickly. The answer was in the perseverance of the Japanese leaders and workers and the development and growth provided by the philosophy of work in small groups (Metri, 2006). Ishikawa (1985) found that young Japanese people postwar were very dependent on each other and only worked reluctantly and then only when they were ordered to do so. Unless given a direct order they would not work. Following the premise that people have their own wills and are able to think and create voluntarily, the idea of creating the activities of Quality Control Circles, while respecting the right of employees to work voluntarily, was conceived.

Statements by Yava and Hill (1995) indicated that the Japanese were in advance of the Americans as far as the quality of their products was concerned. This fact generated great interest and concern in the USA and far-sighted American factory owners started to study and utilize the instruments developed in the Japanese QCCs to improve their own quality control and management systems. Ishikawa (1985) initially felt that QCC activities could only succeed in Japan because of the social, cultural and religious Japanese way of thinking. Assuming that it was possible to extend the QCC activities overseas at all, it was thought that only nations that share the oriental culture could perform the QCC methodologies successfully so that Japanese-type activities could only succeed in Taiwan, South Korea and China (Ishikawa, 1985).

Pinnington and Hammersley (1997) observe that the QCCs were very common in the literature in 1980, but that the popularity of the system had fallen sharply in the second half of the 1990s. It was even believed in some quarters that the QCC methodologies were somewhat of a management fad that would shortly be replaced by a more complete quality management and control system.

The QCCs (Quality Control Circles) can be defined as a meeting of small groups of people in the same workplace who take charge of quality control activities voluntarily. The QCC is accepted as an effective technique to improve the quality of life at work, promoting motivation, satisfaction and improving the work environment (Ishikawa, 1989; GOH, 2000; Metri, 2006).

One of the most valuable lessons learned about implementing QCCs is that talent and creativity in solving problems are not the monopoly of managers but are also created by workers at the operating levels, who are equally capable of providing great ideas. Managers should realize that there is a need for employees to work in teams, measuring the quality of their work, so as to enable them to identify and solve quality problems and possibly improve their manufacturing operations (Salaheldin, 2009).

According to Ishikawa (1985), there are three basic ideas that support the activities of QCC – it will (i) contribute to the improvement and development of business, (ii) promote respect for human beings and create a working environment that is happy, lively and good to work in (iii) fully exercise the human capacities and (iv) possibly promote the use of the considerable capacity of development that people possess but are often not given the opportunity to use. The same author lists ten items that can be used as useful guides in the conduction of QCC activities: (1) self- development, (2) willingness to work unforced, (3) group activities, (4) participation of all employees; (5) use of QC techniques ; (6) activities closely linked to the factory floor, (7) vitality and continuity; (8) mutual development; (9) originality and creativity, and (10) quality awareness, problems and the possibility of improvement.

With the Western attempt to emulate the quality improvements provided by the Japanese methodologies, a considerable amount of specialized literature addressing the experiences of utilizing QCC in different countries - excluding Japan - was published and cited many failures in attempts to implement QCC in the writers` organizations. In Japan, QCC was widely, almost universally used successfully, whereas in the United States, the success rate was not consistent (Hill 1996; Goh, 2000). Thus, it may be said that, although the managers of Western companies were excited about the possibility of gains through the QCC methodology, leading their employees to work in teams, they have not achieved the same results, since the format is specifically Japanese and is molded to operate in a Japanese-style organization. (Strvoulakis, 1997; Aravindan et al. 1996). Hill (1996) reports that the failure of many British QCC programs in the 80's received considerably publicity. Due to these failures, a reaction of contempt towards QCC developed in many western companies.

Sillince, Sykes and Singh (1996) argue that there is a period of about two years in which QCCs present success - after this period, there is a decline. This reaction can be explained by the fact that this is the average time for resolution of the most obvious problems of an organization.

It is possible to list the difficulties in the implementation and use of QCC in many Western companies, due to the large number of failures and frustrating experiences with mediocre results. Aravindan et al. (1996), based on historical and case analysis, identified as the main causes for failure; (i) misuse and (ii) insufficient knowledge of those responsible for the implementation phases of the QCC. The poor performance of the program can be also characterized by the misdirection of issues to be addressed by the QCC activities. According to Stravoulakis (1997), the main task for the QCC system is to identify and resolve problems in the workplace or assembly line. Therefore, issues relating to health and safety should be a priority in selecting and executing projects.

Another reason for the poor performance is the differentiation of cultural factors between nations. Sillince, Sykes and Singh (1996) postulate that, while in the West the QCC is seen as a auxiliary methodology in the organization, in Japan, the QCC is seen as an integral part of the company, and this theme is strongly emphasized as a major element in the company's effort for overall product quality. Moreover, there is a strong cultural influence that is relevant to the success of the program. What may explain the success of QCC in the Japanese culture is the aging population and the desire for stability of employment. An increase of the employee's participation in programs such as the QCCs can mean more job security for members of the groups.

A number of Western countries have made some adjustments to the original model of QCC, to make it more suitable for their requirements. Hill (1996), in a case study, points to the alterations which British companies, (survivors of the implementation of the original QCC model), had to make in order to adapt it to other methods of participative programs that were more effective in their organizations. According to Stravoulakis (1997), for quality circles to perform successfully, it is essential that they have complete autonomy and that the participants develop their creative potentials freely.

Other factors critical for success with QCC programs are: the involvement, commitment and support of senior management of the organizations with a view towards promoting its sustenance; a cultural environment with a focus on quality; and a firm commitment of the employees to the company's objectives (GOH, 2000; Goulden, 1995). Goh (2000) adds that, equally critical to implementing and sustaining the QCC program, is adequate propaganda of successful improvement programs and appropriate rewards for the workers involved in each success. Goulden (1995) reports that, before the implementation of the QCC methodology and the associated teams for quality improvement action, steps should be taken to increase social cohesion in the workplace. Hills and Yavas (1995) state that any alteration of quality involves certain changes, and therefore can result in worker resistance to the quality improvement effort. The challenge for leaders is to ensure that the employees understand and participate in the efforts and that the organization has the necessary flexibility to make the required improvements or alterations.

Authors - such as those named below - of studies of the application of Quality Control Circles in Western countries describe possible opportunities for improvements because of the effectiveness of QCC activities. Goh (2000), Brahm and Kleiner (1996) agree in relating how the implementation of the methodology results in greater worker participation, better quality work output and increased employee interest in sharing responsibility for an improved product. Furthermore, Goh (2000) states that manufacturing cost reductions, significant reduction in the labor requirements, improvements in the ability of the line managers to solve problems, systematization and acceptance of the concepts of continuous improvement were obtained from the regular use of QCC. The QCC approximates the line employees - who know the quality problems and the best solutions - with top management who, guided by the expert inputs from the employees, can take the necessary action to eliminate the problem.

Brahm and Kleiner (1996) state that, besides the advantages mentioned, the QCC promotes cohesion of the employees. On the other hand, they cite as disadvantages of the methodology (i) the relationship of dependence that exists with the employee's supervisor (who may approve or demoralize the group by rejecting the project unreasonably), (ii) the need for constant support of senior management and (iii) specific training that can be costly.

3 Methodological procedures

In the following section, the methodological procedures used during the research will be described. However, for a fuller understanding of the text, a short presentation of the company in which the research was realized and the

phases of the work performed will be given first.

3.1 Presentation of the company

In 1934, the company in question was founded in Porto Alegre as a business dedicated to repairing commercial refrigerators. The business prospered and after a few years of work, it expanded into manufacture of domestic refrigerators and by 1950, the factory was mass producing various products for air conditioning – including the first window unit air conditioner manufactured in Latin America. In 1984, the Brazilian organization joined a U.S. group which was then the world leader in air conditioning, and the association resulted in the introduction of modern technology and expertise. The product line was expanded and currently includes an extensive selection of air conditioning equipments of various capacities ranging from residential appliances of 7500 BTU to industrial equipments generating many tons of refrigeration.

The company is large and both the number of employees and the quantity of product outputted varies during the year. This is because of the seasonable nature of the market which results in greater sales during the high season falling off during colder periods. The factory where this study was realized is organized into two distinct areas: (i) Operations (Industrial, Quality, Engineering, Export, Finance, HR and Information Management), and (ii) Sales and Distribution (Distributors, Retail, Accreditation, Parts Sales Outlet, Distribution and Marketing Operations). The operation area can be characterized as complex because of the considerable volume of production in the high season and the great variety of products. (Hundreds of models with different specifications are produced).

Improvement processes, and procedures normally conducted by sectors with these responsibilities are managed and implemented through the QCC projects (which have the direct participation of employees). The QCC program was implemented in the company in 1991 and is still active at the present time. The employee participation is encouraged through awards and bonuses, and projects are evaluated by the increases in the company's financial return they achieve, and by the improvements in environmental, health and safety conditions, product quality, earnings and customer satisfaction observed. The QCC program management is performed by a group inserted into the quality department responsible for the overall organization of topics related to QCC, that is, promoting events, evaluation systems, training of members of the QCC groups, among other activities.

3.2 Stages of the work

The first stage involves the survey and analysis of the theoretical foundations of the matters discussed. The development of the second stage analyses the QCC methodology implemented in the factory where this study was made. The operational flow of the program was defined to facilitate fuller understanding of the sequence of activities. Furthermore at this stage, the means of payments to employees participating in the projects that have been submitted and approved are discussed.

The third stage lists the areas of application of the projects, thus enabling verification of the focus of the efforts of the employee's work. The areas of application are measured by the focus of the project intended to solve the problem and are: (i) financial, (ii) environmental, health and safety, (iii) quality, (iv) customer satisfaction, (v) internal satisfaction, and (vi) quality system. The fourth stage provides a description of the results obtained with the QCC program, by analysis of the respective performance indicators, viz: (i) financial gain, (ii) gains on environment, health and safety, (iii) gains in product quality (iv) gains in customer satisfaction, (v) gains in quality system, (vi) gains on internal satisfaction, (vii) results of qualitative methodology QCC, and (viii) the survival of the QCC. The fifth and final stage cites the principle conclusions reached during the case-study.

4 Analysis of the QCC methodology utilized in the company

4.1 Procedures of operation of the QCC projects

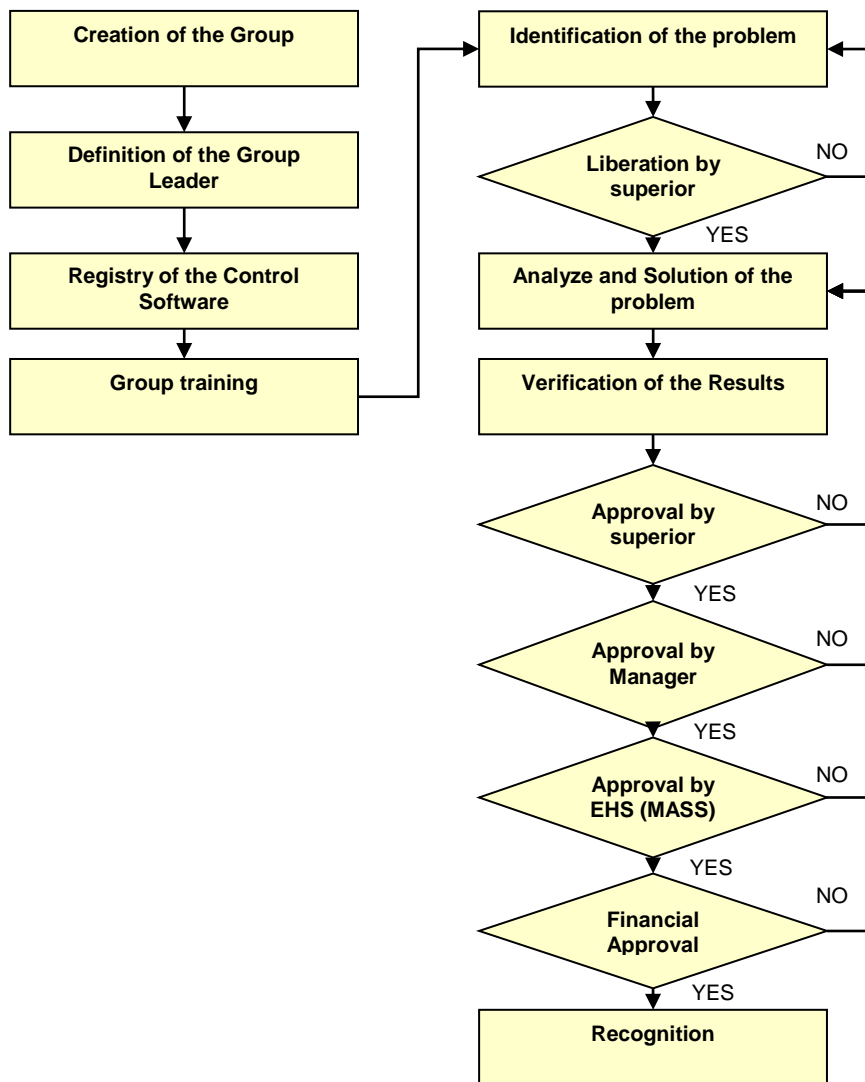
The fact that the program model was originally created for Japanese industries (Ishikawa, 1989) did not prevent its implementation and use in the Brazilian factory of a western multinational during the last nineteen years. The QCC used kept to the original precepts in the format set up by Ishikawa (1989) in the development of the methodology.

The basic intention of the QCC in the company is to involve the employee and give him/her power to improve the company's products, processes and work environments by encouraging the employees' participations as

agents of improvement, without altering the original format of the program. This objective was achieved throughout the process even if some small adjustments were introduced to align the projects submitted with the organization's overall strategic plan.

There are situations in which employees are encouraged to submit projects that meet quite specific needs of the company. As an example, one may cite the global crisis of 2008, when employees were encouraged to submit projects focused on cost reduction. Similar procedures are frequently used to promote improvements in product quality and to reduce product failures in the field. Financial award policies are also aggressively utilized to encourage the participation and involvement of the employees. Following the systematic described by Ishikawa (1989), the QCC groups of the company being analyzed are formed by the spontaneous intentions of the employees. The alignment of the project targets with the company's objectives are evaluated from the results obtained. The flow from the creation to the recognition of a QCC project can be seen in Figure 1.

Figure 1: Flowchart of Operation of QCC projects



Source: Procedure of the QCC Work Procedure of the company under analysis (2008)

Groups are composed spontaneously, usually with up to five (5) employees of the same department. The group elects a leader who has the responsibility of submitting the project and orienting the activities needed to solve the problem. The company provides QCC software control. In this software, the group is registered and obtains an active status. As soon as the software group has been authorized it can start work and submit designs for approval.

When the group meets and is activated, it receives training on the tools and methods needed to design and direct the projects. Part of the training concerns the basic tools for quality, such as Methods of Analysis and Troubleshooting (MASP), Check sheets, Brainstorming, Pareto, Stratification, Diagram Cause-and-Effect, 5W2H, Plan of Action and Verification of efficacy.

The trained and registered group is now ready to submit a design for QCC approval. The selected problems are usually taken from the workplaces of group members and, after identification, are submitted to the manager immediately superior to the group leader to consider whether a QCC project should be opened to resolve the problems. This manager blocks problems that have already been considered or which are not sufficiently important for the QCC procedure. If the manager decides that the problem can be solved without the need for a QCC project, the proposal is returned to the group so that they group members can select another problem and project.

However, if the problem is considered relevant by the manager, the group is authorized to continue the QCC project. The group members are encouraged to identify and promote corrective actions using low complexity quality control tools. The use of EHS (MASP) and of some instruments for quality improvement is stimulated in accordance with the training received. The efficacy is then verified and the QCC project finalized. As soon as the group project has been finalized, it is submitted for approval in the following order: (i) immediate supervisor, (ii) office coordinator where the group was formed, (iii) Department of Environment, Health and Safety (EHS), and (iv) finance department. If the project - considered terminated by the QCC group - encounters restrictions during these verification phases of submission, it is returned to the analysis and troubleshooting stage.

If the project is passed and approved in all stages, the group is informed of the approval of their project and entitlement to the respective bonus – this is final stage of the process called 'Recognition'. At Recognition the groups receive the financial bonuses, the value of which increases in accordance with their performance in achieving the proposed results and their clarity and fidelity in resolving the original problem. Projects are evaluated, scored and ranked.

The score is calculated when the project is presented by the respective QCC group and evaluated by a multidisciplinary group of the organization itself. While still in the recognition step, projects with higher ratings are called “Featured Projects” and receive in addition to the financial bonus: (i) the opportunity to make technical visits to other QCC user companies as an incentive to exchange knowledge, (ii) the opportunity to publish their work in company newspapers which circulate within the organization, and (iii) presentation of their work to the superintendent and the entire organization at the Company’s yearend closing Event with the possibility of receiving additional premiums if elected “Best QCC Project of the Year”.

In 2008, 146 groups opened 1609 correction and improvement projects, with the participation of 56% of the employees. The projects are classified according to their primary area of expertise, focusing on (i) financial return, (ii) environmental, health and safety, (iii) quality, (iv) customer satisfaction, (v) internal satisfaction and (vi) quality system. Some of the projects focus on more than one application area.

In 2009, 152 groups opened 1,200 projects with a participation rate of 49% of the employees. Table 1 shows the number of projects open for each application focus during the years of 2008 and 2009.

Table 1: Quantity of Projects opened in 2008 and 2009 by application area

Application Focus	2008		2009	
	Quantity	Percentage	Quantity	Percentage
Financial	139	6%	166	10.32%
Environment, Health and Safety.	825	35.59%	474	29.48%
Quality	316	13.63%	224	13.93%
Client Satisfaction	133	5.74%	101	6.28%
Internal Satisfaction	865	37.32%	611	38.00%
Quality system	40	1.73%	32	1.99%

Source: Adapted from the QCC indicators (2008 - 2009) of the Company under study

As shown in Table 1, in 2008, the majority of QCC projects were focused on measures to improve the employees’ working stations - 825 projects concentrated on Environment, Health and Safety (35.59%), and 865 projects to improve Internal Satisfaction (37.32%) – for a total of 72.91% focused on direct labor conditions in 2008. In 2009, the same indicators combined totaled 67.48%.

Our results of the concentration of QCC projects in these areas (more than half of all projects opened) were also observed by Stravoulakis (1997) in another study and confirm that employees give priority to solving problems in their own workplaces. Therefore, the company should be aware that the QCC projects prioritize the improvement of the working conditions.

4.2 Results Obtained With the QCC Program

Financial Gains. It should be noted that the financial returns are calculated by the groups and that their figures for the amount of financial return to be obtained is presented (i) to the project acceptance group and (ii) to the multidisciplinary group project evaluator. This latter group contests any situation or results considered questionable. The financial gain obtained with the QCC program in 2008 and 2009 is presented in Table 2.

Table 2: Financial gains per year for 2008 and 2009

Reference Year	Financial gains
2008	R\$ 573,113. 29
2009	R\$ 376,279. 13

Source: Adapted from Company information (2007 – 2009)

The QCC in its original concept and as applied in the company herein analyzed is not primarily concerned with financial return but on promoting employee satisfaction with their processes and their work environments. However, in spite of this, the savings obtained are substantial and justify the investment required to sustain the program. In Table 2, the financial return for 2008 is highlighted because in that year the company launched a special program to stimulate the execution of QCC projects concentrated on cost reduction due to the global crisis then affecting the market. The gain recorded in this indicator of performance is the direct result of the sum of financial gains obtained with the implementation of projects focused on achieving financial return.

Gains in Environment, Health and Safety. The EHS (Environment, Health and Safety) department has an evaluation program that measures the performance of the integrated conditions of Environment, Health and Work Safety. The performance for the years of 2007 to 2009 is shown in Table 3.

Table 2: Gains in EHS

Reference Year	Result of the Evaluation Program
2007	71.4%
2008	72.3%
2009	73.68%

Source: Adapted from the Company's records (2007 – 2009)

Analyzing the main thrust of the methodology it is noted that the employees' efforts were directed mainly to improvements in the workplace. The Environment, Health and Safety (EHS) results show an increase of 3.2% for the period from 2007 to 2009.

Gains in Product Quality. Table 4 provides the percentage of reduction of faults in the field for the years 2007 to 2009.

Table 3: Reduction of faults in the field by reference year

Reference Year	Number of faults	Percentage of fault reduction.
2007	8277	
2008	6143	25,78%
2009	5567	9,38%

Source: Adapted from company records (2007 – 2009)

Table 4 illustrates the fall in the number of faults in the period from 2007 to 2009. The total improvement is 35.16%.

Gains in Client Satisfaction. The gains obtained from increased satisfaction of the clients are measured by the Company every two years. The results for the period from 2007 to 2009 are set out in Table 5.

Table 4: Client satisfaction

Reference year	Result of the evaluation program
2007	77.71%
2009	78.43%

Source: Adapted from Company records (2007 – 2009)

In research realized with clients in 2007 and 2009, it can be seen that their overall satisfaction increased from 77.71% to 78.43%, - an increase of 0.93%. The items evaluated in the index “overall customer satisfaction” include (i) product characteristics, (ii) delivery, (iii) price and payment terms, (iv) the business contact service, (v) guarantee, (vi) post-sale attention, (vii) training, (viii) financial and (ix) marketing support. The research is undertaken and published by the quality department of the company.

Gains in the Quality System. The QCC projects assist in the maintenance of the Integrated Management System, consisting of the ISO 9001:2008, ISO 14001:2004 and OHSAS 18001:2007. Forty projects were opened in 2008 and 32 projects in 2009 in order to correct problems and propose improvements to the Integrated Management System.

Gains in Internal Satisfaction. As a major element for obtaining good results from QCC projects, employee satisfaction can be rated high in the company being analyzed when compared to other organizations. It was cited in a listing of the 150 best companies to work for in Brazil according to research made by a specialized magazine among the Company employees in 2007 and 2008. The research used by the magazine produces a “Happiness at Work” index. In the two years analyzed, where the company is listed among those classified as one of the best companies to work for, its performance is shown in Table 6. The year 2009 was not reviewed by the company.

Table 5: Happiness at Work Index

Reference year	Result of the evaluation program
2007	79.2%
2008	80.2%

Source: Adapted from the Company records (2007 – 2009)

From 2007 to 2009 the “Happiness at Work” index increased by 2.26%.

4.3 Qualitative Results of the QCC Methodology

In addition to the gains reported above (financial, environmental, health and safety, quality, customer satisfaction and internal satisfaction gains), the QCC methodology also has the advantage of motivating the staff. The QCC become a medium for informing senior management of the desires of the employees in the manufacturing areas and identifies talents that can be used in cases of internal opportunities for career advancement. Because projects are usually targeted on areas of the daily activities of the employee, the employee’s intention to be successful in his/her work is reinforced. Consequently, the employee’s commitment becomes a premise in the work.

Interviews were conducted with employees who are QCC group participants, who see QCC as a possible way to “improve the work environment” (an intention already confirmed in quantitative indicators), and the possibility of “professional/personal growth”. In 2009, a need for indirect labor led to the promotion of 16 direct employees from manufacturing, to technical positions as analysts and leaders of quality departments, industrial planning, EHS, process engineering and manufacturing.

The fact that QCC projects focus on improving the work stations and the working conditions may not be in line with the Company strategic objectives and could therefore be considered a disadvantage of the methodology. The Company got around this fact by re-orientation of the employees. During the economic crisis of 2008, the Company had difficulty in fulfilling its financial performance objectives, so it drew up a unique program for the QCCs encouraging them to concentrate their projects on cost reduction. This strategy paid off and in 2008 the QCC financial return was R\$ 573,113.29 while in 2009 – without a specific cost reduction program – the return was R\$376,279.13

On the other hand, a negative point identified was a distortion in the bonus system, because from time to time redundant and irrelevant projects were presented with the sole intention of obtaining the bonus. Therefore, it is very important to establish systems to counter such attempts in the selection of programs, and in addition to make sure that all the employees understand the profit-improvement intent of the programs so that QCC is not misused.

Another disadvantage of implementing the methodology QCC is that it is problematical, and in many cases impossible, to use it to solve problems of medium or high complexity. Users are alerted that the tools usually supplied with the program do not include the necessary structure to solve complex problems.

4.4 Survival of QCC

The QCCs were implemented in the analyzed organization in 1991. Since its timid inception with only two (2) active groups, the QCC program survived and grew to 146 groups in 2009, despite much external adversity for the company over the years, such as the crises of 2005 (50% reduction in the workforce due to the entry of Chinese competitors into the domestic market) and 2008 (the global crisis). The QCC program thrived with the strong purpose and persistence of senior management that provided the necessary resources for program sustainability, as also verified by Goulden (1995) and Goh (2000). This fact can be considered as a key factor for success.

The success and the positive results obtained in the Company analyzed confirm the opinions of Yavas and Hills (1995), who pointed out the growing need for companies to create a structure resilient to change, which encourages teamwork and productivity, and which has a good foundation in technology and education. The company under study owns the technology to manufacture its products, and is a pioneer in the development of refrigeration systems. Furthermore, to encourage its employees to work for personal evolution by study, the Company offers generous incentive programs, with full reimbursement of the costs of technical, graduate, postgraduate and master courses to all its employees.

The gains shown in section 4.3 can be regarded as positive factors that justify the permanence of the QCC program in the company studied. Results of the successful application of QCC projects in Western industry do not agree with statements made by Goh (2000), Stravoulakis (1997), Aravindan et al. (1996) and Hill (1996) citing cases of the failure of the program in non-Japanese companies.

5 Conclusions

The objective of this study was to review the results of the use of the QCC methodology in a Brazilian factory with connections to multinational group.

Initially, the characteristics of the QCC program used by the Company under analysis were described. The Company adopted the original configuration of the program according to Ishikawa (1989) with the principal intention of introducing improvements in the working environment of the employees, and of promoting their participation and improving their motivation. However, without disturbing the basic system, some adjustments were made among which were (i) redirection of the focus of the projects; (ii) alignment of projects with the company's strategic planning and (iii) adoption of an aggressive bonus system – this latter with the intention of encouraging employee participation. Also, the quantitative gains obtained with the QCC program were analyzed for the period 2007 to 2009 from different application stand-points.

The positive gains obtained with the QCC methodology can be verified through the following performance indicators (i) financial gain, (ii) gains on environment, health and safety, (iii) gains in product quality, (iv) gains in customer satisfaction, (v) gains from the quality system, (vi) gains on internal satisfaction, and (vii) results of the QCC qualitative methodology. In general, all the indicators indicated continuous improvement of processes, products and services internal to the organization.

Among the quantitative gains are financial return of R \$ 573,113.29 in 2008 and R \$ 376,219.13 in 2009; a 3.2% improvement in the EHA indicators; 35.16% reduction in the number of field failures; increase of 0.93% in the index of customer satisfaction; coexistence with other quality programs (ISO-9001, ISO-14001, OHSAS-18001), and an increase of 1.26% in the Happiness at Work Index. Among the qualitative gains were the possibilities that the employees themselves could intervene and improve their work environments and that working in the QCC's would make the employee's talents more visible and facilitate their professional growth.

Some distortions were observed in the bonus system because of presentation to the company of redundant and irrelevant projects with the sole intention of financial reward for the employees. It was also found that the methodology was incapable of solving highly complex problems. The Company, the market and the QCC survived the crises of the period and it is clear that the positive results obtained justify the permanence of the QCC program in the user Company.

Finally, it is stressed that the QCCs were not solely responsible for the performance improvements shown. There are other programs focused on improving each performance indicator analyzed that coexist with the program in reference. Although not the only improvement element, it is certain that the participatory culture proposed by

QCC methodology meets the needs of this organization and makes the employees more receptive to the initiatives proposed by other instruments.

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