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Abstract

For organizations to be successful, the use of well-structured management systems (MSs), a quality management (QM) approach and continuous improvement (CI) methodologies, such as Lean Six Sigma (LSS), are essential. In many industries, CI methodologies and MSs are separately implemented, either formally or informally. The effective integration of MSs with CI interventions ensures strategic alignment of all activities and provides an industry with a competitive advantage. LSS is a modern and widely accepted methodology for CI. It can fit under the umbrella of total quality management (TQM), as both methodologies share the goals of pursuing customer satisfaction and business profit. MSs are structured approaches to manage the various aspects of business in an organization. Recently, different MSs have gained more attention as they form a critical infrastructure for improving and controlling the different areas of operating an organization. Classically, different CI methodologies are implemented without being properly integrated with MSs. This is one of the main reasons why lots of implementation efforts of CI methodologies fail. The recently proposed Total Company-Wide Management System (TCWMS) is a comprehensive system that represents a new evolution in QM and covers different aspects of the management disciplines including strategic management, initiative management, process management, daily management and performance management. It provides a solid structure and a foundation for all activities of a business, core value chain and value-enabling activities to ensure the proper alignment of all people and processes. This will lead to the optimization of resources and enhancement of performance. In this paper, this integration is illustrated in a practical way through two empirical case studies, at Company A and Company B. These case studies will demonstrate and prove quantitatively, how effective the TCWMS integration is, through the comparison of both the pre-application status and the post-application status. This paper will discuss the two case studies, including survey results of employees in an effort to verify the theoretical TCWMS model.

Introduction

The effective execution of continuous improvement (CI) methodologies is an important success factor for any organization. As competition gets tougher, the rate of improvement and optimization of processes determines the survival of most organizations. Among various quality management (QM) and CI methodologies, Six Sigma and Lean stand out as excellent methodologies that are widely used by various industries. They are currently referred to as the *state of the art* (Arnheiter and Maleyeff, 2005) and as the methodologies yielding the greatest impact (Kumar *et al*., 2008). The integration of the two into Lean Six Sigma (LSS) has created a strong methodology that is well-known and accepted (Bhuiyan and Baghel, 2005; Bendell, 2006; Snee and Hoerl, 2007). However, even with the best methodologies in place, numerous studies have pointed out that most industries are failing in their CI efforts (Devane, 2004; Bhasin and Burcher, 2006). Two of the reasons why deployment fails, are organizational misalignment and ad-hoc approach, as they lead to scattered projects across the organization (Martin, 2007).

Many industrial organizations are not realizing the full potential of what QM and CI methodologies, integrated together, along with a proper comprehensive management system (MS) can achieve for them. There are several cases of failure in implementing improvement projects and maintaining their benefits (Devane, 2004; Bhasin and Burcher, 2006). These failures result in the tremendous waste of energy, resources and in some cases, the closure of industrial facilities. Success is likely to be in the proper total integration of various MSs and CI methodologies. This will achieve the goal of aligned and optimal CI leading to optimal quality, productivity, efficiency, *etc*., which is expected to make a significant contribution to all stakeholders, including owners, workers, customers and society in general. Different researchers have indicated that there is a need for a comprehensive MS that will serve as a foundation to ensure proper alignment and optimization of all resources in an industry (Chapman and Hyland, 1997; Kaye and Anderson, 1999; Stankard, 2002; McAdam and Evans, 2004; Dahlgaard and Dahlgaard-Park, 2006). Only a few researchers have started looking into this topic and this work is an attempt to pave the way towards this integration. Recent studies on the integration of CI and MSs can be found in (Friday-Stroud and Sutterfield, 2007; Cheng, 2008; Salah *et al*., 2010).

In this paper, an investigation of the implementation of Total Company-Wide Management System (TCWMS) is carried out through two empirical-case studies to explore its effectiveness. This proposed holistic MS focuses on providing benefits across the supply chain for all stakeholders, such as, customer satisfaction and economic production. The two empirical studies, including the comparative evaluation of TCWMS effect on the performance of the companies, are significant from a practical system reengineering and management point of view. They provide insight into how a company can implement a total company-wide quality culture as well as a solid infrastructure for managing and improving its processes.

Total Company-Wide Management System (TCWMS)

The traditional way of doing business is to have two (or more) separate entities: one is managing the business and the other is improving the business. However, there is great advantage in integrating these two entities with each other. In the TCWMS environment proposed here, a strong integration can be achieved where everyone becomes aligned with the CI objectives such that they find out how to improve the process as they work inside that process. The proposed TCWMS is a comprehensive system that encompasses many different aspects of the management disciplines. It mainly draws on five MSs which are grouped into strategic management, project management, daily management, process management (which incorporates total quality management (TQM) and CI methodologies) and performance management. These five MSs may be further detailed to include various MS sub-components such as financial, customer relations, culture, resources, communication, CI, documentation, *etc*.

In the 18-organization study of Kaye and Anderson (1999), some displayed weaknesses such as: CI activities were insufficiently integrated, time was wasted on blaming people instead of dealing with problems, a low-level of empowerment existed and people seemed to always be in crisis (trying to fight problems and their symptoms by quick fixes without paying proper attention to root causes). TCWMS promotes "effective asking and listening"; it focuses on achieving consensus among everyone in the team regarding the decision made. Everyone is guaranteed the right to express agreement or disagreement. This fosters the proper attitude, boosts morale for success in any change initiative and establishes a sense of ownership. Every individual becomes accountable, through their actions, for what the customer and business require. This leads to operational excellence. TCWMS can be considered as an organization governance system. It provides organizations the ability to

align people and operations in the same strategic direction. This can be done through the integration of different MSs to achieve control in an "entrepreneurial and ethical way" (Hilb, 2006) in order to satisfy the desired targets. Also, TCWMS promotes participative management, which involves and empowers employees and builds a culture of total quality and cooperation. The proposed system's name (TCWMS) was partially derived from the well-known Japanese company-wide quality control (CWQC) system to stress the importance of creating a comprehensive system that ensures optimum quality from the perspective of the whole society.

The TCWMS provides a solid structure and a foundation for all activities of a business, the core value chain and the value-enabling activities, to ensure their proper alignment which will result in the optimization of resources and enhancement of performance. Organizations running without a robust MS like TCWMS show symptoms such as: initiatives failure, lack of focus on processes and people, quick decisions which are not based on data, and people frustration (Kaye and Anderson, 1999).

TCWMS helps establish an infrastructure plus a CI supportive culture of learning, information sharing, and empowerment with accountability. It increases the rate of improvement, by faster implementation of more projects along with better selection of the proper teams and projects of highest impact. It also reduces risks and compensates for the weaknesses of an individual methodology or system.

Components of TCWMS
In the literature, different components of management are found under different names. These components have not necessarily been used together. The five components of TCWMS are within different sub-disciplines of management and the tools used, within these components, are generally acknowledged. However, the grouping and connection of these components with each other represents the novelty of the TCWMS. It is because of these groupings and

connections that the TCWMS provides a solid infrastructure for running and improving processes. The five TCWMS components are strategic management, project management, operation management, process management and performance management. Following, is a short description of each of these components.

1. Strategic management

Strategic management is a process for developing achievable strategic plans and deploying them, to be implemented at all levels, to ensure the proper alignment of the organization as a whole. The strategic management approach promoted by TCWMS is a participative approach, where management-by-objective is successful by adding a bottom-up approach to convey the actions or method of achievement. So, the focus is on the "how" and not only on the "who", which can shift people from being demoralized to being encouraged to express, through transparent system thinking, their concerns and ideas. An important tool used within strategic management is the balanced score card (BSC), which is also a performance management tool used to enhance the application of QM tools, such as ISO, LSS, TQM and business excellence models (Anderson *et al.*, 2004). A step-by-step approach to strategic management is explained as follows: Form a cross-functional team, benchmark against competitors, perform PEST (*i.e.*, political, economic, social and technological) analysis, perform SWOT (strengths, weaknesses, opportunities and threats) analysis, use quality function deployment (QFD) to identify enabling strategies (based on customer and employee surveys, financial and operational reports), establish a vision, mission and strategic goals, link the strategic goals to the BSC using KPIs, identify obstacles preventing the organization from achieving its strategic goals, develop initiatives to overcome these obstacles using the Hoshin X-matrix and transform them into operations, assign initiatives to teams, and ensure alignment of the goals with operational tasks.

2. Initiative management

Also referred to as project management or cross-functional management, initiative management is about managing the execution or deployment of the strategy. It depends on clear accountability (Kaplan and Norton, 2006). The key goal for strategic initiatives is to improve the business, in the right direction, which satisfies the strategic objectives. The evaluation of strategic initiatives includes continuous reviews of progress against plan, using feedback systems (Friday-Stroud and Sutterfield, 2007). Another key part of project management is the management of information flow across an organization. This is essential for the implementation and improvement of quality management systems (QMSs) (Zeng *et al.*, 2007). A step-by-step approach to project management is explained as follows: Select initiatives and teams, involve and empower the team members, train and support teams, clarify roles and set-up clear measurable targets, manage the execution of initiatives and monitor progress, focus on the technical and human aspects of change including culture, and develop a strategy to capture knowledge and transfer learning.

3. Daily management

Daily or operations management is about following-up with the people who execute the assigned tasks (which are related to projects and operations plans) on a daily or regular basis, to ensure they are being done properly and on time. It ensures that people understand how their daily activities contribute to the satisfaction of the strategic goals and eventually the customers of the company. A lot of companies have incorporated TQM and other CI approaches into their daily management (Yang, 2004). Deming emphasized the importance of daily CI (Walton, 1990). The check-act part of the Deming cycle (*i.e.*, Plan-Do-Check-Act or PDCA) is the focus of daily management, where the *check* part of the cycle is about evaluating the results and understanding the reasons for any deviations from expectations and the *act* part is about taking corrective actions. A step-by-

step approach to daily management is explained as follows: follow-up with the people who execute tasks, ensure that all people understand how their work affects the strategic goals, set-up a communication plan and a real-time reporting system to support decision-making, set-up meetings at all levels of the organization including agendas, KPIs, actions and variances, incorporate CI approaches into daily activities, and implement a visual management approach.

4. Process management

As known from the basic concepts of TQM, most activities done in business can be defined, or thought of, as processes connected together to form a system for work (Snee, 2004). These processes and their variations must be measured and understood before they can be controlled and improved. Also, processes should be looked at from the perspective of the customer and there should be equal attention given to the process and the results. Process management can be defined as a group of practices that provide better stewardship of business processes, through the use of process measures, tools and documentation (Motwani *et al.*, 2004). Process Management is a method for managers to select, organize, and manage the design, standardization, stabilization, and improvement of processes. A step-by-step approach to process management is explained as follows: assign process owners, define operating polices and responsibilities, select prioritized processes to start improvement using CI methodologies such as LSS and process flow charts, and develop standardized procedures.

5. Performance management

Performance management is concerned with defining what employees should be doing and the ongoing communication during the year that links the individual performance to the organizational needs (which lead to customer satisfaction) along with the evaluation and appraisal of performance.

Basu (2004) included the selection and application of key performance indi-

cators (KPIs) as part of performance management. The successful implementation of measures of performance, through cultural change, can lead to a management style that is more participative and consultative and can drive CI (Bititci *et al*., 2006). Incentives are a key part of performance management and improvement. The main purpose for incentives is to motivate employees. They should reward, in a balanced way, based on individual and team performance, to encourage improvements and team spirit. Out of different aspects of individual human resources management, Yang (2006) found that training, incentives and development had the greatest impact on TQM. Similarly, TCWMS heavily depends on the social aspect of human resources, as it strengthens human relations and facilitates cultural change. A step-by-step approach to performance management is explained as follows: define employees' job responsibilities and measurable objectives, define a performance-based incentive program, conduct interim performance review as well as a year-end review to build-up a development plan, and develop the organization's human capabilities.

Auditing of TCWMS
The establishment of an assessment method is critical to success in implementing the TCWMS. It can simply take the form of an assessment sheet, where scoring criteria can be used to guide an organization through the implementation and maintenance process of the system. The following is a description of the criteria for each component of the system:
1. Strategic management: The criteria include the documentation and understanding of the vision, mission, values, strategies and objectives. They also include the use of BSC, by the people at different levels of the organization, as well as, the continuous communication and commitment.
2. Project management: The criteria include the chartering and execution of initiatives including proper project and team selection. They also include the application of change

or transformation methodology, the involvement of people in establishing initiatives, conducting regular reviews, the documentation of the MS and the proper communication.
3. Process management: The criteria include process documentation and mapping across the different business levels (containing the identification of responsibilities and policies, as well as, the use of points of measurements including KPIs). They also include the use of CI methodologies and tools, the monitoring of processes and the overall standardization and certification.
4. Operations management: The criteria include the documentation and execution of daily plans, the scheduled meetings (for KPIs and progress reviews) conducted at all organizational levels and the understanding of how people's daily work can impact the business.
5. Performance management: The criteria include the documentation of individual performance improvement plans, conducting performance reviews at all levels of organization regularly, management evaluation by employees, the communication of commitments, training plans and their application, performance-based salary increases and the standardization of all processes.

Based on these criteria, a scoring system can be easily developed to indicate how an organization is performing, with regards to TCWMS, using an index that is based on a five-point scale. Each MS of the five listed above is assigned a score out of five points. The total audit score is the average of the

five scores of these five MSs. Table 1 shows an index which can be used in the auditing process. This index represents a quantitative and objective assessment of how close a company is to fully achieve TCWMS culture. The use of this index has an advantage over the use of subjective questionnaire assessments, which may include some bias from the participants. This index also helps in understanding and translating the definition of TCWMS into a roadmap format to facilitate its implementation. Next, the research questions and prepositions are developed in preparation for the two case studies.

Research questions development:
The reason for developing a set of research questions is to refine and focus the research. The main questions of this research are:
Research question no. 1: Does the appropriate integration of CI methodologies and MSs into TCWMS align people and operations in the strategic direction to achieve better financial performance results?
Research question no. 2: Does the implementation of TCWMS produce a better productivity improvement than what is obtained in the same period of time at the same company when TCWMS is not applied?
Research question no. 3: Does the appropriate integration of CI methodologies and MSs into TCWMS align people and operations in the strategic direction to achieve better customer satisfaction results?
Research question no. 4: Does the appropriate integration of CI methodologies and MSs into TCWMS align people and operations in the strategic

Table 1. The TCWMS five-level index

TCWMS Index	Performance Level
1	not existing, not established or not communicated
2	partially established and partially communicated
3	mostly developed to a good and steady level
4	developed, mostly understood and evolving
5	standardized best practices documented, understood and followed

direction to achieve better employee satisfaction results?

Research question no. 5: Does the implementation of the TCWMS achieve better performance results than what is obtained in the same period of time at the same company when TCWMS is not applied?

Research question no. 6: Does the appropriate integration of CI methodologies and MSs into TCWMS establish a culture of alignment, communication, cooperation, motivation, CI, trust, engagement and empowerment?

The first three research questions will be mainly tested through BSC KPIs in the two case studies. Research questions no. 4, 5 and 6 will be tested through the CEO interview in the case of Company A and an employee survey in the case of Company B. The employee survey utilized four prepositions as follows.

Research Propositions:
The research prepositions (which can be thought of as success factors) and the corresponding research questions regarding the proposed TCWMS model are described as follows:

Proposition A: Alignment
A successful organization should ensure alignment of all people and operations across the whole business where all individuals participate in strategic management. Employees should understand the business strategy and how their work contributes to the strategic goals of the organization. They should be encouraged to work on CI. Their supervisors should provide them with feedback on their performance and identify training opportunities for them (Preposition A corresponds to Research questions no. 4 and 6).

Proposition B: Communication
A successful organization should ensure effective communication exists across the whole business where all individuals are well- informed. Employees should be provided with timely information about the company and own unit performance updates. They should

be kept informed about the different challenges faced, corrective actions taken and the achievements and contributions made by the company. They should be receiving information that helps CI (Preposition B corresponds to Research questions no. 5 and 6).

Proposition C: Leadership
Supervisors should provide employees with performance expectations and the assistance needed to enable them to do their work. Employees should feel free to express opinions to their supervisors. Employees should be treated fairly and respectfully by their supervisors. Supervisors should provide good coaching, listen to employees concerns and should ask for their ideas and opinions for CI. Supervisors should inform employees when they do something good. Supervisors should inform employees about company challenges, performance and their career development plans (Preposition C corresponds to Research questions no. 4 and 6).

Proposition D: Motivation
Employees should feel proud of working for the company, feel good about its future and their future with it. They should feel good about the amount of work assigned to them and satisfied with work conditions and safety. They should receive sufficient training, be equipped with sufficient resources and acquire sufficient knowledge to perform their jobs. They should be working in teams involved in CI. Rules and regulations should not interfere with their jobs (Preposition D corresponds to Research questions no. 5 and 6).

Case studies
The comparison of measurements of performance (*i.e*., KPIs), before and after improvements is very important to objectively assess a change process (Seen *et al*., 2001). Two case studies, at Company A and Company B, are used to verify the theoretical model quantitatively. This is done through a contrast of the scenarios before and after the TCWMS implementation. BSC KPIs are selected and monitored, to be used in the benchmarking and comparison of the standing, prior and after the

implementation of the integrated model proposed here (*i.e*., TCWMS). Also, the index for measuring the maturity of an organization's application of all aspects of TCWMS is audited and the survey results are analyzed to test the above research questions. These case studies will further prove how practical this integration is to different organizations. For proprietary reasons, the names of the two companies and some specifics on the processes are not mentioned. Notwithstanding, very few details were changed as not to have the actual facts and experiences misrepresented. According to contingency theory, there is not one single method for business operation, which can be applied to all situations (Foster, 2007). These two case studies are an attempt to validate the TCWMS effectiveness and how helpful it can be to the performance of an organization if properly implemented.

Case study 1
The first case study is about Company A, which is a Canadian manufacturer of specific fabricated wood products. The company was established 50 years ago. It is one of the largest regional producers which serves mainly the North American market and employs about 150 people. The company started the implementation of all of the elements of TCWMS, including process reengineering and LSS, in 2004. Prior to that, the company only had a few Six Sigma projects implemented, but no formal MS. In addition to manufacturing processes, this empirical study also includes the application of TCWMS to transactional or service-providing processes, such as purchasing and warrantee. Factors chosen are the BSC KPIs since they are used to measure the performance of the company. The data required for the validation was obtained from the company records over a period of about four years. Data was collected from sources that included production records, sales records and accounting.

The BSC has KPIs which are listed under four categories: financial, customer, process and people. Each KPI has a weight of points that add up to the

total 200 points of the BSC. Achieving the baseline performance, which is the same as last year performance for a KPI, gets the company a score of half the points assigned to that KPI. Achieving the target score for the current year gets a company three quarters of the total points and achieving the stretch goal set by the company gets it the full points. The second row of Table 2 shows the rates of improvement for two reporting periods (*i.e.*, 2004-2005 and 2006-2007). It clearly shows that the rate of improvement (which is calculated from the total BSC results of one year compared to the past year) significantly increased after the implementation of TCWMS started. More particularly, in 2006 and 2007, the company started exceeding its targeted performance for the year (score is > 150 points). Also, Table 2 (see rows 3-8) lists some actual results provided by the company CEO. These outstanding results were accomplished after the implementation of TCWMS. It shows a snap-shot of the actual values before and after the deployment (*i.e.*, 2004 baseline and the end of 2007). These items were selected to demonstrate effectiveness of TCWMS since they were outstanding. A key indicator for self-assessment against competition is measuring the rate of improvement or rate of change.

In general, the weights assigned to each individual KPI may change from one year to the next as well as some KPIs may be deleted or replaced. On the other hand, for a comparison to be more accurate from one year to another, it is suggested to use a weighted average for each parameter for all of the years within the comparison period (four years in the present case). This results in an absolute comparison as opposed to a customary comparison of the year by year rate of improvement based on a different weight for each year. Additionally, since in the present case some KPIs were not collected for every year, some KPIs with missing data were taken off the comparison (see Table 2, rows 9-16). Some data was not available for other KPIs in some years due to the fact that some

Table 2. Comparison of measures results before and after the implementation of TCWMS and which research questions they positively support (Company A)

Measures	Data sources	Before	After	Positively supporting research question no.
Rate of improvement above last year	BSC overall score	31% (the average for 2004 and 2005 is 131/200)	56%(the average for 2006 and 2007 is 156/200)	5
Financial standing	CEO interview	Losing money in the order of hundreds of thousands of dollars	Making money in the order of millions of dollars	1
Productivity	CEO interview	Baseline	20% improvement	2
On-time delivery	CEO interview	26%	98%	3
Customer satisfaction	CEO interview	60%	96%	3
Employee survey for motivation	CEO interview	55%	71%	4 and 6
Employee turnover	CEO interview	30%	7%	4 and 6
Return on investment	BSC (absolute)	83%	87% (*i.e.*, 4% improvement)	1
Gross margin %	BSC (absolute)	83%	100% (*i.e.*, 21% improvement)	1
Regional market share	BSC (absolute)	45%	75% (*i.e.*, 67% improvement)	3 and 5
Customer satisfaction	BSC (absolute)	75%	85% (*i.e.*, 13% improvement)	3
Fleet utilization	BSC (absolute)	65%	85% (*i.e.*, 31% improvement)	5
Turnover - indirect employees	BSC (absolute)	0%	90%	4 and 6
Employee survey results	BSC (absolute)	37%	50% (*i.e.*, 36% improvement)	4 and 6
% score achieved out of the total weighted average (only for the seven KPIs above)	BSC (absolute)	56%	82% (*i.e.*, 46% improvement)	5

KPIs were removed from the list as new KPIs got introduced. As a result, only seven KPIs are listed, as they all had data available for the listed years. These BSC KPIs were tracked since the start of the TCWMS implementation in 2004 and the next three years after. These KPIs were collected over time and summaries of their results are listed in the table.

Table 2 (see rows 9-16) shows a percentage improvement in the average weighted score for 2004 and 2005 (before and during the start of implementation) compared to the average weighted scores for 2006 and 2007 (after implementation). It is also important to note that if a KPI had a score of 5.0 out of 10.0 points for a year, its percentage improvement above the previous year is 0 % since the mid score is the same as the score for the previous year. A score of 7.5 is equivalent to 50% improvement and so on.

It is obvious from the data in general in Table 2 that major changes and improvements were achieved once the new system was implemented. For example, the financial situation of the company turned from being non-profitable in the order of hundreds of thousands of dollars into becoming profitable in the order of millions of dollars while the *regional market share* improved by 67% despite the fact that the market demand decreased by about 14% over the same period (Canada Mortgage and Housing Corporation, 2009; National Association of Home Builders, 2009). In addition, great cost reduction was realized which is seen through the 21% improvement in *gross margin* and the 20% improvement in *productivity*. Also, there were improvements of 13% in *customer satisfaction* and 36% in *employee survey results*.

In addition, the TCWMS implementation was assessed through regular audits. The interval between each measurement point and the next one is about four weeks (*i.e.*, a total of thirteen observations per year). Figure 1 shows a graphical representation of a summary of the audit scores improve-

Figure 1. TCWMS audit score results
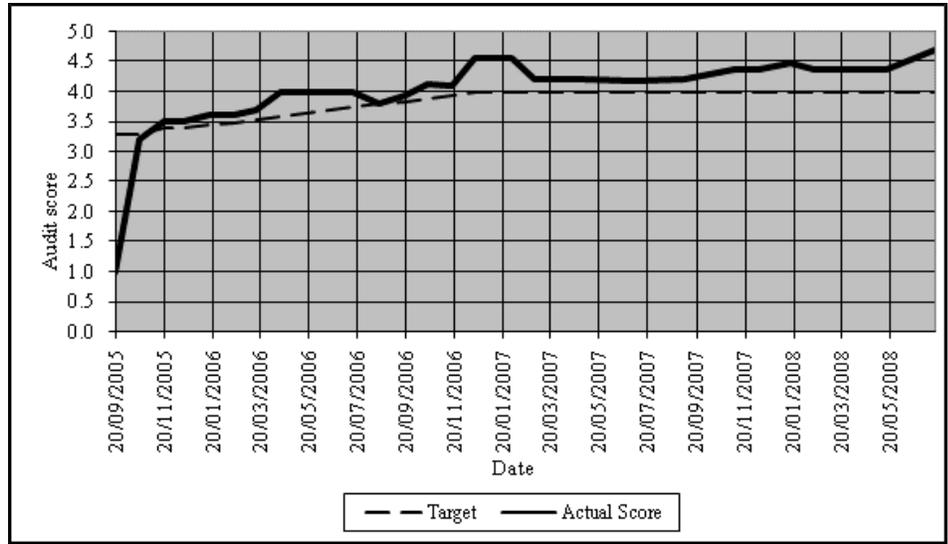
ment through the different years. The actual score is an average for each of the scores of the five components of TCWMS for different departments. The score was audited in September of 2005 and evaluated at 1.0 point out of 5.0. The year 2006 witnessed huge improvement of the score, which reached 3.9 in September of that year. In July of 2008, the score reached 4.6.

Testing of research questions:
Although factor analysis could not be used to support the research questions due to lack of detailed data, the research questions are answered by the KPIs scores provided by the company's CEO interview and the BSC results obtained from the records of Company A. As shown in Table 2 (see column 5), the results indicate a strong evidence of positive changes in Company A which support affirmative answers to the six proposed research questions.

As seen from the results, it can be concluded that the overall performance of the company very much improved. The fact that there was a lot of waste in the existing system also helped in enabling the new system to be widely accepted and eventually successful. The management team was keen on trying new approaches and the successes affected all employees and caused a chain reaction. Successes in departments that implemented the system turned its

employees into preachers of the new approach, who made other employees in other departments very anxious to implement it.

Case study 2
The second case study described in this paper was conducted at Company B, which is a Canadian manufacturer of paper products. Company B is also one of the largest regional producers, which mainly serves the North American market. The company employs about 105 people and all of them were involved in some form of new improvement initiatives (68 of them participated in at least one major transformation event and half of them chose to participate again). In 2004, the company created a position for an improvement coordinator. In 2005, the company introduced TCWMS. Then in mid 2006, the company resumed communication about TCWMS and later that year, assessments and auditing of TCWMS score were initiated. Thus, the implementation started in 2005 and the benefits were starting to be realized in 2006. In 2007, more efforts were spent on building TCWMS culture of alignment and improvement through employee involvement, training, improvement projects, improvement events and cooperation. In January 2007, the company planned extensive training and building of a personal improvement culture, major kaizen events and linking of

TCWMS to critical issues and business planning. The company introduced white belt training to include people at the shop floor and train them on TCWMS and CI tools. Thus, the whole company was prepared to adapt for the requirements of TCWMS, without forcing TCWMS into the company or people. The deployment process also included training of the management team. The business experience of the deployment leaders was a key asset through the implementation. The circumstances were helpful as people were willing to try the new system in hope for a major improvement and change from the inferior circumstances they were experiencing.

BSC data was obtained from different accounting and production records. Table 3 shows the BSC results for seven years, including the milestones and rates of improvement. It clearly shows that the rate of improvement (which is calculated from the total BSC results of one year compared to the past year) significantly increased after the implementation of TCWMS started. More particularly, in 2006, 2007 and 2008, the company started exceeding its targeted performance for every year (score is > 150 points). The overall score for 2004, prior to the implementation of TCWMS, was 128/200 points whereas the score for 2008, after the implementation of TCWMS was 178/200 points.

In general, the weights assigned to each individual KPI may change from one year to the next and some KPIs may be deleted or replaced. On the other hand, for a comparison to be more accurate from one year to another, it is suggested to use a weighted average for all of the years within the comparison period (four years in the present case). This results in an absolute comparison as opposed to the customary comparison of the year by year rate of improvement based on a different weight for each year. As it was the case for the first case study, some KPIs were not collected for every year. Therefore, as it was done before, the KPIs with missing data were taken off the comparison to allow for the desired absolute com-

Table 3. BSC results achieved at Company B out of 200 points (Note: All data for 2008 are as of September, 6)

	Year	Mile stones	BSC results out of 200 points	Rate of improvement above previous year
Before	2002	Management and supervisors changes	114	14%
	2003	Production line rebuilt	76	-24%
Starting	2004	Improvement and TCWMS Coordinator assigned	128	28%
	2005	Started implementation of TCWMS	139	39%
After	2006	TCWMS culture deployment and communication. Started realizing gains.	163	63%
	2007	Continued TCWMS deployment at all levels through training, Kaizen events, CI integration, business planning, *etc*.	161	61%
	2008	Continued TCWMS deployment including CI	178	78%

Table 4. Comparison of the BSC absolute results for same KPIs before and after the implementation of TCWMS and which research questions they positively support (Company B)

Measures	Before	After	% Improvement (after implementation compared to before)	Supporting research question no.
% of flexible budget	86%	95%	10%	1
Total suspended solids	58%	75%	30%	5
Production line in-house rejects	90%	100%	11%	3 and 5
Production/operating day	77%	79%	3%	2
People recorded safety incident rate	26%	73%	182%	4 and 5
Total BSC Score	66%	82%	23%	5

parison (see Table 4). As a result, only five KPIs in the two reporting periods (*i.e*., 2004-2005 and 2006-2007) were listed as these years had data available for these KPIs. It is obvious from the data in Table 4 that major changes and improvements were achieved once the new system was implemented. For instance, the *% of flexible budget*

improved by 10%, *in-house rejects* improved by 30% whereas *people recorded safety incident rate* improved by 182%.

Employee survey:
To present an additional understanding of the effect of TCWMS on a company and its employees, this case study

Table 5. Summary of detailed survey measures and which research question they positively support (Company B). Note: The first column items were adapted from (Human Resources Development Council, 1992; Stat Pac, 1997; Peter Barron Stark Companies, 2004)

Items	2004	2007	% improve-ment	Positively support research question no.
I receive regular performance feedback.	47%	81%	73%	4 and 6
I know the business strategies and KPIs very well.	84%	85%	2%	4 and 6
I have got sufficient training to improve my skills and do my job.	47%	65%	38%	4 and 6
Total alignment score	59%	77%	30%	4 and 6
I receive regular feedback on company and own unit performance.	88%	91%	4%	6
The communication flows effectively through the company and I receive the information and timely updates about business issues.	71%	70%	-1%	
I receive updates on company contributions to the community.	49%	66%	35%	6
The business information I receive assists me and my team to continuously improve.	59%	60%	1%	5
I receive regular updates about the challenges facing the company and the actions taken.	63%	63%	0%	
Total communication score	66%	70%	6%	5 and 6
My manager always communicates my expected performance level.	65%	83%	26%	6
Members of my team are treated fairly.	45%	81%	81%	4 and 6
My manager regularly supports and assists me to do a better job.	67%	80%	19%	4 and 6
My manager regularly encourages me to offer ideas or suggestions.	61%	72%	18%	4 and 6
My manager pays attention to my concerns and problems.	69%	80%	15%	4 and 6
I am satisfied with the respect I receive from my manager.	73%	89%	21%	4 and 6
My manager provides a positive role model.	57%	79%	38%	4 and 6
My manager recognizes me when I do a good job.	71%	75%	5%	
Total leadership score	64%	80%	25%	4 and 6
I am proud to say that I work for the company.	78%	71%	-8%	
I comfortably believe the company has an exciting future.	84%	88%	5%	6
I am contented with the training and resources I got to do my job.	74%	77%	4%	6
I am satisfied with the amount of work I am expected to do.	59%	62%	6%	6
There is a good team spirit among employees at the company.	71%	86%	21%	6
Safety procedures are a common practice at the company.	82%	83%	1%	6
My team is committed to excellence and continuous improvement.	61%	70%	14%	5 and 6
I am contented with my working conditions.	77%	77%	0%	
Total motivation score	73%	77%	5%	5 and 6
Average for all	66%	76%	15%	4, 5 and 6
Total employees	106	97		
Participants in survey	49	80		
Participation ratio	46%	82%		

utilized a quantitative research method. This method used data collected through self-administered questionnaire survey studies, in addition to the archived records of KPIs. These questionnaires were filled by both hourly and staff employees and were believed to be more appropriate than other forms of surveys, such as face-to-face interviews due to the associated costs (see Table 5 for details on the population and sample sizes). These employee surveys were conducted to assess total alignment, leadership, communication and motivation. Each of these categories or survey sections had a list of several related questions or items ranging from three to eight items (*i.e*., 3 items in Alignment, 5 items in communication, 8 items in leadership and 8 items in motivation). The respondents were asked to rate the agreement level for each item. There are a total of 24 questions or items. The questions are in the common five-level Likert scale format. One of the main purposes for this survey is to evaluate the type of environment and culture the employees are encompassed by at Company B. The format of a typical five-level Likert item is: (1) strongly disagree, (2) disagree, (3) neither agree nor disagree, (4) agree, and (5) strongly Agree.

In this case study, the coverage of the proposed survey to the studied matter

has been validated by the researchers and industry experts. It is evident from the data presented in Table 5, that all of the four sections in the survey demonstrated an improvement in the evaluation by the employees, from 2004 to 2007. However, it is worth noting that the survey has limitations, due to participants' subjectivity, participation rates and turnover. Overall, the average evaluation score increased by 15% to point toward a quite meaningful favorable response which reveals another evident indication of the TCWMS effectiveness.

Testing of research questions:
Although detailed factor analysis could not be performed to support the research questions due to lack of detailed data (except for the case of statistically testing the means of the employee survey results), the research questions are supported by the scores provided by the company employee survey and the BSC KPIs results. As shown in Tables 4 and 5, the results indicate a strong evidence of positive changes in Company B which support the acceptance of affirmative answers to the six proposed research questions (23% improvement in the *BSC KPIs results* and 15% improvement in the *employee survey results*). Also, Table 5 shows the detailed employee survey studies results of a survey done in 2004 before the implementation of TCWMS and the same done in 2007 after the implementation. The first column of the table shows a list of 24 items distributed in four sections (*i.e.*, alignment, communication, leadership and motivation), as adapted from (Human Resources Development Council, 1992; Stat Pac, 1997; Peter Barron Stark Companies, 2004). The table clearly shows that every item of the list of 24 has improved with the exception of only two items that demonstrated some declining result. This, however, is countered by the positive results of multiple other items within the same sections which demonstrated greater improvements where the overall results show 15% improvement for all survey items. Moreover, the 24 survey items or data points of 2004 were compared to the 24 data points of

Table 6. Paired t-test results for the means of 2004 and 2007 survey results (using Minitab)

	N	Mean	Standard of deviation	Standard error mean
2004	24	0.6675	0.1239	0.0253
2007	24	0.7642	0.09	0.0184
Differences	24	-0.0967	0.1087	0.0222
95% upper bound for mean difference: -0.0587				
T-test of mean difference = 0 (versus < 0): T-value = -4.36, P-value = 0.000				

Figure 2. Box plot results for the differences between the means of 2004 and 2007 survey results (using Minitab)
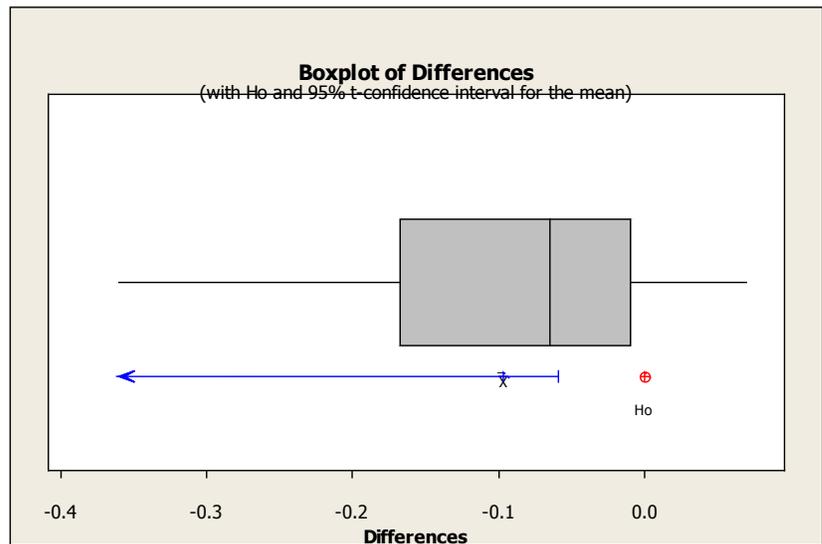
Table 7. TCWMS audit score results

TCWMS component	End of 2006	Quarter1 2007	Quarter2 2007
Strategic management	4.33	4.33	5.00
Daily management	3.00	3.00	3.00
Initiative management	2.60	5.00	5.00
Process management	2.00	2.00	2.33
Performance management	2.83	2.83	4.00
TCWMS total score (out of 5 points)	2.95	3.43	3.87

2007 to investigate if the means of the 2007 survey results were significantly greater than those for 2004 or not for the same questions (paired). Normality tests of the 2004 and 2007 means were conducted respectively using Minitab and the results indicated that there was not enough statistical evidence to reject the null hypothesis (*Ho*: data is normal) versus the alternative hypothesis (*Ha*:

data is not normal) since the P-value in each case was greater than 0.05 (i.e., 0.7 and 0.5 respectively). Then, a paired t-test was used to compare the differences between the two means of 2004 means and 2007 means. The data provided sufficient statistical evidence to reject the null hypothesis (*Ho*: μ1= μ2) in favor of the alternative hypothesis (*Ha*: μ1< μ2) and indicate that the

mean of the means of 2007 is greater than the one for 2004 since the P-value was less than 0.05. This is another indication of the effectiveness of the implementation of TCWMS (See Table 6). Also, box plot of the difference between the means provide visual evidence of the same result (See Figure 2).

Furthermore, the implementation of the TCWMS was assessed through regular audits. The interval between each measurement point and the next one is about thirteen weeks (*i.e.* a total of four observations per year). Table 7 presents a summary of the audit scores improvement through three different years. These audits or reports were filled by department managers and inspected by the process improvement head to ensure validity. The score was first audited in 2005 and evaluated at a baseline of 1.0 point out of 5.0. The year 2006 witnessed huge improvement of the score, which reached 2.95 at the end of that year.

Summary and conclusions
The TCWMS presents a new QM evolution, which provides a solid foundation for all activities of a business, to ensure that proper alignment and communication exist. This leads to the optimization of the resources and enhances the performance of an organization. The TCWMS is a comprehensive MS, which includes aspects of business management and improvement, with the goal of business and people alignment and excellence. The use of such a well-structured system, that engages the entire organization into CI, is essential to survive and stay competitive.

The TCWMS consists of five main MS groups: strategic management, project management, daily management, process management and performance management. TCWMS can be seen as an extension and expansion for TQM. CI methodologies such as LSS, QMS, ISO 9001, safety MS, Malcolm Baldrige National Quality Award or MBNQA, TQM, *etc.*, are all encompassed by the process MS. Process management is the base component of TCWMS, as everything runs as a process and quality does

encompass everything that happens in an organization. TCWMS achieves the integration of management principles, improvement methodologies, implementation practices and cultural change.

The two case studies of focus in this work provide a valuable reference for researchers and practitioner who consider implementing the TCWMS in other industries. The evidence from these case studies strongly suggests that TCWMS can be implemented to achieve alignment, optimize performance, reduce costs and improve the business. In each case study, several KPIs were used to validate the theoretical model by comparisons of their statuses prior and after implementation. In addition, results from the CEO interview in the case of Company A and the employee survey in the case of Company B, were analyzed to test the research questions concerning the implementation of TCWMS. The results clearly imply that TCWMS helps improve the overall business performance, financial health, productivity, customer and employee satisfaction, strategic alignment, employee motivation and the rates of improvement.

Additionally, in this work, a verification method was developed and deployed at two Canadian manufacturing companies. However, more empirical tests are required to provide further perspective regarding practical execution problems in other industries. The two case studies helped in assessing the effects of the TCWMS implementation through performance contrasts. The assumption that the TCWMS will solve all industrial problems, wherever they are, is a limitation since it may not hold at another organization with different structure and culture or under other circumstances, which may not have been included in the study. Other limitations lie in the choice of relevant indicators for the comparison, the measurement and recording of data, difficulties in controlling the organizations' environments from the effects of other events, and the lack of resources to conduct more surveys and collect detailed

data. Organization situations affect the implementation either in favor or against. However, this system requires and helps culture change and spreads a culture of innovation and flexibility, where everyone in the organization thinks of improvements, as they do their jobs. It is important to note that the management commitment, organization effort, culture management, proper deployment and strong leadership are key critical success factors for the TCWMS implementation. An equal effort should be spent on the people in order to transform the culture (people improvement) and not only on process improvement projects. The implementation of TCWMS in two companies provides an illustration of the significant advantages that can be achieved by this comprehensive system. There are some key lessons learned from the case studies. They show that with the implementation of TCWMS, significant performance improvement results can be accomplished. They also show that TCWMS can help companies improve faster by creating a strong foundation for all activities supporting the business management and improvement.

There is a wide variety of influential factors that may or may not contribute to the success of the TCWMS implementation at a company. Also, the improvement rates are influenced by factors such as the implementation time interval and the level of success. In these two case studies, an attempt was made to assess the TCWMS effectiveness. However, the use of data from two companies only, is a limitation as it may not be robust enough to make a generalization about the benefits of TCWMS to all companies in different industries. The results of these two studies can be more reliable and less biased by the use of more experiments in other companies. In sum, it is important to emphasize that the results of these two empirical studies evidently indicate that this TCWMS does indeed optimize the performance of the organization and achieves better improvements and lower costs and that the results obtained can be replicated elsewhere in the future, by adopting this TCWMS.

Finally, the TCWMS requires further evolution in the future to be more robust and comprehensive to all aspects of business management and improvement. A new mathematical model needs to be developed to present the quantitative aspect of this integration that is aimed at achieving optimal CI. The model needs to address the problem of slow rates of CI, by integrating a total company-wide management structure to the CI structure, so that the rate of improvement is maximized, profit is maximized and cost of running an organization is minimized.

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