An overview of continuous improvement: from the past to the present

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Abstract

Purpose – To provide an overview of the history, evolution, and existing research on continuous improvement.

Design/methodology/approach – Extensive review of the literature.

Findings – This paper provides an overview of continuous improvement, its inception, how it evolved into sophisticated methodologies used in organizations today, and existing research in this field in the literature.

Research limitations/implications – It does not provide an exhaustive review of the existing literature, or an exhaustive list of all continuous improvement programs, only the most well known.

Originality/value – This paper traces how organizations have used various tools and techniques to address the need for improvement on various levels. The paper also presents research conducted in this field. It should be of value to practitioners of continuous improvement programs and to academics who are interested in how continuous improvement has evolved, and where it is today. To the authors' knowledge, no recent papers have provided an historical perspective of continuous improvement. Furthermore, our paper also discusses the existing research in this field.

Keywords Continuous improvement, Quality, Lean production, Six sigma, Total quality management, Evolution

Paper type General review

Introduction

Continuous improvement (CI) is a philosophy that Deming described simply as consisting of "Improvement initiatives that increase successes and reduce failures" (Juergensen, 2000). Another definition of CI is "a company-wide process of focused and continuous incremental innovation" (Bessant *et al.*, 1994). Yet others view CI as either as an offshoot of existing quality initiatives like total quality management (TQM) or as a completely new approach of enhancing creativity and achieving competitive excellence in today's market (Oakland, 1999; Caffyn, 1999; Gallagher *et al.*, 1997). According to Kossoff (1993), total quality can be achieved by constantly pursuing CI through the involvement of people from all organizational levels.

We define CI more generally as a culture of sustained improvement targeting the elimination of waste in all systems and processes of an organization. It involves everyone working together to make improvements without necessarily making huge capital investments. CI can occur through evolutionary improvement, in which case improvements are incremental, or though radical changes that take place as a result of an innovative idea or new technology. Often, major improvements take place over time as a result of numerous incremental improvements. On any scale, improvement is

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achieved through the use of a number of tools and techniques dedicated to searching for sources of problems, waste, and variation, and finding ways to minimize them.

Over the past decades, CI has been studied from many perspectives. In this paper, our objective is to present the history and evolution of CI, from its early beginnings to sophisticated CI methodologies that are widely used in practice in quality management programs today. We start by discussing the origins of CI, followed by a description of the methodologies that have evolved over the years, and we trace how organizations have used various tools and techniques to address the need for improvement on various levels. The paper also presents research conducted in this field. Through a literature review, we describe the existing research on CI in order to gain an understanding of how the use of CI has had an impact on organizations, the tools and techniques that are needed to achieve an ongoing cycle of improvement, and the relation of CI to quality and the organization.

History and evolution of CI

The roots of modern improvement programs can be traced back to initiatives undertaken in several companies in the 1800s, where management encouraged employee-driven improvements, and incentive programs were set in place to reward employees that brought about positive changes in the organization (Schroeder and Robinson, 1991). In 1894, National Cash Register's program included reward schemes, employee development opportunities, and improving labour-management relationships. During the late 1800s and early 1900s, much attention was given to scientific management; this involved developing methods to help managers analyze and solve production problems using scientific methods based on tightly controlled time-trials to achieve proper piece rates and labour standards. The US government then set up the "Training Within Industry" service during the Second World War to enhance the industrial output on a national scale. This included job method training, a program designed to educate supervisors on the importance and techniques of CI methods. This program was later introduced in Japan by management experts like Deming, Juran, and Gilbreth, and by the US forces present there after the end of the Second World War (Robinson, 1990). Eventually, the Japanese developed their own ideas, and quality control, which was used initially in the manufacturing process, had evolved into a much broader term, growing into a management tool for ongoing improvement involving everyone in an organization (Imai, 1986).

While CI initiatives in the past reflected the use of various principles related to work improvement, modern day CI is associated with organized and comprehensive methodologies. These CI programs, in which typically the overall organization, or a large part of it, is involved in change, are also more popularly associated with the introduction of the TQM movement, which also gained leverage in Japan thanks to Edward Deming.

CI methodologies

Over the decades, as the need to continuously improve on a larger scale within the organization became an imperative, a number of CI methodologies have developed based on a basic concept of quality or process improvement, or both, in order to reduce waste, simplify the production line and improve quality. The best known of them are: lean manufacturing, six sigma, the balanced scorecard, and lean six sigma.

Lean manufacturing
Henry Ford systemized lean manufacturing during the early nineteenth century when he established the concept of mass production in his factories. The Japanese adopted lean manufacturing and improved it. This methodology is a systematic approach to identifying and eliminating waste through CI by following the product at the pull of the customer in pursuit of perfection.

In the 1950s, the Toyota Motor Company first implemented Quality Circles within the production process itself. As the Second World War came to an end, Taiichi Ohno, former executive vice president of Toyota, was given the task of developing an efficient production system for the manufacture of automobiles in Japan. Learning a great deal from Henry Ford's assembly lines, and customizing a production process to suit the needs of the Japanese markets, which called for lower volumes of cars, Ohno pioneered and developed the world renowned Toyota production system (TPS), also known as lean manufacturing and now used throughout the world (Womack *et al.*, 1990). The methodology is designed to maintain a continuous flow of products in factories in order to flexibly adjust to changes in demand. The basis of such a flow is called just-in-time (JIT) production, where, through systematic techniques designed to minimize scrap and inventory, and essentially, all forms of waste, quality and productivity are increased, and costs are decreased.

The aim of lean manufacturing is the elimination of waste in every area of production and includes customer relations, product design, supplier networks, and factory management. Womack and Jones (1996) describe lean thinking as the "antidote" to *muda*, the Japanese term for waste. Its goal is to incorporate less human effort, less inventory, less time to develop products, and less space in order to become highly responsive to customer demand while producing top quality products in the most efficient and economical manner possible. Waste is defined as anything for which the customer is not willing to pay. Lean manufacturing, if applied correctly, results in the ability of an organization to learn. Mistakes in the organization are not generally repeated because this in itself is a form of waste that the lean philosophy seeks to eliminate (Robinson, 1990). The lean toolbox is used to eliminate anything that does not add value to a process. According to the $US5 million study done by Womack and Jones, the Japanese manufacturers were twice as effective as their US and other Western counterparts. They determined that the three principles of lean manufacturing are: improve flow of material and information across business function; focus on pull by the customer; commitment of organizations to CI (Womack *et al.*, 1990; Womack and Jones, 1996).

Six sigma
More recently, six sigma began to gain popularity in the USA in 1986, when Motorola Inc. introduced it as a means of measuring process quality using statistical process control. Motorola went about on a mission to improve its services and products considerably in a span of five years, and to achieve its goal, the six sigma program was launched in 1987. Six sigma has been defined as "an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in the customer defined defect rates" (Linderman *et al.*, 2003). Minimizing defects to the level of accepting close to zero was at the heart of the methodology, and focuses on

reducing variation in all the processes of the organization. To achieve this, the DMAIC model was developed, i.e. define opportunities, measure performance, analyze opportunities, improve performance, and control performance. Six sigma provides quality measurement that can be used throughout an organization – not only in manufacturing but also in design, administrative, and service areas.

Motorola achieved amazing results through the application of six sigma, from 1987 to 1997, achieving a total savings of $US14 billion while sales enjoyed a fivefold growth during the same period (Klefsjö *et al.*, 2001). Investing in six sigma programs is increasingly considered a mission-critical best practice, even among mid-sized and smaller firms. After the evolution of lean manufacturing, other pioneers have used the six-sigma process to achieve their company's unprecedented goal of a hundred-fold improvement in quality within five years. Top organizations such as GE, ABB, Honeywell, Sony, Honda, and Ford have followed Motorola's lead and have been using six sigma to achieve business excellence.

Balanced scorecard

In the early 1990s, Robert Kaplan and David Norton developed a methodology that translates the objectives of the organizations into measures, goals and initiatives in four different perspectives, namely financial, customer, internal business process and learning and growth. This methodology came to be known as the balanced scorecard. A balanced scorecard is generally used to clarify and update the business strategy, link the objectives of the organization to the annual budgets, allow organizational change, and increase the understanding of the company vision and mission statements across the organization. A balanced scorecard can be used to translate an organization's mission and vision statements into a broad set of objectives and performance measures that can be quantified and appraised, and measures whether management is achieving desired results. About 50 per cent of the *Fortune* 1,000 companies have a balanced scorecard system in place (Kaplan and Norton, 1996). Niven (2002) refers to the balanced scorecard as a combination of a measurement system, a strategic management system, and a communication tool:

- *Measurement system*. The balanced scorecard helps the organization translate its vision and strategy through the objectives and measures defined rather than stressing on financial measures which provide little guidance. According to Gaplin (1997) "measurable goals and objectives" is one of the most important factors to a successful strategy.
- *Strategic management system*. The balanced scorecard helps organizations align short-term actions with their strategy and thus removes barriers towards organizations strategic implementation in the long term.
- *Communication tool*. The balanced scorecard describes the organizations strategy clarifies and brings it to the average employee. Employees, once aware of the organizations strategies, can contribute towards the overall goal (Niven, 2002).

Deming believed that traditional quality assurance methods, such as product inspection after manufacture, were inefficient at finding the source of variations, which occurred throughout the production process. He pointed out that all business processes had to be considered and that they all needed feedback loops in order to improve. The balanced scorecard considers feedback not only in process outputs, but also in business strategy outputs. Rather than improving the performance of existing processes, the emphasis needs to be placed on processes that must be executed successfully for an organization's strategy to succeed. A balanced scorecard consists of managerial tools used for performance evaluation and the types of feedback it considers provide the guidance needed to continuously improve.

Hybrid methodology

While individual CI programs help to improve organizational operations in many aspects, they are not necessarily effective at solving all issues. To overcome the weaknesses of one program or another, more recently, a number of companies have merged different CI initiatives together, resulting in a combined CI program that is more far reaching than any one individually. Lean six sigma is the most well-known hybrid methodology, a combination of six sigma and lean manufacturing. The evolution of this hybrid has taken place since maintaining high production rates and high quality, or producing less waste, simply does not address enough areas that require improvement. For example, lean cannot bring a process under statistical control and six sigma alone cannot dramatically improve process speed or reduce invested capital. So the benefits of both six sigma and lean manufacturing were combined. As another example, TQM was being used as the primary quality initiative by the manufacturing organizations, but with TQM there is no clear way of prioritizing which quality project should receive the highest priority, and projects are carried out irrespective of the cost to the corporation. This was one of the reasons for the advent of six sigma. Six sigma is quite explicit about the financial benefits expected from each and every effort. According to six sigma, each and every black belt and champion are expected to contribute between \$100,000 and \$250,000 of incremental profit every year (George, 2002). However, Tatham and Mackertich (2003) state that while six sigma can be beneficial, it is not appropriate for widespread use.

Lean six sigma. After the apparent benefits of lean and six sigma were brought to the attention of the business world, there were a number of big conglomerates that had implemented both lean and six sigma to attain business excellence. To get a bigger share of the market, they developed a new methodology called lean six sigma. Since lean six sigma is a relatively new methodology, and as such, has not been studied in great detail. Some organizations have been using both methodologies in parallel to each other for years, while some have focused on just lean six sigma as a single methodology for improvement. Lean manufacturing and six sigma individually cannot achieve the required improvements at the rate at which lean six sigma can. Lean six sigma maximizes shareholders value by achieving the fastest rate of improvement in customer satisfaction, cost, quality, process speed and invested capital (George, 2002). Using a combination of lean and six sigma, greater value to the customer can be provided. While lean seeks to eliminate waste, six sigma seeks to reduce variation. By combining the two, waste is first removed, which then allows for variations to be spotted more easily. Lean six sigma also addresses important issues that are overlooked by six sigma and lean manufacturing individually: the steps in the process that should be first tackled; the order in which they should be applied and to what extent and the ways in which significant improvements can be made in terms of cost, quality and lead times. The fusion of the two helps organizations maximize their potential for improvement.

Existing research

The literature shows that there exists no theoretical basis for CI (Savolainen, 1998). CI tends to be used as a general term that has acquired many of its attributes from other quality initiatives such as TQM and lean manufacturing. While valuable research has been conducted on CI (Bessant *et al.*, 1994; Bessant and Caffyn, 1997), more perspectives are required (Gilmore, 1999).

Lillrank and Kano (1989) refer to CI, or *kaizen*, the Japanese term for CI, as the "principle of improvement"; however, the Japanese Union for Scientists and Engineers (JUSE) literature does not clearly define kaizen, but uses it to define other concepts. While the term *kaizen* is often considered synonymous with CI, Imai (1986) proposes that there exist at least three types of *kaizen*: management-, group-, and individual-oriented *kaizen*. Management-oriented *kaizen* is considered to be the most important one as it focuses on the company strategy and involves everyone in the company. Group-oriented *kaizen* is best represented by quality circles, which require employees to form a team or a circle with the goal of finding and solving problems faced during their day-to-day work without any interference from management. Individual-oriented *kaizen* is derived from the concept of bottom-up design, in which the worker makes a recommendation to the problem faced. This has been very successful in the Japanese industry since it is the worker who is on the shop floor and typically knows the best solution to an existing problem. Certain industries even have incentive programs where, depending on the problem and the solution provided, the worker is rewarded, thus encouraging the workers to concentrate on problem areas and find the best solution.

Jha *et al.* (1996) have found that there exists a close link between CI and quality in their survey of the literature. Imai (1986) defines total quality control (TQC) as "organized *kaizen* activities involving everyone in a company- managers and workers, in a totally integrated effort toward improving performance at every level". The link between CI and quality has been expressed by Berger (1996), who asserts that CI "should rightfully be regarded as a general development perspective, applicable with or without the context of TQM". However, from the large number of researchers who associate CI with quality, and from the mere implication that CI seeks to improve, it appears that there exists a link between the two, in some form or another.

CI programs were initially developed in organizations with product-focused processes or repetitive processes, i.e. with relatively high standardization of products and processes. Special teams were organized to work on improvement tasks, which were separate from their typical organizational tasks. Berger (1997) suggests that improvement tasks can be integrated into the regular work of individual employees, and that depending on product design and process choice, CI must be adapted to the degree of standardization involved. The implication is that CI programs can be applied to different types of work environments. The author presents a typology of organizational designs for CI based on two dimensions: basic task design (where the two forms of this dimension are individual vs group tasks), and improvement task (parallel vs integrated). Basic task design is reliant on the work process and product standardization: within this dimension, group tasks are more common in places with a low degree of standardization whereas individual tasks are prevalent in places that have high product standardization systems. In a highly standardized production system, the improvement task is the responsibility of an individual who might be a professional from engineering, quality, etc., and is qualified and trained in the improvement activities. In the case of production systems with a low degree of standardization, there is no resident expert who takes care of improvement, but teams consisting of ordinary employees try to carry out improvement activities within their work groups. An improvement task deals with the different levels of integration in which improvement activities are separated from ordinary work and they run parallel to each other, also known as parallel tasks. An integrated task is one in which improvement activities are embedded as part of the everyday activities of the employee.

Berger's typology presents five organizational designs based on the two dimensions:

(1) *Quality control circles:* a group of people in the staff who meet regularly to discuss problems and issues related to quality so that they may examine them and come up with solutions.

(2) *Wide-focus CI:* a blend of organic CI and expert task force CI (described below). It is used for temporary operations and for CI in self-managed work groups by combining continuous improvement process teams.

(3) *Organic CI:* multifunctional work groups are integrated with improvement activities. Organic CI is different from other CI models since the improvement activities are not left to the experts for design and planning and the decision-making is not left to the authorities outside the group.

(4) *Expert task force CI:* this form of CI is based on the reliance on temporary expert task force consisting of professional from quality, engineering and maintenance and therefore the span of improvement tasks requires considerable time and investment.

(5) *Individual CI:* improvements are set off by individuals and generally organized in the form of a suggestion system. Individuals come up with ideas and the implementation of the ideas is left to the specialists.

Lindberg and Berger (1997) have studied the applicability of CI in various types of organizations. The authors found that a number of Swedish organizations with a relatively low degree of standardization of products and processes had successfully integrated CI in work teams. The main thrust of the study was to emphasize the fact that in the traditional Japanese industries, kaizen improvements were being achieved by running the kaizen activities parallel to the regular work of the employees, which was in total contrast to the concept followed by organizations in Sweden, where CI was integrated into the regular work routines. The parallel structure does have some advantage as it leads to interdepartmental collaboration but it also leads to higher administrative costs (Krishnan *et al.*, 1993).

The CI capability model (Bessant and Caffyn, 1997), developed at CENTRIM at the University of Brighton in the UK, provides a powerful outline and arrangement for evaluating the usefulness of CI implementation. The authors present a framework with suggested routines and behaviours needed to successfully implement CI, and the characteristics needed by companies to develop CI capability. According to Caffyn (1999), CI capability can be defined as "the ability of an organization to gain strategic advantage by extending involvement in innovation to a significant proportion of its members". It comprises a set of ten generic CI behaviours that are seen as essential fundamentals in organizations of all types and sizes:

(1) employee demonstrates awareness and understanding of the organization's aims and objectives;
(2) individual groups use the organization's strategic goals and objectives to focus and prioritize their improvement activity;
(3) the enabling mechanisms (e.g. training, teamwork) used to encourage involvement in CI are monitored and developed;
(4) ongoing assessment ensures that the organization's structure, systems and procedures, and the approach and mechanism used to develop CI, constantly reinforce and support each other;
(5) managers at all levels display active commitment to, and leadership of, CI;
(6) throughout the organization people engage proactively in incremental improvement;
(7) there is effective working across internal and external boundaries at all levels;
(8) people learn from their own and from other's experience, both positive and negative;
(9) the learning of individuals and groups is captured and deployed; and
(10) people are guided by a shared set of cultural value underpinning CI as they go about their everyday work.

It has been found that some of these behaviours might be difficult to practice because firms might find it difficult to break the traditional mindset and encourage their employees to adapt to these new mindsets. However, in order to sustain such behaviour amongst all employees, this model identifies the requirements for a set of CI enablers such as facilitators, recognition systems or company procedures and company policies, which are meant to advance the required CI behaviour, but need to be monitored and developed over a period of time.

Jha *et al.* (1996) state that a better understanding of how CI contributes to an organization's mission and strategy will increase the chances of success. They have also found that there exist distinct elements of CI that revolve around problem solving and make use of problem-solving tools, namely work processes, work simplification, and performance monitoring.

Finally, with respect to comprehensive CI methodologies, Khusrow (2001) proposed a framework comparing improvement programs and found that lean manufacturing was the CI program of choice in the industries surveyed. However, his comparison was done specifically for the aerospace industry. If other industries are to be considered, the results would likely vary since the mandates of each organization is typically different.

Discussion

Continuous improvement programs have evolved from traditional manufacturing-focused systems that concentrate on the production line to reduce waste and improve the product quality, into comprehensive, systematic methodologies that focus on the entire organization, from top management to the workers on the shop floor. More recently, large organizations are developing their own CI methodologies to fit their specific needs by encompassing the various tools and techniques of individual methodologies. This signals the need for hybrid methodologies. While CI has evolved over the decades, the basic underlying factor driving this change has been the endless pursuit of organizations to improve.

Research in this field has been mainly focused on defining the nature of CI, its tools, organizational issues required to support CI initiatives, its applicability to various types of organizations, implementation issues, and critical success factors. The literature extols the many virtues of CI, but researchers have found that a more critical analysis of CI is required as is a more rigorous theoretical basis for conducting research in the field.

Research shows that CI can take place at three different levels within the organization: at the management, group, and individual levels. At the management level, the implications of CI are on the organization's strategy. Group level CI involves problem-solving tasks at a broad level, while individual level CI deals with improvement on a micro scale, i.e. on low level, day-to-day tasks. In order to reap maximum benefits from a CI program, managers must implement CI at each of these levels. CI programs can be applied to different types of work environments. Managers need to evaluate the product design, process choice, and the degree of standardization involved in the organization, and can then decide upon the appropriate methods to use to best implement improvement practices. Managers can evaluate the usefulness of CI programs by monitoring a set of routines and behaviours that are seen as being essential to organizations of all types for CI implementation. It is clear that CI does not come without hardships and struggles; without the active involvement of everyone in the organization, and the required resources and support from top management, CI in any organization cannot be successful.

Conclusion

In this paper, we have traced the evolution of CI from its early roots in manufacturing, to the more sophisticated methodologies that can be used in any organization, and that comprise an extensive toolbox for continuous performance improvement. The literature, while extolling the many virtues of CI programs, also makes it clear that achieving the expected results of modern day CI programs is quite challenging as it involves organizational changes on many levels. It is also generally agreed that CI and quality management programs go hand in hand as they seek to achieve excellence through improvement.

Our paper will be of value to practitioners by providing guidance in implementing a CI program or methodology. Practitioners will find useful principles, methods, tools, and techniques used in CI programs. It should also be useful to academics who are interested in how CI has evolved, and where it is today.

Although much research has been conducted on the individual CI methodologies and assessment tools have been developed to determine the progress of the CI initiative, to the author's knowledge, little focus has been directed towards developing a framework or model that would enable an organization to identify the CI methodology that best suits its needs, given a certain budget for such programs. Thus, an interesting topic to pursue in the field of CI is how to determine the appropriate CI methodology for an organization to implement and what are the tools and techniques that need to be deployed to achieve successful implementation. Furthermore, there is also a need for research in the field of the hybrid CI methodologies that have been developed in the recent past and to determine their applicability and to various organizations.

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