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CONTINUOUS IMPROVEMENT PHILOSOPHY FOR MANUFACTURING PRODUCTIVITY: CRITICAL REVIEW

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Abstract
In the current age of science, Indian industries are facing many challenges especially with the increasing product demand, complexity and competitiveness along with tightened quality, yield and productivity improvement. For the same purpose industries require to identify the potential area for improvement and diagnose the bottleneck. The Continuous Improvement Philosophy (CIP) is a very powerful tool that can be effectively employed to realize fundamental improvements of manufacturing performance in the organization, thereby leading the organizations successfully in the highly competitive environment. Although CIP has been widely accepted but, many critiques and improvement opportunities are possible. This paper explains the review of CIP and critiques which is necessary while implementation of CIP for performance evaluation.
Keywords: Kaizen, 5S, Muda, PDCA, Productivity.

1. INTRODUCTION

In an increasingly stern environment, industries must understand how equipment utilization affects profitability and work on its performance improvement. To accomplish these objectives, productivity plays a crucial role in boosting the growth of the organization and helps them to survive in a competitive world [34]. Nowadays, besides the measuring the productivity that enables the managers to know the current situation of their company, there are some CI tools that help managers to improve the productivity value, improving competitive image of the organisation, improving overall effectiveness of equipments, reducing cost of overhead expenditure, reducing operator mistakes, eliminating waste, and maintaining health & safety standards[34];[39]. A capital-intensive industry has an investment in processing equipment and manufacturing facilities account for about 65% of manufacturing cost [27]. CI can be define as a approach to enhancing manufacturing operations in small increments rather than looking for ways to make quantum improvements in productivity and quality [40]. CIP invariably achieve startling results, particularly in reducing equipment breakdowns, minimizing idling and minor stops, lessening quality defects and claims, boosting productivity, trimming labour and costs, shrinking inventory, cutting accidents, and promoting employee involvement [44]. After successful CI strategic implementation, some cases show that companies achieved 15-30 per cent reduction in maintenance cost, while others revealed a 90 per cent reduction in process defects and 40-50 per cent increase in labour productivity [30]. Also, some Japanese companies that have applied major CI programmes have seen a general increase in equipment productivity of 40-50 per cent [51]. Many companies have reported some benefits as enhancing their

manufacturing productivity when they moved towards becoming Lean by adapting different Lean tools such as 5S, VSM ,single minute exchange of die (SMED) and Kaizen (continuous improvement), setup time reduction, just-in-time (JIT), total productive maintenance (TPM) [12],[8],[24].

2. COUNTINUOUS IMPROVEMENT PHILOSOPHY (CIP)

After World War-II, Japan introduced Kaizen philosophy as a combination of two word, KAI (i.e. change) and ZEN (i.e. for the better) [32]. Masaaki Imai, Chairman of Kaizen Institute, propounded the concept of 'Gemba Kaizen'. Gemba in Japanese means 'real place' or the place where real action takes place. Further, Sarasohn recommended W. Edwards Deming for CI training through Statistical Methods. Further, Kaizen techniques became famous when Toyota used them to rise up in the world automotive leadership. Toyota staff encouraged to identify small problems, no matter how small it is, trace its root cause and implement the necessary solutions. In all, the method suggests a knowledgeable approach to employees for increasing the productivity and encourages participation in Kaizen activities. Three CI pillars as building block for any implemented kaizen are [20]:

a. Five S,
b. Waste Management and
c. Standardization

2.1 FIVE S

5S is one of the best known and most widely used Japanese tools in the manufacturing environment. The 5S for the workplace are 'housekeeping' activities commonly known by their Japanese terms as ***1st S: Seiri (sort out):*** it means that at workplace all the irrelevant items /things should be sorted out/ removed; ***2nd S: Seiton (set in order):*** items should be arranged properly so that they can be identified and approached easily; ***3rd S: Seiso (shine):*** shine means cleaning the workplace till it is spic and span; ***4th S: Seiketsu (standardize):*** this mean developing and maintaining standard work practices; ***5th S: Shitsuke (sustain):*** sustaining the progress made and ensure success in 5S by progress made in above four points must be maintained [30]; [43]; [40]. In additional, 5S for workers, commonly known by their terms as ***1st S: Shinrai Sei (Safety):*** Sense of safe environment to work concept; ***2nd S: Security:*** Sense of safe business concept; ***3rd S: Satisfaction:*** Sense of contentment with job, peoples and machinery; ***4th S: Survives:*** Sense of ordeal;
5th S: Support: Sense of assistance [21].

5S is a non-statistical and visual-oriented method derived for clean and manageable environment. 5-S practice is a well-recognized kaizen key to quality and productivity improvement and becomes the starting point of any CI tools [41]. In addition, 5S can be a reflection of our behaviour. If we have a consideration to 5S, the majority of our routine problems that we face in everyday works could be solved [16].

2.2 WASTE MANAGEMENT

The resources that do not add value to the system are known as muda (wastes) in Japan. Waste management is one of the most effective ways to increase the profitability for any business. Furthermore, different techniques are used of waste reduction and performance enhancement as just-in-time (JIT), TQM, total productive maintenance (TPM) and Kaizen

[39]. Eight Ws are 8 commonly accepted wastes out of the manufacturing operations as shown in Table 1. They include waste from overproduction, waste of waiting time, transportation waste, inventory waste, over processing waste, waste of motion, waste from production defects and unused employee creativity.

Table 1: Description of Eight Wastes [28]

S. no.	Waste	Description
1.	Over production	Producing items for which there are no orders comes under overproduction and resulting in wasted inventory space and excess transportation time
2.	Waiting time	Workers wait for the next processing step due to not having tools, lot processing, equipment downtime, lack of space, bottlenecks, etc
3.	Unnecessary transport	Carrying work in progress at long distances, creating inefficient transport, or moving materials, parts, or finished goods into or out of storage or between processes
4.	Excess inventory	Excess raw material, WIP, or finished goods causing longer lead times, damaged goods, increase transportation and storage costs, and delay. Also, extra inventory hides problems such as production imbalances, late deliveries from suppliers
5.	Over processing or incorrect processing	Taking unneeded steps to process the parts, inefficiently processing due to poor tools and product design, causing unnecessary motion and producing defects
6.	Unnecessary movement	Any wasted motion employees have to perform during the course of their work, such as looking for, reaching for, or stacking parts, tools, also, walking is waste
7.	Defects or rejections	Production of defective parts or correction is defect. Repair or rework, scrap, replacement production, etc. are also defect
8.	Unused employee creativity	Losing time, ideas, skills, improvements, and learning opportunities by not engaging or listening to your employees

For elimination of waste, it is very important to understand what wastes are and where it exists. Products significantly differ from factories to factories but wastes found typically in manufacturing environments are quite similar.

2.3 STANDARDIZATION

A work in which the successive activities have been properly structured so that it can be done efficiently, is called standardized work. Standardisation is the pillar of CI to bring the process under control by reducing variation [40]. This in tern eradicates wastages and increases the productivity. Standards are set by management; however they need to be ready for modification once the setting changes. Standardization is an endless method and best explained by Deming as the PDCA cycle (plan-do-check-act), as shown in Figure 1. The Deming cycle is a continuous quality improvement model consisting of a logical sequence of those four repetitive steps for Continuous Improvement (CI) and learning. The PDCA cycle is additionally called Deming Cycle, the Deming wheel of CI spiral [47].

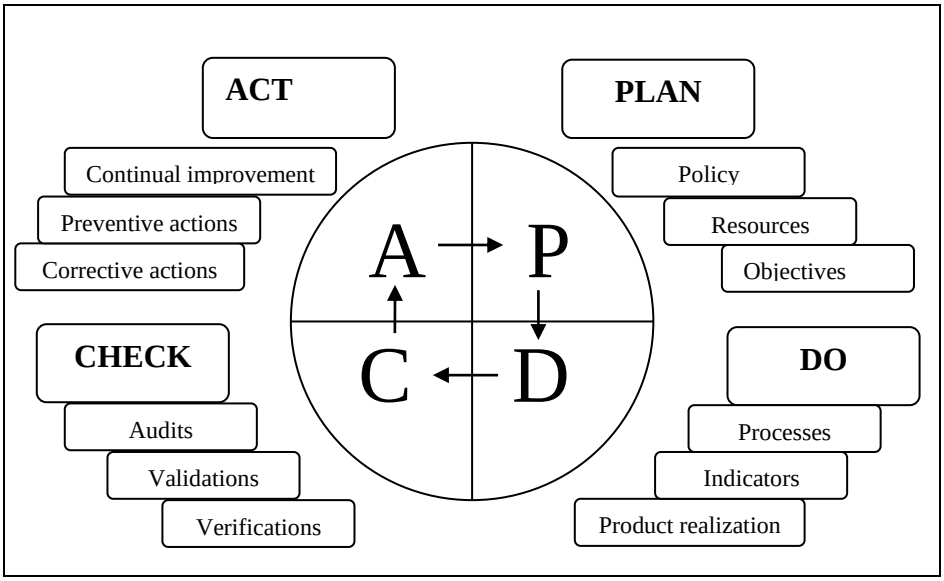

Fig 1: Deming Cycle [9]

• Plan – study current situation and develop changes for improvement.
• Do – pilot measures on a trial basis.
• Check – examine effect of changes to see if the desired result is achieved.
• Action – standardize on a permanent basis.

For above CI pillars selection of appropriate Kaizen tools, with their applicability, incorporation and acceptance within operations is a major problem for many companies **[18]**.

3. CRITICAL REVIEW ON CIP

Literature regarding the productivity and the implemented continuous CIP is conducted and worked up for the review purpose. After the critical literature review on CIP, focus turned to the link between Kaizen (CI), Maintenance and Manufacturing Productivity.

According to **Imai (1986) [19],** Kaizen means continuing improvement involving everyone in the organization can be categories as:

- individual Vs team Kaizen;
- day–to-day Vs special event Kaizen; and
- Process level Vs sub process level Kaizen.

Watson (1986) [47] introduced the Deming or PDCA (Plan-Do-Check-Act) cycle which is a continuous quality improvement model modified from the origin of Shewart cycle in the 1920s.

Suzaki (1987) [42] explains that CI may be a philosophy widely practiced in manufacturing and quality circles. Further, Kaizen signifies incremental improvements and each incremental improvement consists of many phases of development.

Wickens (1990) [48] describes the contribution of cooperation to create the thought of Kaizen by taking an example of Nissan Motor Plant within the UK.

According to **Teian (1992) [45],** Kaizen is quite more than a way of improvement and often applied to any area in want of improvement.

According to **Hammer *et al.*, (1993) [15],** Improvement may be divided into CI and innovation. Kaizen signifies small improvements and it generates process oriented thinking.

Bassant and Caffyn (1994) [3] define Kaizen as progressive innovation and this progressive innovation is supported by many tools and techniques. The problem is that CI needs the consistent efforts of all workers at each level.

Deniels (1995) [10] describes the role of operators as specialists who will be attending to solve their issues and provide right direction in achieving fundamental improvement on the shop floor and performance measurement in highly stern global market.

Yeo *et al.*, (1995) [52] concluded that CI is the most significant way to manage business through two concepts; one is 'Zero defects' which represents CI over quality by detection of defects and other one 'do it better every time' (DIBET) strategy which is related to constant, acutely aware and committed efforts to cut back method variation.

Newitt (1996) [31] has given a replacement insight into the previous thinking. The author additionally has declared that Kaizen philosophy within the business method management provides a climate in which creativity and value addition can flourish.

Imai (1997) [20] explain Kaizen as small but continuous improvements. Improvement can be broken down into Kaizen and innovation. Maintenance and improvement are the major functions to be performed by management under Kaizen.

Williamson (1997) [49] highlights the target cost accounting and Kaizen cost accounting thought in making continuous improvement.

Cheser (1998) [7] explains that Kaizen is basically on creating small changes on an everyday basis—reducing waste and incessantly rising productivity, safety, and effectiveness. Author highlighted that Kaizen has traditionally been applied for manufacturing sector, currently usually applied to service and business sector as well.

Gieskes *et al.*, (1999) [14] described a CI methodology as CUTE (Continuous Improvement using Information Technology towards Excellence) which aimed at the development of a software-aided tool to support companies, in particular small and medium-sized enterprises (SMEs).

Kim and Mauborgne (1999) [26] describe incremental improvement as 'imitation' and not 'innovation'. Kaizen strategy emphasizes mainly on value and customers and this will make this strategy to go beyond incremental improvements.

Williams (2001) [50] highlights that CI as Quality Function Deployment (QFD) technique which is the recognized method of creating vital reduction in production costs and translating client needs for a product into practical specification.

Doolen *et al.*, (2003) [11] describe the variables that are used to measure the impact of Kaizen activities on human resource.

Chen and Wu (2004) [6] elaborate that continuous improvement can be created and continued for extended period without any interruption by careful investigation of the problems.

Bhuiyan and Baghel (2005) [4] describe the evolution of CI from its early roots in manufacturing to the more sophisticated methodologies that can be used in any organization for continuous performance improvement. Further, modern day CI programs involve organizational changes on many levels.

Abdolshah and Jahan (2006) [1] describe a way to use CI tools in several life periods of the organization. Organizations face the problem of which CI tool ought to be used throughout completely different stages and life periods of organization.

Barber *et al.*, (2006) [2] The Knowledge Management Systems (KMS) effectively drives interrogation and analysis of data, and allocation of the best-suited CI tool to solve the highlighted problem area; allowing storage of the information and knowledge gained within the KMS intranet.

Jain and Yadav (2006) [22] explains the benchmarking study carried out in the two food-processing companies. Companies can learn and improve their operations by comparing their processes with the similar companies.

Tseng *et al.*, (2006) [46] investigates the effect of CI and cleaner production on operational performance.

Chadrasekaran *et al.*, (2008) [5] describe the application of KAIZEN technique to solve the part mismatch problem in automobile assembly production line.

Farris *et al.*, (2008) [13] describes that Kaizen event is a targeted and structured improvement project, employing a dedicated cross-functional team to boost a targeted work space, with specific goals, in an accelerated timeframe.

Radnor and Walley (2008) [33] explains that the immediate advantages earned through Kaizen events could be tough than once Kaizen events are utilized in an ad-hoc manner.

Singh and Singh (2009) [36] highlights that awareness, as highly important factor among employees for the success of the Kaizen philosophy in most of the manufacturing industries across the globe.

Singh and Singh (2010) [37] identified TPM, TQM and JIT as CI tools for enhancing manufacturing productivity and quality of product**.** Their survey based results indicated that the manufacturing enterprises are highly focused on customer relationship for carrying out continuous improvement.

Maleti *et al.*, (2012) [29], emphasis the role of CI as a part of TPM practices and its correlation with manufacturing performance, rather than on the creation of direct relationship between CI and maintenance performance.

El-Namrouty and AbuShaaban (2013) [12] promote lean thinking through studying the seven wastes that targeted by the lean manufacturing philosophy. Findings, offer various CI tools and techniques of eliminating wastes, such as, 5S system, Value Stream Mapping, TPM, and JIT, for Indian SMEs.

Janee Ali *et al.*, (2013) [23] describes that organizational self- assessment has a mediating effect on the relationship between strategic focus, learning/knowledge sharing and sustainability of continuous improvement capabilities.

Joshi (2013) [25] identified incremental improvement by suggestions from employees and also from brainstorming. These activities resulted in increased morale and confidence of employees.

According to **Singh and Singh (2013) [38]** CI is an integral part of the TQM, lean and Six Sigma philosophies and is a common approach to improve organisational performance.

Heavey *et al.*, (2014) [17] indicates empirical study of continuous improvement process to increased organisational return on investment (ROI) by customer value focused co-leadership, customer value focused strategic objectives, improvement methodology, improvement specialists with people performance knowledge.

Shafeek (2014) [35] highlights the Continuous maintenance improvement (CMI) that is an ongoing effort to improve maintenance aimed at maintenance process simplification and reduction or elimination of maintenance process waste.

Singh and Singh (2014) [39] has outlined the significance of customer relationship as a vital factor for enhancing manufacturing performance in the manufacturing organisation.

According to **Singh and Singh (2015) [40],** CI approach is a very effective manufacturing philosophy for large as well as small organization. Large organizations are developing their own CI methodologies to fit their specific needs by encompassing the various tools and techniques of individual methodologies.

4. FINDINGS AND SUGGESTIONS

From the literature it can be seen that a wide variety of work has being performed over the Kaizen philosophy which gives us a past practices that are being performed over the world; however, more research work is required in this field.

- CI concepts effectively employed to realize fundamental improvements of manufacturing performance in the organization, thereby leading the organizations successfully in the highly competitive environment.
- CI has become a new management paradigm in all types of organizations and small incremental changes in various sectors such as maintenance, manufacturing, process, services.

- 5-S, Waste Management and Standardization are fundamental CI pillars as building block for any implemented kaizen.
- TPM, TQM, Six Sigma and JIT as CI tools play an important role for enhancing manufacturing productivity and quality of product.
- Various qualitative as well as quantitative tools are to be used in the life cycle of the organizations for improvement and solving various problems.
- 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.

Some suggestions towards implementing of the kaizen events in a company are:

1. Problems incurred shouldn't be connected with people because blaming each other doesn't solve the problem. The approach should be towards the positive parts and the blaming and judging shouldn't be used instead feedback techniques are to be applied.
2. The nominal expenses initially help to get more profit from simple implementation in a long run.

5. CONCLUSIONS

This paper presents a detail review of the literature on the critiques of continuous improvement philosophy. Vast literature on CIP and its growing adaptation in developed and developing countries indicate the interest shown in this area by researchers and practitioners. The review is summarized for academic as well as industry personnel. From the literature reviews, it can be seen that CI approach is a very effective management as well as manufacturing philosophy. The practical approaches of different organisations are different so the modification in the CIP may be accordingly. There is a need for research in the field of the integrated CIP as necessity of complex manufacturing system.

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