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Corresponding Author	Family Name	**Unzueta**
	Particle	
	Given Name	**Goarka**
	Prefix	
	Suffix	
	Role	
	Division	Industrial Organization and Mechanical Industrial Production Department
	Organization	Mondragon Unibertsitatea
	Address	Mondragon, Spain
	Email	gunzueta@mondragon.edu
Author	Family Name	**Esnaola**
	Particle	
	Given Name	**Aritz**
	Prefix	
	Suffix	
	Role	
	Division	Industrial Organization and Mechanical Industrial Production Department
	Organization	Mondragon Unibertsitatea
	Address	Mondragon, Spain
	Email	aesnaola@mondragon.edu
Author	Family Name	**Eguren**
	Particle	
	Given Name	**José Alberto**
	Prefix	
	Suffix	
	Role	
	Division	Industrial Organization and Mechanical Industrial Production Department
	Organization	Mondragon Unibertsitatea
	Address	Mondragon, Spain
	Email	jaeguren@mondragon.edu

Abstract

This study presents an analysis of implementation and assessment of a frame of reference to adapt and execute an evolutionary continuous improvement process (CIP) in a mature small- and medium-sized enterprise (SME) that works in the capital goods sector. For this, the research team developed a continuous improvement model (CIM) to implement improvement routines and develop an organisational culture of continuous improvement (CI) to improve companies' CI maturity level. Case study methodology was used

	in the investigation, where, in the same context, eight units of the aforementioned company were analysed for two years to have a holistic view of the organisation's evolution. To analyse the implementation of the CIP, we developed an evaluation system based on a questionnaire completed by the company's management and CI leaders. The assessment results explain how the implementation of the CIM through the application of the CIP helps develop improvement routines and increase the organisation's CI maturity level. In this specific case, the application of the assessment system shows that although the assimilation of the routines evolved positively in most cases, not in all routines maturity level 2 was achieved, thus emphasising the needs of the organisation and the future actions to be implemented during the following CIP cycles.
Keywords (separated by '-')	Continuous improvement process - Continuous improvement routines - Continuous improvement maturity level - Industrial case study

Chapter 23
Evaluation of the Maturity Level of Continuous Improvement Based on Improvement Routines: A Case Study of SMEs of Capital Goods

Goarka Unzueta, Aritz Esnaola, and José Alberto Eguren

Abstract This study presents an analysis of implementation and assessment of a frame of reference to adapt and execute an evolutionary continuous improvement process (CIP) in a mature small- and medium-sized enterprise (SME) that works in the capital goods sector. For this, the research team developed a continuous improvement model (CIM) to implement improvement routines and develop an organisational culture of continuous improvement (CI) to improve companies' CI maturity level. Case study methodology was used in the investigation, where, in the same context, eight units of the aforementioned company were analysed for two years to have a holistic view of the organisation's evolution. To analyse the implementation of the CIP, we developed an evaluation system based on a questionnaire completed by the company's management and CI leaders. The assessment results explain how the implementation of the CIM through the application of the CIP helps develop improvement routines and increase the organisation's CI maturity level. In this specific case, the application of the assessment system shows that although the assimilation of the routines evolved positively in most cases, not in all routines maturity level 2 was achieved, thus emphasising the needs of the organisation and the future actions to be implemented during the following CIP cycles.

Keywords Continuous improvement process · Continuous improvement routines · Continuous improvement maturity level · Industrial case study

G. Unzueta (✉) · A. Esnaola · J. A. Eguren
Industrial Organization and Mechanical Industrial Production Department, Mondragon Unibertsitatea, Mondragon, Spain
e-mail: gunzueta@mondragon.edu

A. Esnaola
e-mail: aesnaola@mondragon.edu

J. A. Eguren
e-mail: jaeguren@mondragon.edu

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23.1 Introduction

The outcomes of continuous improvement (CI) implementation are well documented in the literature [5, 13, 15], but the literature also identifies that in many cases, maintaining initial results is difficult and the effectiveness of applied techniques decreases [2]. Many authors point out that to address this problem, it is necessary to adapt the CI system to the needs of each organisation, defining a strategy for the implementation of the CI system to establish a culture of improvement that naturally sustains the implemented system [3, 6, 12, 15, 18]. In order to sustain and increase the CI maturity level of the organisations, taking previous models as references [17], a continuous improvement model (CIM) was designed to deploy and develop an organisational culture of CI. The current paper analyses through a specific assessment system how the implementation of the model positively influenced the development of a CI culture in an industrial small- and medium-sized enterprise (SME), measuring this development through a specific assessment system.

Previous Unzueta et al. work assesses the CI maturity based on five different aspects [17]: (1) management commitment and leadership, (2) training and education programme, (3) improvement teams and promotion of teamwork, (4) participation and involvement in CI activities and (5) generation and assimilation of new CI routines. Based on this previous work, this paper deepens how to assess the CI maturity based on the evaluation of CI routines, aspect 5 of [17]. This paper describes how to assess CI routines and analyses the company as a whole, describing the evolution of a company's CI maturity according to the development of improvement routines. The study is based on data collected over a period of two years (November 2017–July 2019).

The paper is organised as follows. Section 23.2 describes the research methodology. Section 23.3 presents the theoretical framework and explains the CIM, and Sect. 23.4 describes the continuous improvement process (CIP) applied to implement the model. The case study is presented in Sect. 23.5, and finally, Sect. 23.6 presents the results and discussion and Sect. 23.7 the conclusions.

23.2 Methodology

The investigation was based on a case study methodology [19]. To have a holistic view of the organisation, eight units of the company were analysed for two years, as shown in Fig. 23.1, where the deployment of the methodology is presented in detail. First, a literature review was conducted to identify the key elements of CI and establish a basis for the CIM [17]. Subsequently, the CIP was designed, and the units to be analysed were selected. These correspond to the various production areas of the company.

The CI maturity level was evaluated through a questionnaire that measured the extent to which improvement routines were assimilated, based on the constitutive

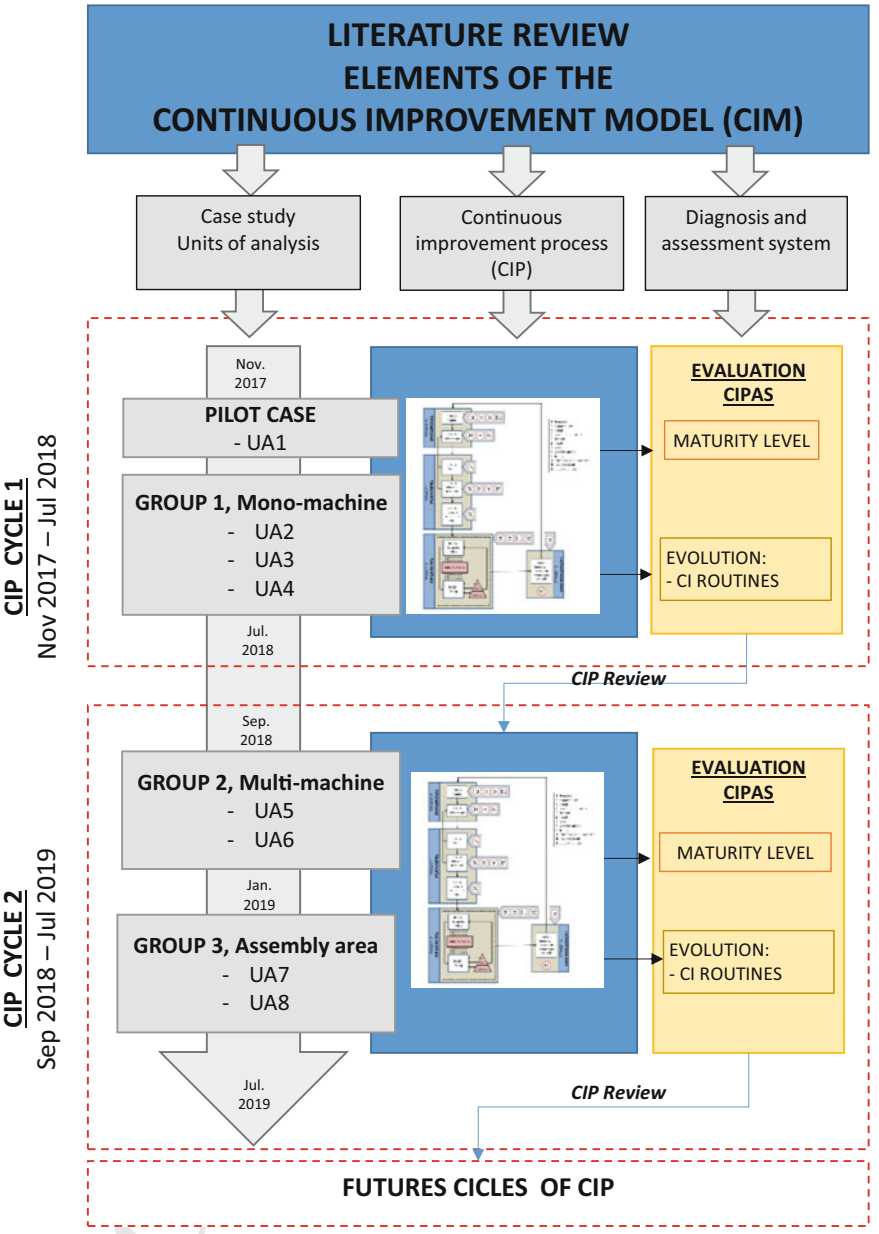

Fig. 23.1 Investigation methodology

routines related to each routine defined by Bessant et al. [4]. Annually, at the end of each CIP cycle, the organisation's management team and CI leaders completed the questionnaire. This study analyses two cycles of the CIP from November 2017–July 2019.

23.3 Theoretical Framework

According to Boer et al. [7], CI is "the planned, organized and systematic process of ongoing, incremental and company-wide change of existing practices aimed at improving company performance". A number of researchers have studied the critical success factors and the elements that influence when a company wants to implement a CIM. Some of them highlighted some specific elements depending on the context and the type of company (e.g. in a large enterprise or an SME, public or private). Considering the literature and the case study company context, the most important elements identified are as follows [17]: management (E1), company culture (E2), strategy (E3), leadership and structure (E4), resources (E5), projects (E6), areas (E7), operating method and improvement tools (E8), training (E9), monitoring and communication (E10), level of involvement (E11) and facilitator or CI leader (E12). Figure 23.2 shows the general structure of the implemented CIM.

According to Bessant et al. [4], CI refers not only to improving results but also to the process by which improvements can be achieved. This process, described in Sect. 23.4, allows the company to evolve its CI maturity level. Bessant et al. [4] proposed an evolutionary CI maturity model consisting of five levels. Based on this model, organisations can identify their level of CI by analysing the uptake of eight improvement routines (see Fig. 23.2). The model proposes that the organisation can advance its level of CI by acquiring the following eight routines [4, 8]: understanding CI (R1), getting the CI habit (R2), leading the way (R3), focusing CI (R4), shared problem-solving (R5), aligning CI (R6), CI of CI (R7) and the learning organisation

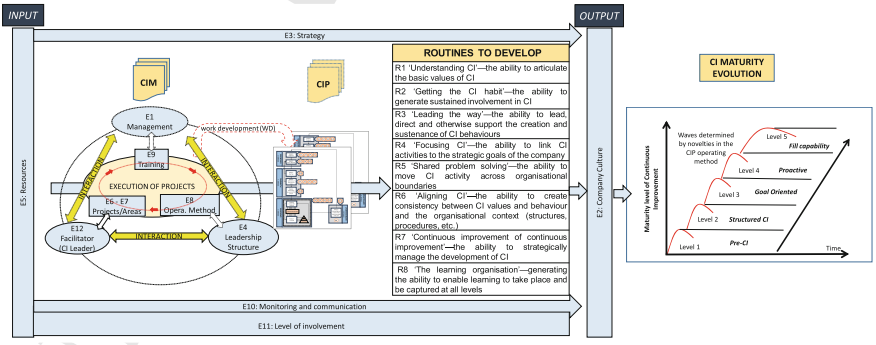

Fig. 23.2 Continuous improvement model. Based on Unzueta et al. [17]

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Fig. 23.3 CI routines: complementation objective for each maturity level. Based on Dabhilkar and Bengtsson [8] and Garcia-Sabater et al. [9]

(R8). Considering this evolutionary model analysed [9] how the organisation, in order to increase its level of CI, has to progressively consolidate improvement routines until they are normalised on a day-to-day basis, while taking on new routines that raise its level of CI [8, 9]. As shown in Fig. 23.3, as routines are assimilated, the CI maturity level of the company increases.

23.4 Continuous Improvement Process

To increase the company's CI maturity level, it is necessary to create and assimilate new CI routines, applying systematic improvement methods and tools through a structured process. This structured process is the CIP, the process of implementing the CIM. The CIP presented in Fig. 23.4 identifies four stages, phases of each stage and the significant elements of each phase [17].

Stage 0: Diagnosis. The company should be diagnosed considering the production maturity levels [11] and the improvement tools previously applied. Finally, the appropriate operational method should be extracted for the specific case. Depending on the maturity level, basic lean tools, such as 5S or visual management, or more complex tools based on Six Sigma may be more appropriate. The company's management must also create an organisational structure appropriate to the organisation for the development and implementation of the CIP.

Stage 1: Planning. After having trained the management and the managers of the departments concerned during Stage 0 to ensure their support, the selected operational method is adapted to the organisation and the defined projects. In addition, the management must develop the appropriate channels and activities to communicate the characteristics and benefits of the CIP [16]. Finally, a plan is developed for each project.

Stage 2: The operative stage. In this stage, the execution of the selected projects and the training of participants are done in parallel. The projects are managed and executed following the defined project plan. Training is adapted in accordance with the operating method and to each organisational structure level. Adapting this training is especially important because each organisational level has different activities and responsibilities [1].

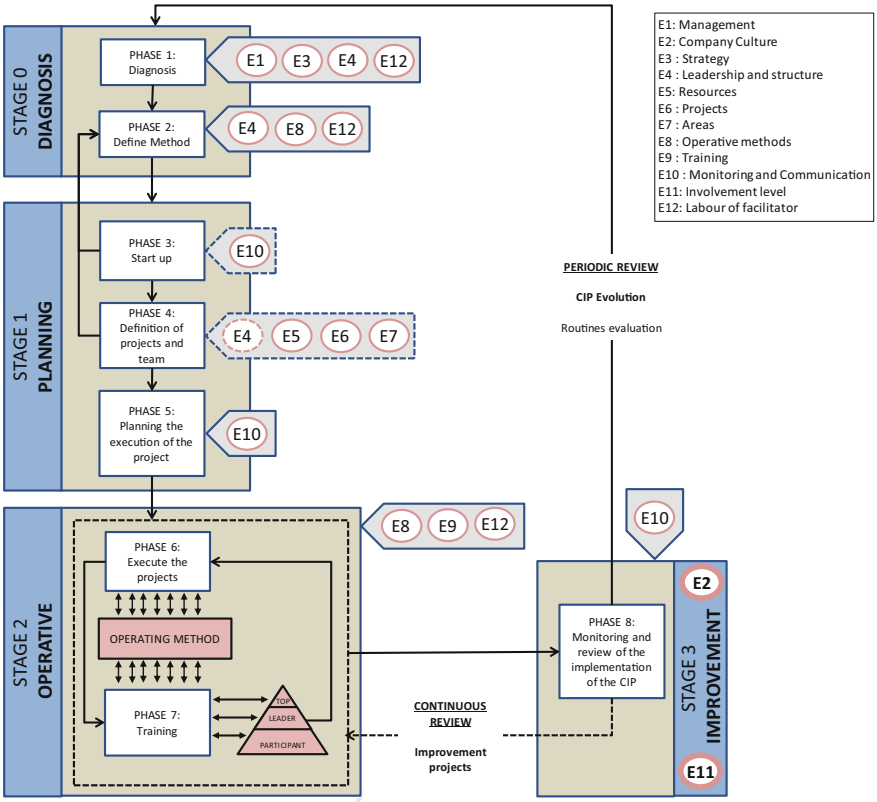

Fig. 23.4 Continuous improvement process. Based on [17]. Based on Unzueta et al. [17]

Stage 3: The improvement stage. This stage has two different reviews: continuous review and periodic review. Regarding the continuous review, Wu and Chen [18] suggested that the metrics used in the evaluation system should be suited to each CI level (continuous review, see Fig. 23.4) to continuously review the progress of the defined projects. On the other hand, considering that self-examination is the most effective way to achieve successful CI [10, 18], organisations must analyse the CIP periodically to understand its weaknesses and implement improvements to increase CI maturity (periodic review, see Fig. 23.4).

In this study, we present how the case study organisation applied the CIP and increased its CI maturity level in accordance with a periodic evaluation of CI routines at the end of each CIP cycle (periodic review, see Fig. 23.4). The assimilation of CI routines was evaluated through a questionnaire based on the constitutive behaviours related to each routine [4]. The company's management team members and CI leaders completed the questionnaire using a four-point Likert scale (see Table 23.1).

Table 23.1 Example of questions posed on the questionnaire based on constitutive behaviours to measure R1 routine

Routines [4]	Constitutive behaviours [4, 8]	Questions [9, 17]	Likert 1–4
R1. Understanding CI The ability to articulate the basic values of CI	People at all levels demonstrate a shared belief in the value of small steps, and everyone can contribute by themselves being actively involved in making and recognising incremental improvements	Do workers have the time and resources to think about, propose and implement small improvements in their daily work?	
	When something goes wrong, the natural reaction of people at all levels is to look for reasons why, etc., rather than to blame individual(s)	Are root cause dynamics implemented? Are these dynamics implemented instead of looking for people to blame? Are there adequate discussion forums to discuss and seek solutions to problems?	
	People make use of some formal problem-finding and problem-solving cycles	Are problem-solving tools (e.g. seven basic quality tools) applied in the discussion forums?	

Questions based on Bessant et al. [4], Dabhilkar and Bengtsson [8], Garcia-Sabater et al. [9] and Unzueta et al. [17]

23.5 Case Study

The CIP and the assessment system were applied in a cooperative model organisation located in Basque Country, Spain. The company had three different businesses, and the projects supported by the CIP were implemented in the power transmission equipment business. Unzueta et al. [17] conducted a previous study on the company, in which the evolution of the implementation of the CIM was analysed by comparing various units of analysis with each other during the first year of the CIP implementation.

In this study, the data obtained in the previous case study [17] and the data achieved during the second year of the CIP implementation were used to analyse the evolution of the company's CIM as a whole and to validate the assessment system based on the assimilation of the improvement routines by the organisation. In the first stage of the CIP (in the first cycle executed between November 2017 and July 2018), it was diagnosed that the company was in the first level of CI, and the management, together with the research team, decided to set a goal to achieve in a period of two years to overcome the second level and establish the basis for the third level of CI maturity. To this end, an organisational structure was defined, identifying the responsibilities

related to CI at each level of the structure, and the people involved in the structure were trained in the use of basic improvement tools, starting with middle management and ending with the employees. The training was adapted to each organisational level.

Taking into account that the organisation was at the first level of CI, a basic improvement tool was selected to start laying the foundations of the improvement system. The tool selected was 5S because it is a simple tool to apply, and it facilitates the involvement of staff in a common project for the whole organisation, thus promoting teamwork [14].

23.6 Results and Discussion

The results of the evaluation confirm that by implementing the CIP, the organisation progressively assimilated CI routines and increased its CI maturity level. People involved directly in the CI organisation structure, management, middle management and employees and assimilated several improvement routines at the end of the second cycle. As seen in Fig. 23.5, the first three routines exceed 90% of routine uptake or are close to it. Routines were successfully assimilated, although the objective set for maturity level 2 was not achieved for all routines. It was observed that in routines R6 (aligning CI) and R7 (CI of CI system), which should be assimilated to a greater extent by the management and leaders of CI, the level of assimilation is much higher than the objective defined for the second level of CI. This is evidence of how CIP serves to foster the development of an organisational culture oriented towards CI. The

Routines and constituent behaviours	Routine assimilation	
	CYCLE 1	CYCLE 2
R1 'Understanding CI'—the ability to articulate the basic values of CI	94%	100%
R2 'Getting the CI habit'—the ability to generate sustained involvement in CI	75%	94%
R3 'Leading the way'—the ability to lead, direct and otherwise support the creation and sustenance of CI behaviours	63%	88%
R4 'Focusing CI'—the ability to link CI activities to the strategic goals of the company	38%	56%
R5 'Shared problem-solving'—the ability to move CI activity across organisational boundaries	56%	69%
R6 'Aligning CI'—the ability to create consistency between CI values and behaviour and the organisational context (structures, procedures, etc.)	69%	81%
R7 'Continuous improvement of continuous improvement'—the ability to strategically manage the development of CI	44%	75%
R8 'The learning organisation'—generating the ability to enable learning to take place and be captured at all levels	38%	44%

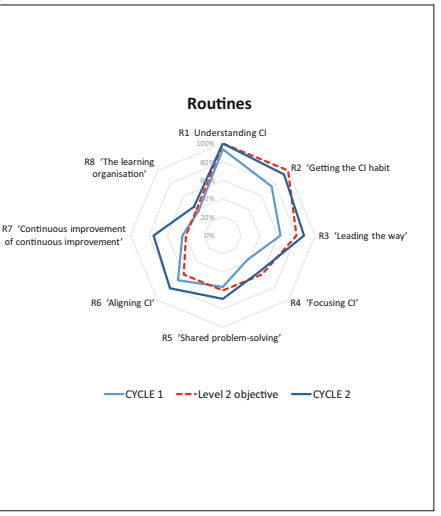

Fig. 23.5 Routine assessment. Based on Bessant et al. [4], Dabhilkar and Bengtsson [8], Garcia-Sabater et al. [9] and Unzueta et al. [17]

main reason for this is the actions implemented in Stage 1 of the CIP, through which the company analyses the evolution of the system on an annual cyclical basis and defines the strategic projects to be developed in the future cycle. On the other hand, the defined organisational structure, taking into account the people, their responsibilities regarding CI and the work dynamics implemented, facilitates the development of the R5 routine (shared problem-solving).

23.7 Conclusions

The questionnaire for evaluating the extent to which CI routines were assimilated was useful in helping the organisation to see the evolution and define its approach to the deployment of each CIP cycle.

Analysing each area individually, the research team observed that the areas where suggestion management systems and manufacturing process measurement were implemented developed more deeply the R2 routine (getting the CI habits). This is because these routines, at the initial levels of CI, must be assimilated to a greater extent by the employees, and the measurement of the manufacturing processes together with the possibility of making suggestions for improvement in a systematic way facilitates the involvement of the employees in the improvement dynamics implemented.

Considering the organisation as a whole, it was observed how the selection of projects has evolved, increasing the difficulty of the projects in the third cycle of the CIP. In the first two cycles, the projects selected were oriented towards the standardisation of workplaces and the establishment of CI dynamics. In the third cycle, projects that are more specific were defined, such as changes in layout and development of quality control through self-monitoring in critical manufacturing processes. These new projects will boost middle management involvement and consolidate routines R4 (focusing CI) and R5 (shared problem-solving).

Compliance with Ethical Standards The results of this work are supported by a questionnaire. Participants of the research study voluntarily agreed and gave informed consent to participate in the questionnaire. All data was anonymised before publication. The "Research Ethics Committee of Mondragon Unibertsitatea" (Ref. IEB-20210924) approved the entire procedure used in the research process.

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