



Coping with New Business Challenges: Analysis of the Elements that Affect the Sustainability of Continuous Improvement Programs

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Abstract— Companies have evolved over time and this includes their efforts to overcome obstacles. In this article, we discuss sustainability as synonymous with success, and evaluate the sustainability of Continuous Improvement Programs (CIP) and the elements that affect it. The objective of this article is to highlight and analyse the results from a self-assessment investigation. We appraise the impact of a set of elements over sustainability and their maturity (absence or their degree of presence) while being deployed within the organization. This appraisal is done by assigning different weights and scores to the answers of the self-assessment investigation. We were able to observe that those elements with a higher impact score are heavily linked with management approaches. On the other hand, those same elements are not necessarily the more mature or appropriately displayed, and by the use of the maturity scoring system, we investigate the different stages of each element. This opens a pathway for further research into the behaviour of particular elements with the potential of enhancing or diminishing the sustainability of Continuous Improvement Programs.

Keywords— *Sustainability, Continuous Improvement, Self Assessment Investigation, Elements, PDCA.*

I. Introduction and Context

Operational excellence practices are borne from solutions to industry demands as a way of achieving desired performance and “*ensure a continuous delivery of positive results*” [1 p. 143]. At the beginning of the 20th century, the industry was marked by mass production, and so improvement methods such as standardization, time measurement analysis, worker motion study, and ergonomics were the solutions to overcome the obstacles at that time.

Adaptability is the key to longevity [2]. According to Bonebeau *et al.* [3 p. 9] some organization systems “*can be understood as a set of dynamic mechanisms in which global structures appear from a system of interactions between components at different levels*”. Moreover, since companies are formed by people, they tend to be in a state of constant

change. Jaca *et al.* [4] suggested the idea of flexibility and adaptation to satisfy customers, meaning that the idea of constant change is distinctly present. Companies launch initiatives that increase successes and reduce failures [5], and become what is known today as a culture or philosophy [6] of **Continuous Improvement (CI)**. This is related not only to the above (deviation reduction), but also to *quality management programs* [6], *reduction of production costs* [7], *effective resource management, employee empowerment* [8], and *customer satisfaction* [9], among others.

There are three main features regarding CI philosophy, worth highlighting. The **first** is CI considers not only technical tools but also different management approaches [10]. CI is capable of handling the symbiosis between these two styles: a purely technical aspect, which leverages operational excellence, whilst a managerial aspect is less visible but has high impact, especially on long-term and medium-term strategies. **Secondly**, providing feedback is the core of CI since it builds mutual understanding and teamwork [11]. Mistakes are inevitable in any process; they are not seen as a negative aspect but as a useful tool for re-analysing strategies based upon previous experiences. **Thirdly**, the complex structures created by today’s companies can also affect CI [12]. In order for CI to be successful, it must consider all agents within the organization, which are disseminated through different levels and with different evaluation approaches.

Being sustainable can translate into corporate success [13], and yet despite proving that the application of those **Continuous Improvement Programs (CIP)** can drastically upgrade operational performance [14], firms experience problems in gaining acceptance for CIP and sustaining them [10]. In terms of the issues associated with the lack of sustainability of CIP, authors cite lack of direction, motivation, structure, among others [15]. According to other authors, there is a lack of research defining **sustainability** [15], which contributes to our research motivation. Therefore, it is necessary to study the concept of sustainability that can be deployed within a CIP framework.

This article is presented as follows: in section two, we present our approach and methods, and explain the tool used to collect the data from firms surveyed; in section three, we explore the results obtained. Section four discusses the question formerly posed, while the final section presents the conclusions and suggested further research.

II. Sustainability of CIP

According to Prajogo *et al.* [16 p. 207], a definition of the term sustainability within a CI context can be described “*as the ability of an organisation to adapt to change in the business environment, to capture contemporary best practice methods and to achieve and maintain superior competitive performance*”. In this case, it is possible to transfer it into our framework. However, there are limitations, such as the lack of capacity to translate the definition within the objectives of the organization.

The challenge dwells on how companies can understand its profound meaning and the innate incongruences that surrounds it [17]. From previous works [18 p. 4], and by analysing the same terminology from different research fields, we define sustainability as:

“The capacity to maintain a high level of performance achieved gradually over time, that is measurable, according to well-defined processes, limited by finite resources (financial, material, human among others), and with the particularity of being able to adapt itself to context evolution”

Sustainability can be seen as an ability to adapt and change its environment [19]. It is imperative that companies understand the factors that characterize the sustainability of CIP [4]. From previous studies [20], and based on a literature review e.g. *scientific journals, case studies, reviews articles, interviews, books and books reviews*, we identify 15 elements that influence the sustainability of CIP (see Table 1). From that exercise, we were able to source approximately 231 references, of which 60 revealed *Tools and Methods for CI* as having the greatest influence over the potential for sustaining CIP. Only six references were found for *Diagnosis*, suggesting it has the least influence by volume of sourced literature.

Constant adaptation is a big part of the sustainability definition [19]. Therefore, we propose a concept that *Continuous Improvements Programs balance themselves between a two-state dynamic, one stable and other fluctuating*. This should enhance our research process thought.

Basing ourselves on that idea, we do believe that a set of elements (already mentioned) (Table 1) helps to create this balance. This leads us to an appreciation that the maturity of elements can be seen as triggers for change, or factors that can act as stabilizers. Having developed a definition of

sustainability pertaining to CIP, and the elements that characterize it, two questions arise:

Is the perception of the elements impacting the sustainability of CIP in agreement with current theories?

Can the maturity level of each element be measured or evaluated?

Table 1. Elements impacting the sustainability of CIP and their frequency of occurrence in the sourced literature.

	Abbreviation	Sources	Rank	% Occurrences
Tools and methods for CI	TOOL METH CI	60	#1	26%
Change management	CH MGMT	26	#2	11%
Leadership	LD SHP	20	#3	9%
Organizational routines	ORG R	18	#4	8%
Performance of CI initiatives	PER CI	17	#5	7%
Employee engagement	EMP ENG	15	#6	6%
Risk management	RISK MGMT	14	#7	6%
Knowledge management	KNOWL MGMT	10	#8	4%
Decision-making	DEC-MAK	9	#9	4%
Training on methods and tools for CI	TOOL METH CI	8	#10	3%
Organizational culture	ORG CE	8	#11	3%
Communication management	COMM MGMT	7	#12	3%
Time management	TIME MGMT	7	#13	3%
Resources	RES	6	#14	3%
Diagnosis	DIAG	6	#15	3%

Our objective is to evaluate **the impact of those 15 elements** upon the sustainability of CIP **and their degree of maturity**, then later compare those two outcomes. In order to measure the maturity or level of deployment of those elements, we are using the **Plan-Do-Check-Act (PDCA)** cycle as a ruler to quantify that maturity. Introduced in 1951 by Dr W. Edwards Deming at the Japanese Union of Scientists and Engineers (JUSE), this approach has become one of the bases of CI. A tool capable of being applied to all types of organizations, promoting knowledge, benefiting the use of team-working and empowering organizations to improve their endeavours [21]. With these results, we intend to answer the questions already established and respond to the ideas previously presented.

III. Approach and Methods

The approach used to measure the impact and the degree of maturity of the elements was a self-assessment investigation aimed at companies experienced in the deployment of CIP. For this endeavour, Mont-Blanc Industries¹, a business cluster from the Haute-Savoie department in France, supported us. We designed a self-assessment investigation composed of 113 questions to be completed over a three-month period from December 2016 to February 2017. Mont-Blanc Industries has 315 members who were approached obtaining 80 results. The assessment tool was electronic-based (the companies were approached

¹ <http://www.montblancindustries.com/>

² <http://www.lesphinx-developpement.fr/>

directly via e-mail) by using the software SPHINX², an electronic tool for data collection and analysis.

In the assessment, we have two sections. **Section 1**, was general positioning, made of seven questions, one of which was open, and the others closed. We covered: the company sector, respondent's role within the organization, years of experience, company size, their perception of their own knowledge concerning CIP as well as how they describe the maturity of the companies they work for regarding CIP. These latter two questions were evaluated with a three-scale selection: *Beginner*, *Intermediate* and *Confirmed*, from Figure 1.

Figure 1. First section of the assessment self-assessment investigation.

Questions d'ordre général

Votre fonction au sein de l'entreprise

Responsable amélioration continue

Secteur d'activité de votre entreprise

☐ Aéronautique
☐ Agroalimentaire
☒ Automobile
☐ Cabinet de conseil
☐ Chimie / Pharmacie
☐ Distribution
☐ Industrie lourde / Plastique
☐ Médical
☐ Services
☐ Société de technologie
☐ Autre

Votre ancienneté dans l'entreprise

☐ Moins de 5 ans
☒ 5 à 10 ans
☐ 10 à 20 ans
☐ 20 à 30 ans
☐ Plus de 30 ans

Taille de votre entreprise

☐ Moins de 10 employés
☐ 10 à 249
☒ 250 à 4999
☐ Plus de 5000 employés

Comment qualifieriez-vous votre niveau de connaissance sur les DAC (Lean, Kaizen, WCM, etc) ?

☐ Débutant
☐ Intermédiaire
☒ Confirmé

Comment qualifieriez-vous la maturité de votre entreprise vis-à-vis des DAC (Lean, Kaizen, WCM, etc) ?

☐ Débutant
☒ Intermédiaire
☐ Confirmé

Depuis combien de temps avez-vous mis en place des DAC ?

☐ Moins de 3 ans
☒ 3 à 5 ans
☐ 5 à 10 ans
☐ Plus de 10 ans

The **second section** (Figure 2) was composed of **closed questions**. We examined two major streams: element impact over the sustainability of CIP and their degree of maturity (with a PDCA approach).

Figure 2. Second section of the assessment self-assessment investigation.

Introduction of the element and small definition

1. Formation sur les méthodes et outils d'AC

posées au sein de l'entreprise pour améliorer les compétences et les connaissances des employés sur l'AC

D'après vous, quel est l'impact de la "Formation" sur la pérennisation d'une DAC ?

☐ 1. Pas d'impact
☐ 2. Impact faible
☒ 3. Impact modéré
☐ 4. Impact significatif

Situation de votre entreprise

1.1 Connaissance des programmes de formation sur les méthodes d'AC

X. La plupart sont connus, formalisés à tous les niveaux de l'entreprise et utilisés par les employés

1.2 Mise en place de la formation du personnel

S. La plupart sont réalisées, en s'inscrivant dans un cycle de performance et généralisées à toute l'entreprise

1.3 Évaluation des programmes de formation du personnel

M. L'évaluation est réalisée, les résultats sont exploités mais non partagés à tous les niveaux de l'entreprise

1.4 AC des programmes de formation

S. La plupart sont réalisées, en identifiant les causes des écarts avec une capitalisation de l'expérience mais non généralisées à toute l'entreprise

Commentaires (optionnel)

In order to illustrate that section, Figure 2 shows a screenshot for the element *Training on methods and tools of CI*. The first question regarding the impact is, “**According to you, what is the impact of Training over the sustainability of CIP?**” With four options: *No-Impact*, *Low-Impact*,

Moderate-Impact and *Significant-Impact*. The question was designed to garner the respondents point of view, their **knowledge and personal experience**.

For element maturity, the next four questions were directed to the **work experience** of the respondent. We used an original approach based on the PDCA cycle. By doing that, we position the element within a problem-solving scope [22]. Using the same *Training on methods and tools of CI* element as an example, the PDCA approach was divided as follows: **P** (1.1 Knowledge of the training programs concerning CI methods), **D** (1.2 Application of employee training), **C** (1.3 Evaluation of employee training programs) and **A** (1.4 CI of employee training programs). For each step of the PDCA cycle, the respondent selected how the element is being deployed in the organization. The scale used was: *Not present*, *Present*, *Methodical*, *Systematic*, *Exemplary* (IEM SX by its French initials) (Table 2). Each of these scale levels represents how the element is being deployed.

Table 2. Subdivision of the PDCA cycle by element.

(I) Not present	This part of the element is not applied within the company
(E) Present	The company has taken into account this part of the element
(M) Methodical	The practice of improvement is processed according to a method which can be generalized
(S) Systematic	The practice is processed with method and the application field is effective and systematic (sustained in time)
(X) Exemplary	The method, its application and their results deserve to be communicated externally because they are effective and simple

In this **second section** of the self-assessment investigation, we applied an evaluation scale based on weights (Table 3), enabling us to obtain the respondents’ perception, by scoring the element global impact over sustainability of CIP, as well as their perception of the element deployment throughout the company (element maturity).

Table 3. Weight of the impact of an element over the sustainability of CIP and weight of the maturity of an element.

Element Impact Degree	Weight
No-Impact	1
Low-Impact	2
Moderate-Impact	3
Significant-Impact	4
Maturity of the Element with PDCA approach	Weight
(I) Not present	1
(E) Present	2
(M) Methodical	3
(S) Systematic	4
(X) Exemplary	5

IV. Results of the Self-Assessment Investigation

The first result from the assessment showed that 95% of the respondents place themselves between *Intermediate* and

Confirmed regarding their knowledge of the CI philosophy. In the case of the companies' maturity regarding CIP, 34% of them belong to the *Beginner* tier, 46% *Intermediate* and finally 20% as *Confirmed*. As we can see from Figure 3, the presence of *Significant-Impact* is high among the majority of elements, with an average of 62%. In the case of *Employee Engagement*, it is high as 95% while for *Risk Management* it is only 35%.

In order to obtain an overall score for the impact of elements, we used the weights assigned to every impact degree, and then calculated the arithmetic mean for all.

$$Ie_i = \frac{\sum_{j=1}^N W_{i,j}}{N}$$

Where:

Ie_i : Arithmetic mean of the impact of the element i

N : Number of terms (80 companies)

W_i : Weight (1 to 4) of the impact degree of the element i for firm j

Considering the global score from the 80 companies, *Employee Engagement*, obtained the highest score with 3.91. On the other hand, the lowest score among the whole elements is *Risk Management* with 3.13. A deeper analysis

regarding these results is explored in the **Discussion** section, to obtain results over the maturity of the element, we used a similar approach. However, in this particular case, each element was divided into four steps (PDCA) and each of those steps had a deployment score (IEMSX).

$$Me_i = \frac{\sum_{j=1}^N (W_{P_j} + W_{D_j} + W_{C_j} + W_{A_j})}{N}$$

Where:

Me_i : is the Arithmetic mean of the maturity of the element i

W_{P_j} : is the weight (1 to 5) of the maturity of the Plan step

W_{D_j} : is the maturity of the Do step

W_{C_j} : is the maturity of the Check step

W_{A_j} : is the maturity of the Act step

The results are interesting (Figure 4) since the elements do not follow the order of the previous exercise, meaning: *Tools and Methods for CI* is the most mature with 12.41. On the other extreme of the chart, the element less mature concerning a PDCA approach is *Time Management* with a score of 8.58 points.

Figure 3. Elements impact and their global scores concerning the sustainability of CIP.

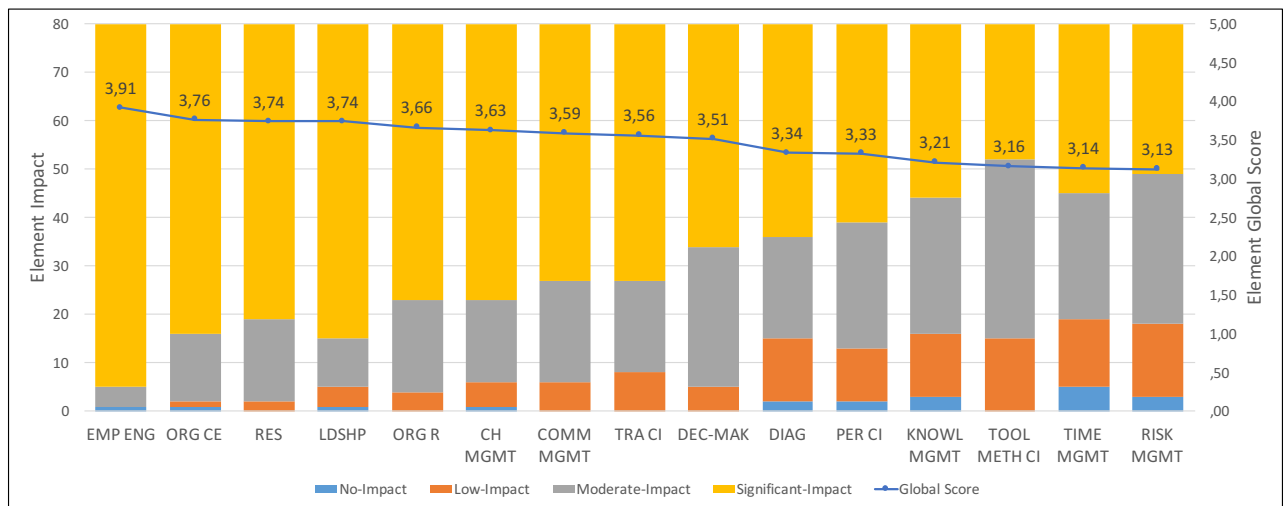
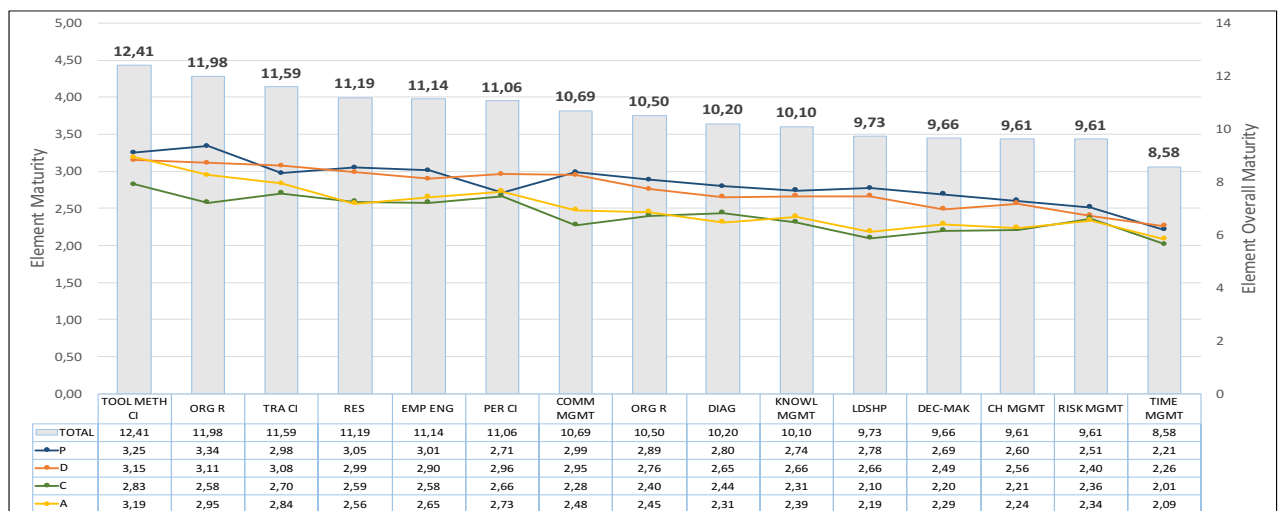


Figure 4. Maturity of the elements and their overall scores using a PDCA approach.



V. Discussion

The first question that we posed in this article was related to; verify if the perception of the elements impacting the sustainability of CIP is in concordance with current CI theories. To tackle that question we focused on the respondents' knowledge and experience: 95% of the respondents were between *Intermediate* and *Confirmed* regarding knowledge over CI theories, which can be seen as a positive outcome in relation to the possible prevention of any misinterpretation of the questions posed.

It is interesting that the quantity of *Significant Impact* across the 15 elements is high (Figure 3), because this suggests that the respondents placed significant importance upon them, and that these elements were well selected for study.

As stated before, CI has the particularity of taking into account two approaches, one managerial and other technical. From Figure 3, we can note that the elements with a minimum of 50 "votes" on significant impact, are among those with a strong management character, such as *Employee engagement*, *Organizational Culture*, *Leadership*, *Change management*, *Organizational routines* and *Communication management*. The nature of these elements makes them difficult to measure [13]; nevertheless, this does not detract from the importance of their role. In the case of *Employee engagement*, not only is it the element with the highest impact, but also has the highest quantity of *Significant-Impact* appreciation. This denotes the importance of the human factor, showing how passion and commitment of the employees impact upon their productivity, while also becoming agents of innovation in order to solve problems.

Additionally, the last three elements with global scores smaller than 3.16 are: *Tools and methods for CI*, *Time management* and *Risk management*. It is also noted that they are more diversified regarding the participants' perception.

These elements are highly involved with CIP, leading us to believe that their impact is relative to the ease of their exploitation. As essential parts of CIP, these elements are easily approachable, consequently their impact on sustain the CI endeavours is less relevant.

The second question focused on the potential for evaluating the maturity of the elements. While addressing this issue, the questions are embedded within the respondent perception of the organization, meaning that we are dealing with another point of view, which can be seen as more practical. In this case, we analysed two angles, the first examined how the elements are being deployed within a **PDCA framework**, and the second concerned the **overall maturity** score of each element.

By analysing the arithmetic mean of each step of the PDCA, it is noticeable that the stage **PLAN** is the highest followed by **DO**, **ACT** and **CHECK**. This leads us to believe that a PDCA framework is useful to analyse the way the company embrace the CI.

The stages **PLAN-DO** are always the easiest stages to achieve and put into practice, they are highly linked with strategies and are tangible. Meanwhile the levels **CHECK-ACT** that are linked with improvement, feedback and adaptability to change [25], are less developed.

In our particular case the stage **CHECK** is the less developed, which generates an interesting analysis, and new questions to answer. For example, *do we need to consider other factors in order to approach this framework?* It is important to remark that in this article, and for the sake of a first analytical attempt, we are considering the whole population instead of separating the samples per maturity, which can give us new information.

While studying the **element overall maturity** score, there are some valuable impressions to discuss. The first deals with the fact that the elements considered mature are not the same as those measured with high relevance within their impact over sustainability of CIP. For example, in the case of *Tools and methods for CI*, it is the third lowest element within the impact appreciation (with a global score of 3.16), however, it is the more mature within a company environment (with an Element overall maturity of 12.41). The same analogies can be seen with other elements, for example *Leadership* which is considered to have a *Significant-Impact*, but in our study population its maturity is not well displayed.

This comparison shows us a dichotomy rarely studied: the perception of the elements impacting the sustainability (in our case with theories related to sustainability of CIP) is not faithfully translated to an actual working environment (in our case of study their deployment over a PDCA cycle). The difficulty in deploying a specific element within a CI framework can be the reason for its impact, and vice versa.

These behaviours invite us to explore even further, and even improve certain characteristics of our methodology. For example, only one person from each organization completed the self-assessment investigation, which can create some misconceptions or misinterpretations regarding certain elements, and expose the results to a single response bias. In addition, our population was almost entirely formed by people working in high rank positions that can generate a skewed view of the organization regarding the CIP, therefore it would be interesting to include other profiles to add different points of view over the matter, the use of personal interviews may have altered the outcome of our self-assessment investigation. With respect to the evaluation carried out and noting that the difference of the global score (Figure 3) between the first element (*Employee Engagement*)

and the last one (Risk Management) is small, it would be wise to reconsider the scores scale given in order to visualize it better, on the same idea it will be recommendable to run statistical treatments to measure the significance of the difference already mentioned.

VI. Conclusion and Further Research

Continuous Improvement philosophies have gone head-to-head with the industrial demands, and it considers different factors across the organization in order to be in optimal setup. Since being sustainable is synonymous with success, it is important to analyse a group of elements that have potential to affect the sustainability of CIP.

We set out to identify whether the perception of the impact of the elements that affect the sustainability of CIP can be evaluated and be in concordance with CI current theories. We demonstrated that they could be evaluated and by the use of an electronic self-assessment investigation, we observed that the majority of elements that have high relevance regarding their impact are linked with human factors, such as *Employee engagement, Leadership, Culture and Communication*.

Our second question regarding the evaluation of the maturity of elements was answered by using a **PDCA** approach (where each element was analysed relating to its deployment within the organization). We found that high impact elements are not necessarily the more mature, and while analysing each element by its cycle we can observe how the steps **CHECK** and **ACT** are the least mature regarding their deployment.

As prospective research, and since we are dealing with a highly rich database, we are in a position to analyse the impact of the elements by respondents' knowledge level and compare their conducts. The same exercise could be conducted with enterprises and measure each PDCA cycle separately and study possible coincidences between elements, or even between different types of companies. Moreover, as future research, it is planned to address the analysis of the whole maturity population and appraise those elements that are affecting the overall performance in order to obtain behavioural patterns that influence the sustainability of CIP.

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