Methodology for the Reduction and Integration of Data in the Performance Measurement of Industries Cement Plants

Noel Varela Izquierdo[1(✉)], Henrry Ricardo Cabrera[2], Guillermo Lopez Carvajal[3], Amelec Viloria[1], Mercedes Gaitán Angulo[4], and Maury-Ardila Henry[1]

[1] Faculty of Engineering, Universidad de la Costa (CUC), Barranquilla, Colombia
{nvarela2,aviloria7,hamaury}@cuc.edu.co
[2] Faculty of Business Economics, Universidad de Cienfuegos (UCF), Cienfuegos, Cuba
hricardo@ucf.edu.cu
[3] Universidad Metropolitana del Ecuador, Quito, Ecuador
glpezcalvajar@gmail.com
[4] Corporación Universitaria de Salamanca, Barranquilla, Colombia
m_gaitan689@cues.edu.co

Abstract. The investigation responded to the need outlined by directive and interested parts, in relation to the lack of mechanisms for the administration control and the need to reduce the amount of data when making measurements of performance in the cement industry. Throughout the employment of an outlined methodology, it was obtained an Integral Index of Acting that relates to the aspects that controlled the acting of the processes in function of managerial strategies, of easy mensuration as a result, automatic and that it facilitates to summarize a big amount of criteria and data, through their standardization, and thus the realization of comparisons with other production plants.

Keywords: Management control · Management indicators
Indices synthetic or integrals · Data and criteria reduction

1 Introduction

The organizations in this century are subject to tensions generated by the competitive and increasingly dynamic and aggressive, environment that tests their capacity of action and reaction from the perspective of satisfying changing markets [1] and increasingly demanding [2]. Its own dynamics brings with it which should be considered as complex adaptive systems [3].

For this reason, the ability to create and maintain a system that makes possible the changes that are required, not only in their processes of operation but in their way of perceiving and responding to the demands of its various stakeholders [4, 5], it is assumed as one of the most important responsibilities of the management of organizations [6].

Therefore the management of companies in the growing complexity of their activities, must ensure human components preparation [7], and the improvement of the materials. The achievements in the management on the basis of an approach for process are

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common [8]. The quality of products and services is an important element in the survival [9] and the positioning in the market, hence many executives to focus time and resources to this essential link to the success [1]. Added to this, it is important to bear in mind that the methodologies and tools used in the achievement of improvements impact on people and introduce changes in their attitudes [10] skills and behaviors and lead to a better use of resources [11].

The foregoing argues the prevalence of different enterprise management systems, resulting in a greater complexity in the operativity in business management, it is not easy for a manager working in response to so many systems [12]. In the search for solutions, intends to systems integration as a way out. The existence, more and more, companies around the world that begin in the integration of standard systems manifest the acceptance that is reached by the Administration [13, 14] to obtain important advantages [15].

As a result, constitutes a challenge to raise the performance of processes and issue solutions that allow the improvement with contribution to the standard systems [16]. However, [17] proposes that many of the programs designed to improve processes that run under different management systems or under one integrated, single issue response in the field of quality improvement and leave behind solutions that they integrate or respond to the rest.

However, it is important to highlight the increase in the number of indicators emanating from managing several systems management and operational complexity that this causes. Affects even taking a position right on the measurement of business performance.

On the other hand, nationwide that want to boost the economy, the construction sector is vital, and inside the cement production is crucial.

Also, the production of cement releases pollutants [18, 19], primarily carbon dioxide (CO_2), this is responsible for approximately five (5) percent of the emissions generated by man [20], recognized, therefore, as one of the most polluting international [21]. In addition, they are characterized by being major consumers of electricity, it is estimated that the energy cost round 20% of the total costs of production.

Recognized institutions sector emphasize [22, 23], by the existing risks in the industry (heights, high temperature, high voltage, hazardous substances, among others), the importance that has the protection of workers with regard to its safety and health at work. This makes inclusion to the cement within the need to improve their processes under the requirements of different interest groups and that can exist a considerable number of resulting indicators the display developed for the measurement of performance business. On this basis, this publication aims to propose a comprehensive index of performance for the cement industry. Therefore, work is in the design of the index that allow to relate from business strategies to control process indicators, mainly employees for the standard technical functions.

2 Materials and Methods

Due to the size of the databases, to the presence of noise, inconsistent data, redundant, etc., becomes necessary the application of preprocessing techniques about sets of data. The objective pursued by the preprocessing is to obtain sets of data such that when applying techniques of data mining about them generate representative models with greater benefits.

2.1 Strategies for Preprocessing of Data [3] and [4]

- Data cleaning: It increases the Data quality at the required level through selective analysis techniques. This process consists of the elimination of erroneous or inconsistent data.
- Data reduction (RDD): Consists in deciding what data should be used for the analysis. The critery which is still included the relevance with respect to the objectives that are pursued in data mining (MDD), and limitations techniques such as can be maximum volumes of data or Well, specific data types. Us we will focus on this case in this

Preprocessing perspective: reduce the volume of data by selecting the most relevant for your subsequent use by MDD algorithms.

- Data integration: It is based on combine multiple tables or records to create new records or values. Combining tables makes reference to join two or more tables that present different information about the same objects. The combination of data also includes the aggregation. Aggregation consists in operations where they are obtained new values through the union of information from several records or tables. This task includes same operations related to construction of data such as production of derived attributes, new complete samples, or transformations of the attribute values already existing. The attributes derivatives can be built with one or more attributes present in the same pattern.
- Transformation of data: The transformations consist mainly in modifications syntax carried out on the data, without involving a change in the meaning of them.

The control is successful if it is used in the decision-making process, provided it is established under the correct definition of variables that determine the results [18], the establishment of indicators, measurement and comparison with set or desired parameters [8], as well as proactive decision-making [24]. The definition of indicators is a complex work [25–27] but fundamental and manifests itself with the philosophy of the scorecard [23]. Indicators should summarize a set of data obtained during the execution of the process, allowing to know their behavior and predicting the future in similar conditions and they are closely related to management by processes [3].

On the basis of the foregoing, it follows that regardless of the size of the Organization, it will generate a considerable number of indicators in function of the processes and

management systems implemented. Hence, managers are forced to attend several indicators for the performance of the organisation [18]. This leads sometimes to the neglect and mismanagement of some.

The creation of synthetic indicators or integrals, to evaluate the effectiveness of the system, is a resource used in response to this need. According to [16] the reasons are as follows:

- The result is a single value that allows an easy comparison with previous periods or other organizations; as well as the study of trends.
- It does not require that employers have a deep knowledge of the subject that deals with the indicator for use in decision-making.
- They can be easily automated.
- It is feasible to create a relationship between the results achieved and performance inductors.
- They are tools that allow a permanent diagnosis of the system, as well as link to other improvement procedures.

Along with this, the authors set out a group of constraints:

- Little use of software associated with integral indicators, despite the facilities that provide for its automation, and even less, the link of the software created to the computerized systems in companies.
- Evaluation criteria for the elements that part of indicators, are not set which implies non-homogeneous assessments in your application.
- They evaluate the system, limited to diagnose the main provocative elements of deviations and not affect your triggers for action.
- Limited use of the proactive character.

The proposed methodology lays its scientific basis in the following authors: [16, 20, 23]. This involves the need to consider an Integral performance indicator in the cement industry, adjusted to the standard technical functions.

3 Results

3.1 Design of the Performance Index Integral

The Performance Index Integral (PII) consists of a generic indicator that draws on the results of others designed for the measurement of specific parameters of each process and in its preparation is passes through a set of steps that allows its correct implementation, see Fig. 1. This proposal starts from the creation of business strategies, using a breakdown through work, tasks and indicators for evaluating objectives, added to a weighting system and a feedback process that allows in a single index, measuring the performance of the industry. Below are the steps suggested for its implementation.

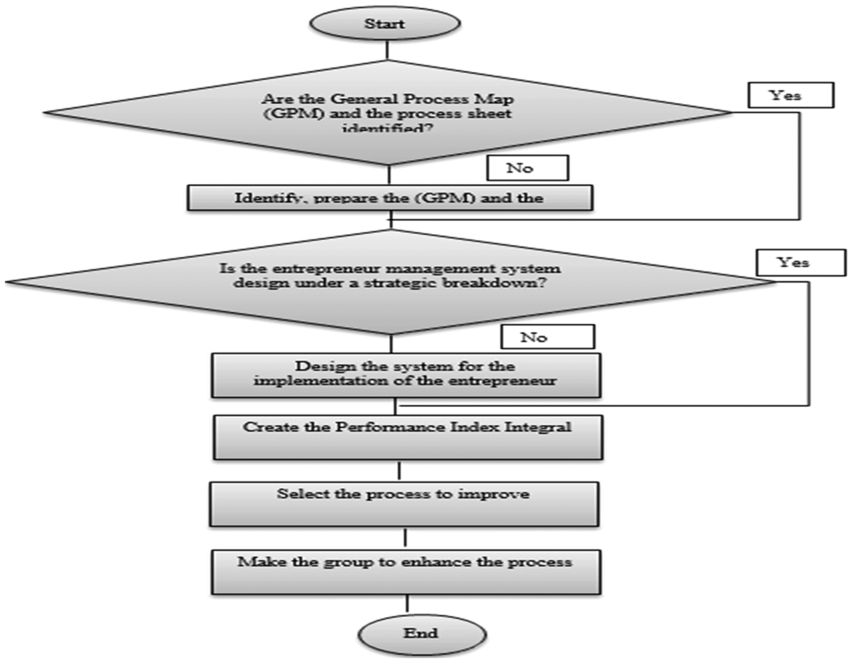

Fig. 1. Procedure for the design of a performance index integral in the cement industry.

3.2 Overview of the Steps for the Design of the Performance Index Integral

Step 1: Identification, preparation of the general map of the business processes and their corresponding tabs. This step may not be developed, only depends on the industry has correctly identified their processes correspondence with management by processes. The starting point is to have identified all the processes of the organization to better manage. Once identified, one must be checking them to see if they respond to business strategies and if they include all the activities implemented in the company. The Improvement Executive Team (IET) should conduct this review and may include external experts.

In case of the company processes have not been identified, it is suggested the classification provided by the APQC model or the EFQM model. They can be used interchangeably as they have the same purpose. It is recommended that processes oscillate between 10 and 25 depending on the type of organization, failure to do so, it may increase the difficulty of their management [27].

After the selection of the classification model to follow, it proceeds through the application of the Delphi method for the process selections.

Delphi method for the process selections

You must determine the number of experts and then select them according to the criteria of competence that are suggested by The Improvement Executive Team (IET).

Preparation of the process sheet

As for the processes and indicators sheet, should be selected the one that includes the representation of processes, the integration of the various systems of management, the realization of the indicators and their link with the strategy; as well as achieving the reflection of the things designed in an information system according to the generator and legal framework of actions for the decision making.

Step 2: Design of the entrepreneur management implementation system.

Business processes must be aligned with its strategy, mission and goals to achieve business success. From the previous approach is proposed a system for the implementation of business management in the cement industry:

2.1 The system part of the work commitments declared by the business group at the national level, in addition to: mission, vision and goals that industry in particular trace.
2.2 Business strategy and strategic objectives will settle (for the strategic period).
2.3 Work objectives, which are in charge of materialising the strategy annually are plotted.
2.4 You will be assigned a weight or level of importance to each objective of work as it may consider senior managers, in correspondence with its impact on the implementation of the strategy.
2.5 For the implementation of each objective the high management proposes a group of tasks. For their measurement is assigned a weight or level of importance, which added is equal to the weight of the objective of study that correspond.
2.6 The objectives of the work and tasks are broken down by processes.
2.7 Therefore, each process can specify the tasks corresponding to the objectives of work that taxed.
2.8 The process responsible for attaching weight to each task according to the importance for its process (reviewed and approved by management). This value is the weight assigned to the task previously unrelated and moves on a scale of 100.
2.9 The performance of the process will be measured through indicators that reflect the points reached in the fulfilment of the tasks, intends to the diagram in Fig. 2.

The Fig. 2 define the indicator (s) evaluating the task (implies the complete elaboration of the sheet, to scale depending on the distribution of the points assigned to the task), evaluate the indicator (s). Compare the results of the indicator with the distribution of the points scale to achieve, Assigning scores to the task

In case there is more than one indicator by task, it must previously have distributed potential points to achieve the task in the process.

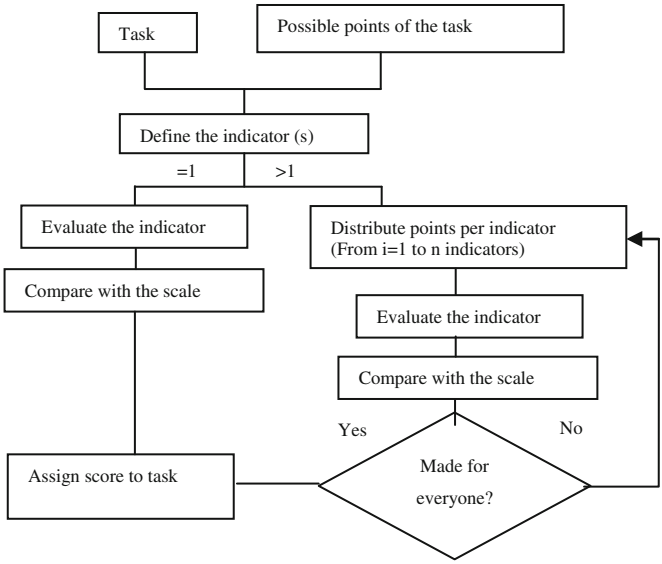

Fig. 2. Scheme for the evaluation of the process performance.

Step 3: Creation of the Performance Index Integral.

The presence of a Performance Index Integral (PII) gives industry an element that allows you to evaluate the performance without having to analyze a set of indicators formed for specific processes. The design of the PII is based on the implementation of the management system proposed in the previous step. For better understanding the Fig. 3 is proposed.

3.1 To determine the actual weight in each task assigned by process. Depending on the level of compliance of indicators designed to measure the performance of the process, in correspondence with the step **2.9**

3.2 Calculating the actual performance achieved by different processes task:

- The weight reached by the task is added in each of the processes where it was assigned. According to step **2.6.**
- Determines the percentage of fulfillment of the task according to the total points achieved in its performance, in each process where it was assigned,
- Repeat the calculation for each task.

3.3 Calculating the total points achieved by task for each goal to work, to do this:

- Take the percentage of fulfilment of the task and the possible points allocated by processes (in correspondence with the step **2.5**).
- Calculate using the rule of three total points reached by the task one hundred (100) possible points, as a percentage of the actual performance of the task-level processes is to weight reached. Repeat the calculation for each task.

3.4 Calculating the points reached by objective: sum of all points achieved by the tasks assigned to the objective. Calculate it for each objective.

3.5 Determine the PII according to Eq. 1, and thereby the effectiveness of the cement company, see Table 1. The calculation formula for the PII is the following (1):

$$\text{PII} = \sum \text{Reached points within the fulfilment of the work objectives} \quad (1)$$

Table 1. Cement factory effectiveness degree.

	High efficiency	Medium efficiency	Low efficiency
PII (efficiency of the process)	95–100 Points	85–94 Points	Less than 85 points

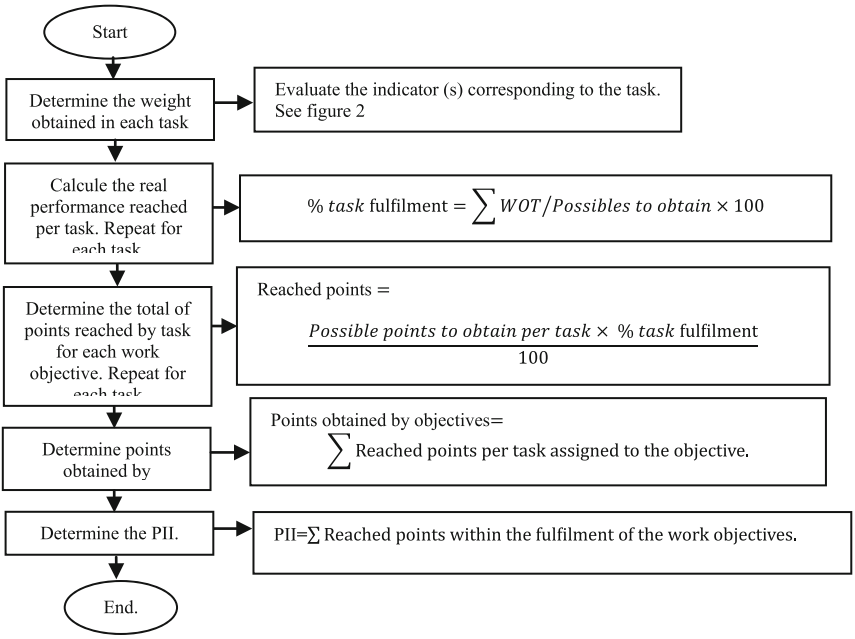

Fig. 3. Scheme for the calculation of a performance index integral.

4 Discussion

This article is achieved to implement a Performance Index Integral, ending in a single value for easy comparison with other periods or organizations. The elements that compose it are scientifically argued, it is easy to deploy in the enterprise and does not require rigorous training for its use in making business decisions. In addition, facilitates finding the causes roots when the expected thresholds indicators that comprise it are not

reached. Unlike other indexes, creates the foundations for an easy programming of software associated with their structure, also, allows a proactive screening in the conformation of the improvement plans and has a direct impact on inductors performance (or indicators that measure the tasks).

5 Conclusions

Now any attempt to formalize the management and process improvement should contain theoretical assumptions around the process management and systems integration. Also there is agreement on procedures for the conduct of the management and improvement of processes in terms of cyclical presentation and preparation phases and stages. It is essential to accept the good management practices, treated with a process approach, that stand out in the selection of processes, definition and assessment of the opportunities for improvement, indicators and their relationship with the strategies as a basis business treated implicitly or not in the proceedings taken as background.

The development of management and process improvement should be with a focus on the integration of management systems to achieve more effective improvements and systems. This consists of a new line for future scientific work. Nowadays the use of integral or synthetic indexes has gained strength, primarily by synthesizing the behavior of various indicators in a single value. The creation of a Performance Index Integral makes it possible to strengthen the system of management of any industry, using a single indicator can determine the degree of efficiency in real time. Management system designed based on strategic objectives, work objectives, tasks and indicators, allows to link from strategic design to control indicators.

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