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**Development of a web-based information system for managing performance of SME
clusters**

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Abstract

This article deals with performance measurement in clusters of small and medium enterprises (SMEs) and presents a proposal of a web-based information system to help the governance agents manage a cluster's performance. The requirements for this system were determined by reviewing the literature about industrial clusters and via interviews with the manager of a governance agency of a cluster in Brazil. The structure of this system, including its data sources, types of users and some prototypes is presented here. This paper ends with some considerations about the proposed system and with an agenda for future works.

Keywords

Performance measurement, industrial clusters, information systems, knowledge management.

1. Introduction

An industrial cluster is usually referred to as a geographic concentration of companies of the same economic activity. Many authors agree that this proximity can bring several advantages to the companies [1-3]. Because they have similar needs, they can collaborate and achieve better results than other companies that work by themselves. Unfortunately, it is quite a difficult task to organize these joint actions and measure their effects over companies' results. In order to foster collaboration, there must exist an unbiased and centralizing agent that provides companies with relevant assistance and information. This agent, which will be hereafter called governance, must aim at the growth of the cluster as a whole.

In this context, this article presents the proposal of an information system (IS) to help the governance agency manage the performance of its industrial cluster. This management is carried out mainly through performance indicators, improvement actions and a benchmarking database. The system takes advantage of internet to divulge the cluster and to publish relevant information to companies and other cluster stakeholders.

In order to achieve this objective, this article starts with a literature review on industrial clustering and performance management in clusters. Afterwards, in Section 3, a classification of performance measures according to their data sources is discussed. Section 4 gives an overview of the IS, including its requirements, functions and users. At the end of the article, some considerations about the proposed system are made and an agenda of future works is given.

2. Literature background

2.1 Industrial Clustering

The advantages of grouping together companies linked to a certain economic activity were first identified back in the 19th century by Marshal [1]. This author emphasized that the concentration of companies in a geographic region might bring large-scale gains and thus transform the regional economy. In the 1990s, Porter popularized the term industrial clustering [2, 3]. He defined it as a geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standard agencies, trade associations) in a particular field that compete but also cooperate.

The benefits of industrial clustering can be explained by means of external economies [1], which refer to the cost-saving benefits of locating a company in the proximity of external resources such as skilled labor, specialized training, research institution, etc. However, some authors state that external economies are not enough to explain the success of clusters. They add that there must be deliberate cooperation among companies in order to foster collective efficiency [6]. This efficiency can be seen as the competitive advantage that results from the combination of local external economies and cooperative joint actions.

Altenburg and Meyer-Stamer [16] list some characteristics that, besides external economies and joint actions, are said to be present in most definitions of cluster, which basically comprise the following points:

- Forward and backward linkages between firms inside the cluster;
- Information exchange between firms and institutions;
- The existence of diversified institutional infrastructure supporting the activities of the cluster;
- A social cultural identity made up of common values.

Several approaches and definitions can be found in the literature to understand the clustering phenomena [3-5]. Despite all this variety of definitions, there is consensus that industrial clustering is crucial to the economic development of a region or even a country. Also, adoption of the concepts and practices of performance management and measurement to carry out joint actions among companies of a cluster can aid to consolidate cooperation, linkages and information exchange among companies as well as develop a culture of continuous innovation, thus contributing to the development of the collective efficiency of the cluster. Therefore, this gives rise to the need of managing the collective efficiency of a cluster focusing on the concepts and practice of performance management, as discussed in the next section.

2.2 Performance measurement in SMEs clusters

Performance management research has been gradually evolving, especially since the 1980s, due to its importance to help companies pursue their strategic goals. Despite this considerable growth, researchers face some challenges in this field because of its high diversity [7]. There are too many variables involved, such as the companies' size, type of business, culture, geographic location, etc. However, most of the literature on performance management treats this subject regardless of the size, type or location of the businesses [8].

Many frameworks have been proposed to help managers design a performance management system (PMS) for their businesses. Most of these frameworks were created in the 1980s and early 1990s [7-9] - the Balanced Scorecard (BSC) [10], Performance Prism [11], dynamic performance measurement system [12], performance pyramid [13] and the performance measurement questionnaire [14].

There's a lack of works regarding the particularities of SMEs. Although performance measurement is considered to be an important issue for these companies, some inherent limitations cause a gap between theory and practice [15]. When taking into account clusters of SMEs, it could be argued that the frameworks previously mentioned are able to design PMSs for them, once clusters also have strategic objectives and want to determine measures to assess these objectives. A specific model for performance measurement in clusters has already been proposed and tested [8]. Its structure is based on the BSC and can be seen in Figure 1.

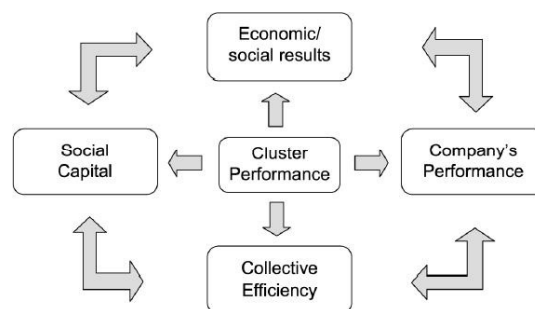


Figure 1: Conceptual model of a performance measurement system for a cluster [8]

Because of the collective nature of clusters and its important impacts on the local society, this model raises four major perspectives, which can be adapted to each cluster it is applied to [8]:

- *Economic and social results*: includes measures related to economic and social benefits, such as workforce occupation or local gross product;
- *Firm's performance*: deals with the results of the firms, including financial and non-financial measures;
- *Collective efficiency*: measures related to external economies and joint actions among the companies;
- *Social capital*: measures related to cultural values such as trust and cooperation.

3. Types of performance measures for clusters

A PMS built for a single company and one designed for a cluster have some similarities and differences. Among the similarities, we can mention the existence of strategic objectives, the performance indicators and its elements (formula, frequency, unity, etc), the targets for each measure and the periodic evaluation of the results. On the other hand, the differences would be the data sources and the level of detail of information.

When dealing with performance indicators for a cluster, several types of data sources must be taken into consideration. First, much of the relevant data must be gathered from the companies that form the cluster. In some cases, for one indicator to be computed, performance data has to be collected from several companies and then weighed to obtain a final result. Thus there is the need to determine an agent who will be responsible for centralizing all this information, which is usually done by the cluster's governance.

Company data play a vital role in a cluster's PMS, but there are other factors that must be measured, such as cooperation, social capital or even the governance agency's own performance. Such measures do not rely just on information provided by the companies, but on data that can be already available at the cluster's governance. For example, measures such as the number of joint actions sponsored by the governance, training initiatives, courses and trade fairs can be obtained directly from the agents that support them. There is no need to go into a company-level detail for these measures.

In order to manage performance properly, the governance agency must also keep track of some indicators whose data need to be provided by external sources. These measures may refer to both benchmarking data and regional, social and environmental factors. Neither the cluster's governance agency nor the companies can provide this type of information. Instead, it can be obtained by external sources, such as consultants, governmental agencies and social organizations. Therefore, these measures are referred to as external measures, once they do not depend directly on the governance agency and often cannot be calculated by it. Examples of such indicators would be the workforce available, number of vocational schools and universities, unemployment rate, average wage, etc.

The following list summarizes the types of performance measures discussed above. Figure 2 illustrates the relations among them and their data sources.

- *Company-level measures*: measures that are calculated with data gathered from the companies in the cluster. The final result of this type of measure is the weighed mean of all companies' results;
- *Governance-level measures*: this set of measures reflects the governance's and the cluster's performance as a whole. The data used for them is often obtained inside the governance itself;
- *External measures*: economic and social measures used to benchmark the cluster's performance against other clusters. The source of this type of data is external, i.e. they are provided by external agents such as governing bodies or consultants.

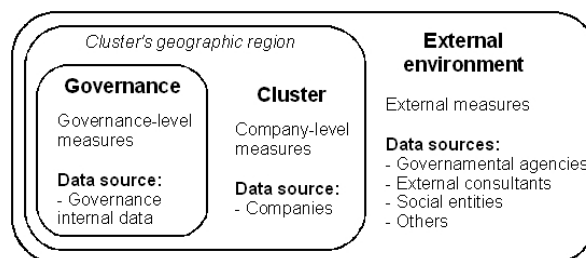


Figure 2: Types of performance measures and their data sources

This classification for performance measures can be associated to the perspectives shown in Figure 1. By doing so, it's possible to specify the possible data sources for each perspective, as shown in Table 1.

Table 1: Types of performance measures that can be linked to each performance perspective

	<i>Company- level</i>	<i>Governance- level</i>	<i>External</i>
<i>Company's performance</i>	X		
<i>Collective efficiency</i>	X	X	
<i>Social capital</i>		X	
<i>Economic and social results</i>	X		X

4. Development of a web-based information system for performance management

4.1 General requirements

The general requirements herein presented were defined by means of literature research and interviews with the manager of a Brazilian industrial cluster located in Sertãozinho. The companies from this city, which is in the state of Sao Paulo, manufacture mainly capital goods for the sugar cane industry. The interviews helped to understand the governance needs regarding performance management, information and communication with companies. After these interviews, four major needs could be identified:

- The companies need to inform the governance about their performance results periodically;
- The governance must process and publish these results in a way that they can be useful to the cluster's stakeholders;

- The governance also needs a means to manage its improvement actions, both the joint actions and the ones initialized by themselves;
- There must be an accessible and standardized means for the companies to pass performance data on to governance.

4.2 System functions

Because a cluster involves many entities such as companies, governance, suppliers, society and government, an information system to manage its performance should be capable of both spreading and gathering information. There must be then an agency to centralize all this data. Such job should be of governance's responsibility. Therefore, considering that the governance is in charge of collecting, processing and publishing performance data, the system should help companies send data to the governance and also assist them in analyzing this data and producing reports. Besides the performance data provided by the companies, there are other types of performance measures with which the IS must deal, as discussed in Section 3. Hence, a proper structure must be devised to organize all the types of measures, in order to make further analysis more intuitive. The following list presents the modules proposed for the IS in order to fulfill the identified requirements. Figure 3 shows some prototypes for these modules.

- *Cluster website*: the website should be used as a means to publish general information about the cluster. Such information may include the type of businesses found in the cluster and some general reports on performance, social responsibility or environmental issues. The purpose of this website is to call the attention of everyone involved with the cluster's activities. Therefore, anything related to the cluster, such as news, training courses or trade fairs, should be made publically available through this website;

- *Performance management*: this module organizes performance indicators according to the perspectives defined by the governance. A suggestion for such perspectives is shown in Figure 1. As the performance indicators are created and associated to perspectives, there is also the need to inform its data source. As previously discussed, data for some indicators must be provided directly by the companies. The indicators which have this data source will make the IS periodically generate a form that will be sent to companies. As soon as they return, properly filled out, data will be automatically recorded into the system's database and performance results will be updated;
- *Improvement actions management*: some actions, which are of governance's initiative, have the objective of improving one or more performance indicators of the cluster. However, such actions may not rely directly on companies in order to be accomplished. Training courses are an example of such actions because they are developed by the governance and companies just attend them. There is no need for the companies to help the governance create and give such courses. Hence, this module makes it easier for the governance to distribute tasks among its staff, set deadlines, goals and targets. By doing so, it is possible to follow the actions' effects over the performance indicators;
- *Joint actions management*: this module is similar to the previous one, but the difference lies on the type of agents involved with the actions. It means that now some of the tasks may be of another organizations' responsibility, such as companies, government, research institute, etc. Therefore, the fundamental characteristic of this module is that now an action can involve many organizations outside the governance but inside the cluster. However, governance must still play the supervisor role in order to keep the action going.

With this module, the agents involved with an action will easily understand their responsibilities and the governance will be able to keep track of everyone's work;

- *Benchmarking database*: the performance data that are periodically collected from companies inside the cluster can be used to form a benchmarking database. With it, companies will be able to compare their performance to other companies' results. However, it is important not to publish company names along with these results. Besides performance data, this module will also store best practices reported by companies, in order to help other companies improve their own practices.

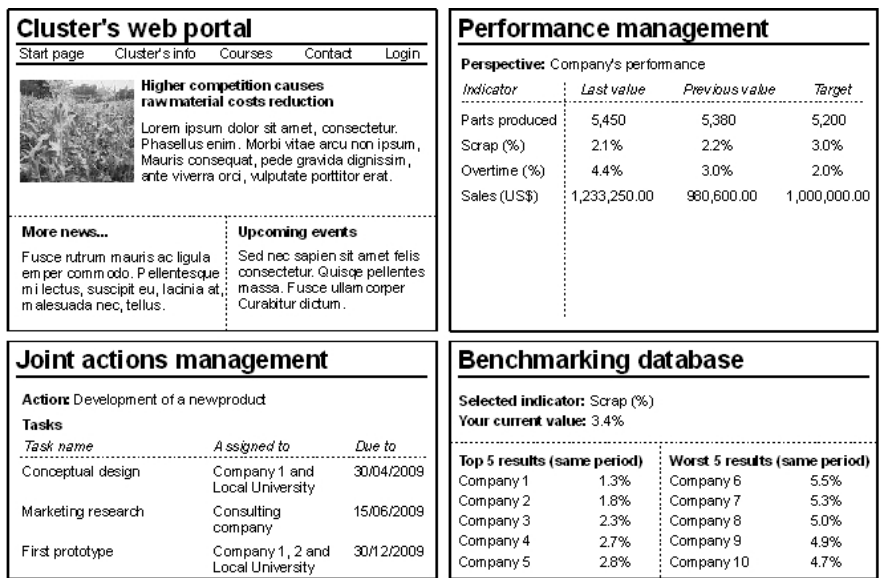


Figure 3 – Prototypes for the proposed modules

4.3 System users

After its full deployment, the IS will be accessed by many types of users. However, not all the users can have access to all the system functions. Actually, most of the functions will be

accessible only to the governance, which will use them to manage both the system itself and the cluster. The following list identifies three categories of system users:

- *Governance Agency*: as previously mentioned, governance will have access to all the system's functions. Their role is to manage the system, create users, indicators, actions, set targets, assign tasks and keep track of the cluster's performance. With all this information in hand, the governance can identify performance problems and give quick answers to them. Also, the management of joint actions is done by the governance, even if it has received no tasks. Another role is the gathering of performance data, processing of data and publication of reports through the website. All the information stored on the website is of the governance's responsibility;
- *Companies*: this category regards only the companies inside the cluster. These users have access to the website and, through a user account, they can send their periodic performance data and check their performance history. After logging in, the company will also be able to reach detailed reports on the cluster's performance, which are provided by the governance, and access the benchmarking database;
- *General users*: this category includes any other users that may have interest about the cluster. These users vary from competitors, suppliers, companies from other regions to home users. Such users have access only to the website, through which they can get to know the cluster, have some useful reports and contact info.

5. Conclusions

This work presented a web-based software for managing performance in SMEs clusters. Indeed, it is not only a single software, but a set of modules to assist the governance on the cluster's

management. By using this system, the governance will be able to foster and manage collaboration among companies. This is a very important issue when dealing with SMEs. Usually, this type of company can neither afford external expert assistance and consultants nor have the strength to deal with suppliers for better prices and delivery dates. Because of this, these companies have to be assisted by the governance, which must keep track of the cluster's performance and check whether their actions are improving companies' results or not.

The centralizing role played by the governance is a requirement for this system to work. However, the governance does not have authority to force companies to join this IS. Actually, governance must gain the trust of all the companies by showing the advantages of having access to all this information. One company will only gain access to functions such as performance management, benchmarking and detailed reports if it also provides governance with its own performance data. It may take some time for the companies in a cluster to realize this, but this reciprocal relationship will gradually facilitate collaboration.

Finally, it is important to highlight that this information system is now under development and will be soon implemented in the cluster of Sertãozinho. After that, further work must be carried out to assess the functionalities developed. Also, more research must be done on the collaboration among companies, in order to check if the system actually helped them increase the number and quality of joint actions.

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References

1. Marshall, A., 1890, "Principles of economy", Prometheus Books.
2. Porter, M. E., 1990, "The Competitive Advantage of Nations", London: McMillan.
3. Porter, M., 1998 "Clusters and the new economics of competition", Harvard Business Review, Nov-Dec, pp. 77-90.
4. Krugman, P., 1998, "What's new about the new economic geography?", Oxford Review of Economic Policy, 14 (2, Summer).
5. Schmitz, H., 1999, "Collective efficiency and increasing returns", Cambridge Journal of Economics, vol. 24, no. 4, pp. 465-483, Jul.
6. Schmitz, H., and Nadvi, K., 1999, "Clustering and industrialization: introduction", World Development, 27 (9), 1503-14.
7. Neely, A., 2005, "The evolution of performance measurement research: development in the last decade and a research agenda for the next", International Journal of Operations and Production Management, 25 (12), 1264-77.
8. Carpinetti, L., Cardoza, E., and Gerolamo, M., 2008, "A measurement system for managing performance of industrial clusters: a conceptual model and research cases", International Journal of Productivity and Performance Management, 57 (5), 405-19.
9. Neely, A., Gregory, M., and Platts, K., 1995, "Performance measurement system design: a literature review and research agenda", International Journal of Operations and Production Management 15 (4), 80-116.
10. Kaplan, R., and Norton, D., 1996, "Using the balanced scorecard as a strategic management system", Harvard Business Review, 74 (1), 75-85.

11. Neely, A., and Adams, C., 2000, "Perspectives on performance: the performance prism", in Bourne, M (Ed.), "Handbook on performance measurement", Gee Publishing, London.
12. Bititci, U., and Turner, T., 2000, "Dynamics of performance measurement systems", *International Journal of Operations and Production Management*, 20 (6), 1693-713.
13. Lynch, L., and Cross, K., 1991, "Measure up: the essential guide to measuring business performance", Mandarin, London.
14. Dixon, J., Nanni, A., and Vollman, T., 1990, "The new performance challenge: measuring operations for world class competition", Dow Jones-Irwin, Homewood, IL.
15. Hudson, M., Smart, A., and Bourne, M., 2001, "Theory and practice in SME performance measurement system", *International Journal of Operations and Production Management*, 21 (8), 1096-115.
16. Altenburg, T., Meyer-Stamer, J., 1999, "How to promote clusters: policy experiences from Latin America", *World Development*, 27 (9), 1693-713.