

## BA: Lean Manufacturing Indicators Applied to HR Applications - An Implementation Study

Robson Thanael Poffo  
*Innovation*  
*TOTVS*  
 Joinville, Brazil  
 robson.poffo@totvs.com.br

Mehran Misaghi  
*Researcher*  
*SOCIESC*  
 Joinville, Brazil  
 mehran@sociesc.org.br

**Abstract**—In the last few years, the world witnessed a large number of changes on the way to manage the production on factories. This changes were motivated by a financial crisis. With each passing year the companies feel the need to be faster when making decisions and one way to do this is through indicators (KPIs and KRIs). Remember that the difference between a company that grows its market share and the other companies is how fast they make decisions. Based on the mission, vision and values of the company, this article describes indicators that are used on lean manufacturing and that can be used in human resource management. Furthermore, it describes the best way to design the data warehouse considering the level of granularity and the level of data detail. First we will analyze the lean manufacturing indicators addressed on the academic literature. Then, we will analyze these indicators with the other indicators used by leading research companies in Brazil. After that, we will analyze the mission, vision and values of the company to determine the KRIs and KPIs that we need to monitor. Thereafter, we will design the data warehouse to comport these indicators considering the level of granularity and the level of data to analyze them. Finally, we will apply these indicators and data warehouse in a software development company to see the results. At the end of this project, we would like to get the list of indicators that would be able to manage and analyze the production and performance of the employees in the factory. With these indicators, the factory will be able to manage the team correctly despite the weather of global finance. This approach allows us to determine the indicators that will make a difference on the management of the company analyzing the performance of human resources associated with the performance of the manufacture. These indicators will determine the way to implement BI solutions associated with human resources systems and manufacturing systems successfully.

**Keywords**—BA; Lean Manufacturing; Indicators; HR Systems.

### I. INTRODUCTION

The study of lean manufacturing indicators applied to people management with the purpose of reducing waste involves many crucial concepts for the success of the project. For this study, it is important to know the main concepts of lean manufacturing, the main characteristics of people management, the main characteristics of the indicators and how to apply the management of indicators to people man-

agement. Finally, it is also important to acknowledge the main characteristics of how to model a data warehouse in order to use these indicator correctly.

Aiming to determine the main characteristics of lean manufacturing, Pettersen [1] developed a research that contained a total of 38 bibliographical references. After finishing his research, Pettersen [1] identified only two concepts of lean manufacturing equally described in all references:

- 1) Reduction of the preparation time;
- 2) Continuous improvement.

With the result obtained by Pettersen it is possible to see not only how vast is the understanding of the concept of lean manufacturing is but also which concepts are more important. Carreira [2] highlighted that one of the main concepts of lean manufacturing is the continuous elimination of waste. For Hibbs, Jewett and Sullivan [3], one of the most important proposals of lean manufacturing is to deliver the final product to the client as fast as possible.

Jekiel [4] points out that the application of the concepts of lean manufacturing for people management had a limited outcome in many companies because they were not ready to provide the necessary support; in other words, applying the concepts of lean manufacturing to people management is not such a simple process and it needs monitoring to achieve success.

Jekiel [4] recommends using the concepts of lean manufacturing on people management in order to implement the culture of continuous improvement with the purpose of waste reduction. Jekiel also highlights the five main causes that make it difficult for companies to implement these concepts:

- 1) Job positions limit people in their projects: the definition of very specific roles and the attribution of many processes end up limiting knowledge and people's experiences.
- 2) Power is limited to a select group of people: the problem of power limitation is related to leadership, in many cases, leaders believe to have more knowledge than the rest of the group.

- 3) People do what they are asked of: Many people at work do only what they are paid for.
- 4) To channel abilities creates a new job: the problem related to channeling abilities relies in the absence of an administration to manage the result of these abilities.
- 5) There are no costs for people that work in inferior capacities: The majority of assets inside a company are measured according to their capacity, such as constructions or equipments, however, when it comes to the percentage of production of an employee, abilities that will be able to optimize the process are rarely considered.

The reasons identified by Jekiel [4] have something in common: they can all be monitored through indicators. However, the question now is, how to correctly choose the right indicators for this task.

There are three ways to measure development, according to Parmenter [5]:

- 1) Key Result Indicators (KRIs): Inform the results obtained in one perspective;
- 2) Performance Indicators (PIs): Inform what to do;
- 3) Key Performance Indicators (KPIs): Inform what to do in order to drastically increase the performance.

Usually, the KRIs are reviewed in monthly or six-monthly cycles, not daily or weekly, like it happens with KPIs indicators.

The KPIs represent a series of measures to demonstrate the most critical organizational development to the actual and future success of the organization.

Besides understanding the concepts of KPIs and KRIs, it is also important to understand the basic concepts related to the indicators of development, according to Bancalero [6]:

- 1) Effort: Energy level and human creativity invested on a task;
- 2) Performance: It is how to use the effort in order to obtain a final goal;
- 3) Objective: What you wish to obtain by conciliating effort and development in a task;
- 4) Result: It is the consequence of using this energy;
- 5) Productivity: It is the proportion between the result obtained and the amount of energy necessary to obtain the result.

Fitz-enz [7] commented on a recently published report, entitled The Conference Board, that only 12% of the interviewees informed to use the management of human capital to help achieving the strategic goals of the company. However, 84% of the same interviewees said that the use of human capital related to the strategies of the company will be bigger on the next 3 years.

Related to indicators of human capital management, Fitz-enz [7] highlights that first it is important to know what is

not working properly, the author calls this process system failure measurement (or to measure what is important).

Two questions, according to Fitz-enz [7] help defining what must be measured inside companies:

- 1) What is the most important thing people management must do?
- 2) How can it be measured?

We can only measure something that is indeed important, for this reason, the second question is strongly related to the first.

According to Vercellis [8], a data warehouse depends on the objective one desires to achieve. Before drawing a data warehouse, it is necessary to bear in mind which questions must be answered. At this moment, the definitions made by Fitz-enz [7] relate themselves to the main purpose of a data warehouse.

A different approach used by Rainardi [9] is to work with data warehouse with two levels of granularity. With this data warehouse it is possible to navigate with greater flexibility among the data from the data warehouse and their source of formation.

In the next section, the way the concepts approached so far were applied inside the project in execution will be shown.

## II. STATE OF THE ART

This work in progress aims mostly to update the developed and detailed activities in the article published by Poffo and Misaghi [10].

In this article, new concepts and new directions were considered, taking into account all knowledge obtained and discussed during the HR Metrics Brazil [11], in which many Brazilian companies and multinationals showed how they use the management of indicators inside their companies, supporting the strategy of the company, increasing the involvement of the employees and integrating the indicators of people management to the indicators of the organizations.

## III. METHODS

According to McClellan [12], for about 20 years, the MES (Manufacturing Execution Systems) systems were the focus of manufacture management. Initially developed to provide the first line of management, with visibility to coordinate service orders and work unites attributions, the MES systems were involved in the essential bond between stakeholders and the events for process of production and logistics. Because MES systems manage and store the events of process of production and logistics they are very important sources of accurate data in real time, integrating themselves to the intelligence of the corporation.

Levinson [13] points out three rules to help identifying development indicators in processes:

- 1) Indicators need to be objective: Indicators need to be clearly defined and need to be quantifiable (it must be possible to measure through numbers);

- 2) The process measured through the indicator must be under the subordination of the team or person responsible for the measure (which means the indicator needs its own control);
- 3) The indicator must encourage the work environment and needs to help the company to obtain corporate results. In addition to being related to the company's wealth or goal it must be understood to all as such.

Besides the data identified by Levinson [13], it is important to consider that employees are measured by their results and not by their work hours anymore, as Sabatini [14] highlights on his research. In other words, an employee that works many long hours but produces as much or less than those who work the regular amount of time, is no good.

Parmenter [5] suggests that indicators of result (KRIs) and indicators of development (KPIs) should be based on the mission, vision and values of the company. This way, the indicators will be consistent with the goal the company pursues, and also, it will be clearer for the partners of the company to understand the rules they are being charged by. One of the expectations, according to Parmenter [5], is to motivate the partners, because the rules are clear to everyone involved in the process.

Figure 1 shows an example of how to make the deployment of the mission, vision and values of the company to define KPIs and KRIs indicators.

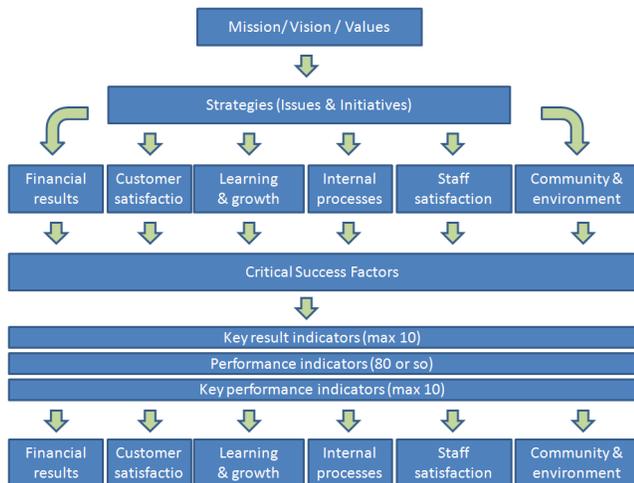


Figure 1. KPIs and KRIs

Among the indicators considered on this work in progress, it is possible to highlight the indicator below (the full paper contains more indicators):

- 1) Indicator to show the quantity of items produced by hour by an employee.

$$Productivity = \frac{TotalofProducedUnits}{TotalofProductionHours}$$

- 2) Indicator to show the wage cost of each unit produced,

that is, the percentage of an employee's wage that the product retains by its manufacture process.

$$WageCostUnit = \frac{AmountofRemuneration}{TotalofProducedUnits}$$

- 3) Indicator to show the billing per capita (the value invoiced by each partner, in case this value decreases along time, it indicates an increase of unproductiveness).

$$Billingpercapita = \frac{TotalNetRevenues}{TotalNumberEmployees}$$

- 4) Indicator to show productivity related to the value paid to the employee for hour.

$$PaidHoursProductivity = \frac{\frac{Netprofitperiod}{totalhoursofwork}}{\frac{Renumberingtotalgross}{totalhoursofwork}}$$

To design the data warehouse the star Model was used. Laberge [15] describes the star model as the model that contains, indeed, a central entity, in which it possesses all the measures as attributes, and a relation with the entity of dimensions.

The goal of this work in progress is to use the approach presented by Rainardi [9] that defines the data warehouse with multiple dimensions, allowing the visualization of the data in a managerial level and once at a granular level.

Figure 2 is the simple implementation of the model of data warehouse for the indicator Paid Hours Productivity, shown on the list above.

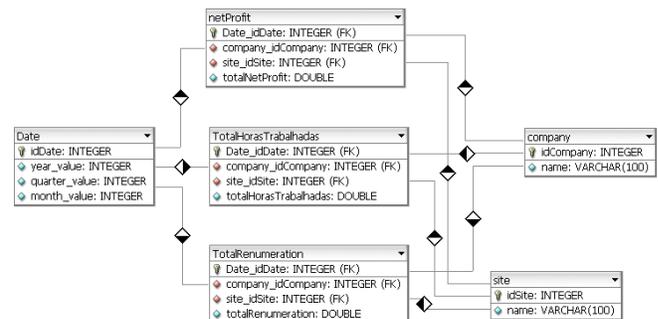


Figure 2. Data Warehouse Model.

This model of data warehouse considered the date dimension, company and establishment. In case it becomes necessary to visualize any detail in a larger way, it is possible to use the company dimension. In case it is necessary to visualize any data in a smaller dimension (in a more focal way) it is possible to visualize at establishment level. It is possible to use other levels for this treatment, in order to be brief, the other levels were omitted.

One of the proposals of this work in progress is to make it possible to access the level OLTP of data in progress, allowing managers to have access to the initial source of the indicated indicators.

Based on this proposal, the data warehouse model shown on Figure 2 has the objective of allowing managers to see a macro view or detailed as needed. On this figure, through the entities 'empresa' (company) and 'estabelecimento' (establishment) It is possible to create a macro view (company) or a view in detail. The final version of the work will contain the details of all levels that are needed to achieve the goals proposed by the indicators.

#### IV. EXPECTED RESULTS

Due to the fact that this article is about a work in progress, the final objective expected is the validation of the efficiency of the proposed indicators for people management, with the purpose of reducing waste. In this article, only some indicators that will be fully developed were shown.

Nowadays, literature possesses many works related to measuring the development of manufacturing processes, however, our goal is to measure the development of human resources connected to manufacture processes, considering that in some manufacture processes, human resources are essential.

DW modeling uses the following concepts to work with the level of granularity of the DW model:

- 1) Dimension: Used to make the dimensions available, in some cases, it will be the level of granularity of the data to be shown;
- 2) Measures: They are the summarized data, according to the dimension used to visualize the data.

At the present moment, the project finds itself at the final phase of mapping the indicators and elaborations of the DW model that will be used to apply them.

The results obtained so far are related to the identification and categorization of which indicators are important to the company's core business.

By the end of this project, the full proposal of the data warehouse used to implement the indicators will be validated, verifying the advantages and disadvantages obtained by using them.

The DW model defined in this work progress will be validated through its application on a software development project. The various cycles defined in the project will be measured separately, aiming to create ways that will enable people to see the progress of the project.

#### V. CONCLUSION

This article reported the developed activities used to list the indicators used in people management that have a connection with the concepts of lean manufacturing.

Besides providing a study of concepts of lean manufacturing, this article also provided a review of the main concepts related to people management, indicators, data warehouse and how to use people management through management of indicators.

At this stage of the project, it is possible to conclude that the indicators created so far will positively aggregate on the process of people management, aiming to eliminate the waste (reminding that this process must be continuous).

Finally, this article adds to a lack of material related about creation of indicators to people management based on the concepts of lean manufacturing.

#### ACKNOWLEDGMENT

We would like to thank all the people who have directly and indirectly helped the development of this work so far.

#### REFERENCES

- [1] J. Pettersen, "Defining lean production: Some conceptual and practical issues," *International Journal of education and Information Technologies*, 2009.
- [2] B. Carreira, *Lean manufacturing that works: powerful tools for dramatically reducing waste and maximizing profits*. Amacom Books, 2005.
- [3] C. Hibbs, S. Jewett, and M. Sullivan, *The art of lean software development*. O' Reilly, 2009.
- [4] C. M. Jekiel, *Lean human resources: redesigning HR processes for a culture of continuous improvement*. Productivity Press, 2011.
- [5] D. Parmenter, *Key Performance Indicators: Developing, Implementing, and Using Winning KPIs*. John Wiley & Sons, 2009.
- [6] J. Bancalero, "Indicadores tradicionais de recursos humanos," *Seminar HR Metrics - IIR, Lisboa*, 2006.
- [7] J. Fitz-enz, *The new HR analytics: predicting the economic value of your company's human capital investments*. AMA-COM, 2010.
- [8] C. Vercellis, *Business Intelligence: Data Mining and Optimization for Decision Making*. John Wiley and Sons, 2009.
- [9] V. Rainardi, *Building a Data Warehouse: With Examples in SQL Server*. APress, 2008.
- [10] R. Poffo and M. Misaghi, "Bi: Lean manufacturing indicators applied to hr applications - an implementation study," in *Fourth International Conference on Advances in Databases, Knowledge, and Data Applications 2012 (DBKDA 2012)*. Curran Associates, Inc. ( Apr 2012 ), 2012, pp. 34–37.
- [11] H. Metrics, "Hr metrics 2012," in *HR Metrics Brasil*. Sao Paulo: IQPC International Quality Productivity Center, Jan 2012.
- [12] M. McClellan, "The heart of intelligent manufacturing," set.
- [13] W. A. Levinson and R. A. Rerick, *Lean Enterprise: A Synergistic Approach to Minimizing Waste*. ASQ, 2002.
- [14] T. Sabatini, "Vagas em ti: quatro exigencias das entrevistas de emprego," jun.
- [15] R. Laberge, *The Data Warehouse Mentor: Practical Data Warehouse and Business Intelligence Insights*. McGraw-Hill Companies, Inc., 2011.