

A Webibliomining Analysis of PPC in the Perspective of Creating an Educational Software for Brazilian University Education

Gabriel Riso Oliveira¹ and Ailton da Silva Ferreira²

¹Universidade Estadual do Norte Fluminense (UENF), Campos dos Goytacazes – RJ, Brazil

Email: gabriel.riso@gmail.com

²Universidade Federal Fluminense (UFF), Rio das Ostras – RJ, Brazil

Email: ailtonsilvaferreira@yahoo.com.br

Abstract— *The teaching of practical subjects such as PPC (Production Planning and Control) can be enhanced through the use of suitable educational software as it engenders aspects of dynamism and interactivity in the learning process. The present article aims to develop a webibliomining analysis in order to expose the theoretical framework and to explain the state of art of research related to PPC in scientific literature. The key content of PPC topics will be used as a guideline for the development of an specific educational software framework. As for the methodology, bibliographic and bibliometric research resources were used to compose the webibliomining analysis, thus making the article acquire the character of qualitative and quantitative research. The renowned Web of Science database and Nails software were used in order to formulate and prioritize the PPC content. As a result of this, the product of the article consists of the framework of the referred software which has highly relevant content because it is aligned with the inputs generated by the use of webibliomining resource as a facilitating tool on content selection of PPC subjects seeking to increase the learning process efficiency by students of engineering and business at Brazilian universities.*

Keywords— *Bibliometric Analysis, Educational Software, Planning and Production Control, Webibliomining.*

I. INTRODUCTION

In the context of university teaching and learning, the practical subjects, such as Production Planning and Control (PPC) course, can be improved by means of so-called educational software frameworks which, despite of being relevant, are still little used in Brazil. The use of those software frameworks assisting teachers in classroom has being made relevant by its dynamism and interactivity factors.

The present article proposal makes use of webibliomining analysis as a methodological tool for selection and prioritization of PPC themes to be addressed in a conceptual model used for the creation of educational software with the objective of increasing the teaching-learning efficiency of this subject for students of engineering and business at Brazilian universities.

The themes inherent in the content of PPC addressed in university classrooms and laboratories should follow not only the basic theory founded by traditional authors, but also the progress and trends that are occurring in practical field.

The article is divided into the following sections: Literature Review; Methodological Aspects; Webibliomining Analysis of PPC; Application in the Educational Model; and, Final Considerations.

II. LITERATURE REVIEW

In the scientific literature of the macro field of study of PPC it is possible to find efforts to produce models of reference in order to enhance the learning process of this subject.

According to Sauaia & Zerrenner (2009), such educational models offer as main advantages the low investment cost (time, energy, resources) and the effective contribution in learning the proposed theme.

The same authors also warn that systematic errors may occur, since the models are not able to cover all the variables of the real dynamic scenario that is intended to model.

2.1. Tubino (2000)

One of the pioneering and still relevant contributions to educational software models in Brazil continues to be the scientific work of Tubino (2000), as a way to stimulate the learning of PPC themes, the author proposes a business simulation in the form of a game that represents,

in turn, the operation of a manufacturing productive system, as can be seen in figure 1.

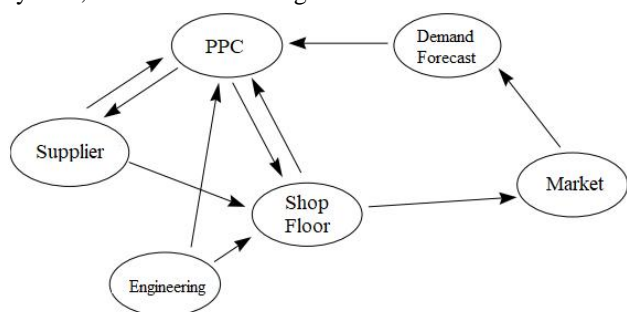


Fig.1 : Basic model of a manufacturing productive system

This model, called GPPC-1, was developed following the basic logic of the PPC, focusing on Production Programming:

- a) Forecast sales from previous sales;
- b) Production based on expected demand;
- c) Sale of finished products;
- d) Cycle feedback.

The dynamics of this model emphasize that the maintenance of inventories, raw materials or finished products, generates costs. On the other hand, the lack of such items also generates significant losses. Finally, the company efficiency is evaluated through the cost of production indicator, given the PPC decisions made in the purposed simulation.

2.2. Barretini and Campos (2010)

Another proposal of an educational model aimed at improving the learning of PPC concepts, both by managers and students can be found in the work of Barretini e Campos (2010).

Using the CIMOSA modeling language, through the computational tool CIMTOOL, the Brazilian authors develop an Aggregate Planning model, in which the user is able to observe its dynamics aspects through the behavior of general variables.

The demands of product families for certain periods should be foreseen and planned; make a decision about the type of labor to be used (normal shift, extra, outsourced); observe and manage inventory costs, lack of products and unit cost of production.

2.3. Ferreira et al. (2014)

Dissering about dynamic scenarios, there is the study promoted by Ferreira (2014) et al. adapted from Tsai & Sato (2004), who, despite not focusing on university education, develops a UML class diagram model on the theme of Agile Planning and Production Control and its respective methods and attributes, and the interaction relations between these.

Such a theme is centered on make-to-order manufactures where quick changes in customer orders require agile reactions on the PPC model adopted.

III. METHODOLOGICAL ASPECTS

In this section the research methodology to be used in the development of this article is presented. Conceptual aspects of bibliographical and bibliometric research are used in an approach that covers both quantitative and qualitative characteristics.

3.1. Type of research

According to Ciribelli (2003) the definition of research focuses on the act of investigation from a problem situation; Its purpose is to broaden the understanding of a particular research topic, maximizing scientific knowledge, improving or developing new theories, and characterizing new principles.

Already in the view of Rampazzo (2005), research is an activity focused on the solution of problems through the processes of the scientific method; It is characterized as a reflexive, systematic, controlled and critical procedure that allows discovering new facts or data, solutions or laws, in any area of knowledge.

For the present article, it was used the bibliographic methodology research that, according to Gil (2002), is developed from previous elaborated material, which is consisting mainly of books and scientific articles.

This research material has been expanded and improved through the concept of webibliomining research, defined by Vanti (2002) as a set of research methods that uses quantitative, statistical and data visualization analyzes. It is a useful tool not only to map the knowledge structure of a scientific field, but also to analyze the behavior of researchers in their decisions in the construction of this knowledge.

In the spectrum of webibliomining analysis as a tool, Costa (2016) classifies the five main types of methodology used as: citation analysis; co-citation analysis; bibliographic grouping; co-word analysis; and "webmetry". This work is focused on the citation analysis methodology.

3.2. Type of approach

Regarding the approach of this scientific article, it can be defined as qualitative and quantitative. This fact implies in qualifying and quantifying the data obtained through information collected through observations, organizational documents and data analysis.

As an example of this, it can be cited the natural subjective behavior of the researcher in relation to the relevant content generated by the webibliomining of the

subjects carried out through the Web of Science database and classified by the software Nails. That is, relevance data are generated quantitatively by this software, which analyzes the number of citations and the impact factor of the articles to rank them in order of importance for the research.

However, the subjectivity of the researcher engenders the qualitative character of the research approach when the articles that have greater affinity with the project theme are analyzed, among those considered relevant in the first quantitative analysis.

In the scientific methodological framework, the present research can still be defined as being of an applied nature, since it is part of the proposal of this project to test the educational software in a sample of university students.

IV. PPC WEBBIBLIOMINING ANALYSIS

One of the most notable aspects of PPC processes is the general decision-making model that, according to Erol & Nakiboglu (2017), is relevant in the process that seeks to solve the problem through the generation and evaluation of alternatives and finally, the choice of the best of them, taking into consideration an organization oriented towards profitable and efficient results.

The importance of decision-making can also expand to its implementation and control the decision-making process to determine when additional decisions are required. In this case, decision making becomes practically synonymous with management.

In an educational model, with the objective of promoting the learning of the concepts of PPC, the decision making enters as one of the main philosophies, since it is an inherent attribute at all levels of planning having its relevance easily understood in the holistic concept of the subject in question .

Another attribute to be portrayed in the educational model would be mathematical models adjacent to the (complex) levels of planning, such as mathematical and computational models of inventory.

Nahmias (1997) explains that inventory theory naturally comprises inventory models because of their high complexity of variables. Such models have as their main objective to minimize the total cost of this and to balance the economy of large orders or large production launches against the cost of maintaining the stock and the cost of scarcity.

The market is rapidly advancing as companies incessantly pursue new methods and procedures in the constant attempt to outdo competitors; or stay at the top, dominating the largest share of sales in the market.

These factors are described by Mesquita (2008) as: reduction of production lead times, reduction of

inventory costs (raw materials, consumables and final products), reduction of production costs (idle, overtime, subcontracting), compliance with timeliness and agility of response to changes in demand.

Regarding the most relevant authors for the PPC themes, the list of the most cited authors (figure 2) generated by the Nails software was obtained from the bibliometric research data in the Web of Science database.

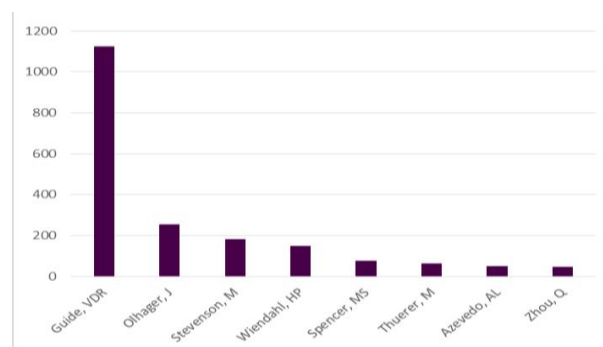


Fig.2: Most Cited Authors on PPC Topics

The most relevant author for the study fronts of PPC themes and their correlates is the Pennsylvania State University professor, VDR Guide.

One of the most important themes addressed by this author is the concept of remanufacturing, where the processes on PPC philosophy have to be remodeled to adapt to a production line with some particularities.

Expanding the remanufacturing aspects and exploring its theoretical concept, we have that it is consistent in production models in which the organization input promotes the transformation of its products with activities of disassembly, maintenance, repair of damaged parts and cleaning. The output, in a simplistic approach would be the same input product, however, remodeled, restored, remanufactured.

According to Gray and Charter (2006), a product can only be considered remanufactured when it is conditioned to the same specification of the original manufacturer from the perspective of the consumer.

Thus, a remanufactured product or component can be defined as one that can be brought to the condition of new after being used (or discarded) by the consumer.

In the view of Guide (2000), the most cited author, remanufacturing represents a greater form of value-added recovery than material recycling.

Remanufacturing systems are common and profitable in the United States. However, the author discusses that the management of PPC activities in the remanufacturing processes can differ greatly from management activities in traditional manufacturing and,

through their scientific research, proposes a PPC model adapted to this.

Another author considered relevant in the bibliometric research carried out is J. Olhaguer, professor of Supply Chain Management at Lund University. His research is naturally based on topics related to efficiency in supply chain management.

In his main work, Olhaguer (2003) discusses the Order Penetration Point (OPP). According to the author, the OPP defines the moment in the value chain where a given product becomes linked to a specific customer order.

Different manufacturing environments (make-to-stock, assembly-to-order, make-to-order, engineer-to-order) relate to different OPP positions. In these different ways, PPC displays varied strategies in delivering products, having different implications for manufacturing objectives such as customer service, manufacturing efficiency and inventory investment.

Finally, as the third most cited author, we have Stevenson (2006) who explains different approaches to PPC based on methodologies such as Kanban, MRP II and Restriction Theory.

This author considers factors such as the importance of the step of analyzing customer demand, company size, degree of customization and factory floor configuration and shows that they play an important role in the applicability of PPC concepts.

In this way, the aspect of raising awareness of researchers and professionals for the flexible options offered by the PPC philosophy to aid in decision-making in the selection of the management model is addressed.

The same author stresses the importance of a clear implementation strategy for such a model.

Therefore, there is a dynamism aspect inherent on PPC practices. For the creation of a reference model that serves as a teaching and learning tool on the subject, one should address its basic conceptual principles and foundations.

However, the various processes and their variables (depending on the type of industry, market, production) that impact the final PPC model for a particular organization should also be mentioned in terms of dynamism, flexibility and mutability.

As for the most relevant articles (classified according to the impact factor of the software Nails), there are works such as that of Kingsman (2000) who lecture on Workload Control (WLC), a PPC concept available for practical operations.

According to this author his principle is to control queues in front of the workstations on the factory floor by means of norms and rules pre-established. With better control of waiting times in the overall

manufacturing, queues are kept short, increasing the operational efficiency of the organization.

In addition to the objective of controlling the workload and queue length in workstations on the shop floor, it is desired at the same time to process the products in order to meet the promised delivery dates with machine capabilities available.

In this concept, the Workload Control in the Reference Model can be cited as a methodology to assist in the elaboration of the Master Production Schedule, since this includes a more operational and direct approach to the factory floor in the general theme of PPC.

Silva, Almeida and Roque (2006) discuss the adaptations in the PPC process to increase production efficiency in a specific mold industry.

Already in the article authored by Hendry et al. (2013), the WLC is treated with a greater degree of individualization in the company, that is, the specific needs of the organization dictate the priorities to be addressed in its operational planning processes. This corroborates the assertion of the dynamic character that the philosophy of PPC can assume.

As a result, the authors' approach is based on principles and methodologies of assistance to PPC such as MRP II, Kanban and even initial concepts of Workload Control.

With regard to the most frequent keywords classified by webibliomining research we have a view of the most elementary terms of the macro fields of study Production Planning and Control, as can be seen in table 1.

Table.1: Most Frequently Searched Keywords

Keyword	Frequency	Keyword	Frequency
PPC	245	Remanufactu- ring	25
Production Planning	76	Manufacturing	23
Simulation	52	Supply Chain Management	20
Scheduling	45	Production	
Workload Control	32	Optimization	17
Production Control	26	Make to Order	12

As expected, the words: Manufacturing; Production Planning and Control (PPC); Production Planning; Scheduling; Production Control and Production appear frequently because they represent the elementary basis of the methodological of PPC structure.

Macro specific aspects inherent to the theme which are also frequently cited are: Work Load Control and Supply Chain Management. These aspects guide the concept of PPC to be used. Be it in a more operational approach such as the WLC, or in a more strategic one such as Supply Chain Management.

Basic actions of PPC processes also appear as the most cited words: Optimization and Simulation. And finally, we have Remanufacturing and Make-to-Order as specific production styles often cited in scientific articles.

Having knowledge about the themes of PPC through the resources obtained from the webibliomining research carried out, one has the necessary knowledge base to foment the structuring of the content that will be present in the reference model for the learning in the said subject.

V. APPLICATION ON THE EDUCATIONAL MODEL

In the context of the construction of a basic conceptual model for the creation of an educational software in order to increase the efficiency of the teaching-learning processes of PPC, webibliomining process plays a very important role in exposing the theoretical framework and explaining the state of art of that subject.

The researcher is responsible for selecting the relevance that new research brings to the purpose of interest. That is, which topics on PPC should be explored in the Brazilian universities for engineering and business students.

The model proposed by this article is established in a software application that will act as a question and answer game about the themes inherent to PPC, a software interface is available in figure 3.

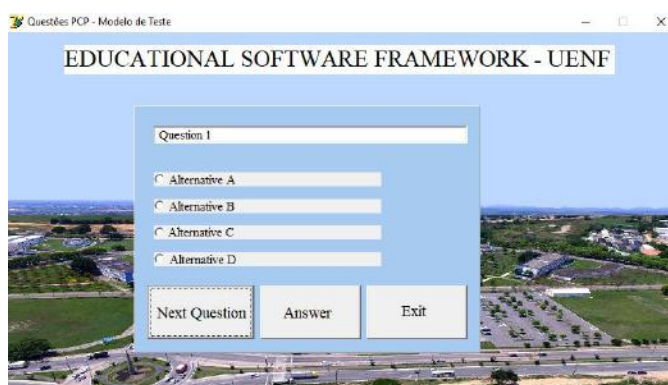


Fig.3: Purposed Educational Software Template

The student should be able to have an elementary and sequential learning of the themes of PPC through the game of questions and answers that bring, in addition to the principles and basic elements of the matter, the updates of relevancies generated directly from

the use of bibliometrics.

VI. FINAL CONSIDERATIONS

Webibliomining is an important instrument on formulation of programmatic content of a conceptual framework of educational software. From the specific search for the most frequent keywords, we have a quantitative notion of the topics of PPC most covered in the journals, that is, in which subjects the scientific research is most concentrated. Software, in turn, represents a field in the field of teaching-learning in which there is still much to explore.

It can be concluded that the webibliomining analysis plays a fundamental role by allowing to align in a coherent way the relevant theoretical content of the subjects of PPC collected from the scientific literature.

Concepts approached as: Workload Control; Simulation; and Remanufacturing, contrast with the traditional concepts of Production Planning and Production Planning. From this, there is a basis for prioritizing the most relevant subjects to be treated in the software, not only the classic subjects covered by the traditional books, but also the trends of PPC aligned to the new scientific researches in the theme and also to the needs industry.

Finally, the educational software models, from the perspective of the students, have great potential on increasing quality and efficiency of practical courses teaching-learning. Parallel to this, the use of webibliomining method is proven as being of extreme value for the selection and prioritization of the content to be approached.

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