THE SUBJECT OF INTERDISCIPLINARITY IN THE PRODUCTION ENGINEERING

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ABSTRACT

The Production Engineering, assists to a wide range of differentiated demands, of interdisciplinary order. Not only in the ambit of teaching but also of the research, the interdisciplinarity constitutes a problem. Taking into consideration the need to recognize objects different from its physical-mechanical matrix, opening up, in that way, to the conceptual resources of Administration, Social Sciences and Educational Sciences and devices that are being designed..

INTRODUCTION

Production Engineering (PE), an engineering of wide growth in Brazil, assists to a wide range of differentiated demands, of technical and managerial order. Its contents, ideally interdisciplinary, embraces technological, administrative, economic and sociological disciplines, but it is still an object of discussion, due to lack of homogeneity.

For the teaching of PE, the solution to this problem passes by the interdisciplinarity to be distinguished from the simple multidisciplinarity (juxtaposition of disciplines), so that it can organize the contributions, to turn them into homogeneous, with a conceptual and methodological basis capable to consider the interface on the technical side of the engineering (physical-mechanics matrix) with the human side, for example, the administration of human resources, the professional formation of operators, etc.

Thus, Production Engineering needs to recognize objects different from its physical-mechanical matrix, opening up, in that way, to the conceptual resources of Administration, Social Sciences and Educational Sciences, to deal with the organizational and educational aspects of the systems or devices that are being designed.

The reconceptionalization work and extension of objects of the Production Engineering is related to an interdisciplinary discussion to found those articulations and alliances, considering epistemological and methodological caution required by our time of reflexive modernization.

PRODUCTION ENGINEERING

The production engineering is an area that grows in many differentiated directions. Its origin is in the extension of the traditional core of the old industrial engineering, linked to the mechanical engineering, initially restricted to the industrial activities, assemblage and processes of assembly lines, machining, layout, robotics, that were successful in the metallurgy section. Nowadays, the production engineering embraces economic, financial and ethical subjects, ranging from financial to service areas.

In the conception of production systems, the work conditions, the characteristics of the products, as well as the characteristics of the machines and workers, are also taken into account. In that sense, an ideally interdisciplinary content should exist, embracing technological, administrative, economic and sociological disciplines, that are still an object for discussion due to the lack of homogeneity.

In Europe and Latin America the discussion of the contents of engineering is frequent, while in the USA, the tradition of discipline is stabilized and, besides, there is a larger circulation among the academic disciplines. In the anglo-saxonic world, for example, there is the industrial engineering, the production engineering and the management engineering.

The presence of a management engineering, different from the production engineering and of the industrial engineering is a subject that has been largely discussed in several congresses of industrial engineering[4]. The characteristic that differentiates it from the other engineering types, is obviously, the fact that it possesses a larger emphasis in the managerial aspect. Its curriculum is interdisciplinar, including the areas of, operational research, business administration, computer science, quality systems, l ay-out, programming, just-in-time, etc.

UFRJ's PE course has a very close character of the engineering management, just as it is conceived in the USA. Considered as one of the largest schools of Brazil, its program curricular stands out of another courses. For example, according to Santos et al[7], UFRJ's EP course is treated like Full Production Engineering, for concentrating its emphasis in

Economic Engineering and Production Management, and not assuming a specific technological area.

This school still possesses teachers and researchers that work with mathematics, statistics, mechanical engineering, computer science, ergonomics, philosophy, psychology, sociology, therefore, with the largest non technological component, which sometimes generates difficulties in understanding of the part of other engineerings.

This scenario has been demonstrating that its interdisciplinary character is still larger than other courses in Brazil. And this also happens in virtue of the labor market in that area to be essentially of services.

But in spite of this character, its interdisciplinary content is still multidisciplinary, there is little or no interdisciplinarity at all, that is, an accumulation of things without great connections, a juxtaposition of subjects and themes that don't converge to each other.

This multidisciplinary content, that still meets in the apprenticeship of search of the interdisciplinarity, constitutes a problem, because this reflection still seems not to exist so much in the ambit of the teaching as in the one of PE research.

Then, as to organize the several contributions, as to turn them homogeneous, or as to reconstruct a conceptual and methodological base to approach problems of interface on the technical side of the engineering (physical-mechanics matrix) with the human side, for example, the administration of human resources, the professional formation of the operators, etc.?

What would the minimum condition be to develop the embryo of an interdisciplinarity without the risk of being in the multidisciplinarity?

MULTIDISCIPLINARITY AND INTERDISCIPLINARITY

It is generally accepted that interdisciplinarity and multidisciplinarity are different. The difference between interdisciplinarity and multidisciplinarity is in the object change that the former acts.

According to the Research Councils' UK academy of science:

The multidisciplinary research involves people from different fields cooperating: working together towards a common goal but staying within the boundaries of their own fields. They may reach a point where, because of the restrictions and limitations of their disciplines, they cannot make further progress. They may then be forced to work at the fringes of their fields, and forge new ones. At this point the research becomes interdisciplinary.

In the engineering education the interdisciplinarity is outstanding subject, it is the central part of any educational endeavor about production systems, including social and environmental aspects, with an intense collaboration between technologies and humanities.

The interdisciplinarity is required for a social, cultural and organizacional approaches of industrial development, and also for an ecological approach[3]. If PE covers all those aspects, it will be necessary to conceive its object the kaleidoscope.The environmental implications of industrial systems are also the relevant topic in PE, and that is the factor of the increasing complexy of its object.

According to Serres[8] and Prigogine[6], the interdisciplinarity is necessary in the new perpective of science.

Serres[8] emphasizes the opening of exact sciences to the thematics of human, social sciences and philosophy, because they aren't able to understand questions about their own meaning. Their meaning is changed by the recent developments of molecular biology, cognitive sciences, etc. The interdisciplinarity is the necessary condition for a further development.

The knowledge and the technique give us a master. If we dominated a technique, with her we dominate the world. That domain generates difficulties(...).There is not more scientific discipline than it is not in the discipline the need to dominate its own domain. Then it is necessary to increase to that process scientific-technician the domain of another processes that are ethical in certain cases and deontologic or juridical in others. In other words, the humanities, the law, the moral and the philosophy should allow us to become not the owners of the world, but the wise persons, possessors of the nature.[6]

Another thing that Morin[5] showed is that the recent science is rediscovering thematic which were expelled of the science of the time positivisty, front to an official science that was associated to a complex of notions as causality, legality, determinismy, mechanicismy, rationality, arising a group of strange themes which for the classic science, such as: the life, the destiny, the freedom, the spontaneity, becaming an emanating of profundities in the time and that were intended inaccessible the reason.

The words such as: machine, mechanics, engineering, utilised has a similar etymological history, it is not subject of knowing rational, but the artifice, of trick. It just is not to know the natural problems, it is to deceive the nature, to plan something, of having marvels, the creation of strange effects to the natural order. The artifice and not the science.

An alliance that there was in the experimental dialogue, arrives like this to the that constitutes the singularity of the modern science, reigning that technical vision, inside of that alliance, of that encounter of the theory and of the technique with the culture. The systematic alliance among condition of modeling the world and that of understanding it.

The technical world that the classic science helped to create, needs to be understood, of concepts very different from this science (Prigogine, I. and Stenghers, I., 1979 : 294)

Taking into the argumentation of Prigogine in relation to these subjects, the heterogeneity between the domain of the practical manipulation and the domain of the rational knowledge of the nature is abnormal, what denotes as fundamental the opening of the engineering.

THE RISK OF OBJECT INDEFINITION OF PRODUCTION ENGINEERING

That wide opening should not make to forget the limitations that are imposed to the Production Engineering. For being an activity guided praxeologically (efficiency search), this discipline doesn't have the condition of producing the theoretical-conceptual objects assumed by other sciences.

Without thinking in the limits of its object PE it ends up injecting in its content whatever goes through on mind. Where the humanistic problematic elements are brought, but without recognition of the objects of the human or social sciences. They are presented as subjects of the point of view of the production engineering, while they should be shown of several point of view, respecting the specific objects of each science or it disciplines.

It is inadequate the speech of the production engineering when it doesn't possess homogeneity and it doesn't recognize the specificity of the objects of the other sciences.

Sometimes, the production engineering doesn't recognize the specificity of Human Resourses Management or of the disciplines specialized in professional formation. It doesn't take them into account and it makes a parallel speech.

In the field of the studies organizacionais and of engineering, the sociological level is frequently requested, even so technically badly solved. In the reaching of that dimension the study of the culture is fundamental, because the hard science, purely is unable considered into account.

In the conception of such partisan, the theme of the interdisciplinarity is not highlighted, because the production engineering would have a self-sufficient object to consider of all the managerial aspects, humans or formatives, although, to build such object, its necessary to mention many authors who are not of the area of production engineering, for example, psychologists, sociologists, philosophers, etc.

When an engineer, in important work, mention authors of such categories of knowing, will he be building a speech of production engineering?

With a wide range of citations of different disciplines, a text is built, that, in fact, it is intertext, making bridge among several indication of heterogeneous knowing. However, the fact of they are mentioned by a production engineer it doesn't check to the psychological, sociological or philosophical sources to that characteristics of the production engineering.

As the idea of object of a science is not recognized, nor the object of a discipline, it doesn't make sense to want to do alliance, because everything is equal, it is an absorption vision. If the engineer found an interesting idea regarding an author, he makes this reference in scientific work him.

It doesn't make itself alliance. PE is a very big thing that absorbs, that makes everything. It makes a theory of the industrial relationships, it makes a theory of the education.

The risk of the indefinition of the production engineering is of having an object of type " fourre-tout ", meaning “sack where any fits thing”.

The idea contrary to this vision would be to seek the foundation bases and this way to create a hybrid, theoretical, conceptual object, with base in those sciences, I.E., in the pedagogy, in the sociology, producing the bases to propose solutions for that bases, in this sense, it is an alliance, a partnership.

Because a course of more demanding engineering will want to criticize and to consider such things, starting from theories that it doesn't create itself (organizational, communicacional, educational), arising the need to have a conception of production engineering that establishes a dialogue with several sciences.

CONSTRUCTION AND RECOGNITION OF SCIENTIFIC OBJECTS

The scientific knowledge is constructed. In the well defined scientific field, the conceptuel and theoretical construct can be considerated as an object. Classically, the necessity of the construction of scientific objects had been formulated by the french philosopher G. Bachelard[1]. For him, the main function of the constructed object is to establish a rupture between scientific knowledge and common sense or other forms of illusory knowledge.

That idea is important in applied scientific fields, where the two types of knowledge are often confused.

The formation of the scientific spirit is an important question in the engineering teaching.

It is not possible to avoid completely the common sense, specially in business matters. The corporate culture and its tenets are diffused in the language of every day life. Young engineers and managers ought to know that. But intellectually, the scientific formation needs to criticize the spontaneous representations of the job.

As mentioned previously, the PE is viewed as a space, within the Technology Center of the UFRJ, in which it is possible to develop studies on social aspects of production systems and technology, for example:

Social science and philosophy have an important role to play in the context of technology, and particularly, PE.

Psychology is useful in order to understand decision processes and to build models for decision supports.

Sociology, specially sociology of organizations, is required for analyzing the social and organizational viability of the adopted technology, designed systems and other modelling applications.

In the industrial context, human and social sciences aren't only a mean for the engineer to enrich his general culture. They are a foundamental intellectual basis for problematizing the PE objects and assessing the planned or designed solutions.

In PE, the participatory requirement is relevant at the methodological level, because the design, or management, of the process or system, in the industrial field, suppose an interaction between engineers and users or operators.

In what it says respect to the opening of the educational or formative field (adaptation of the formations to the demanded professional competences, for example), the production engineering can participate in the diagnosis and in search of solutions.

The possibility of redefinition of the professional formation in industrial context is an objective followed by the engineering of enlarged production, that embraces industrial relationship subjects and of formation systems. (please, see[9]).

For so much, the Production Engineering needs to recognize these objects that are different from its physical-mechanics matrix, opening up, to the conceptual resources of Administration, Social Sciences and Sciences of the Education, to work with the aspects organizational and educational of the systems or devices that are being designed.

But the difficulty resides in the approximation on the scientific " side " (physics, mechanics, etc.) and the managerial and social side, that is sometimes it is seen as not scientific. However the human behaviors are also object of scientific approach.

THE PROJECTION-PRAXEOLOGICAL DIMENSION

The engineering is an activity praxiological, in the search of the efficiency, where it works only with pre-conceived object, a lot of times of way a-critical, with an entire organization structure already predetermined.

The distinction between the engineer and a social cientist and an educator is that they don't have the projection dimension. The dimension of the engineering is projection-praxeollogical.

Therefore, PE it should think of the limits of its object, seeking its bases, its foundations and proposing practical solutions by virtue of being hybrid, that is to say, of being paved in two natures.

The electric engineering has as object electric devices. The mechanical engineering, as mechanical object, and so on.

In the production engineering, for the fact of being an engineering that has the human being in its analysis object, all the aspects of the human life can be related, however, in the same way that, for its physical side, the Production Engineering doesn't contribute to the theoretical development of the mechanics or electronic, it doesn't either contribute to the creation of theoretical-conceptual objects of the Social Sciences.

But what is practiced, it precedes of a following reasoning: the production engineering deals with the man and with the machine. The man has a certain psychology, then the psychology can be part of the production engineering. The man exists inside of a net of social relationships, sociology object; then the sociology can also be part of the production engineering. The man believes in God and he has a certain morals, so the theology and the ethics are also subjects for the production engineering. The man can have problems of health, the medicine can serve to the production engineering. The worker is unionized and politicized. The industrial relation and the political behavior interest to the production engineering. And it is so on. All the social and humanistic areas can be associated to the production engineering, however it is good that those multiple relationships are thought with a clear object demarcation, what in general doesn't happen.

SOLUTIONS - ARTICULATIONS AND ALLIANCES

The problem of the formation and of the use of objects of Social Sciences and Educational Sciences can be solved by an interdisciplinarity, understood as:

a) articulation of objects or formation of hybrid " objects ", whose elements are thought of itself and in its in relations.

b) “alliance " (or partnership) among several disciplines, to be thought of senses indicated by the authors: I.Prigogine, I. Stenghers and M.Serres.

The interdisciplinarity of the production engineering should be given in a form of a dialogue with the other disciplines. Concerning the objects of the production engineering they should be built in way to establish bridges with the objects of the other disciplines.

It is not, as many times it happens, of starting from the object of the production engineering, just to call some free ideas of the disciplines, psychology, sociology, etc., without examining the own object of those disciplines and without worrying with the entail type that can exist between the object of the production engineering and the objects of the human science.

A more appropriate solution would be to examine the concepts of the human sciences and to see in that measured they are tied up with the one of the production engineering and to see in that condition those objects can be tied up knowing this contact will be interpreted in terms praxeollogical in agreement with the general optics of the engineering, for example:

The system of Human Resourses Management and the formation system (training) they happen on

the characteristics of the production system, it is that the specialists of PE need to establish a "interface" with those areas to adapt the projects or management forms.

The production engineering plays an important role in the current context of the modernization. It constitutes a form of performance in the organizations and it is used to introduce innovation and new administration techniques, possessing an object constituted starting from a systematization of the productive practices.

Its body conceptual proceed from, on a side, of organizational tendencies taylorist, toyotist, etc. and on the other side, of formal tendencies, instruments built starting from the operational research, theory of systems, etc.

In the context of the globalizacion, it brings a series knowledge of several origins (Japan, USA, Europe...), lately, very pawned in the administration and control of the quality, in the managerial models, in the sociotechnical, in the reengineering, proposed these that are disclosed in the ambit of EP and they play an active role in the productive restructuring, in this current context of the called of reflexive modernization, according to U. Beck's conceituacion and A. Giddens[2], that it requests the due taken care epistemological and methodological demanded inside a vision of appropriate science, which is adequate to the current time.

The reconceptual work and extension of objects of the Production Engineering goes by a discussion interdisciplinary to base those articulations and " alliances ". Besides, the practice of those alliances is necessary to avoid the reproduction of a new type of technocratism in the context of application of the Production Engineering.

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