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Knowledge transfer for process improvements of SMEs in the region: experience from Project-Based Learning

Jose Alonso Caballero Márquez[a], Mauricio José Martínez Pérez[b], Katherine Julieth Sierra Suárez[c], Zulay Yesenia Ramírez León[d]

[a]Industrial Engineer, M.Sc. in Industrial Engineering, PhD (s) Science of Administration. Professor and researcher at Unidades Tecnológicas de Santander. Bucaramanga, Colombia. E-mail: jcaballero@correo.uts.edu.co, [b]Industrial Engineer, Electronic Engineer, M.Sc. in Industrial Engineering. Professor and researcher at Unidades Tecnológicas de Santander. Bucaramanga, Colombia. E-mail: mjmartinez@correo.uts.edu.co [c]Industrial Engineer, M.Sc. in Industrial Engineering. Professor and researcher at Unidades Tecnológicas de Santander. Bucaramanga, Colombia. E-mail: ksierra@correo.uts.edu.co [d]Industrial Engineer, M.Sc. in Industrial Engineering. Professor and researcher at Unidades Tecnológicas de Santander. Bucaramanga, Colombia. E-mail: zramirez@correo.uts.edu.co

Abstract

Knowledge has become the resource that enables higher levels of value aggregation in the production of goods and services, the sustainable insertion of emerging economies into the global village and the improvement of the living conditions of individuals. Based on the abovementioned, academia, particularly universities are called to lead the generation of knowledge, not only for teaching and research, but also for offering solutions to the productive sector, that is, by generating knowledge transfer of businesses, the state and communities. This is the main challenge faced by the academic community in order to prove if its intervention in organizations may have a great impact on the productivity and competitiveness of the different economic sectors. Therefore, this research aims to structure a teaching-learning strategy intended to the identification and analysis of a case problem of the productive sector. This strategy is based on the active methodology of project-based learning, as well as on the application of knowledge acquired by students in the following three areas: 1) Methods and Timing Analysis, 2) Human Talent Management; c) and Budgeting Fundamentals. Taking this into account, the students managed to diagnose and provide solutions to real problems of companies belonging to the productive sector of the region of Santander, Colombia. As a result of the research, it was possible to have a positive impact both from the point of view of the productivity of the organizations in the

thematic axes addressed, as well as from the students' appropriation of knowledge. In the same way, it was achieved the strengthening of the relationship between University – Business, contributing to the advance in the transfer of knowledge in the productive sector of the region from academia.

Keywords: *Project-Based Learning, Knowledge Transfer, University-industry.*

Topic: *University-industry cooperation*

Introduction

Based on the project-based learning methodology, students and teachers of a higher education institution look for solutions to real problems that arise in companies in the manufacturing sector. To his end, they use theoretical knowledge acquired in several subjects belonging to the third semester of the Industrial Production Technology program, articulated by propaedeutic cycles with the Industrial Engineering program.

The process includes a diagnostic stage, the search for solutions, the implementation and economic evaluation of the solution. Since students do not yet have a complete professional education, it will be important to generate a dynamic and inclusive interaction between the actors involved in the search for the solution, that is: teachers, students and entrepreneurs. At this point, it is important to emphasize that the success of the integrating project lies in the fact that the students have permanent academic accompaniment along the project, which will allow a continuous feedback throughout the process.

Finally, it is worth noting that one of the intentions of the integrating projects is to privilege competencies such as research, to achieve an analytical and critical perception of the phenomena under study, and to respond to the dynamics of the contexts, demonstrating the integration between theory and practice, thus bringing knowledge closer to realities.

This document is structured as follows: initially the theoretical framework is found, in which the foundations of the project are described, followed by the methodology, in which the different stages carried out in the development of the project are detailed, followed by the main results achieved and ending with the most prominent conclusions and constraints in relation to the project.

Theoretical Framework

Taking as reference the guidelines of the Institutional Educational Project (PEI) of the Unidades Tecnológicas de Santander, the formative research is approached from the problemic paradigm, under the Project-Based Learning strategy – ABP (Chen and Yang 2019). Likewise, from the micro curriculum, formative research is proposed as a cross-cutting topic, with a diversity of applications regardless of the discipline or area of knowledge, being implemented in the classroom at different levels through methodologies such as: the identification of problems, the study of cases, and the development of classroom projects or integrating projects that address two or more subjects of the same level (Ausín et al. 2016).

This integrating project is led by the Incubator Research in Production - SIPRO, belonging to the program of Technology in Industrial Production, which works the research line Production Engineering, Processes and Operations. Having into account the abovementiones, the integrating project was framed into three approaches.

The first approach focuses on the study of methods and times which, according to Guzmán & Castaño (2013), seeks to improve performance in all activities that involve physical and mental efforts aimed to obtaining a product or providing a service. The improvements achieved through this study seek to reduce unproductive movements and efforts that do not bring value, since they reduce efficiency by producing, generating delays, quality problems, accidents and industrial injuries, among others (Aquilano, Chase, and Jacobs 2009). This study was initially formulated by Frederick Taylor and improved by the Gilbreth spouses, pioneers of industrial engineering.

The second approach is related to Budget component. According to Polimeni (1994), a budget is a planning and control tool for management, which allows to determine whether a given investment decision will be successful in the future. In such a way, it is possible to determine if the improvement proposals raised by the students will be feasible for implementation in the company.

Finally, the third approach is linked to the study of wages from the point of view of the administration of human talent which, according to Pérez (2007) from his study in the thirteen main cities of Colombia, wage levels are explained by different demographic variables typical of the city where the labour demand occurs. One of them is comfort, in this study, it was highlighted that Bucaramanga is one of the cities with high level of well-being. Although sometimes wages are not so high, a good standard of living is maintained. In this sense, it is necessary to study the salaries of the companies involved in the integration project, in order to review whether they are aligned with the labor market of the city or whether they represent an opportunity to reduce costs (Orozco and Tovar 2015).

In a highly competitive world, companies are constantly preparing for market challenges. To achieve success, they must have an expert, agile and innovative work team. People are responsible for making things happen: they do business, manufacture products and provide services according to the company's objectives. For this reason training is essential for the company to materialize its goals by obtaining a desired performance (Vidal Holguín 2010). For successful companies, training is not a lost money, it is an investment for the future that will bring direct benefits (Chiavenato, 2009).

Methodology

For the development of this research, a four-step methodology was carried out, as shown in Figure 1. These are detailed below:

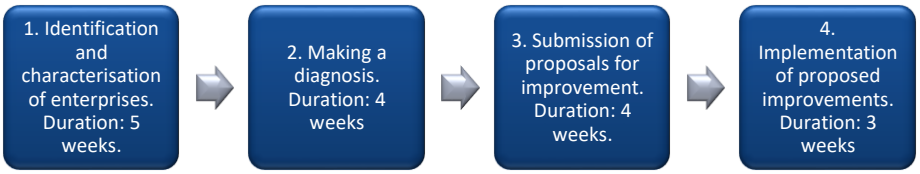

Fig. 1. Methodology of the investigation

1. Identify and characterise an enterprise in the production sector in order to understand its internal functioning.

2. Conduct the diagnosis of the company identified above, using quantitative tools, from the approach of studying methods and times, studying salaries (administration of human talent) and budgeting, to identify opportunities for improvement.

3. Propose improvements, in relation to the findings obtained from the previous diagnosis, taking into account the interpretation of the results obtained. In this phase, it is expected to generate robust consultancies that will strengthen students' knowledge.

4. Implement the proposed improvements: on the basis of the work done previously, the implementation of the identified improvements will be launched in order to bring value to the company, in addition to students being able to experience process improvement in real life. It is sought that these implementations, are formalized in the

form of innovations, either in the organizational management as in productive processes, guaranteeing their degree of novelty for the different companies.

Results

The integrating project starts at the beginning of the the university academic period, which has a duration of 16 weeks, in order to address the topics of the selected subjects (Methods and Times, Budget Fundamentals and Human Talent Management). In parallel, the project' components are presented to the students, in order to work with the theoretical component and the practical component at the same time.

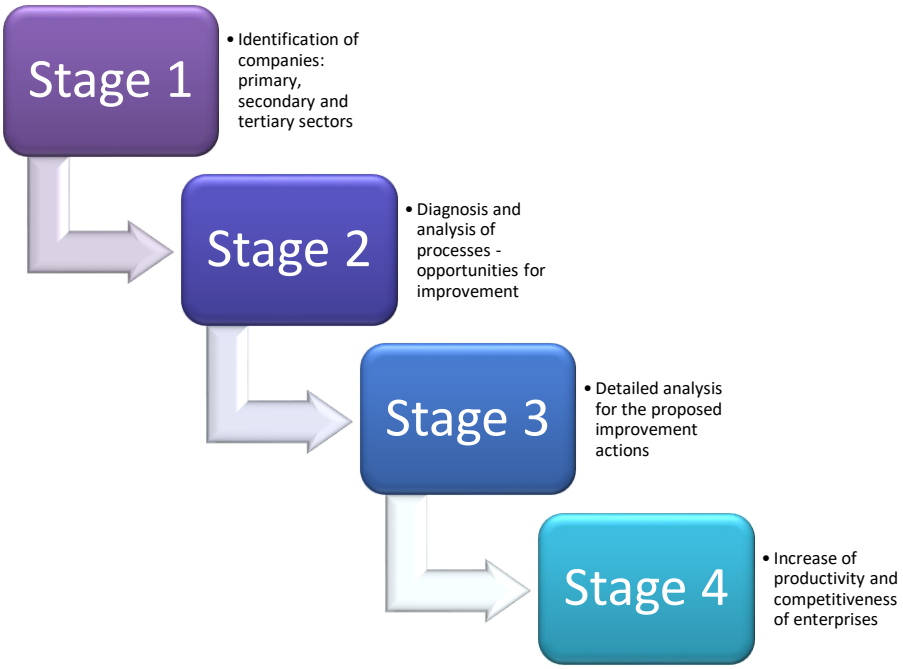

Fig. 2. Development of the project

On the stage 1 of the methodology (first 5 weeks of the academic period), 19 companies belonging to the primary, secondary and tertiary sectors, located in Bucaramanga and its Metropolitan Area were identified. These companies have a size of Micro, Small and Medium Enterprises, due to the number of workers and the value of the assets they own. Once the companies have been identified, the second methodological stage starts, which is focused on the diagnosis of each organization.

For this second stage, which last about 4 weeks, will begin the application of the theoretical component studied in each subject (Methods and Times, Human Talent Management and Budget Fundamentals). Students applied several tools for the diagnosis of the companies, such as Diagrams of Activities of Processes, Diagrams of Operations of Processes, Diagrams of Routes, as well as methodology 5's. These tools made it possible to analyze the current state of the processes in each of the 19 companies, in order to establish opportunities for improvement, either from the point of view of methods and times, at the organizational or budgetary level.

Subsequently, depending on the type of improvement opportunities identified, a Pareto Diagram is applied, which allows students to prioritize those improvements that could generate a greater impact on organizations, focusing on vital components rather than trivial ones. This gives way to stage three of the methodology which, taking into account the results obtained, proceeds to the detailed analysis for the proposed improvement actions in each particular case, in order to use the theoretical component of each subject and translate it into practical solutions for businesses. For this, students had a total of 4 weeks, in order to carry out a rigorous and detailed work.

Among the main proposals for improvement stands out: a) the organization of critical jobs, based on the Principles of Movement Economy; b) improvement in processing and assembly techniques from Bimonthly Analysis; c) recommendations in terms of posture and use of tools and equipment based on principles of Ergonomics and Anthropometry; among others. From the Human Talent point of view were developed organizational components such as Mission, Vision, Strategic Objectives, Organizational Chart and manual of functions while. From the budget component wasstructured and socialized the master budget of some of the companies to their managers and/or legal representatives, so that they could implement it into the organization.

Finally, in order to ensure that these opportunities for improvement were carried out within the organization, and thus provide added value to them, during the last 3 weeks the fourth methodological stage was given way, related to the implementation of the proposals. Based on the process so far carried out, the students, advised by teachers and entrepreneurs, initiated the process of implementing the mentioned improvements, for the increase of productivity and competitiveness of enterprises, thus encouraging the transfer of knowledge from academia to the productive sector.

The previous proposals for improvement, as well as their respective implementation, were registered and formalized from the modality of Consultancies and Innovations, according to the guidelines and requirements of the Ministry of Science, Technology and Innovation of Colombia, in order to formalise the process, both by the educational

institution and by the participating companies. Finally, as final products of the integrative project, 17 consultancies and 19 innovations were performed, formally structured and supported, coming from the joint work of the academic sector and the productive sector.

Conclusions

Nowadays, knowledge transfer plays a key role in the competitiveness of organisations. The continuous improvement of its processes, both productive and organizational, enable companies to maintain high standards, positioning themself in the market. This can be achieved through work between the academic sector and the productive sector, allowing knowledge to flow and materialize into improvements by organizations, as well as the strengthening of knowledge by students and teachers.

The development of integrating projects, as well as the use of Project-Based Learning strategies, allows this process of knowledge transfer for productive improvement to take place in an appropriate way. For the present case, this was possible from the point of view of methods and times, of human talent and budgets. However, it is important to highlight the potential that this type of initiative has with other areas of knowledge, whether from Industrial Engineering, as from other academic programs.

Although the results were formalized according to the guidelines of the Ministry of Science, Technology and Innovation to test its development, it is empirical knowledge the greatest value in these processes, not only for companies, but also for higher education institutions. On the one hand, such empirical or tacit knowledge will allow to increase the organizations' productivity, as well as it will enable students to enhance the theoretical and practical component.

Finally, there is great potential in the development of this type of project, not only by Higher Education Institutions, but also by basic and secondary education. This kind of projects allow to address various areas of knowledge, in order to promote the training processes, strengthening the relationship between educational institutions and the productive sector.

Limitations

Although important work has been achieved in terms of process improvement, it is important that it has a greater scope with respect to the number of companies with which it works, in order to further boost the industrial sector of the city. Also, due to the pandemic, access to information and communication between university and business was limited, which may improve in future experiences. Finally, the use of

limited tools for process improvement is highlighted, and there are many more that can be linked to the project.

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