World class manufacturing in micro manufacturers of handmade wooden furniture industry in Puntalarga - Colombia

Manufactura de clase mundial en microempresas fabricantes de muebles artesanales de madera del sector de Puntalarga- Colombia

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Abstract

This article is divided into five chapters, namely: first, the state of the art corresponding to the progress of the department in relation to the objective set in the CONPES 3527 document (2008), which is focused on promoting world class sectors; second, the theoretical review of the subject of World Class Manufacturing, based on the 16 principles proposed by Schonberger (1996) and from other experts in the subject; third, the methodological framework, in which a questionnaire that included the 16 principles mentioned above was designed and administered in order to know the developments of the micro-enterprises of the sector of Puntalarga- Boyacá in the use of tools that make these industries into "world-class" companies; fourth, discussion and analysis of research results; and fifth, conclusions. In the methodological phase a survey was used as a technique and a Likert scale questionnaire was used as a tool administered to owners of the 16 companies included in this study. The conclusions show that there are flaws in the production and that new strategies to promote the work of these companies are required.

Keywords: *Manufacturing, production, micro-enterprises, Lean manufacturing, tools.*

Resumen

Este artículo está dividido en cinco capítulos, a saber: primero, el estado del arte correspondiente al avance del departamento en relación con el objetivo establecido en el documento CONPES 3527 (2008), que se centra en la promoción de sectores de clase mundial; Segundo, revisión teórica del tema de World Class Manufacturing, basada en los 16 principios propuestos por Schonberger (1996) y de otros expertos en la materia; En tercer lugar, un marco metodológico en el que se diseñó y administró un cuestionario que incluía los 16 principios antes mencionados para conocer los desarrollos de las microempresas del sector de Puntalarga- Boyacá en el uso de herramientas que hagan de estas industrias " Empresas de clase; Cuarto, discusión y análisis de los resultados de la investigación; Y quinto, conclusiones. En la fase metodológica se utilizó una encuesta como técnica y se utilizó un cuestionario a escala Likert como herramienta administrada a los propietarios de las 16 empresas incluidas en este estudio. Las conclusiones muestran que hay defectos en la producción y que se requieren nuevas estrategias para promover el trabajo de estas empresas.

Palabras clave: *Manufactura, producción, microempresas, Fabricación Lean, herramientas.*

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1. INTRODUCTION

World Class Manufacturing in recent years has established itself as a theoretical body that seeks the use of tools and principles in organizations aimed at improving operational strategies. Thus, the search involves the overall strengthening of productivity and therefore competitiveness from business networks with the aim of creating world-class organizations. Unfortunately, from 2009 to 2013, Colombia showed little competitiveness. In fact, instead of improving, we have remained in the same place. In 2009 Colombia was ranked 69 out of 133 countries, and in 2013 this country remained at the same position (69) among 148 countries, which means that the vision proposed four years ago to be among the three most competitive countries in Latin America was not met, as shown in the classification of the World Economic Forum (Private Competitiveness Council, 2013).

Boyacá is no stranger to this situation, as it is an agricultural department, which provides a minimum percentage of national GDP. In recent years, its industry has been strongly oriented towards the sales of national organizations and foreign economic groups, and the closure of many companies for various reasons, including the pressure by Corpoboyacá because of environmental reasons. The micro-enterprises that manufacture handmade wooden furniture in Puntalarga, municipality of Nobsa are in very similar conditions because their situation is not only compounded by the reduced production levels due to the arrival and commercialization of furniture with cheaper prices in other countries, but its production has also decreased due to lack of raw materials because of the environmental restrictions regarding the use of different kinds of wood considered native. That is, the sector is in a difficult time and needs to find lasting solutions to continuously improve its productivity and to establish operational strategies.

In Colombia, some progress in the use of world-class manufacturing tools has been partially achieved thanks to individual efforts of companies interested in the subject. However, there are no national policies that promote particular enterprises. Achievements have been obtained from the impulse of "world class sectors" defined as "Those that have a high demand in the global economy, where Colombia has the opportunity to have a growth of 10 times per sector in the short term" (Gartner, 2009).

The Government of Boyacá (2012) designed a development plan with a vision to 2020, which determines the creation of world-class sectors as one of the axes guidelines, following the CONPES documents. However, more research is needed on the issue, as these sectors are seeking competitive advantages in international markets, but they lack real strategies to get those benefits from their individual strengths and then as a group. That is, world-class sectors concept has been created, but it is still necessary to elucidate one of the major processes that industries must have, *i.e.*, the use of world-class manufacturing tools (Arsovski *et al*, 2011).

2. THEORETICAL FRAMEWORK

2.1 WCM

Richard Schonberger introduced the concept of World Class Manufacturing in the 80s in order to make visible a philosophy used by successful companies of Japan. "WCM is a philosophy that seeks both to remain in the market, and to achieve indefinite term competitive advantages for the company; a world-class company is recognized as a standard of excellence for its industry and, in some respects, by companies from other sectors" (Kallewaard *et al*., 2000 cited in Bermúdez, 2007).

Table 1. Comparison between the traditional system and WCM

Characteristic	Conventional System	WCM
Organization	Complex, functional, with boundaries between departments	Simple, customer-focused
Employees	Individuals, piecework	Workforce
Program	Centralized, forecasts	Demand-focused
Production	Push, batch	Pull, flow
Maintenance	Reactive, reaction to failures	Proactive
Quality	Detection, defect report	Prevention, zero defect
Control	Supervision, guilt	Visual, equipment, well oriented

Source: Villareal (2001).

2.1.1. Principles of World Class Manufacturing

Schonberger (1996) establishes 16 principles for organizations initially grouped in 8: General principles, design principles, operations principles, human resource principles, principles of quality improvement and the processes, principles of information for operations and control, principles of capacity and production, and marketing principles (See Annex A).

2.2. Philosophies and tools used in World Class Manufacturing

Just in Time (JIT) is a methodology whose purpose is to eliminate large amounts of activities that do not add value to a product, which means to produce the minimum number of units in the smallest possible quantities and at the last possible moment, eliminating the need for inventories. A key aspect of Just in Time is the analysis of value added, which is an important tool that helps us understand the inefficiency of traditional manufacturing process. It also helps an organization to improve its process based on activities that generate transformation, helping to eliminate sources of waste (Hay, 1997). According to Marin and Delgado (2000), successful implementation in JIT techniques such as manufacturing cells, pull information systems, production leveling, JIT procurement systems, Total Quality Management, Total Productive Maintenance, SMED systems, multifunctional workers, autonomous defect control and knowledge management, depend to a large extent on the favorable environment in the company, which can occur in both Japanese and Western companies. Studies such as those carried out by Horta, Coelho and Relvas (2016) show the positive results that a company has when applying techniques such as cross-docking in warehouses operating in the JIT environment. Similarly, Emde (2017) proposes mathematical models to understand the inherent equilibrium to the problem of the delivery frequency and the inventory in process in the supermarket system for assembly lines in automobile plants. However, there are phenomena that cannot be controlled, as Hara (2016) states, who studied the tendency of companies to have certain levels of inventories after the earthquake in Japan, finds that most companies try to keep small levels to ensure production.

Therefore, the seven elements of this Japanese approach are described below:

- *The JAT philosophy itself.*

It is a system of organization of production in which a continuous production is sought, without interruptions and in the shortest possible time. The basis of this method is based on continuous improvement (kaizen), which entails the obligation to innovate to improve productivity, involving all staff. (Garcia, & Agudo, 2011, 45).

Therefore, overproduction waste, unnecessary movements, defective articles, inventories, the waiting period, and delays in the transfer, both in the production and in the delivery of the product to the customer, must be eliminated under this method.

- *Quality at the source.*

It implies that quality must be immersed in each job, it should not be taken as a department, since, as Rojas (2017) indicates, "the objective of quality at source is that quality does not depend on the inspection of arrival. It is necessary that the company has quality assured much earlier, "(p.21).

- *Uniform factory load*

Rojas, (2017) also mentions that uniform factory load is an element of the JAT and incorporates two thoughts "cycle time: which refers to the rate of production. And the level load: it refers to the frequency of production ", (p.21). - Matching operations. These relate first to the physical organization, location, and placement of machinery in a manufacturing organization; In the second instance to the flexibility to work at different levels of production. (Rojas, 2017, p.21).

- *Minimum time of enlistment*

Rojas, 2017, conceptualizes the enlistment time as "the time it takes to move from a quality product to another quality product with a minimum reduction of 75% without costs or with low costs" (p.21). The author also emphasizes that the purpose is to reduce enlistments, not to impede them.

- *Halar system, kanban or crawling operations*

This is a method that works as a work order, using a card that contains basic information such as what is produced, in what quantities, what media it uses and how it transports it, among others. On the other hand, Méndez, Jaramillo, & García (2007) mentions that "In the Kanban system the machines do not produce until they are asked to do so, so that they do not generate unnecessary inventories that maybe in the end they are stranded and not sold, because they would be surplus production ", (p. 223).

- *JAT purchases.*

Regarding this element, Casanovas, (2011), mentions the importance of buying or "having only what is necessary, at the moment it is necessary, ...; The aim is to eliminate intermediate manipulations and reduce inventories, "(p.71).

A fundamental aspect that analyzes the Fair in Time system is the analysis of value added. This is presented as an important tool that helps to understand how inefficient the traditional manufacturing process is. On the other hand, it helps an organization to improve its process in function of those activities that generate transformation contributing to eliminate the foci of waste.

2.2.1. Lean Manufacture

According to Gonzalez (2007), many authors define Lean Manufacture as a philosophy focused on reducing waste, its concept comes from the Toyota Production System, where Lean is a set of "tools" that help the identification and the elimination or waste combination (muda), quality improvement and time and production cost reduction. Some of the best-known tools are continuous improvement (kaizen) and methods of solving problems, such as poka yokes. He also affirms that there is a second approach, which considers Lean Manufacture as "a production flow" (mura) through the system and not towards waste reduction. Several studies have implemented this philosophy not only for manufacturing but also for services, finding excellent results in terms of efficiency (Martínez,

Martínez, Cavazos and Nuño, (2016); Monge Cruz and López (2013); Cardozo, Rodríguez and Guaita (2011)).

2.2.2. 5S Theory

The 5S refers to five words in Japanese that describe a useful methodology for improving the workplace (Villaseñor and Galindo, 2007), according to Suarez (2017). "This principle is integrated by a series of common sense values that Are basic to any organization or individual, such as: organize, organize and clean the area where each one works, "(p 66).

The five S have the following meanings established by authors like Takeyuki, 1995; Melnyk et al., 1998; Suárcz Barraza, 2007 (cited by Suarez 2009, p. 67).

- **Seiri (organization-separation):** means to differentiate between necessary and unnecessary work elements of the work area to discard what is not used, taking into account that the separation of these elements allows to make use of them easily and quickly.
- **Seiton (order):** place in an ordered form all the elements (materials, equipment, parts, etc.) remaining after the first step, so that they are easy to use and practical. In this step it is necessary to locate the work elements by size, functions, colors and label the space where they will be located, reducing search time and accident risks.
- **Seiso (clean):** keep all equipment, machines and work areas that make up the general working environment clean. Keeping the work elements clean allows the correct functioning and guarantees their optimal state. In addition, it implies that the worker is constantly checking expiration dates and the conditions in which their work tools are.
- **Seiketsu (systematize):** to extend to oneself the concept of order and cleanliness, and to practice it in a continuous and systematic way the three previous steps.
- **Shitsuke (discipline):** acquire self-discipline and form the habit of committing to 5S by setting standards.

2.2.3. **Theory of Constraints**

The Theory of Constraints is the result of a detailed analysis by Edwards Deming and Eliyahu Goldratt who wanted to make a guide in order to look at the organization as a system with a network of interrelated components that work together to achieve the goal of the system. The theory is based on ten steps defined as follows: define the goal of the system, the measurement units and the operating gauges, understand the system, make the system stable, identify the restriction and apply the five steps of targeting, apply the buffer management, reduce the variability of restrictions and major processes, develop an adequate administrative structure, remove the external constraint, sell excess capacity, take the restriction into the organization whenever possible, and implement a continuous learning program.

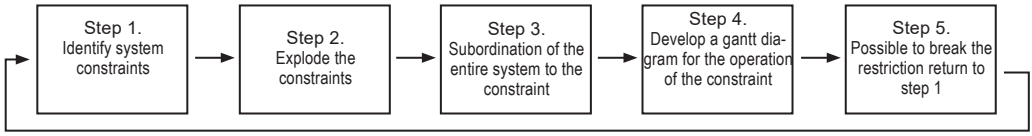
Theory of Constraints constitutes an important method to sustain an improvement based on the knowledge of the organization; it is different from many intuitive methods that are limited in the medium or long term (Deming and Goldratt, 1999).

The above-mentioned theory is conceptualized by Estellés, Barbera, Albarracín, & Dema (2010) as "a systemic methodology of management and improvement of business, based on the objective of any lucrative company, which is to earn money on a regular basis and if not, it is because its limitations do not allow it, "(p.194). In the theory of restrictions, Manotas, Manyoma, & Rivera (2006) define three main types of restrictions:

- Physical constraints: When the constraint is imposed by a machine, a material, a supplier, or in general any aspect that may be related to a tangible factor of the production process.
- Market Restrictions: When the impediment to performance is imposed by conditions external to the company on the demand side of its products or services.
- Policy Restrictions: When the company has adopted practices, procedures, incentives or forms of operation that are contrary to its produc-

tivity or lead (sometimes subtly and inadvertently) to results that are actually contrary to the desired. (p.64).

For their part, Ortiz, & Caicedo, (2014) present the steps of the theory of constraints as follows:



Source: Ortiz & Caicedo (2014). Optimum scheduling of production in a small footwear company.

Figure 1. Steps of the theory of constraints.

2.2.4. Total Productive Maintenance

The total productive maintenance (TPM) is performed by employees through activities with small teams, this type of maintenance provides a new direction for production, it is a system of equipment maintenance at the company level that can support sophisticated production facilities. The goal of TPM is zero breakdowns and zero defects of the general improvement of the company that is reflected in the equipment operation, costs reduction and inventories, and staff productivity increase (Shingo, 1990).

2.3. Studies on the subject of WCM

Villareal (2001) carried out his study in a Mexican automotive company based on three key aspects of WCM: Just in Time, Total Quality Assurance and Total Quality Participation. Cruz (2004) studied the impact caused by the use of each of the WCM tools on productivity of enterprises. For that purpose, 43 companies in the metropolitan area of Monterrey, Mexico were interviewed; they concluded that total productive maintenance tools and total quality management had the greatest impact.

Other studies have sought, for example, the implementation of specific techniques such as Lean Manufacture (Bautista et al, 2010), (Niño

and Olave, 2004), (Anzures, 2010), (Ramos, 2012), as well as the 5S methodology (Gusñay and Loja, 2013).

Arsovski *et al*. (2011) claim that a world-class company has some positive differences from other organizations. These authors also state that there is no shortcut to become a world-class company, since the essence of success is doing things the right way. Society should not make misguided efforts for these companies to become world-class category. The use of the world-class manufacturing tools is a way to achieve that goal; therefore, companies must become competent leaders without forgetting that their implementation is a matter of time.

Other authors such as Leoni (2012) have also agreed on the enormous benefits of the implementation of multidisciplinary processes of Lean Manufacture as opposed to Taylorist methods. They also state that world class manufacturing is a modern form of work organization that has high impact on productivity of organizations. The latter, in essence, keeps the same elements of the past but combined in new ways and with different amounts, which undoubtedly makes the difference compared to the results that an industry expects from its production department.

Mamat, Deros, Ab Rahman Omar and Abdullah, (2015) argue that the most used lean manufacturing practices include some aspects necessary within the organization, *e.g.*: Commitment of senior management, management of human resources, employee commitment, employee involvement and empowerment, supplier management, customer focus, training, teamwork, reward and recognition, communication and continuous improvement.

Kukla (2016) describes the results obtained from the use of WCM to improve working methods in cast iron; the results are focused on reducing costs, quality improvement from the elimination of waste and hazardous activities for workers.

2.4. Advances for Colombia

Some partial achievements have been reached in Colombia regarding the use of world-class manufacturing tools, thanks to the individual efforts of companies interested in the subject. However, it is necessary to create national policies that promote particular firms. Achievements have been reached because of "world class sectors".

2.5. Advances for Boyacá

According to the Ministry of Commerce, Industry and Tourism (2013), in the classification of competitiveness, Boyacá ranked 9th in 29 departments, 10th in 21 departments studied by Doing Business and 8th in 22 departments. In 2011, Boyacá had a contribution to the national GDP of 2.69% in which the manufacturing industry contributed 12.2%; in contrast, regarding exports, cokes represent 45.7%, natural gemstones 36.3% and the rest of the exports are divided into other types of industrial, mining and agricultural products to generate a total of US $ 389.3 million in exports.

3. METHODOLOGY

In this chapter, the following aspects are explained: population and sample, reliability test (Cronbach's Alpha), definition of variables, techniques and tools, technical data of the study and the methodological process diagram.

3.1. Population/Sample

In Puntalarga-Boyacá, there are currently industries dedicated to the manufacturing of wooden furniture; 16 of those producers participated in this research project; therefore, that is the number of companies that make up the sample of this study. These micro-enterprises are managed with a more empirical approach in the production area and, in general, in all their management processes.

3.2. Reliability Test

The instrument reliability was measured by Cronbach's Alpha, the closer the value to 1, the greater the internal consistency of the items that make up the instrument.

Table 2. Cronbach's alpha statistic

Reliability Statistics	
Cronbach's Alpha	N of Items
.952	70

Compiled by the author from calculations with SPSS

3.3. Definition of variables

The variables used in the instrument are classified according to the 16 principles of Schonberger (1996). Each of these principles is broken down into different items for a total of 70 statements that constitute the measuring instrument.

3.4. Techniques and instruments

Two techniques were used, the first one was a survey and the instrument used was a questionnaire which was based on assertions and had a Likert scale, it was administered to business owners involved in the study; for quantifying responses, the SPSS package (Statiscal Product and Services Solutions v21) and an Excel tool were used.

3.5. General description of the study

The technical specifications of the study are presented as a complement. Table 3

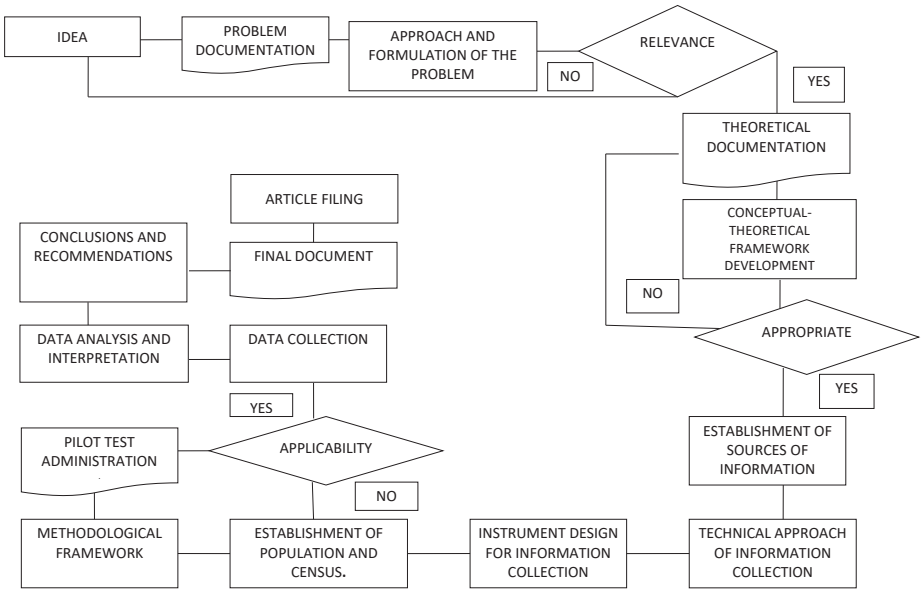
Table 3. Technical details of the study

Data sheet	
Poll completion date	**January - December 2015**
Institution	Pedagogical and Technological University of Colombia - Tunja
School	Business Administration
Department	Boyacá
Town/City	Microenterprise of the industrial sector
Population size	16 companies
Collection technique	Census
Processing system	SPSS ™ (v. 20)
Methodology	Written questionnaire (Schonberger, 1996)
Unit of analysis	Microenterprise owners
Director of the study	Project researchers
Pilot test	A total of 4 surveys were administered

Source: Authors.

3.6. Process diagram - methodology proposal

This is the process diagram of the methodology proposal of this research; the most important phases of the process are included (Quivy & Campendhoudt, 2005). (Figure 1)



Source: Authors.

Figure 1. Methodological process diagram.

4. RESULTS

The evaluation criteria, weighting and numerical score scale ranging from low, medium low, medium, medium high and high was used for the descriptive analysis.

Table 4. Weighting, numerical rating and evaluation criteria

Low	Medium low	Medium	Medium high	High
Warning	**Deficient**	**Acceptable**	**Good**	**Excellent**
1	2	3	4	5
1-0	(1.1-2)	(2.1-3)	(3.1-4)	(4.1-5)

Source: Authors

4.1. Result of the analysis:

Table 5 shows the principles of WCM proposed by Schonberger (1996), along with the number of items of each principle used in the instrument, the average obtained according to the established scale, and the standard deviation of the data.

Table 5. Results of the study

Principles	N of Items	Average	Standard deviation
Principle 1: Teaming up with customers; organized by families of customers or products (what customers buy / use).	6	3.451	1.232
Principle 2: Capturing and requesting competitive information and the best practical application related to the customer.	5	3.025	
Principle 3: Engaging in continuous and expeditious improvement in quality, response time, flexibility and value.	5	3.237	1.24
Principle 4: Determining the employees of the frontlines committed to change and strategic planning in order to achieve the unifying purpose.	4	3.749	0.808
Principle 5: Reducing to the best components, operations and suppliers.	4	3.578	0.918
Principle 6: Reducing the flow time, distance, and startup and change times along the customer chain.	3	3.499	1.251
Principle 7: Operating closely with the rate of use or customer demand.	5	3.125	1.399
Principle 8: Expanding continuously human resources through cross training, job rotation and career and improvements in quality, safety and security.	4	3.812	1.139

Continúa...

Principles	N of Items	Average	Standard deviation
Principle 9: Expanding the range of rewards, recognition, compensation and celebration, in order to equip the wide variety of employee contributions.	3	3.041	0.993
Principle 10: Reducing continuously variations and setbacks.	5	3.578	0.783
Principle 11: Establishing teams in the front line that record and have information about processes in the workplace.	4	2.856	0.793
Principle 12: Controlling the root causes of cost and performance, reducing transactions and reports; simplifying external communications.	6	3.425	1.004
Principle 13: Aligning performance measures with universal desires of customers; quality, speed, flexibility and value (QSFV).	4	2.499	1.211
Principle 14: Improving the team and human work before considering new equipment and automation.	3	2.708	1.335
Principle 15: Ensuring that equipment and working facilities be simple, flexible, mobile, inexpensive and readily available, one for each family of products or customers.	5	3.1375	1.312
Principle 16: Promoting, marketing and selling the growing capacity and competence of the organization, each improving the results of the other fifteen principles.	4	2.651	1.059

Source: Authors.

Most of the principles have an average between 3 and 4, a rating of Good. However, those averages are undesirable as to the measurement of these principles. Three of the principles had averages below 3, indicating that it is necessary to consider the items that constitute it.

4.2. **Factorial Analysis**

The commonalities indicating the variance between variables or principles were determined through factorial analysis, dependence and correlation are observed, *i.e.*, the coefficient to measure the degree of relationship between variables (with values between 0.1 and 0.5 the ratio is considered weak, between 0.6 and 0.8 the ratio is medium, between 0.8 and 1 the relationship is strong), and an extraction process for determining the most important variables when selecting the proposal to improve the sector was done. This allows data to be reduced and the main components to be determined.

Table 6 shows that the commonalities are high, *i.e.,* greater than 0.8 except for principles 3 and 6, the other principles are well explained from extracted components. This shows the close relationship between the component and principle 11; especially, with inventory management of the company and the creation of production plans. Principle 16 that promotes the improvement and increased competitiveness of the company and principle 7 on production based on demand have a close relationship with the component.

Table 6. Table commonalities

	Initial	Extraction
Principle 1	1.000	.857
Principle 2	1.000	.801
Principle 3	1.000	.779
Principle 4	1.000	.882
Principle 5	1.000	.802
Principle 6	1.000	.746
Principle 7	1.000	.933
Principle 8	1.000	.807
Principle 9	1.000	.931
Principle10	1.000	.888
Principle11	1.000	.956
Principle12	1.000	.864
Principle13	1.000	.887
Principle14	1.000	.833
Principle15	1.000	.885
Principle16	1.000	.937

Source: Authors.

Table 7 shows that out of all the principles discussed, components 1, 2, 3 and 4 referred to principles 1, 2, 3 and 4 explain the phenomenon in 86.183%.

Table 7. Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.545	59.659	59.659	9.545	59.659	59.659
2	1.840	11.501	71.160	1.840	11.501	71.160
3	1.355	8.469	79.629	1.355	8.469	79.629
4	1.049	6.553	86.183	1.049	6.553	86.183
5	.729	4.554	90.737			
6	.640	4.000	94.737			
7	.328	2.048	96.785			
8	.244	1.522	98.307			
9	.159	.993	99.300			
10	.112	.700	100.000			
11	3.183E-016	1.989E-015	100.000			
12	2.353E-016	1.471E-015	100.000			
13	9.217E-017	5.760E-016	100.000			
14	-2.539E-017	-1.587E-016	100.000			
15	-3.792E-016	-2.370E-015	100.000			
16	-8.538E-016	-5.336E-015	100.000			

Source: Author.

5. CONCLUSIONS OF THE ANALYSIS OF THE PRINCIPLES

1. Entrepreneurs say that there is high customer participation in product design. Since they are handcrafted furniture, in many cases, they are designed as specified by the final consumer. However, there is a constant weakness due to the lack of production engineering and methods and times systems.

2. The lack of studies to determine customer needs, as well as the need for satisfaction surveys and suggestion boxes to know customer feedback are recognized. This is a recurring weakness in different companies, showing the need to approach consumers in order to meet their wishes and needs.

3. The companies of the study show some quality management activities; setup time reduction is not a great concern and operators do not always understand the added value of the products at each stage of the process. In general, more actions for continuous improvement in terms of quality and flexibility are needed.

4. There is a good perception towards innovation; this is partly due to the dynamics of this industry and to the fact that these companies produce handmade and custom-tailored products, which gives them the opportunity to create a variety of unique designs. Unfortunately, the level of empowerment of workers is low and although they have a shared philosophy, the existence of a strategic platform to guide the actions of the companies is not displayed.

5. The improvement of the production process lacks dynamism in terms of reducing and simplifying operations tasks. The reduction of suppliers in this sector of the economy is a little more complex since state restrictions on wood (raw material) make enterprises buy depending on the purchase opportunity, *i.e.,* suppliers' reduction is not as easy as in other industries.

6. Entrepreneurs claim that they partially check productivity by periods and measure the efficiency of the overall process. However, they should improve machinery and equipment setup to increase the overall productivity of each company.

7. In general, the products are manufactured in order of arrival. The companies have a certain amount of raw material in their inventory as safety stock. In addition, all customers are treated equally.

8. The companies do not have an occupational health program and few of them offer training about it. The use of skilled labor and the fact the workers can perform in various jobs are considered strengths.

9. It is necessary to create more incentives and recognition for workers, different from the basic remuneration, and to create mechanisms to listen to the worker with respect to situations that occur in the company and in the production area. This is reinforced by the conclusion generated from the low levels of empowerment given to them.

10. Entrepreneurs claim to know the costs of the process; similarly, they say that they have performed activities to reduce process variability. However, there are weaknesses related to the lack of use of methodologies of continuous improvement and the pursuit of production time reduction.

11. The fact that companies do not have production plans, controls or records in the workplace, detailed control of machinery and equipment maintenance or inventories control is considered a weakness. In addition, there is not measurement from indicators of quality, flexibility and value.

12. Entrepreneurs claim to have carried out actions aimed at reducing the amount of raw material and production time.

6. CONCLUSIONS AND RECOMMENDATIONS

In Boyacá, and especially in wood furniture manufacturing industries, there are major deficiencies in the use of different tools to help increase their productivity indices (Cruz, 2004). There are only minor actions regarding quality management and there is need for knowledge of many other tools. On the other hand, the environmental restrictions limit

them to reach production levels of previous years, it is necessary to generate fundamental innovation processes in this type of manufacturing.

WCM principles proposed by Schonberger (1996), apply only partially in some respects. Greater assistance from the state is needed for entrepreneurs to use it as part of their continuous improvement. It is known that in Boyacá some companies have begun to implement techniques such as 5S, autonomous maintenance and greater control of inventories. However, these are unknown techniques and tools that any manufacturing company could use at low costs, as stated by Marín And Delgado (2000) when they talk about changes in the philosophy of production for the whole company.

There is a clear need for further research to integrate theoretical and practical aspects of world-class manufacturing due to the common belief that only large companies can access these acknowledgements for the implementation of those aspects. Thus, the fact that they are universal principles with application in any company regardless of its size and specific characteristics is neglected. Therefore, any attempt to know their status is valuable and generates methodologies of general application.

Departmental and municipal governments should direct their attention to this type of analysis that guides them on specific aspects of the sectors for them to base their actions and create programs for competitiveness of organizations. As Monge *et al*. (2013) and Hara (2016) claim, studying different models of production improvement leads to knowing and affecting other aspects such as financial, employee satisfaction, sustainability of the company and environmental impact. The model also shows that the studied factors affect financial performance, employee satisfaction, sustainability culture and environmental impact on discrete manufacturing plants in Mexico.

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