ALTERNATIVE TOOLS TO MASS PRODUCTION AND HUMAN PERFORMANCE INDICATORS IN SHELTERED WORK CENTERS OF VALENCIAN COMMUNITY (SPAIN)

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Abstract

The most popular alternative systems to mass production at an academic level (lean manufacturing, agile manufacturing, flexible customization, mass customization...) share many characteristics. Our article identifies an extensive set of alternative practices to mass production; analyzes the classification of practices in categories (Flow, TQM, TPM, Customer Relations, Supplier Relations and Human Resources Practices) and analyze the impact on several human performance indicators such as satisfaction, absenteeism, voluntary turnover, permanent contracts, knowledge, personal& social adjustment activities and Workers who become integrated into ordinary companies

Keywords: Lean production; High Involvement Work Practices; Sheltered Work Centers

1. Introduction

The number of scientific publications related to mass production alternative systems in the last 20 years is abundant. The most popular alternative system proposal in the academic world is lean manufacturing, although other ways to refer to the production systems that share many characteristics with lean manufacturing cannot be left aside. For example, agile manufacturing (Agarwal, Shankar, & Tiwari, 2006; Vazquez-Bustelo & Avella, 2006), flexible customization (Narain, Yadav, & Antony, 2004; Agarwal, Shankar, & Tiwari, 2006), mass customization (Ismail, Reid, Mooney, Poolton, & Arokiam, 2007; Brown & Bessant, 2003), etc.

Our research is enclosed within the line different authors are working at international level (Holweg, 2007; Shah & Ward, 2007; Portioli Staudacher & Tantardini, 2007) and cast up from the recent adaptations to create and to validate questionnaires of operation management practices in Spanish (Martín Peña & Díaz Garrido, 2007; Tari, Molina, & Castejón, 2007; Urgal González, Diz Comesaña, & García Vázquez, 2007; Vazquez-Bustelo & Avella, 2006; Marin-Garcia & Carneiro, 2010). We extend previous researches in various aspects. First, we confirm that, in practice, the tools defined in production models alternative to mass production are basically the same, thus defining the set of tools important to use in a company. In the second place, a broad questionnaire representing a sufficient number of items and constructs related to the alternative tools to mass production is created. Moreover, we test the relationship between human key performance indicators (KPIs) and the operations tools in a sample other than the usual one (automotive, electronics, machinery, etc.).

People with disabilities are a social problem of increasing importance in Spanish society and, in particular, should reflect on their effective participation in the labor market. In recent years various strategies have been articulated in order to facilitate job in this sector of the population. This article discusses the Special Employment Centres (hereafter CEE), because it is the formula that has gotten more significantly alleviate the high unemployment figures in this segment of the population. An CEE is a company with at least 70% of employees with disabilities to perform productive work on an equal footing with the ordinary company. The business environment is increasingly competitive, necessary to develop and implement the best practices for working with employees, equipment and materials in the CEE.

To address the effect of lean production practices on the results, some authors use financial indicators (Molina, Llorens-Montes, & Ruiz-Moreno, 2007). However, most authors suggest analyzing the non-financial indicators, such as competitive advantage, because they reflect more clearly the direct impact of operations management practices and are less influenced by the crisis or deterioration of the variables socio-economic area outside the corporate action (Diaz, Gil, & Machuca, 2005; Fullerton & McWatters, 2001).

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The research presented in this paper reviews and summarizes the literature that investigates the relationship between individual practices of lean manufacturing with non-financial performance of the company, determines the extent to which Spanish Special Employment Centers have implemented lean manufacturing practices and the effect it produces in the non-financial performance of the company. We believe that our research is interesting because it describes the situation of a sector (Special Employment Centers) and one country (Spain) only investigated in the scientific literature on lean manufacturing. In addition, we will further analyze the effects that the implementation of lean manufacturing tools in companies of different sectors of the automobile.

2. Alternative tools for mass production

Several authors consider that the expressions lean manufacturing, flexible, agile or mass customization represent different approaches to the productive system (Krishnamurthy & & Yauch, 2007; Da Silveira, Borenstein, & Fogliatto, 2001). Some opinions are based on the fact that a company using lean manufacturing can be considered to be a mass production company that has eliminated wastes whereas a flexible company is different because it has the capacity to better adjust to the environment but not so fast as an agile company (Duguay, Landry, & Pasin, 1997). On the other hand, the concept of agile manufacture is considered to be based on flexible manufacturing, lean manufacturing and Time based competition (Vazquez-Bustelo & Avella, 2006). For this reason, the authors claim that agile manufacturing combines the efficiency of lean manufacturing with the operative flexibility of flexible manufacturing, offering personalized solutions with similar costs to mass production. After that, we provide a very brief review on each of these systems and verify whether they are really so different to each other with regards to the practices that they start up.

Lean manufacturing is dealt in the literature as a set of tools as its main objective eliminating the waste (time, space, personnel, material, rework, stocks, etc.) (Shah & Ward, 2007). The list of lean manufacturing tools is large and not always homogenous, although they can be classified in five categories, namely total quality management (TQM), just-in-time (JIT), total preventive maintenance (TPM), supplier relationship, and product and process development (Swink, Narasimhan, & Kim, 2005; Bonavía Martín & Marin-Garcia, 2006; Gurumurthy & Kodali, 2008; Carrasqueira & Machado, 2008). Some authors include as a sixth element the continuous improvement culture and the worker involvement. But others consider that this element is necessary but independent of the specific practices of lean manufacturing (Ahmad, Schroeder, & Sinha, 2003; Sakakibara, Flynn, Schroeder, & Morris, 1997).

Flexible manufacturing is defined as the ability of a company to adapt to the demand fluctuations and the other changes in its environment (Duguay, Landry, & Pasin, 1997). But it is also understood as the capacity to produce diverse products under the same production chain, establishing an wide product range, admitting production volume modifications and multiple processes (Krishnamurthy & & Yauch, 2007). Flexible systems are focused, primordially, on production technology, including automated material handling systems and machinery (Krishnamurthy & & Yauch, 2007). The main objective of flexible manufacturing is to do the necessary changes to adapt to the new market requirements, to improve quality, costs, manufacturing times and delivery, simultaneously (Duguay, Landry, & Pasin, 1997). In order to ensure these objectives, it is necessary to maintain a closer relationship with customers and suppliers, use advanced manufacturing technologies, have an organizational structure with less levels and use innovative human resources policies (Duguay, Landry, & Pasin, 1997).

Most authors define agility as the ability to attend the customer's needs in the minor time possible and at low cost (Vazquez-Bustelo & Avella, 2006; Brown & Bessant, 2003). It has been suggested that agile manufacturing groups up diverse techniques, among them just in time, cell manufacturing, flexible manufacturing and total quality management. All techniques are used with the objective to improve quality, productivity and customer service (Monplasir, 2002). Some authors claim that there exists a clear dividing line between lean manufacturing and agile manufacturing systems (Vazquez-Bustelo & Avella, 2006; Avella & Vazquez-Bustelo, 2005). In principle, agile manufacture is an integration of both flexible manufacturing and lean manufacturing concepts (Vazquez-Bustelo & Avella, 2006).

Mass customization is a strategy related to the ability to offer customized products or services by means of flexible processes with high volumes and at a low cost (Krishnamurthy & & Yauch, 2007). The main objective of mass customization is to attend the customer specific necessities (Ahlstrom & Westbrook, 1999). This is obtained by means of four customization profiles (Brown & Bessant, 2003), which include designers who work together with their customers, products standard which the customer can change during use, a standard product set which is unique for each customer; and products which are modified according to specific individual needs. Mass customization uses some elements of lean manufacturing (product development, supplier chain management, production management, continuous improvement), which includes the after-sales service and marketing (Da Silveira, Borenstein, & Fogliatto, 2001).

Reviewing the information commented in the previous paragraphs, it seems possible that the principles or underlying philosophies of each of the systems are different. Nevertheless, if we pay attention only to the practices that are put into practice (see table 1), we can see that they are mainly very similar. As table 1 shows,

the set of alternative practices to mass production can be classified in around 6 constructs and 16 dimensions with good references in the academic literature

Table 1: Production systems and set of related practices included in previous research

Construct	Dimensions	Lean manufacturing
Total Quality Management	Visual Management	(Doolen & Hacker, 2005; Shah & Ward, 2007; Marin-Garcia, Pardo del Val, & Bonavía Martín, 2006; Gurumurthy & Kodali, 2008)
	Continuous Improvement	
	Process control	
One piece flow	JIT/ Kanban	(Shah & Ward, 2007; Kannan & Tan, 2005; Doolen & Hacker, 2005; Gurumurthy & Kodali, 2008; Marin-Garcia, Pardo del Val, & Bonavía Martín, 2006; Treville & Antonakis, 2006; Carrasqueira & Machado, 2008)
	Process Standardization	
	SMED	
	Line Balancing	
	Continuous flow and Cell manufacturing	
Maintenance	Maintenance	(Shah & Ward, 2007; Doolen & Hacker, 2005; Gurumurthy & Kodali, 2008; Marin-Garcia, Pardo del Val, & Bonavía Martín, 2006)
Supplier relationship	Supplier relationship	(Shah & Ward, 2007; Doolen & Hacker, 2005; Kannan & Tan, 2005; Gurumurthy & Kodali, 2008; Carrasqueira & Machado, 2008)
Customer relationship	Customer relationship	(Shah & Ward, 2007; Doolen & Hacker, 2005; Gurumurthy & Kodali, 2008; Carrasqueira & Machado, 2008)
Human Resources Management	Empowerment	(Perello-Marin, 2010; Marin-Garcia & Conci, 2011; Gibson, Porath, Benson, & Lawler III, 2007; Guerrero & Barraud-Didier, 2004; Katou, 2008)
	Trainign	
	Team-work	
	Rewards	
	Communication	

Most articles published on the effect of lean production on non-financial performance of the company, have taken joint lean manufacturing practices (constructs) and analyzed their relationship on performance indicators independently (Cua, McKone, & Schroeder, 2001; Flynn & Sakakibara, 1995; Ketokivi & Schroeder, 2004; McKone, Schroeder, & Cua, 2001). However, there is very little research on the effects of alternative practices to mass production on human performance indicators.

3. Methodology

The population subject to this study is composed by Sheltered Work Centers for the disabled in Spain (646). After a first telephone contact with the company, an electronic mail address from a person with a responsible job in that same company (Manager, Person in charge of Production, Person in charge of Quality, etc.) was requested so that we could send the link to the questionnaire which was to be completed on the Web site. If a questionnaire was not completed, up to three electronic mails were sent before the questionnaire was considered to be unanswered. A total of 237 answers were received. Only128 of them had all the complete data (19.81% rate of answer), which was the information used in the research. We use Regression analysis in order to probe relations between explicative and criterion variables.

4. Results and discussion

Table 2 summarises the descriptive statistics of the items forming the factors included in the research. The degree of use of alternative practices to mass production vastly varies amongst the companies included in the survey. Thus, while practices such as customer relationship or human resources management are quite frequent, practices as the use of one piece flow or maintenance are almost non-existent. In general, the factors of customer relationship, continuous improvement, standardization of processes, cell manufacturing and supplier relationship are the most widely implemented in the surveyed companies. In the opposite end, practices like JIT/Kanban, single minute Exchange of die, automatization and proprietary equipment, design integrated with manufacturing and knowledge management virtually do not appear in the survey. The rest of the factors are shown as being moderately introduced. Human resource KPIs (competitive advantage against ordinary firms) are rated medium to high, but the percentage of workers who become integrated into ordinary companies is extremely low.

Table 2. Descriptive Statistics of variables.

	N	Min	Max	Mean	Std. Dev.
Customer relationship	128	0	5,00	3,0684	1,29143
Supplier relationship	128	0	5,00	2,3117	1,04419
One piece flow	128	0	5,00	1,6800	1,05850
Total Quality Management	128	0	4,82	2,4467	1,01247
Human Resources Management	128	0	4,58	2,7697	0,87118
Maintenance	128	0	5,00	2,1354	1,54557
Job satisfaction	113	3	5	3,62	0,623
Permanent contracts	112	2	5	3,91	0,787
Knowledge	112	1	5	3,15	0,782
Workers who become integrated into ordinary companies	37	1	4	1,86	0,910
Personal& social adjustment activities	38	1	5	3,63	1,057
Less absenteeism	83	1,00	5,00	3,1566	,89008
Less Voluntary turnover	83	2,00	5,00	3,9036	,80569

Analyzing the results of multivariate regressions (table 3), we see that the main effects are generated by close relationships with customers and management of human resources. The first one generates demand stability and continuity of sheltered work centers. Because this more satisfaction, a more stable contracts, the ability to perform more activities of personal and social adjustment, and less intentions to withdraw from the company is achieved. The second is a tool that clearly affects the job satisfaction and training of employees. However, the explanatory power of the variables used is quite low (between 4% and 27%). These figures, although still common in research in the area, suggest us that human KPIs are mainly affected by a different variance sources than operations management tools. At least this is the conclusion we can draw for companies in this industry that participated in the sample.

Moreover, it is noteworthy that none of the variables has been able to significantly affect the integration of disabled staff in ordinary companies. It is also awaiting further analysis that the use of preventative or autonomous maintenance is related to less absenteeism in companies.

Table 3. Relationship between human KPIs and alternative tools to mass production (regression standardized Beta)

Human KPI→	Job satisfaction	Permanent contracts	Knowledge	integrated into ordinary companies	Personal& social adjustment	Less absenteeism	Less Voluntary turnover
Customer relationship	**1,812+**	**0,249****	0,068	0,031	**0,408****	0,019	**0,219+**
Supplier relationship	0,266	**-0,247****	-0,126	-0,142	-0,151	-0,066	-0,147
One piece flow	-1,212	0,056	0,031	-0,252	-0,026	-0,107	0,0212
Total Quality Management	-0,807	-0,240	-0,064	0,086	0,246	-0,029	-0,226
Human Resources Management	**2,494****	0,178	**0,298****	0,316	0,063	-0,032	0,008
Maintenance	-0,371	,050	0,082	-0,011	0,051	**0,271+**	0,064
R^2	0,099	0,090	0.094	0,163	0,273	0,042	0,082

5. Conclusions

Lean manufacturing practices can be divided into six constructs with several dimensions. The results of our research allow us to identify four constructs with significant effects on the human KPIs. It would be desirable to extend this research to analyze in detail the particular effect of each of the sixteen dimensions of the human KPIs

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