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HOW FAR FROM JUST-IN-TIME ARE PORTUGUESE FIRMS? A SURVEY OF ITS PROGRESS AND PERCEPTION.

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Abstract

As competition increases, Just-in-Time (JIT) manufacturing becomes an important issue in Portuguese industry. After a brief review of its history, elements, advantages and limitations, this paper presents the results of a postal questionnaire survey about JIT system sent to a sample of manufacturing firms in Portugal, with the aim of determining the degree of development, perception and status of JIT production in Portuguese industries. The findings suggest that the surveyed firms have a basic JIT perspective: a tool to reduce inventories, to increase quality and to eliminate waste. Despite the good perception of the JIT concept, less than 6% of the firms surveyed have the necessary conditions to successfully implement a JIT system.

JEL Code: L60, M11

Key words: just-in-time, Portuguese industries, manufacturing

1. INTRODUCTION

As regional and global competition increases, Just-in-Time (JIT) manufacturing becomes an important issue in all industries. In a turbulent, competitive environment many manufacturing firms have been looking for new production systems to help improve their operations. JIT is one of those systems driving enterprises to improve their performance. In spite of the Japanese/American success with JIT, its implementation in Portugal is quite recent.

This study has two principal objectives: first, it investigates how far the JIT system is implemented all over the world and the benefits received from its adoption; second, it explores the strategic significance of JIT in Portuguese industry, researching how far and effective it is being implemented. Broadly speaking, this paper presents a study of JIT practices in Portugal. Similar studies have been conducted elsewhere, from Italy to Korea, Singapore, Australia, Mexico, Egypt, Spain, Germany, Sweden, China, USA and UK to Hong Kong. These studies are briefly presented in Section 2.

As we will see, most of the literature is focused on JIT implementation in firms in developed countries like the United States, United Kingdom, Japan, Australia, and Canada. Ebrahimpour and Schonberger (1984) were the first to discuss the applicability of JIT in developing countries. They argued that developing countries desperately need to improve the quality and productivity of their goods to survive and to reduce the gap with developed countries. Just-in-time system would help solve many of the problems those companies face. Its basic simplicity and resource saving makes it particularly well suited for use in these countries. There have, however, been very few pieces of research that have studied the utilization of JIT in developing countries compared with the developed ones.

This paper presents the first comprehensive study of JIT practices in Portugal. The objectives of this questionnaire survey study include examining the firms' implementation experiences (those production sectors that have the basic characteristics for its accomplishment), the firms' perception about JIT and the status of implementation. We would like to know if when a firm says it is using JIT system, it does have practices that are consistent with that claim (like, continuous quality improvement, training and flexible employees, setup time reduction, supplier partnership, etc.).

The current study contributes to a very limited number of empirical studies of JIT implementation in developing countries in general and in Portugal in particular. Therefore, an important contribution of this paper is that it adds to the empirical database of actual JIT

practices. Another contribution is that it explores the strategic significance of JIT in Portuguese industry. A practical contribution of this research is pointing out the common obstacles for JIT application in Portugal so that Portuguese firms that want to implement it, can be prepared for those crucial points.

The paper starts, in Section 2, with a brief JIT review: the history, elements, advantages and limitations, and a synopsis of the empirical studies of JIT practice in several countries. A description of the research methodology (sample, method, questionnaire, etc) follows in Section 3. This description includes discussion of the instruments used to measure the JIT practices in the plants surveyed. Section 4 contains the analysis of the results of the survey using descriptive statistics and multivariate analysis. Finally, a summary of the results, some conclusions and recommendations for practitioners considering the use of JIT in Portugal are presented in Section 5.

2. JIT REVIEW

The JIT system was developed in Japan in the 1950's, and twenty years later began to be implemented in other countries. Its major objective is to eliminate waste — to have the production cycle completed without breaks and waste. Along with this objective are quality improvement and the timeliness of production and delivery of products.

2.1. Definition

There are many different definitions of JIT, from the early definition of Schonberger (1982a), who says JIT is a system of synchronizing the delivery of parts to their desired location at the right time, to a philosophy of improvement [Vokurka and Davis (1996)]. In a broad sense, JIT is a manufacturing philosophy that attempts to produce with the shortest possible lead-time, the lowest possible level of inventory and the fewest possible waste. JIT is a system that emphasizes achieving excellence through the principles of continuous improvement and waste reduction. Nowadays it is used not only in manufacturing, but also in engineering, purchasing, accounting and data processing.

2.2 Implementation conditions

There are, however, some conditions to implement the JIT system with success, such as a uniform production rate (to ensure schedule stability), a *pull* control system, small lot sizes, quick and economic setups, high quality levels, preventive maintenance, supplier long-range relationships, etc. These conditions are called the JIT elements and are presented by several authors, among which are Groenevelt (1993), Gargeya and Thompson (1994), Zhu et al. (1994), Spencer and Guide (1995) and Ramarapu et al. (1995).

Golhar and Stamm (1991) conducted an extensive review of the JIT literature and identified four basic principles of the JIT management philosophy: i) the elimination of waste, ii) the employee involvement, iii) supplier long-range relationships, and iv) total quality control. These principles provided the foundation for the survey research design, as we will see in Section 3.

2.3. Implementation benefits

Some of the benefits include higher quality, lower inventory levels, improved throughput times and shortened customer response times (Schonberger (1982b)). Inman and Mehra (1993) point out three main advantages: lower costs, better quality and higher competitive advantage. But the most consistent benefit from JIT adoption found in the empirical studies is a reduction in the inventory levels and/or an increase in inventory rotation [Billesbach (1991), Billesbach and Hayen (1994), Balakrishnan et al. (1996), Droge and Germain (1998), Toni and Nassimbeni (2000), Cua et al. (2001), Fullerton and McWatters (2001), Kaynak and Pagán (2003), Kannan and Tan (2005)].

2.4. Limitations and possible problems

There are, however, some limitations and problems. In spite of the benefits, JIT requires several adjustments in support activities (accounting system, personnel evaluation, worker and management incentive systems, etc.), both within and outside the firm, which, in some cases, require substantial investments. Use of JIT production systems can be problematic. Most companies introduce JIT into an existing plant trying to have the minimal interference on production and achieving a smooth changeover requires careful planning and prioritization of the JIT techniques to be implemented. Various implementation schemes have been

presented in the literature underlying the importance of a phased achievement [Lee and Ebrahimpour (1984), Safayani et al. (1991), Stalk and Webber (1993), Tucker and Davis (1993)].

According to Zipkin (1991), the highest risk is to reduce inventories too fast. The suppliers and the workers are under pressure because, if delays occur, all the system is in danger. Several other authors have studied the JIT limitations and impact on organization aspects [Kim and Lee (1989), Klein (1989), Groebner and Merz (1994), Chhikara and Weiss (1995), Mullarkey et al. (1995)]. More recently, Polito and Watson (2006) present the five major constraints regarding JIT philosophy toward future use. They are: economic conditions, logistics, organizational culture, finance practices and small supplier difficulties.

Pragman (1996) talks about a JIT II system, which is based on a strategic alliance between suppliers and customers with the aim of reducing lead-times and becoming more competitive. This new system evolves naturally from the traditional JIT and is also due to the recession that affected all firms in the 90's.

More recently Currie (1999) presents the JIT as a system that has considerable overlaps (scope, style, content, aim and objectives) with other emerging concepts, like Total Quality Management (TQM), Activity Based Costing (ABC), Business Process Re-engineering (BPR) or Process Innovation (PI). Kannan and Tan (2005) empirically examine the extent to which just in time, supply chain management, and quality management are correlated, and how they impact business performance.

2.5. Implementation rates

Since the 1970's, twenty years after its utilization in Japan, JIT has been implemented in many firms all over the world. There are several empirical studies about JIT implementation, summarized in Table 1. Almost half of these are surveys about JIT employment in the United States. Some of them provide empirical evidence, comparing other management control systems as they relate to JIT in the US and Japan. The United Kingdom is another country that has several studies.

Other studies have being reported about West Germany JIT implementation conditions, about the Hong Kong electronics industry, its use and application in Australia, Italy, Korea, Spain, Canada, Mexico, Sweden, Singapore, Ghana, Egypt and in China.

Table 1. Existing studies relating to JIT implementation in several countries

Country	References
United States	Schonberger (1982c); Plenert (1985); Susaki (1985); Celley et al. (1986); Crawford et al. (1988); Im (1989); Im and Lee (1989); Gilbert (1990); Ahmed et al. (1991); Billesbach (1991); Billesbach et al. (1991); Freeland (1991); Young (1992); White (1993); Huson and Nanda (1995); Cook and Rogowski (1996); White et al. (1999); Fullerton and McWatters (2001); Kaynak and Pagán (2003)
US and Japan	Womack et al. (1990); Cusumano and Takeishi (1991); Daniel and Reitsperger (1991); Nakamura et al. (1998); Aghazadeh (2003)
United Kingdom	White (1983); Voss (1984); Voss and Robinson (1987); Thomas and Oliver (1991); Mould and King (1995); Oliver et al. (1996)
Canada	Handfield (1993); Deshpande and Golhar (1995)
Australia	Buxey and Petzall (1991); Clarke and Mia (1993)
Mexico	Lawrence and Lewis (1993); Lawrence and Hottenstein (1995)
Singapore	Hum and Ng (1995); Min and Pheng (2005)
West Germany	Wildemann (1988)
Hong Kong	Cheng (1988)
Italy	Bartezzaghi et al. (1992)
Korea	Lee (1992)
Spain	Zantinga (1993)
Sweden	Engstrom et al. (1996)
Ghana	Gyampah and Gargeya (2001)
Egypt	Salaheldin (2005)
China	Pheng and Min (2005)

As we can see, most of the literature is focused on JIT achievement in firms in developed countries like the United States, United Kingdom, Japan, Australia, and Canada. Compared with the developed ones, there have been very few pieces of research that have studied the application of JIT in developing or less-developed countries.

Given this background of apparent just-in-time production system superiority and a high enthusiasm on the part of firms all over the world, to what extent is this system being adopted by Portuguese firms? How *lean* are Portuguese plants? What are the obstacles to performance improvements in Portugal? These are the main questions this paper seeks to explore. The methods that generated the data to answer these questions are described in the following section.

3. RESEARCH METHODOLOGY

The method used for data gathering was a survey questionnaire. The subset of data obtained was used to explore the research questions. This research instrument has been well validated and used by several researchers in various forms in global manufacturing planning and manufacturing control (for example, Handfield and Withers (1993)).

3.1. Sample firms

JIT was first introduced in Japan by the Toyota Motor Company and then followed by many automobile and electronic manufacturers. Traditionally JIT can only be implemented in repetitive manufacturing (Schonberger (1982a) is one of the studies that discuss that question). Having that in mind, we concluded that some of the Portuguese industries that are likely to perform repetitive manufacturing, and as such are potential users of JIT, were the electronic, metal parts and paint manufacturers.

The research project consisted of a questionnaire survey sent to a sample of manufacturers of those industries. The questionnaire was sent to the manufacturing or general manager of the selected firms. The criteria to select the firms were the number of workers and the annual sales volume, so that only firms with the dimension required to implement the JIT system were surveyed. We, first, compute the mean value of the number of employees in each industry and the mean sales value. All the firms that had more than a half of those values were surveyed. Through this process, the questionnaire was mailed to 384 companies (293 from the metal parts industry, 53 from the electronic materials industry and 38 from the paint manufacturers).

3.2. Questionnaire design

The questionnaire was developed to collect three types of information:

- (1) general information about the firm, that would allow an evaluation of its characteristics;
- (2) information that would permit an assessment of the extent to which the responding firm was using JIT;

(3) information that would allow an assessment of the extent to which the person responding to the questionnaire knows the JIT system.

The main reason for using a questionnaire survey was to obtain answers in a short time and to cover a wide range of firms.

The JIT elements presented in the literature (a uniform production rate, flexible employees, a *pull* control system, high quality levels, supplier long-range relationships, small lot size, quick and economic setups, preventive maintenance, quality circles) provided the foundation for the survey research design.

The design and administration of the questionnaire followed Salant and Dillman's total design method as closely as possible [Salant and Dillman (1994)]. An initial version of the questionnaire was developed based on an extensive literature review (the studies presented in the previous section) and the JIT elements analysis. The initial questionnaire was pre-tested on operations management professors and questionnaire survey builders and, after incorporating the comments and suggestions of these individuals, an intermediate version of the questionnaire was tested on a group of firms, in order to eliminate any ambiguity and misleading or misunderstanding questions. Thus, a few firms were visited, and the questionnaire was tested with the top operations managers through personal interviews. Comments from these managers were incorporated into the final version of the questionnaire, which consisted of 26 questions:

- six questions about the firm's characteristics (main activity, second activity, number of employees, sales volume (thousands of euros), final products inventory value (thousands of euros) and work-in-process inventory value (thousands of euros) – questions 1 to 6 of the questionnaire,
- five questions about the quality system implemented (questions 12 to 16 of the questionnaire),
- three about the suppliers (questions 17 to 19),
- two about the products seasonality/production rate (questions 7 and 8),
- two about employees flexibility (questions 9 and 10),
- two about the preventive maintenance (questions 22 to 23),
- one about the production control system – push or pull system (question 11),

- one about the production lot size (question 20),
- one about the set-up times (question 21),
- one about quality circles in terms of existing (or not) quality teams (question 24),
- one about the knowledge about the JIT system (question 25)
- and one about the use/not use of JIT technique (question 26).

The questions selected for the questionnaire had the JIT elements as a base for its construction to assess the conditions for its use. It also included questions about the company's inventory management profile and 4 control questions. The last question (n° 26) asked the firm if it had the JIT production system implemented to control operations. The sole propose of this question was to deduce the extent to which Portuguese firms knew what a JIT system was, and was not useful to identify the characteristic of a JIT system, as it had already been listed in several studies.

In total, 142 questionnaires were received from the original 384. The response rate is 37%, which may be better than similar studies reported in the literature [e.g. Cheng (1988), Bartezzaghi et al. (1992), Lee (1992), Clarke and Mia (1993), Lawrence and Hottenstein (1995), Lawrence and Lewis (1996)]. However, only 131 questionnaires could be used in the project, as 11 questionnaires had to be discarded. Returns mirrored the composition of the original sample closely, indicating no systematic response bias.

In order to be able to analyse the questionnaires, we had to codify eight answers, as they were qualitative (the answers of questions n° 9, 11, 12, 13, 16, 18, 20 and 22). Eleven of them were categorical in nature and were entered into the analysis through the use of 0-1 code. Five answers were continuous (the answers of questions n° 3, 4, 5, 6 and 17) and were considered by their values. The type of data collected in the questionnaire and the codifications of the answers are summarized in Table 2.

Table 2. Answers' codification

Questions		Description
1	Firm's activity	Firm's main activity
2	Other activities	Firm's other activities
3	Employees	Number of employees
4	Sales value	Sales value in thousands of euros
5	Final products inventory	Final products inventory value in thousands of euros
6	Work-in-process inventory	Work-in-process inventory value in thousands of euros
7	Seasonality	1, if the firm has seasonal products; 0, otherwise
8	Work over time	1, if the firm needs more workers; 0, otherwise
9	Workers' specialization	1, if workers have low specialization; 2, if they have medium specialization; 3, if they have high specialization
10	Workers adaptation	1, if workers can easily perform other tasks; 0, otherwise
11	<i>Push-Pull</i> method	1, if the production control is made from the beginning to the end (<i>pull</i>); 2, if the production control is made from the end to the beginning (<i>push</i>)
12	Quality vs Price	1, if quality is more important than price in the firm's market; 2, if price is more important than quality in the firm's market
13	Position of quality	1, if the firm has relative "less quality" than its competitors; 2, if the firm has the same quality as its competitors; 3, if the firm has relative "more quality" than its competitors
14	Quality certification	1, if the firm is certified; 0, otherwise
15	Products inspection	1, if the firm has some quality control mechanism; 0, otherwise
16	Control phase	1, if the control is made at the beginning of the production process; 2, if the control is made after several (or all) phases of the production process; 3, if the control is made at the end of the production process
17	Suppliers of raw materials	Number of raw materials suppliers
18	Purchases frequency	1, if the purchase frequency is less than 1 week; 1.5, if the purchase frequency is between 1 and 2 weeks; 3, if the purchase frequency is between 2 and 4 weeks; 9, if the purchase frequency is between 1 and 3 months; 30, if the purchase frequency is more than 3 months
19	Timely deliveries	1, if suppliers deliver materials at the due date; 0, otherwise

Table 2. Answers' codification (Cont.)

Questions	Description
20 Production lot size	1, if the production lot corresponds to less than 1 day of sales; 5, if the production lot is between 1 and 10 days of sales; 15, if the production lot is between 10 and 20 days of sales; 25, if the production lot is between 20 and 30 days of sales; 40, if the production lot is more than 30 days of sales
21 Set up reduction	1, if the firm has made efforts to reduce set-up times; 0, otherwise
22 Breakdown frequency	1, if breakdowns occur every day; 3, if breakdowns occur between 2 and 5 days; 8, if breakdowns occur between 5 and 10 days; 20, if breakdowns occur between 10 and 30 days; 60, if breakdowns occur between 1 and 3 months; 150, if breakdowns occur between 3 and 6 months; 270, if breakdowns occur in more than 6 months
23 Preventive maintenance	1, if the firm has a preventive maintenance system ; 0, otherwise
24 Quality circles (teams)	1, if workers have periodic meetings to discuss quality; 0, otherwise
25 JIT knowledge	1, if the firm knows what JIT production system is → open answer: which are the JIT most important elements 0, otherwise
26 JIT use	1, if the firm has implemented the JIT system; 0, otherwise

4. RESULTS AND DISCUSSION

As this is primarily an exploratory study, we make no attempt at formally testing any hypothesis and, only descriptive analysis will be presented throughout. The results are based mainly on the aggregate data obtained from the 131 sets of responses.

The questionnaires received were analyzed using descriptive statistics and multivariate analysis. Multiple discriminant analysis, principal components analysis and hierarchical cluster analysis were the techniques used, using the Unistat Statistical Package software.

The answers to the yes-no questions are presented in Figure 1.

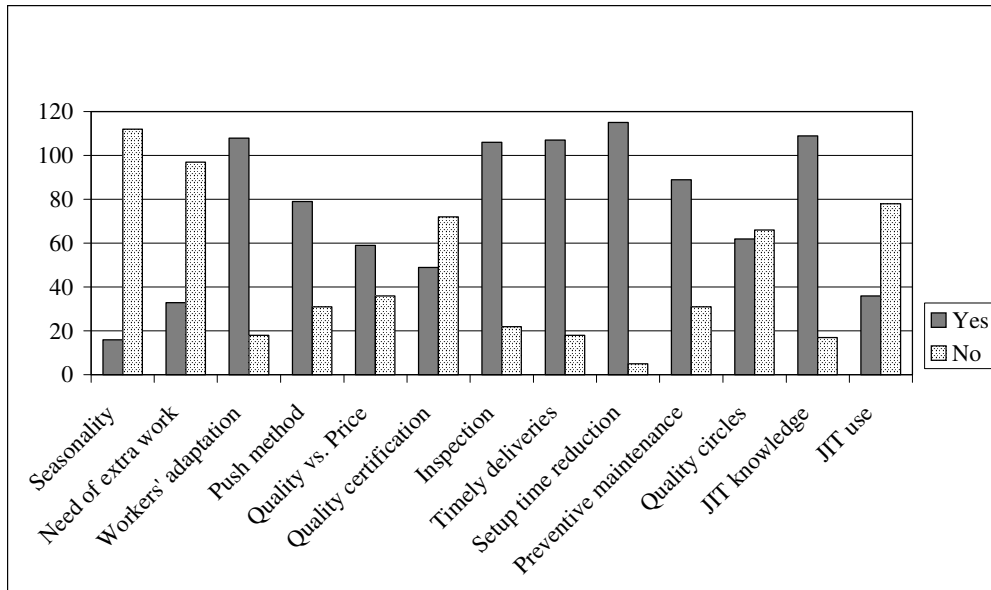


Figure 1. Answers to yes-no questions

It can be seen that most firms (87.5%) experience no seasonality, 74.6% of them don't need extra work, and 85.7% have flexible workers (strengthened by the answer to the question related to the workers' specialization – Table 7), thus having some of the necessary conditions for a JIT system. However, most firms still use a *push* method to control production (71.8%).

Quality is a major concern: in spite of the fact that less than half of the firms are certified, quality is considered more important than price and almost all the firms surveyed had some kind of inspection mechanism to detect defectives (see Tables 8 and 9). In most cases suppliers deliver in time (around 85%) and there are efforts to reduce setup times. Although used by less than one third of the firms, the JIT system is quite well known by 86.5% of the firms. Through the analysis of the answers to question 26 we concluded that when a firm says it is using a JIT system (31.5% of them answered “yes”), that does not necessarily mean that it has practices consistent with that claim (like, continuous quality improvement, training and flexible employees, setup time reduction, supplier partnership, etc.).

Other questions were either quantitative or had more than one possible answer. The number of people employed by each company ranged from 17 to 3,686, with a mean of 190 (see Table 3). The sales value per year ranged from 8,000 euros to 312,500 millions of euros, with a mean of 4,750 millions of euros – see Table 4. In both inventory types (work-in-process and final products) the mean value was high for companies that were trying to implement the JIT

system (see Tables 5 and 6). The average number of suppliers was quite high, but most firms had a relatively small number of suppliers — the average was 85 suppliers but 40% of the firms had 10 suppliers or less. Very few firms (less than one fourth) purchased raw materials in periods longer than 4 weeks; of the remaining firms, roughly half purchased every 2 to 4 weeks and the other half every 2 weeks or less (see Table 10). In some cases the production lot was quite large, large enough to last for 20 or more days; however, more than half of the firms used lots that lasted only for 10 days or less (Table 11). The time between machine breakdowns is also an important issue. Some firms experienced frequent failures, but for the majority the time between machine breakdowns exceeded one month (Table 12). As can be seen, some of the conditions for using a JIT system are already met or there is a significant trend towards it, but not when all the JIT elements are considered.

Tables 3 to 6 record statistical data regarding the number of workers, sales and inventory system profile of the responding companies.

Table 3. Number of employees

	Standard			
Mean	Mode	Deviation	Min	Max
190	40	375	17	3,686

Table 4. Sales value (millions of euros)

	Standard			
Mean	Mode	Deviation	Min	Max
4,750	50,000	32,755	8,000	312,500

Table 5. Final products inventory value (millions of euros)

	Standard			
Mean	Mode	Deviation	Min	Max
5,745	0	37,335	0	350,000

Table 6. Work-in-process inventory value (millions of euros)

	Standard			
Mean	Mode	Deviation	Min	Max
4,400	0	30,640	0	275,000

Tables 7 to 12 record data pertaining to the responding firms' manufacturing system profile. The data are classified according to the higher or lower value of the variable being answered.

Table 7. Workers' specialization

Answer	Code	Frequency	Percentage
Low	1	26	20%
Medium	2	89	69%
High	3	14	11%
Total		129	100%

Table 8. Firm position in terms of quality

Answers	Code	Frequency	Percentage
Inferior	1	0	0%
In the mean	2	59	45%
Superior	3	72	55%
Total		131	100%

Table 9. Where control is made

Answers	Code	Frequency	Percentage
At beginning	1	10	10%
Several phases	2	81	78%
At end	3	12	12%
Total		104	100%

Table 10. Raw material purchases frequency

Answers	Code	Frequency	Percentage
< 1 week	1	15	12%
[1,2] weeks	1.5	33	27%
]2,4] weeks	3	45	37%
[1,3] months	9	26	21%
> 3 months	30	4	3%
Total		123	100%

Table 11. Production lot

Answers	Code	Frequency	Percentage
< 1 day	1	18	18%
[1,10] days	5	34	35%
]10,20] days	15	18	18%
]20,30] days	25	18	18%
> 40 days	40	10	11%
Total		98	100%

Table 12. Machine breakdown frequency

Answers	Code	Frequency	Percentage
Every day	1	8	7%
[2,5] days	3	9	8%
]5,10] days	8	8	7%
]10,30] days	20	22	20%
[1,3] months	60	21	19%
]3,6] months	150	20	18%
> 6 months	270	23	21%
Total		111	100%

The principal components analysis allows the identification of the most important characteristics of the firms, through the analysis of the factors that mainly explain the differences between the firms that were using and the ones that were not implementing JIT. These were the frequency of raw materials purchases (that had a correlation of 89.7% with the principal factors or components), the specialization of the workers (that had a correlation of 82.3% with the principal factors) and the knowledge about the JIT system (with a correlation of 81.4%). We have, now, a starting point (and a checking point) for the multiple discriminant analysis. We know that, probably, the elements that distinguish the two groups of firms analysed are the ones brought in by the principal components analysis.

The multiple discriminant analysis allows the identification of the most important variables in discriminating between the firms that say they use a JIT system and the other ones. Table 13 shows the variables that discriminate the two groups and their statistical significance. The greater the value of the significance, the greater the probability of rejecting the hypothesis that the variable is statistically significant to discriminate the groups. It can be seen that among the most important variables are the existence of a preventive maintenance mechanism, an inspection mechanism to detect defectives, the knowledge about JIT elements, the specialization of the workers, and the frequency of raw materials purchases. This conclusion goes in the same direction as the principal component analysis.

Table 13. Univariate Statistics

Questions/variables	Wilks' Lambda	Statistical F	Significance
25 JIT knowledge	0.90256410	6.693181	0.0120
23 Preventive maintenance	0.91559808	5.715301	0.0199
15 Products inspection	0.94092244	3.892784	0.0530
9 Workers' specialization	0.95942051	2.622341	0.1104
18 Purchases frequency	0.97357740	1.682660	0.1994
11 Push-Pull method	0.98103346	1.198659	0.2778
19 Timely deliveries	0.99214564	0.490824	0.4862
21 Set up reduction	0.99689015	0.193411	0.6616
13 Position of quality	0.99849624	0.093373	0.7610
8 Work over time	0.99851186	0.0924016	0.7622

The hierarchical cluster analysis defines groups or clusters of firms. Cluster analysis classifies the items (firms, in our study) so that the firms belonging to a specific group have similar characteristics. Two sets (clusters) were defined because the analysis of the mean value for each possible group (from one to five) showed that most firms (93.7%) belong to two groups. Eight firms were out of those two groups, and each of them constituted a different cluster. Therefore, they were ignored. We made the cluster analysis with two groups, and it is interesting to point out that the key characteristics of the firms belonging to the same group were consistent with the results previously obtained: an inspection mechanism to detect defectives, the specialization of the workers, and the knowledge about the JIT system.

5. CONCLUSIONS

From the results obtained one may conclude that Portuguese firms have four basic perspectives about the JIT system:

- (1) it is perceived as a way to reduce inventories;
- (2) it highly depends on suppliers' performance;
- (3) it helps improve quality and thus reduce scrap and defectives;
- (4) it is a means to carry out production planning.

The firms are aware of the importance of quality, and almost all of them have an inspection system to detect defectives. However, very few of them are certified, and quality circles practically do not exist. The multivariate analysis showed that the main factors of the use/not

use of the JIT system in Portugal are the existence of an inspection mechanism, preventive maintenance of the equipment and frequency of raw materials purchases.

Most Portuguese firms do not have all the necessary conditions to successfully implement a JIT system. However, there are efforts in reducing inventories, paying attention to quality and building long-term relationships with suppliers.

Although there is an increasing concern with quality, this is not enough to adopt a system that requires the involvement of everybody in the firm. The results obtained showed that, although Portuguese firms have the right concept of a JIT system, only 6% have the necessary conditions to successfully implement it. Portuguese firms have still a long way to cross.

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