

## **Economic and Technical Aspects on Quality Control for Wood Products: The Case of Furniture Enterprises in Thessaly (Greece)**

Ioannis J. Papadopoulos<sup>1</sup>, Michalis Scarvelis<sup>1</sup>, George A. Ntalos<sup>1</sup>

<sup>1</sup>Dept. & Furniture Design and Technology, Technological & Educational Institute of Larissa,  
V. Griva11, 43100 KARDITSA, GREECE  
[papad@teilar.gr](mailto:papad@teilar.gr), [skmi@fria.gr](mailto:skmi@fria.gr), [gntalos@teilar.gr](mailto:gntalos@teilar.gr)

### **ABSTRACT**

The present research paper, carried out by the Laboratory of Quality Control, of the Department of Wood & Furniture Design and Technology of Karditsa, has as target the study of the technological implementation and the financial evaluation of the quality control, both in raw materials as well as in final products of wooden furniture enterprises, in one of the 3 most important areas of furniture production of Greece, Thessaly. Data were collected through properly constructed questionnaires and the statistic elaboration of those questionnaires had as a result useful conclusions for the enterprises, regarding quality control issues. This quality control is carried out today in a percentage of 63.9% of the enterprises, using only optical checking and experience, without using any technological equipment at all. So, the establishment and operation of a quality control laboratory for furniture, from an independent conveyor, staffed with experts, is considered as necessary in a percentage of 83.3%. Besides, the quality of the furniture produced, seems to consist the second competitive advantage of the Thessaly enterprises, in a percentage of 75.0% considered more important even from the price of the product.

**Key words:** Quality control, furniture, wood products economy, furniture marketing, thessalian furniture, quality control laboratory, cost.

### **INTRODUCTION**

Recent years, especially after 1990, quality in furniture has been found as one of the most important factors – criteria of purchase from the consumers' side, as well as of the enterprising activities (Zantanidis et al 1995; Papadopoulos 2005). The furniture industries that realize this consumers' behavior, try to come up to the requirements by differentiating many times their production procedure, having though as a basis the marketing department, that will promote and show the quality of as a competitive advantage (Papadopoulos et al 2004).

The focus of a furniture industry or its external collaborators on quality matters or research for development and certification or use of special programs for quality control and total quality management, as well as the impact of the previously mentioned factors on the final cost of the product, should be a continuous target, because a system of quality control could be also used as reference in the various contracts (Brown 1982; Logothetis 1992; Dervitsiotis 1993).

Ideas of the past, that the best quality furniture has always the biggest cost and also that it leads in reduced productivity, have been revised when put in action -but also from more recent research- and are considered mistaken, because through the modernization of the production procedures an enterprise can be lead to a significant reduction of the total production cost (Papadopoulos et al. 2007).

Besides the above mentioned, the generally low percentage of Greek furniture export in countries that demand high quality standards, has as the main reason the lack of certifications of the furniture produced, the failure to meet the international standards, as well as the lack of the quality control. For this purpose of course, the furniture enterprises should have modern production facilities, able to produce furniture that meets international standards. Last but not least, is the lack of staff with qualifications and conscience needed for products' quality.

In the international market, the orientation of the enterprises to the exports might "force" the use of high quality standards.

Recent research (Matzaris 2003), showed that 60-70% of totally observed faults in final products (which are of course discovered in the last phase of the production), is caused from omissions in the sectors of design, of the productions flow, of the quality control of raw materials and of course from the total lack of quality control. So, the re-evaluation of the importance of the quality control is really needed.

Generally, in wood and furniture enterprises, the quality control usually used is that of raw and subsidiary materials (sawnwood, veneers, wood-based panels, fitting materials etc.) of the production procedure and the final products. Greek specifications of quality classification for sawnwood do not exist and -when it is imported- the rules of the country of origin are used, provided that the largest part of the sawnwood consumed in Greece is being imported (Ntalos 2003; Papadopoulos *et al.* 2005; Papadopoulos and Karagouni 2007). The quality of the products and the services of an enterprise depend on the creation and implementation of a reasonable Management – Administration System of the production procedure. Such a system should first accept and implement the principles of quality assurance and then extend them to the upper level of quality administration, namely the Management of Total Quality.

The aim of this research is to find out the degree to which quality control is or not being made in the raw material and in the final products of the Thessalian furniture enterprises, in order to create a new route based on the European data.

## **METHODOLOGY OF THE RESEARCH**

The methodology used for the research was based on fulfilling special questionnaires, properly constructed, following the general principles for their design and composition (Tull and Hawkins, 1990; Doyle, 1998; Aaker *et al.* 2004).

In order to form the final questionnaire, the principle of pre-questionnaire was used, which means that pre-test was made in 2 enterprises, where some vagueness was located, which was seriously taken into account when composing and forming final questionnaire (Dillman, 2000).

36 questionnaires were filled in total, the first 12 from Thessalian enterprises that took part in the European Programm RISC, while the rest were filled from 24 other Thessalian enterprises, selected using of random sample method. In total, the research covered about 5% (representative sample) of the Thessalian furniture enterprises, from the prefectures of Larissa, Trikala and Karditsa.

Each questionnaire included groups of questions of closed and opened type, including among others: the application or not of quality control in both the raw materials and the final products, the listing of the viewpoint and knowledge of the enterprises on quality control issues, in combination with the basically used equipment (conversion equipment, means of transportation etc, raw materials, quantity, quality and way they are provided).

Collecting data was made from April to June of 2003 and then were statistically analyzed using the statistical package of SPSSWIN ver. 17.0 and statistic controls of Frequencies, Descriptives, Crosstabs and Binary or Bionominal Logistic Regression were made (Hovitt and Cramer 2003; Siomkos and Vasikokoloulou 2005; Norusis 2007).

## RESULTS

### *Use of raw materials and criteria for their selection*

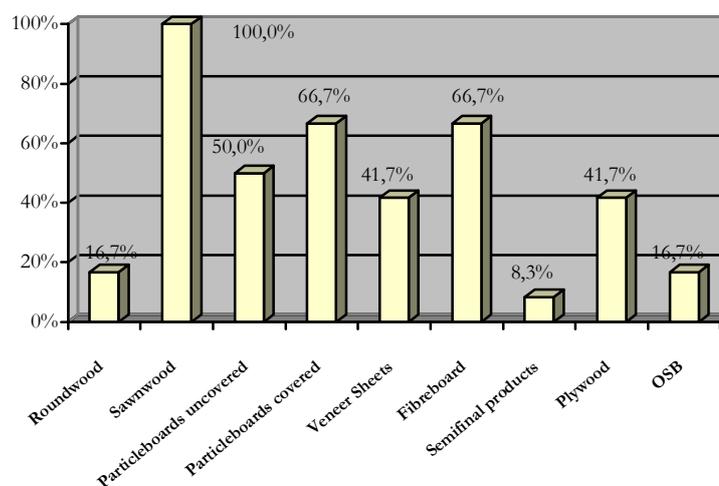
Quality control of raw materials consists a basic element of this marketing research of the Thessalian furniture enterprises. In Figure 1, where the percentages for every raw material category are presented, it can be seen that 100% of them use sawn wood of “A” quality, mostly from beech and to a lesser extend from poplar, oak, chestnut, walnut and lime wood. Wood origin is exclusively Greek in a percentage of 37.5%, both Greek and imported wood is used by a percentage of 37.5 %, while the exclusively imported wood is used a bit less in a percentage of 25 %. Their suppliers were mainly commercial enterprises from Thessaly.

An also significant percentage of those enterprises (66.7%) uses fibreboards and particleboards, as raw materials for their products production. Particle-boards is used by 83.3% of the enterprises with a turnover smaller than 500.000 €, while there is a negative connection between the use of raw materials and the conduction or not of exports (Cramer’s V coefficient = 0.707 for  $\alpha < 0.02$ , kendal’ s tau-c = -0.667).

Moreover, half of them (50 %) use also covered particleboards, decorative veneer sheets and plywood. All the enterprises that have a turnover smaller than 500.000 € use plywood (Cramer’s V coefficient = 0.89 for  $\alpha < 0.01$ , kendal’ s tau-c = 0.661), while the S.A. do not use plywood all.

On the opposite, half-ready raw materials, such as cabinet doors, boxes, curved materials, profiles, frames etc, are being used only by 8.3% of the enterprises. Use of half-ready raw materials is being made by all enterprises having a turnover smaller than 500.000 €, or do not export their products, or are consisted of one person, or have less than 10 staff members. Decorative veneer sheets are used by all enterprises that have a turnover smaller than 500.000 € (Cramer’s V coefficient = 0.69 for  $\alpha < 0.01$ , kendal’ s tau-c = 0.661).

It is remarkable to mention the case of using a relatively new product in Greece, the OSB, as a furniture raw material by 16.7% of the enterprises, which proves that they are innovative. The use of OSB is negatively related to all enterprises that have a turnover from 500.000 – 1.000.000 € (Cramer’s V coefficient = 0.77 for  $\alpha < 0.05$ , kendal’ s tau-c = - 0.397), as well to those that have less than 10 staff members (Cramer’s V coefficient = 0.529 for  $\alpha < 0.1$ , kendal’ s tau-c = - 0.389), while it is mainly used by those that produce living room furniture or are G.P.



*Fig. 1. Percentages of various raw materials that the Thessalian furniture enterprises use for their products.*

Of course, apart from the above wooden products, some enterprises (8.3%) use also aluminum, glass and leather as raw materials.

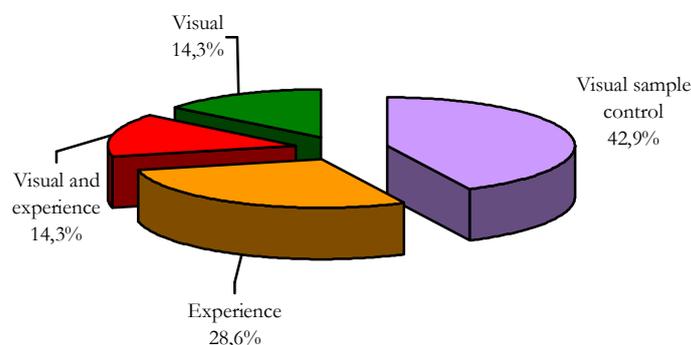
For the supply of the above materials, the Thessalian furniture enterprises never use exclusively one supplier and the biggest percentage of them (41.7%) trusts more than 4 suppliers, while 3 and 2 suppliers are used in percentages of 33.3% and 25% in correspondence. Of course, the criteria by which the suppliers are being selected are of great importance and it seems that the most important is the ensuring of good quality (in a percentage of 83.3%), as well as their low price (75%) (Table 1). The criteria of responding time to the order (33.3%) and of the former dealings (25%) follow but to a great distance. From the above answers speculates us a little the fact that while quality is in the first position of their criteria, none of the enterprises occupies a certificate that reassures about the quality but -at least- they can see its importance.

As long as quality consist the fist criterion for the selection of raw materials, it is of great importance to find out if those enterprises are satisfied from it. 25% of them are not satisfied from the quality of the raw materials supply and try to use imported raw materials. The imported raw materials satisfy the 91% of the furniture enterprises, despite the fact that they have a higher price, specifically about 20% higher in average.

**Table 1. Criteria for selecting a supplier, used by the Thessalian furniture enterprises**

<i>Criteria</i>	<i>Percentage %</i>
Quality	83.3%
Price	75.0%
Time needed to respond to the order	33.3%
Former dealing	25.0%
Member of the professional association	8.3%

One of the most important factors that influences the production cost of furniture products seems to be the percentage of the raw material wastes, which ranges between 10-30% (average 20.8%), as well as the implementation of specific technical specifications for the products produced. But in this sector, the Thessalian enterprises are not good enough, as only 1/3 of them implements them, without being exactly defined which specifications they are, even though many of them are enforced by the law. Moreover, 75% of the enterprises that offer their products to the local market, does not implement any technical standards.

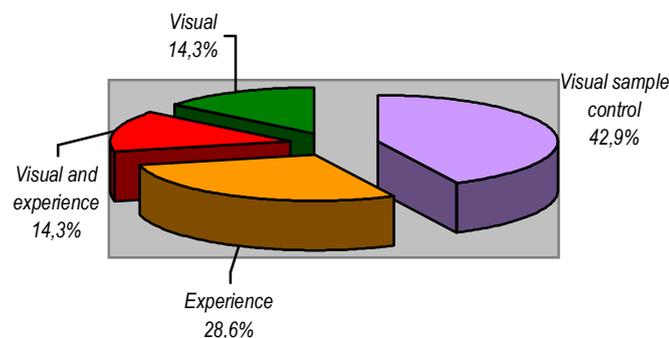


**Figure 2. Percentages of the Thessalian furniture enterprises that implement procedures of quality control in raw materials.**

### ***Implementation of quality control and certification of the enterprises***

Regarding the implementation of quality control in raw materials (Fig. 2) and in final products (Fig. 3), only 36.4% of the enterprises does not implement it in both cases. Also, all enterprises that apply quality control, use only visual and not at all laboratory control. Besides the visual control they also use their experience in a percentage ranging between 28.6 – 42.9%. The implementation of quality control is positively related to the turnover made (Cramer's V coefficient = 0.829 for  $\alpha < 0.1$ , kendal' s tau-c = 0.39), negatively to exports (Cramer's V coefficient = 0.878 for  $\alpha < 0.1$ , kendal' s tau-c = -0.76, which means that none of the enterprises that make exports conducts quality control) and positively with their activities (Cramer's V coefficient = 0.908 for  $\alpha < 0.05$ , kendal' s tau-c = 0.227).

The implementations of environmental protection procedures (security and health of the employees, use of ecological enamel etc) is implemented by 50% of the Thessalian enterprises and consists one more competitive advantage of the furniture enterprise, that can of course be increased, if they manage to give the proper information to the customer.



***Figure 3. Percentages of Thessalian furniture enterprises that implement procedures of quality control in final products.***

During data analysis, an attempt was made to create models of regression that can allow the implementation of quality controls, specific standards, ISO 9000 or future implementations of it (depended variable), in relation to the independent variables (total invested money in the enterprise, total value of fixed capitals, average turnover, total number of employees, total size of the enterprise (main factory, warehouses, uncovered areas) and the total number of working days of the enterprises on annual basis).

A lot of tries using Binary Logistic Regression were made, which calculates logarithmic probabilities of the depended variable. It means that the maximization of the probabilities was examined, as after the depended variable is turned into logarithmic variable (the natural logarithm of the probabilities to happen or not). This method is being used when the depended variable is dichotomy (for example YES, NO etc.) and the logarithmic model of the regression has the following form:

$\text{Ln} \left[ \frac{p}{(1-p)} \right] = a + bX$ , where:  $p$  = the probability that the  $Y$  will happen ( $Y=1$ ),

$\frac{p}{(1-p)}$  = (odds ratio),

$\text{Ln} \left[ \frac{p}{(1-p)} \right]$  = (log odds ratio),

$a$  = the constant of logarithm model and  $b$  = the logarithmic regression coefficient.

The prediction for implementation or not of the ISO 9000 is possible with the following model binary logistic regression:  $\text{Ln} \left[ \frac{p}{(1-p)} \right] = -0.129 + 3.775X$ , where  $X$  is the total number of staff used.

The model is statistically significant ( $X^2 = 4.857$ ,  $p < 0.05$ ), rejecting the null hypothesis that the independent variable is linearly connected to the logarithmic probabilities of the depended

variable. The Nagelkerke  $R^2$ , which adjusts the Cox-Snell  $R^2$ , which in turn corresponds to the  $R^2$  of the linear regression is 0.560, which is considered satisfying.

The prediction of implementation of the specific technical standards for products of wooden furniture that they produce or not is possible, with the following model binary logistic regression:

$\ln \left[ \frac{p}{(1-p)} \right] = 92.160 - 0.026X$ , where  $X$  is the total surface of the uncovered areas of the enterprise.

This model is statistically significant ( $X^2 = 8.997$ ,  $p < 0.05$ ), rejecting the null hypothesis that the independent variable is linearly connected with the logarithmic probabilities of the depended variable. The Nagelkerke  $R^2$ , which adjusts the Cox-Snell  $R^2$ , which in turn corresponds to the  $R^2$  of the linear regression is 0.999, which is considered as very satisfying.

An important factor during the production procedure is also the degree to which the enterprises themselves are satisfied from the quality of the products they produce (91.7%), regardless of the prices, the disposal or other factors. The total of the S.A. or personal companies are satisfied from the quality of their products. The rest (8.3%) reports non satisfaction and this might derive from the fact that they are traditional enterprises (foundation year  $< 1960$ ) that haven't manage to implement new technologies, as there is a positive relation between them (Cramer's V coefficient = 1.000 for  $\alpha < 0.02$ , kendal' s tau-c = 0.306).

Besides, the quality of the products produced consists the second competitive advantage of the Thessalian furniture industries, according to their opinion, while the first position is occupied by the service they offer to their customers. Reasonable prices and the guarantees that are given, consist the next characteristics of those enterprises (Table 2).

**Table 2. The main competitive advantages of the Thessalian furniture enterprises**

<i>Advantages</i>	<i>Percentage %</i>
Costumers' service	91.7
Quality of products	75.0
Price	50.0
Guarantee	41.7
Network of distribution	33.4
Product design	8.3

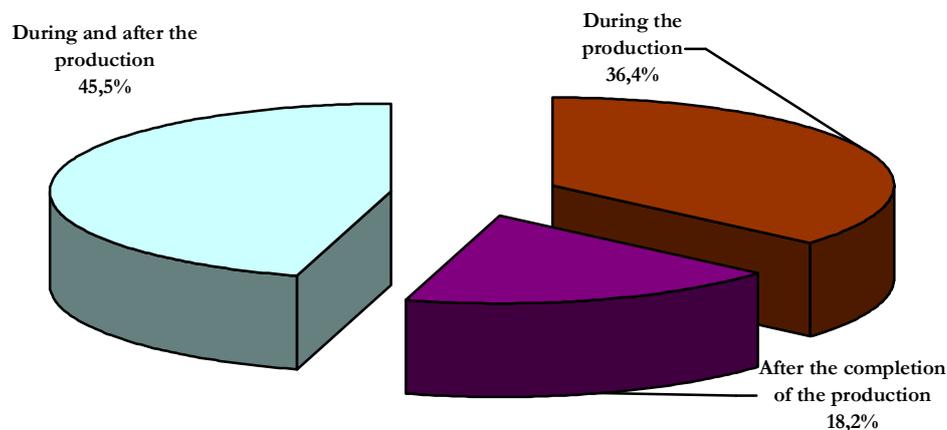
On the opposite, the lack of technical experts is their main weakness (Table 3).

**Table 3. The main weaknesses of the Thessalian furniture enterprises**

<i>Weaknesses</i>	<i>Percentage %</i>
Lack of technical experts	33.3
Insufficient production areas	25.0
Quality of raw materials	16.7
Long time of production	8.3
Organization of working	8.3
Promotion of the products	8.3
Big expenses	8.3
Lack of subsidized programs	8.3
Mechanical equipment	8.3
Network of distribution	8.3

The confirmation of the good quality of the Thessalian furniture enterprises, that results from the former observations, reassures the fact that 91.7% of them implement the quality control during the production of their products and after it (36.4% of them exclusively during it), while

after the completion of it the 18.2%. But most of the times they implement it also during both phases mentioned before (Fig. 4). The highest percentage (60%) of the G.P. enterprises implements the quality control also during the production, as well as after its completions.



*Figure 4. Percentage of the Thessalian furniture enterprises with implementation of quality control procedures during different phases of the production procedure.*

Of course, all of the controls are only visual and none of the enterprises conducts laboratory controls, either because they do not have the equipment and the experts needed or because there is lack in the relative knowledge and the ability.

Asking about the implementation or not of the quality control, it seems that gave to the enterprises the spark to say that they consider it (in a percentage of 83.3%) as necessary for the establishment of a furniture quality control laboratory, which should belong to an independent conveyor, staffed with experts. All of the enterprises (100%) that have a turnover >500.000 €, as well as the S.A., state that the establishment of such a laboratory is necessary.

All the above enterprises stated in a percentage of 83.3% that this quality control should be made both for raw material and chemical additives, as well as in final products.

Of course, all the above mentioned regarding the quality of the produced furniture, can not be accomplished without informing and training of those enterprises' employees. So, 54.5% already motivate their employees to attend relevant informing seminars, which are being held both inside the enterprise in a percentage of 83.3% and outside it in a percentage of 16.7%.

The categories of the employees that are motivated by their enterprises for training through special programs seem to be mostly (more than 42.9%) the management executives of the enterprises, while -in most cases in the SME's- those positions are occupied by themselves (the owners or their children), while all the other categories of the employees (medium executives, the experts and the unskilled employees) reach the same percentage (14.3%) each one.

## CONCLUSIONS-SUGGESTIONS

In Thessaly, for the furniture branch, which continues positioning traditionally a big share of the local market and that has good chances of an increase in its turnover, there is no other choice apart from using the offensive implementation of marketing, which in turn will be based on the quality of the products and the after sales service support of the consumer.

Factors showing the capabilities and the ability of a competitive advantage of the above enterprises are a turnover higher than 500.000 € in the largest percentage of them (63.6%), as well as the participation of the founders' children as high executives (university graduates) in those enterprises. Additionally comes the fact that proper selection of raw materials in a

percentage of 83.3% and the use of innovative raw materials (such as OSB) consist basic criteria for upgrading quality.

The non use of specific technical standards in the production of furniture (by the 2/3 of the enterprises), as well as the way that quality control is being made (only with visual observation and experience, without any assistance of laboratory quality control), is a sector where enough attention should be paid. An independent and flexible organization is proposed, staffed with experts that will certificate the quality control of the furniture, as this is the will of 83.3% of the furniture enterprises.

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