Using 3D Computer Graphics for Furniture Design and Marketing. The Greek Companies Case Study

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Abstract: The aim of this research is to indicate, evaluate and promote the capabilities of using and utilizing the 3D Computer Graphics software in the procedure of studying the development of furniture design as a competitive advantage of marketing. Furthermore, the main target was the furniture enterprises are made the best decision using the most effective 3D CG software and to have the suitable education of their executives. At first a recording of the uses and applications of this software was made following the integrated planning and research conducting. The research focused not only on the enterprises developing and trading the software but also on the furniture enterprises. The combination of personal interviews and questionnaire methods consisted the main mean for gathering the necessary data which were statistically processed and finally transformed into results in order to make conclusions and specific pleadings. The total of questions (11 open and 11 closed type) was structured in two subgroups, in relationship to type, use, applications, cost, profit, special characteristics of 3D CG and the special characteristics of enterprises using that in their furniture design and production. A pro-sample from those enterprises was selected, some suitable correction was made and finally 72 questionnaires were gathered. 121 variables were analyzed using the SPSS Statistical software (ver 16.0) and the Frequencies, Descriptives, Crosstabs and Correlations controls were made. From that research resulted that the two main powerful motives of 3D CG's software use in furniture design is the need for a realistic optimize of design and the competition between the enterprises in the market. Their application expands in all the stages of design planning, but also in sectors before and after this, as in the marketing, the production and the sale. In the furniture branch that software constitutes an exceptional importance bridge between the creative design and the industrial design, while they recommend an important management tool too, especially when it concerns big and complex projects. The relationship of design planning with the promotion and advertisement material is bidirectional and that is owed in the conformity of digital generated pictures, but also in the possibility that these allocates of approaching the reality. The interest of using CAD software, is focused in the sectors of design (92.3%), production (92.3%) and sales (76,9%). From these software users, the ages 21-30 years old believe that that software contribute in the better design, while these 31-40 years old they dispute the contribution of that in the production. The economic benefits are focused mainly in the time design reduction at 49,6%, in the cost production reduction at 27% and in the increase of sales at 28,3%.

1. Introduction – Literature Review

Computers, are today a very important communication tool between the designer and the client and have been established as something necessary in many designers enterprises. (Curry et al, 1993). CAD software allows designers to easily manipulate the design to meet the needs of clients as a marketing tool (McLain-Kark and Rawls, 1988).

Since early 1970, when the first CAD software was designed and until 1980, the 2D and 3D CG (3 Dimensional Computer Graphics) were a small and specialized section, due to the cost of the computers and the lack in programs friendly to the user (Foley κ.ά. 1990).

The 3D CG , in order to reach today's level of development went through a decade which was focused on intensive research regarding them (Bertol, 1994; McConnel and Waxman, 1999).

The use of 3D graphics in the sector of the furniture design had initially the target to impress. (Maxmann and Zhang, 1995; Otjacques et all, 2008). But soon, it was found that the potentials of their use are much bigger. Nowadays, those graphics do exist in the area of furniture and expand in areas beyond its design. (King, 1998; McConnell and Waxmann 1999; Leslie and Reiner 2006; Oh et al 2006; Ansel et al 2007). This means that, the Greek furniture market, shows a mobility regarding the use of software packets for design. It is not known though, to what degree this mobility, with the introduction and the use of those new technologies and the new potentials they can offer, consists a new phase of the furniture sector's development (Gianousiadis, 1981; Sinometis, 1982; Clemons and McLain-Kark 1991). The furniture design and the capability of creation and introduction in the market of new models, have to do with the cycle of life of those in the market (Nanouris, 1981; Bumgardner et al 2001, Nes and Cramer 2003; Papadopoulos, 2005). In this framework, the institution of "awards for furniture design" were repeatedly created and operated both in the international and the Greek area (Stamou 1982, Benningston, 1986; Pile, 1990).

Recently the interest of the professional designers was focused in the use of 3D CAD software in 3D printers of rapid prototyping and manufacturing to produce buildings, furniture and models (Sass, 2005; Iwamoto, 2004; Igarashi et all, 1999; Lipson and Spitalni, 2002).

Despite the mobility of those programs in the furniture sector, it hasn't been clarified enough, how the furniture enterprises valuate those programs. The result of this vague picture is, in general, the slow acceptance and promotion of the use of this relatively new technological mean. So, what remains is to find out and analyze the existing implementations of 3D graphics programs in the sector of furniture design, that it the essential usefulness of them and their benefits are being evaluated and that conclusions regarding the aim and the potentials of their expansion and their implementation's expansion are made. So, in this sector of furniture design, the research is judged necessary.

The aim of this research is to look for and find out the degree to which the 3D CG has penetrated and is utilized in the furniture design and under which way of thinking. In this framework, the documentation and the evaluation of the benefits and advantages of the use of software packages for design, also consists another aim of the research. Aim of this research is also to find out to what degree the 3D CG has penetrated in other procedures of the furniture sector, apart from the design area. The combination of the development and the use of those programs with special users – enterprises characteristics – is being seeked, so that we can interpret with this the degree to which those programs are being developed and used. The ultimate target is, through this research's conclusions, to benefit: a. the furniture enterprises decision making process regarding the use of those programs and b. the proper training of the executives.

2. Methodology

The organization of the research and the methodological procedure that was implemented is briefly given in the Fig 1.

The market research covered the 3D CAD software, creation enterprises inside and outside the country of Greece, with initial implementation of a relative research on the internet, so that the 3D software creation enterprises are located and that a full catalog of 3D software is created. A first communication with those enterprises was made (using the phone or the e-mail). Then the creation of a preliminary questionnaire was made, which was answered from the abroad enterprises through e-mail and from the local ones through a personal interview with their representatives. The aim of this questionnaire was to gather information regarding the existing 3D CAD software, to see their potential use in the furniture sector, as well as to find out the degree of the information on this subject. The analysis of the answers to the questionnaire made the enrichment, the expansion-completion of the information possible and leads to the creation of a completely new and fully focused on those subjects questionnaire. The creation of this questionnaire was made with the implementation of all the rules of the social science's methodology (McCarthy and Perreault 1987; Kouremenos, 1987; Zacharopoulou, 1993; Kiriazopoulos and Kioulafas 1994; Churchill, 1996; Kotler 2001) and of the market research (Lee et al, 1987; Tsaklaganos, 2000). The total of the questions (11 open type and 11 close type), was structured in 2 subgroups, the one of the questions regarding the 3D CAD software (type, use, implementations, cost, benefit, special features etc) and the one of the special characteristics of the enterprises that use them in the furniture design or CAD-CAM systems.
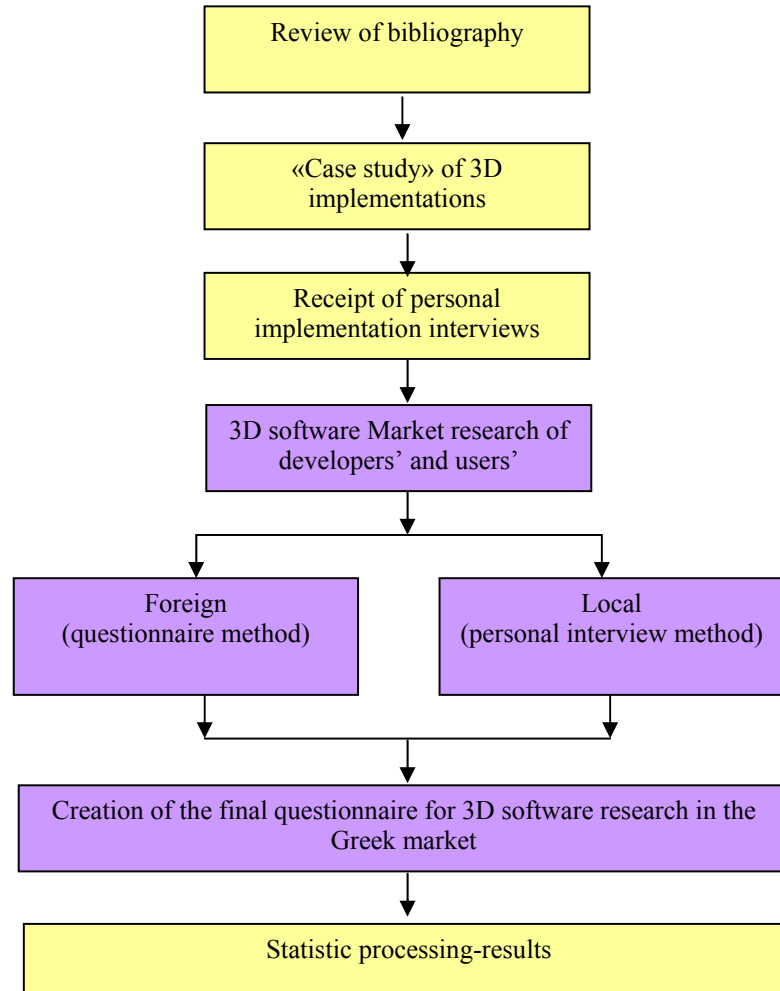
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Foreign (questionnaire method)	Local (personal interview method)

Creation of the final questionnaire for 3D software research in the Greek market

Statistic processing-results

Figure 1. The methodological approach of the research's object (in purple color the market research).

From the total of the enterprises that use 3D software for the design and the production of furniture, a sample of 15 enterprises was randomly chosen, which was then expanded to 35 (Zacharopoulou, 1993; Tsaklaganos, 2000). The questionnaire was send to this sample. The research was made in the period 2003-04.

The answers were then statistically analyzed with the social-economical statistic packet SPSS for Windows ver 16.0 where 121 variables were used and the Frequencies, Descriptives and Crosstabs checks were made (Norusis, 1997; Howitt and Cramer, 2003).

3. Results

From the questionnaires that were sent, a percentage of 87% was sent back to us, which is a really high percentage compared to similar researches.

3.1 The level of market's knowledge regarding the existence of 3D CG

Initially, the percentage of enterprises information regarding the market of 3D CG was researched. As it was expected, the total of the CAD – CAGD software users is aware of the terms «photorealistic» and «3D», while especially high is the percentage that is aware of the terms «three dimensional representation», «photo representation» and «Render» (Fig. 2). Other terms that have to do with 3D CG special terms, are known from only 33.3%. It is worth to mention here, that this percentage consists of people only within the age of 21 to 30 years old. This result can also be regarded as expected, as people of younger ages are more familiar to new technologies, in opposition to the people of older ages that tend to dislike them to some degree.
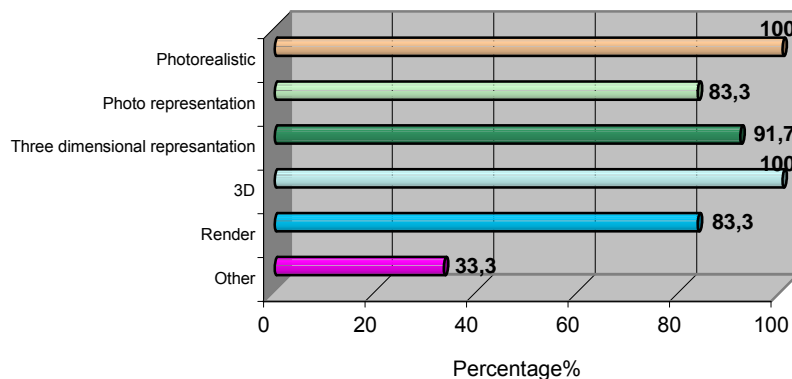

Figure 2. Knowledge of terms regarding the CG

Despite the fact that the take overs, the amalgamations and the changes in the condition of the enterprises is an everyday reality that causes confusion to some degree, it was found that in the Greek market we have 39 3D programs, which is a really significant number for the size of the Greek software market, from which the most popular are given in declining order as follows: *AutoCAD (100%) >3ds MAX (83.3%) > Archicad (75.0%) > Maya - Solidworks - Pro-engineer - Lightwave (58.3%) > ESTIA (50.0%) > 1992 PRO - Rhinoceros - Form Z - Catia (41.7%) > Vector works - Cinema 4D (33.3%) > Softimage XSI - Messiah - Truespace - Imagine - Renderman (25.0%) > Strata 3D - Hoydini - Amapi/Infini*

D / Carrara - Ray dream studio (16.7%) > Inventor series - Ideas master – Solidedge – Poser (15.4%) > Extreme 3D – Universe (8.3%) > Bruce – Helix - Motion builder – Sculptor – Aris – Tekton - Claris CAD – Planit (7.7%) > Allplan (0.0%).

3.2 The level of software use

The software programs used are presented in the Fig.3, where AutoCAD is the mostly in use program in the market and 3D Studio MAX follows next, while with a small percentage difference follows the Greek 1992 PRO (23.1%) and Pro-engineer (23.1%). The other Greek program falls also behind in its use from the Greek furniture enterprises. This means that despite the advantages of the 2 Greek programs, they haven't yet gain an important part of the market. One of the reasons for this is also the low degree of awareness of them in the Greek market. (see above 3.1 chapter).

A relevant research (McConnel and Maxmann, 1999) in Florida, USA showed that the use of AUTOCAD rises to the percentage of 46%, of the 3D Studio to 34% and of the Form-Z to 7%.
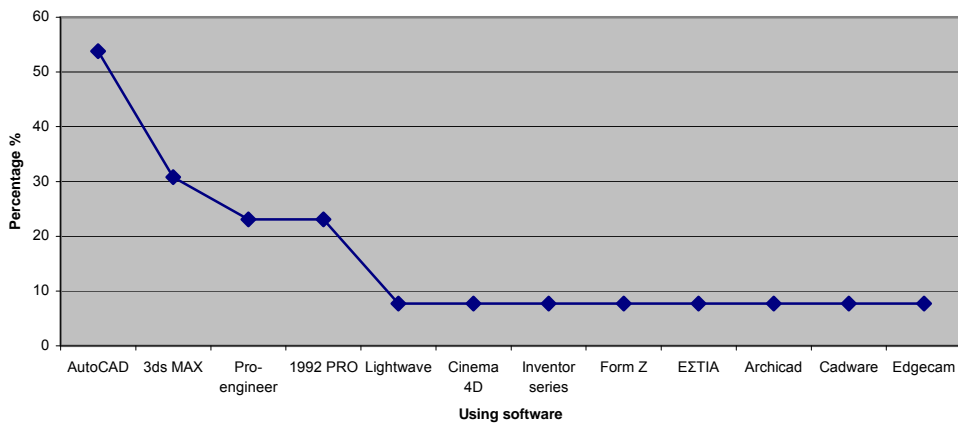

Figure 3. The level of software use

Regarding the furniture products categories, in the design of which, a design program is used, the kitchen furniture, the closets and the office furniture are mostly designed with such programs, something that was expected, as those categories have to do with surface furniture, which production has a big degree of industrialization. Characteristic is also the result that in a small degree (less than 40%) the use of such programs has been implemented for all the categories of furniture products.
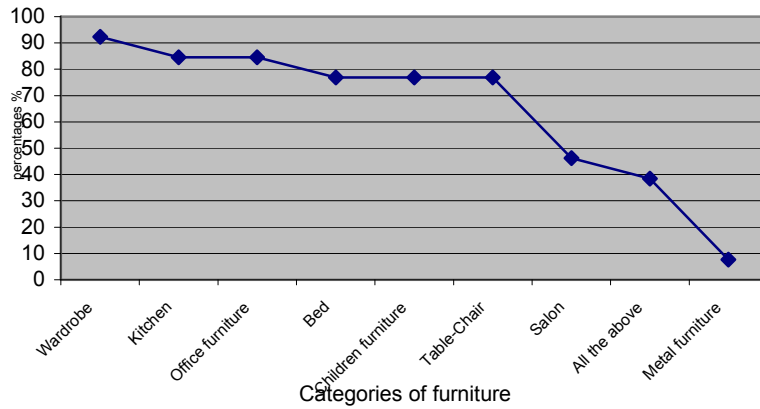
Figure 4. Percentage of use of 3D CG programs in the furniture production

The programs can be implemented in all the stages of a design with higher percentages in the formation of the initial idea, in the study of the final form, in the 3D design and in the final presentation. (Fig. 5). Based on the opportunities for creative development of imagination that those programs offer, it is impressive but also expected, the percentage of their use in the stage of the initial idea (84.6%). Although, the opinion that those programs have nothing to offer in this stage of design does exist (McConnell and Maxman, 1999; Ansel et al, 2007). Of course, the last years, many attempts from the enterprises that produce software, for the improvement of this sector are being made.
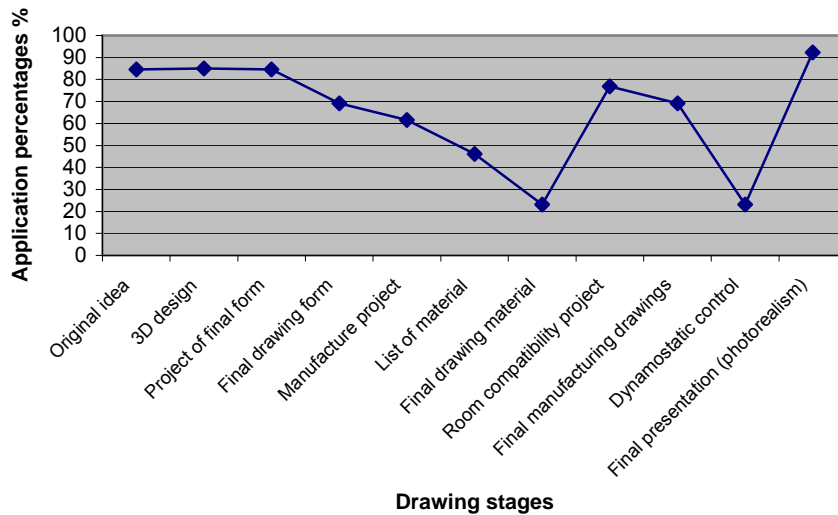

Figure 5. Application percentages of 3D CG in all stages of furniture design

The use – implementation of such software packages goes back to 1 to 14 years, with an average of 9 years. The 53.8% of those who answered has been using software packages and 3D CG for a period bigger than 9 years, while nobody exceeds the 14 years of use. 100% of the, relatively, new users, of those who have been using the programs from 1-9 years, do not use them in the study of materials which shows that, in this stage of the design process there is signifcant room for improvement.

3.3 The benefits from the use of those programs

The interest of everyone who answered that use the design programs (CAD), is focused on the sectors of design, production and sales, where the percentages are 92.3% for the 2 first sectors and 76.9% for the third. From the users of such programs, those that were between 21-30 years old believe that the software contributes in the better design, while those who are between 31-40 doubt about their contribution in the production. The biggest percentage of the last ones believe that that the advantages from the use of such graphic computers have to do with the creation of designs easy to understand, which are easily modified and impress the costumers. All those that believe that the programs contribute in the better design, see that the benefit comes from the ease with which one can make modifications to those designs.

Benefits from the easily conceivable designs, is believed from the 100% of those who believe in the contribution of the software in sales. Table1 shows initially the benefits of the use in every occasion, where remarkable percentages gather the Easily understandable Designs and the Ease of design modifications (92.3%), the Impressive for clients (84.6%), the reduction of the mistakes and the speed and clarity of the depiction (from 76.9%). Table 1 also presents the results of Pearson correlation coefficient for all the benefits of 3D CG using benefits, in order to realise their cross-correlation per pairs. Thus, it appears that the bigger values of Pearson correlation coefficient are presented in the variables: economy of design – speed of design (0.822), accuracy of the result – creation of new shapes (0.732), – reduction of mistakes (0.693), improvement of the design of the production communication with convenience in modifying the designs (0.640) and digital information about the product (0.677) for significant level $p<0.01$. That is to say that the means of the above pairs of benefits do not differ statistically considerably at a 2 tailed level.

More analytically the above results show that:

a) the bigger the saving in designs the bigger the speed of the completion of the design

b) the bigger accuracy of the result creates more effective new etc.

The benefits mentioned before from the use of 3D computer graphics in furniture design become a financial benefit. More to the point, the increase on sales prevails in the total of those who answered (100%), with second, close to the previous the reduction of the time needed for the production of the (92.3%) and third the reduction of the production cost (76.9%). Those percentages involve the total of those asked that believe that there is financial benefit from the

use of software. The average reduction of the production time for the design of a design proposal is considered to be 49.6% and the average reduction of the production cost 27.0%. Finally the average increase in sales is about 28.3%. The further analysis of the answers in relation to those 3 subjects gives interesting information:

- The quantification of the reduction of the design time, in the opinion of those asked is very characteristic: one third (1/3) of the answers give reduction of the time in a percentage of 20-35%, another one third (1/3) of the answers show a percentage of 36-50% and in the other 1/3, 51-80%.

- As to the factor of production cost reduction, it becomes evident that in 70% of the answers this is around 10-30%, while in the other 30% it is around 31-50%.

- In 20% of the answers, increase in sales of a level of 3-10%, results from the use of 3D graphics. In 50% of the answers the sales increase in the region of 11-30% and in the other 30% an increase of 31-60%.

- The X^2 control showed that there is a positive correlation between the finding of financial benefits and the use of the above programs and the years of use and the amount of staff used. More on the point the more the enterprises have used 3CG programs and the more staff they have the bigger financial benefit they have (X^2 Pearson = 3.933, Kendall's tau-b = 0.318, p=0.01 και X^2 Pearson = 5.714, Kendall's tau-b = 0.082 and p=0.01 respectively).

- Finally, the financial benefits in production seems to have a positive connection in a big degree with the number of staff used and a negative with the annual turnover of the companies (X^2 Pearson = 13.333, Kendall's tau-b = 0.126, p=0.001 και X^2 Pearson = 13.982, Kendall's tau-b= -0.051, p=0.005 respectively).

3.4.   The research's profile

From the enterprises that participated in the research of the final questionnaire, the 69.2% is active in the construction and the trading of furniture, the 15.4% in the industrial design and the rest 15.4% belongs to modeling-rendering-animating enterprises (Table 2). The total of the enterprises, that have to do with the industrial design and the modeling-rendering-animating, believe that the financial benefit comes because of the advantages in the design. Also 100% of the industrial design enterprises believes that the financial benefit comes from the advantages in production despite the fact that they do not deal with this, while from the construction and commercial a benefit in the production can be seen by only the 77.8% of them. Finally the construction and commercial enterprises combine the use of sales' programs with professional or industrial in contrast to the others.

Table 1: Frequencies and Pearson correlation coefficients of benefits of 3D CG software usage in furniture design

3D CG using benefits	Frequencies	t-test	Pearson correlation coefficient												
			1	2	3	4	5	6	7	8	9	10	11	12	13
1. Easily understandable Designs	92.3%	24,913	1.000												
2. Speed of design	76.9%	17,466	-0.192	1,000											
3. Plausibility of design	61.5%	18,073	-0.267	0.386*	1.000										
4. Impressive for clients	84.6%	18,007	-0.158	0.426**	0.225	1.000									
5. New form development	53.8%	19,024	0.267	0.283	0.238	0.507**	1.000								
6. Reduction of mistakes	76.9%	18,007	0.527**	0.426**	0.225	0.133	0.507**	1.000							
7. Speed and Clarity of depiction	76.9%	22,603	-0.433**	0.444**	0.617**	0.365*	0.386*	-0.030	1.000						
8. Accuracy of result	69.2%	17,544	0.365*	0.158	0.220	0.318*	0.732**	0.693**	0.184	1.000					
9. Design economy	46.2%	18,007	-0.158	0.822**	0.225	0.567**	0.141	0.133	0.365*	-0.058	1.000				
10. Ease of design modifications	92.3%	17,466	0.433**	.0278	0.051	0.426**	0.617**	0.426**	0.083	0.158	0.426**	1.000			
11. Digital product information	69.2%	24,913	-0.083	0.433**	0.312	0.527**	0.267	0.527**	0.192	0.365*	0.527**	0.433**	1.000		
12. Improvement of communication between design and production	7.7%	19,714	-0.123	0.178	0.461**	0.272	0.395*	0.272	0.284	0.101	0.272	0.640**	0.677**	1.000	
13. Space savings at retail locations	30.8%	44,488	0.083	0.192	0.267	0.158	-0.267	0.158	-0.192	-0365*	0.158	0.192	0.083	0.123	1.000

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The biggest percentage of those enterprises is from the aspect of legal institution A.E. (46.2%) while with the same, but seriously lower than A.E. percentage, the E.Π.E. the A.E.B.E. and O.E are represented. The personal companies consist a small percentage of the total (Table 2).

The 75% of the enterprises that took part in the research have up to 30 people on staff. Particularly the 37.5% has up to 10 staff, the 37.5% of the enterprises has 11-30, while only 25% have more than 30. From the aspect of the education level the 81.8% of them are college graduates and more specifically 54.5% are technical college graduates, 18.2% university graduates and 9,1% holds a Master. Of those asked there is a percentage of 18.2% that correspond to graduates of high schools and I.E.K. (Table 2).

Finally, the structure of the enterprises that took part in the research, from the aspect of the level of the annual turn over is given in Table 2.

As for the occupation of the people who filled the questionnaires on behalf of their enterprises, they are in the mostly (90%) either design directors (50%), or just designers that work in the design office (40%).

As for their age the people who answered the questionnaire, they are classified in 2 groups. The 66.7% are 21-30 years old and the rest 33.3% 31-40 years old. This attests that 3D CG as a tool of new technologies is used from relatively young people. Those of younger age have better knowledge of the market of such software programs as there are 14 programs that are known from people only from 21-30 years old.

Table 2. The profile of the research's enterprises

A/A	Characteristics of the companies in study	PERCENTAGE %
A.	Area of interest	
	Production and trade of furniture	69.2
	Industrial design	15.2
	Modeling – Rendering -Animating	15.2
B.	Company's legal status	
	A.E.	46.2
	E.Π.E.	15.4
	A.E.B.E.	15.4
	O.E.	15.4
	Personal company	7.7
Γ.	Educational Level of staff	
	Post-graduate	9.1
	Graduate University (AEI)	18.2
	Graduate Technical college (TEI)	54.5
	Highschool and equivalent (IEK - B'ΒΑΘΜΙΑ)	18.2
Δ.	Annual turn over	
	>1.000.000 €	44.4
	300.000 – 1.000.000 €	33.3
	100.000 – 300.000 €	11.1
	< 100.000 €	11.1

4. Conclusion

The two most powerful motives, for the use of 3D computer graphics for furniture design, seems to be the need for realistic visualization of the designs and the competition between the enterprises in the market. The initial decision for the use of 3D CG is taken in order to promote the enterprise. This is because the visual power of the graphical representation is highly regarded in today's world of multimedia. At the same time, the competition begins to appear as a motivation, as those who gain a good experience with the use of 3D CG, can have further advantages. In general, in most cases, the tools of 3D CG are not essentially involved in the production of the design proposals and these tools are usually seen as something extra that it's use in not mandatory. The use of digital design technology, as part of a complete information system, is for the time being, a privilege for only a few of the big enterprises.

The first important data that is acquired from the first contact is the familiarization with this software technology, the discovery of the capabilities that this offers and its expansion. So, every time that a need comes forward, it is examined if it could be better completed by the design programs. It is slowly being discovered that the basic demands of the design procedure, like accuracy and speed, are facts that has, someone who uses this computer technology. The use of the programs leads to the gradual discovery of the convenience that they offer, in their adoption and their acceptance as a tool for work.

But the thing that usually captivates the use of this software is the discovery of its power as a production tool. Easily can someone see that, the implementation is expanded in all the steps of the design study, but also in sectors before and after this, such as marketing, production and sales. Those programs, in the furniture sector, where the design is a fundamental characteristic element of the production, are a very important bridge between the artistic creation and the industrial design, while at the same time consist an important management tool, when it comes to big and complicated projects.

The goal is the continuous improvement of the graphics quality combined with low cost, as well as the development – exploitation of the capabilities and the advantages of the 3D designs beyond the design study. The relation of the study's designs with the materials for promotion and advertising comes from two ways and this comes from the accuracy of the digital pictures, but also from the ability those have to approach the reality. Of course, the digital 3D world can not substitute the sense that the reality gives, but an affluence of digital generated pictures. Also this can not substitute the creative experience that the designer has when he creates an idea. But it gives tremendous capabilities of alternatives, modification and changes of the idea and offers a substance of really new capabilities to this.

The excess supply of design programs makes the choice of the most appropriate for the furniture design difficult. The phenomenon observed,

is the use of the most popular CAD software packages, something that in not irrational. The question is weather this is something useful, or differently if it is the best solution. The specialized programs for furniture only, serve at the same time both the production and the sales, but not also the research and the development of new products. But it is important to take into account to whether a software is going to be a part of a complete informational system of the enterprise or not.

The cost for the implementation of 3D computer graphics in the furniture design depends on many factors. First of all, the extend of the implementation of the design study is crucial, and after that also in other sectors. In any case it is clear that somebody can have very good results from the use of 3D CG, sparing only a small amount of money.

An important role has the education, through which educated handlers with demands are obtained. This is needed in a market that moves really fast and demands a continuous observation of the developments. Anyway, most of the users and especially the younger ones, seem to be enough up to date about the software that exist in the market, while they are completely familiar with the new technological definitions such as photorealism, 3D etc.

Generally, for most of the enterprises that took part in the research, it is found that they have a complete awareness of the benefit they can have from the use of 3D computer graphics programs. Almost all of them have a design unit, in which they use digital technology. This unit is mainly staffed from young people and in more of half of the enterprises from T.E.I graduates.

It is found that the benefits from the use of 3D graphics, extend, apart from the design, to two other sectors, those of production and sales. The maximum benefit is achieved when the examination of the production procedures is being made through a complete informational system. Then, the additional benefits in the additional sectors are being added increasing the total benefit for the enterprise.

The majority of those using 3D graphics computer programs, believes that there is a benefit in the design and uses them in almost every kind of furniture, in some of them less, in some of them more, emphasizing on the furniture categories that have a big degree of industrialization of their products.

The use of such programs is being preferred especially for the stages of the design study that have to do with the rational design and the final results, but many are those who use them as tools and for the study (esthetic, constructional) of the material and their behavior. Benefits appear in the reduction of the space of work, in the advantageous methods of storing and filing, in the easily conceivable designs, in the credibility of the 3D picture, in the creation of new shapes, in the speed of completion of the design process, in the attribution of different views from a 3D digital model, in the attribution of different options from a 3D digital model, in the clarity and accuracy of the designs, in the easiness in interfering and modifying them and in the eradication of mistakes in the

creational and esthetic part of the study.

The thing that without doubt brings immediate financial benefit in the sector of design study is the time savings needed for its production, which is in average reduced in half.

An also big percentage of the users believe that there is a benefit in the sector of production. This comes from the reduce of the mistakes in the production, in the small number of trial models, in the simulation of the dynamic integrity checks, in the connection of the production with the sales, in the credibility of the product in relation with the designs and in the improvement of the communication between the design and the production.

The biggest financial benefit comes from the reduction in the production cost almost 33%, because of the minimization of the mistakes in production.

Of course, less are those who find out that the benefit from the use of 3D CG programs in the design comes in the sector of sales. This benefit is the same with the credibility of the designs, the complete comprehension of the designs, in the impact on the customers, the sense of individualization in the service to the customer, but also in the way the product is handled, in the capability for interfering for improvements in the stage of the design study. The sales, as known, are importantly helped by the advertising and the communication marketing. In both of those sectors, photorealistic illustrations are used very often, which have contributed in the increase in sales. It is a general belief, that from the use of software comes an increase in sales and because of that, a financial benefit.

5. Proposals

Beyond the things mentioned before, it additionally comes up that the researched software packages in the sector of furniture and the wood could have very efficient implementations. The advertising use of 3D interactive digital models is being suggested, instead of the static photorealism. It is certain that those will have a greater effect on the prospective buyer, as every one who is interested, will at least be able to rotate a furniture or be rotated around this. Much more, if he is given the ability to browse a part of the furniture (eg. to open a drawer or the door of a furniture) and have experience and pictures equivalent to those of a visit in a furniture exhibition. Also, the use of **«ghost models»**, as they are called, could help in the discovery of the hidden mechanisms, the method of assembly, materials of inner contruction. The result would be the satisfaction of a part of the consumers, without the necessity to have a complete model in every showroom (which takes space).

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