ARE BOOKS ON MANUFACTURING TECHNOLOGIES AND DESIGN REALLY READ? A SURVEY ABOUT HOW YOUNG FURNITURE DESIGNERS STUDY MANUFACTURING TECHNOLOGIES

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ABSTRACT:

Knowledge on manufacturing technologies (MT) is recognized by academics as being an important element of product design curricula and practice. Consequently many authors have proposed various approaches to teach potentialities and constrains of MT. These approaches could be classified in four typologies: the normative approach, the selective approach, the case study approach and the multi-sensorial approach. However do young product designers practice these approaches to learn MT? If not what kind of methods and tools do they follow? A survey was carried out among 97 young furniture designers in order to examine the relationship between young designers and MT. The survey was conducted during the "Salone del Mobile 2012", an international furniture trade fair held in Milano, Italy. Analysis of the data explored methods and tools practiced by young product designers to learn MT potentialities. Results reported that knowledge on MT is very important for young furniture designers and nearly all indicated MT as a potential source of inspiration for their professional practice. Additionally our findings would seem to suggest that the most utilized and important tools for studying MT are two: look at the made products and speaking with experts. Internet and publications on MT are also quite practiced, but they are not perceived as important as the others. In our opinion these findings would seem to highlight the importance of direct experience for young product designers in learning of MT. Despite our research is preliminary, we believe that our conclusions could have an impact on future researches on tools and techniques for teaching MT.

1. THE IMPORTANCE OF MANUFACTURING TECHNOLOGIES IN PRODUCT DESIGN

MT are a fundamental aspect of industrial design discipline. Dorfles (Dorfles, 2001) argues that the advent of machines in the production of objects is one of the essential conditions for being able to talk about industrial design. For him an industrial object is what is made completely whit the intervention of machine without any further human agency. In his definition there is no idea of industrial design without industrial production technologies. Maldonado (Maldonado, 2001) highlighted another important aspect of the relation between MT and industrial design. He stated that industrial design came when the industrial revolution, according to Taylor's doctrine of fragmentation of work, imposes a clear division in terms of space, time and cognition between design and production. Also Risatti (Risatti, 2007) more recently pointed out that the difference between industrial design and craftsmanship is in the relation between the design stage and the production stage. While a craftman controls both the design and the production stage, a designer manages only the design stage with no involvement in production.

This means that designers don't have any direct experience of production technologies; however, a prompter knowledge of manufacturing processes is important for product development.

Pedgley wrote that regardless of the relationship between designers and technologies, "Materials and production processes are vital for the creation of a new product." The author pointed out how design concepts are concretize from the abstract world of the computer to the physical world through the media of materials and manufacturing processes (Pedgley, 2009). During the process of concretization, the project will change according to the characteristics of the chosen manufacturing technology. The production process leads to a substantial change in the shape of the object and determines important functional and formal transformations (Dorfles, 2001). In fact project is a network of interactions, where function, material, shape and process influence each other in a constant dialogue (Ashby, 2011). Therefore the designer must know the grammar of technology and materials

in order to obtain consistent formal and aesthetic solutions and avoid errors and inefficiencies (Bralla, 1999). Adorno (Adorno, 1967) stated that an in-depth knowledge of characteristics of production technologies and in particular of the most innovative is a source of inspiration for the generation of new design solutions and languages. Also Fischmeister (Fischmeister, 1989) expressed the same idea indicating that product innovation can arise from study and application of new materials and manufacturing processes. Flexible MT can become also the object of design research (Mari, 1970).

2. A TAXONOMY OF THE STUDIES ON DESIGN AND MANUFACTURING TECHNOLOGIES

Due to this relevance in design practice, by the Second World War onwards several authors have developed different approaches to transfer the design related characteristics of MT.

Based on the methods and tools used to convey this knowledge, in literature we identified four approaches: the normative approach developed in the context of mechanical engineering; the selective approach developed by the discipline of material engineering, the casuistic approach developed by industrial design scholars and the sensorial approach that is cross disciplinary

The normative approach, also called in literature Design for Manufacturing, has been developed by several authors in the field of mechanical engineering (Boothroyd, 2005; Boothroyd, Dewhurst, & Knight, 2002; Bralla, 1999.; Kalpakjian, 2010; Poli, 2001). The assumption of this approach is to reduce production cost integrating knowledge of manufacturing in the early stages of the design process (Boothroyd et al., 2002; Bralla, 1999.). The authors state that incorporating manufacturing knowledge in the design process reduces errors and production times, improving product quality and reducing production costs (Bralla, 1999.). The manufacturing technologies are generally presented in two sections, which are the general design considerations and the detailed design recommendations (Bralla, 1999.). The general design consideration is textual descriptions of the physical process involved and of the relevant elements that characterize the different

production processes. The detailed design recommendations are quantitative rules and formulas that guide designers in choosing the most efficient geometrical solution for the process selected.

The selective approach is a method developed by Ashby for the selection of materials in the design process (Ashby & Kara, 2010, Swift & Booker, 2003). An expansion of the approach also incorporates manufacturing technologies. All the production processes are collected in a database and each process is summarized in a form with a brief textual description, schematic illustrations and a list of technical characteristics. Some characteristics are: the obtainable shapes, the physical specifications, the possibility to make low volumes production, the continuous or discrete nature of the process and some economic aspects. The characteristics are expressed in form of numerical range or with true and false. The aim of the selective approach is to give a tool for helping designer in selecting the most suitable process and material for their projects.

The case study approach applies a case studies methodology for describing the design potentialities of manufacturing technologies. Many authors that use this approach are researchers in product design (Byars, 2003; Lefteri, 2007; Thompson, 2007, 2011), consequently, case study approach was assumed to be the closest to the industrial design discipline. In the first part of the approach, the technology under study is presented in a general way, with textual description of the physical process and illustrations of phases and components. In the second part a case study is presented. The case study documentation is composed of photos and textual explanations. It clarifies the production stages, the process particularities and the product features achieved.

The cross-sensory approach was recognized in an approach proposed by Kalpakjian and taken up by Poli (Kalpakjian, 2010; Poli, 2001). The approach main idea is to transfer knowledge on design and manufacturing using different media like: videos, web sites, physical and virtual models. The knowledge on manufacturing technologies is the same of the DFM approach, but the assumption is that a multi-sensory representation is more explicative (Kalpakjian, 2010) and leads to a more immediate understanding. For

example the authors have stated that a process is better understood if presented through a video that shows all phases and moving components. Inside this approach can be identified three sub methods due to the different media used. These sub methods are: the multimedia method, the virtual and the physical. The multimedia method foresees the use of videos with illustrations and spoken descriptions (Kalpakjian, 2010). The virtual method utilizes a virtual environment where the machine is recreated. Students can interact with the environment and watch elements of the machine that usually aren't visible (Poli, 2001). The physical method foresees the use of a physical model and mock-ups

3. METHOD

But these approaches are utilized by young design practitioners? In order to understand what young product designers think about MT and which approach they use a survey was carried out.

The survey was conducted using a structured questionnaire. The questionnaire was structured in four parts: demographical data on respondents (origin, academic background, profession and years of experience), questions about the importance of production technologies, the influence of MT on projects, the capacity of MT to inspire new projects and the tools used to study MT (See in appendix A for the questionnaire).

The panel selected for the survey was young product designers. This panel was selected because their knowledge on production technology is not yet complete, so they could be interested in knowing new design potentialities and exploring new MT. Also they are a good tester of the contemporary design educations system.

The questionnaire was subjected to two tests before final delivery to the selected panel. Two versions were built one in Italian to capture the Italian designers and one version in English for designers coming from foreign countries.

The survey was conducted during the Salone Del Mobile 2012 and designers who exhibited their projects during the event were interviewed. The questionnaire was administered in the areas of Ventura Lambrate, Zona Tortona and SaloneSatellite.

The decision to administer the questionnaire in this event is motivated by practical and methodological reasons. During the Salone del Mobile designers from around the world gather in one place, allowing putting questions to a heterogeneous panel in terms of provenance and background. On days with minor turnout is easy to find designers in times of waiting, this makes respondents willing to answer questions. In addition, the fair is a low technological content. This indicates that the designers do not necessarily have a technical training or a specific interest for production technologies, giving us the ability to check prototypes to an audience of people who potentially could be not interested in production technologies.

Simple statistical analysis was employed to treatment of the data.

4. RESULTS

100 designers were interrogated and 97 delivered a completed questionnaire and were included in the data analysis.

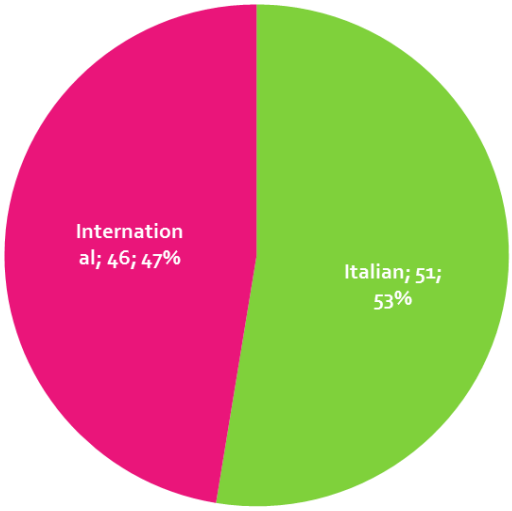

Figure 1 nationalities

The nationality of the participants was not requested directly, but the questionnaire was delivered in Italian and English. Counting the number of

respondents that have returned the questionnaire in English (47%) the panel was assumed to be an half Italian and half international (Figure 1).

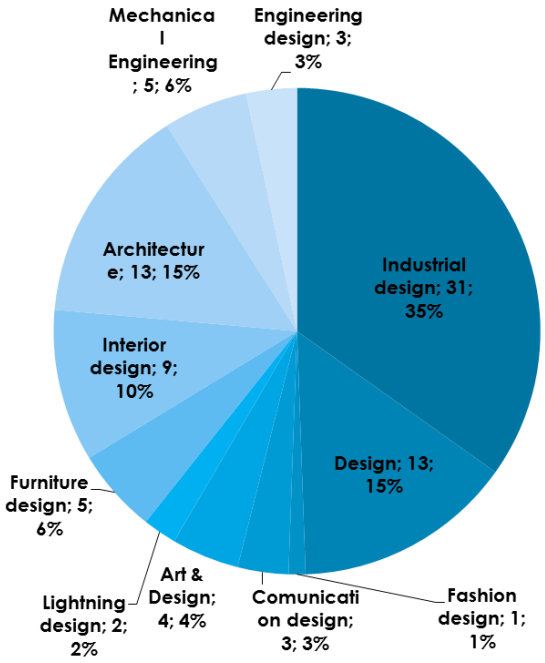

Figure 2 academic backgrounds

The academic background of the participants was asked explicitly. If we consider the design disciplines as a whole, about 76% of the sample had trained in that field, however, these design disciplines range from fashion, interior design and lighting. Respondents with background in architecture are about 15%; while engineers are 9%. If we analyse the design disciplines the predominant component consists of industrial design 35%. Generic design and architecture are 15% and interior design 10% (Figure 2).

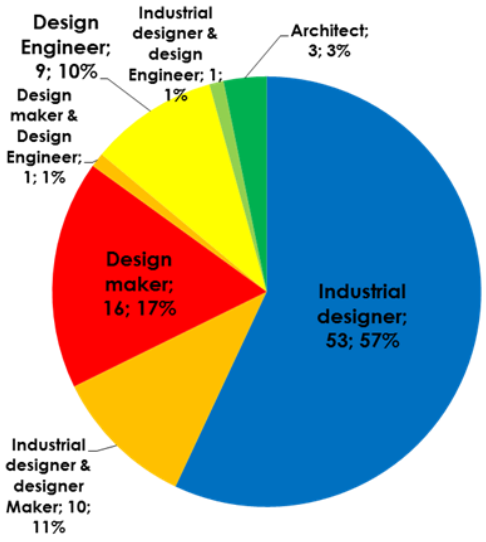

Figure 3 professions

Following the scheme proposed by Black (Black, 1964) were asked to the respondents to enter their profession choosing among three alternatives: industrial designer, design maker and design engineer. Respondents were allowed to choose more than one response, in order to seize a broader vision of how they define their profession. As shown in Figure 3 57% defined themself industrial designer, 17% designer-maker, 11% industrial designer and designer maker and 10% design engineer. Initially the architect choice was not included among the possible answers, but three respondents asked specifically to be placed into this category.

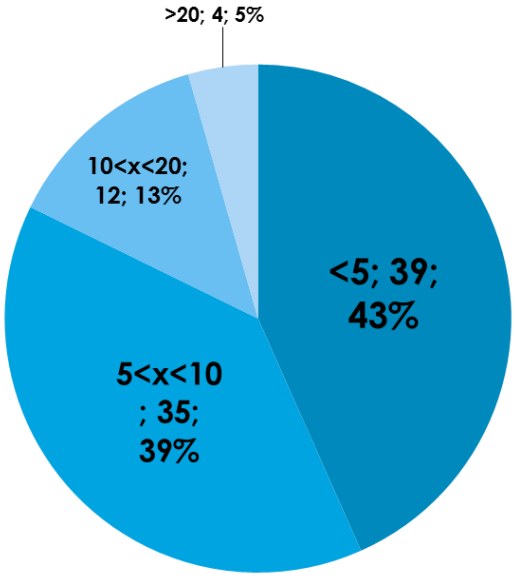

Figure 4 years of experience

As can be seen from the graph above, 82% of the interviewers have less than 10 years of experience. This data underlines that the panel was composed predominantly by young designers.

4.1 THE IMPORTANCE OF MANUFACTURING TECHNOLOGIES

80% of those who were interviewed indicated that knowledge of production technologies is very important.

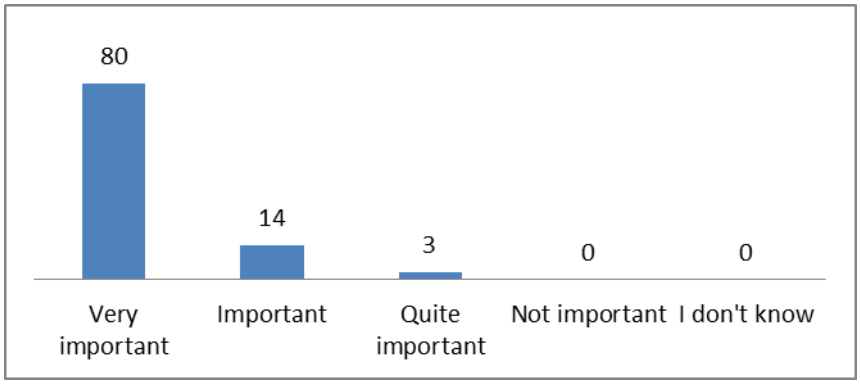

Figure 5 1) how much do you believe that knowledge of production technologies is important for a designer?

When it was asked if production technology affects the project, the majority of respondents, the 60%, reported that MT always affect the project. About the 35% specified sometimes.

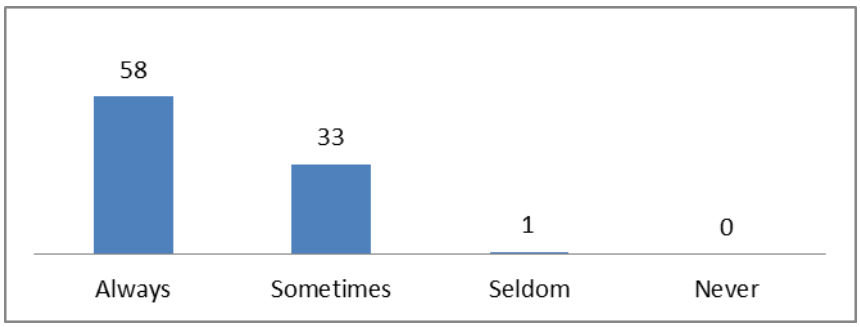

Figure 6 9) do you believe that production technology affects the project?

In response to question 10: How much does production technology affect the project? Over half of those surveyed (56%) indicated a value greater than 8 with a peak on the value 8. 75% of the respondents gave a value between 7 and 10.

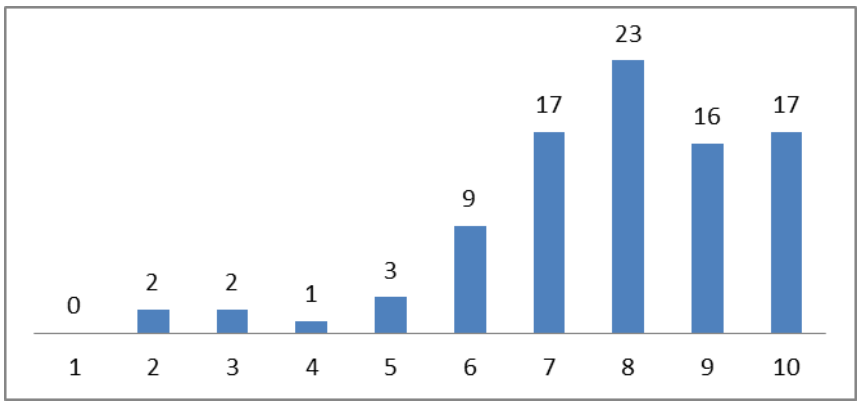

Figure 7 10) how much does production technology affect the project?

1. TOOLS TO STUDY MANUFACTURING TECHNOLOGIES

To assess which kind of tools are used to study manufacturing technologies and the importance that these tools have in the professional practice three questions were asked. The first question regarded a self-evaluation of the knowledge of MT. This question helped to understand the level of knowledge and the predisposition to learn more about MT. Question number 3 helped to understand which tools are used most. In the question was given nine close answers: reading books, looking at the product made, experimenting with projects, using directly MT, speaking with experts, visiting trade fairs, reading trade magazines, internet and other. Question number 4 uncovered which of these tools are considered the most important.

Figure 8 shows the results of question number 2. The majority of those who responded felt that their knowledge was good (68%). A minority of participants indicated excellent 10% and fair 22%.

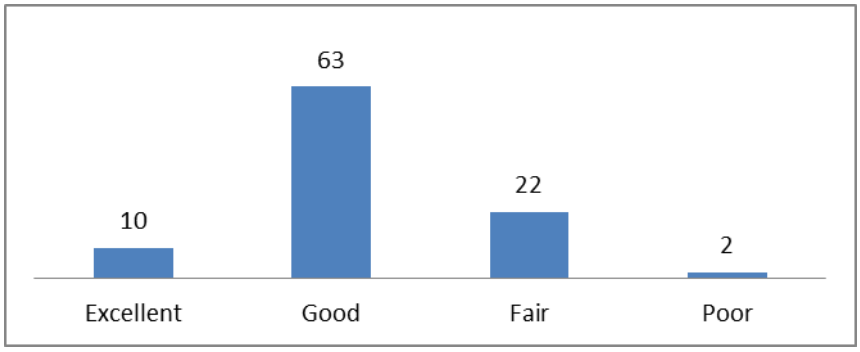

Figure 8 2) how do you rate your knowledge of production technologies?

The Figure 9 below illustrates the results of question number 3. The data show four levels of tools. In the first level can be identified the tools with more than sixty preferences. This means that at least two thirds of the participants use these tools. The tools that belong to this level are: speaking with experts, looking at the products made and internet. The data shows that these three tools are the most used to study MT among the participants. The second level can be identified in tools with about 40 preferences. In this level we can put the tool reading books that scored 43. In the third level we can identify the tools that scored about one third of the preferences. In this level the data show three tools: experimenting with projects, using directly a

production technology, visiting trade fairs. Finally the fourth level is made by the tools that scored less than 30 like reading trade magazines.

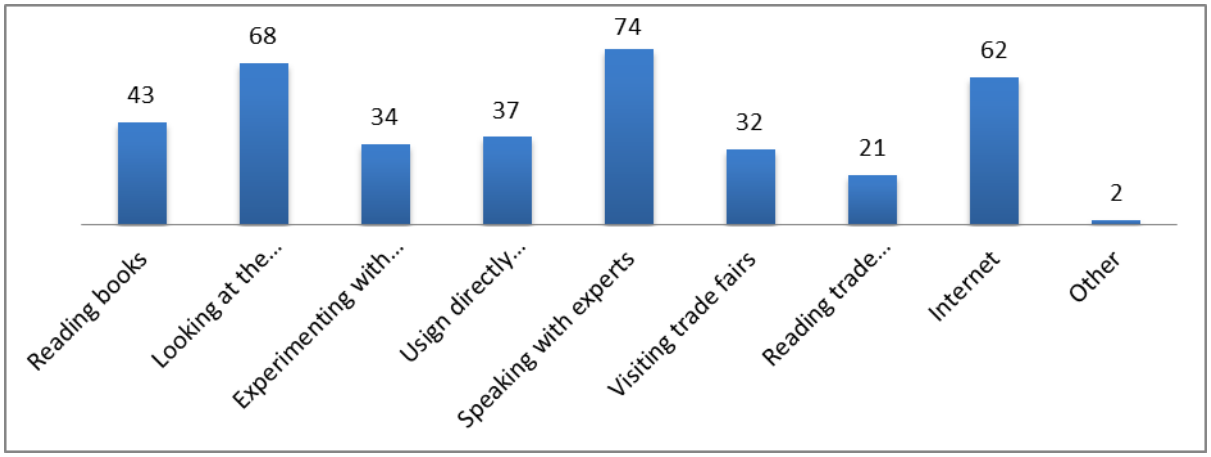

Figure 9 3) How do you study production technologies?

Figure 10 shows the relative importance of these tools for the study population. In this question was asked to rank in order of importance the first three tools indicated in the previous question, from the most important to the less. The most striking observation to emerge from the data comparison is that internet, that is indicated has one of the most used, is not one of the most important. The same result is true also for reading books. From the data we can observe clearly that reading books is not perceived as important as experimenting with project or using directly MT.

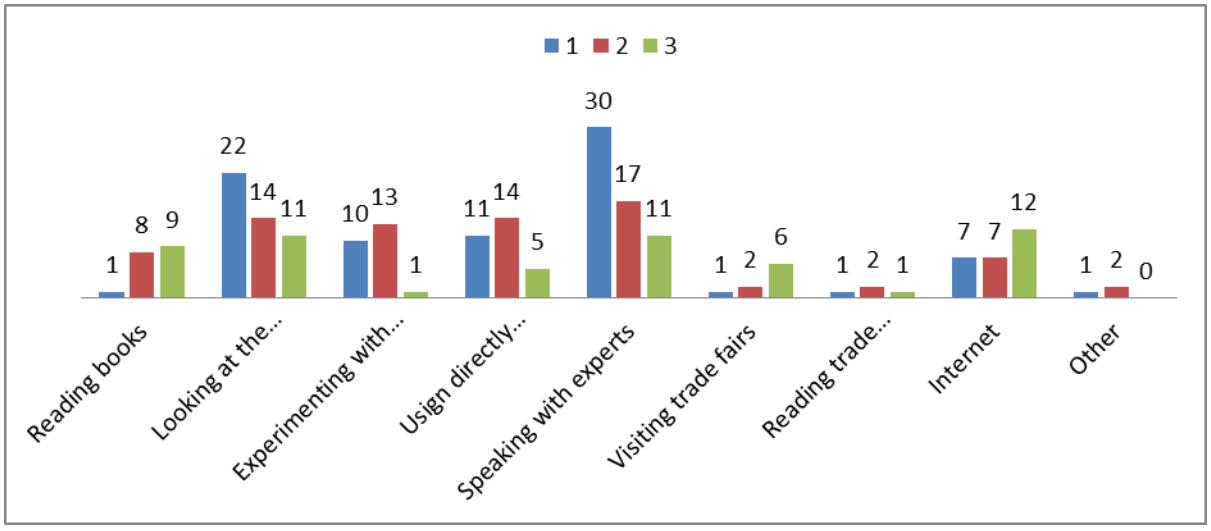

Figure 10 4) what do you consider most important?

1.1 TECHNOLOGY THAT INSPIRES DESIGN

In order to assess what the participants think about the capacity of the production technology to inspire new design solutions, three questions was asked to the panel. The first question was a direct question about the capacity of a production technology to inspire a project. Then was asked to give a score of how much a production technology can inspire a project. Finally was asked to the participants if they had used the characteristics of a production technology to develop and innovative project.

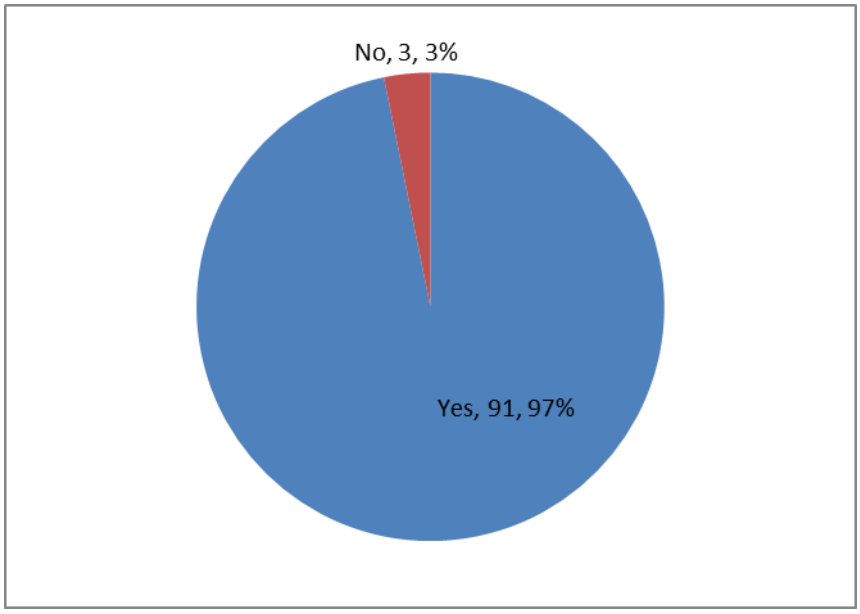

Figure 11 11) can a production technology inspire a project?

The data of question 11 show that the totality of respondents (97%) felt that a production technology can inspire a project. This data strongly underlines how young designer believe that production technologies can inspire new design solutions.

Figure 12 presents the result of question number 12. In this case the results are not so strong, but the distribution shows a peak on value 10 that is comparable with values 7 and 8.

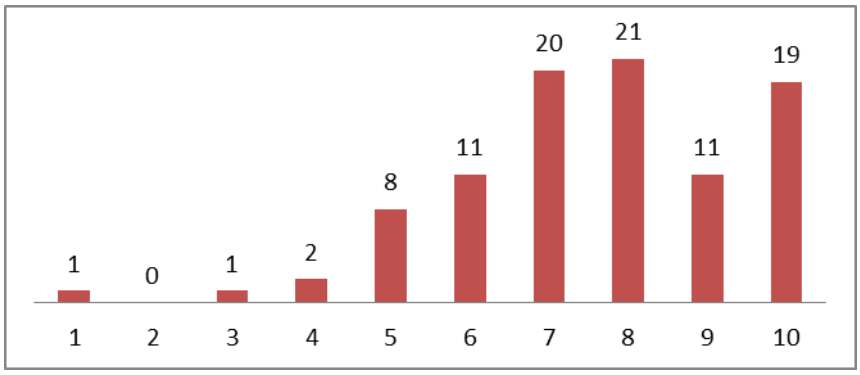

Figure 12 12) How much can a production technology inspire the project?

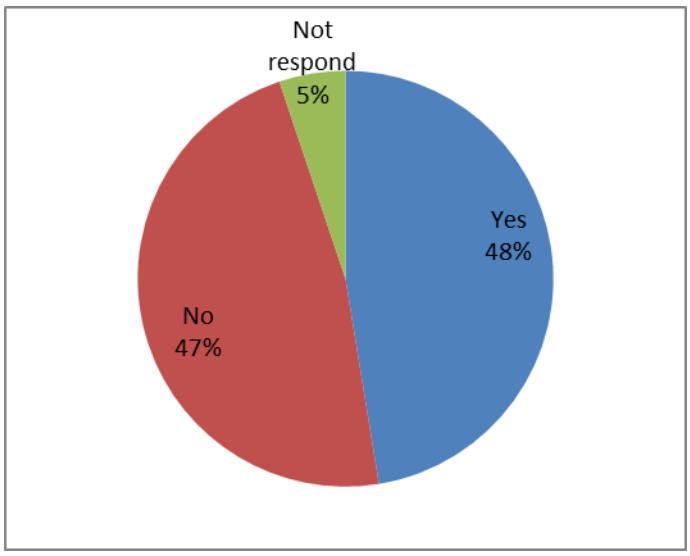

Figure 13 7) Have you ever used the characteristics of a production technology to develop innovative projects?

The results of question number 7 are shown in Figure 13. In this case the answers show that only half of the participants used the characteristics of a manufacturing technology to develop an innovative project.

5. DISCUSSION AND CONCLUSION

The present study was designed to determine which kind of tools designers use to study MT. Prior to assess that, was determined the importance of knowledge of MT in affecting and in inspiring the project.

The general result about indicates that the knowledge of production technologies is very important for young furniture designers. The participants stated that MT affect very often projects and MT can influence the project quite in deep. These underlined the awareness that young design practitioners had about MT.

The result of question 11 provides a strong evidence of the inspirational potential of production technologies. In fact almost all (97%) the participants thought that production technology can inspire new projects.

In our opinion this result is interesting if compared with question 7. Question 7 shows that an half of the participants didn't take advantage of manufacturing technology characteristics; despite, all of them thought that MT can inspire a project. It would be interesting to understand the reasons of this data. In fact several interesting reasons could be hypothesized. For instance this data could be related to the difficulty to acquire the propter knowledge in order to develop an innovative project.

The results of questions 3 and 4 about what kinds of tools are used to study MT are quite surprisingly. Participants stated that speaking with experts and looking at the product made are the most important tools to study MT, both in terms of total absolute total score than in terms of relative importance.

Internet has the third position in terms of total score, but unexpectedly the fifth in terms of importance. This could demonstrate that knowledge acquired on internet is not formative enough to develop new products; despite, several multimedia materials produced by companies and universities can be found on internet. This consideration seems also to insinuate that multimedia materials is not sufficient to transfer the knowledge needed to exploit production technologies in order to develop innovative products.

This reflection is also corroborated by the score of the other tools. Reading books for instance scored the forth place and its relative importance is quite low. In fact designers seem to not acquire knowledge using standard academic tools such as books.

This could be related both to the quality or quantity of knowledge available in the books and in designer's practices. Design practitioners feel probably more comfortable to learn from objects and from experts instead that reading books.

This interpretation is consistent with other findings that highlighted how design discipline relies on visual cognition (Casakin, H., 2004, Oxman, R. 2002) and how MT can be taught effectively through multimedia material (Kalpakjian, 2010, Poli, C., Fisher, D., Pollatsek, A., & Woolf, B. P. 2003, Poli, C., & Woolf, B. P. 2003). However, also multimedia materials seem to be not sufficient in order to transfer limitations and potentials of processes.

More research on this topic needs to be undertaken to investigate which of tools are suitable to convey the knowledge on MT and what characteristics these tools should have. We hope that this will be a good starting point to uncover the strategies to convey the knowledge of MT in order to develop innovative products.

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