

# Studying Knowledge about Eco-Design Tools at Department of Industrial Design, Brno University of Technology

Richard Sovják<sup>1</sup>

<sup>1</sup> Brno University of Technology, Faculty of Mechanical Engineering; Technická 2896/2, 616 69 Brno, Czech Republic; xssovjakr@vutbr.cz

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**Abstract** The article focuses on the research of students' knowledge about using the eco-design tools and their subsequent demands on education in the field of environmental impacts. Students should acquire these skills during their studies at the Department of Industrial Design at the Faculty of Mechanical Engineering of the Brno University of Technology. Research questions were asked 72 of the total 78 respondents bachelor's and master's degree. A research questionnaire was formulated, having 12 questions in total, where 10 of them were closed with a possibility of answer Yes / No and two open questions with free answers to fill up with up to three answers. The research was not focused on the gender of the respondents.

**Keywords** Eco-design, environmental impacts, industrial design, LCA, LCI

## 1. INTRODUCTION

Product design and products require not only knowledge of art, aesthetics and ergonomics, but also an understanding of the technological processes that lead to the realization of the final proposals. Industrial designer should have multi-disciplinary expertise from both the product design and marketing, but also in terms of the use of LCA (Life Cycle Assessment) [1]. The traditional approach of industrial design is narrowly focused on the production and use of products which neglect the importance of eco-design in a broader context, namely phase of acquiring raw materials and production process. A very important aspect is particularly the end of the product itself and the subsequent recycling, which significantly reduces the negative environmental impacts such as landfilling [2]. Knowledge of designers about eco-design tools and their use is very small. The research was conducted in 2003 in Japan, and was executed in 70 independently working designers, including 197 designers working in nineteen companies such as NEC, Sony and others, where only 23% of them were developing products with the help of LCA. It should be appreciated that from total amount of 197 involved designers only 23 worked in the eco-design [3]. Eco-design tools have different nature of the results, varying intensity data preparation (for example: inventory analysis LCI) and use. Research acquaints us with the most known tools that are used in practice as MET Matrix, Checklists, LiDS Wheel, LCA and more. [4] To protect the environment, a set of ISO 14000 standards and especially ISO 14044, which relates to LCA products or services, was created, but an important step to reduce

the negative environmental impacts of greenhouse gases is the ratification of the Paris Protocol on October 5th, 2016 which is valid until 2030 [5, 6].

The aim of the research is to determine the awareness of students participating in the survey on the environmental impact of products and to determine appropriate learning mechanisms in the early stages of product design.

## 2. METHODOLOGY

Research on knowledge of eco-design and requirements of students was conducted at the Department of Industrial Design at the Faculty of Mechanical Engineering of the Brno University of Technology within two days of teaching. The profile of respondents was given by the curriculum, students who already form separate artistic outputs in bachelor's degree program (study group 2ePDS and 3ePDS) and master's degree program (study group 4oPDS and 5oPDS). The data were collected through an electronic form on a Google server, including the option of completing the questionnaire via print form that was also used because of greater data collection. Age of respondents ranged from 20 to 26 years without considering sex of the respondent. The collected data were processed through MS Excel spreadsheet.

The research of knowledge on the eco-design consists of 12 research issues. Two questions were targeted at the needs of students - if they would like to gain knowledge on eco-design tools during university studies, and one to determine whether they want to get familiar with environmental impacts at an early stage of their product designs.

Research questions to answer Yes / No:

- Q1. Do you know the eco-design tools?
- Q2. Using tools of LCA (life cycle analysis of the product / service)?
- Q3. Do you know what a set of standards ISO 14000 deals with?
- Q4. Would you like to design products that meet eco-design rules?
- Q5. Do you know the difference between qualitative and quantitative approach to assessing the product's life cycle?
- Q6. Would you be able to create LCI (inventory analysis) of your service or product?
- Q7. Should an industrial designer have knowledge of LCA (life cycle of the product)?

- Q8. Would you like to gain LCA knowledge during studies at BUT FME IMID?
- Q9. Would you like to learn about the environmental impacts (energy requirements for the manufacturing of products and the carbon footprint of products) of your proposals in the early stages of product design?
- Q10. Do the requirements for eco-design reflect in products that fulfill greendesign?

Research questions with free response of up to three data:

- Q11. List three ways you can reduce the environmental impacts of products and services.
- Q12. Fill in one software LCA tool.

### 3. RESULTS

The answers were dependent on the type of questions: Yes / No or free response. The total attendance for all study groups (2ePDS, 3ePDS, 4oPDS and 5oPDS) was 92.3%, individual participation in study groups is in the graph (Figure 1).

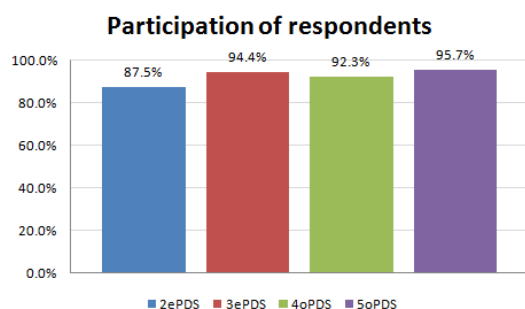


Figure 1. Graph of participation survey respondents

Figure 2 contains graph depicting an affirmative answer (Yes answer) in questions with fixed answers. The smallest variance across the entire spectrum of responses at the Department of Industrial Design students is observed on issues of Q3, Q7 and Q8. The greatest consensus was achieved on the issue of Q7, which is further elaborated in (Chapter 3.3).

Graph of affirmative responses - Yes (answers to Q1-Q10)

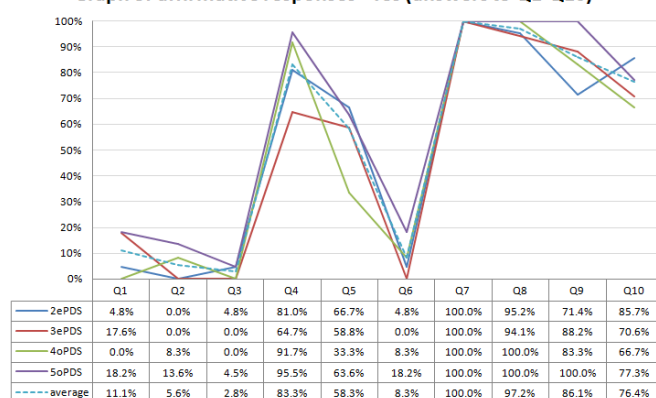


Figure 2. Summarization graph of affirmative responses - Yes (answers to Q1-Q10)

The question Q1 focused on knowledge of eco-design instruments and was crucial in research at the Department of Industrial Design. The graph (Figure 3) shows apparent ignorance of these instruments. It is interesting that knowledge of eco-design tools exhibit 17.6% of the final year of undergraduate study (3ePDS) and 18.2% of master's degree students (5oPDS). 100% of the master's degree students (4oPDS) showed ignorance of eco-design instruments despite their responses to question Q2 that showed that 8.3% of them use LCA tools.

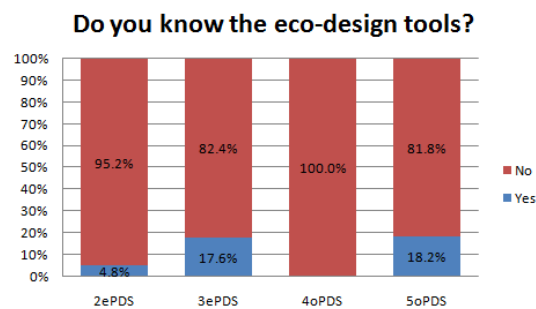


Figure 3. Summary charts (answers to question Q1)

#### 3.2 How to Reduce Environmental Impacts

Research was also carried out with open questions in order to ascertain the views of students, how it is possible to reduce the environmental impacts of a product or service. Of the 72 students (the entire spectrum of academic years) responded to this question, only 36.1% of them responded (Figure 4). Responses were composed by students from one to three examples of how it would be possible to reduce environmental impacts.

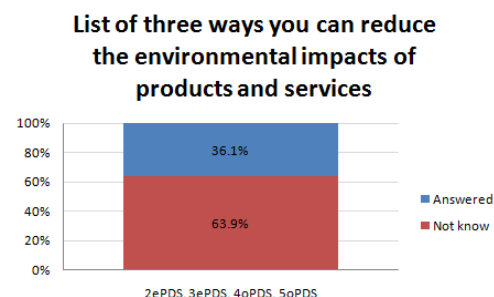


Figure 4. Chart of number of responses (response rate to the question Q11)

Detailed analysis (Figure 5) showed that the largest proportion of responses to the question Q11 constitute material recycling 26.7%, followed by appropriate use of materials 21.7%. In total, 48.4% of the responses focused on the nature of the material used for parts or components of the products or articles. Students are aware of the appropriate use of materials related to the subsequent recycling and reducing landfill and supporting the considerate use of material resources.

#### 3.1 Knowledge of Eco-Design Tools

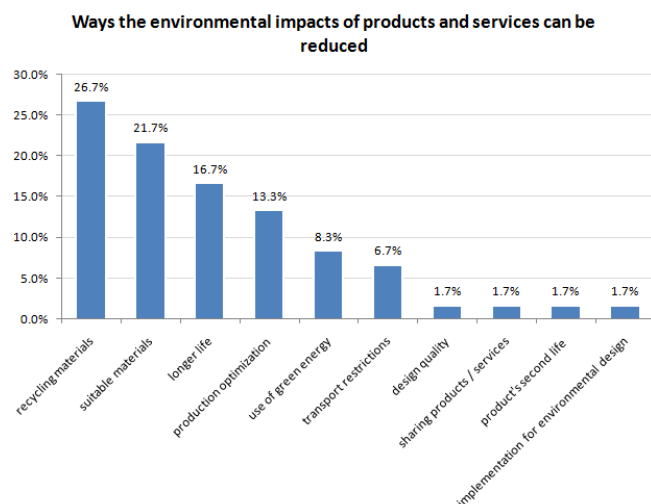


Figure 5. Graph of options to reduce environmental impacts (answer to question Q11)

It was found that an important phase for the respondents is the user phase, totalling 20.1% (longer lifetime in 16.7% share of products/services 1.7% and the second life of the product 1.7%). Very interesting result is observed in reducing the environmental impact of the production optimization and reduction of transport totalling 20.0%. Only 1.7% of the responses show that it is possible to reduce the environmental impact by quality of product design. The research question Q11 had a total of 60 individual responses.

### 3.3 Requirements for Environmental Education

The aim of the research was to find out whether students are interested in gaining knowledge in the field of eco-design during university studies and apply them in their product designs. Answers to questions Q7-Q9 provide important information (Figure 6) for LCA development of teaching in the Department of Industrial Design.

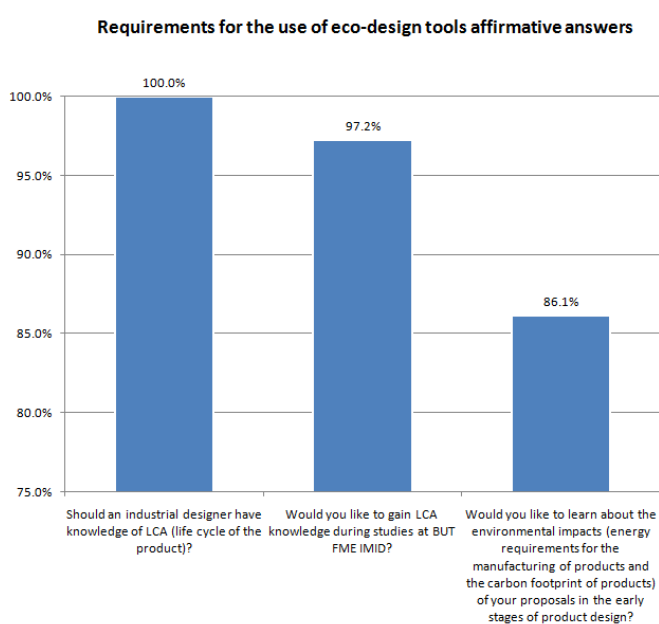


Figure 6. Graph student requirements in the LCA (answers to questions Q7-Q9)

The graph (Figure 6) shows the average results of all responses of bachelor and master studies at the Department of Industrial Design. 100% of respondents believe that the industrial designer should have knowledge of LCA product (Figure 7) and 97.2% of respondents believe this knowledge should be acquired during their studies at the Department of Industrial Design.

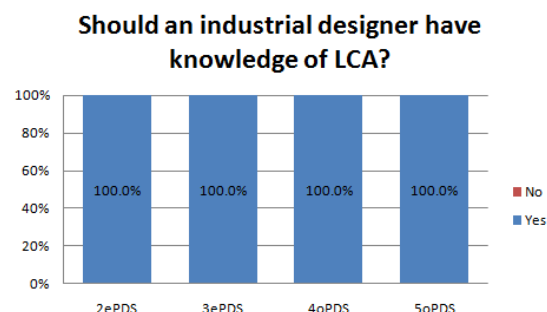


Figure 7. Graph of demands of the students (answers to questions Q7)

Answers to the question Q9 provide valuable information about requirements of possible LCA training regarding the early draft stage of the specific products (Figure 8). Thanks to the distribution of respondents by grade, there is visible interest of 100.0% in the last year of master's studies students (group 5oPDS). This group would like to learn about the energy requirements for the manufacturing of products and their carbon footprint. Students in the last year of undergraduate studies also expressed interest, where such information would like to know 88.2% of respondents (group 3ePDS).

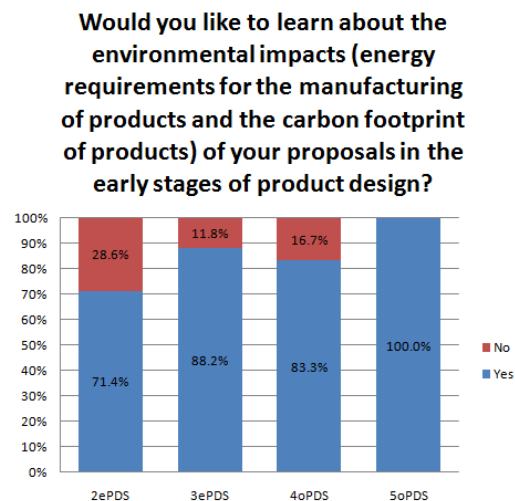


Figure 8. Graph of requirements of respondents (answers to questions Q9)

## 4. CONCLUSION

Comparing the results of the research that has been done in the past in Japanese companies, there hasn't been any progress in the knowledge of designers themselves about the product lifecycle. So I think that the Department of Industrial Design graduates are not ready to practice and thus may be disadvantaged. Around 92.3% of students enrolled in study groups 2ePDS, 3ePDS, 4oPDS and 5oPDS participated in the research. The results of the questions Q1 and Q9 show interest of final year students of bachelor's and master's degree in the knowledge of the environmental impacts and awareness of eco-design. According to the graph (Figure 5) students

are aware of justified use of materials and subsequent recycling, as well as extending the user phase, requirements for transport and production of the product itself. It is strange that three students from 5oPDS and one student from 4oPDS responded that they use LCA tools, but neither of them listed any specific instrument (not recorded reply to the question Q12 from any of 72 respondents). The research is also possible to conclude that the higher year of study increases interest in the environmental effects of the design proposals (Figure 1). The research has provided valuable information for the future direction of the Department of Industrial Design at the Brno University of Technology Faculty of Mechanical Engineering.

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