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A NOVEL SOFTER AND MORE CREATIVE APPROACH FOR MATERIALS SELECTION WHILE INCORPORATING EMOTIONAL ASPECTS

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ABSTRACT
The concept of material selection and its importance has widely been investigated and its significance in the proper design and technology has also well proven. It is also clear that to fully understand its importance and utilising it properly within the context of Product Design Specification (PDS), one needs to have at least some rudimentary knowledge of material science and processing. However, this study is aimed at a more aesthetically and creative student or designer. How could the descriptors such as luxurious, shinny, soft, delicate, as well as warm etc be used within material selection? How can creativity influence choice? BA and BSc Design students on levels C & I were tasked with the materials selection process for two case studies. They could only use non technical jargons. Their responses were then analysed to establish a mechanism for the language of softer more creative material selection. Finally other groups were asked to use the available engineering tools, such as datasheets etc to select the suitable materials based on the criteria laid out by the first group. The findings were then consolidated. To establish reliable and reproducible results, the exercise was repeated with different groups for different case studies.

Keywords: Creativity, materials selection, emotional aspects, design study

1 INTRODUCTION

What is materials selection? Why we need to conduct materials selection is a question which is often asked by students on the softer side of design. In other words students who are studying courses such as BA (Hons) Industrial Design or Design Business Management regularly question the merits of the fact that they will need to select the materials. It is seen by many of them as a task performed by a production engineer or at the worst, by a Product Designer or a Design Engineer.
Engineering design relates to the design of engineered artefacts formed by materials of various types. Materials play an important role during the entire design process. At the early design stage, materials may achieve some of the required functions. Hence, designers may need to identify materials with specific functionalities in order to find feasible design concepts. 'Materials identification' is used to refer to this materials-related design activity. At the downstream design stages, when the physical structure for a design has been determined, materials with specific properties should be selected from a set of candidates, which is commonly referred to as 'materials selection' [1]. To a production engineer or a more technically based designer, the concept of material selection is clear and its importance plainly obvious. It is also hoped that the principle is understood and hopefully embraced. However, as mentioned earlier, many from Bachelor of Arts (BA) design routes find the concept alien and in fact many cases positively resist having to learn it. In many cases it is an issue of communication. An issue of technology and lacking the confidence and the knowledge underpinning the principles. There are several methods by which material selection can be done but one of the most recent and comprehensive techniques has been to use an interactive electronic database in the form of Cambridge Engineering Selector software (CES) which is based on Professor Ashby's innovative technique developed with David Cebon in 1984 [2]. However, the software is written by software engineers and is mainly used by Engineers and Technical Designers. It presents a daunting sight for many young designers, who do not even understand the terminology much alone, use it. It would be very useful to link the selection process to the descriptors which the body of students on BA courses understand. It was decided to try to create a new vocabulary of design. The science of aesthetics is closely related to

human emotions. Colour therapy has successfully been used in such sciences as interior design in order to categorise products according to shape as well as colour to age groups and even gender of the user. Clearly even before science came to the rescue, certain classifications were made such as pink being feminine and blue masculine. We now can relate colour to mood and tabulate the perceived effects. It is this science which influenced the choice of colour for the surgeon's overall or that of a child nursery. The science of colour and variety of shades and shapes and sizes have been very successfully utilised to great effect by clothes designers to packaging designers and in many cases extending the boundaries of even political correctness.

2 LITERATURE REVIEW

How can more sustainable products be developed and produced? Current methods as well as presents models on how to develop sustainable products were reviewed. Different methods for achieving products with as low environmental impact as possible are shown as well as principles for product development with special regards to materials selection, design, the product in use and recycling are given. Definition of a sustainable product, triple bottom line, dematerialisation, recycling, design considerations, ISO 14001 standard and the EMAS (Eco Management and Audit Scheme) regulation are examples of areas, which are reviewed in this article. Life cycle assessment, environmental impact, eco-efficiency, environmental space, market contacts, cultural aspects, fashion and trends are also reviewed. Guidelines for sustainable product development are presented with special regard to material, design and ecology. A description of materials selection and models for design based on a sustainable society is also presented [3]. A web-based process/material advisory system that can be used during conceptual design has been described. Given a set of design requirements for a part during conceptual design stage, the system produces process sequences that can meet the design requirements. Quite often during conceptual design stage, design requirements are not precisely defined. Therefore, it allows users to describe design requirements in terms of parameter ranges. Parameter ranges are used to capture uncertainties in design requirements. The system accounts for uncertainties in design requirements in generating and evaluating process/material combinations. The system uses a two step algorithm. During the first step, we generate a material/process option tree. This tree represents various process/material options that can be used to meet the given set of design requirements. During the second step, various alternative process/material options are evaluated using a depth first branch and bound algorithm to identify and recommend the least expensive process/material combination to the designer. The system can be accessed on the World Wide Web using a standard browser. It allows designs to consider a wide variety of process/material options during the conceptual design stage and allows them to find the most cost-effective combination. By selecting the process/material combination during the early design stages, designers can ensure that the detailed design is compatible with all of the process constraints for the selected process [4]. Artificial intelligence provides powerful techniques for formalising the art of engineering problem solving: for modelling products, describing task structures, and representing problem solving expertise as inference knowledge and control knowledge. Signposting systems extend the scope of these methods beyond automatic design by using them to provide both information and guidance for decision making by human designers. This paper outlines the application of AI methods according to cognitive engineering considerations, to the development of knowledge management tools for engineering design. These tools go beyond conventional knowledge management and decision support approaches by supplying both inference knowledge and strategic problem solving knowledge to the user, as well as information about the state of the design. By focusing on tasks and on the dependencies between design parameters, signposting systems support contingent and flexible organisation of activities. Such tools can support product modelling, design process planning and capturing expert design knowledge, in a form that can be used directly to guide the organisation of design activities and the performance of individual tasks. A key element of this approach is the incremental acquisition of product models, task structures and problem solving knowledge by defining variant cases [5]. A novel approach to the teaching of materials to engineering students is outlined. It starts from the overview of the "world" of materials made possible by material property charts, and develops both an understanding of material properties and skills in selecting materials and process to meet design specifications. It is supported by extensive computer-based methods and tools, and is well adapted both for elementary and for advanced courses [6][7].

3 METHODLOGY

It was decided to investigate what sort of terminology would be used by Industrial Designers and then try to link them to the underlying engineering principles which are listed in the Cambridge Engineering Selector (CES). In order to achieve this, firstly the students of the entire Design Framework cohort were given a series of lectures on the classical theory of materials selection including an introductory six hours of lecture and product analysis using CES. Next students were asked to relate terminologies such as luxurious, expensive, warmth, perception of quality, aesthetic features and qualities as well as the feel and texture to a descriptor in the CES as such terminologies do not exist within CES. However, in this case it was intended to reverse the process by investigating what engineering properties would be defined the descriptors. This would inform the expert system being developed separate from this article, enabling non technical designers to make their material selection. The expert system would either have its own database or a link into CES, enabling everyone from non scientist to engineering designers to base their selection on both humanistic and engineering descriptors.

4 RESULTS & DISCU8SSION

Students on the first and second year within the Design Framework were given a series of exercises which was meant to test their understanding of the vocabulary that are used as the basis of descriptors for the materials selection process. The terminologies used were deliberately selected to be biased towards the Bachelor of Arts (BA) students. This served four purposes. Firstly, it addressed the difficulty that BA students had with the technical jargons used within CES. Secondly it gave the Bachelor of Science (BSc) students the opportunity to sample the vocabulary and understand the mindset of the BA students. Thirdly it established the link between those terminologies and the emotional implications with that of the descriptors used within CES. Fourthly, the exercise was to inform the process of developing the Softer Option Material Selection Expert System.

When questioned about what property would give indication of Luxury, 91% identified surface finish as the descriptor. 5% had also linked the luxury to the mechanical properties with 9% completely not knowing what would describe luxury. It is difficult to be sure that the concept of luxury was understood. The level of luxury is very difficult to define. In fact it is possible that the students may have interpreted the word as that of value for money. When asked what descriptor gave the feeling of something expensive, only 55% saw the surface finish as the main descriptor. 19% saw other factors such as modulus of elasticity playing a part. 33% could not establish any descriptors which would adequately describe the price. The price scale which defines how much something costs is on a sliding scale. The perception of cost is also gender and class based. It is very much linked to affordability. This could be the reason why over 30% of students could not identify a descriptor. When asked about the warmth, i.e. the feel good factor, the emotions, 92% identified colour as the main descriptor with 29% also choosing surface finish. 5% also added the Young's modulus as a descriptor. The feel good factor is easily identifiable by all. Warmth as a descriptor has been used by paint industry and the classification of various shades is heavily reliant on it. Thus as one of the first things observed of a product, is its colour and texture, then the responses of the students stand to reason. When asked about the perception of quality, as it should compliment price, warmth and feel, 76% choose colour, surface finish, mechanical properties and cost as the main descriptors. 20% thought of mechanical properties alone and 4% choose cost as the main descriptor. What is one's perception of quality? How do we judge quality? We rely on brand reputation and recommendation. However, for an unknown company or a new product, we will rely initially on aesthetic and subconsciously compare it with a well known brand. This could underpin the fact that more than 75% listed three descriptors, two of which are clearly biased towards aesthetics of the product. When asked directly about what affects how a product looks, 78% indicated both colour and surface finish as the descriptors. However, 7% only considered surface finish and 12% just the colour. 3% seemed to think mechanical properties affect the look of a product. The answers given make sense since customers are initially attracted by the look. The initial visual impression counts. Therefore, it could be concluded that actually over 95% thought of a visual descriptor. To compliment the look of the product, students were asked to describe what would define the feel good factor. What would influence their emotions about owning a product? 70% chose colour, surface finish and texture as well as mechanical properties as the main descriptors. 25% chose only the colour and surface finish. The emotions of owning a particular product are linked to possibly many factors. Is it a luxury item, does it have a function which makes you smile or simply an excellent value for money. Does it have a sentimental value? Does it make life easier or is it a gadget? It makes sense that almost 95% chose the aesthetics of the product. However, it is good to realise that the mechanical properties of the material would define to some extent the form of the product. The form and shape of a product as defined by shape grammars clearly affects our moods. Finally students were asked to define the descriptors which implied sustainability. 80% indicated processing and material types as well as the mechanical properties as the main descriptors. 10% thought of just the materials and 7% only the processing. Interestingly 3% indicated the mechanical properties as the only descriptors. It is interesting that materials and processing are mentioned together since they directly affect each other. However, it is possible that the concept of sustainability was not correctly understood. There are more factors involved than just if the material is recyclable.

5 CONCLUSIONS

It is possible that the questions asked, were not clear or the students do not have enough depth and experience to respond to the question. It is also a possibility the students and young designers do not have enough life experience to be able to really appreciate what each of the questions really was asking. However, in reality CES is used by these students and they are the ones who will need to inform the expert system. The questions could have been more leading, by asking very specific questions about the feel and emotions. Shape grammar could have also played a vital role in this. The study needs to be expanded. In order for these feedbacks to inform the expert system, more systematic questions need to be asked and the database expanded. A series of actual product analysis exercises will be run with the results directly feeding into the project.

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