PRODUCT VISUALIZATION PRAXIS AND ITS INTEGRATION TO ACADEMIC CURRICULA

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ABSTRACT
This study aims to show the importance of integrating the existing Design Praxis and Product Visualization Methodologies from industry, into an academic curriculum that provides students with the awareness and competence level required to understand how these methodologies fit into the more general Product Lifecycle Management concept, on the assumption that a proper assimilation of this knowledge can help design professionals overcome global competition in this area.

Keywords: Computer Aided Design, Virtual Prototyping, Rapid Modelling, Product Visualization

1 INTRODUCTION

The design process is an uncertain activity and designers have to cope with it based mostly on their previous experience. Since every design is different, companies very often deviate from their standard design procedures, as designers try to meet the product specifications goals with very little initial information. Uncertainties in design during initial stages force designers to work on conservative, non optimized solutions that can lead to inefficient designs and eventual lack of competitiveness so these uncertainties need to be identified and avoided as earlier as possible in the design process. As designs and requirements become more and more complex the creation of physical models is discarded in favour of technical drawings which contain the product's relevant information, however, there is a possibility that these drawings only make sense to the experts in the field and leave other interested parties out of the main product development loop; thus increasing the chances of having some uncertainties and errors in the design process. With the integration of available technologies such as Computer Aided Design, Virtual Prototyping, Rapid Modelling and Visualization Techniques it is possible again to restore the habit of building a model of the product so everyone involved in the process can see and feel how the product evolves throughout its different stages.

2 COLLABORATIVE PRODUCT DEVELOPMENT

Product Lifecycle Management (PLM) is a business approach to managing the set of product definition information comprising its creation, management and dissemination throughout the lifecycle of a product. PLM provides access to detailed information during the full product development process. PLM offers the possibility to make information easily available to people in all levels of an enterprise including managers, product designers, product engineers, manufacturing engineers, maintenance engineers, and everyone included in marketing, sales and purchasing. This information is made

available from the time the information is first created until the product is retired from the market.

Making information easily available is useful only if this information, in turn, can be understood by the people involved in the information loop. Historically communication among collaborative product development teams has been done synchronously via verbal discussions using paper-based documents. But as product complexity and design requirements increase, the need for a better handling of high volumes of information arises. Traditional 2D product visualization tools include technical drawings, photographs and early versions of CAD drawings. However modern product design methodologies include 3D and 4D analysis such as flow simulation, motion studies, ergonomic evaluations and product structures among others [1].

3 MOTIVATION OF RESEARCH

2D drawings and text barely support the representation of three-dimensional and time-based motions. Photographs can leave out important information of the product and its associated elements and complex 2D technical drawings can be easily misred even by highly trained engineers and drafters. The capabilities to use and understand modern product visualization tools since an early stage of academic education justify the research on this topic to get a realistic picture of how developed these capabilities are.

4 PRODUCT VISUALIZATION IN INDUSTRY

Enabling effective data communication is the key to a successful collaborative product development processes and product information is a key enabler for collaboration among different departments in an enterprise, however to make the most out of this collaboration companies need to develop a strategy that embraces the complete product lifecycle methodology. Product visualization is not a solution to be applied only to one or a few processes in a company; Product visualization has the potential to be applied to manufacture, service and maintenance processes not to mention outside production floor opportunities such as supply chain, marketing and management fields [2].

5 ADVANTAGES AND PROBLEMS OF PRODUCT VISUALIZATION

Collaboration enables innovation and creativity among teams and profiting from the value of information-rich design provides companies with competitive advantages to reduce costs, improve quality and reduce product time-to-market. However, there are many different formats for data visualization and this can lead to several problems, i.e. when data has to be kept in several formats, many files have to be maintained and they can become inconsistent and out of synchrony with the original data. Outdated information can in turn propagate errors and problems. Another problem could be that users have to learn how to use multiple tools leading to an increase in the possibility to make errors in the product development process [3].

6 PRODUCT VISUALIZATION IN ACADEMIC CURRICULA

Visualization in education is usually a simulation or representation created on a computer to create a graphical view of something that needs to be taught, this is very useful for topics that are otherwise difficult or expensive to see such as mechanical deformations, temperature distributions, etc. In order to know in an illustrative way the reach and extent of product visualization, its tools and knowledge among graduate students, a survey was created to elicit this information [4].

7 QUESTIONARIE DESIGN AND INTERVIEWS

A questionnaire containing 19 questions was created in order to know the level of knowledge of the participants about product visualization, the population consisted of the PhD Students of the Technological Innovation programme at the Technical University of Catalonia (UPC) and its associated academic staff, this population includes academics, working professionals and full time students. This is considered to be a homogeneous group in the sense that they all research on product and process development and are supposed to be well versed in its methodologies. Besides people with similar background to those interviewed in this research are the ones more likely to use computerized product visualization tools in the first place in an enterprise environment.

8 RESULTS

The most relevant information obtained from the questionnaire is shown below. The categories in which the answers fall are Surveys, Respondents, Working Experience per Economic Sector, Number of Respondents That Have Used 2D Tools per Economic Sector, Number of Respondents That Have Used 3D & 4D Tools per Economic Sector and Additional Questions.

The following is a summary of results of the questionnaire.

Table 1 Survey's Information

Sent	20
Returned	16
Response Rate	80%

Table 2 Respondents' Demographics

Average Age	34			
Sex	Male 11		Female 5	
Academic Area of Specialization	Natural Sciences 2	Physics 1	Mechanical 4	Industrial 9
Working Area of Specialization	Education 9	Automotive 3	Manufacturing 4	
Current Academic Degree	Bachelor 9	Master 4	Doctor 3	
Aspiring Academic Degree	Doctoral Degree 13			

Table 3 Respondent's Working Experience at Different Sectors

Average Years in Primary Sector	2
Average Years in Secondary Sector	5.5
Average Years in Tertiary Sector	5
Average Years in Quaternary Sector	1.5

Table 4 Number of Respondents That Have Used 2D Tools per Economic Sector

Primary Sector	Yes 1	No 15
Secondary Sector	Yes 5	No 11
Tertiary Sector	Yes 3	No 13
Quaternary Sector	Yes 3	No 13

Table 5 Number of Respondents That Have Used 3D & 4D Tools per Economic Sector

Primary Sector	Yes 0	No 16
Secondary Sector	Yes 6	No 10
Tertiary Sector	Yes 5	No 11
Quaternary Sector	Yes 7	No 9

Table 6 Additional Questions to Elicit Visualization Tools Acknowledgement

If you use a computerized product visualization tool,	I don't Use 7	Low 1	Medium 5	High 2	Expert 1

what is your proficiency level?					

For how long have computerized product visualization tools being used at your workplace?	Not Used 6	Average No. of Months if Used 33

If you use computerized product visualization tools at your workplace do you know of difficulties during its implementation and use?	Yes 6	No 10

Where did you learn to use product visualization tools? (Simultaneous Possibilities)	I don't know yet 4	Work Training 4	On my Own 5	Academic Setting 5

Do you know any specialized product visualization tool such as Autovue (Oracle), Dassault Systems (Ennovia MatrixOne), Etc.	Yes 7	No 9

Do you think the use of product visualization tools would bring advantages to your job?	Yes 8	No 3	I don't know 5

Are you interested in learning how to use computerized product visualization tools?	Yes 9	No 4	I don't know 3

9 CONCLUSIONS

As it can be seen from the table above computerized product visualization tools are considered an important enabler to bring advantages to the jobs currently performed by the PhD candidates and the academic staff at the doctoral programme on Technological Innovation at the UPC , of course the sample is too little to make any statistical conclusions , but one can assume that product visualization is in fact present in current jobs, especially those related to the quaternary sector (R+D+I related jobs) and secondary sector from the automotive branches.

While visualization tools are used in most of the job categories mentioned in this study we can see that the proficiency level declared by the participants is mostly assessed as "Medium" and it is interesting to see that a significant part of those who use them had to learn this tools on their own. Another interesting fact is that those companies already using computerized product visualization tools have been using it in average for almost three years which shows how novel this field still is. Product visualization still has a long way to go to be fully implemented at companies and many of the respondents identify problems in the implementations and use of these tools.

For how long and at which economic sectors 2D tools will continue to be present and how they'll interact with the newest technologies is still a question to be answered, but we can see from the data here that the use of 2D, 3D and 4D tools isn't still as separated from one another as one may think and 2D tools are in fact still popular. As the use of

3D and 4D tools increases in all economic sectors many considerations both technical and business related will have to be taken into account as well.

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