Communicating and contextualising new product development tools and methods for engineering students

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Abstract

A web-based tool has been designed to make the design elements of undergraduate courses in New Product Development (NPD) more attractive. It does this by showing how knowledge translates to real products and by providing real life examples of the design process to help students understand and relate to abstract engineering design principles. Some of the content of the tool, called CoLab, was derived from a PhD that was undertaken at Loughborough Design School by Dr Eujin Pei and supervised by Dr Mark Evans (with a background in industrial design) and Dr Ian Campbell (with a background in engineering design). The CoLab website supports understanding in the nature of NPD by providing 35 examples of the key sketches, drawings, models and prototypes that are used by engineering designers and industrial designers. Figure 1 shows an image of a Study Sketch (from the Sketches section of the CoLab tool) and Figure 2 an Experimental Prototype (from the Prototype section of the CoLab design tool).

Figure 1: Image of a Study Sketch
Figure 2: Image of an Experimental prototype

To facilitate understanding and collaboration, the taxonomy is extended to provide information on the different ways in which engineering designers and industrial designers use the 35 design representations i.e. when they are used and what types of information (design or technical). The CoLab tool is of interest to engineering students and students interested in engineering from secondary school to undergraduate/masters and early career practitioners. The web site is available at www.colab.lboro.ac.uk

Keywords: New product development; engineering design; industrial design; design representations, CoLab
Background

Originating from a Loughborough Design School PhD, the CoLab design tool was devised as a card-based system to promote understanding and collaboration between engineering designers and industrial designers during NPD. Despite an overwhelmingly positive response to the tool during validation as part of the PhD, the cost of the 116 full-colour, double-sided physical cards proved to be a barrier to commercialisation. With an identified need for the tool, the National HE STEM Programme facilitated the adaptation of CoLab into a web-based resource which included the collation of 35 carefully selected images that could be used without risk of copyright infringement.

CoLab has been developed for use by school pupils and undergraduate students on a wide range of engineering courses (e.g. engineering design, mechanical engineering, product design engineering/ manufacture). Following discussions with secondary school teachers, the 'Design Representations' section will be of particular benefit in the Design and Technology curriculum to promote engineering as a career and support understanding of NPD.

Rationale

The nature of New Product Development is poorly understood by undergraduate engineering students but can be a challenging and rewarding career for those who choose to work in the field. The tool promotes understanding and provides tangible examples of the design representations that are used during NPD. This is of significance in the context of promoting the undergraduate study of engineering and choice of careers relating to NPD. A highly visual approach was taken in the design of the Colab tool by selecting images of design representations that were informative but also appealing. Figure 3 shows the CoLab page for the Study Sketch, with the purple bar indicating that it is from the set of 35 Design Representations. The red card shows the types of information that industrial designers use a Study Sketch and for what types of information. The blue card provides the same information for use by engineering designers. The "Quick Tips" serve as a reminder for this.

Figure 3: CoLab web page for the Study Sketch
A clear demand for CoLab was indicated via the PhD research (literature review and empirical data collection) and when presented at conferences. It was designed to address key emerging issues from the national agenda, including improving interdisciplinary working by enhancing the joint understanding of engineers and designers as suggested in The Royal Academy of Engineering, *Engineers for the 21st Century* and as a key recommendation of the Cox Review of Creativity in Business: "Higher education courses should better prepare students to work with, and understand, other specialists".

Building on the work of the London Engineering Project (Delivering Inclusive Engineering: A practical tool to promote best practice when developing and enhancing engineering courses), the tool was designed to contribute to the following pedagogic needs:

- Ensure the practical application of theoretical principles are an integral part of teaching.
- Build inter-disciplinary links and apply them to existing courses and teaching material.
- Use a broad range of contemporary examples and contexts.
- Demonstrate how engineering relates to society and to a broad range of social and environmental needs by including examples of engineering in society where possible.

**The Approach**

The approach involved the translation of key outcomes from a PhD into a web-based design tool. The PhD developed a validated tool to support understanding and communication in the use of design representations during NPD. The former PhD researcher collated the data and presented this in a format that could be used by a website design consultancy (who were match funded by the Loughborough University EngCETL). A significant additional role for the former PhD researcher was to identify and collate 35 images of design representations that could be used on the web site as those used in the PhD had been cited from published texts. The design and development of the CoLab design tool was supervised by Dr Mark Evans who liaised with the PhD researcher and website consultancy.

During the design of the web-based tool, a simple but highly interactive approach has been taken that allows a high degree of cross referencing by allowing the user to select cards using the word descriptors that appear in the % use matrix. For example, on the blue engineering designers card in Figure 3, the most popular use for a Study Sketch is to communicate information on “Areas of Concern” which is Card 12. 90% of the engineering designers interviewed used the Study Sketch for this purpose. The wording for Card 12 is a hyperlink and when clicked displays the full information for Card 12.

The presentation of the website is intentionally simple, being laid out in three main sections of “Home”, “Use Colab” and “Information”. “Home” provides sufficient information to enable the user to understand the rationale and functionality of the tool. The layout of the CoLab home page can be seen in Figure 4.
“Use CoLab” provides access to the tool and gives the user the options of searching by:

- **Design Stages** (to explore how engineering designers and industrial designers use design representations during four stages of NPD)
- **Design Information** (to explore how engineering designers and industrial designers use design representations to communicate 10 types)
- **Technical Information** (to explore how engineering designers and industrial designers use design representations to communicate 8 types)
- **Design Representations** (to identify 35 types of design representation and explore how engineering designers and industrial designers use these to communicate design/technical information during the stages of NPD.

“Information” indicates the background to the project; the nature of the research; the results from the research and information on the development of the CoLab web site.

The website is intended to be a stand-alone tool, the content of which has been validated through the PhD that was a precursor to the project.
**Evaluation**

The information embodied in the CoLab design tool was identified prior to the project as being of value to engineers. The aim of the project was to make this accessible through translation into a web-based resource. This has been achieved by making minor modifications in taking a physical card-based tool to a web-based tool. However, as the management of the website is through searching a spreadsheet, it is possible to click on the words that give names of the design representations and types of design/technical information to link to their descriptive ‘cards’. Considerable effort was applied to identifying the 35 images that were to help increase understanding in the process of NPD and inspire students to study engineering. No objective information is available to confirm that this has been achieved although the project leader has a high degree of confidence that the images will support this.

**Discussion, Summary**

The conversion of the card-based tool that came out of the PhD proved to be a significant challenge and required greater web development time than was anticipated. The creation of a spreadsheet, collation of the 35 images and general support went according to the project plan. However, the complexity of the web site required more time to complete than scheduled and the Project Leader appreciated the support of the Loughborough University EngCETL who funded the web development phase of the project. Despite the challenges, the outcome is a highly interactive and attractive website that is now being rolled out to schools and universities around the country.

**Further Development**

CoLab is now being rolled-out to the academic community and the tool is currently available at www.colab.lboro.ac.uk

The link to the website and project details will shortly become available via the projects pages of the HE STEM website. An academic journal paper is currently being prepared for submission to the Journal of Engineering Design. The project was presented at the International Association of Societies of Design Research at TU Delft on 2 November 2011.

Further dissemination of the tool will continue via blogs and the intention is for the site to disseminate through links on secondary school and engineering school web sites.

**Further Reading / Bibliography**

CoLab [viewed 02/09/11]. Available from www.colab.lboro.ac.uk


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