

DIGITAL FUTURES: ALTERNATIVE CREATIVE APPROACHES FOR DIGITAL PRODUCT DEVELOPMENT

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ABSTRACT

This paper proposes an initial framework of alternative creative approaches for product design using digital design technologies. It investigates how such technologies enable designers to explore new design concepts and it outlines the methods used. This is considered against the backdrop of setting up a digital design laboratory, where designers and small and medium enterprises (SMEs) are guided through a structured programme to develop and prototype innovative product concepts.

Digital Product Innovation Lab (DPI Lab) at the University of Central England (UCE Birmingham) is a strategic project aimed at unifying the disparate digital technologies and expertise located within the university and beyond. Access to expensive digital design technologies and essential knowledge and skills is critical for the successful adoption by SMEs and designers. But there are, at present, a number of barriers to exploring the creative potential that such technologies can offer them.

Underpinning DPI Lab's engagement with digital technologies is the desire to encourage an interdisciplinary approach to product development which, through its notion of the creative digital workflow, it has started to address. The findings outlined in this paper will also provide a basis for further research into digital product design and the role that universities play in commercial product development and digital design education.

Keywords: Digital design technologies, design creativity, creative digital workflow, interdisciplinary design

1 INTRODUCTION

"Computers are wonderful for transmitting and accessing information, but they are, more broadly, a new medium through which people can create and express." [1]

Computing technologies have the potential to revolutionise the way that products are designed, manufactured, distributed and consumed [2]. In order to fully capitalise on this potential, SMEs and designers face many challenges from developing new business models and systems to implementing new design processes and strategies. This paper investigates how digital design creativity starts to address and stimulate new approaches to such challenges. Rather than looking at how improvements can be made to the efficiency of the design process, it will investigate how the technology can stimulate

design creativity and innovation. Furthermore, it is important to establish a framework that allows SMEs and designers to access digital design technologies to explore their design capabilities and potential business benefits. To facilitate this, Digital Product Innovation Lab (DPI Lab) aims to provide SMEs and designers with access to, and understanding of, the creative approaches for digital technologies.

The paper then presents DPI Lab's concept of the 'creative digital workflow', as a way to stimulate a multi-disciplinary approach to digital designing.

2 DIGITAL DESIGN AND PRODUCTION TECHNOLOGIES

"The real benefits of rapid manufacturing lie in totally new approaches to design, not just simple process and material substitution." [3]

Over recent years a growing number of creative approaches for digital technologies have emerged. This paper concentrates on pioneering methods in the following design technology areas: computer aided design (CAD) software, digital input devices and prototyping technologies. It also outlines two general concepts for digital production: non-direct manufacture, where a machine assists with one or more steps in the manufacturing process and direct manufacture, where finished parts are obtained directly from a machine. This section presents a range of approaches to digital design across product design, craft, fine art and architecture.

2.1 Design technologies

Paul Atkinson and Lionel Dean, pioneers of the 'FutureFactories' project, have developed a system for "individualised consumer products" [4]. Using parametric CAD software, variable designs can be automatically produced by computer, which enables "the designer to define relationships that form the character of a design rather than a single, discrete, design solution". They believe that "computer generated random mutation(s)" can offer the consumer "mass-produced, one-off, products". Their research has, more recently, explored evolutionary design principles, incorporating a "selection" process, which enables a virtual model to "develop generation by generation in a desired direction". This new approach exploits genetic algorithms, which reject product mutations that could not function or are not within "desirable" aesthetic parameters.

While Atkinson and Dean's ideas are based on a mathematical system to generate concepts, alternative methods are being explored that use a more intuitive approach. Tavs Jørgenson, researcher at University College Falmouth, explores how an input device such as a motion capture glove can be used within a design context. He exploits the device's ability to capture dynamic hand gestures, which are translated into digital drawings and used to create virtual forms, applying them to product concepts. Jørgenson believes that this device "has the potential for crossover applications in design, particularly if it is used as a creative tool, rather than merely as a mechanical tracking device...by injecting human qualities such as playfulness, spontaneity and informality into digital design" [5]. The conceptual forms generated by such input devices can be used to create alternative aesthetic approaches for product design.

Creative design processes are also being aided by 3D scanning devices. Japanese designer Tomoko Azumi has developed furniture and lighting products using data from

scanned natural forms. Her technique consists of manipulating scanned data and composing it in CAD, which draws parallels with the process of collage, where found or existing objects can be juxtaposed to create new designs. This method enables a less formal approach to digital concept development.

Digital prototyping technologies, including rapid prototyping (RP), laser cutting and other computer numerically controlled (CNC) systems, enable such concepts to be manifested in physical form. Heatherwick Studio, a London-based design practice, uses a combination of workshop models and digital prototyping to enhance its creative process. Typically, its designers digitally capture a workshop model to create a design template, which can be stretched, scaled, sliced and recombined with other data, then outputted to a prototyping machine for aesthetic and functional analysis. Their processes exploit the ability to move freely between virtual and physical models, maximising the strengths and abilities of both.

2.2 Production technologies

CNC systems are widely used within industry to assist with non-direct manufacturing methods. Currently, such methods account for the majority of digital production processes, however, many companies have difficulty accessing and understanding the benefits of digital production. Dr Justin Marshall, research fellow at University College Falmouth, has applied non-direct manufacturing techniques to produce innovative decorative plasterwork. Master models are created using a combination of 2D software and CNC processes in conjunction with traditional plasterwork skills to produce finished products. Marshall's designs employ flexible production methods. For example, his Penrose Strapwork series, "a non-repeating modular tiling system", generates "elaborate geometric...patterns of infinite variety and complexity" [5]. By exploring such technologies, Marshall and other 'digital makers' are helping to draw old and new technologies and processes together.

CNC production technologies such as laser cutting are also used for the direct manufacture of products. Production will no longer be bound by the limitations of conventional manufacturing, as explained by industry leader Terry Wholers. "Without the constraints imposed by tooling, designers are given the freedom to create new designs that were before impossible or impractical to manufacture" [2]. Rapid manufacturing (RM) offers further potential. Its additive-based system allows aesthetic variations that are only limited by the creative imagination, while offering new functional strategies such as parts consolidation and body fitting customisation.

The distribution of RM products will be equally as radical. Why have an assembly line when all the components can be consolidated for direct manufacture? Why ship products when they can be emailed to a local RM machine? This highly flexible manufacturing method subverts conventional production processes, "dematerialising the supply chain" [2] and reducing costs, offering substantial business opportunities to SMEs and designers.

3 DEVELOPMENT OF DPI LAB

The vision for DPI Lab embraces two strategic aims. Firstly, to establish a product innovation research unit to expand academic knowledge of digital design technologies and processes for product design. Secondly, to establish a mentoring programme for

SMEs and designers to create innovative product concepts using, where appropriate, the university's digital resources.

DPI Lab will explore and develop new creative methodologies using digital technologies with a particular focus on their application within product design, documenting possible new business and design process models. It will also initiate a digital technologies special interest group to help foster inter-departmental collaboration.

3.1 Engagement with companies

Companies undertake an initial seminar programme to raise awareness of emerging digital technologies, processes, production capabilities and product innovation opportunities. DPI Lab then mentors companies through a structured programme to agreed design objectives. These objectives are defined through a collaborative process of knowledge sharing and idea generation.

There are three different project goals to suit a particular company's, or designer's, product development criteria.

- Initial design and prototype development for the exploration of several product opportunities, supported by activities such as brainstorming, concept development and prototype analysis.
- New product(s) developed and taken through to manufacture and market launch, aided by partner organisations.
- Experimental design and prototyping in order to generate an understanding of new methodologies for product design.

The first two goals aim to meet strategic commercial aims such as product differentiation, product branding or product optimisation while the third feeds into commercial and academic research.

4 CREATIVE APPROACHES AND METHODOLOGIES

The following outlines the three approaches that DPI Lab has incorporated into its seminar programme. The first two are indicative of alternative creative approaches while the third presents a more pragmatic approach.

4.1 The intuitive approach

Scanning and digital input devices provide an alternative to designing through pre-defined CAD toolsets. These intuitive interfaces engage the tactile and artistic sensibilities of designers and present a new freedom to explore the physical environment beyond the desktop. DPI Lab has devised the methods of 'digital collage' and 'digital templates' to stimulate the designers in constructing digital design concepts.

4.2 The mathematical approach

Advanced software systems are enabling a new level of design complexity offering alternative methods of production. Atkinson and Dean's model for "aesthetic evolutionary design" provides a vision for automated bespoke product designs, which begin to exploit the capabilities of direct manufacturing [4]. In contrast, Justin Marshall has successfully applied simpler software solutions to transform the design capabilities and diversify the production methods within a traditional skill base. Such mathematical

approaches offer alternative creative visions for design and production that engender product outcomes such as randomness and surprise.

4.3 The rational approach

At present, many industries integrate non-direct manufacturing methods to provide incremental enhancements to conventional manufacturing processes. However, direct manufacturing requires a completely different 'design for manufacture' mentality. The latter needs to incorporate the methods and processes offered by direct manufacture. Furthermore, companies need to develop design strategies that consider the business opportunities brought about by the changing relationship between design, manufacturing and the consumer.

5 ENABLING AN ALTERNATIVE CREATIVE APPROACH

Increasingly, companies involved with product development are establishing fully digital processes where different work outputs are synthesised. For example, rendered CAD models can be used to support the development of product literature. Such concurrent processes are often referred to as digital workflows, which provide greatly enhanced process efficiency over traditional analogue methods. In some cases digital processes have completely eradicated the need for certain intermediary activities, for example, CAD software had removed the need for hand-drawn general assemblies.

5.1 Creative digital workflow

The current notion of the digital workflow concentrates on the efficiency and optimisation of a process. However, DPI Lab's notion of the creative digital workflow is concerned with the supplementation of new knowledge, methods and skills within a process. In the context of the design process, creative digital workflows encourage alternative design data to be translated into design concepts with a higher degree of fluency. This is becoming increasingly possible as digital design interfaces enable access to a greater diversity of practitioners, SMEs and designers. This idea of the creative digital workflow is an attempt to create an alternative vision for digital engagement, encouraging product design to embrace new methods and explore inter-disciplinary collaboration.

6 CONCLUSIONS

The creative approaches and methods outlined in this paper require further investigation for successful application in product design. DPI Lab has created a direct link between the digital technologies and expertise within UCE Birmingham and the needs of SMEs and designers. Current DPI Lab work has also identified that it is becoming increasingly important to establish a value-adding strategy for the application of digital technologies within SMEs. Moreover, understanding the future longer-term relationship between the universities, SMEs and designers will affect how knowledge and resources are exchanged to support the development of digital design skills within industry.

The approaches and methodologies described in this paper encompass an extreme range of skills, from computer programming, engineering to tactile modelling. If this diversity of digital design skills can be encouraged to collaborate, exciting interdisciplinary design opportunities will emerge. However, such a collaborative approach to designing will require that new strategies for inter-disciplinary communication, knowledge transfer and knowledge exchange are established. Also, it is imperative that the design

education system keeps pace with the diversity of opportunities that digital technologies present. The re-evaluation of creative digital approaches and methods for product design and the encompassing of a broader scope of skills will ultimately define our digital future.

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