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# NEW CONTEXTS, REQUIREMENTS AND TOOLS TO ENHANCE COLLABORATIVE DESIGN PRACTICE

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## ABSTRACT

*The competitive, post-recessionary business environment is increasing pressures on the design industry to accelerate the cycle of product development. This has clear repercussions for product design practice. Design practitioners are under pressure to quickly develop products which will have immediate success in fiercely competitive markets. The ability to creatively innovate alongside other NPD (new product development) stakeholders has become a priority. Whilst collaboration has always been a cornerstone of design, the new contexts require a greater degree of transparency, sharing and communication amongst cross-disciplinary stakeholders. In order to be fit for purpose the available ICT tools need to evolve if they are to meet these challenges.*

*An interdisciplinary research project entitled 'COnCEPT' (Collaborative Creative Design Platform) has been established, and is funded under the European Commission Framework 7 programme. The project examines how technology can be used to support collaborative and creative design practice. This paper reports on the literature surrounding collaboration in creative practices. The current context of professional design practice is described and qualitative research exploring shortcomings in the ICT set-up in design studios is examined. The paper sets out a case study to illustrate how the COnCEPT platform will address designers' requirements for a collaborative software environment. Key features of the software are described – for example, real-time collaborative sketching spaces, 'smart' search tools, and the automatic generation of mood boards – which aim to facilitate creativity and streamline collaboration. The paper explores the potential of the platform, delineating its value in the design process.*

*Keywords: Design practice; design collaboration; human-computer interaction*

## 1 INTRODUCTION

Design practice is undergoing a period of significant change. In business, the challenge of intense global competition and economic pressures are having a significant impact on design and new product development (NPD) processes. In education, new courses focusing on service and experience design are gaining momentum. Today's environment is one in which 'new' quickly becomes 'dated', and as such, speed to market is increasingly valued. Similar to the fashion industry, manufacturing firms are under pressure to hasten NPD cycles, and to regularly present new products to satiate consumer demand. Products are also becoming more technologically complex in their intrinsic meanings, values, capabilities, and methods of production and manufacture. In realising such

sophisticated products, designers are increasingly required to partner with a larger network of stakeholders to bring designs to fruition.

In navigating this transition, and coping with such demands, the design profession is in need of new tools. Existing working practices and tools in the design studio are rapidly becoming out-dated, cumbersome and unfit for purpose in the new landscape of design. While there exists a range of software tools in common use in design studios, it is clear that none have been developed specifically with the needs of product design in mind – applications designed for graphic designers, photographers, engineers and architects are in common use. Although well recognised, such software requires a deeper understanding (Lubart, 2005) in order to enable natural and intuitive interaction between individuals and computers (Edmonds et al., 2005). Moreover, such software focuses on the visualisation and modelling tasks predominant in the later phases of the design process. Also widely in use is the typical productivity software found in offices worldwide.

Despite the need to facilitate and streamline the process of conceiving new products, there are few tools that support ideation, and collaborative creativity in the design process. In addressing this gap, a three-year European Commission-funded research project is developing a software platform to assist the design profession. Entitled COnCEPT (Collaborative Creative Design Platform), the project seeks to understand how software can best assist professional designers. COnCEPT includes nine European academic and industry partners who are exploring how software can support design teams, and enhance the early stages of the design process.

The initial phases of the project have focused specifically on how the design process unfolds in professional practice. Discovery-driven, qualitative research – including interviews and observation research – with practicing industrial designers across Europe informs the development of the software. In convening an interdisciplinary team – including design, human-computer interaction (HCI) and computer science specialists – it has become a firm belief that ICT can be developed to be more efficient by being tailored around the specific needs of target users. Therefore, rather than adapting existing technologies which have been developed for other disciplines, COnCEPT is being developed specifically for use by the design profession. As such, COnCEPT is being designed to complement and enhance the creative instinct of the individual designer, and of traditional practice, in order to enhance the design process.

The project has revealed a number of ways in which design practice is changing. It has emerged that how designers find information, share this across stakeholders, and gain inspiration, is crucial. These become starting points for exploring ideas in order to develop the new software platform. The way in which these needs are then refined and developed into software that is of value to designers is the main focus of the project. The research question being

addressed as part of this project focuses on how ICT systems can enhance collaborative design practice:

*How can ICT systems enhance collaborative design practice?*

The following literature review considers collaboration in design before exploring the use of ICT in professional design practice. The paper goes on to describe the requirements that have been identified by practicing product designers, and matches these to the features to be developed in the COnCEPT platform. The implications and impact of ICT upon professional practice is discussed.

## 2 CHANGING CONTEXTS: THE NEED TO IMPROVE EFFICIENCY IN THE DESIGN PROCESS

### **2.1** STIMULATING CREATIVITY IN COMMERCIAL DESIGN PRACTICE

The design process is inherently complex, and varies considerably by project depending on a range of factors. Scholars have long debated the activities, phases, and sequence of stages making up a typical design process. While definitions are often conflicting, and models and frameworks vary, there is consensus on what characterises the design process, for example – unpredictability (e.g. Lloyd and Snelders, 2003); a lack in rigidity of structure (e.g. Candy and Edmonds, 1996; Cross and Cross, 1996); symbiosis of the problem and solution (e.g. Cross, 1997); and the importance of iteration on the outcome (e.g. Lawson, 2005). In addition, many scholars agree that the process is both objective and subjective. Whilst using a set of criteria to design for society or a particular group of individuals, the designer's personality and taste impacts on the result (e.g. Dorst, 2006; Forty, 2005). Successful designers must therefore have an ability to balance conflicting forces.

The abilities of a successful designer to temper personal style with design objectives requires a considerable degree of creative thought in order to surmount constraints and parameters in innovative ways. Freedom and curiosity are at the foundation of the designer's quest to improve existing situations. According to Michlewski (2008:34), the main goal of the designer is the "creation of fundamental value through… exploration", where exploration, experimentation and creation are key prerequisites. Since most designers work commercially, and for other people, constraints, restrictions and conflicts are features of the process. These pressures can, however, hinder the creative mind at work. Along with deadlines and time pressures, there are many factors which prevent the freedom to experiment creatively, such as pinpointing precisely who the 'client' is (Norman, 2002); identifying and prioritising the needs of a range of stakeholders (Norman, 2004; Stevenson, 2013); and managing relationships with clients and team members (Maciver, 2011).

These tensions are especially pertinent at the beginning of the design process. According to the Design Council's (2007) 'Double Diamond' model (which

identifies four basic 'phases' through which any design project progresses, and which is a widely accepted model of the process), the earlier 'discovery and 'definition' stages in the process focus on the conceptual and ideation tasks. By contrast, the later stages – 'development' and 'delivery' – centre on the practicalities of prototyping and visualisation tasks related to the implementation of the final design. Table 1 compares early and later stage design phases. Innovative thought processes are of particular importance in the early stage of ideation.

| | **EARLIER NPD (DISCOVER, DEFINE)** | **LATER NPD (DEVELOP, DELIVER)** |
|---|---|---|
| *Focus* | Conceptual | Practical |
| *Approach* | Exploratory | Applied |
| *Goals* | Discovery-driven | Grounded |
| *Systems* | Objective/subjective analysis | Aid of technical software |
| *Activities* | Ideation, thought, brainstorm | Technical realisation |
| *Mind set* | Potentials, the future | "Making things happen" |
| *Nature* | Unpredictable | Controlled |
| *Outcomes* | Creation | Production |

*Table 1 : Comparison of early vs late design process stages*

*Source: the authors*

The conceptualisation and exploration of problem and potential solution is unpredictable, and takes considerable time and effort. It is argued that this process is more time consuming than the later, more logical stages of the design process, as characteristics and activities have been planned and decided earlier in the process (Birkhofer, 2011). Some liken the process of developing new ideas to a journey, where ideas are incubated through dogged perseverance (Lubart, 2005). Moreover, in the early phases, there is a greater likelihood that inconsistencies and errors can be corrected prior to incurring greater expenditure (Craft and Cairns, 2006). It is therefore worth spending the time looking for a satisfactory solution before proceeding with a project. While this in

itself cannot be accelerated, in the commercial context, there still remains a need to facilitate creativity and to enhance the creative process. This is perhaps even more important as projects become more complex, and the inclusion of stakeholders adds complexity to the designer's tasks.

**2.2** COLLABORATION IN THE DESIGN PROCESS

Design rarely occurs in a bubble: most designers work and design for other people (Wang and Oygur, 2010). The issues surrounding collaboration during the design process have therefore been well documented in the literature, for example, communication (e.g. Arias et al., 2000; Sonnenwald, 1996); cross-cultural translation (e.g. Chiu, 2002; Edmonds et al., 2005); intellectual property and authorship (e.g. Mun et al., 2009; Simoff and Maher, 2000); user participation (e.g. Wilkinson and De Angeli, 2014); and interaction with the client (e.g. Tzortzopoulous et al., 2006). As problems become more complex, and products more sophisticated, in the ever-competitive environment there is a trend towards collaborative working.

There are ample strategic benefits to collaborating to a greater degree in the design process, for example, 1) using outsourced, specialist expertise to enhance the technical expertise within the design team increases product quality and design efficiency; 2) cheaper manufacturing facilities abroad reduce costs and expenditure, and 3) understanding the needs of end-users increases relevancy of the product on the market. Therefore, forming partnerships, collaborating and cooperating with others – firms and users – can bring many advantages (Fill and Visser, 2000). In doing so, stakeholders are greater in number, and NPD teams are more distributed.

While these advantages make good business sense, in the design discipline, there has been much debate about the value of consulting different groups of people when developing a new product. For example, in terms of innovation, taking on board the views of end-users is considered to affect product 'newness'. A new product can be radical and frame breaking in nature, or it can be incremental and an improvement on a previous iteration. Norman and Verganti (2014) argue that a focus upon the user (as in a user-centred approach) leads only to improvements on existing situations. By contrast, radical innovations result from different and new ways in tackling problems.

It seems that there is a balance to strike between so-called 'design by committee' and consulting with different groups to achieve optimal product results. Improvements in communications technologies can enable collaboration to take place without strenuous effort. However, a number of studies have emphasised the need to improve collaboration support (e.g. Liapis, 2008; 2011), since such interactions impact on the quality of design outcomes.

**2.3** ICT AND CREATIVE, COLLABORATIVE DESIGN PROCESS

Developments in technology have changed design practice at a fundamental level (Lubart, 2005). For example, graphic design software allows two-dimensional sketching, photography software facilitates the rendering of realistic images of potential design concepts, and computer aided design (CAD) and rapid prototyping software allows the generation of three-dimensional prototypes and production ready files. While these tools assist product designers, they were originally developed for other professions – for graphic designers, photographers, and architects and engineers respectively – and often for those working independently (Liapis, 2011). As such, the concepts and terminology used in the interface of such packages (e.g. vectors, mathematics and geometry) reflect the practice of its original intended user group. Recent projects have examined the application of IT and new technologies specifically for design. For example, Jowers et al.'s (2013) research suggests that eye tracking can be utilised to streamline the process of computer-aided design (CAD) through eye-controlled shape exploration, construction, and manipulation.

Designers' requirements for subtlety and organic forms are beyond the capabilities of many of the applications currently available on the market. In addition, there are few applications focusing on the conceptual phase (Gero, 2000): it is only in recent years that applications have emerged to assist ideation methods and techniques, for example mind mapping, concept mapping and storyboarding software. Development of software aimed specifically at improving the ideation and conceptual phases of the design process is suggested to be of concern and value for addressing the issues currently pertinent in the design industry, specifically: 1) the speed of designing, and; 2) ease of collaboration.

The COnCEPT software platform currently in development and discussed in this paper seeks to address these concerns. The early stages of the COnCEPT project have focused on researching the nature of product design practice. Discovery-driven, qualitative research, including interviews and observation research with practicing product designers across Europe is informing the development of the software. Researchers in the consortium have developed understanding of the current needs and requirements in contemporary design studios. The platform aims to provide tools to enable collaborative, creative design work. The COnCEPT project focuses on the development of a software environment to support creative ideation and to streamline collaboration.

## 3 CONCEPT: A RATIONALE TO ENHANCE THE DESIGN PROCESS

It has been suggested that ICT can bring about greater change to cope with new requirements in the design profession. Figure 1 provides an overview of how ConCEPT will address the needs of designers. The diagram outlines two models of the design process. A hypothetical scenario for designing an adjustable table lamp structures the stages of the design process where the platform will add

value. Using this case study example, the left hand side of the diagram maps out how the project may unfold in current practice, using the tools and methods widely available. On the right hand side of the diagram, the application of COnCEPT's additional tools shows how these will assist the design process during the same project. The remainder of this section describes the importance of these features for the support of creativity and collaboration, and hence how the software addresses the issues highlighted in the literature review.

The COnCEPT platform will provide an integrated environment dedicated to the design project. All documentation related to a design project are linked and contained within this project 'space', for example: all email correspondence between the design team, the designer-client contract, team roles and contributions by team members etcetera.

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# *New contexts, requirements and tools to enhance collaborative design practice*

*Fiona MACIVER, Julian MALINS, Aggelos LIAPIS*

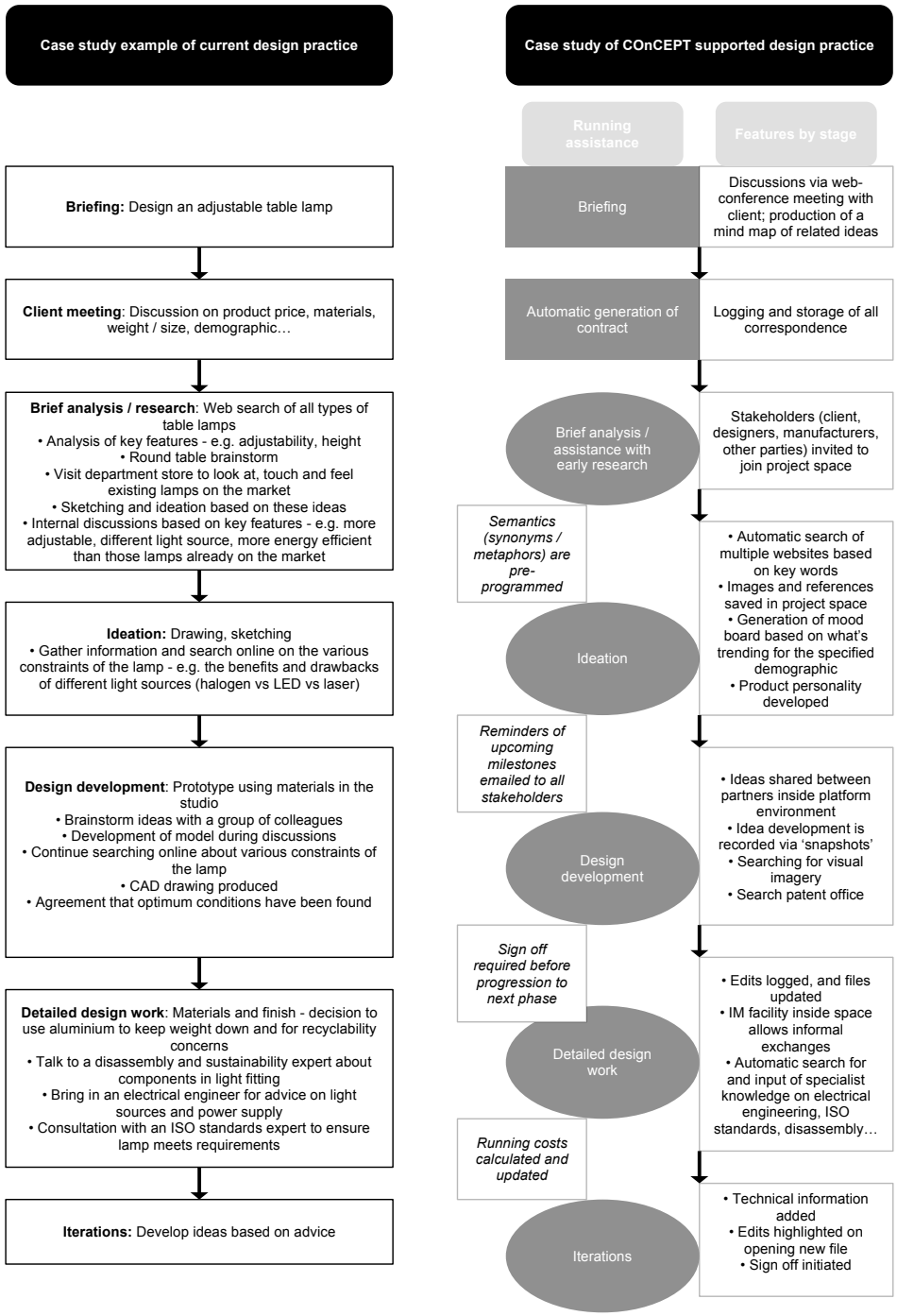


*Figure 1 : Charting collaboration and creativity in the design process*

**3.1** 'DEFINITION' AND 'DISCOVERY': SEARCH TOOLS TO ENHANCE CREATIVITY

The designers interviewed commented on how they initially tackled a design brief by using various methods to stimulate the ideation process of a project. In the traditional approach, there are a variety of research vehicles, for example via online research, consulting books and magazines, shopping and viewing products already on the market, sketching and drawing, and CAD sketching. Such research is used to find information on a range of concepts, for example on pre-existing products, materials, technology, and people. This early research is considered to play a pre-eminent role in forming the ideation stages of a project. However, there are flaws in the generally adopted research approach of design studios, for example: 1) the process is time-consuming and laborious; 2) designers themselves may lack specialist training in research methods; and, 3) the search results can be idiosyncratic to the search methodologies deployed. Moreover, the uncertain, unpredictable nature particularly of the early stages of the process means that it is difficult to be precise about the desired search parameters.

For a new software application to be successful, the characteristics of traditional methodologies should be reflected in the 'new' environment. At the outset of the design process, designers meet with clients and discuss and ratify the parameters of the design brief. In the case study example illustrated in Figure 1, price, materials, size and target audience may all be discussed. Tools in COnCEPT simplify and streamline how this information is included in the subsequent work using an inter-connected mind mapping and 'smart' search tool, which seeks to simulate the real-life situation within the digital environment. As designers feed the brief parameters into a mind map, a smart search tool undertakes research around these terms, returning visual, numeric and text-based data. Synonyms and metaphors for terms are pre-programmed; hence a possible return may be images of 'table lamps', 'bed-side lamps', and 'touch lamps', as well as desk lamps. Tolerances are set by the designer, and alter the amount of information presented. This information may present new ideas, and stimulate discussion across the design team. While search results cannot be considered wholly scientific (rather, they rest on human programmed algorithms), they can be used to stimulate associative thinking, and promote the questioning of assumptions, thus protecting the creative integrity of the project. It is of paramount concern in the development of the software that information presented to designers will be useful and valuable. The speed and format in which the information is presented is key. IT has the propensity to present too much information; therefore to be effective and useful, balance is required between too much broad data, and limited narrow data. When prompted, this search facility also has the capability to provide information on current trends, news and affairs related to the proposed demographic information and/or the product.

In the research process, the collection and presentation of visual data of lamps and associated ideas is an important component. Designers may gather images about, for example: light sources; materials for manufacture; colours; the setting in which the product will be used; and examples of other products that have an adjustable component, etcetera. The designers interviewed as part of

this study spoke about the process of saving images, tagging them, naming the files and then storing them inside a repository on the studio's server or hard disk. However, there are many problems associated with this approach, for example: 1) it is difficult to find images saved; 2) it is difficult to view the images together, important when compiling mood boards; 3) saving and annotating is time consuming, and; 4) there is often an overlap between projects meaning that images often need to be re-viewed. Designers use web-based, cloud storage repositories (such as the visual discovery tool Pinterest), however the interviewees flagged up security and confidentiality issues associated with web applications. In addressing this requirement, the platform under development seeks to integrate a function to allow images to be saved into a central repository, tagged inside of this environment, able to be searched, with results viewed on one scrolling page. Moreover, users can select images to form mood boards and/or client presentations. This is an important aspect of selecting and filtering ideas to create a personality for the product.

### **3.2** 'DEVELOPMENT' AND 'DELIVERY': COLLABORATION TOOLS TO ENABLE DESIGN, ITERATION AND MANUFACTURE

During the development and delivery stages, collaboration and communication across the wider project team emerges as a crucial concern. Partners in the design process need to exchange ideas in bringing the product to a format where it can be manufactured. The project space established inside the COnCEPT platform allows project materials to be shared amongst the design team, the client team, any specialists who are partnering on the project, as well as suppliers, subcontractors, manufacturers and other producers. This is especially useful when the NPD team is distributed geographically. By having contracts stored and agreed, milestones pre-programmed and clear, all parties are offered protection. In this respect, the design-business transaction also becomes more transparent, facilitating proximate stakeholder relationships and easing the process.

Further testing, detailed planning and exploration takes place during the design development phase to progress the project. In the studio, designers may create prototypes to visualise the product. Fine-tuning of prototypes will ensure the product meets the specification laid out in the brief. While such hands-on work cannot be simulated in a computer package, COnCEPT adds an extra layer of verification and accuracy to the plans. For example, it searches through patents databases to ensure that the details in the plan are not already in existence. This information is presented to the design team in real-time while they are working on the project, preventing potentially costly errors. Searches are also made for technical and specialist knowledge which may not be possessed by members of the project team, for example, electrical engineering expertise, ISO standards details, and disassembly and recycling information. COnCEPT searches online repositories and reports and presents useful and essential information to the team.

To enable greater exchange, instant messaging facilities are incorporated within the platform so that informal exchanges can take place with specialists in the

project team. This is intended to simulate the informal face-to-face interaction within the physical design studio. Indeed, as the desk lamp moves into the iteration stage, collaboration with the partners and wider team is crucial to ensure the product is manufactured as per the agreed specification. Annotations of changes to CAD files are logged and highlighted each time members log in. This is suggested to be of potential use to designers when checking any edits to design files, which was a major concern for those designers interviewed. Such a visual style of communication also overcomes language and cultural barriers between producers and manufacturers in different countries, again preventing potentially costly mistakes. Additionally, 'snapshots' of files and project progress are taken automatically throughout the project at specified intervals. This feature has application during the final client presentation of the project as it shows continuity and the story behind why design decisions are made, and is useful in the business context where selling the product upstream within the client organisation is essential.

## 4 DISCUSSION: UNITING CONVENTIONAL AND DIGITAL METHODS

The COnCEPT platform seeks to *enhance* existing methods of designing, rather than using technology to replace conventional design methods. For the further development of the platform, the researchers consider it crucial for its success that the platform is in fitting and sympathetic to the current requirements of designers, and subtleties and nuances are being programmed to effectively merge these conventional and digital approaches. This paper has suggested how software may be developed which fits its intended purpose and the needs of its target user group.

In examining a software development cycle, specifically teams working in product design processes, the detailed case study example in this paper has highlighted several key issues. First, the importance of synthesising creativity in the design process is palpable in both a) a tangible sense, as designers visualise ideas, and b) in how visual imagery is gathered during research, for the purpose of synthesising inspiration and ideas for the project. Second, it has deepened understanding of the subtleties of collaboration and the interaction of team members during the design process. Third, the significant advantages to utilising the potential of ICT to its fullest in design practice has become apparent. For instance, ICT allows the constant cycling back and forth between problem and solution, which is a prerequisite for achieving project success. To that end, the architecture underpinning the COnCEPT platform is very well suited to design, since iteration is a key feature.

The complexities in the design process illustrate the necessity for a deep level of understanding to allow the development of software fit for purpose, which will be 'useful, useable and desirable' to the design profession. While the COnCEPT project examines design contexts in particular, it is suggested that these principles are of use when developing any application, package or new technology. In section 2.3, it was discussed how photographic, graphic design,

engineering and architecture software has been developed particularly with the needs of that profession in mind. It is proposed that such successful applications examine existing situations and contexts in depth, before tailoring technology solutions around the precise requirements of the target users, in line with a user-centred design philosophy. Such technology should be simple to use and be able to cater to all requirements.

## 5 CONCLUSION

This paper has outlined three key ideas. First, it has outlined how ICT has the potential to enable and enhance creativity and collaboration in the product design process, which are suggested to be drivers in the ultra-competitive, post-recessionary business environment. It has been suggested that ICT can bring about new ways in which to cope with added pressures on the design industry. The COnCEPT platform is being designed to enhance and 'accelerate' the design process by providing creativity tools. Therein, it also has the potential to stimulate innovation more radical in nature by applying tools that encourage associative thinking. It also enables groups to collaborate more easily, and facilitates communication in distributed, interdisciplinary teams. By supporting design management tasks, COnCEPT assists in the context of wider NPD team management, and thereby aids the acceleration of NPD cycles.

Second, and in harmony with user-centred design, the paper has argued that understanding nuances of the target market through using a design approach is vital when developing new software tools. It is significant that the characteristics of contemporary design practice are mirrored in the consortium carrying out the research and development of the COnCEPT platform – both are, for example, international, interdisciplinary, distributed, and have differing approaches, backgrounds and methodologies. The first-hand experience of such challenges has allowed the issues to be addressed more thoroughly.

A third and final outcome is that no matter what the pace of change and capabilities of technology, traditional design practice is unlikely to be superseded in its entirety. Rather, it is our role as researchers to bring together conventional and digital approaches to respond to the changing commercial environment.

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