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Inspired by Information: Combining Data Visualization and Generative Techniques in Early Stage Design Research

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ABSTRACT
The growth in online services and ubiquitous computing has resulted in organizations holding large amounts of valuable data. The technical and monetary barriers to reusing these data for new products or services are relatively low. To be successful however, such products or services require a potentially radical re-framing so that these data acquire new meaning. In addition, the contexts surrounding these data present all the difficulties associated with 'wicked problems'. In this paper I will outline research investigating how we might utilize generative design methods, creativity techniques and information visualization to address some of the challenges in this design space. These challenges include the need to better understand what these data mean at present, how the context they come from is experienced and what these data could potentially do or mean in future. This will be illustrated with the work undertaken in two case studies.

Author Keywords
Design Research; Information Visualization; Workshop Techniques

ACM Classification Keywords
H.5.m. Miscellaneous.

General Terms
Human Factors; Design.

INTRODUCTION
The recent trend for placing services and transactions online, together with the increasing ubiquity of computing systems, means that many organizations are now in possession of a growing amount of valuable data. Because these data are digital they can be re-purposed with relative technical ease and at a relatively low cost. This presents an opportunity to create new products and services that generate additional value and enable individuals and organizations to gain new benefits from existing resources.

Design projects that result from this opportunity are likely to be initiated by the availability of data. Their motivation being 'What can we do with data X?' rather than 'How can we solve problem Y?'. In this way, such projects, where designers investigate additional uses for new or existing data, share similarities with the type of *Radical Innovation* identified by Norman and Verganti [5]. This is because they seek a re-framing that could provide new meaning to accompany new technology. In addition, the contexts these data are generated in can be deeply human, highly complex and contain all the difficulties associated with the now familiar 'wicked problems' of design. These are problems that require an understanding of more than just the technical difficulties and monetary constraints.

Such projects will require design research that seeks to gain a deep understanding of the materials at hand, in this case data, and the context they come from, which will often be inextricably linked to the experiences of the people whose lives generate these data. They will also require an early focus on creativity and methods that utilize critical perspectives to explore alternative ways of interpreting common or shared experiences, so that data can be re-imagined and innovative products or services created.

RESEARCH OBJECTIVES
In my PhD studies I am investigating how we might utilize information visualizations in conjunction with generative design methods that include creativity techniques to begin to address some of the challenges and opportunities presented by this emerging design space. I am exploring this combination of tools both as a way to gain an understanding of data and the contexts they come from, and also to support the critical evaluation and re-framing that will help in re-imagining data and their future purpose.

By information visualization I am referring to the graphical representation of data. This will often, although not exclusively, be interactive. Information visualizations are used for their ability to support users gaining insight and acquiring a deeper understanding of data. Following the distinctions made by Pousman, Stasko, & Mateas [6], such insights might be *analytical*, like those associated with traditional exploratory visualizations, or *reflective*, like those associated with more artistic styles of visualization. A distinction that I see as being useful when moving between activities that seek to explore present context and those that seek to imagine possible futures.

By generative design I am referring to methods in which stakeholder representatives are provided with the tools to generate new ideas that reveal requirements or inspirations for design. Here the creativity techniques used by Jones,

Maiden & Karlsen [4] and the generative research methods described by Sanders [7] are influential. So too are the ideas behind Gaver & Dunne's cultural probes [3], which provide inspiration for how generative design research may be used to explore current experience through a critical lens and suggest possibilities for alternative meaning.

To carry out this research I am undertaking a series of case studies within projects where real world design opportunities have resulted from the availability of data.

CASE STUDY 1: SMART ENERGY DATA

The initial case study undertaken for my research is part of an investigation with E.ON, a major energy provider, into new products or services that could be developed using the data generated by smart home technologies. Within this project a sophisticated model of typical energy consumption patterns has been developed. Data generated by this model was used to build interactive information visualizations that provided stimuli during a one-day creativity workshop held with E.ON customers and staff.

These visualizations were used as part of a pair of workshop activities. In the first, participants worked in small groups to create collages describing different aspects of the household they imagined might be represented by the energy consumption data. In the second, these data were further explored to complete a competition entry outlining ways in which the imagined household could be smarter in their energy use. These imaginary households and the contexts of their energy consumption behaviour were later used as inspiration in service design activities. Further details of this case study are presented in a paper submitted to this conference [2]. We are currently evaluating the prototype designed as a result of this workshop.

This case study showed evidence that using information visualizations within generative activities can be an effective means through which workshop participants are able to better understand data, explore the context they come from and gain insights which remained evident in later design ideas.

CASE STUDY 2: REFLECTIVE LEARNING APPS

In my second case study, I am investigating how data generated by a collection of apps that are being developed to explore different aspects of reflective learning within a European research project, can be shared, combined and reused creatively to provide new services from existing resources or provide new meanings that suggest new contexts of use. This case study is at an early stage and we recently held an initial one-day workshop where we looked to build a shared understanding of data generated by the various apps. To achieve this we used a series of generative techniques culminating in the creation of a large-scale paper 'map'. This map is made up of a number of individual collages that participants created to describe an apps' data and the context of its use. Having placed these on the map, connections between data in different apps were made explicit using colored ribbon, and ideas for new connections were added.

The next stage in this project will be to design a digital version of this map and augment it with visualized examples of the available data. This will provide an online platform to enhance our understanding, share insights and suggest alternative ways data might be viewed. We will then arrange a second workshop where the objective will be to explore alternative meanings and generate ideas that reuse data creatively for innovative services.

CHALLENGES

The key challenge I currently face is identifying effective evaluation methods. We have developed a technique for assessing participants' responses through reflective postcards that will be presented in a workshop at this year's CHI [1], and there are established methods to evaluate the product of a design process. However, a satisfactory way to evaluate the processes taking place remains elusive.

CONTRIBUTION

This research will contribute to the design community by suggesting ways to approach an emerging design space. It will contribute to the creativity research and visualization communities by identifying and explaining connections between insight, data, visualization techniques, generative activities and creativity.

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