A Computational Framework for Supporting Design Terminology

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A widespread problem in design is the lack of a shared terminology between the stakeholder groups involved in a design across various disciplines. This study will use approaches from computing to create and test a framework for shared design terminology that can be used across the design process, reducing misunderstandings and miscommunication, improving safety, facilitating sharing designs more explicitly and increasing interoperability.

Key words: design terminology, miscommunication, content analysis

1. INTRODUCTION

Failures in design can have significant consequences. It is widely assumed that such failures often occur because of miscommunication due to the use of different terminology and concepts across different groups involved in the design process. However, this assumption does not appear to have been systematically tested in the existing literature on design. This study will use a content analysis approach to test this assumption. The data from this suggests that there are significant differences in terminology and concepts not only between different disciplines in design, but also within disciplines. Examining the implications of these findings, this study will try to create a Unified Design Language that could act as a lingua franca across these groups. Moreover, it will describe a novel way of combining elicitation methods, ontologies, and use of human parallel processing, to improve the process of clarifying terminology used by different groups. As design as an activity is constantly changing, and it has been practised in different cultures for different goals, this study will look at the various strands of design principles used across various cultures, focusing mainly on the cosmological, practical, and aesthetic strands.

2. BACKGROUND & RATIONALE

The rationale for carrying out research in the field of design as a discipline and the issues caused by the lack of a shared terminology in the design process is valid as there is a lack of research in this area. Several disciplines are commonly involved in design. One set can be broadly termed human factors, including physical ergonomics (Tosi, 2019), cognitive ergonomics (Sheridan, 1992) and human error (Day, 2016). These disciplines deal with very different concepts from each other, so it might appear self-evident that they would use very different terminology. As stated earlier, this issue has not been systematically addressed.

Terminologies and concepts will cause ambiguity for users too, as they obtain advice based on different and mixed sources of expertise (Shaw and Gaines, 1989). Ambiguity in the design process makes it difficult to understand the characteristics of communication in general. Eckert et al. (2005) contend that it is challenging to identify communication problems in many practical design situations as they are strongly interwoven with other process issues. As such, companies often struggle to see where the problems emerge from.

This study aims to create a shared terminology to be used across the design process. As stated by Salustri and Rogers (2009), having a shared language in the design process may not limit expression, while it can provide a framework for communicating effectively, which should in turn be very beneficial in establishing a distinct discipline of design.

Differences in design terminology can lead to misunderstandings and failures of communication, which in turn can lead to undesired outcomes. In a worst case, design failures can lead to deaths (Leveson and Turner, 1993), so improving design communication has significant consequences. For example, the term "non-functional" is used differently in computing design versus other fields. In computing, "non-functional" means that a requirement is not located in a particular place in the code (e.g. a requirement for the code to respond within a given time) whereas "functional" means that it is located at a particular place in the code (e.g. the part of the code that adjusts costs for inflation). In
other fields, "non-functional" means that something does not work. An obvious way of improving this situation is to create a shared core set of terminology within the design chain, which is the aim of this study.

3. METHODS
This study will employ elicitation methods, content analysis, ontologies, and approaches from computer science to create a Unified Design Language.

4. MY PHD PHASES
The study consists of the following individual studies:

Study 1: Comparing Terminology Across Disciplines
This study will adapt a framework from requirements engineering to tabulate systematically the core terminology used across several design disciplines. This will show which terms are used with the same meaning across disciplines, and which terms are used in other ways that could lead to miscommunication problems. The main approaches used will be the framework by Boose, Gaines & Shaw to categorise similarities and differences in meaning, and laddering to unpack meanings of terms in a rigorous, systematic way.

Study 2: Creating a Single Shared New Terminology
This study involves creating a new terminology derived from Study 1, to provide a single set of terms that cover the core concepts where the different design disciplines need to communicate, as identified in Study 1. This terminology will need definitions, explanations and examples, so that users can learn it properly. This study will design a software interface to provide online support for this, for the design communities involved. As with Study 1, this will involve only a small amount of data collection from human participants.

Study 3: Case Studies
This will involve trying out the terminology, methods and framework from Study 2, in two case studies of product designs. An agreement has already been reached with a company willing to provide case studies. The results from this will be used to improve the methods, framework, etc.

5. SUMMARY
Creating a Unified Design Language is a serious problem in terms of knowledge representation. In addition to the knowledge representation issues associated with creating a Unified Design Language, there are also serious problems involving human and organisational factors, such as conflicts between stakeholder groups. A stakeholder here is defined as a person or group with an interest in the outcomes of a project. Stakeholders may be directly or indirectly involved in the project, or even external to the organisation (e.g. customers, regulatory groups, or other organisations that will be affected by the project). A Unified Design Language may reduce these conflicts once it is established, but the design process for this language needs to be informed by input from soft systems (Checkland, 1981) and the literature on diffusion of innovation (Rogers, 2003). The approach described above should offer a better way of handling the communication issues involved in both these areas. It also offers a possible way of solving some long-standing problems in ontology, by combining computationally tractable approaches with human skills in spatial pattern matching in a novel way.

6. ABOUT THIS RESEARCH
This PhD is supervised by Dr Goksel Misirli and Dr Gordon Rugg, and it is based in the School of Computing and Mathematics at Keele University.

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