

What Makes a Prototype Novel? - A Knowledge Contribution Concern for Interaction Design Research

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ABSTRACT

In HCI/interaction design research much of our work is prototype-driven. We explore new concepts through the design of new interactive systems. Still, as a field of research we lack documented methods for examining the relation between design ideas and design manifestations although this ability to examine if a design (idea) is new and novel contribution to our field of research is crucial. This paper contributes to this need by proposing ‘generic design thinking’ as a first step towards a method to move from ideas and designs to classes of conceptualized designs. In short, a method for examining designs as knowledge contributions in HCI/interaction design research. We argue for this suggested method through two examples including 1) how one such method can be used to analyze and conceptualize existing designs, and 2) how one such method can be useful for working with new concepts, and the generation of new knowledge through design. We conclude with a discussion on how our initial sketch of one such method can facilitate systematic knowledge development in HCI design research.

Author Keywords

Design conceptualization; design ideas; design theory; generic design thinking; novel design; prototypes.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI)

INTRODUCTION

In HCI much of our work is prototype-driven. We explore new concepts through the design of new interactive systems [6], [31]. It is commonly agreed that the design of digital

artifacts and interactive systems can provide novel contributions to the established body of research in (see for instance [6] and [32]). Typically, this is accomplished by adopting a design process that encompasses all of the stages from concept development to the actual design of a new interactive system (see for instance [4],[11],[24],[25],[26],[32]). However, an interactive system may incorporate numerous technologies, data sources, functionalities, input and output modalities, and so on. It is entirely possible that all of these individual components have previously been implemented in existing systems. From a novelty perspective, the question becomes one of determining whether the combination of these individual components or the way in which they are implemented represents a concept that is uniquely new and clearly differentiated from existing designs, that is, if it is a knowledge contribution. We state this as a problem of how to *conceptualize* a concrete particular design and how to *relate* it to an existing body of knowledge in our field.

Even though there is a lack of well-developed methods and approaches for conceptualizing designs, there is some promising research that has been recently published that take this question seriously ([26],[14]). However, even though these contributions acknowledge the problem and also suggest potential ‘solutions’, they do not yet offer detailed methodological suggestions. At the same time, this is something we repeatedly do in HCI in a more informal way. Every time we review a paper describing a new interactive system, every time we go to a conference or when we are presented with a new interactive system from industry we repeatedly find ourselves asking “*Have I not seen this system before?*” or stating “*This system does not remind me of anything I have ever seen...*”. These statements are related to a fundamental research consideration concerning how it is possible to conceptualize and relate different designs to each other and to the existing body of knowledge. In short, we address the question “what makes a prototype novel?” and accordingly a manifestation of something new - a knowledge contribution to our field.

As an example of this challenge consider the “new” iPhone function for managing availability via pre-formulated messages like “I’ll get back to you in 5 mins”. Isn’t this design actually just another implementation of the same

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NordCHI '14, October 26 - 30 2014, Helsinki, Finland
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<http://dx.doi.org/10.1145/2639189.2639487>

design idea that was demonstrated in the “Managing Availability” ToCHI article [30] back in 2005? If it is, it may still be a new feature in commercial settings but it would be less novel from the perspective of being a knowledge contribution.

This particular example highlights the fundamental question of how to make these kinds of judgments of potential knowledge contributions through design more systematic, more precise, and less intuitively constructed. In short, it is the question of how to read a design as a manifestation of a (design) concept.

Beyond the particularities of any interactive system we can quite easily have a feeling about what a certain design reminds us of. Still, formal methods and approaches for “reading” designs and relating them to design concepts are difficult to find in our field. We believe that this lack has serious consequences. If we, as a field, fail to systematically judge the knowledge contributions of particular designs we risk not being able to make scientific progress, especially in research-through-design projects (see for instance [11] and [32]). While users of new technology might care more about their user experience than about if the design is an example of a new idea, the tracing, evaluation and critiquing of ideas are essential for any academic discipline. Methods for tracing design concepts is accordingly essential and critical for the progress of HCI research.

In this paper we propose ‘generic design thinking’ as a first step towards method to systematically trace and work with design concepts by *grouping*, *describing* and *illustrating* designs in HCI. We believe that this approach can help HCI researchers and interaction designers to: (i) evaluate designs in relation to existing design concepts, and (ii) help designers to pinpoint how their design is fundamentally new and unique or similar and related to previous designs. Finally, we present our method and approach as a way to (iii) facilitate theoretical development in HCI design research.

We propose the notion of ‘*generic design thinking*’ as a possible way forward. We see our contribution as adding to a body of recent research that argues the value of understanding fundamental concepts or ideas behind a particular design ([26],[14]).

We also propose the first draft of a method for doing ‘design conceptualizations’, enabling HCI researchers to start building an explicit common repertoire of generic designs that can be used to theoretically systemize our field while *remaining close to the artifacts* we design. In short, we provide the skeleton of a method for doing a form of artifact analysis of interactive systems for the purpose of examining fundamental design concepts, and how these concepts relate to the existing body of knowledge in our field.

In this paper we describe how generic design thinking allows for a process of conceptualizing designs into classes,

and to relating classes of designs to each other. We also see this proposed method as a way of supporting the process of imagining and designing new interactive systems in HCI. In particular, we notice how our proposed method adds to the Hook & Lowgrens [14] notion of ‘strong concepts’ and to Gaver & Bowers work on ‘annotated portfolios’[10].

While we notice that in many fields of design there have been concerted efforts to relate new designs to existing ones and to the history of design concepts we simultaneously notice the lack of a similar systematic effort in HCI. This is remarkable in many ways because such comparisons are regularly performed (albeit informally) when conducting new design projects, and with an analytical perspective when reviewing design contributions for conferences and journals. This suggests that there is a need for a more systematic method for conducting analyses of this kind, and that the introduction of such a method would represent a significant advance in HCI research. The aim of this paper is to explicitly address this need.

EXISTING APPROACHES FOR EXAMINING DESIGNS AND DESIGN IDEAS IN HCI AND INTERACTION DESIGN

User experience research in HCI has taught us that people interpret, understand and experience technology in many different ways. Still, we argue in this paper that beyond any interpretation or perception of a particular design there are also fundamental ideas that a design manifests. We also claim that to what extent a design is considered as novel and important as a knowledge contribution has to do with how well the fundamental idea is *manifested* and *explained*.

Still, when it comes to analyzing designs beyond any individual interpretations, that is, beyond what a user reads into a design or how a user perceives it, we argue that we are left with insufficient methodological support for doing artifact-analysis of interactive systems.

There are of course already existing collections of artifacts in HCI (among the more rich examples see e.g. the ‘Buxton collection’ of interactive artifacts) and there are also approaches developed in HCI for analyzing designs in use. *Task analysis* [12] has for instance been developed to enable an analysis of *characteristic activities* related to a particular design. For instance, what the most typical activities are when a user operates a mobile phone. Still, when it comes to *conceptualizing designs* this type of analysis of artifact use provides almost no support for reading designs.

Design Patterns [8] may be an exception from the current lack as it stands out as an explicit approach for identifying design *elements* in a particular design. However, as a method and approach it provides no support for (i) identifying and describing the fundamental concept behind a design, that is, the fundamental design idea it is built upon, and (ii) it does not provide any conceptual tool for tracing how ideas are developed over time and over

designs. It does not support any type of relational or historical design idea analysis.

It seems as if our field has actively focused on the development of methods for generating design ideas (such as brainstorming techniques) and methods for working with ideas for design (from concept development to implementation) while simultaneously providing less support for *identifying* and *tracing ideas* in designs.

Existing approaches for working with ideas in design and to give a design a certain character can be described as either: *proof-of concept designs* (see e.g. [24],[27]), designs according to *design guidelines* (see e.g. [20]), and *concept design* (see e.g. [9]). Each of these approaches was developed to address different needs relating to the task of turning ideas into design, that is, to make ideas manifest in practical interactive systems.

Proof-of-concept designs have typically served to illustrate that a design can be implemented in practice and to show that ‘it works!’. The computer mouse by Douglas Engelbart back in 1968 [5], via the Dynabook [18] to products such as TeleNotes [29] are all examples and demonstrate the power of this approach.

Design guidelines provide directions for designers, or highlight factors that should be considered when designing interactive systems. In this respect, design guidelines serve as checklists for the designer to ensure that she has thought about everything that is important during the design process.

Concept design has recently been put forward as a method complementary to more empirically driven user-centered design approaches in HCI [26]. It was developed with the aim of enabling designers to combine empirically-driven methods such as user-centered design with conceptual elaborations to explore new conceptual ideas in design. Although newly formulated as an explicit approach we see traces of this approach across our field’s history reaching back to the early days when Douglas Engelbart not only designed the mouse as a proof-of-concept but also did it as an attempt to demonstrate his concept of “augmenting the human intellect” [5].

While these approaches emphasize the importance of working with ideas in design in one way or another, they all leave some fundamental questions unanswered. Specifically, none of them are particularly suited to determine the extent to which a particular designed artifact can be seen as a manifestation of a given design idea, and if the particular design can be said to belong to a certain conceptual class of interactive systems. What we suggest is that we need to look beyond design elements, beyond small differences in functionality or “look and feel” and instead consider fundamental differences if we are serious about HCI as a field where research moves forward through its design manifestations.

TeleNotes [29] as mentioned above is an example relevant to this discussion. Telenotes was a prototype system that provided an early illustration of the concept of “lightweight communication support” and is similar to more recent commercial implementations such as ICQ, MSN and Skype. There are some clear similarities between the Telenotes system, ICQ, MSN and Skype. However, while the particular and differentiating properties of these systems might be easily identified, it is less obvious how the essential similarities of these communications systems can be identified, described, and formulated in conceptual terms using any existing theoretical framework. As such, while HCI has a strong cumulative tradition, it can be difficult to determine whether or not a particular implementation of a new prototype represents the introduction of a substantially novel and unique concept.

Over the years, various approaches to design have been developed and established. These range from empirically driven methods such as user-centered and participatory design (see references [3] and [17]) to methods that lean more towards idea-driven design (see references [4], [11], [26], and [32]). These latter approaches are of particular relevance to our work because they deal with the fundamental questions concerning the implementation of ideas in design and ways in which designs can constitute contributions to the body of knowledge within our field.

However, we are convinced that there is a need for analytical perspectives, tools and methods that can be used to deepen our understanding of what it is that a particular prototype actually prototypes [13], how the design of prototypes can help us explore and transcend a given design space [21], and how we can develop our methods for understanding and evaluating how specific designs can constitute significant conceptual contributions to the field as concept designs [26] and new classes of designs.

WHY IS IT SO IMPORTANT TO UNDERSTAND WHAT’S NEW ABOUT A PARTICULAR DESIGN?

While the question of how to “read” a design is important for the conceptual advancement of HCI research, it is also increasingly important in practical HCI design. The following example from an ongoing industry debate about “pads” and “tabs” illustrates this dilemma.

The issue of identifying the unique or novel aspects of a given design recently surfaced in a debate between major commercial manufacturers of interactive “pads”. The debate initially focused on particular properties of specific products. During this stage of the debate, the discussion centered around things such as the visual similarities between different designs, including their wallpaper images, icon designs, and so on. A new phase of the debate was initiated by the emergence of an Apple patent (Community Design patent #000181607) for a “general pad”. This patent does not contain any detailed descriptions of any specific properties of the iPad. Instead, it illustrated a

more generic design as it outlined a design space in which the iPad could be said to be situated.

This turn away from arguments about minutiae to a “raw model” design or a generic design lead to a new discussion about whether products such as the Samsung Galaxy tab, which resembles the generic design in some respects, is also situated within the same generic design space.



Figure 1. Left: Apple iPad. Middle: Apple’s Community Design Patent. Right: the Samsung Galaxy tablet.

Samsung made the counter-argument that their design and the concept that underpins their specific implementation of this design (the Galaxy tab) had nothing to do with the Apple design patent or the design space conceptualized within it. In contrast to the rationale presented within the Apple patent, Samsung argued that their design was inspired by other sources and reference points including a scene from the 1968 Stanley Kubrick sci-fi movie “2001: A Space Odyssey” in which two astronauts eat a meal while looking at pads lying on a table (see figure 2).



Figure 2. “Tabs” in use in the Stanley Kubrick movie “2001: A Space Odyssey” from 1968

This example illustrates several important things. First, it shows how uniqueness in design can be a question of very specific implementations or of more generic aspects. Second, it shows that the question if a specific design can be regarded as an implementation of a more generic design idea is not only theoretical but highly practical. Finally, it shows how almost identical designs can be argued to reflect different generic design ideas rather than being variations of the same underlying idea.

A more general lesson to be learned from this example is that it is possible to distinguish at least four ways in which ideas and specific designs can be linked. Specifically, a

given design can be analyzed in terms of: the particular manifestation, the character of the design, its inspirational roots and its patented form.

In this case, the two companies made their respective arguments in different ways with respect to all four aspects. However, there does not seem to be any standard or generally accepted way of performing such comparisons or analyses.

It is not our intent to try to resolve this particular industrial dispute or to argue for either party. Rather, we use this example to illustrate a more general and fundamentally challenging problem for HCI practice and research, which is the problem of determining whether a specific design is or is not based on a particular idea, and whether or not a given design can reflect a more generic design idea.

THE RELATION BETWEEN A NEW IDEA AND ITS MANIFESTATION IN DESIGN - AN AGE OLD QUESTION

The question of whether something is new is of course not unique to our field and far from new. On a more general level, this question can be traced back through the history of philosophy. For example, Plato discussed the similarities between everyday objects of a particular kind, such as chairs. He went on to develop a philosophy that embraced the concepts of the real and the ideal. According to Plato, there is a world of ideal ideas where the true version of a particular object resides and then there is our everyday reality which contains only vague copies of the ideal idea. Each real object is to some degree related to the true ideal in that it shares certain qualities and characteristics with the true idea, but none of the real objects is a true manifestation of the ideal object; the ideal cannot be created in the physical world. Throughout the history of philosophy, there has been an ongoing debate concerning the relationship between ideas, ideals and truth on the one hand, and the real, the concrete, and the manifestation on the other. We do not claim that our discussion can add or contribute to this debate, but we note that it is inextricably linked to our discussion in this paper and it provides a foundation for theorization.

We are fully aware that the concept of novelty is complex. It can relate to the introduction of a new idea, the implementation of this new idea in practice, or to the way in which the new idea embodied in the artifact is situated in relation to existing ideas, that is, its position within the world of ideas.

We see this complexity as something that merits analysis and exploration. Our aim in doing this is to reach a position in which we have: (i) a better understanding of what makes a design novel and unique, and (ii) a better understanding of how to determine what represents a substantial contribution of new knowledge in design-oriented research. To achieve these goals, we draw on concepts from design and design theory.

TURING TO DESIGN THEORY - EXAMINING THE RELATION BETWEEN IDEAS AND DESIGNS

Any design can be read in a number of different ways [2]. A design can be read from the perspective of whom it serves, the functionality it provides [20], its performance, its aesthetics, the materials used in its implementation, or the values or political orientation or cultural situatedness it symbolizes or represents. So, how do we know if a design represents a new idea or if it is just a slight variation an idea already explored? In short, is there any way to relate the practical instantiation of a design on the one hand, and its fundamental character on the other hand?

Some writers on design theory have discussed the practical implementations of designs in terms of the ‘ultimate particular’. For example, Nelson & Stolterman [23] argue that a design is typically understood and described by its designers as operating at the level of “the ultimate particular”. According to these authors, science, as the concern for the development of ideas, can be said to operate at the level of the universal and general, and is concerned with the development of theories, explanatory patterns, predictions, and the establishment of generalizable conclusions. In contrast, design is concerned with the practical, the ‘ultimate particular’.

One implication of this argument for HCI research is that it is possible to find important contributions in ultimate particulars, even in one ultimate particular. There is a particular form of knowledge that can be manifested in the practical implementations of a given design and the specific ways in which functions, features or aesthetic qualities have been combined in the whole. Accordingly, uniqueness is achieved via the composition of a design’s particular qualities arranged into a new manifestation, and the essence of the thing is defined by the ways in which the particular qualities and properties relate to and comprise the full manifestation – the specific design.

So, when considering the factors that determine the uniqueness of a particular design and whether it incorporates or extends existing generic design ideas, we should not, and cannot, separate the general and the particular. On the contrary, this perspective, which is grounded in design theory, allows us to uphold a position in which *the general is considered to be integrated into the particular* on a fundamental level. One could extend this view to argue that *ideas and their manifestations in specific objects represent ontologically inseparable dimensions of design*. If this is so, it should be possible to analyze the relationship between ideas and objects (designs).

Since the need for a more well-developed vocabulary for discussions of design has been raised in the past (see [19]), we should be careful and try to avoid re-inventing the wheel when introducing new terms to describe the relationships between uniqueness, generic aspects of design, and their manifestations within a specific design. The generic dimensions of design have received some attention in HCI

research (see for instance the discussions on theory-based design in references [2],[4],[22]; and [32]). Still, we were only able to find a very small number of documented attempts to describe how general, theoretical, or generic concepts in HCI can be expressed in the particular. One of the more interesting recent attempts along these lines uses the notion of “annotated portfolios” to link the ultimate particulars to a conceptual level through the use of annotations [11]. Another related approach is suggested by [14] through their notion of ‘strong concepts’.

In contrast to the situation in HCI studies, some related disciplines, particularly architecture, have traditions for analyzing the relation between generic ideas and ultimate particulars. The architectural model of generic design often involves some kind of formulation of “patterns” aimed at guiding the design process. This is illustrated for instance in the work of Christopher Alexander, notably in his studies on “genres of designs” and classes, types, and groups of (architectural) design [1].

In this paper, we suggest that the concept of *generic design* can be used in HCI research in the same way as scaffolding principles and patterns are used in architectural studies. The notion of generic design points to a *mediating structure* that can establish connections between *ultimate particulars* (as manifested in designed objects) and more general *ideas*. In the next section, we take a closer look at generic design, both as a perspective and in terms of what it offers in related fields of design and what it could potentially offer to HCI research.

GENERIC DESIGN THINKING – FROM IDEAS AND DESIGNS TO CONCEPTUALIZED CLASSES

In his book “A science of generic design”, Warfield [28] describes generic design as the practice of formulating classes, and the act of describing and defining the properties of these classes. He further argues that the very definition of something being “generic” is that it “*belongs to a certain class*” and goes on to define a generic class as “*a description of the properties shared by all members of that particular class*”. In a sense, this practice of formulating classes, and the act of describing and defining their properties, is about working both conceptually with the formulation of generic classes and the practice of analyzing artifacts in terms of how a particular design matches the established properties of designs within a certain class.

In HCI we have a growing body of designed artifacts and interactive systems. In addressing our challenge to more systematically move ideas forward as an academic field of research through a design-oriented approach to HCI we believe we can be inspired by Warfield’s “generic design”.

A generic design in HCI can be seen as a design concept that captures some essential qualities of a large number of particular designs, i.e., it defines a class or design space of interactive systems. These generic design concepts can be about core technological properties, or related to form or

function, or maybe often in our field, related to interactional qualities.

With generic design thinking as a general approach and method for systemizing our design-oriented research in HCI, both in terms of evaluating existing designs, as well as a guide for new design research projects we see it possible to contribute to Stuart Card’s CHI2012 keynote on “theory development through design and tests of theory through building and evaluating designs” with a grounded and explicit method for how we might do this in our field.

We can already see how generic design thinking has succeeded in related design-oriented fields. In the field of architecture we find a design history and a consistent practice of systematically developing different archetypical classes over time and a consistency in applying these generic classes in the design of particular buildings. In many cases, these two processes of building and advancing architectural classes are heavily intertwined in that they employ both forward-looking and retrospective perspectives. Several famous architects have become known for developing architectural styles (classes) that express their underlying architectural ideas and ideals—their theory or philosophy.

Over several centuries of architectural history, the practice of formulating classes and describing and defining their properties has played an important role in the establishment of architecture as a field and as a design method for its systematic advancement. It has made it possible for architects to identify when a building manifests a novel idea or when it is only a re-combination or re-configuring of existing and well-known design ideas.

So, what can HCI learn from this tradition? How might we advance HCI to a position from which it would be possible to systematically identify the novel aspects of a particular design in relation to HCI design history? For instance, is it possible to more deliberately integrate designed artifacts and systems as arguments in theoretical developments?

TOWARDS GENERIC DESIGN THINKING AS AN APPROACH FOR CONCEPTUALIZING DESIGNS IN HCI

As we mentioned previously, HCI research has led to the development of numerous successful approaches for developing new ideas in design and their practical application. These approaches include proof-of concept design, concept design, and methods for working with design guidelines. We will here introduce *generic design* as a forth approach.

While these approaches can all serve as scaffolding tools for design, they also differ in important ways. The matrix presented in Figure 3 shows how *generic design* relates to these existing approaches.

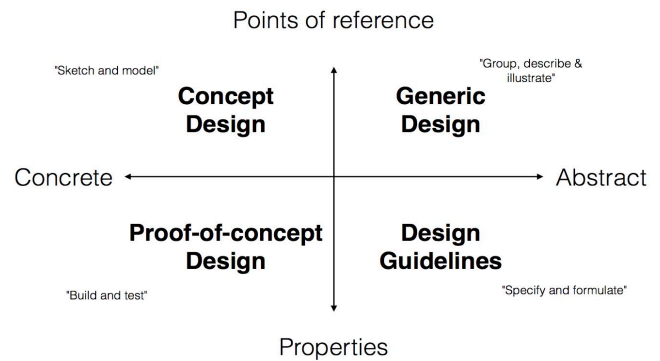


Figure 3. The relationship between generic design and other approaches to HCI design.

According to this matrix, approaches for working with ideas in design can be arranged along two dimensions. The horizontal dimension represents a scale ranging from the *concrete*, that is, the ultimate particular on the left hand side, to the *abstract* universal model that guides the design process on the right hand side. In this context, the term “concrete” refers to the essential ideas that are manifested in the design of a particular thing, whereas “abstract” refers to ideas that are used as scaffolding during the design process. In contrast, the vertical dimension represents a scale from the real (at the level of particular properties of a design) to the level of theoretical discourse. In a sense, this second dimension stretches from the ultimate particular and the real to the imaginary and into the realm of ideas and generic models. Reaching back to the introduction of this paper, the extremes of this axis can be understood in terms of Plato’s distinction between objects in the world and the world of ideas.

If we now arrange the three design approaches discussed above on this two by two matrix, we find that concept design is about the practical “sketching and modeling” of ideas, at a high level of design abstraction and conceptualization. Further on, the Proof-of-concept approach has some similarities with concept design in that it is also about designing the particular object. However, the process of conducting proof-of-concept design is more about “building and testing” than about manifesting abstract design ideas in concrete form (hence the “proof” part of the name). From this, we can see that proof-of-concept design is about specifying, at the property level, what the ultimate particular should be about in relation to theory and then determining whether it satisfies the criteria required of the particular design.

It is clear that the design guidelines approach is also about the properties of the design. The development of design

	Purpose	Main activity	Outcome or goal	Relation to design space
Proof-of-concept design	Verify design	Build and test	Plausible design	Demonstrate the possibility of the realization of a design space
Design guidelines	Guide design	Specify and formulate	Complete design	Defines a design within a design space
Concept design	Position design	Sketch and model	New design	Points to a possible design space
Generic design	Describe design	Group and describe	Characteristic design	Defines a design space

Table 1. Approaches to working with concepts in design

guidelines is about generating a general description of what should be included in a particular design. Accordingly, this approach functions on a more abstract level than proof-of-concept design; its main activities involve “specifying and formulating” the factors that a design must incorporate in order to be considered a complete whole.

Generic design thinking is as an approach clearly situated in a unique position relative to the other three. Generic design thinking is about “grouping and describing” particular designs. It involves the establishment of classes, the identification and formulation of the core concepts that are incorporated in a particular design, and the act of describing how this core can be identified in other particular designs. In other words, it focuses on identifying the unique aspects of the ultimate particular and relating them to other designs and classes of design concepts.

To further show how generic design relates to *proof-of-concept design*, *design guidelines* and *concept design*, we created the following table (see Table 1) to show that each approach has its own purpose, major activity, outcome or goal and how the approaches operate in relation to the design space of a particular design.

It is apparent that the main purpose of *proof-of-concept design* is to verify the design at hand. Accordingly, the main activity within this approach involves building a design and evaluating or testing it to prove that a particular design is viable. The outcome of the proof-of-concept design process is thus proof that a plausible design can be developed.

Design guidelines as described in table 1 are also quite practical tools. However, their purpose is quite different to that of proof-of-concept design, and the process of establishing design guidelines is quite different to that of constructing a proof of concept. The main purpose of working with design guidelines is to ensure that specific

design elements are considered and incorporated in a particular design. Building on this, most design guidelines have a built-in assumption that if the design is constructed according to the guidelines, it will work.

Concept design is not so much about the existing design space as much as it is about highlighting and delineating the potential for establishing a new design space. The main activities in this approach involve sketching and modeling ideas that may lead to manifestations (e.g. prototypes, illustrations, models) and the outcome or goal of the process is the demonstration of a new idea through the presentation of a new design. Accordingly, concept design ideally results in the identification of a new design spaces.

When considered in relation to these three established approaches for working with ideas in design, it is clear that *generic design thinking* stands out due to its focus on *grouping particular designs* and *describing the qualities that they have in common on a fundamental level*. This is achieved by *analyzing, comparing and contrasting designs*.

When applied in design, its purpose is to use these defined design classes and the resulting vocabulary (i.e. the names of the newly-established classes and their associated definitions) as a framework to facilitate descriptions of the general nature of a design within a specific design space or across design spaces. It thereby makes it possible to identify the degree of similarity and uniqueness between designs.

Generic design can thus be modest in scope, but ultimately has the potential to define new design spaces and create new genres for others to fill with additional designs. As such, generic design thinking is *both a design tool and an analytical tool*.

We see many opportunities for HCI to apply generic design thinking to examine the uniqueness or novelty of designed artifacts by examining the relation between the particular design and the class of interactive system it can be said to belong to. We will in the next section show how the ability

to systematically link particular designs to their underlying conceptual class provides an opportunity for the conceptual and theoretical advancement of HCI through design.

PROPOSING 'GENERIC DESIGN THINKING' AS A FIRST STEP TOWARDS A METHOD FOR MOVING FORWARD

Krippendorf [19] has argued that there is a need to develop design languages that will enable in-depth discussions of product qualities, design properties, and design semantics. Building on recent work that has paved the way for the development of design-oriented HCI and recent calls for new theoretical approaches in HCI (see [2],[6],[7],[11],[26],[32]) we argue that there is a similar need for advancement in our field in terms of *class formulation*, the process of *describing and defining the properties of these classes*, and *relating these classes to new designs* within our field via a process of design analysis and design critique, i.e., there is a need for generic design thinking in HCI.

By adopting *generic design thinking* as a method for conceptualizing designs, HCI researchers will be able to start building a joint repertoire of generic foundational designs that can be used to theoretically systemize our field while remaining close to the artifacts we design. To facilitate this task, we suggest the following four steps as essential when doing design conceptualization in HCI:

- *Identify* existing groups, classes, modes and genres in HCI.
- *Relate* existing designs to these groups and classes. There should be a specific focus on identifying high-level ordering or organizing principles as manifested in particular designs and analyzing how these designs can be said to belong to a certain group or class.
- *Elaborate and explore* the similarities and commonalities within and between each group or class, and formulate definitions for each class that incorporate the designs that are said to belong to each class.
- *Design, implement and evaluate*, ways of creating new designs that either fit into these classes or deliberately violates their definitions in new ways.

As the last of these steps show this method addresses the recurring question of novelty and uniqueness in design-oriented HCI research.

TWO CONCRETE EXAMPLES ILLUSTRATING HOW WE CAN WORK WITH GENERIC DESIGN THINKING IN HCI

We will now demonstrate, through the use of two examples, how our proposed method and approach works with some contemporary efforts made in HCI. Our two examples will illustrate generic design thinking as an analytical tool for conceptualizing designs in HCI. Both examples are aimed at illustrating the importance of understanding the link between a core design idea (class) and its manifestation (the core design idea manifested as an ultimate particular).

First we demonstrate how our four steps approach can be used to re-read the area of Tangible Bits [15] in HCI. This area has steadily grown, not only as a set of design manifestations, but more importantly as a solid class of designs all tightly related to the core idea of human-computer interaction through physical UIs. Secondly, we will demonstrate how one novel prototype system, in this case the TeleNotes system [29] introduced in 1997 can serve as an important marker of a new design space, i.e., as a new class of interactive systems.

So, our first example, “Tangible Bits” serves as an example of a well-defined class of interactive systems explicitly designed to advance the idea of tangible user interfaces through design. In 1998 Hiroshi Ishii *identified* and formulated a new class of interactive systems. He labeled this class “Tangible bits” [15]. Ishii used this class to *relate* to and distinguish between existing examples of GUIs and TUIs. Ishii then conducted design-oriented HCI over 15 years exploring this class of systems through design-oriented HCI. During this time he was engaged in the *exploration* and *elaboration* of the basic idea that he had earlier formulated but that was not manifested in real designs. This process meant that he also engaged in *design, implementation* and *evaluation* of a diverse set of manifestations in order to further the understanding and formulation of the basic idea. Right now, Ishii is again moving through this cycle with his recently proposed “Radical Atoms” [16] as a label for a new class of interactive systems. Again the idea behind this new class is to demonstrate design ideas that are distinctively different from the tangible bits design idea previously explored.

Our second example “TeleNotes” was presented in 1997 as a new and novel system for lightweight inter-personal communication. While the first example illustrate how we can conceptualize particular designs by relating them to a class of similar systems and its generic class (i.e., core idea) this example illustrate how a particular design can work as the starting point for further design explorations. As described by Lim et al [21] prototypes fill the two purposes of manifesting design ideas and to provide a tool for the filtering of a design space. According to our proposed method a new design idea manifested in a prototype like Telenotes, does not only provide the manifestation of the idea and the tool to filter a design space. It also marks the first instantiation of a potentially new class of interactive systems. Telenotes represented the *design* and *implementation* of a new design idea. In the presentation of the system the author [29] *identified* the need for a new class of systems supporting lightweight interactions, and *elaborated* on the distinguishing qualities this system needed to fulfill in *relation* to already existing designs.

While the first example demonstrated how our proposed method can be used to *analyze* and *conceptualize* existing designs, the second example illustrate how the four parts of our proposed method can be useful for working with new

ideas by engaging in design with the purpose to establish a new characteristic design.

We see similar possibilities across the whole field of HCI. From the general classes of interactive systems we have already developed (including e.g. the classes of interactive systems such as e.g. affective computing, embodied interaction, pervasive systems, mobile computing, etc) we see opportunities in the creation of even more particular *classes* of interactive systems which can serve to relate a particular design to a generic design concept and to enable the analysis, and comparison of designs. To move forward the classes need to be formulated as precise as for instance “tangible bits” or systems supporting “lightweight communication” as highlighted as the key idea behind the design of the TeleNotes [29] system.

DISCUSSION – WHAT IS A ‘NEW’ DESIGN? AND HOW CAN WE ADVANCE HCI DESIGN RESEARCH THROUGH GENERIC DESIGN THINKING?

When generic design concepts are used in architecture, there are two ways of handling designs that are new: as *novel* or as *unique*. Importantly, for something to be considered new it is not sufficient merely to be novel in the sense of having “odd properties”. Instead, for a design to be unique or new, it *must* involve at least one of the following criteria:

- the application of an established generic model to a new problem or in a new domain
- a design that combines elements from multiple established generic models
- the addition of a new element to a known generic model manifested in a design
- a combination of a new generic model and a design that defines a new design space such that the design demonstrates the potential scope of the new space.

In this context, novelty that stems from an evolution of a design’s underlying model reconfigures the landscape of design spaces; if done particularly well, it creates new space within this landscape that others can join and exploit.

We see several important implications of this suggestion for the advancement of HCI design research.

First, *generic design thinking reject designs that are not properly situated within a web of existing and already known design ideas*. The new cannot be advanced without understanding how it relates to existing design ideas. That is to say, a new ultimate particular (a concrete design) needs to be anchored in the general (that is, in some theoretically articulated idea).

Secondly, *generic design thinking implies a shift in focus away from specific properties of a given ultimate particular towards generic dimensions in new designs*. This shift has implications for what we need to express with a particular

design. It also raises questions about which factors should be incorporated into a design and which can be omitted when designing prototypes during the research process. This could potentially reduce the difficulty of developing research prototypes as fully implemented systems (and the need to include a lot of specific system features, etc).

Thirdly, *generic design thinking implies the need for more deliberate work in HCI on the formulation of classes of interactions*. Today, direct manipulation, embodied modes of interaction, and agent-based interaction models could be seen as some relatively stable classes that are important for the formulation of generic design principles in HCI. But what other kinds and ways of grouping interactions and interaction technologies can we imagine? And how can we move forward and become more specific? And what are the existing good examples?

Finally, *generic design thinking provides a practical tool to improve our ability to compare and evaluate different designs*. In this way, it could provide a foundation from which to address design quality and to make judgments about designs that are rooted in more than just the opinion of an individual designer. This aligns well with the proposed concept of interaction criticism [2].

In this paper we have proposed, described and exemplified *generic design thinking* in the format of a four-step method and approach to systematically move forward (design) while also more systematically understand and learn (analyze) from past designs. Although we have so far only described this as a first draft of a method we are convinced that this approach might redirect our field slightly from being heavily future-oriented to also acknowledge the utility of working backwards from a design to its conceptual roots – to trace design ideas through the analysis of designs. Importantly, generic design approaches require critical analysis of the history of design within HCI in order to anchor the new and novel in the history of ideas.

In wrapping up our paper, we should return to its basic message. We do have recent research stressing the importance of concept-driven design research [26] and we do have a good understanding of how ‘strong concepts’ [14] can advance our field. At the same time we lack methods to systematically relate different concepts to each other and in relation to particular designs. Here is where generic design thinking can play an important role as to systematically advance our field while keeping our design-driven approach. Given this take on the subject we should state that in order to answer the most central question for design-driven HCI “*when is a new design a knowledge contribution?*”, we must first, as a field of research, establish the method and approach for guiding the systematic work of conceptualizing and theorizing these designs. In this paper we have suggested ‘generic design thinking’ as an initial attempt to move in the direction of the development of one such method and approach.

In opening up for some broader thinking on this matter we conclude our paper with some words from the Romanian-born sculptor Constantin Brancusi and his idea that the essence of an object is also what is real about the particular object, and that what is real is not the exterior but the idea, the essence of a thing – the thing and the idea as one thing:

“What is real is not the external form, but the essence of things. It is impossible for anyone to express anything essentially real by imitating its exterior surface.” - Constantin Brancusi

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