Design isn't a Shape and It Hasn't Got A Centre: Thinking BIG About Excellences in Post-Centric Interaction Design

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Abstract
In this paper in support of a keynote presentation at MIDI 2013, I compare three major design paradigms and their commitments to 'centric' design activities through analyses of their Abstract Design Situations, which differ in their commitment to making and co-ordinating various types of design choices. Combining existing design paradigms provides new post-centric opportunities for design that are Balanced, Integrative and Generous (BIG). To realise these opportunities in design work in specific settings, we need to provide support via re-usable resources, and guidance on development and use of local resources to realise a balanced range of integrated functions. Abstract Design Situations and Resource Functions are core concepts within the *Working to Choose* (W2C) framework, a systematic conceptual structure that supports analysis, assessment and improvement of design work.

Author Keywords
Human-Centred Design, Engineering Design, Design-Led Innovation, Design Paradigm, Design Resources.

ACM Classification Keywords

H.5.0. Information interfaces and presentation (e.g., HCI): General

Introduction

Design is a complex creative human activity. Interaction Design is rarely a personal enterprise, but most typically occurs within inter-disciplinary teams. Design is social as well as cognitive, emotional and embodied. Such complexity means that we should be very cautious about locating the secret of design success in any single homogeneous focus for design work. Thus, while successful Interaction Design may be partially or substantially the result of user-centred activities, it can never wholly be the result of user-centredness alone. We need to move beyond looking for the secrets of design success in a single factor such as user empathy, creativity, business models, design craftsmanship, technological opportunities or the management of design innovation. All such factors can and do contribute to design success.

The mix underlying design excellence varies from project to project, design team to design team, and agency to agency. The right mix is always down to balance and integration of different design factors. No single factor can guarantee success in isolation, but what does appear to be indispensable is the *committedness* of the design team, whatever its composition (e.g., designers only, designers and stakeholders, designers and co-designers).

Committedness is a Meta-Principle for Designing [5] that requires an explicit scope for design activities. Design teams commit to activities via more specific principles such as *designing for usability* [14] or *design-led innovation* [17]. Excellent design work requires complex commitments that balance and integrate a broad range of design inputs and activities.

Committedness can take design teams beyond meeting requirements to surprising and delighting through a generosity of spirit that strives for excellence as standard. Such generous design teams seek to deliver designs that no-one imagined were possible. Thinking **BIG** about excellence in (Interaction) Design is thus enabled by a **B**alance of factors, their effective **I**ntegration and the **G**enerosity of the design team.

To explore the factors that need to be balanced and integrated in generous design practices, we first compare and contrast two major design paradigms with human-centred design.

Three Major Design Paradigms

Human design activities predate writing. Design practices that span millennia, continents, cultures and craft milieu are so diverse that attempts at generalization face massive challenges. Nevertheless, to have general frameworks for design, we must generalize across diverse design practices. The strategy adopted for this paper distinguishes different design paradigms through differences between combinations of types of choices, their coordination, and the standards applied to design work.

Three major design paradigms can be distinguished: applied arts, engineering and human-centred. There may be others, but to show this we need a basis for distinguishing between distinct paradigms [10].

The oldest design paradigm is *Applied Arts*, which is well characterized as *conversations with materials* [16] Such mostly tacit conversations rely strongly on craft expertise and critical judgments. The youngest paradigm is *Human-Centred*, which is *primarily research-driven*. New knowledge about project stakeholders (especially target users), project goals and usage settings is gathered before considering artefact features and qualities, and is continuously refreshed, particularly by formal evaluations. Designers are expected to give more weight to user needs and preferences than to their own expertise and judgment. In between, although still relatively young at less than four centuries old, is the *Engineering Design* paradigm, which is well characterized as the *optimal solution of well specified problems*. Its design inputs draw more on secondary scientific knowledge than on primary contextual research.

Major Design Paradigms as Ideal Types
The three main design paradigms should be thought of as *Weberian Ideal Types*, i.e., they are hypothetical constructs that abstract over concrete design practices. They have not been systematically validated against 'all' existing design practices, but are nevertheless evidenced in established ubiquitous design practices. They are thus not immune to falsification, but they also have strong directional value, as evidenced by the analysis below. They correspond closely to the two paradigms compared by Dorst and Dijkhuis [12], whose *reflection-in-action* paradigm is Applied Arts, and whose *rational problem solving paradigm* corresponds to Engineering Design. The human-centred paradigm is a break away from Engineering Design that focuses on collecting primary data for both contextual understanding and usage evaluation.

Applied arts design has its roots in the guild practices and apprenticeships of the decorative arts. It predates seventeenth century scientific thinking by millennia. It is an embodied, tacit, reflective and responsive practice. Schön's studies showed that the personal judgement and *artistry* of applied arts practices are shared across several modern professional practices. Schön characterised professional practice as "reflective conversation with the materials of a given situation" [16]. Such materials could be physical, as in applied arts practices, or social, personal or conceptual, as in professional practice. Much of Schön's position is consistent with Aristotle's position on *techne* (Art [2]), where excellence is demonstrated in what is made, and results from the maker. The Applied Arts are thus centred on the designer, rather than on human beneficiaries or on artefacts themselves.

Engineering design has its roots in the scientific revolution of the seventeenth century. In Descartes' unfinished *Regulae ad directionem ingenii* (Rules for the Direction of the Mind), Book Two's Title is *On Perfectly Understood Questions*. It begins with Rule 13 *On the Direct Resolution of Questions*, and little of the writing here would be out of place in a contemporary engineering design text book. To be tractable, a problem specification must be framed so that solutions can be objectively and precisely validated and verified. Problem specifications are Engineering Design's keystones.

Engineering design is closely related to scientific method, with problem specifications replacing hypotheses, and the design process replacing experimental confirmation. In scientific experiments, it should be clear whether a hypothesis is confirmed or not. Similarly, in Engineering Design, it should be clear whether a design meets specified requirements or not. The language of Engineering Design (problems, requirements, specifications) has a strong hold. Jeff Conklin's reformulation of *Wicked Problems* [11] begins with "The problem is not understood until after the formulation of a solution". This exposes a key contrast between applied arts and engineering design, where problem specifications should not change substantially. However, the language of Engineering Design was used to characterise wicked problems (largely as what they are not), and not the applied arts vocabulary of, for example, briefs, problem and question framing, insights, inspiration, reflection or refinement. As a result, an opportunity was missed to align wicked problems with applied arts design that pre-dated engineering design by several millennia. Engineering Design is thus centred on the artefact, rather than on human beneficiaries or designers.

Human-centred design (HCD) evolved from a form of engineering design, *Human Factors Engineering*, which developed after World War II, and mostly focused for almost three decades on anatomical, physiological, motor and perceptual factors, with the latter two referred to as *Engineering Psychology*. Human Factors Engineering (*Ergonomics* in Europe) systematically explored specific biological and psychological inputs to design by evaluating the impact of specific parameters on human performance. This was compatible with engineering design practices on specification and verification. Human performance requirements could be included in engineering specifications and verified as part of testing. Often, ergonomists were engineers with postgraduate qualifications, which greatly enabled effective work within engineering contexts.

In the mid-1980s, usability requirements were specified in accordance with human factors engineering practice. Results were mixed, so HCI experts at Digital and IBM shifted their attention to contextual understanding. Whiteside, Bennett and Holtzblatt [18] shared their experience and evolution of usability engineering, and separated user-centred user experience practice from its human factors heritage. From the 1990s, HCD could no longer be considered as being within the engineering design paradigm. Without usability specifications, it was no longer clear what usability evaluation should assess. Similarly, contextual research no longer provided scientifically derived generic performance targets or feature specifications (e.g., reach distance, display brightness, keycap size and travel). Without such support, decisions about interaction designs became more remote from the main user-centred activities of user research and usage evaluation. Human-Centred Design thus came to centre on human beneficiaries, rather than on designers or designed artefacts.

With such distinct centres, conversations between the design paradigms often are formed from misunderstandings, mistrust, accusations and recrimination. Each has something to offer, but each also has weaknesses. None are adequate for excellence in 21st century design.

We can roughly identify strengths and weaknesses with reference to the above brief paradigm characterizations. The strength of the applied arts paradigm is its centre, i.e., the exploitation of designers' craft knowledge, aesthetic skills and expert judgment. This is also its main weakness. The strength of engineering design lies in precise problem specifications that focus design on solutions and direct how proposed solutions will be evaluated. The weakness of engineering design is the requirement that its centre, i.e., the artifact that is designed, must be specified completely in advance, along with the criteria against which it will be evaluated. HCD's strength lies in its ability to involve its centre, i.e., human stakeholders, throughout the design process. Its weakness is that detailed design and implementation receives limited support from human-centred practices.

A more balanced design paradigm, which integrates across existing paradigms' practices, could combine the strengths of all and minimize the weaknesses of each. A more flexible, balanced and integrating paradigm is needed to combine the engineer's accountability with human-centred empathy and applied arts generosity. Such a paradigm cannot have a centre, since by combining three paradigms with distinct centres, no single centre can be allowed to dominate, since this would reestablish one paradigm as dominant. A more flexible, balanced and integrating design paradigm must thus inevitably be *post-centric*. Rather than betting everything on one dominant focus, post-centric design allows potentially multiple foci to shift during the design process. There is no single predetermined centre before design begins, and nothing remains fixed during design.

Abstract Design Situations as a Basis for Unifying Design Paradigms

This section adapts and updates material from [10]. The three major design paradigms have distinct disciplinary origins (arts, engineering, human sciences). Strengths and weaknesses are due to different emphases and foci within each paradigm, which are reinforced by differences in disciplinary vocabularies (e.g., engineering design's *problems* vs. applied arts design's *briefs*). However, we can cut across these vocabularies (and to a lesser extent, their axiologies or value systems) by focusing on *types of design choices* that let design paradigms be idealised as *Abstract Design Situations* [6], defined as specific combinations and co-ordinations of up to four choice *types*, and explicit standards for design work.

Types are abstractions that group together massive groups of design choices on the basis of their categorical focus, i.e., the sorts of decisions that are made for each choice type. Four such distinct types of design choice are now briefly surveyed.

Choices of Qualities and Features for Artefacts

The first abstract type of design choice is common to all design paradigms, which all make choices about the features and qualities of designed *artefacts*. Something always results from the activities of designing, typically a product or service, but increasingly some coupling of both. A design may or may not be realised, but even when not, it is communicated with sufficient detail to let us imagine how it would appear and behave. We understand what is proposed via the qualities and features that are expressed in some form (e.g., sketches, specifications, scenarios). The term *artefact* generalises over a very wide range of design outputs. For example, the outputs of interaction design include apps, web sites, multimedia titles, interactive installations, automotive user interfaces, video games, and public terminals (kiosks).

Choices of Values for Motivating Purposes

The values that motivate designing vary across the three design paradigms. In Applied Arts, design *purpose* can be tacit and largely experimental, with creative insights and opportunities shaping evolution of realised artefacts. Such craft practices lie at one extreme of Applied Arts design. At the other extreme, purpose in commercial design (product, fashion marketing, retail interiors etc.) is closely aligned to business needs via clearly expressed positive value propositions. Engineering Design too can have a commercial focus, but also covers public goods, e.g., civil engineering. However, it translates intended purpose into specifications that state required functions and performance for designed artefacts, and thus tends to subsume choices of purpose within choices about artefacts. It could be that there is an explicit paradigmatic choice within Engineering Design to *not* express design purpose other than via artefact features and performance.

Motivating purposes thus span from the tacit dynamic goals of the designer-maker to the explicit fixed requirements of Engineering Design. Purpose in HCD tends to gravitate towards engineering, focusing on non-functional requirements related to usage qualities and experience. However, such requirements are rarely specified, or may not be shared by designers and product managers, placing them outside a design's core purpose. It may not be clear what choices, if any, have been made about intended purpose within HCD, apart from paradigmatic values such as ease of use, ease of learning and user satisfaction.

It is thus a stretch here to span all practices that set design direction across the main design paradigms. *Motivating purposes* is an umbrella term for a second type of design choice. It has a limited fit to some design settings, due to a lack of explicit product-specific intentions (HCD), or due to specifications that are effectively descriptive artefacts that state precisely *what* will be realised, rather than (prescriptively) *why* it is being realised. At the extreme, there is little distinction between the realised artefact and intended purpose in Engineering Design.

The term *purpose* must thus generalise over a very wide range of design goals. For example, the goals of interaction design may be expressed as requirements, specifications, product visions, or design briefs, each motivated by a client strategy. These differ in the extent to which they make choices of design purpose explicit in terms of (a) benefits to be enhanced or added, and (b) costs to be reduced or averted. Interestingly, all of the existing design paradigms make their centre their purpose, i.e., the purpose of Applied Arts is to express craft excellence, the purpose of Engineering Design is to create artefacts with required properties, and the purpose of HCD is to meet stakeholders' usage requirements. In each case, the purpose is the centre and the centre is the purpose. In post-centric design, purpose must be separated out as a distinct and separate form of design choice.

Choices about Validating Evaluations

HCD has an uneasy relationship with the artefact, but has lavished attention on empirical evaluation. Engineering Design has an equally strong focus on evaluation, but on the realised artefact, rather than its resulting usage. Evaluation activities in HCD and Engineering Design are typically explicit, distinct and planned, with expectations for design modifications where results are not satisfactory. In contrast, evaluation activities in Applied Arts are often tacit, opportunistic and unscheduled, and can focus as much on motivating purposes as on their achievement. Reflection by designers can result in a change of purpose as well, or instead of, changes to the current design. Whereas the artefact and intended purpose can be hard to separate in Engineering Design, evaluation and purpose can blur into each other in the Applied Arts. This holds for the distinct practices of the 'crit' (*criticism*, especially in design education). 'Crits' do not just focus on aesthetic qualities. Design intent is often a more dominant focus on whether or not a design's purpose is worthwhile. This extends from educational crits to the wider world of design awards, juried exhibitions and critical reviews. There may be an explicit paradigmatic choice within Applied Arts to *not* make any choices about evaluation practices, but to trust designers' judgements on whether to stick with existing choices of artefact features and qualities, to choose new ones, or to revise design intentions.

Much of HCD's initial success and attractiveness could be attributed to its evaluative focus on usage. Such practices are not native to other paradigms, but can be readily incorporated, especially if they can be tightly coupled with design purpose. However, HCD evaluators often choose evaluation criteria independently of product strategy, especially routine HCD metrics such as ease of learning, time on task, error rates, contextual fit or subjective satisfaction. *Evaluations* are thus the third type of design choice, with each paradigm managing them differently, and making choices in terms of testing, assessment, verification, validation, and critique.

Choices of Benefitting Stakeholders

HCD would not exist if other paradigms had established a strong effective focus on users and stakeholders. While some Engineering Design practices include ergonomic considerations (especially safety-critical and military), human factors engineering focused on universals rather than individual differences to provide re-usable parameters for ergonomic requirements.

Applied Arts design varies extensively. Much remains focused on the dialogue between artefacts and designers, with limited attention to human contexts. However, there have been strong documented human-centred traditions in architecture since at least 80 AD (Vitruvius' *de Architectura*). Even so, human insights tend to be opportunistically sourced and rapidly absorbed into designers' conversations with materials. Systematic studies of usage contexts remain exceptional in Applied Arts practices, making it hard to find explicit choices, documented or otherwise, as to who a design is meant to benefit and how (especially with respect to usage contexts and activities).

Benefitting stakeholders, including users, thus receive varying attention across design paradigms. Even HCD is inconsistent in whether it is *human*-centred across a range of stakeholders, or solely focused on *users*. *Beneficiaries* are thus the fourth type of design choice, although this only covers those to whom good is done, and not those who lose out (e.g., criminals in design against crime). A word to cover both would have to be made up, e.g., *anyficiairies*, those for whom something is made, whether for good or for harm.

In HCD, the choice of beneficiaries extends beyond a simple list of included stakeholders *who* will be considered during design, and instead includes *what* will be considered about beneficiaries as potentially relevant when making decisions about design purpose or about artifact features and qualities.

	Artefact	Purpose	Evalua-tions	Benefici-aries
Applied Arts	👍	👍	👎	👎
Engineering	👍	👎	👍	👎
Human-centred	👎	👎	👍	👍

Table 1. Design Choice Type Strengths across Paradigms.

DESIGN PARADIGMS: MORE ON STRENGTHS AND WEAKNESSES

For the rest of this paper, I refer to types of design choices using short names: *Artefacts*, *Beneficiaries*, *Purposes* and *Evaluations*. Making explicit choices for all four types of design choice requires competences in creative and technical invention, strategic focus, human sciences, humanities and ethics. This is very demanding, so unsurprisingly, paradigms are not strong on all choice types (Table 1).

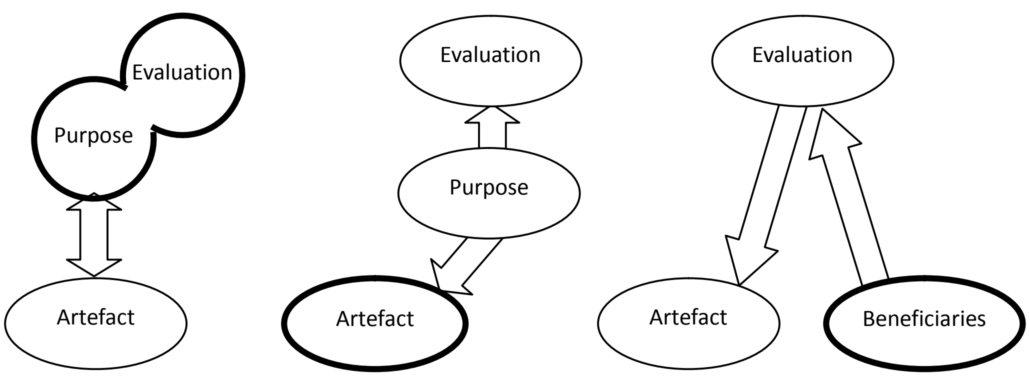

Figure 1: Design Paradigms, Centres (bold ovals), Design Choice Types and their Co-ordination

Figure 1 contrasts the three main design paradigms via the design choice types that they commit to, what they centre on, and the extent to which they co-ordinate these choices with other types of choice. On the left, Applied Arts design combines tacit choices of purpose and evaluation in the minds of designer-makers, with artefacts evolving explicitly through conversation with its materials (two way arrow). In the centre, Engineering Design expresses purpose explicitly through specifications that describe the artefact and its verifiable properties (for evaluation). Specifications are subject to rigorous change management procedures (hence one way arrows). On the right, HCD involves beneficiaries in evaluations of artefacts, but provides few systematic effective inputs [13] to support choices about artefact features and qualities. Evaluation in HCD tends to focus on negative issues, and contextual research more often indicates what is *not* desirable rather than identifying clear options for artefacts [13].

The absence of one type of design choice in each of the three diagrams in Figure 1 indicates a lack of methodological support. In reality, there will be some ephemeral or tacit considerations of missing choice types, but this will not be well supported by tools, techniques and methods for a paradigm.

It is possible to indicate diagrammatically what a post-centric fusion of the three major paradigms would look like. This suggests a way forward for design teams who want to escape from the confines of existing design paradigms and explore more co-ordinated comprehensive design practices.

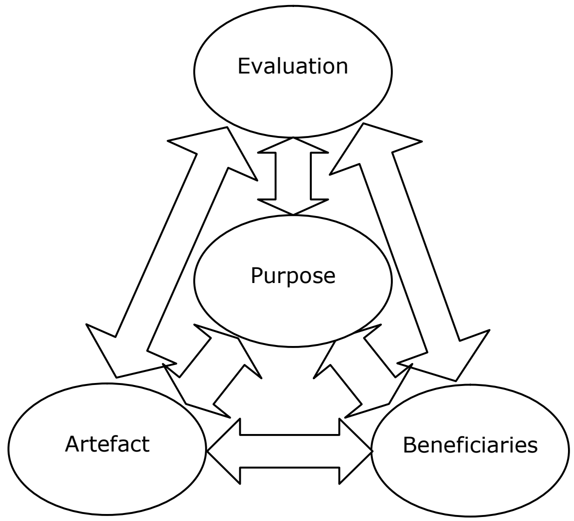

Figure 2: A Fusion of Existing Design Paradigms: All Choice Types with 2-Way Co-ordinations

Figure 2 shows a fusion of existing design paradigms that provides a broad reference structure. Figure 2 only shows 2-way co-ordinations, 3- and 4-way co-ordinations are possible, along with infinite recursive co-ordinations of co-ordinations [6].

This is of course, a very small first step towards post-centric design. Every choice type needs methodological support and related design resources to create, source, strengthen, record, share and select options, as does every form of co-ordination within the scope of an Abstract Design Situation. All support and resources need to be able to meet the generic design standards associated with an Abstract Design Situation.

Balance and Integration in Design Work

Design is a complex activity where questions of fine detail must be continuously resolved to arrive at a final artefact, either in concept, sketches, prototypes or manufacture. *Abstract Design Situations*, as commitments to specific balances and integrations of up to four types of design choice, are highly abstract and idealised, to the extent that they hide almost all sense of how design work progresses. Thus while the Abstract Design Situations for each major design paradigm expose differences of coverage, balance and integration, it is at the most abstract level possible. This gives us no concrete guidance on how to support design work to improve balance and integration and thereby exploit the strengths of existing paradigms while reducing the impact of their weaknesses.

A Framework for Understanding Design Work

In 2011-12, I developed the *Working to Choose* (W2C) framework [7,10] to systematically relate Abstract Design Situations to design work via very high level principles (*Meta-Principles for Designing* [5]) and a *resources* model of method use in design [19], where design methods are not regarded as complete re-usable work structures, but instead are the result of design work that completes incomplete re-usable *approaches* [19]. It is called *Working to Choose* as it conceives design work as primarily identifying options and strengthening and testing these until some can be chosen. Options relate to all types of design choice.

Design work completes incomplete re-usable *approaches*, which name groups of re-usable resources with varying extents of completion. Design work locally adds required resources that are missing from an approach (e.g., test user profiles) and completes re-usable ones as appropriate (e.g., generic persona skeletons [15]).

Completed resources have specific *functions* at specific points within specific design settings. W2C treats resource functions are concrete realisations of Meta-Principles, usually through 1-to-1 associations [7]. Meta-principles thus express forms of standards for design work that are made concrete and realised via resource functions.

Within the initial W2C Framework, Abstract Design Situations scope design settings that will be supported by a range of approaches, each comprising a set of resources with potential functions that could meet the requirements of related meta-principles. One such resource function was *scoping*, which indicated the coverage of an approach. It turns out that the scope of an approach can also be modelled as an abstract design situation, as can each resource within an approach, method or process.

The scope of a design setting, design approach or design resource is thus support for making and co-ordinating choices of one or more of:

- artefact features and qualities
- intended beneficiaries
- intended purpose
- evaluation practices

Thus *wireframes* can express choices about screen layout, *personas* [15] can express choices of beneficiaries and relevant information about them, *value propositions* can express choices of intended purpose, and *heuristics* can express evaluation criteria.

Abstract Design Situations express scope across different extents of design work to of:

- design processes
- design approaches
- design resources

This has created a common structure throughout the W2C framework, alongside further modifications to W2C since its initial publication [7] and elaboration [10]. It is now a framework that anchors *Committedness* in Abstract Design Situations and Meta-Principles for Designing, with the latter realised through *resource functions*. W2C now forms a systematic concept network from 4 design choice types, 12 current Meta-Principles for Designing, and 10 current resource functions. This concept network can be used:

- *analytically*: to decompose design settings, methods and approaches
- *evaluatively*: to critique specific design settings, methods and approaches
- *generative*ly: to develop new Abstract Design Situations and/or supporting design approaches and resources for them

Resource Functions in Design Work

Resource functions operate at a more concrete level than the very abstract Meta-Principles for Designing and Abstract Design Situation. Design resources can realise specific functions that support specific design activities. Thus personas have an *expressive* function when used to record design options, whereas persona life cycles [15] can add *inquisitive*, *directive* and *performative* functions that respectively: inform persona structure and content; improve persona quality; and communicate personas to a broad range of stakeholders.

The quality of resource functions as realised in design work can be assessed with reference to related meta-principles, which have been renamed where necessary to align them with resource functions [7, 9]. For example, the meta-principle of *inquisitiveness* sets standards for *inquisitive* resource functions. While this example may appear to be content free, it makes an important distinction between *what* a design resource achieves in use (its *functions*) and *how well* it achieves them (its support for meta-principles). Similarly, *expressive* functions should achieve *expressivity*, and *performative* functions should achieve *performativity*. Such morphological simplicities have to be relaxed at times. For example, *directive* functions should achieve *tenacity*. Here, the required quality for design work is that chosen design options should be *tenacious* (rather than simply *credible* as in [5]).

Morphological devices such as suffixes (*-ness*, *-ity*) are used systematically when naming meta-principles. Meta-principles such as *committedness* are *virtues* or excellences in the Aristotelian sense [2], and thus must be kept in balance, avoiding excesses through 'golden means', e.g., courage lies somewhere between cowardice and recklessness, but this *golden mean* could lie anywhere on the continuum [2]. It is thus possible for the meta-principle of *Committedness* to be overcommitted, and try to co-ordinate all possible combinations (i.e., infinite [6]) of design choices, but also to be undercommitted, by neglecting some types of design choice and their co-ordination, and/or some meta-principles.

Similarly meta-principles such as expressivity are *potentials* that can be subject to Pareto's Law (80:20 law, 80% of outputs result from 20% of inputs [1]), but where not, they are still subject to some law of diminishing returns, whereby additional effort returns fewer rewards. Thus, return on extensive documentation (expressivity) and validation (tenacity) may be poor. Even so, increasing documentation and validation from a low base could better support reflection, audit and review.

The resulting conceptual system tightly couples Abstract Design Situations to design settings, approaches and resources, and also tightly couples Meta-Principles to resource functions. The resulting system is highly generative, resulting in co-derivation of resource *functions* [9] and new Meta-Principles (from 6 in 2009 [5] to 8 in 2011 [10] to 12 currently), and the replacement of resource *types* [19] with resource *functions* [9]. Resource type concepts fitted usability evaluation methods [19], but once design methods were considered, it was also recognised what was being named were not types, but *functions*, since one resource can have multiple functions without this resulting in multiple types. Sketching for example has an *expressive* function, but can also have an *inquisitive*

Challenging Resource Function Vocabulary
(with helpful glosses, based on [9]*)*

1. Adumbrative *(rough outline of an approach's scope)*
2. Ameliorative *(an approach's guiding values)*
3. Inquisitive *(finds stuff out)*
4. Directive *(systematically guides design work)*
5. Expressive *(gets stuff down)*
6. Informative *(puts stuff in)*
7. Performative *(spreads stuff out)*
8. Invigorative *(spurs things on)*
9. Protective *(keeps things up)*
10. Integrative *(pulls stuff together)*

Directive functions are only one form of design support, and require many local resources if other functions are unsupported.

function (as an ideation technique) and also a *directive* function (in the way that sketch sequences develop through refinement, discarding some options, and triggering new directions). Refinement draws on knowledge resources that guide improvements to the 'finish' of sketched elements.

Consideration of design work and the way that it related to approaches and resources also exposed a cognitive bias in [19], but such a focus on designers' minds downplays the important roles of moods, buddies and bodies in design work. Making the most of what design teams have to give as people requires a range of resources and approaches to shape their use, as I argued recently in an alt.chi paper [9]:

> "The Cobbler's Children Have No Shoes", a saying of unknown origin, refers to the tendency of skilled workers to reserve these skills for their clients, to the neglect of the needs of themselves and their families.
>
> Designers are the cobbler's children of HCI. HCI's ever extending richness of understandings of users has not been extended to interaction designers.

As a result of this critique, drawing on work by some of my current PhD students (Malcolm Jones, Michael Leitner and Vicky Teinaki), we have been able to identify new resource functions at process as well as approach level. Resource function analyses support detailed assessment of balance, integration and generosity in actual design work, at the opposite end of the abstraction spectrum to Abstract Design Situations.

Vocabularies for Resource Functions

A resource function *vocabulary* [9] supports understanding, assessment and improvement of existing design and evaluation approaches, as well as targeted creation of new ones (on the basis of conceptual analysis and not demonstrated need). The underlying concepts thus have extensive valuable practical applicability. Resource function analysis can quickly reveal gaps that must be filled by local resources in specific design settings. Alternatively, re-usable resources can be designed to fill gaps, or complementary approaches can be added to achieve coverage. Analysis can also reveal duplication and related ambiguity, redundancy and complementarity, which could support approach simplification by removing and/or replacing resources.

[9] has identified further benefits of resource function analysis:

- it can focus studies of design and evaluation methods that expect approaches to interact extensively with local resources in projects.
- it can support audit and improvement of design practices.

It is important that researchers and practitioners have a good grasp of the meaning of each potential resource function. Careful choices of function names are thus required. So far, three cognitive functions (*inquisitive*, *directive*, *expressive*) and one social function (*performative*) have been mentioned. *Scoping* functions have also been alluded to, but were not named as being *adumbrative*. Experiences with the changing names of resource functions [7] and meta-principles

Everyday Vocabulary,
(from [9])

1. Limiting
2. Valuing
3. Sourcing
4. Steering
5. Recording
6. Telling
7. Sharing
8. Energising
9. Caring
10. Linking

Technical Vocabulary
(from [9])

1. Utilisation
2. Prioritisation
3. Investigation
4. Instruction
5. Registration
6. Education
7. Presentation
8. Acceleration
9. Correction
10. Co-ordination

[5] suggest that no single stable vocabulary may ever be adequate. Vocabularies for resource functions and related meta-principles for designing present substantial challenges, even for native English speakers.

Parallel vocabularies for resource functions have therefore been developed. A challenging vocabulary appears in the side bar to the left. A second everyday vocabulary has been developed, and is shown at the top of the sidebar on the next page. A more formal but neutral technical vocabulary appears below it. While the primary aim of multiple vocabularies is to provoke creative developmental reflection for designers and researchers, it is possible to match vocabularies to audiences. Research papers could use either the challenging or the technical vocabulary depending on the audience. The everyday vocabulary can be used to explain design thinking to clients and other project stakeholders. More experimental poetic vocabularies have been developed to stretch the imagination of design researchers and practitioners ([9] presents colour and exotic historic occupation analogies).

Regardless of what we call resource functions (and I would argue that one vocabulary is never enough), they form the basis for balance and integration at the concrete level of design practices. The Persona Life Cycle [15] thus balances the expressive function of personas with inquisitive, directive and performative functions across a lifecycle from persona conception to maturity, and integrates these functions within a coherent design process.

Balance, Integration, Generosity and Resource Functions

In the introduction to this keynote paper, I referred to a need to Think **BIG** about excellences in Interaction Design, and the ability to achieve this through a **B**alance of factors, their effective **I**ntegration, and the **G**enerosity of the design team.

Balance and *Integration* can be achieved via Abstract Design Situations with a broad scope and tight co-ordination, with concrete support from a broad range of resource functions provided via re-usable approaches and process resources. *Generosity* in contrast is achieved via specific practices. Some relate to choices of design *purpose*, especially the design team's desire to surprise and delight throughout long term usage. Such generosity towards intended beneficiaries also needs to extend to the design process itself, with *emotional and social resource functions* playing a key role here.

Invigorative (energising acceleration) resource functions tend to emerge at process level. These give rise to positive emotional resources (i.e., resources with emotional functions) that drive designs forward. In contrast, *protective* (caring correction) resources manage negative emotions in design work. Imaginative design practices can be *invigorative*, whereas curtailing fruitless energy sapping activities can be *protective*. Enthusiasm and care must be balanced and integrated in design practice, with protective moves transformed into invigorative ones. Generosity towards beneficiaries comes more readily when design teams approach design practices with generosity towards each other.

Meta-Principles as Standards of Design Excellence [10]

1. Committedness to design scope
2. Committedness to design principles
3. Inquisitiveness
4. Tenacity
5. Expressivity
6. Informativeness
7. Performativity
8. Propulsiveness
9. Protectiveness
10. Desirability of Artefacts
11. Viability of Purpose
12. Inclusiveness for Beneficiaries
13. Improvability from Evaluations

There are 12 rather than 10meta-principles, as there are four meta-principles for the integrative function (10-13 = 3 extra), distinguished by the design choice type in focus, but committedness spans two functions (1-2).

Performative (sharing presentation) resource functions result from social design practices that are generous in terms of the time devoted to sharing design options, challenges, and progress with a wide range of stakeholders. Here too, generosity towards beneficiaries comes more readily when design teams are generous towards all stakeholders.

Design isn't a Shape and It Hasn't Got A Centre

As an Interaction Design Conference, *Multimedia, Interaction, Design and Innovation* (MIDI) 2013, following on from the previous Kansei – User Interaction Design series, is strongly aligned with the human-centred design paradigm. However, MIDI's new name clearly indicates a broadening beyond HCD to Applied Arts practices (Multimedia, Design) as well as commercial and social innovation, with positions on design purpose that are broader than ease of use, efficiency, effectiveness and user experience qualities.

This broadening of scope marks a move away from a superficially exclusive HCD focus (which was not exclusive in practice) to a more balanced position on Interaction Design practices.

Over the last decade, HCI research and Interaction Design have moved away from an initial human factors focus [14] to a more broad and balanced view of the important factors in Interaction Design [8]. All notions of there being *A* centre for design now have to be abandoned. Balance and centredness are incompatible. Asserting that design has any dominant centre gives undue weight and prominence to any centre.

Centredness also distorts integration by limiting the co-ordination of design choices to integration with the dominant central type of design choice. Also, centredness tends to fix design processes into specific sequences of homogeneous stages. For example, designing for usability [14] requires contextual research to fully precede design activities, and empirical evaluation to precede design iterations. These requirements have been ossified in standards such as ISO 9241-210. Such requirements limit the initiative and independence of design teams to apply their own judgement when committing to the content and structure of design processes. They are presented as formulaic absolutes, without the judgement required for establishing virtuous golden means or avoiding further diminishing returns from design potentials.

Centredness also favours some design standards over others, and thus prefers some meta-principles and associated resource functions over others. HCD's initial cognitive focus has turned designers into the Cobbler's Children of HCI, with a narrow construction of *tenacity* as scientific credibility and an overemphasis on *directive* functions that has created a gap between how Third Wave HCI understands users and how designers are still constructed as *Model Designing Processors* [9].

The move away from an Engineering Psychology based HCD requires a broader range of potential design standards, expressed as meta-principles, for the assessment of resource functions (see side bar to left). Note again the distinction between *virtues* (-ness) and *potentials* (-ity), with adverse consequences of maximising the former, and decreasing pay back for maximising the latter. The addition and renaming of meta-principles since [5] is discussed in [9, 10]. Meta-principles 6-9 do not appear in [10], but correspond to four new resource functions identified in [9]. Numbers in the side bar box correspond to resource function numbers in the previous two side bars.

The simplicity of centredness brings both easy prioritisation and exclusion. The complexity of 12 meta-principles associated with 10 resource functions and 4 types of design choice brings challenges of balance: what should the priorities and focus be, and when? It also brings challenges of integration: how will all the resulting separate design activities co-ordinated? This complexity is further increased by an expectation of generosity: not only must design teams manage the complexities of balance and integration, they must do so in ways that will enable delight and surprise through the life time of product or service use.

Summary: Thinking BIG About Excellence in Post-Centric Interaction Design

HCD for Interaction Design is now into its fourth decade. Moving beyond its certainties, simplicity, foci and priorities will be unsettling for those who have most embraced HCD values. However, the same is true for other simple centres for design, such as Design-Led Innovation [17]. While [17] provides convincing examples of design led innovation in consumer products, it is not clear that the lack of HCD activities in the associated design processes would guarantee success in all product and service categories. Similarly, leading agencies such as IDEO who have exploited HCD practices very successfully, nevertheless stress the need for balance in design practices [3].

We thus need to think BIG about the new design excellences that will result from balance, integration and generosity in a new fusion of the major design paradigms. Existing design process models will need to be revisited, with more activities in parallel of fewer homogeneous phases in sequence. Iteration will not follow a fixed order, but will instead be potentially *total* [4], with the potential to iterate any design activity at any point in a design process, in heterogeneous phases or stages that take their coherence from the current design vision and its development, rather than from intellectual coherence and homogeneity of activities such as problem analysis, requirements specification, conceptual design, detailed design or formal evaluation. This will better suit existing HCD practices to the more Agile development environments preferred for contemporary software development.

We also need to think BIG about how design work is actually achieved, which is not via flawless cognitive execution of complete re-usable methods [9], but through active completion and complementing of re-usable resources. Some resources are grouped into re-usable named approaches that are typically commoditised as methods, but are not so in any strict sense. Some resources can be re-used within or alongside several approaches [19]. Few resources are complete before design work commences, and some may be little more than a prompt before extensive design work makes them actionable.

We therefore need to generalise across design work in terms of potential resource functions, rather than in terms of fixed resource attributes, since such attributes are not only typically the *outcome* of design work rather than *inputs* to it, but also change dynamically across design activities.

It is time to let go of HCD and its associated approaches masquerading as methods. Instead, we need to integrate human-centred *activities* as appropriate in design settings within an overall balance of activities that prioritises specific project needs over disciplinary ideologies. We need to support human-centred and other design activities with re-usable resources, grouped into named approaches (e.g., personas) when appropriate, and support design work with guidance on the local completion and addition of resources. It's time to think BIG and aim for new excellences in Interaction Design.

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