Models, Collections and Toolkits for Human Computer Interaction: What Can We Learn?

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Abstract. The growing use and acceptance of Human Computer Interaction has fostered continued development and refinement of the associated tools and methods. As a result a large variety of HCI tools are available, improving our ability to access and utilize user information. On the other hand, the large number of options makes it increasingly difficult to identify and use the most appropriate tools, especially for novices and students. To address this issue of complexity several models, collections, and toolkits have been developed to help identify or recommend appropriate tools and processes. This paper presents a review of these collections and illustrates underlying barriers, which make the process of tool selection even more difficult. In this paper we describe prominent similarities, differences, what is missing, and suggest how these insights can contribute to improving Human Computer Interaction in education and practice.

Keywords: Human Computer Interaction (HCI), Human Centered Design (HCD), User Centered Design (UCD), Models, Collections, Toolkits, Guidelines, Tools, Methods, Techniques, Education.

1 Introduction

The growing use and acceptance of Human Computer Interaction (HCI) has fostered continued development and refinement of the associated tools and methods. HCI practitioners and interface designers are now able to focus on how to access and utilize the information users possess. In addition, HCI is being applied to increasingly complex applications, connecting networks of humans with the systems of technology they use [5]. These advances are also evident in the development of new and sophisticated HCI tools. These new tools allow designers to go beyond simply incorporating *user information* into the design process and focus on *how* to incorporate *users* [14] and unlock the information they possess. In 2005, Stanton et al. identified more then 200 human factors tools and methods [15]. This toolbox continues to expand as new tools are developed to accurately, efficiently and creatively access, collect and communicate the information desired from users.

Unfortunately, the growing number of tools, along with the growing complexity of interactions, complicates practitioners', students' and educators' ability to gain awareness and later select and apply the most appropriate tools. These problems are

also evident in the limited or slow adoption of new tools [3] and in the continued misuse of common tools such as focus groups and usability tests [4, 12].

In response to this complexity, a diverse group of models, collections, and toolkits have emerged to support the use of HCI tools. These collections strive to provide awareness, structure, and information in order to facilitate the understanding, selection, and application of HCI tools and processes. Although each of these collections was designed with the same promising intentions, the issues of adoption and misuse continue.

To understand why these issues have not been resolved, this study will examine the similarities and differences between the models, collections, and toolkits to identify potential barriers. Although numerous collections exist, this analysis focuses on nine collections that are readily available online. This analysis pays specific attention to the origins, goals, organization, and the information that is included (or excluded). This comparison reveals a number of insights into how practitioners, educators, and researchers think about the tools they use and highlights some key issues.

Although none of these collections seems to provide a universal solution, the current examination demonstrates the differences in how authors chose to structure and organize the tools. Additionally, the information they choose to include provides useful insight into how the field of HCI thinks about these tools, including preferences and blind spots. In turn, the differences demonstrate the diversity of HCI as well as the benefits and challenges that come with that diversity. This paper concludes by offering handholds for improving the education, adoption, and proper use of the tools in our increasingly complex HCI toolbox.

2 Method

To begin the current study, web and literature searches were conducted to identify models, collections, and toolkits that support awareness and application of HCI tools. The searches were conducted with Google and Google Scholar using a combination of search terms related to HCI and collections (Human Computer Interaction, Human Factors, User Centered Design, Human Centered Design, collections, models, toolkits and guidelines). What emerged from this search was a diverse group of more then forty collections of HCI tools, that are readily available online.

This list was reduced through a preliminary analysis based on three criteria. First, earlier editions from the same source were removed. Second, collections that were narrowly focused (five or less tools) were removed. This reduced the list to 14 collections. Third, collections that did not provide adequate information for comparison with the other collections were removed; most common was a lack of expressed goal or intended use. This revealed nine collections for detailed analysis and comparison.

To facilitate a structured comparison, each of the remaining collections was analyzed to document a list of nine descriptive attributes and gain a thorough understanding of each collection. The attributes documented were origin, title, publication date, expressed goal, number of tools, form or presentation, organizational structure, phases (organization categories), and informative details about the tools included. This information was organized into a matrix (see Table 1) to facilitate

comparison across attributes. The results of these comparisons are described below.

3   Results

The results are organized into three sections; the attribute matrix (Table 1), detailed descriptions of three example collections, and finally a comparison of the collection attributes. Table 1 provides an overview of each of the collection across all nine attributes. The three collections that are described in detail were selected for their comprehensive supplemental information and in the view of the authors, demonstrate the spectrum of differences across the nine attributes.

   The rows in Table 1 describe the individual criteria used to compare the different collections. These criteria are: expressed goal/intended use, number of tools included, form/structure of presentation (e.g. matrix, diagram, etc.), organization (e.g. process phases, cross-reference, groups, etc.), organizational groups, and information provided (types and level of detail). The differences evident in the table are described in more detail in the examples below.

3.1   Three sample collections

   Table 1 provides an overview of the collections and highlights many of the similarities and differences. To provide deeper insight into the structure and organization of theses collections the authors selected three collections to describe in more detail: IDEO, Usability Net and Rotterdam University. As with the matrix (Table 1) they represent the diversity between the collections in origins, goals, and organization. Despite their differences, they also exhibit a number of similarities.

Human Centered Design Toolkit, 2nd Edition (IDEO).
Origin. The *Human Centered Toolkit* is a collaborative effort between IDEO, IDE (International Development Enterprises), Heifer International and ICRA (International Center for Research on Women). This *toolkit* was made available as a free download from IDEO's website in 2009 [6]. The introduction states that the process was specially adapted for non-government organizations (NGOs) and social enterprises working with impoverished communities around the world.

Form. This *toolkit* is presented as a booklet organized into an introduction followed by three sections each describing a phase of their 'Hear', 'Create' and 'Deliver' process. The introduction provides support and understanding for why and how 'HCD' can be used to connect NGOs with the people they strive to help and how this information can enhance their efforts. The introduction provides simple descriptions of how this process can help, with four 'flexible' scenarios of use. The remainder of the *toolkit* focuses on the process and application of the tools presented.

Table 1. Consolidated matrix of the nine collections of HCI tools. Each row describes the details of the attribute captured during analysis.

	Usability Professionals Association (UPA)	NAMAHN	Usability.gov	IDEO	INDACO - Politecnico di Milano	KAIST	Rotterdam University of Applied Sciences	UsabilityNet.org	Design for Ageing Network / Presence Web
Developed By	Usability Professionals Association (UPA)	NAMAHN	Usability.gov	IDEO	INDACO - Politecnico di Milano	KAIST	Rotterdam University of Applied Sciences	UsabilityNet.org	Design for Ageing Network / Presence Web
Title, [ref]	Designing the User Experience, [18]	Work & Methodology, UCD Map, [11]	Step-by-Step Usability Guide, [16]	Human Centered Design Toolkit, [6]	Service Design Tools, [8]	User Centered Design Methods, [9]	Human Centered ICT Toolkit, [13]	Methods Table, [17]	The Methods Lab: User Research for Design, [1]
Publication Date	2000	2009	na	2009	2008	2007	2009	2003	1999
Expressed Goal/ Intended Use	"This "Designing the User Experience" poster illustrates the path to more usable products."	"...we share with you an ongoing effort to describe the components of our method and a unified representation of them."	"Your guide for developing usable & useful Web sites"	"This toolkit was made for you." "This process has been specially-adapted for organizations like yours that work with communities of need…"	Initial Purpose investigate relation between communication design and service design	Created by ID508 User-Centered Design Methodology Course	"This toolkit offers an overview of the methods and techniques which can be used throughout the user-centered design process."	"You can select the most appropriate methods based on 3 conditions" [and project phase]	"… build an authoritative resource based on expert consensus…"
Number of Tools	11 Tools, 26 Steps	20	26	16 Tools, 37 Steps	40	42	Short: 39, Long: 92	39	16 Described (53 listed)
Form	Game Board (poster)	Map (linked, website)	Flow Diagram (linked, website)	Toolkit (booklet)	Table (linked, website)	Matrix (poster)	Table (linked, website)	Table (linked, website, filters)	Table & Map (booklet)
Organization	Process Flow/Steps	Intersecting Process Paths	Process Flow/Steps	Process Flow/Steps	Cross-referenced, 3 Visual Organizations	Cross-referenced	Group by Process Steps	Group by Process Steps (Filterable)	Cross-referenced
Phases (Organization Categories)	4 Phases: - Analysis, - Design, - Implementation, - Deployment	3 Paths: - Ideation, - Interaction Design, - Information Architecture	4 Phases: - Plan, - Analyze, - Design, - Test	3 Phases: - Hear, - Create, - Deliver	Cross-referenced: - Design Activity, - Representation, - Recipients	5 Processes: - Programming, - Research, - Analysis, - Development, - Verification Management 4 Ps: Project, Product, - Participant, - Present	5 Phases: - Research & Analysis, - Concept, - Design, - Develop, - Implement	6 Phases: Planning & Feasibility, - Requirements, - Design, - Implementation, - Test & Measure, - Post Release Filter by 3 conditions: - time/resources, - access to users, - skills/experience	Cross-referenced: - 9 Typologies, - Output Type, - Inputs
Information Details Included	Description	Description, Risks, Effort, Related	(Varies) What it is, What you learn, Benefits, Conducting, Next steps, etc.	Description, Time, Difficulty, Steps, Tips & warnings, Case studies	Description, Related tools, Case Studies	Ratings based on cross-references (no descriptions)	Description, Purpose, Points of interest, References, Phase	Summary, Benefits, Method (details for planning, running and reporting), More info (links), Methods, Next steps, Case studies, References	Methods Map, Output, Inputs (level of expertise, time taken, staffing, costs, tools), Description, Used with, Further Reading

Information detail. Each of the three sections is organized in the same way and presents the same type and depth of information as it guides the reader through a HCD process. Each section begins with short descriptions of the "goals", "outputs" and "theory" specific to each phase. This is followed by a series of 'steps', some steps include 'methods' that can be selected to help accomplish the step. Each of these steps and methods is presented in the same way with the same type of information. Each step provides a simple description including what it should accomplish. Next, practical "tips", things to "try" and things to "watch out" for are presented. In addition, there are "Facilitator Notes" that provide information about time, difficulty, and sub-steps to carry out a method. Finally some of the steps include "case studies" that provide an example of how that step provides value. This toolkit provides a lot of detail for both the process and the individual tools. As is the case for IDEO's popular *Method Cards* [7], there is a lack of references for additional or supporting information [6].

Methods Table (Usability Net).
Origin. Usability Net is a project conducted from 2001 to 2003 and funded by the European Union's (EU) Framework V IST Programme. The goal was to provide resources and networking for usability practitioners, managers and EU projects. This collaborative effort had representatives from 18 companies, universities and organizations across the EU, China and South Africa. To accomplish their goal they conducted a number of large surveys and a User Centered Design workshop. This resulted in the first prototype and was further refined based on feedback and 'user tests'. The result of this project, including the *Methods Table,* are now available online at Usability Net's website [16]. The *Methods Table* is aimed at "providing a comprehensive set of authoritative information and resources" [16].

Form. The *Methods Table* is presented on the website as a hyperlinked table with filters and links to additional information. The header states, "You can select the most appropriate methods depending on three conditions." [16]. The *Methods Table* is visually arranged into six columns representing the phases of a design or engineering process. The phases identified are: Planning & Feasibility, Requirements, Design, Implementation, Test & Measure, and Post Release. Under each phase is a selection of 3 to 13 methods (39 total). Selecting any of three filters listed along the top will filter the methods accordingly: Limited time/resources, No direct access to users and Limited skills/expertise.

Information detail. Each of the methods in the table is linked to its own page that provides additional information about the selected method. Varying amounts of information are available for each method, but all conform to a specific framework. The information provided generally includes: Summary, Benefits, Method, More Information, Alternative Methods/Variations, Next Steps, Case Studies and Background Reading. Within these descriptions the Method is usually divided into subsections: Planning, Running and Reporting. The Alternative Methods and Next Steps sections include links to the relevant information within the website, while the Case Studies and Background Reading often provide external links. The *Methods Table* uses the web format to provide access to additional detail while keeping the

table simple. Despite all these details and links to additional information, there is a lack of support for how the methods can be incorporated into a design process.

Human Centered ICT Toolkit (Rotterdam University).
Origin. The *Human Centered ICT Toolkit* is self-described as "This toolkit offers an overview of the methods and techniques which can be used throughout the user-centered design process." [13]. An accompanying publication [10] provides further insight into the motivation behind this collection of tools. "The overarching goal is to enlighten human computer interaction (HCI) and software engineering (SE) researchers and practitioners … and enable them to develop a shared understanding and a holistic view of the overlapping fields of SE and HCI." In practice it is a living document that aids students in selecting methods for projects and promote critical analysis of the methods they choose. It is also being used to build awareness among faculty and incorporation of human centered tools into the curriculum [10].

Form. The *Human Centered ICT Toolkit* is available online and is very similar in format to the Usability Net's Methods Table. It is organized into columns representing five phases of a design process: Research & Analysis, Concept, Design, Develop and Implement. Each of the phases has between 11 and 59 methods and tools listed (some repeated in different phases) for a total of 92 unique tools. The graphical depictions of the phases along the top imply iterative cycles of analyze, create, and test for each phase.

Information detail. Each of the tools is linked to a page that provides additional information about the tool. The description pages conform to a simple format: Description, Purpose, Points of Interest, References and Project Phase. Each of these sections is generally limited to one or two sentences and Points of Interest are occasionally omitted. This *toolkit* provides one of the largest collections of tools; unfortunately it has some of the shortest descriptions. This presentation provides a clear overview that facilitates the comparison of available tools, and the references provide a good staring point for the additional information needed to adopt specific tools.

3.2 Comparison

The examples above and the matrix of collections show diversity according to the structure, process phases, number and type of methods included, and the type of information included in the descriptions. These differences in structure, terminology, and detail may be expected due to the diversity of their author's backgrounds and intended goals. This is a common trait for emerging and multidisciplinary fields of study where a common language and shared perspectives are still developing.

As noted earlier, there are a number of similarities and differences evident when comparing these three collections. Specific similarities include: aiming to support the awareness and use of human centered tools, organization according to process phases and providing summary information about each tool that is included. Although these

elements are similar there are distinct differences in their goals and audiences, the number and naming of the process phases, and the types of information provided. In addition, the origin of each collection is different, be it research, education, government, practice, or some combination or application to a specific domain. Examining Table 1 highlights the complexity of these comparisons.

4 Discussion

The comparisons above provide insight into how professionals (educators, students, researchers, consultants, and companies) organize the complex landscape of HCI tools and techniques available today. On the surface they are separate attempts to provide support for the use and adoption of human centered tools and processes. They do this through organization and providing information on a variety of tools that support a human centered approach, which can be beneficial for education and practice. However, these comparisons also highlight a number of barriers that are part the complex and multidisciplinary field of HCI. The primary difference that emerges is the variety of perspectives held by professionals in our field. Closely related to this, and evidenced in the collections, is the lack of a common language.

The different perspectives can be considered a strength. The different perspectives supporting our ability to combine ideas and tools from different disciplines and provide solutions to complex projects. The same diverse perspectives make it difficult to educate newcomers as well as share ideas and information; this includes the tools and collections that are designed to help. These differences are shown in several ways. First, the origin of these models is very diverse, including government projects, professional organizations, universities, consultancies, and different nationalities and cultures. Practice-based collections provide more practical data (time required and supplies) where academics include more theory and references. Second, the varying perspectives are reflected in the stated goals and audience (help NGOs become user-centered, overview for students and educators). A third difference is the information included in the descriptions of each tool. As authors work to keep the details concise they demonstrate which elements they consider important.

Each of these differences impacts the value of a collection to others. By addressing the needs of a specific group and neglecting the information needs of other groups. For example, practitioners indicate a need to have ready-to-use methods, complete with cost estimate and argumentation to sell them (to management). Most collections only provide limited information on these topics. Students, on the other hand, are still coming to grips with the basics of a design process and how tools contribute. Their focus is to explore how a method contributes to the development of their design competencies and has very little to do with return on investment.

The differences continue in the representation of the design process. Although nearly every collection is oriented along a design process timeline, the phases they chose to include and the naming of these phases present exceedingly different perspectives on when and how HCI tools should be applied. Some collections provide an overview of options, while others present a full process and promote a user-centered mindset. Both approaches provide little support for practitioners on how tools can be integrated into an existing process. Each of these collections is more

useful when you begin to appreciate the author's goals and perspectives. A key problem for students and practitioners alike, is the level at which a tool (or process) is described is not clear. Liz Sanders [14] distinguishes five levels of understanding: tool, method, methodology, mindset, and culture. The effect of these different levels is that discussions fail to find a common ground. A key example from the past decade is the discussion about 'probes' or 'workbooks' [2], where some use the notion of 'probe' to refer to a format of materials intended to uncover ambiguous inspirations, while others insist on their use for comprehensive data collection with detailed analysis. These discussions emphasize the mixed nature of our field, where social sciences, arts and technology, and their associated value sets and paradigms come together, but as yet have failed to create a shared understanding. These constrained descriptions presented from varying perspectives may also contribute to the conflicting opinions concerning the use of fundamental tools like focus groups and usability tests [12, 4]

Unfortunately, even as HCI gains insight into these differences in perspective and information needs, there are still other barriers inhibiting the utility of these collections and tools; the lack of a common language and a lack of awareness in the levels of understanding. Although this difference is evident in the naming of the project phases and tools it is also evident in the descriptions of the tools. While this may not be an issue for some experts it creates unnecessary confusion. Using numerous terms to describe fundamental tools (e.g. usability testing is also know as: user testing, implementation testing, verification, post release tests) is problematic.

While there are many additional comparisons and distinctions that can be analyzed, the different perspectives and terminology present the significant barriers. They hinder our ability to effectively communicate with each other and ultimately inhibit the sharing of ideas, as we strive to advance Human Computer Interaction.

5 Conclusion and Future Work

Collections of methods provide an overview of recommended methods and aim to educate and guide HCI down a more user-centered path. However, there are still significant hurdles to overcome before HCI can collectively understand and adopt the growing array of available tools. While useful on their own, the tools do not guarantee success; no one expects that buying a hammer and nails will make you a master carpenter. In order to move forward, HCI needs to leverage the state-of-the-art in our profession by considering the tools and processes we employ, to meet increasingly demanding challenges. For this change to occur we need to understand and educate ourselves in the different perspectives held by the participants in our domain. Additionally, we need to effectively communicate ideas in ways that support the perspectives of the numerous disciplines that contribute to HCI. No one group within HCI should accomplish these efforts alone; this is a collective effort encompassing education, research and practice across all disciplines and domains. Researchers need to publish the details necessary for others to critically analyze new ideas and tools according to their perspective and provide enough information to adopt them successfully. This includes adapting existing tools to other domains. Practitioners and clients should continue to ask for cost benefit tradeoffs. Armed with this information

they need to take advantage of new and refined tools that better meet their needs. And finally, education should provide students with the skills and mindset needed to critically analyze new (and existing) tools and provide insight into the perspectives of research, practice and related domains. We have clearly come a long way in developing HCI, but the journey has just begun.

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