

Facilitating the take-up of new HCI practices: a ‘diffusion of innovations’ perspective

Arnold Vermeeren

Industrial Design Engineering,
Delft University of Technology
Landbergstraat 15
2628 CE Delft, The Netherlands
a.p.o.s.vermeeren@tudelft.nl

Gilbert Cockton

Department of Media and
Communication Design
Northumbria University
Newcastle upon Tyne, NE1 8ST, UK
gilbert.cockton@northumbria.ac.uk

ABSTRACT

The workshop *Made for Sharing: HCI Stories of Transfer, Triumph & Tragedy* focuses on collecting cases in which practitioners have used their HCI methods in new contexts. For analyzing the collected body of cases we propose to apply a framework inspired by the *Diffusion of Innovations* approach which focuses on what facilitates the adoption, re-invention and implementation of new practices in social systems.

Author Keywords

Human-computer interaction; user experience; usability; diffusion of innovation; methods.

ACM Classification Keywords

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

INTRODUCTION

The workshop *Made for Sharing: HCI Stories of Transfer, Triumph & Tragedy* [9] focuses on “Understanding, via structured case studies, how HCI professionals transfer the same (set of) design and evaluation methods across use contexts in terms of appropriating and configuring method-resources”. Based on his empirical and theoretical work on adoption and adaptation of usability evaluation methods, Furniss [7] stressed that “adoption and adaptation cannot be fully understood devoid of context”. Therefore, this workshop “intends to generate insights in the design work required to get HCI methods to work, and how this is impacted by contextual factors such as application domains, organizational factors and project constraints.” In this position paper we propose an initial framework for structuring the findings from the case studies, that is inspired by Rogers’ work on *Diffusion of Innovations* [12].

Transfer of HCI methods seen as Diffusion of Innovation

Rogers defines an *innovation* as “an idea, practice, or object that is perceived as new by an individual or other unit of adoption.” Diffusion is defined “as the process by which (1) an *innovation* (2) is *communicated* through certain *channels* (3) over *time* (4) among the members of a *social system*.” In this paper we treat HCI methods or approaches that are applied in a new context as innovations.

Applying the diffusion of innovations framework means that the new context is seen from the perspective of a *social*

system, and that next to social context factors, *communication* is seen as playing an important role in the adoption and implementation of new methods. Furthermore, the diffusion of innovations approach implies a *process view* of adoption, adaptation and implementation, rather than a static view on matching characteristics of a context to attributes of a method.

Methods and Innovations are no Indivisible Wholes

According to Rogers [12] “Until about the mid-1970s, it was assumed that an innovation was an invariant quality that was not changed as it diffused” and since then some researchers started seeing *re-invention* as “the degree to which an individual’s use of a new idea departed from the “mainline” version of the innovation” or as “the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation”. This view is very much in line with Woolrych et al’s view on not seeing HCI methods as indivisible wholes [13]. Rogers [12] emphasizes that “We should remember, therefore, that [...] adopting an innovation is not necessarily a passive role of just implementing a standard template of the new idea.” The present workshop focuses on exactly this process of changing or modifying HCI methods when implementing them in a new context.

METHOD TRANSFER AS DIFFUSION FROM A SOCIAL COMMUNICATIONS PERSPECTIVE

HCI method selection tools (e.g., UsabilityPlanner.org, UCDtoolbox.com, AllaboutUX.org) provide their users with assistance in finding appropriate methods or approaches for specific contexts. They do this largely based on matching method attributes to (presumed) attributes of the target context in which they will be used. Such tools may also provide advice on how to adapt methods to the situations. This was also the original approach taken in the EU Cost Action IC0904 TwinTide project [http://TwinTide.org], as well as (implicitly) in the EU COST action 294 MAUSE [http://cost294.org]. More recently, there has been a shift in the TwinTide project towards a focus on the *process* of transfer. The framework we propose in this paper attempts to connect the two approaches, via *social system* and *communication* perspectives.

Part 1: Method Transfer as Resource Matching

As already expressed in the Introduction section, when discussing the use of methods in new contexts we don't see methods as indivisible wholes. We even consider the word 'method' as misleading in the sense that it suggests that a method is an invariant entity, a fixed set of procedures, materials, etc. For example, this could refer to its 'mainline' version (cf. Rogers [12] for innovations) or the version as it was originally (intended to be) applied by its developers. Following Woolrych et al. [13] we would rather conceptualize *method attributes* as *resources* for *approaches* to HCI work. Matching attributes then comes down to matching (approach groups of) resources to the work to be done and the values, skills, experiences (etc.) of the people that need to do that work. Approaches always are incomplete and always require modification, replacement or addition of resources for specific design work needs.

One way to expose gaps in an approach's resources is via Woolrych et al's [13] categorization of resource types for usability evaluation work. In the TwinTide project we have taken a broader view, not only considering usability evaluation, but HCI design and evaluation work. Based on various workshops we have so far come up with an adapted categorization of resources [5], and in TwinTide we now see resources as having functions, rather than types (more accurately, resource have several attributes, of which one is the types of functions that they perform). This is because 'types' suggests a simple resource taxonomy, whereas 'functions' suggests something about the action or activity for which it is used, and are only one attribute of a resource (the form of its materialization is another). For many resources it is problematic to categorize them as being of a certain type, as they can have more than one function (i.e., have multiple practical ways of using them). For example, as well as communicating ideas, sketching can also support their generation and structure the process of selecting and refining promising options.

Scoping and axiological functions

According to Cockton [5] scoping and axiological resources, express the intended coverage, motivating values and proscribed practices of approaches. *Scoping resource functions* indicate the extent of a method's applicability in terms of the purposes and usage contexts of what is being designed or evaluated, including application areas/domains [13]. These functions relate to issues such as the extent to which approaches are intended for specific target groups, specific application areas, or for specific activities (e.g., analysis, rather than creation). Approaches can also be scoped by technology (e.g., ambient display heuristics [10]) or application domain (e.g., games [6]). Further to this, approaches may be focused on specific design choices, such as choosing how users should benefit, or choosing user interface features.

Scoping resources support rapid initial matching by design teams looking for new approaches through their focus on development phases, target users, application domains or sectors, or technologies. However, an approach that may appear too general (e.g., games heuristics) may be modifiable for a specific genre (e.g., sport games). Similarly, specialized heuristics (e.g., for ambient displays) may transfer to loosely related technologies (e.g., splash screens on kiosks or in games).

Axiological resource functions indicate the values underpinning a method (perspectives) [13] (axiology is the study of values). These resources relate to for example ethical considerations in using certain approaches, as well as to factors related to the disciplines from which an approach originates (as disciplines bring along specific systems of values, content and method). For example, an evaluation from a psychological perspective is based on a different axiology than an evaluation from a software engineering or sociological perspective. Discount methods value cost reductions, which would be appealing in design contexts where budget is not available for extensive user experience work. In contexts where user-centered design is highly valued for its benefits, discount methods may be less attractive.

Axiological resources support rapid initial matching by design teams looking for new approaches in a similar manner to scoping resources. Teams needing to minimize costs will be drawn to discounting values, while teams developing high integrity systems will be drawn to approaches that prioritize valid results.

Harvesting functions

Woolrych [13] defines instrumentation resources as 'resources to collect issues and measures for evaluations'. Cockton [5] broadens this to harvesting resources to also include creative design activities rather than evaluations only. A resource has a harvesting function when it collects data, both for contextual research and evaluation, but also for design inspirations and directions. In evaluations, examples of harvesting resources are the type of data that are collected (e.g., quantitative data from surveys, eye movements, etc.) and the equipment needed for that. In terms of inspiring designers in their contextual research or creative acts one can think of for example the use of cultural probes [8] or the materials used and the type of data one gets from participatory design activities [1].

Harvesting resources support transfer by drawing attention to potentially new information and inspiration that could fill known gaps (or previously unrecognized ones) in the inputs to design processes.

Directive functions

Cockton [5] sees directive resources as a combination of Woolrych et al's [13] procedural and project management (process) resources. Woolrych et al define procedural resources as guiding the use of a method, including partial

automation through tools. Project management (process) resources situate a method within an embracing development and collaboration context. This is now seen as a function of resources that scope approaches for particular phases of a particular design process structure (i.e., scoping function).

Directive resources are here defined as any resources that guide behavior, i.e., they direct interaction design work. Examples are the procedures that an approach prescribes. In user testing it can, e.g., refer to constraints such as an observer not being allowed to interfere with a participant's actions. In brainstorming it can refer to rules such as not criticizing ideas prematurely. Different approaches may vary in the level of formality of such procedures, in the number of prescribed procedures or the level of strictness of applying them, e.g., there are not many formal and detailed prescriptions for conducting a heuristic evaluation [11], whereas there are very detailed instructions for how to do Key Stroke Level Modeling [2]. Using procedures may also be supported by automated tools, such as SPSS for statistical analyses.

Directive resources support transfer by indicating how approaches are used in practice. Transfer will often depend on the costs of using an approach. Directive resources can indicate the work required to get an approach to work.

Expressive functions

All resources have knowledge and expressive functions (as each resource must express itself in some way, and must have a set of underlying concepts and/or knowledge). For usability evaluations Woolrych et al. [13] defined expressive resources as “communicating the output of a method via specifications, reports etc.” In design, expressive resources will be chosen in relation to what a designer is trying to create or envision, e.g., for developing the aesthetics of a web site, a designer will use different expressive resources (e.g., broad nib markers or Adobe Illustrator), than for designing the navigational structure or interactivity of a website (e.g., scripting in Adobe Flash, or MS-PowerPoint). Hence, we broaden the definition of expressive resources to resources that communicate output of the use of a method or content while using it, as well as intermediate results of design work. Some expressive resources are local to designers, but others serve as boundary objects between designers and other project stakeholders.

Expressive resources support approach transfer by offering new ways for design teams to track their design work internally, as well as new forms for external communication. As with all resources, this will offer solutions to a known need, or highlight opportunities that design teams were not aware of.

Knowledge functions

In case of resources with a knowledge function, the knowledge expressed can be conceptual, theoretical or

substantive, e.g., information about an approach's origin, or about its fundamental concepts (e.g., goal, task, severity). These are typically issues that are in focus about methods, in scientific or professional articles, manuals, tutorial sessions, etc.

Knowledge resources support transfer through a range of valuable benefits, including inspiration, guidance, confidence, more efficient work through re-use, and more effective design work through new capabilities. Again, these either offer to meet known needs or suggest new opportunities.

Current Developments on Resource Functions

In [5], the Working to Choose (W2C) framework integrated extensions to resource types from [13] with *Meta-Principles for Designing* [3] and *Abstract Design Situations* [4]. This related scoping functions to the different types of choice and their coordination (which result in different Abstract Design Situations). Resource functions were shown to realize meta-principles.

Currently, new resource functions are being identified [14], via the distinction between *expressive* functions (local to designers) and *performative* functions (communication with design stakeholders), identification of *emotional* functions for some design resources (through propelling or caring for the design process), and *integrative* functions (corresponding to meta-principles associated with co-ordination of design choices). These new functions support transfer by offering improved internal audit trails or external communication, more dynamic and less frustrating work cultures, and more effective integration of design inputs, activities and results.

Part 2: Diffusion of approaches in practice

Part 1 highlighted resource functions that play a role in determining if an approach can be used in a specific context and what needs to be modified or added to how an approach has been implemented in a preceding context. Part of the process of implementing an approach in a new situation is trying to match the various resources as objectively as possible, in order to find an appropriate fit for the work to be done. Insights from diffusion of innovation research add a further perspective. This perspective makes clear that even if there seems to be a perfect fit, there are other factors that play a role in deciding on an approach or on how to implement an approach. This perspective relates to the social context in which practitioner work. Below we will discuss three groups of findings from diffusion of research that seem relevant to our case: *adoption-relevant attributes of innovations*, *change agent success factors*, and the *innovation decision process*.

Adoption-relevant attributes of innovations

Rogers [12] mentions five main attributes of innovations that play a role in whether an innovation will be adopted in a social context or not. In our cases, when practitioners start working in a new (social) context, wanting to apply an

approach they are familiar with, a similar situation may occur: not only should the practitioners themselves find a match between the approach and the work to be done, they will also be confronted with some social context in which they work. To this social context, the new approach may be an innovation, and usually they may have to modify an approach to increase the chance of a successful implementation. According to Rogers [12] the following five attributes of an innovation (here: approach) as perceived by the members of a social system may play a role in the adoption process: 1) *relative advantage*, 2) *compatibility*, 3) *complexity*, 4) *trialability* and 5) *observability*.

Relative advantage is the degree to which an innovation is perceived as being better than the idea it supersedes [12]. When practitioners introduce a new approach in their social environment, it has a better chance of being adopted if the people in that social environment *perceive* the approach as having a relative advantage. Note that the word *perceive* is as crucial as *relative advantage* here (as it is with the following four attributes). If the practitioner's environment doesn't see the relative advantage there is a higher chance that they will resist the change in their usual way of doing things. *Compatibility* is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. For HCI approaches as innovations, this is largely related to the match of resources discussed in part 1, however, this attribute emphasizes that what matters, is how social contexts shape perceptions of matches. *Complexity* is the degree to which an innovation is perceived as relatively difficult to understand and to use. If the social context thinks a new approach is difficult to use, or if they don't understand it, this lessens the chance of them agreeing about using it. *Trialability* is the degree to which an innovation may be experimented with on a limited basis. So if an approach can be tried out on a limited scale without too many risks, this helps in introducing it. *Observability* is the degree to which the results of an innovation are visible to others. The results of some ideas are easily observed and communicated to others, whereas some innovations are difficult to describe to others. The same is true for new approaches. If after using a new approach it is difficult to observe or describe whether there is any difference in results or not, this lessens the chance of an approach being adopted.

Change agent success factors

Much of the diffusion of innovations research is about the role of change agents. About change agents Rogers states: "A change agent is an individual who influences clients' innovation decisions in a direction deemed desirable by a change agency. In most cases a change agent seeks to secure the adoption of new ideas, but he or she may also attempt to slow the diffusion process and prevent the adoption of certain innovations." Rogers concludes that "a change agent's relative success in securing adoption of

innovations is positively related to 8 factors: (1) the extent of change agent effort in contacting clients, (2) a client-orientation, rather than a change agency-orientation, (3) the degree to which the diffusion program is compatible with clients' needs, (4) the change agent's empathy with clients, (5) his or her homophily with clients (homophily is compatibility as the degree to which pairs of individuals who interact are similar in certain attributes, such as beliefs, education, social status, and the like [12]), (6) credibility in the clients' eyes, (7) the extent to which he or she works through opinion leaders, and (8) increasing clients' ability to evaluate innovations." Considering the situation of a practitioner entering a new context some of these may be considered relevant as well. Effort in contacting the client (1) doesn't seem to be relevant here, as we assume that the practitioner is in the same team. This would also mean that client-orientation and change agent's orientation (2) will generally be the same. Furthermore, the situations we consider do not deal with diffusion programs (3) deliberately aimed at spreading certain practices just for the sake of spreading them. Increasing a client's ability to evaluate innovations (8) comes down to change agents seeking to raise the clients' technical competence and ability to evaluate potential innovations themselves. This is a long-range endeavor, which is also not relevant to the cases we consider here. What remains are empathy (4), homophily (5), credibility (6) and opinion leaders (7). For HCI practitioners wanting to introduce new approaches into a new context, this means that this will be more easy if the practitioner shows *empathy with other team members*, is *more homophilous with them*, if other team members *see the practitioner as credible*, and if the change agent can refer to *other teams or people that use the practitioner's approach* and who are seen by the team as *opinion leaders*.

The innovation decision process

Rogers [12] defines the innovation-decision process as "the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision." Rogers originally distinguished five stages in the innovation decision process [12]. Although he consistently talks about an individual *or other decision making unit*, these stages seem to relate to individuals making choices mostly. These stages are 1) the (awareness-) *knowledge* stage when the individual (or other decision making unit) is exposed to the innovation's existence and gains some understanding of how it functions, 2) the *persuasion* stage in which one may become interested in the innovation and starts forming a favorable or unfavorable attitude towards it, 3) the *decision* stage when activities are undertaken that lead to adopting or rejecting the innovation, 4) the *implementation* stage in which an innovation is put into use, and 5) the *confirmation* stage when an individual (or other decision making unit) seeks reinforcement of an innovation-decision already

made, but he or she may reverse this previous decision if exposed to conflicting messages about the innovation. Evidence for a very clear distinction between implementation and confirmation stage is weak according to Rogers [12]. Rogers also discusses the innovation process in organizations and in that he distinguishes the following stages: 1) *agenda setting stage* in which an organization becomes aware of a problem in the organization that needs to be solved or is confronted with an innovation that uncovers a thus far unknown need, 2) *matching stage*, in which an organization is trying to figure out whether it seems worthwhile to adopt the innovation or not and tries to imagine the consequences of the innovation when implemented in the organization, 3) *redefining/restructuring stage*, in which a solution is sought for an imperfect match between innovation and organization, either by re-inventing the innovation or by restructuring the organization, and 4) the *routinizing stage* in which the innovation becomes part of the daily life.

Transfer is thus prepared for at the agenda setting stage and then achieved via the others. If we translate this to the case of the practitioner wanting to introduce an approach to and in a new context we could summarize the process as follows:

The practitioner in the new context makes the others aware of a candidate approach or of an organizational need (knowledge stage), and makes the organization aware that a certain approach could fit an organizational need (agenda setting). To be able to apply the new approach, the practitioner needs to persuade those most directly involved in applying the approach or at least get them interested to cooperate (persuasion). For the practitioner's work to be done, he or she would need to evaluate the match of approach resources to the new situation (decision stage) and for the organization it would mean matching how it would fit the organization: what is the effect on the organization, how does it benefit the organization (matching stage and decision stage). Once the decision is taken to start using the approach the implementation phase starts, involving actually redefining the method by selecting appropriate resources and at the same time restructuring the organization (redefining/restructuring stage). Once taken into use the routinizing stage and/or confirmation stage can start.

FRAMEWORK FOR ANALYZING THE CASE STUDIES

By using this framework for analyzing cases of problems in using approaches in new contexts, one may gain a better understanding of why this happens, and learn where to search for solutions. Below, the items discussed so far are summarized and presented in a form that can be used for analyzing cases of using approaches in new contexts.

Resource functions and innovation process stages

In case of rejection of a (proposed) method, or of having to adapt it, this may occur at different stages of individual (I) or organizational (O) innovation decision processes:

- *Knowledge/awareness* (I1 - i.e., people in the new context not being aware of the method or not knowing what it can do);
- *Persuasion/interest* (I2 - i.e., difficult to get people in the new context interested or to make them form a favorable opinion about the method);
- *Agenda setting* (O1 - i.e., difficult to convince people that using the method leads to fulfilling organizational needs).

In the above stages an initial match of resources is usually being made for axiological or scoping resources. Possible reasons for not adopting an approach at these stages are:

- *Scoping*: the method does not fit the purpose of the work or the usage/process context well enough;
- *Axiological*: the method takes a different perspective on the work than is desired in the new context (e.g., with respect to what is valued), or there are ethical problems in using the method.

Reasons for not using an approach or for having to adapt it can also be found in the following stages, in which actual decisions are being made and implemented:

- *Decision/matching* (I3/O2 - i.e., difficulties in the actual process of taking the decision on whether to start using a method or not; evaluating its pros and cons; thinking through the consequences of implementation);
- *Implementation/restructuring/redefining* (I4/O3 - i.e., identified mismatches between resources and work context that lead to adaptations or modifications of the method's resources; or to changes in the organization to make it work);
- *Confirmation/routinizing* (I5/O4 - i.e., problems in sustaining a method's use).

In the above stages, considerations concerning the following resource functions play a major role. This is especially so in the decision and matching stage. However, in the later stage they continue to play a role:

- *Harvesting*: the instrumentation or type of data that the method works with, does not provide the kind of data or insights that the new context (wants to) work with;
- *Directive*: there is something about the procedures in using the method that does not fit the new context, or the procedures are perceived as being too complex or as having a poor cost-benefit ratio;
- *Expressive*: the kind of output the method gives or the way important elements are expressed with the method does not match the expectations and/or standards for communication in the new context.

Attributes of innovations

Rejecting a (proposed) method or having to adapt it often relates to attributes that are typical for innovations in general:

- *Relative advantage*: not enough relative advantage, or relative advantage not being clear enough;
- *Compatibility*: perceived problems of applying the ‘old’ method in the new context (i.e., team perceives a mismatch between resources and work to be done);
- *Complexity*: method perceived as being too complex to use, or too difficult to learn;
- *Trialability*: method cannot be tried before deciding to use it;
- *Observability*: merits of the method are difficult to observe by people not directly involved in using it.

Personal (Change Agent) Factors

Sometimes application of a specific method also largely depends on personal relationships. The following change agent factors can obstruct success for someone wanting to introduce a change (e.g., a new approach):

- *Empathy*: not enough empathy between the practitioner and the new team.
- *Homophily*: difficulties in identifying with and associating with the people involved in using the new method in the new context, making them feel they are on different wave lengths.
- *Credibility*: the other people in the new team just didn’t believe enough of the presented benefits of using the method.
- *Opinion leaders*: there was a lack of opinion leaders (in the eyes of the other people involved) who are also in favor of using this method.

CONCLUSION

A framework has been presented for analyzing cases of introducing or adopting HCI practices in new contexts. The framework combines the innovation decision process stages from Rogers [12] diffusion of innovations approach with W2C’s [5] resource functions approach. Additionally, general attributes of innovations and personal factors that play a role in successful diffusion of innovations are part of the framework. Thus this framework takes a step beyond the approach most current method selection tools take, by taking social system and communication factors into account.

REFERENCES

1. Bødker, S., Ehn, P., Kammersgaard, J., Kyng, M., Sundblad, Y. A Utopian experience. In G. Bjerknes, P. Ehn, & M. Kyng. (Eds.), *Computers and democracy: A Scandinavian challenge*. Aldershot, UK: Avebury (1987), pp. 251–278.
2. Card S.K., Moran T.P., Newell A. The keystroke-level model for user performance time with interactive systems. *Commun. ACM* 23, 7 (July 1980), 396-410.
3. Cockton, G. Getting there: six meta-principles and interaction design. In *Proc. CHI '09*. ACM press (2009), 2223-2232.
4. Cockton, G. Design Situations and Methodological Innovation in Interaction Design. *Ext. Abstracts CHI 2010*, ACM press (2010), 2745-2754.
5. Cockton, G. Making Designing Worth Worth Designing (2012). Available through: ii.tudelft.nl/ValuesInDesign/submissions/cockton.pdf
6. Desurvire H., Caplan M., Toth J.A. Using heuristics to evaluate the playability of games. *Ext. Abstracts CHI 04*, ACM press (2004), 1509-1512.
7. Furniss, D. Beyond Problem Identification: Valuing methods in a ‘system of usability practice’. PhD Thesis. UCL. (2008). Available through http://dl.dropbox.com/u/2191887/MyPublications/2008_Furniss_PhDThesis.pdf
8. Gaver W., Dunne T., Pacenti E. Design: Cultural probes. In *interactions* 6, 1 (January 1999), 21-29.
9. Law E. L.-C., Hvannberg E., Vermeeren A.P.O.S., Cockton G., Jokela T. Made for Sharing: HCI Stories of Transfer, Triumph & Tragedy. *Ext Abstract CHI'13*. ACM Press (2013).
10. Mankoff, J., Dey, A.K., Hsieh, G., Kientz, J., Ames, M., Lederer, S. (2003). Heuristic evaluation of ambient displays. In *Proc. CHI 03*, ACM (2003), 169-176.
11. Nielsen J. and Molich R. Heuristic evaluation of user interfaces. In *Proc. CHI '90*, ACM (1990), 249-256.
12. Rogers, E. M. *Diffusion of innovations*. New York: The Free Press (1983)
13. Woolrych A., Hornbæk K., Frøkjær E., Cockton, G. Ingredients rather than recipes: A proposal for research that does not treat usability evaluation methods as indivisible wholes. *IJHCI* 27(10), (2011) 940-970.
14. Cockton, G., A Load of Cobbler’s Children: Beyond the Model Designing Processor. To appear in CHI EA 13.