Immediacy in User Interfaces: An Activity Theoretical Approach

Sturla Bakke

The Norwegian School of Information Technology, Oslo, Norway
sb@nith.no

Abstract. In this paper the relation between the [new] concept of *immediacy* in user interfaces is discussed by taking an activity theoretical approach. When discussing so-called 'user-friendly' technical artefacts, the term intuitive often turns up in the human-computer interaction (HCI) discourse, as a kind of buzzword. The problem with the term *intuition* is that it lacks a sufficient level of precision, and could very well mean different things to different people. This paper discusses how familiar HCI concepts such as *intuition* and *affordances* in combination can form the basis of the new concept of *immediacy*, and how it can be justified on the basis of activity theory.

Keywords: immediacy, user-interfaces, activity theory, action.

1 Introduction

The very basic foundation for interaction is, besides having an idea of what to do, the activity itself, and the "what"-part is increasingly done with the help of some kind of computerized artifact - through a human-technology interface. We could ask what is the character or quality elements in an user-interface which makes it a good tool? This paper employs the *mediated action perspective* on affordances presented by Kaptelinin and Nardi which states that "the most characteristic feature of humans, differentiating them from other animals, is that their activities and minds are mediated by culturally developed tools, including technology." [1].

Intuitive user-interfaces has been a central term or term in HCI-research as something to strive for in many instances of socio-technical practice. However, we believe that it is not sufficiently precise, and means different things to different people, which makes it a clear candidate for abolishment. In this paper we present *immediacy* as a contextual activity-related concept, and as a framework for discussing the quality and character of socio-technical interdependent work and play. This paper discusses *immediacy* as a new conceptual term within the HCI discourse with the activity theoretical approach that has increasingly dominated the field from the 90's to the present. We propose a definition of the term *immediacy* in user-interfaces as: *an immediate UI, is immediately understandable and actionable, not to all users regardless of education, experience or what they wish to achieve, but to users within a specific context, with a specific goal, based on defined conceptual models. It relies on the user's experience-based intuitive approach to the task at hand, combined with the contextually relevant affordances in the UI.* It is presented here as a part of the activity theoretical HCI discourse.

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The paper continues with a brief presentation of activity theory connected with HCI-discourse, related to the topic of this paper, followed by an empirical example from a case study within the shipping industry regarding software support for the process of stowing chemical tankers, and leading to the discussion of activity theory and immediacy. The paper ends with the concluding remarks.

2 Current Theory and Literature

We draw from the body of literature, emphasizing, although not exclusively, on Nardi's focus on contextual practice [2]p. 7], Kuuti's underlining of object dependent transformative activity *structure* [3], while including Bödker's mediation and transparency perspective [4], and also Kaptelinin and Nardi's foundational activity theoretical HCI-approach [5] among others.

2.1 Activity Theoretical HCI: Context, Structure and Mediation

Nardi states that activity theory «focuses on practice, which obviates the need to distinguish 'applied' from 'pure' science—understanding everyday practice in the real world is the very objective of scientific practice. […] The object of activity theory is to understand the unity of consciousness and activity.» Also activity takes place within a context of the group and the group's goal [2]p. 7].

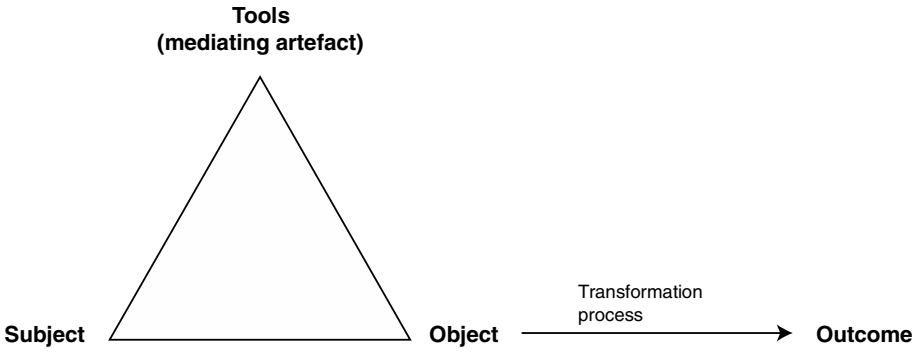

Fig. 1. The structure of activity [6]p. 29

Kuutti, concurs with Nardi's descriptive theory approach, but is focusing on the structure of activity . "An activity is a form of doing directed to an object, and activities are distinguished from each other according to their objects. Transforming the object into an outcome motivates the existence of an activity. An object can be a material thing, but it can also be less tangible." [3]

Kuuti [3; 6], Engeström [7] and Miettinen [8] shows that activity is primarily goal-directed, and mediated by artefacts in addition to being contextual and social. On an individual level the relationship between subject and object is mediated through tools. In Nardi and Kaptelinin these are coined as mediated affordances[1]. In an activity

system, where we can analyze the complex structure of human activity, we might, in addition, see that the relationship between a subject and the community is mediated by rules (of conduct), the relationship between the community and the object of activity is mediated by division of labor [9].

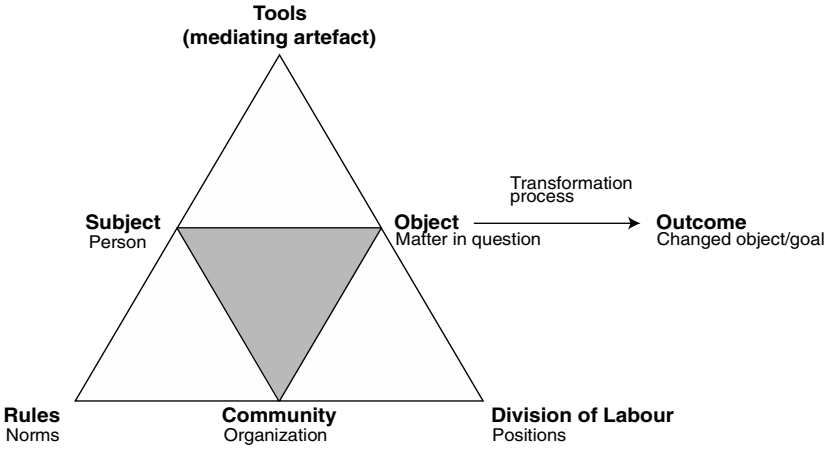

Fig. 2. The structure of an activity system. Based on Engeström [10].

This is an important aspect of the discussion about the structure of activity theory since it formalizes the theory's ability to encompass varying degrees of agency, which is needed in the theoretical challenge HCI research has faced in making the conceptual frameworks strong enough to encompass both humans and technology within the same conceptual models [11].

Leaning on Bødker and Bertelsen [4; 12]pp. 300-301] we see that a subject's activity towards an object is ordinarily mediated by one or several tools, what we could call *mediated artifacts*. According to Bødker this mediation is fundamental in how we perceive or interpret artifacts.

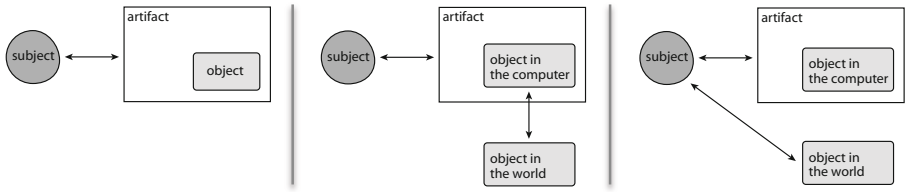

Fig. 3. Mediating aspects of different activity situations [4]pp. 38-39]

The figure to the left shows a situation in which the object exists only in the artifact, while the figure in the middle shows a situation where the object exists as a physical object, but is only present in the activity as an UI-abstraction in the software. The figure to the right shows a situation where the object exists physically outside the artifact and might be accessed without going through a user-interface. We'll apply this model from Bødker on the empirical example in the discussion section.

3 Empiric Example from a Case Study

To convey some concepts of the activity theoretical HCI-approach to *immediacy*. We'll present a part of a related case study, regarding the development and implementation of a client/server software for the control of stowing chemical tankers. A chemical tanker differs from an oil tanker in almost all aspects of being a tanker. An oil tanker transports one type of cargo, crude oil, in five or six huge tanks, from the point of extraction to a refinery. A chemical tanker is significantly smaller, and transports chemicals in a multitude of smaller, specialized tanks, between various port terminals, in a multi-point to multi-point pattern. Also, a chemical tanker must adhere to international rules and regulations that requires chemical tankers to follow the International Bulk Chemical Code (IBC Code)[1] regarding transport of hazardous liquids at sea like eg. SOLAS ch. VII[2] and MARPOL Annex II[3]. One example could be that we must, for instance, transport phosphoric acid in a stainless steel tank and not in a tank with coating. Likewise, there are rules for the filling of adjacent tanks - which chemical liquid that may be transport alongside each other. This is an operational practice associated with a significant degree of complexity, sometimes critical complexity.

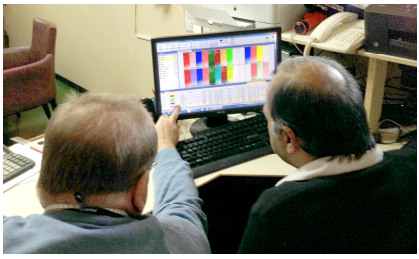

Fig. 4. Users planning stowage through the mediating artifact

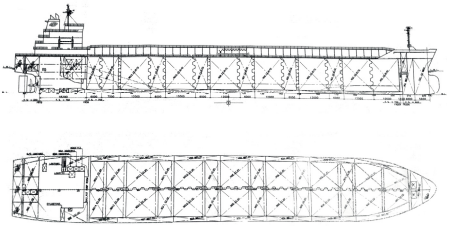

Fig. 5. Technical drawing of physical object

There is an adamant need for a software that can handle this kind of complexity in a fashion that is as easily understandable as possible, due to the context and environment that it will be operating. The software is used both on land, in the company HQ (operations), and on the bridge on all ships loading and unloading cargo (fleet). This means that there will be a rather heterogenous group of users, as well.

[1] `http://www.imo.org/OurWork/Environment/PollutionPrevention/ChemicalPollution/Pages/IGCCode.aspx`. Accessed: Sept. 5th 2013.

[2] International Convention for the Safety of Life at Sea (SOLAS). Chapter VII - Carriage of dangerous goods.

[3] International Convention for the Prevention of Marine Pollution from Ships (MARPOL). Annex II - Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk.

Fig. 6. Physical objects - tanks on chemical tanker, as seen from the bridge

The new stowage software utilizes abstractions in the user interface that, in short, are based entirely on previous activity – *vocational practice*. User participants have been involved from the very beginning, drawing on experience from a very specific work practice and environment, and also with an established division of work tasks, in addition to ten years experience with the previous software.

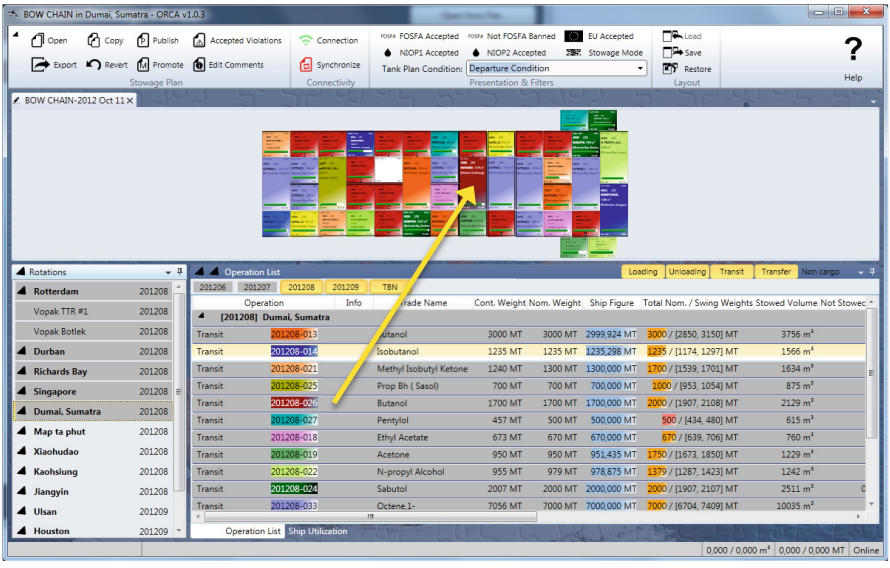

Fig. 7. Tank plan in the new stowage system. Mediation: Abstracted representation of vessel, with interaction directly unto the tank representations which provide direct system feedback. The Operation list beneath the tank plan has direct drag and drop functionality, both related to the Rotation list to the left and to the tank plan above. This is simple activity based HCI development. The yellow arrow is not part of the UI, but a marking made by the author to visualize drag and drop activity.

This resulted in a set of specifications that relied solely on former practice - *intention and action*. On top of the user requirements list was «Good user experience/friendliness». The next important points on the list of requirements were: 2. Support ease of communication between Vessel-Operator 3. Support ease of communication between Operator-Broker 4. Emphasis on an intuitive Graphical User Interface (GUI).

4 Discussion

Bødker's mediation perspective, that people are not working *on* the interface but *through* it, as in employing the UI as a tool that eventually, by the users' active engagement becomes *transparent*, is thus an essential aspect of explaining the importance of *immediacy*. *Immediacy* arises when the combination of mediated affordances and user's level of intuitive skills, and subsequent active engagement with the user-interface, makes it transparent, ie. when the users don't consciously think of interacting through it, but just do.

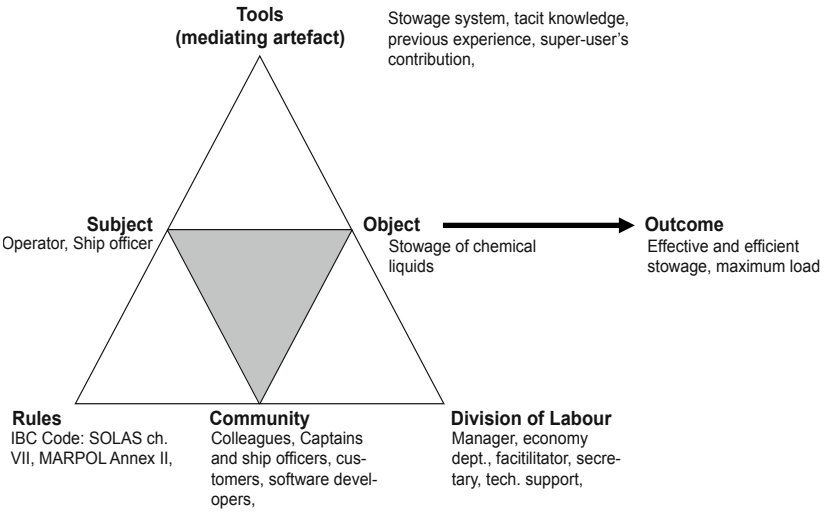

Fig. 8. Activity system linked to the empirical example

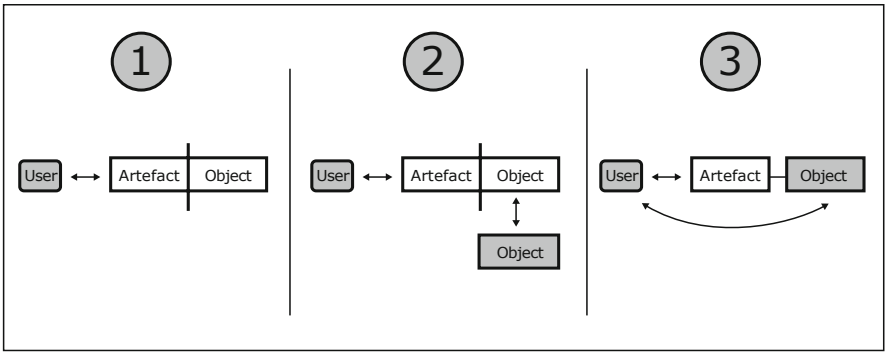

Fig. 9. Activity as a hierarchical system related to the stowage software [12]p. 307

In the depiction in Figure 9, of activity as a hierarchical system, we would, by linking it to the empirical example of stowing chemical tankers, see three distinctly different types of situations: **1.** The object, in which in this case is a tank, is present only through the mediating artefact (GUI). This would have been the occasion if this situation had been eg. a simulator session for training captains and ship officers. **2.** The object exists as an actual object as physical tanks on vessel but is only available in the use-activity as a representation in the user interface. This would be the case if this situation shows an actual stowage planning session. **3.** The object is physically co-present outside the artefact. Tank on vessel is represented by the mediating GUI. The interaction with the artefact (GUI) will be followed by actual loading and unloading of tank, which is accessible for physical inspection. Model by Bertelsen and Bødker [12]p. 307].

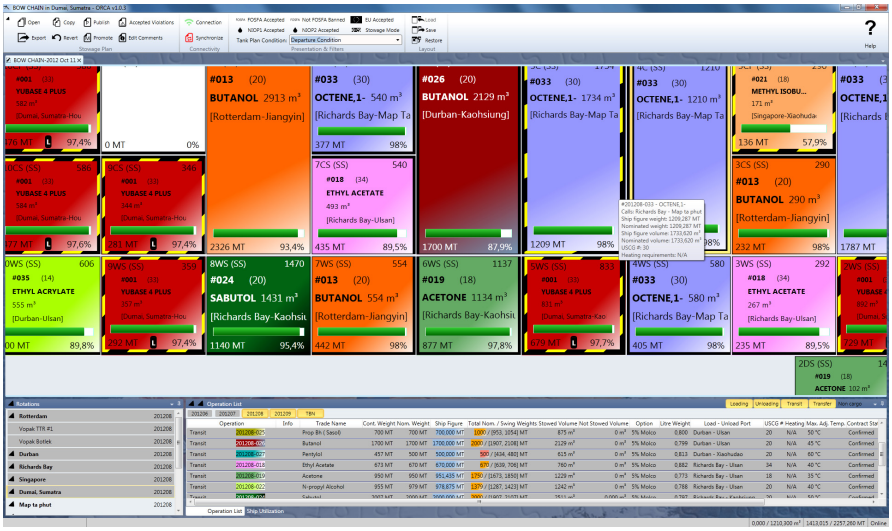

Fig. 10. Details of tank plan in the new stowage system. Observe how the system provides direct feedback on each abstracted element: recipient port, weight, grade of filling, warning border for adjacent hazard, and so on.

The tank plan gives us, through the user-interface, ie. the mediating artifact, an abstracted representation of the vessel, with interaction directly unto the tank representations which provide direct system feedback. The Operation list beneath the tank plan has direct drag and drop functionality, both related to the Rotation list to the left and to the tank plan above. This is simple activity based HCI development, and immediacy in a user-interface. The operator intuitively knows, by vocational experience, what is shown on the screen. The functional elements in the user-interface then affords, based also on the previous experience the required/possible/best practice actions that collectively constitute the stowage activity, in junction with the experiential intuition. By leaning on these two elements of the user-experience we rely on making it a good one, not on intuition alone, but combined with the mediated affordances in the user-interface, giving us an added level of precision, by the possibility of adjusting or designing one more parameter or element within the mediated artifact.

This activity based approach, follows what Kaptelinin and Nardi calls "second wave"-HCI, with its user activity centric focus. They argue that human agency through mediation is an important aspect of activity theory, and therefore, it provides the conceptual tools in order to analyze how people relate to ie. new software, and also how, through adherence to 'rules' and participating in the 'community', a 'subjects's knowledge becomes extended [13]p. 190]. Mediation in an activity-theoretical HCI perspective is goal- and artifact-oriented˙ and therefore rather suitable as an analytical framework for the activity theoretical *immediacy* concept. How might we situate the *immediacy* term within the activity theoretical discourse? One argument, mentioned previously in this paper, which is based on Dreyfus and Dreyfus [14], is that intuition is based on skills. Skills originate from experience. While experience, according to Rubinshtein ([15], cited in [5]p. 47]) should not be separated from action. This situates the term experience and the term derived from it, intuition, within an activity theoretical discourse. Then by turning to affordances in an HCI context, we might follow Kaptelinin and Nardi in situating affordances on the top of the activity structure triangle, see figure 1, defining «technology affordances» as possibilities for acting through the technology in question on a certain object [5]p. 6], thus adopting what they frame as a *mediated action perspective* [1].

5 Concluding Remarks

As the main method of measuring the character of *immediacy* in a HCI setting is through human activity - action, it follows that an important aspect of *immediacy* is human agency. How much control, in terms of customization, mimicking real life work flow, possibility of overriding software guidance and suggestions based on field discourse and rules, does the software allow? We would argue that the number, or absence, of user errors could say something about the perceived *immediacy* of a piece of software. The character of a user-experience, measured by the the outcome of the activity, will determine the degree of *immediacy* with which a user perceives a program. As of its epistemological connection, this paper, then, argues that, as

immediacy emerges from a combination of empirical, skill based intuition and mediated affordances in the user-interface, and since both intuition and affordances are grounded within the activity theoretical discourse, *immediacy* will inherit this theoretical relation.

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