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Applying the conception of HCI engineering to the design of economic systems ☆

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ABSTRACT

The Long and Dowell conception for HCI design (Long and Dowell, 1989) outlined the general design problem for HCI and contrasted between applied science and engineering disciplines of HCI. Salter (1995) sought to clarify the applied science conception through the application of Kuhn's conception of science. Salter also built upon the work of Long and Dowell to produce a generic conception of engineering design. As part of this work the notion of preference was formalized. Building upon the generic conception a set of criterion for an engineering discipline is established. A general design problem for economics is outlined in order to apply the generic conception to the field of economics. Roth's (2002) implicit conception of economic engineering is analyzed against the criterion and the formalized notion of preferences and found to be a consistent but not complete example of an engineering discipline. The general problem of economic design, based upon Long and Dowell's approach, is employed to analyze a regulatory response (Turner, 2009) to the global financial crisis of 2007+ and develop a design-based solution to the problems. It is argued that the current applied science based responses to the economic crisis are insufficient and that a multi disciplinary engineering approach is necessary. This approach includes consideration of how economic participants interact with computers as part of the financial system.

1. Introduction

In 1989 John Long and John Dowell (Long and Dowell, 1989) outlined different conceptions for HCI disciplines based upon the general problem the discipline seeks to address, and the consequent knowledge and practices that arise. Engineering disciplines have problems of design whereas scientific disciplines have problems of understanding and prediction. They conclude that in order to address the design problems of HCI an engineering discipline of HCI is required. The Long and Dowell conception took the form of a set of concepts that were used to structure work on HCI design.

The economist Alvin Roth, with respect to the field of economics, expresses similar thoughts:

> 'Economists have lately been called upon not only to analyze markets, but to design them. Market design involves a responsibility for detail, a need to deal with all of a market's complications, not just its principle features. Designers therefore cannot work only with the simple conceptual models used for theoretical insights into the general working of markets. Instead, market design calls for an engineering approach' (Roth, 2002).

Roth outlines an implicit conception of economic engineering through the analysis of the redesign of the entry-level labor market for American doctors.

Salter (1995) developed a generic conception for engineering design, based on the Long and Dowell approach. In what follows this conception is extended through the addition of a number of criteria that a discipline should fulfill to claim it is an engineering discipline in the sense of Long and Dowell. The generic conception is then instantiated for economics through the postulation of a general design problem for economic engineering.

Through consideration of the American doctors labor market redesign, Roth's implicit conception is analyzed with respect to the postulated general problem and the generic engineering conception. The aims of this analysis are:

- To validate the postulated general problem of economic design.
- To assess the consistency and completeness of Roth's implicit conception with respect to the generic engineering conception.

Roth's conception for economic design is restricted to the consideration of microeconomics and the design of individual markets. The continuing global financial crisis that began in 2007, and continued into 2008 causing considerable financial upheaval, has

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pushed the discipline of Economics to the forefront of public debate. It seems clear to many that some form of macro-economic redesign of the global financial system is necessary to ensure both economic revival and that such a crisis cannot happen again.

The UK Financial Services Authority (FSA) proposes a number of changes to the financial system through the Turner review (Turner, 2009). The postulated general design problem for economic engineering is used to analyze the Turner review. A simple redesign of the global financial system is proposed. The aims of this analysis and redesign are:

- To consider the value of the use of the postulated general design problem in specific instances of design, even when the knowledge and practice of an engineering discipline are unavailable.
- To illustrate that a design focused approach is of value in addressing the current crisis.

By considering these micro and macro instances of economic redesign it is argued that an discipline of economic engineering, of the type envisage by Long and Dowell for HCI, is required in order to provide solutions to economic design problems. It is further argued that economic engineering would draw practitioners from other disciplines and that those with a background in HCI will have a key part to play.

2. The conception of HCI design

Long and Dowell (1989) considers different possible conceptions for the discipline of HCI. Each type of discipline is characterized by three components:

- Knowledge.
- Practice.
- General problem.

Knowledge is used to support practice aimed at solving the general problem of a discipline. For the discipline of HCI the scope of the general problem is identified as:

> 'humans and computers interacting to perform work effectively' (Long and Dowell, 1989).

The scope of the general problem (see Fig. 1) is extended in another paper (Dowell and Long, 1989). The human and computer interacting together are thought of as an interactive worksystem. The concept of effective work is captured by the notion of desired worksystem performance, which is expressed in terms of both the desired quality of work and the costs of the human and computer components of the worksystem that are incurred in doing the work. Interactive worksystems exhibit actual performance, which is a function of the actual quality of work done by the worksystem and the actual costs incurred.

The Long and Dowell paper (Long and Dowell, 1989) outlined three different conceptions of the discipline of HCI, distinguished by the nature of their knowledge and practices. These conceptions are:

- Craft.
- Applied science.
- Engineering.

In what follows, the applied science and engineering conceptions from Long and Dowell (1989) are considered and illustrated with figures from Salter (1995). The nature of the knowledge and practices that correspond to each conception are considered in terms of their definition, operationalization, testability, and generalization.

The term definition is employed to mean the explicit definitions of the knowledge and practices. Operationalization is the transformation of the definitions of the knowledge and practices into a form that can be used and tested. The testing of the knowledge and practices is aimed at determining how well they support the general problem. Finally, knowledge and practices are general if they can be applied to more than one instance of the general problem. that correspond to each conception.

2.1. Applied science conception

The conception of an applied science design discipline describes a practice in the form of 'specify and implement and test' and knowledge in the form of 'guidelines'. In the applied science conception of design, artifacts are still designed by a process of construction and evaluation and reconstruction. However, knowledge in the form of guidelines, derived from scientific knowledge, is used to guide the process. The conception of HCI as an applied science discipline is represented in Fig. 2.

By considering examples of HCI as an applied science discipline, Long and Dowell conclude that the knowledge and practices of HCI as an applied science are derived from scientific theories that are operationalized, tested and generalized. However, the knowledge and practices themselves are not operationalized, tested and generalized with respect to the general problem of HCI. The limited account given of the relationship between scientific knowledge and applied science design in Long and Dowell (1989) was not well understood at the time. Salter (1995) attempted to clarify what was meant through consideration of Thomas Kuhn's (1970) conception of science (see Fig. 3).

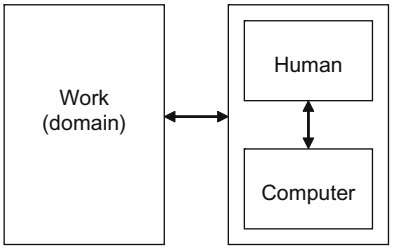

Fig. 1. The general problem for human computer interaction.

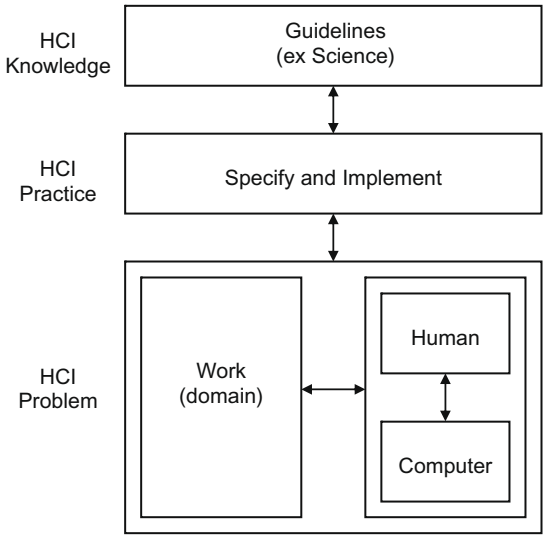

Fig. 2. The applied science conception of HCI.