The New Frontier Issues for Cognition Technology

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Abstract: Cognitive engineering has developed enormously over the last fifteen years. Yet, despite many excellent research projects and publications, its full potential has not been embraced into mainstream system design. This paper will examine the reasons for this failure and argue that the problem is not simply inertia or lack of education. There are strong organisational influences that cause resistance to this particular approach, The discipline itself has characteristics that make it fragile in the modern corporate structure. In addition, the cognitive engineers themselves are not blameless in the equation. They appear to have done exactly what they criticise the engineering community for doing: they have packaged their product in a manner that is not 'user friendly' to its target population, not structured to suit its application, and not output in the format required. Suggestions will be made to rectify the situation: a list of actions is proposed for practising cognitive engineers to make their product more likely to enjoy widespread uptake.

Keywords: Application; Design; Organisation; Resistance; Specification; Uptake

1. INTRODUCTION AND SUMMARY

1.1. Background

Fifteen years ago, the term ‘cognitive engineering’ (CE) was almost unknown in the manufacturing industry. It was heard in select academic and research establishments, but had very little real application in the design of commercial systems. Today, most designers are at least aware of the existence of the discipline; some are already using it and others are willing to try. This is great progress and a credit to all those involved in the field.

Yet, there are still significant obstacles to overcome. Some practitioners believe that the only remaining challenges are to persuade traditionalist engineers of the value of ‘human-centred design’, and the necessity to include the user in their mental model of the system. I disagree. No doubt these are useful things to do, but to achieve real success there are other, less obvious barriers to cross.

This paper will discuss the factors surrounding CE as an innovation in industrial organisations, and attempt to identify the key factors in improving its uptake in real commercial applications. This will be done by drawing upon the literature on innovation within organisations, then discussing some of the relevant issues that have been observed by the author.

Throughout this paper, the terms CE, human factors and human-centred design are used interchangeably. While there are many related specialisms in this area, each with its own emphasis, they do have issues in common from the organisational point of view. Since these issues are the focus of this paper, distinctions between the specific content of these areas will not be drawn.

1.2. Summary

A brief exploration of the literature on innovation will suggest that the adoption of CE in commercial industry faces more obstacles than simply proving its worth in a fair contest of technical merit. Since there are barriers to progress that are not of a strictly technical nature, those who wish to promote the adoption of CE should, perhaps, start to invest some effort in organisational, rather than strictly technical, approaches. This would not be separate from the technical content of CE; rather, it would step back and examine the best way to present the technology, given the organisational context. CE professionals may not find this the most natural way to work but, unless it is done, their strong technical advances may be wasted as they will not enjoy widespread uptake.

In the author’s view, there are three real ‘frontier’ issues to resolve, if cognitive engineering and associated dis-
Disciplines are ever to take an equal place alongside other aspects of design. They are the ability to:

- set minimum requirements for design;
- contribute at an earlier stage;
- bridge the gaps created by organisational divisions.

The second part of this paper will discuss each of these items in turn, explaining in detail the issues involved, and then offer an ‘action plan’ for CE practitioners to promote their specialism.

2. INNOVATION IN ORGANISATIONS

2.1. Human-Centred Design and ‘the Systems Approach’

Grose (1987) explains why ‘the systems approach’ is needed in the modern aviation industry. He argues that the complexity of aerospace systems is now such that ‘no longer can one person posses total knowledge of any system’ so that individuals must become increasingly specialised until they know ‘everything about nothing’. This is almost inevitable because of the high degree of technical knowledge required for each separate aspect, but the cost is a loss of vision of ‘the big picture’ and this detracts from the efforts toward human-centred design. The best antidote, he argues, is the ‘systems approach’.

Grose discusses the reason why both the ‘systems approach’ and the contribution of ‘human factors’ specialists have not always delivered the promise of flawless systems and human-centred designs. It is clear that in order for human factors to fully contribute to the design, a ‘systems approach’ to the overall design issue is required.

Human factors is one of what Grose describes as the ‘moralistic functions’ (akin to quality assurance, reliability, maintainability, etc). Academics and leaders in these disciplines have a tendency to exist in ‘pockets’ of incomplete groups, and compete with other similar ‘pockets’ to have the last word on whatever contentious issues are currently in vogue. Unfortunately, they do not form a cohesive group that can produce a consensus solution to the problem.

They can, Grose argues, become ‘do-gooder functions’ that have found a ‘missing ingredient’ in the product design, and the fact that the ingredient was missing may often be attributed to the fact that each individual design discipline has become so specialised – by necessity – that they have lost sight of key characteristics of the overall product, such as usability. Unfortunately, human factors itself has become a specialisation, and therefore ‘lacks the global perspective required for systematic control of human error in aerospace systems’. Within the design project they are frequently involved too late as an ‘afterthought’ in the hope of ‘human factor-ing’ a design as a finishing touch.

Riley (1996) indicates that while a designer may ‘human factor’ a product as a superficial ergonomic exercise in the arrangement of ‘knobs and dials’, a ‘human-centred’ design requires the basic architecture to be constructed around the user requirements from the outset. It is this latter concept that is likely to make real improvements in system applications. For this ‘human-centred’ concept to be achieved, the human user focus must be sustained throughout the design cycle and not ‘bolted on’ at the end.

Grose comments that although the ‘systems approach’ actually originated in the aerospace industry of the 1950s ‘it has been surprisingly ignored there, almost like a stillborn child in many cases’. Yet, there is no evidence that this avoidance is caused by a reasoned opposition to the idea. Grose writes, ‘As far as can be known, there are no arguments against it’. So, why is it not universally practised?

According to Grose, this owes much to the following characteristics of the company organisation:

- the ‘systems approach’ has no specific organisational advocate; no one is responsible for ‘doing it’;
- it is, as a concept, diffuse and untestable; ‘this unfocused, diffuse and amorphous attribute becomes a force against its utilisation’;
- it can come under attack from certain types of personality that are commonly found in organisations – Grose refers to them as ‘table pounders’ – ‘strong personalities who – in their impatience, ignorance or arrogance – will not permit the process to be carried out’ and this is likely to be due to ‘self interest – the desire to have a parochial viewpoint prevail against all odds’;
- ‘ignorant familiarity’ – a term Grose uses to describe the commonly held belief by almost every engineering employee in the industry that they ‘know all about the systems approach’; everyone wrongly believes themselves to be an expert. Grose likens this to knowledge of the Bible – everyone thinks that they know what is in it, but very few have actually read it and even fewer practise it, even in a ‘Christian’ country.

Good human-centred design needs ‘the systems approach’ to succeed, and both could be considered innovations in the traditional world of aerospace, and probably other areas of system design. To understand the factors affecting their uptake or otherwise, it may be useful to consider the issues surrounding innovation in general.

2.2. Identifying Innovators

The most relevant literature to explore the fate of CE in commercial organisations would probably be that of organisational innovation, although individual and group innovation also play a part. West and Farr (1989) review some of the literature on innovation and report that, at the organisational level, despite the large quantity of research