THE INTEGRATION OF INFORMATION AND IDEAS: CREATING LINKAGES THROUGH A NOVEL CONCEPT DESIGN METHOD

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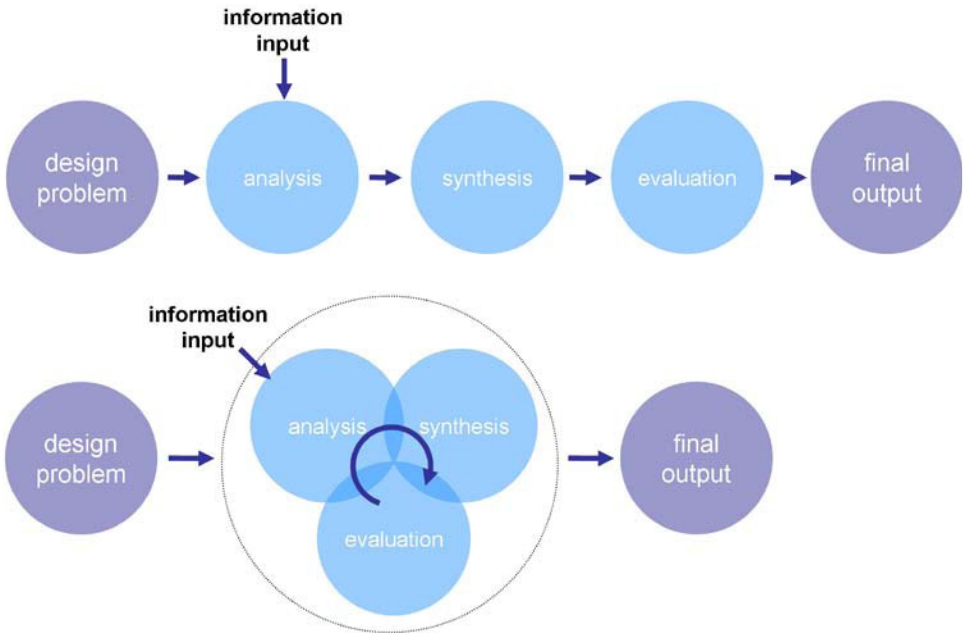
ABSTRACT This paper describes the *ICR Grid* as a novel representation of information and ideas. Developed as a method for enhancing utilization of digital information sources in conceptual design, the name is derived from the cognitive processes (inform, create, reflect) that are systematically employed and the resulting grid output. As a prescriptive method it requires design teams to find and build information resources in parallel with creating solutions. It does, however, maintain the freedom of designers to decide on the direction of exploration and encourages flexible thinking by using an activity-based approach. The output of the method is a linked grid of information sources and their application that emphasizes their relationships and evolution over time. The paper reviews the evaluation of a prototype ICR Grid in a number of industrial scenarios using a shared OneNote document, and outlines the development path for future bespoke implementations. As digital technologies and organizational strategies continue to rapidly evolve, this work is timely in bringing new thoughts on how information is sourced, used, and managed in the development of ideas. Issues regarding team structures and interaction, information reuse, and the capture of rationale are also addressed in relation to the grid format. It is anticipated the findings will be of particular interest to industrial designers, information specialists, and the digital library community, as well as being of relevance to any organization undertaking idea generation or problem solving.

INTRODUCTION Industrial designers generate ideas and turn them into viable product solutions. Within the overall product development process, concept design is the phase where ideas are generated, selected, and embodied in conceptual form in preparation for further development. Concept-design work is often undertaken by groups in collaborative, studio-based environments and despite the development of a number of formal tools and techniques to support it,[1] informal approaches such as brainstorming remain the most popular. Additionally, access to appropriate information, principles, exemplars, and context have been shown to be important in creating well-substantiated concepts and acting as stimuli for discussion.[2–3] This presents a challenge in effectively

FIGURE 1



PHASE-BASED
Traditional phase-based concept design process

ACTIVITY-BASED
Proposed activity-based concept design process

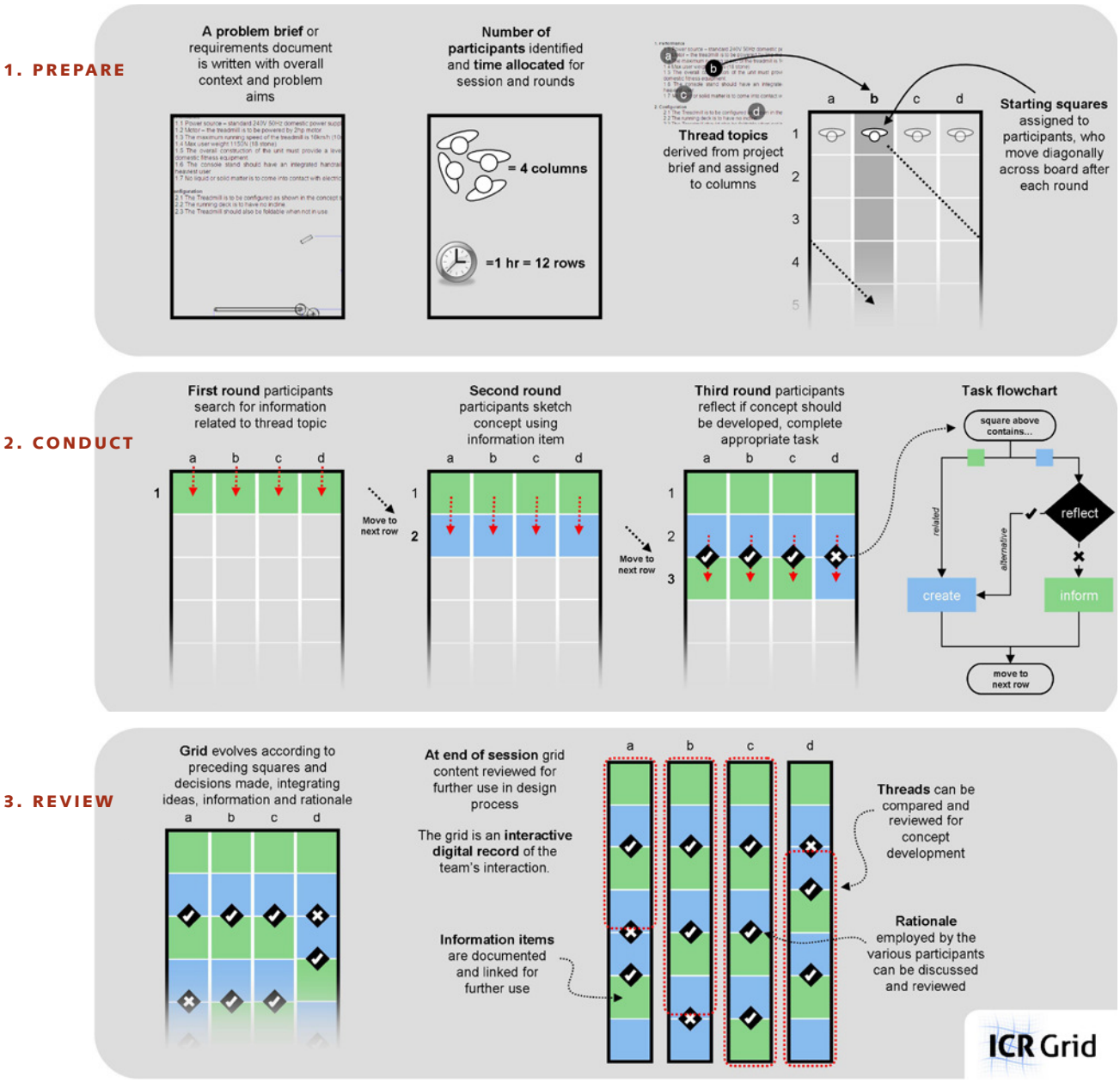


FIGURE 2: *An illustrated guide to the ICR Grid*

integrating information into the concept-design activity without prescribing a highly systematic approach that inhibits such creativity.

The ICR Grid attempts to do this by providing information support for concept design in an intuitive way while having sufficient structure to allow the coordination of individuals within a team. Rather than demanding significant work on design requirements and research as a precursor to concept generation, the ICR Grid is a design method that aims to embrace the fuzziness of design problems and allow designers—who will often engage in sketching and idea-creating activity as soon as a problem has been identified—to bring information into this process in an *activity-based approach*, as opposed to a *phase-based approach*. In this way, ICD Grid allows repeated iterations of the *primary* cognitive activities most closely associated with problem solving: analysis, synthesis, and evaluation.[4–6] FIGURE 1 (shown on the preceding page) suggests how the linear concept-design process can be revised to increase the proximity of information to the task of designing through the iteration of analysis, synthesis, and evaluation activities.

STRUCTURE OF ICR GRID

The ICR Grid can be viewed as a development of the 6-3-5 Method[7], where a group of six individuals sketch three ideas each in five minute sessions and then pass them to the adjacent person, who, in turn, uses them as inspiration to generate three further ideas. The ICR Grid uses a similar approach, but builds upon it, by incorporating information search and concept-evaluation tasks in order to help develop context. The ICR Grid procedure results in a linked grid of ideas and information. The method derives its name from the three tasks undertaken (each aligning with the cognitive activities highlighted above) by participants:

- **INFORM (ANALYSIS)**
  Find any broadly related item of information that you think could be used to help develop the concept further.

- **CREATE (SYNTHESIS)**
  Sketch a concept that broadly uses previous information item as inspiration or stimulus.

- **REFLECT (EVALUATION)**
  Decide if concept is worth developing further, then complete appropriate task based upon this decision.

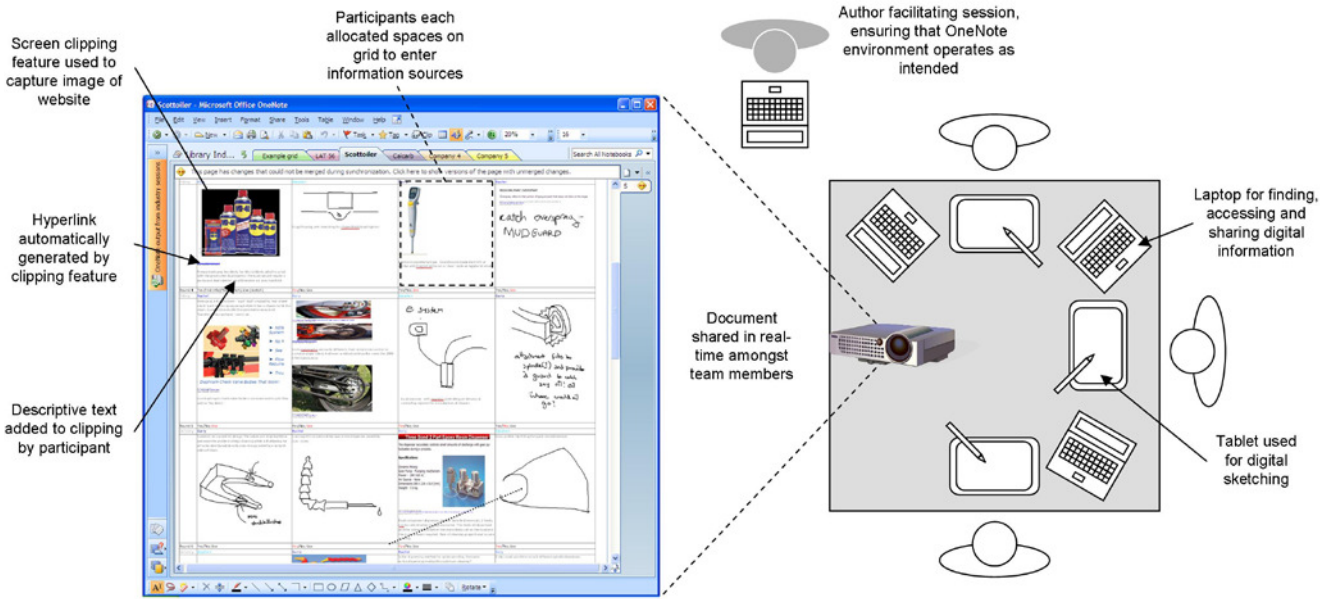
If a positive decision is made, a new information resource is found to apply to the concept and added to the library. This means that if positive decisions are consistently being made then a concept can evolve with the continual addition of relevant information. If a negative decision is made, a new concept is created, starting a fresh line of development. This cycle continues for a number of rounds—creating a grid of information and ideas whose relationships are defined by the actions taken during the session. An illustrated guide to using ICR Grid is shown in FIGURE 2 (shown on the preceding page).

APPLICATION IN THREE INDUSTRIAL CONTEXTS

While it is possible to execute an ICR Grid in a paper format, constructing and using a digital environment provides the benefits of integrated and active concept and information links in the grid output—this sets it apart from other concept-design methods. It also provides a powerful legacy in that any work undertaken can be revisited and reused throughout the product development process.

Microsoft OneNote was used for this prototype implementation of the ICR Grid, as shown in FIGURE 3 below. Though not necessarily designed for this mode of use, it provided the necessary functionality regarding real-time sharing of a document—with the grid outlined in table form and cells completed during the sessions. Tablet interfaces were used for sketching, allowing the sessions to take place entirely in the

FIGURE 3: *Prototype Implementation of the ICR Grid*



digital environment. To help clarify the status of the shared grid (which was subject to short update lags) the researcher's laptop was connected to a projector, providing a unifying visual focus for the sessions.

Concept-design sessions of one hour duration using the ICR Grid were conducted with three different companies, addressing ongoing design problems in each organization. Concept-design sessions are discussed below with accompanying grid output for *Company B* shown in FIGURE 4.

COMPANY A: *Design and manufacture technical business travel luggage*—The design problem was to develop an integrated device that would allow a suit carrier to be hung over a rail or door. The format of only two participants was one not previously envisaged for the method and although the mechanics were still workable, it was found that convergence was achieved very quickly and the grid perhaps lacked diversity. This was in part also due to the fact that the participants had similar pre-conceived views regarding the design problem. The session did, however, provide a facility to consolidate their thoughts in a directed way. Significant development of the concept was achieved during the session, with a number of manufacturers that could be utilized in development identified. The rapid capture of this process was valued by the participants who cited previous problems in documenting their concept-development work.

COMPANY B: *Design and manufacture chain lubrication systems*—The design problem was a generic one: how to improve delivery of oil to the chain of a motorcycle. A diverse range of information items and concepts emerged, with the team size of four found to be more effective regarding engagement and information

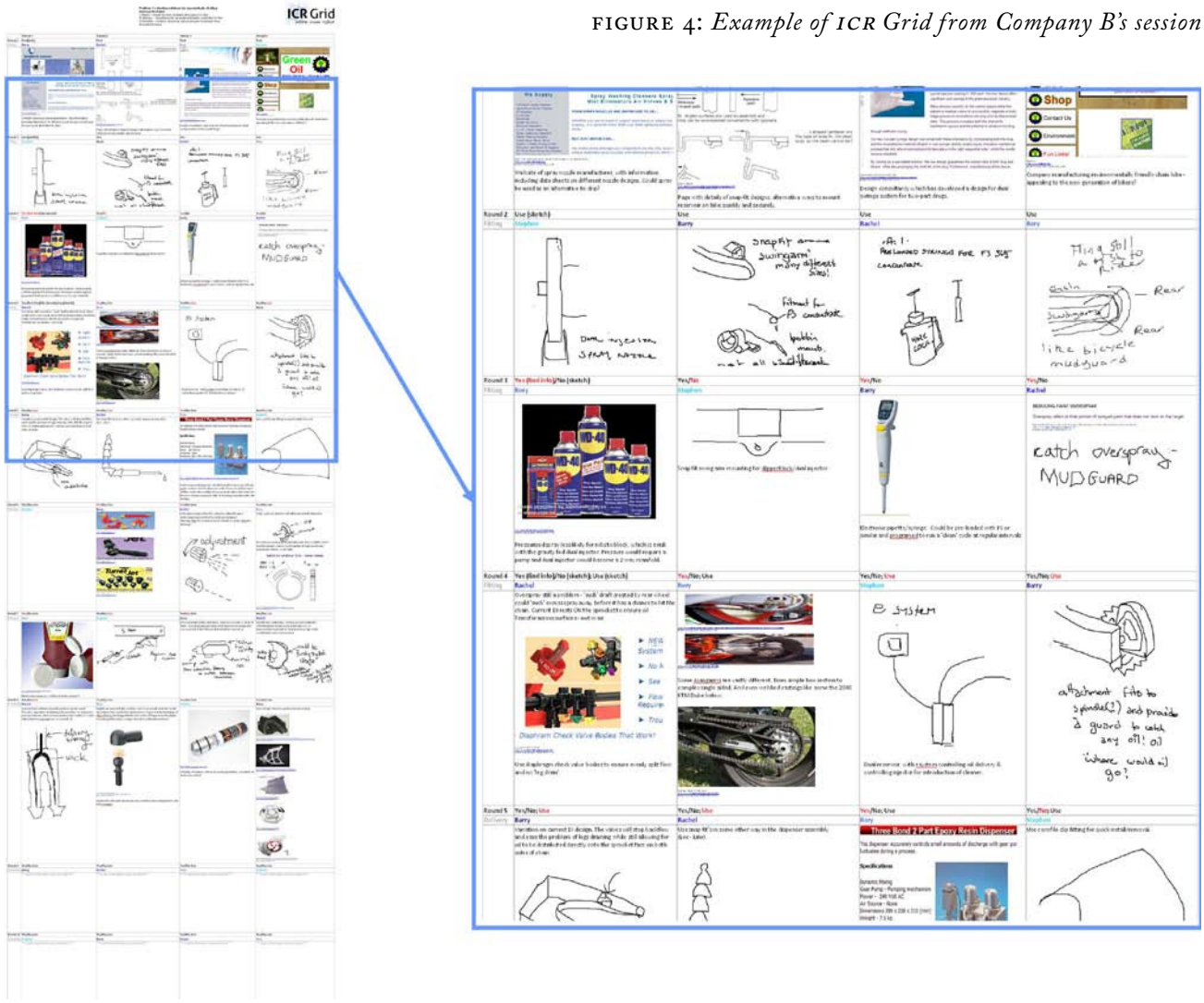


FIGURE 4: *Example of ICR Grid from Company B's session*

exchange. The participants cited the structured sharing of ideas and information as an effective way to encourage team-working and improve communication—the reflective element of the process seemed to matter less than the collaboration moving concepts forward in some way. Towards the end of the session the participants seemed to find the general direction of one particular thread most exciting in terms of its development, though there were elements of cross-fertilization across the columns of the grid.

COMPANY C: *Manufacture furnace insulation*—The design problem was the marking of products for identification purposes through the production process. Initially, and to various degrees, the four participants struggled to use OneNote and the tablet interfaces. Despite this challenge the session picked up when a number of information items were identified that provided new ways of approaching the identification problem. It was at this point that participants also overcame a lack of fluency in sketching (perhaps due to the manufacturing background of the participants) by focusing on text and annotation—meaning that the grid began to take the form of a shared information resource. This unanticipated approach provided output which was of use, despite the fact that the session was not conducted in the expected manner.

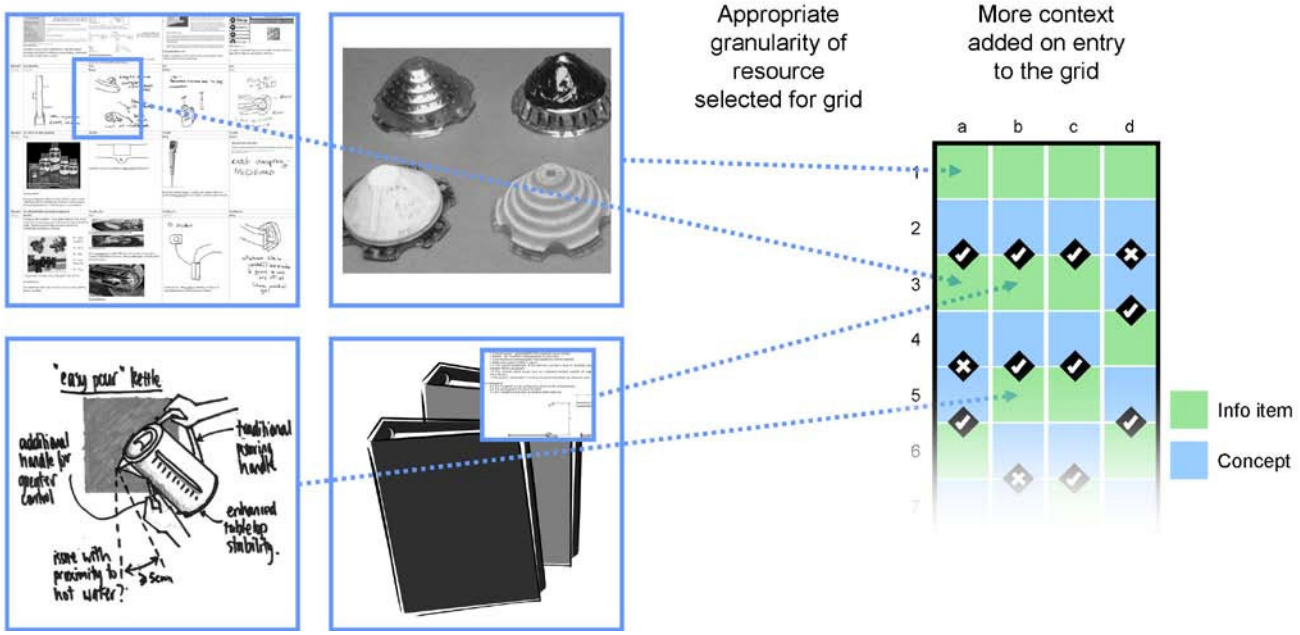
It was found the ICR Grid performed well, if differently, in the three different contexts. Participants acknowledged the potential benefits in conducting all their concept-design work in an integrated environment, particularly the recording of pertinent information sources and the contextualization of them by linking them to sketches. While the presentation of thumbnails is not in itself novel, helping teams to search for information and generate ideas in parallel, and to then link these in an integrated grid that captures rationale and context, is something new in the field.

The sessions did, however, highlight a number of issues with the usability of the OneNote interface—the optimal solution would have been to have had a computer-based version operating on the company premises to allow them: flexibility in tailoring it to their working practices, increased comfort, and access to on-site resources (while ensuring that the correct procedures were followed in its execution).

INFORMATION REUSE

The key differentiating factor of the ICR Grid is its use of information: as well as creating concepts, the team also builds an information resource. This information resource is used in the development of concepts as the ICR session progresses, but it also provides a legacy which can be used future projects, and in turn becoming a potential input for future ICR Grids. As an input, the grid could be searched and cited like any other resource. The two stage process of identifying and contextualizing information items is highlighted in FIGURE 5 below.

FIGURE 5: *Reuse of Information*



The granularity (the resource size) of items sourced and used in the grid can vary significantly—from an image of a product to a textbook. The grid operates on the basis that the most relevant part of the resource is sampled through an image, and, when deemed appropriate, the remainder can be accessed. For example, if a report has a relevant paragraph or diagram, this is captured through a photograph or screenshot and included in the grid with the appropriate description of use, but the entire resource can be freely be accessed if a participant wishes to explore it further. This provides maximum flexibility in the range and types of item included.

It may be that the ICR Grid is employed to help organize or apply information that has already been gathered by the project team. For example, user studies, theoretical data or market analyses may have been completed. The ICR Grid in this instance becomes a facility to identify the most relevant aspects and apply them to concept-solutions, while allowing the possibility of introducing new and alternative information sources as appropriate.

CONCEPT DEVELOPMENT

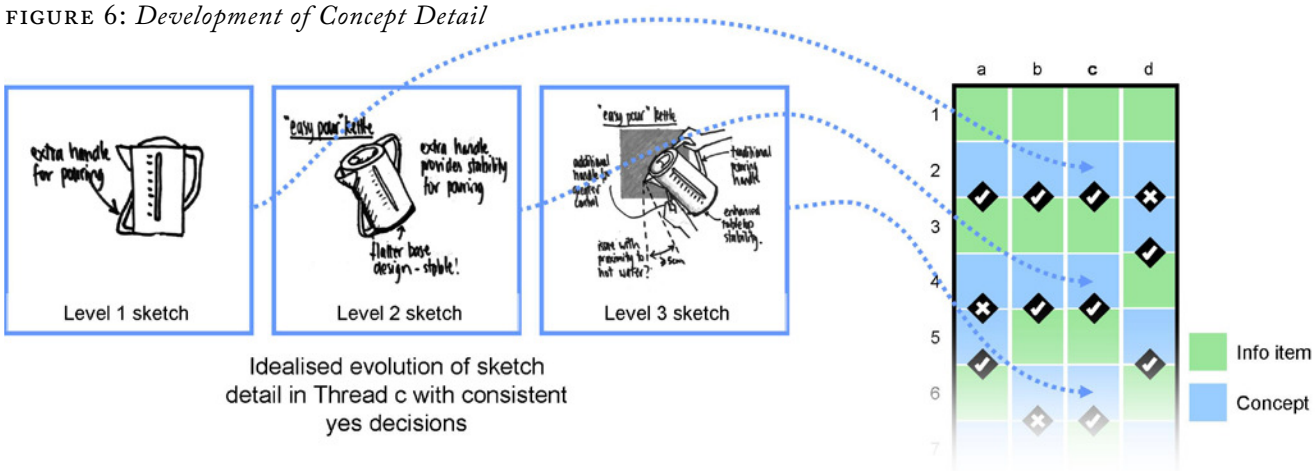
A concept can be defined as "an approximate description of the technology, working principles, and form."[8] The synthesis of this description can, however, be at different levels of product detail (whole system, sub-system, component) depending on the context of work.[9] For example, a design team may be working on the redesign of the handle of a kettle rather than the entire product. The ICR Grid can, then, be applied to any topic at any level of detail, but when undertaking the session synthesis of concepts takes place.

The nature of the proposed ICR Grid is to engage in vertical transformations by continuing to embody highly rated concepts as the session progresses, while incorporating lateral shifts in focus through the various threads. While many other conceptual tools such as brainstorming and 6-3-5 have been shown to produce higher numbers of concepts in the lateral mode with a relatively low level of detail, the opportunity for promising threads to be explored in the course of the session means that key revelations can be driven out and these concepts worked to a higher level of detail at one sitting rather than through a serial process. An illustration of increasing concept detail as a result of consistent thread development is shown in FIGURE 6.

The "rationale points" as a thread develops form an important legacy in the grid, capturing the type of knowledge that often remains tacit and subsequently lost to organizations engaged in informal collaboration. With each rationale point connected to a concept and associated information item, these provide a alternative way to interrogate and investigate the body of material, the decisions made, and concepts selected during the concept-development process.

CONCLUSION The ICR Grid is a new way of organizing the ideas and information that result from the concept-generation work typically undertaken by designers. It facilitates the retrieval of digital information sources and development of conceptual ideas in the same environment. The mechanics of the method mean that information and ideas are inherently linked to form threads of development. While the ultimate vision for the work is a fully-programmed stand-alone application, the emphasis of this paper has been on the format and purpose of the grid

FIGURE 6: *Development of Concept Detail*



rather than the supporting IT architecture. For the prototype version of the grid, however, an implementation using Microsoft OneNote has been outlined.

Even though the ICR Grid was initially developed as a concept-generation method for industrial designers, it is applicable to any group of people trying to create and develop new ideas. The novel aspect of the method is that it integrates information through the concept-generation process in a way that has not previously been the case. The work addresses the specific information needs of creative groups, affording the opportunity to find, capture, and use sources as new ideas are developed. It also presents a new form of "library" that is not based on a hierarchical list, but instead allows navigating a structured grid of ideas and information. This feature in conjunction with the forms of interrogation mentioned above is highly relevant to information specialists and digital librarians who are trying to meet the needs of this category of creative users.

BIOGRAPHY Andrew Wodehouse is a Lecturer in Design at the Department of Design Manufacture and Engineering Management at University of Strathclyde since September 2003. He graduated as an MEng in Product Design Engineering at the University of Glasgow/Glasgow School of Art and an Ing from the Hanzehogeschool Groningen, the Netherlands, before working as a product design engineer for a number of design consultancies, including Cambridge Consultants, LTD. Research projects include the Digital Libraries for Distributed Innovative Design Education and Teamwork (DIDET), and Knowledge and Information Management Through Life (KIM), and his PHD focuses on digital information support for concept design.

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