Generating and disseminating intermediate-level knowledge on multiple levels of abstraction: An exploratory case in media architecture

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ABSTRACT

The concept of *intermediate-level knowledge* is increasingly used in interaction design research and media architecture. Recently it has been proposed that intermediate-level knowledge is better actionable to designers when it is conveyed on multiple levels of abstraction. This paper shares an approach-in-the-making to generate and disseminate knowledge in line with this proposition. We describe an ongoing exploratory case in which the aim is to generate actionable insights with regards to promoting neighborhood resilience through media architecture. In our approach we explicate knowledge on three levels of abstraction: design examples (most concrete), a framework (most abstract) and design strategies (in between design examples and framework). We discuss how the roles of these levels of abstraction are distinct when either generating or disseminating knowledge. We conclude our paper by looking ahead. As our research team will start to engage with partners in social design, architecture and urban planning, we will explore how our multi-level approach to intermediate-level knowledge is fruitful in generating actionable insights for a more interdisciplinary audience.

CCS CONCEPTS

• **Human-centered computing**; • **Interaction design**; • **Interaction design theory, concepts and paradigms**;

KEYWORDS

Research through design, intermediate-level knowledge, urban resilience

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1 KNOWLEDGE ON MULTIPLE LEVELS OF ABSTRACTION

In the field of interaction design (IxD) research there is an increasing interest in the concept of *intermediate-level knowledge* – i.e., "knowledge that is more abstracted than particular instances, yet does not aspire to the generality of a theory" [14]. The concept offers design researchers a way to express insights that concern aesthetics, values and other intangible ingredients in IxD [12] and it is considered fruitful way to advance the discourse on theory in IxD research [13, 14]. Also in media architecture different forms of intermediate-level knowledge are being contributed, such as design patterns [11] design spaces [10] and mechanisms [19]. While increasing in popularity and use, the notion of intermediate-level knowledge is still new and questions are being asked about what forms it can take, and how it can be generated and disseminated [12, 15].

Recently it has been proposed that intermediate-level knowledge is better actionable to designers when it is conveyed on multiple levels of abstraction [3]. This paper shares our approach-in-the-making to deliver such knowledge. The approach is developed in an exploratory case that is focused on promoting neighborhood resilience through media architecture. We highlight how our approach explicates three levels of abstraction and discuss some of the implications that this brings for generating and disseminating intermediate-level knowledge. Finally, we describe how we will apply and expand on this approach in future work and how our approach and its outcomes will come to serve a wider range of disciplines, beyond media architecture.

2 EXPLORATORY CASE: MEDIA ARCHITECTURE FOR NEIGHBORHOOD RESILIENCE

As part of a larger ongoing research project about designing for resilience in urban neighborhoods, we recently started an exploratory case in the context of media architecture. We are experimenting with an approach to generating insights for promoting neighborhood resilience, in particular in relation to social and ecological aspects. In the following sections we describe how the notion of intermediate-level knowledge is fruitful for our purposes, how our approach to generating such knowledge involves navigating multiple levels of abstraction, and we discuss implications and future considerations for generating and disseminating such knowledge.

2.1 Promoting neighborhood resilience: A need for intermediate-level knowledge

There is a growing awareness that for cities to function and thrive, now and in the future, they need to become more *resilient* – i.e., they need to be able to resist, adapt, or transform in response to various shocks and stressors [1]. Promoting resilience is a high-level goal, which can concern a wide variety of shocks and stressors (e.g., a pandemic, economic recession or effects of climate change) and can be applied to different scales (from individuals or households to neighborhoods or entire cities). For this reason, any project aiming to generate insights about promoting neighborhood resilience requires a clear scope (e.g., asking resilience 'of what', 'to what' and 'for whom' [16]).

In our research, efforts to generate knowledge are at the service of disseminating it to professionals in media architecture and other fields, so that it can be put into practice. This requires a generative form of intermediate-level knowledge – i.e., knowledge that is concrete enough to inform design activities, yet generic enough to be applicable in different contexts. In the current stage of our research, we aim to learn from existing design examples in media architecture to see how they can contribute to social and ecological resilience in urban neighborhoods. We believe media architecture has this potential, for example, through participatory design approaches and by adopting a 'more-than-human' perspective [6, 8].

2.2 Generating intermediate-level knowledge on multiple levels of abstraction

Below the research process is broken down into steps in a way that emphasizes the level of abstraction that these steps concern. Note that only later in the process we started to see our research as a multi-level process, which then led us to explicate these levels as a fruitful basis for our subsequent steps (see subsection 2.2.3).

2.2.1 Collecting and selecting appropriate design examples. With the goals of promoting neighborhood resilience in mind, examples of existing media architecture projects were collected. To find these design examples, online search engines were used as well as publications that compile various media architecture projects and designs [17, 19]. Ten design examples were selected for analysis, based on the extent that the researchers associated these with ecological and social resilience. Examples are the Waterlicht installation by Studio Roosegaarde, which raises awareness about rising sea levels, and the SMS Slingshot project by The Constitute [7], which aims to give citizens power over public screens. Other design examples that were included are 'Biomer Skelters' by Will Pappenheimer and Tamiko Thiel, 'Human Beeing' by The Constitute, 'Musical Swings' by Daily tous les jours, 'NAMAland' by Conor McGarrigle, 'One and a half meter monitor' by the Municipality of Amsterdam, 'Organic Cinema' by World Wider Web, 'Starling Crossing' by Umbrellium, and 'Walk Walk Dance' by Daily tous les jours.

2.2.2 Scoping: Articulating an initial framework consisting of a set of generic design questions. An initial framework was created, consisting of six design questions for both ecological and social resilience. These two domains of resilience were not clearly defined at the outset, and the questions were intended to articulate them better. To illustrate, an example of a design question for social resilience was "How to enable citizens to feel connected with public spaces in their neighborhood?".

2.2.3 Explicating three levels of abstraction: Generating actionable and transferrable design strategies. With the initial framework and design examples as a basis, the project set out to generate actionable insights. After struggling with attempts to derive these insights, a discussion among the team led to a better-defined approach. First of all, we explicated three levels of abstraction. At the most abstract level, the framework would serve as a scope for the analysis, focusing on ecological and social resilience in neighborhoods. At the most concrete level, design examples would serve as the data for our analysis. At the level in between, we would articulate design strategies, defined as ways to a achieve a goal [5]. These formed the link between the design questions in the framework and particular aspects of the design examples. For example, in between the question 'How to enable citizens to feel connected with public spaces in their neighborhood?' and a particular aspect of the SMS Slingshot – being able to contribute your own text message to a projection on a local façade – we articulated the design strategy 'Enable locals to appropriate the design or a public space'.

A second decision was to make our approach visual. We used Miro boards, which allowed us to graphically position the three layers of abstraction in one format, and to identify draw connections between the three levels. We analyzed each project separately in such a visual format, as exemplified in Figure 1.

2.2.4 Creating a 'master visual': Synthesizing and integrating design strategies. After analyzing the separate design examples, we created a 'master visual' in which we brought together the design strategies, derived from each of the design examples, and organized these according to the design questions of the framework. Some design strategies were integrated due to their similarity, leading some design strategies to be represented by multiple design examples. We also made new connections between the design strategies and design questions, meaning some design strategies addressed multiple questions.

2.2.5 Revisiting the design questions: Through a creative leap the framework crystallizes. With the new design strategies, the design questions of the framework were revisited – some were merged, others left out, and still others were slightly rearticulated. At some point it started to stand out that some questions of social resilience

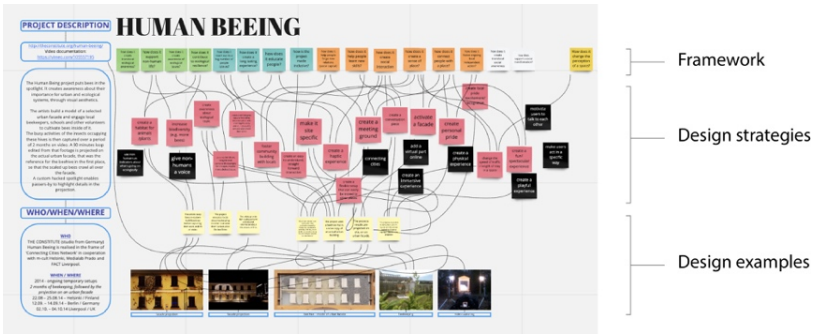

Figure 1: In our analysis we used a visual format that allowed us to make connections between three levels of abstraction: framework, design strategies and design examples.

were similar to those of ecological resilience, whereas other questions remained unique to social resilience. The idea arose to create new questions for ecological resilience that matched the questions unique to social resilience. For example, a question concerning 'social skills and knowledge' was supplemented with one about 'ecological skills and knowledge'. In this way a coherent and symmetric framework crystallized, which was thought to uncover new and relevant design directions for promoting neighborhood resilience.

2.2.6 Tweaking the design strategies: Finding the right level of abstraction. After revisiting the design questions, the design strategies were reconsidered. We noticed how the design strategies differed in terms of their level of abstraction, with some being closer to the level of our design questions, while others being closer to the specific design examples. We rearticulated several design strategies so that they would be on the same level of abstraction – a level that was distinct from the design examples and questions.

2.2.7 Back to the design examples: Attuning, articulating and supplementing. At the time of writing, we are in the process of reconnecting the design examples to the newly articulated design strategies in the master visual. We are also articulating more precisely how the design examples instantiate the design strategies; these descriptions will form the most concrete level of intermediate-level of knowledge in our dissemination (section 2.3). Furthermore, stimulated by the newly articulated design questions (section 2.2.5), we will be bringing in new design examples that we think answer these questions. This, in turn, will lead us to derive new design strategies that connect the new examples with the design questions from the framework.

2.3 Disseminating intermediate-level knowledge on multiple levels of abstraction

In our research we are driven to deliver insights that can be put into practice. With this in mind, we consider the framework to demarcate a particular solution space with regard to promoting neighborhood resilience. The design strategies instantiate the framework, and serve as more concrete and *actionable* insights within the given solution space. The design examples, in turn, serve as rich illustrative examples of the framework and design strategies. We are currently experimenting with various formats for disseminating the generated insights on these three levels of abstraction. In our experimentation, several considerations are emerging. For example, how to make the complexity of the subject matter – visible in Figure 1 – accessible to other design practitioners and researchers? What level of abstraction should lead in structuring the format? And, following from the previous question, what type of document or tool might then be appropriate? If the design questions are central, a linear report could work that addresses each question separately. If the three levels matter equally, then a more flexible format might be more appropriate, such as a card set or an interactive website.

3 KEY INSIGHTS AND LOOKING AHEAD

In this paper we shared our approach-in-the-making to generating intermediate-level knowledge, in which we explicate three levels of abstraction. We have described how the process involved continuously shifting between the three levels (see Figure 2). During this process we were constantly attuning the framework, design strategies and design examples to one another, in order to create a coherent whole in the end. Our process so far occurred rather intuitively, and we intend to define the approach more clearly. We will articulate criteria while being careful not to restrict the creative processes that our three-level approach requires [9].

In describing our three-level-approach, we distinguished between generating and disseminating knowledge, the first being at the service of the latter. For both activities, the framework, design strategies and design examples play distinct roles, which are summarized in Table 1. These distinct roles can offer general guidance to other design researchers in taking a multi-level approach to generating and disseminating intermediate-level knowledge.

Our experimentation with the three-level approach has led to valuable outcomes, although we consider them preliminary. We will continue to develop the framework and design strategies, not only by bringing in new existing design examples, but also by initiating new 'research through design' [4, 18] projects within our consortium, ranging from participatory to more speculative. In these efforts, the role of the framework in our research will likely be similar to that of a 'design perspective' [3] or 'design program' [2], in that it will allow for multiple studies and design experiments to form a coherent whole.

With our next steps, we will venture outside the field of IxD and media architecture and engage with partners in social design,

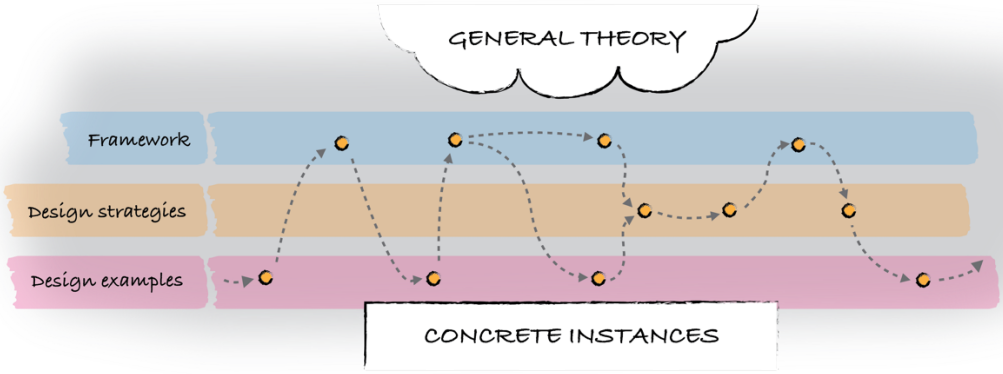

Figure 2: In our approach to generating intermediate-level knowledge, we explicate three levels of abstraction (i.e., framework, design strategies, and design examples). The research process involves continuously shifting between these levels. Figure adapted from Höök and Löwgren [14].

Table 1: Located on different levels of abstraction, the framework, design strategies and design examples play distinct roles in the process of generating and disseminating intermediate-level knowledge.

	Generating knowledge	Disseminating knowledge
Framework	Constructing the framework involved scoping the project, centering the attention to the design questions we wanted to address and generate insights for.	The framework opens up a particular solution space for designers and other practitioners that have the aim to promote neighborhood resilience.
Design strategies	The design strategies were the form in which key insights were articulated. They were the means to connect characteristics from the design examples to the design questions of the framework.	The design strategies represent actionable insights that allow designers and other professionals to take action within the solution space of the framework.
Design examples	The design examples formed the data from which we derived the design strategies. In future steps, bringing in new design examples will help us to further supplement the framework with new design strategies.	Descriptions of the design examples illustrate the design strategies and framework. They show how the design strategies and framework can be implemented in real world contexts.

architecture and urban planning in order to apply our generated insights. In terms of dissemination, this means we will be addressing a wider audience, which will pose new requirements to the kinds of formats and tools that we develop. For example, we can reasonably assume that urban planners look for other insights and forms of guidance than media architects – their perspectives on neighborhood resilience, and their ability to contribute to it, are different. As we initiate new RtD projects and expand our scope to an interdisciplinary audience, we will examine whether and how our three-level approach to intermediate-level knowledge will remain fruitful in generating insights for promoting neighborhood resilience.

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