Working towards academic knowledge integration
Facilitating integral design of multifunctional flood defenses
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The MFDO research program aims for integral design of multifunctional flood defenses. A team of academic researchers from multiple disciplinary backgrounds would integrate their knowledge to reach this goal. The aim of the current research project was to design and organize an interactive trajectory by means of Action Research to facilitate the collaboration process within the research program. This was easier said than done. In the very first team meeting, the researchers discussed ‘the definition of a MFDO’, and it became clear that many concepts of this research program meant different things to different participants. The challenge became clear: how could we integrate these different perspectives towards an integral design?

This chapter explains the analytical framework I developed as a practical route towards integrating academic knowledge. Additionally, I provide examples of several practices we developed to reach the goal and finish with the lessons learned in this challenging, but fun, trajectory.

**Figure 1** Working towards Academic Knowledge Integration (WAKI) for integral MFDO-design

**Figure 2** (left below) WAKI Step 1: Knowledge externalization by means of mini-lectures for colleagues.

**Figure 3** (right below) WAKI Step 2: Knowledge internalization.

***Baukie Kothuis***

**WORKING TOWARDS ACADEMIC KNOWLEDGE INTEGRATION**

**FACILITATING INTEGRAL DESIGN OF MULTIFUNCTIONAL FLOOD DEFENSES**

- **Step 1: Externalization**
  - Every researcher has specific disciplinary knowledge that is unfamiliar to other researchers. This ‘unshared or internal knowledge’ becomes ‘external knowledge’ when the researcher communicates it. We made this step by means of mini-lectures and case-presentations. However, communicating knowledge is a one-way action. It does not mean that other researchers actually absorb the information given. To achieve this, they have to become active as well.

- **Step 2: Internalization**
  - Only when other researchers internalize ‘external knowledge’, does it become ‘shared ground’. The researchers have to actually acquire the content being communicated. However, sharing is still shallow, since acquiring the content does not imply processing or understanding. The words and concepts describing the knowledge content might still entail different meanings and assumptions in different disciplines.

- **Step 3: Translation**
  - Recognizing and acknowledging multi-interpretable and disciplinary differences permits the ‘shared ground’ to be translated into ‘recognized knowledge’. In this step, researchers work to understand each other’s assumptions and points of view, which gives them a collective pool of knowledge. As words can have different meanings in different disciplines, different words can have the same meaning. It is necessary to convey tangible objects in this step (e.g., maps, architectural models, games, drawings) and discuss the underlying ideas during the process. We discovered that different interpretations became clear when tangible objects had to be designed together. “Ah, so this is what you mean by design variables. Nevertheless, after this step, researchers may – and often will – still have different insights, goals, or values for the final design. However, at this stage, they now recognize each other’s insights, goals, and values.

- **Step 4: Negotiation**
  - When the differences and commonalities between researchers in the team are recognized and understood, the floor is open to negotiate common and complementary ground and find the design-space for co-creating an integrated design.

- **Step 5: Integration**
  - Once this common and complementary ground has been established, different disciplinary knowledge blocks can be combined into an integrated design.

In the collaborative design process, these five steps are often iterated and do not always occur in this precise order. Designing, like many other creative activities, is a messy process.
API practices in MiFID program
We developed several ways to support knowledge integration within the MiFID program. This included three overarching and regularly recurring activities:

- Three-monthly Program Reflection Days (PRDs) with all researchers in the program (PDGs and postdocs), often with the Program Leader, the MiFID Project Officer from STW, and – when relevant – various project leaders and supervisors. The PRDs generally lasted a full day and included multiple activities contributing to the steps in the WAIK process (see also page 132).

- Monthly Postdoc Meetings (PDMs) to develop integration on a theoretical level and to develop activities to practically facilitate the knowledge integration process within the full research team. For the last goal, the PDMs worked fairly well. Although the postdocs were based in different (sometimes competing) faculties and universities, these regular personal contacts created mutual trust. The PDMs also led to collective activities and Program Case studies (see page 138). However, integration on a theoretical academic level turned out to be very difficult, if not impossible, and only few multidisciplinary publications resulted (see also page 140-141).

- Yearly User Days (UDs) to disseminate knowledge gathered by the researchers, to exchange their experiences and needs, and to collectively learn from other projects and users. UDds were also only partly successful, as many practitioners are unable to devote a full day to an academic research program. This meant that only a handful showed up. Despite the low turnout, the UDds were successful in persuading researchers to summarize and communicate their work at various stages and for different audiences (including their MiFID colleagues). Users who did participate were generally positive about what they learned and could communicate during UDds.

Lessons learned
1. Trust and interaction are necessary to make knowledge integration happen, especially at the stage of going from Shared ground to Common & Complementary ground, which is a necessary condition for integration. This seems to be best created by regular meetings in person, which not only entail ‘work’ (exchanging content), but also ‘stay’ (building trust and mutual understanding).

2. Researchers need to collectively ‘tinker with tangible objects to effectively integrate multidisciplinary knowledge, discussing and presenting information is not sufficient. We acknowledged that researchers from different disciplines often speak different languages, with their specific knowledge and jargon, and discovered that just talking does not make them bridge their specific boundaries or recognize multi-inter-pretabilities. However, collectively creating tangible objects often lead to an ‘aha-experience’, making researchers aware of these disciplinary boundaries and better able to transcend them.

In the MiFID project, this pattern was clear with the maquette-game of wind turbines on a dike (see page 133), and the development of the Lego game (see page 132). It was also reflected in many of the interviews. When we asked the question ‘When you experienced that different disciplinary knowledge was effectively integrated, what was taking place at that very moment?’ many respondents mentioned making something tangible: by drawing, cutting and pasting, screwing, hammering, sketching or coloring, while at the same time discussing and negotiating their knowledge, they were able to achieve a collective outcome.

3. To stimulate knowledge integration, the aim must not be perfection! When building communicating and ‘playing’ with the tangible objects, being imperfect, not pretending that everything is correct and under control, is precisely what tempts other participants to bring in their knowledge, to make changes, additions, or maybe even remove parts. There is often a tendency to make serious games for knowledge integration ever more perfect, for example by using the most sophisticated simulations. Of course, this demonstrates professionalism, but it also has an adverse effect on knowledge integration. For participants, the perfection suggests that everything has already been thought of and is ‘correct’, which constrains new contributions.

This means that a topographic map with rough, hand-drawn contours provides a better base for co-design than a printed digital version. And asking a group of researchers to co-build a potential design by hand, using wood, ropes, plastic toys, Lego® or play-dough is more likely to prompt them to contribute and share than asking them to ‘move blocks’ virtually in a professional pre-designed environment on an iPad. In many activities, ‘imperfection’ can also be reached by using the ‘pressure-cooker’ method. Having limited time prevents participants from working too analytically and trying to make things perfect – something which academic researchers, in particular, seem inclined to do – but instead makes them interact intuitively, opening space for creativity and new input.

4. Integration in an academic research program needs professional support: it does not happen by itself. A program that aims for multidisciplinary knowledge integration requires resources in time and money to support the WAIK group process. Additionally, experienced and knowledgeable researchers must be appointed to guide and study this process. This involvement provides the key to a successful WAIK process: personal engagement with all researchers, and time to create and facilitate activities that help develop mutual recognition and trust, and assist in the group process.