



# Harmoni-CA

## **Making complex multidisciplinary processes transparent**

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### **Abstract:**

Complex multidisciplinary projects are hard to execute and may encounter many problems, related to miscommunication, malpractice, insufficient knowledge of the problem at hand, and diverging perceptions of procedures to follow and results to obtain. This often obstructs transparency and hinders audits.

Within the HarmoniQuA project, a technology has been developed to support the configuration and execution of this type of processes. This technology has been implemented for multidisciplinary model-based water management and consists of an ontological structure, an ontology development

environment (Protégé 2000), a web based knowledge base editor and a Process Support Tool. Together with a knowledge base filled with domain process knowledge, the technology can be used to support complex processes, such as model-based water management (HarmoniQuA) and water stress mitigation (AquaStress).

The knowledge base is filled with specific knowledge (expertise, practices, methods, theories, etc.) of problem solving processes. The knowledge is multidisciplinary, originating from relevant disciplines for in process in the domain. Project teams consist of members with different roles that can be defined in the knowledge base. The Process Support Tool manages multidisciplinary projects executed by team members with different roles by providing guidance on what needs to be done and by monitoring what multidisciplinary teams subsequently do.

Arriving at an ontological knowledge base containing sufficiently complete and consistent process knowledge is a major challenge. It requires agreement within a group of experts defining the process in the knowledge base. As such, it is a treaty – a social agreement – among experts with a common motive in sharing their perception on the process. This will contribute to improve communication between team members and to bridge the gap of misunderstanding, caused by different disciplinary and cultural backgrounds. Knowledge bases for this process support technology use a common – ontological – structure, decomposing the overall *process* in *steps*, steps into *tasks* and tasks into *activities*. Furthermore, *methods / tools / options* can be coupled to tasks or to activities. Moreover, tasks are related to each other with precedence relations, determining the order of tasks and feedback loops to redo parts of the process, if necessary. There are three types of tasks: (ordinary) *tasks*, *decision tasks* and *review tasks*. Decision tasks have feedbacks to previous tasks and review tasks are decision tasks in which teams discuss progress and decide on continuation. Finally, many details on steps, tasks and activities can be added to the knowledgebase. To fill a knowledge base with knowledge on a specific process, a (web based) knowledge base editor has been developed, which acts as front-end between domain experts, unskilled in knowledge engineering, and the knowledge base implemented in Protégé2000.

Process support technology can support participatory processes, in which mediators facilitate interactions between experts and stakeholders. These interactions include three levels of participation by stakeholders, ranging from providing *information* to stakeholders by experts, written or oral *consultation* of stakeholders on problems / solutions / decisions and, finally, active involvement of stakeholders (*co-designing, co-decision-making*). Participatory aspects of processes can easily be included in a process definition organized in the knowledge base and stakeholders and mediators can be members of a team with their own roles.

The Process Support Tool further helps during various stages of a project. In the project set-up phase, it tunes the process in specific subprojects and specifies team members, their roles and their

authorization to participate in executing multidisciplinary model-based water management projects. Subsequently, in the project execution phase, the tool provides guidance (i.e. best practices on what to do, generated from the knowledge base) and monitors what each team member does and stores this in a common (synchronized) project journal. Finally, the Process Support Tool generates reports for various audiences (scientists, managers, professional engineers, stakeholders and interested members of the public) and different purposes (informing other team members, management checks on progress, auditing, and final reporting to the client).

The process support technology has been developed within the HarmoniQuA project, which aimed at Harmonising Quality Assurance in model based catchment and river basin management (2002-2005). As a backbone for quality assurance, a knowledge base with modelling knowledge has been realized by decomposing the modelling process according to the ontological structure of the knowledge base. The knowledge base provides guidance on what to do, specific for the relevant water management domain (hydrodynamics, groundwater, precipitation-runoff, flood forecasting, surface water quality, biota and socio-economics) and filtered for the type of user (water manager, modeller, auditor, stakeholder and interested member of the public). The Process Support Tool and the modelling knowledge base have been tested in two series of ten test cases, covering various climatic regions in Europe and various water management domains. The first test case series included mainly single domain projects and the second consisted of multi-domain studies, of which some with socio-economic aspects.

The AquaStress project (2005-2009) aims at water stress mitigation by providing various water stress mitigation options (technical, management, institutional and others), scientific evaluation of options (multicriteria analysis, simulation, case based reasoning, etc.) for specific sites or problems and supporting participatory processes, in which stakeholders and public participate in selecting and evaluating water stress solutions. The process support technology, developed in HarmoniQuA, is applicable in AquaStress by defining the water stress mitigation process, organize it according to the ontological structure (steps, tasks, activities, etc.) and store it in a knowledge base. There are no technical hurdles encountered until now, to use the technology in AquaStress, but a high-tech technology is always difficult to implement, as its intended users and experts in the field have to be convinced of its usefulness in practice and to participate in building up the specific knowledge base. We are now in the middle of proving its potentials for water stress mitigation.

Making the complex process of implementing water framework Directives (WFD) explicit and support implementers with their immense job will be a next challenge for the process support technology. Implementing WFD is a cyclic process, of which the first cycle has to be completed between 2004 and 2015. Just as modelling (HarmoniQuA) and water stress mitigation (AquaStress), implementing WFD is a complex process, in which teams with different disciplinary backgrounds have to co-operate.

Making this process explicit by defining it and structuring it in a knowledge base is a reward in itself. Even if parts of the process are not completely clear, such a knowledge base can facilitate the process of getting a shared perception. Furthermore, the Process Support Tool can help managing the process, advising on what has to be done, keeping records of what has been done and facilitating internal and external auditing of the process. The ontological character of the knowledge base allows redefining the process at low costs, which is a prerequisite for a process that has to be continued for so many years.

In conclusion, the technology can be used for supporting the definition and execution of complex processes. Teams, which members have different disciplinary backgrounds and play different roles, have to co-operate in a project, instantiating a process into a specific process to be executed. In such cases, the process support technology facilitates making the process explicit and achieving agreement within the group of experts involved in defining the process. The so derived explicit definition, organised in a knowledge base, makes the process transparent. What teams actually do is recorded with the Process Support Tool and stored in a common project journal to facilitate auditing. Use the technology and make projects transparent.