NeWater

DATA REQUIREMENTS AND DATA MANAGEMENT FOR SUPPPORTING ADAPTIVE MANAGEMENT ANALYSIS

Report of the NeWater project -
New Approaches to Adaptive Water Management under Uncertainty

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Executive Policy Summary

This report contributes to WP 1.6 (*Transition to advanced monitoring systems*) and WP 1.1/1.7 (*Adaptive Management Regimes/Methods for the Transition towards Adaptive Management)* of the NeWater project. The underlying task aimed to assess the data requirements for the NeWater Management and Transitions Framework (MTF). The MTF is "*an interdisciplinary conceptual framework supporting the analysis of water systems and management regimes to improve the scientific understanding of system properties and to give practical guidance for the implementation of transition processes towards more adaptive systems*" (Pahl-Wostl et al. 2008:75). Its current state can best be described as a prototype which provides the general structure for data as well as it supports first analysis.

For this reason, the original task 1.6.2 in the implementation plan, which was to classify actions situations "*in order to find classes that share the same type of indicator to monitor different phases of transition, the need for transition, and to support the evaluation process"*, could not be reached.

Instead we would like to take the chance with this deliverable, to present the challenges of data requirements and data management linked to the broad scope of the MTF. With this document we point out to the different needs for data when analysing context and processes at the same time in diverse basins. For this, we introduce first briefly the MTF with its translation into three different relational databases. We then present which data is necessary for the representation of the water system and the societal system as a more static representation of the water regimes (class diagrams). Next, requirements for and management of process data are presented, building on the action situations in the different processes as categorizing class. The document closes with conclusions and outlook for next research steps.

Data requirements for analysing transition in water management regimes are diverse ranging from public accessible (static) data to highly research context dependent data elicited through social scientific methods. In the Management and Transition Framework these different kinds of data are combined. Making use of the seven case studies, much effort has been spent to transfer field experiences into the databases. However, in particular for the data on the management processes, it is central to the quality of the databases that the data generation and implementation takes place in close interaction with experts of the basins. Data implementation is thus linked to strong efforts. Quality insurance needs to be improved including documentation of the validation and verification and the sources for process data. This becomes even more central for informal processes where also the issue of confidentiality might have to be addressed.

In addition, it has to be considered that the diversity of the data-base implementation processes acknowledges the diversity among the different water management regimes but at the same time puts a strong challenge on the comparability of the different basins. Comparability might be improved if similar issues are addressed in the different databases. In order to balance the acknowledgement of diversity with the required homogeneity to maintain comparability, research questions need to be specified precisely in the beginning of the data base implementation processes for (new) basins.

In conclusion, the first steps with the relational data bases point out that the potential of the MTF is huge for applying comparative studies. However, more data is necessary and more analyses have to be carried out, especially allowing the same researcher(s) to address different basins simultaneously.

Introduction & Aim of report

This report contributes to WP 1.6 (*Transition to advanced monitoring systems*) and WP 1.1/1.7 (*Adaptive Management Regimes/Methods for the Transition towards Adaptive Management)* of the NeWater project. WP 1.6 defined a monitoring system to support adaptive management processes. WP 1.6 aimed at defining the architecture of a new monitoring system able to overcome the limits imposed by data scarcity, particularly in data-poor regions. To reach these aims different sources of information have to be integrated. While most efforts in WP 1.6 focused on developing a monitoring system in the Amudarya basin to support practical water management decisions, the task 1.6.2 aims to assess the data requirements for the NeWater Management and Transition Framework (MTF) which is the core of WP 1.1/1.7. The MTF is "an interdisciplinary conceptual framework supporting the analysis of water systems and management regimes to improve the scientific understanding of system properties and to give practical guidance for the implementation of transition processes towards more adaptive systems" (Pahl-Wostl et al. 2008:75). Its current state can best be described as a prototype which provides the general structure for data as well as supports first analysis. For this reason, the original task of 1.6.2 in the NeWater implementation plan, which was to classify actions situations "*in order to find classes that share the same type of indicator to monitor different phases of transition, the need for transition, and to support the evaluation process"*, could not be reached.

Instead we would like to take the chance with this deliverable, to present the challenges of data requirements and data management linked to the broad scope of the MTF. With this document we point out the different needs for data when analysing context and processes at the same time in diverse basins. For this, we introduce first briefly the MTF with its translation into three different relational databases. We then present which data is necessary for the representation of the water system and the societal system as a more static representation of the water regimes (class diagrams). Next, requirements for and management of process data are presented, building on the action situations in the different processes as categorizing class. The document closes with conclusions and outlook for next research steps.

1 The MTF and its three relational data bases

One of the strongest challenges of applying the MTF using relational databases is the objective to support cross-comparisons of different basins. This requires keeping a balance of basin-specific information and the necessary homogenization of the different basins. For this, the MTF is designed to include both information describing the state of a water system and process information describing the interaction of actors, institutions, knowledge and outcomes (Figure 4). Acknowledging the complexity of socio-ecological river basin regimes, relational databases have been developed, allowing three different views for analysis: the Total System Data Base, the Multi-Level Governance Database and the Social Learning Database. These databases are briefly introduced in the following.

This deliverable is linked to the work of WP 1.7 and WP 1.1 and builds on the deliverables 1.1.4/1.7.1 and 1.7.2. In the context of this deliverable, we will only introduce very shortly the structure of the MTF, i.e. how data is collected and analysed in the three different data bases. You find more information on the conceptual background of the MTF in the references.

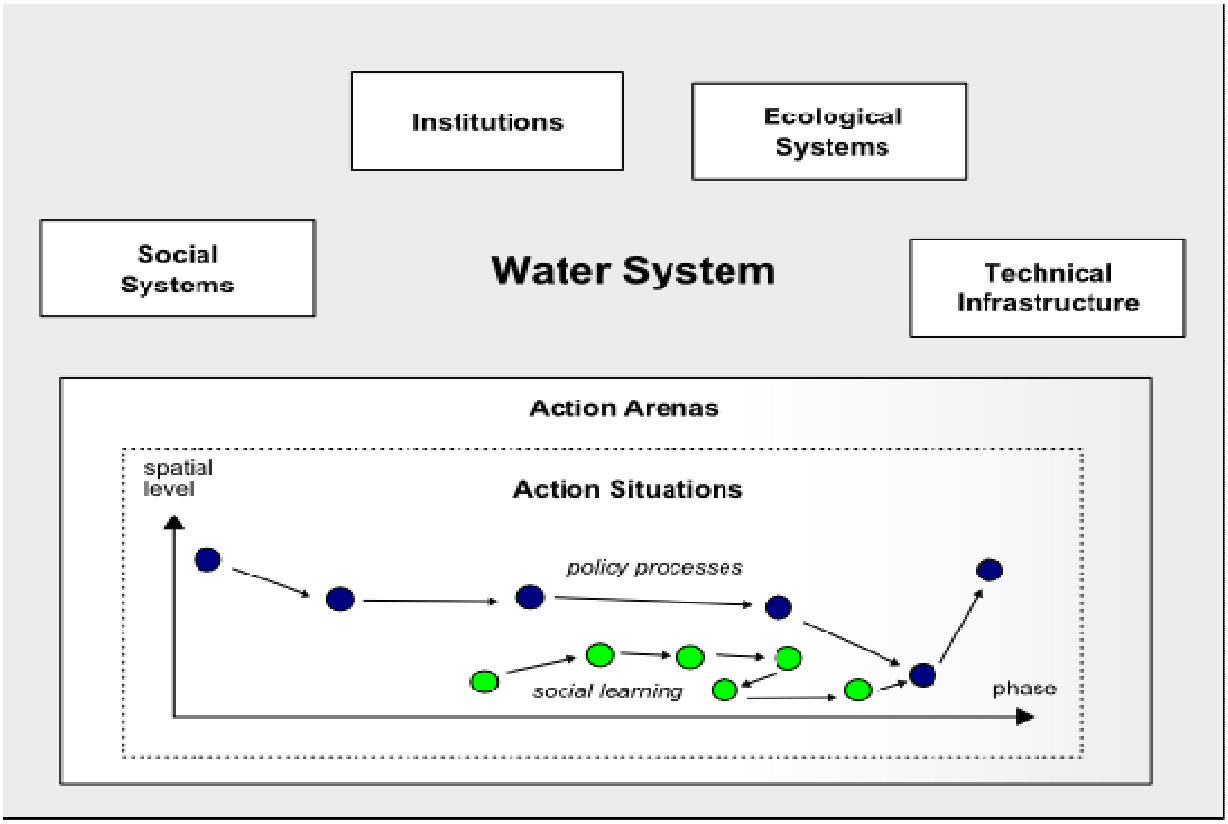
1.1 Total System Data Base (TSD)

As described in Deliverable 1.7.2, the TSD was derived from the MTF class diagram and the descriptions of the policy and learning cycles as documented in the double loop diagram (see Pahl-Wostl and Knieper 2009). It describes the main elements of a water system and the action arenas characterizing and influencing water management. A simplified

overview is represented in Figure 1. Societal system, ecological system, technical infrastructure and institutions refer to the context which is influencing and may be influenced by water management. Data at national or basin level is provided for the different cases through a general literature review, including also public data bases (see section 3).

Similar, governance processes are represented at a highly aggregated level allowing a simplified multi-level representation of water governance. So far, the processes are distinguished in policy processes and social learning processes. The phases of the policy cycle (Strategic Goal Setting, Assess Current State, Policy Formulation, Developing Operational Goals, Developing Measures, Implementation, Evaluation) structure the studied processes. In addition, Action Situations are further linked by causal dependencies (e.g. institutions produced by one action situation may influence another action situation). Learning cycles and processes of social learning are only represented in an aggregated and simplified way distinguishing the following phases: Problem structuring and reframing, Develop action plan and mobilise additional support, Implementation and evaluation of pilots/experiments.

Figure 1: Simplified overview of database structure (Figure 1.2 from Deliverable 1.7.2)



1.2 Multi-Level Governance Database (MLG)

Where the TSD allows a stronger consideration of the overall ecological, social-political, and environmental contexts, the MLG and the social learning database allow both to go more into the depth of the actual processes.

In deliverable 1.7.2 it is stated, that "t*he MLG adopts the most important elements of the MTF that are needed to analyse formal policy processes (see* ***Figure 2****). The core elements of such processes are Action Situations, which represent single water management steps (e.g. the development of a plan). Each Action Situation belongs to at least one Action Arena, in the sense of a thematic sector (e.g. water supply or agriculture). Actors participate and interact in Action Situations in order to produce results, which may be Institutions (plans, rules, norms etc.), Knowledge (e.g. a prediction of land use in the future) or Operational Outcomes (all other kinds of results, e.g. actions). Institutions,*

Knowledge and Operational Outcomes can influence other Action Situations, e.g. a produced plan must be considered in the following water management steps."

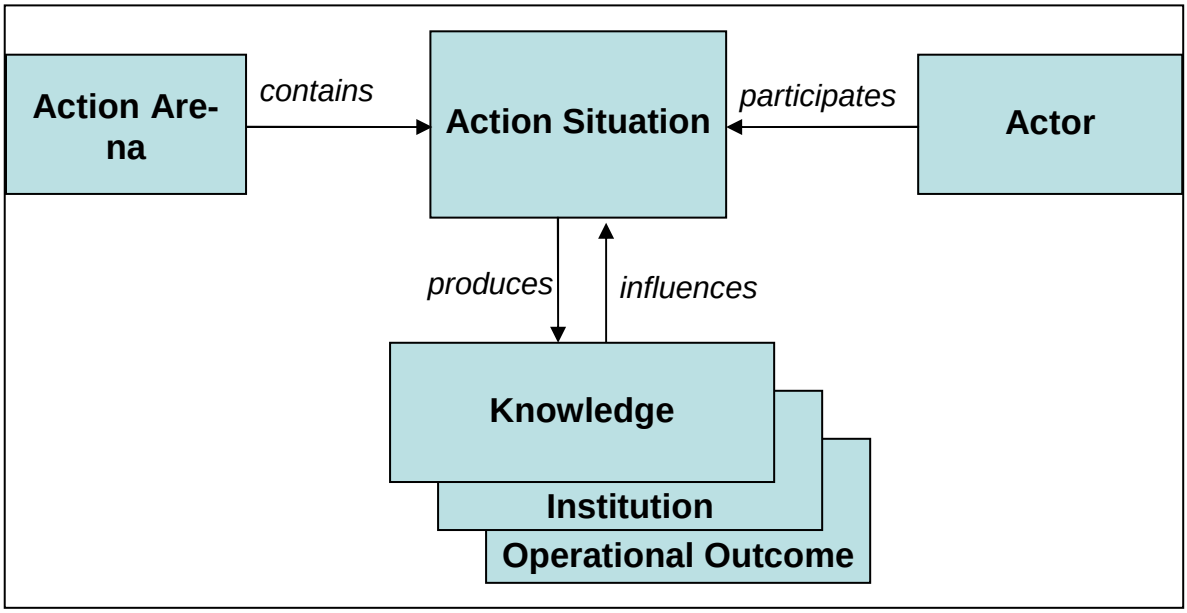


Figure 2: Conceptual data model behind the multi-level governance database

1.3 Social Learning Database (SLD)

Where the processes studied in the MLG or the TSD are described often towards a background of a longer timeframe (e.g. years or decades), the current approach in the SLD supports a rather detailed description of interaction among actors and of development of knowledge or of learning. The most important elements of the MTF that are needed to analyse learning processes are shown in

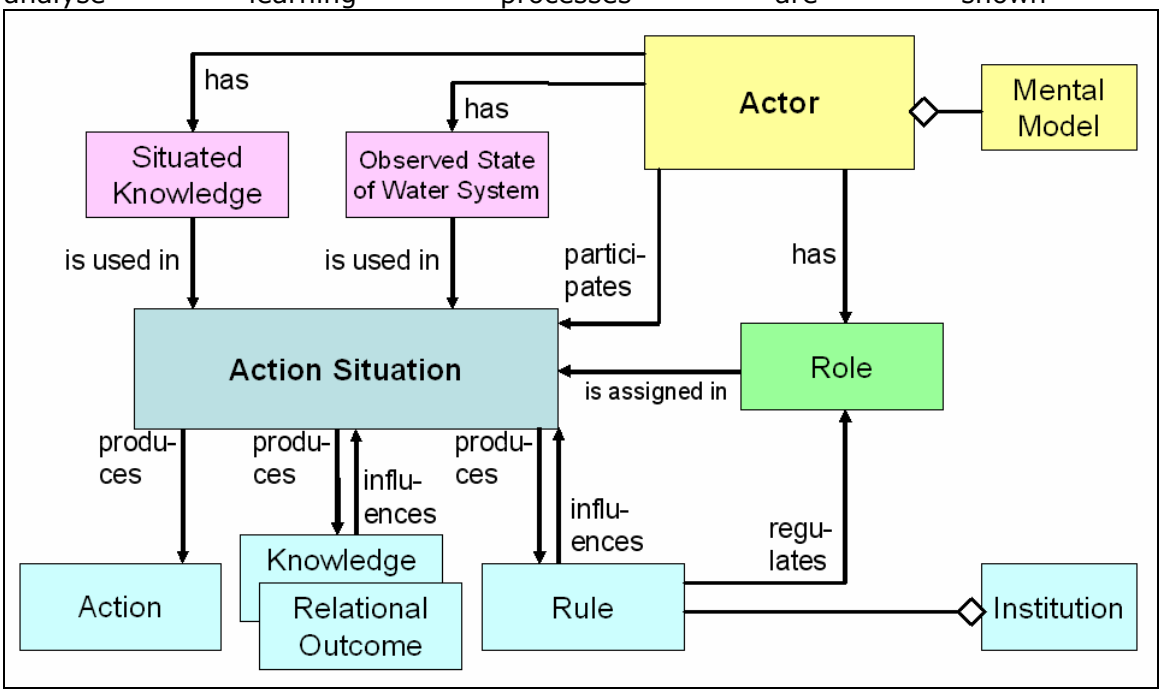


Figure 3. Deliverable 1.7.2 describes Action Situations as the core elements of such proc-

esses. Action Situations represent single water management steps (e.g. the development of a plan). *Actors* (e.g. authorities, stakeholders) participate and interact in Action Situations in order to pursue their goals. Actors are here described in terms of their *Mental Models* (e.g. "rivers are dangerous and must be controlled"), which influence their behaviour. *Roles* (e.g. facilitator, active participant) determine which scope for actions Actors have in a certain Action Situation. The Actors' behaviour is also influenced by their Observed State of the Water System (e.g. perception of a bad ecological state). Both the used *Situated Knowledge* and the *Observed State* of the Water System of an Actor can vary, depending on the Action Situation. Outcomes of an Action Situation may be *Rules* (e.g. about how to make decisions in the learning process), *Knowledge* (e.g. about the impact of land use on water quality), *Actions* (e.g. restoration measures) or *Relational Outcomes* (e.g. creation of trust). Rules, Knowledge and Relational Outcomes again can influence further Action Situations.

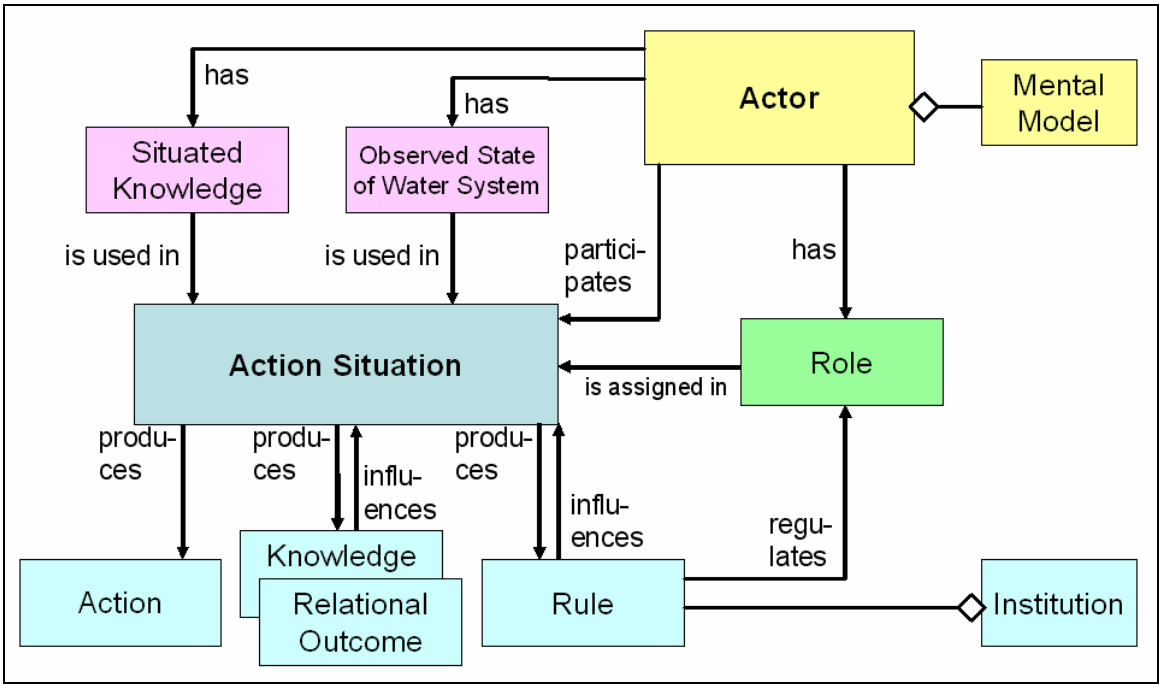


Figure 3: Concept behind the SL database: Main elements and relations

The description of the three relational data bases shows that in general two types of data can be distinguished in the relational databases: Structural data and process data.

Data supporting process analysis is process dependent. It more directly reflects the perspectives and frames of the researchers and their guiding research questions. Sound social scientific methods are central and include verification and validation of the data in close exchange with the actors involved in the basins.

In the following, we will give a brief overview on the requirements for the structural data. Then we look at the requirements for process analysis, using the action situations as the starting point for the formal representation of water management processes in the case studies.

2 Structural data for analysing regimes

Structural data is mainly used in the TSD. It has got a mostly static character. The resolution of the parameters is in general rather coarse: basin or national level. In addition, data sources are not synchronized with the processes considered in the same database. This implies that data included can be considered as static, collected along the structure

of the MTF class diagram. It can be collected through literature review or from other public databases.

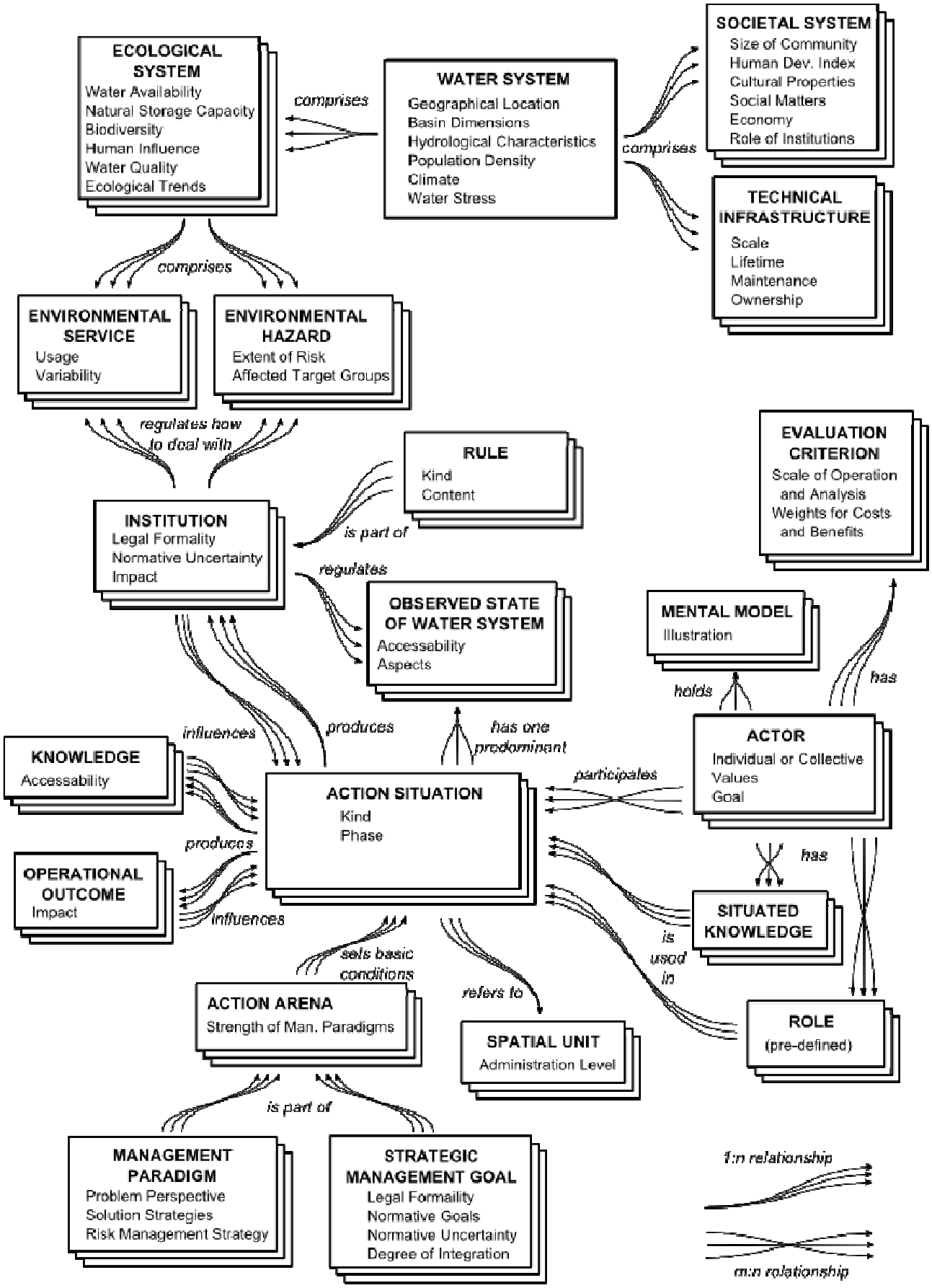
The structural data described varies strongly between the basins. The reason is that the description of water management regimes (see definition below) is often driven by the central pressure in the water regime, i.e. the "societal function" of strongest concern, studied. When developing the MTF TSD, the first starting point was the "Rapid Assessment Matrix". This was developed by Cross, Bergkamp et al. (2006) in the first year of NeWater for case studies of NeWater to identify pressures and the interests of the case study stakeholders. This way, a very general overall description of the basin was complemented with a strong focus on the most present pressure. This assessment lay the foundation for developing research questions In addition, regime data (ecological, social, economic, structural) was collected for each NeWater case study basin for the different structural MTF classes through USF to build comparable databases and to later allow the comparative analysis of (assumed) factors for transition (e.g. general economic state, climate conditions) among the basins. For this, mainly public databases were used (see Textbox 1). More information on the details of the parameters and the data sources can be found in the documentation of the TSD (Pahl-Wostl and Knieper 2009).

Definition:
A management regime is referred here to as the whole complex of technologies, institutions (= formal and informal rules), environmental factors and paradigm that together form a base for the functioning of the management system targeted to fulfil a societal function. Due to the high level of interconnectedness and internal logic, individual elements of a regime cannot be exchanged arbitrarily. (Pahl-Wostl 2008:5)

Textbox 1: Public databases used for complementing information from the Rapid Assessment Matrices on the river basin regimes

- Economic data: https://www.cia.gov/library/publications/the-world-factbook/index.html
- Biodiversity: http://www.feow.org/index.php
- Efficiency of Formal Institutions: http://www.icgg.org/corruption.cpi_2008_worldmap.html
- Human Development Index: http://hdr.undp.org/en/statistics/
- Protection Status: http://wikipedia.org and http://www.wdpa.org/
- Run Off: http://www.grdc.sr.unh.edu/

Figure 4: MTF database – scheme as presented in Pahl-Wostl and Knieper (2009)



3 Process data: Classification of Action Situations as guiding element in analysis

Processes represented through the MTF cover diverse topics. For example, in the Orange basin, the introduction and implementation of a new water law was included whereas the processes of the Rhine and the Elbe basins deal with flood protection policy due to a series of flood events. Implementation of the Water Framework Directive (WFD) has been addressed in the MLG for the Rhine basin whereas in the SLD processes on different issues in the Kromme Rijn, the Hungarian Tisza and the Wupper basin are described. Depending on the focus of research, these processes have been included in either the TSD, the MLG or the SLD database. However, all processes are described along Action Situations (see definition in Textbox 2).

Textbox 2: Definition „Action Situation"

> An 'action situation' is a structured social interaction context that leads to specific outcomes. Actors have to make decisions in a social context taking into account socio-economic and environmental boundary conditions. 'Action situation' is the regime element where 'actors' take certain 'roles' and perform certain 'actions'. Also, 'knowledge' is part of 'action situation'. 'Action situation' are the main link to the process view. Attributes of 'action situation' are its level (constitutional, collective choice, or operational) and the rules which are, for the sake of analysis of a specific 'action situation', considered temporarily fixed and external to this 'action situation'. (Pahl-Wostl et al. 2008:85)

As a basic rule of the MTF all Action Situations are defined through their names and categorized along the IAD Framework whether they describe activities at the constitutional, collective choice or operational level. In all MTF databases the attributes phase, spatial unit, actor, outcome, institutions/rules are mandatory to describe an action situation, although the databases allow different levels of resolution responding to their different foci.

First analyses were carried out using the option for automated analyses within the relational databases. They show, however, that it is most central to ensure complete databases, also indicating if gaps in data indicate difficulties for generating data (e.g. on informal processes) lack of data (e.g. on the development of the ecological status). It shows also that the attributes linked to different classes need to be refined considering the scope of the analysis. For example, also for the overall regime analysis in the TSD, actors need to be characterized also through their spatial scale. This would allow insights on the interaction among the different scales and the participation structure.

Reflecting on the huge efforts spent to develop the databases, the current process of filling the databases seems to be neither efficient nor effective and does not ensure quality.

Still, the analyses give first impressions for testing hypotheses on adaptive water management. For example, it can be checked whether lead actors remain the same through all Action Situations or how many scales interact. For analysing processes, informal and formal processes have to be further developed in their representation in the data bases. The current linkages between the different processes, although they need to be improved in their representation, already point towards cultural depending roles of formal and informal institutions and as a consequence, towards different paths of supporting the transition towards Adaptive Water Resources Management.

4 Conclusions & Outlook

Data requirements for analysing transition in water management regimes are diverse ranging from public accessible (static) data to highly research context dependent data elicited through social scientific methods. In the Management and Transition Framework these different kinds of data are combined. Making use of the seven case studies, much effort has been spent to transfer field experiences into the databases. However, in particular for the data on the management processes, it is central to the quality of the databases that the data generation and implementation takes place in close interaction with experts of the basins. Data implementation is thus linked to strong efforts. Quality insurance should also be improved, e.g. through only one person working on a comparative analysis of several basins, who should fill the databases in direct exchange with informants from the basins and or by own research. This would most certainly benefit the data quality in representing the processes that are addressed.

In addition, it has to be considered that the diversity of the processes acknowledges the diversity among the different water management regimes but at the same time puts a strong challenge on the comparability of the different basins. Comparability might be improved if similar issues are addressed in the different databases. In order to balance the acknowledgement of diversity with the required similarities to maintain comparability, research questions need to be specified precisely in the beginning of the data base implementation processes for (new) basins.

Not much attention was paid so far how growing databases on the different basins could better be preserved and further developed, e.g. also by other researchers or follow-up research activities. Quality assurance or confidentiality issues of the process data are not documented so far.

In conclusion, the first steps with the relational data bases point out that the potential of the MTF is huge for applying comparative studies. However, more data is necessary and more analyses have to be carried out, especially allowing the same researcher(s) to address different basins simultaneously.

5 References

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