Exploring Scenarios for Urban Water Systems Using a Socio-Technical Model

The Societal Transitions Module in DAnCE4Water

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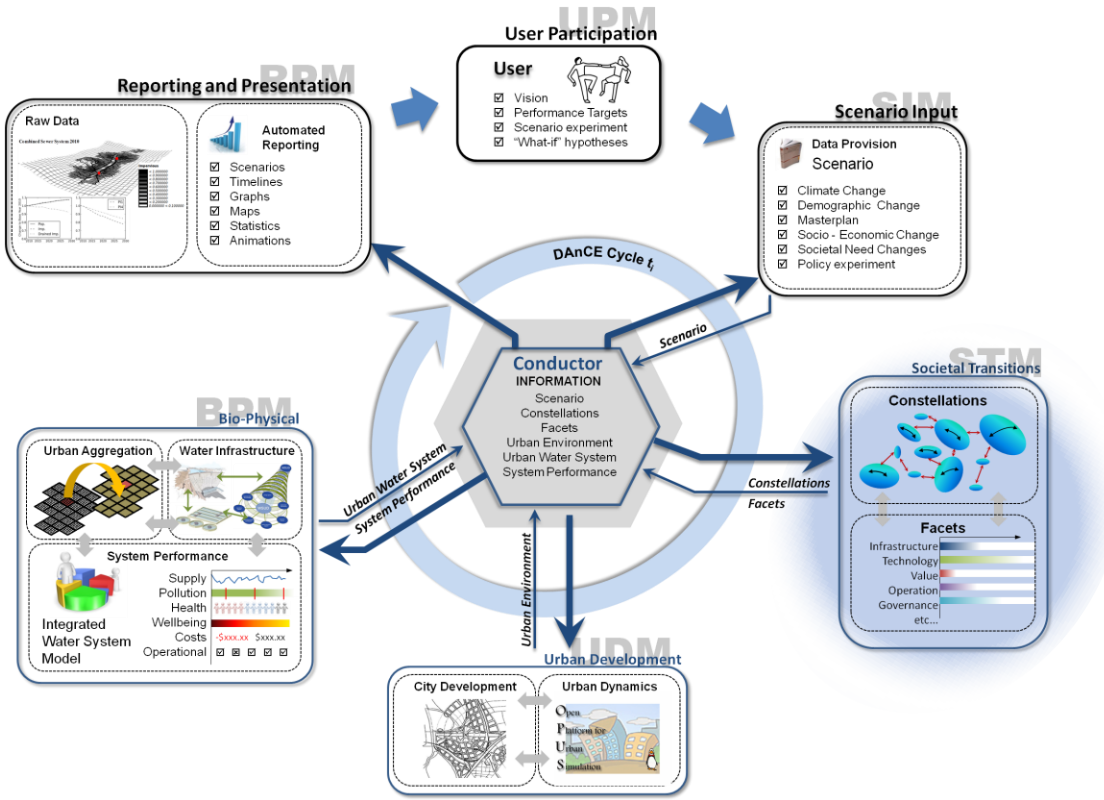
DAnCE4Water

Dynamic Adaptation for enabling City Evolution for Water



Strategic Planning Tool

- Scenario assessment on the longer term and city scale
- Software and participatory scenario making
- Integrating biophysical, urban development and societal models

EU FP7 Project

- PREPARED: Enabling Change
- Austria-Australian Collaboration between Innsbruck University and Monash University

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What is the STM supposed to do?

To simulate the societal evolution of urban water servicing solutions, represented by their relative influence – ***power*** – on the functioning of the entire urban water system.

Within DAnCE

To indicate to the other modules – notably the BPM – what technology society is most likely to implement at a certain time to meet a certain urban water need

As a standalone Societal Innovation Workbench

To explore the possible consequences of policy and strategic action under several scenarios

A Workbench for What?

Exploring the *various pathways* **an urban water system** *could* **take under different** *scenarios*

No explicit technology focus

- *emphasis on 'ways of meeting societal needs'*

Different water servicing solutions – different constellations

- *constellations represented as sets of* institutions *and* infrastructures

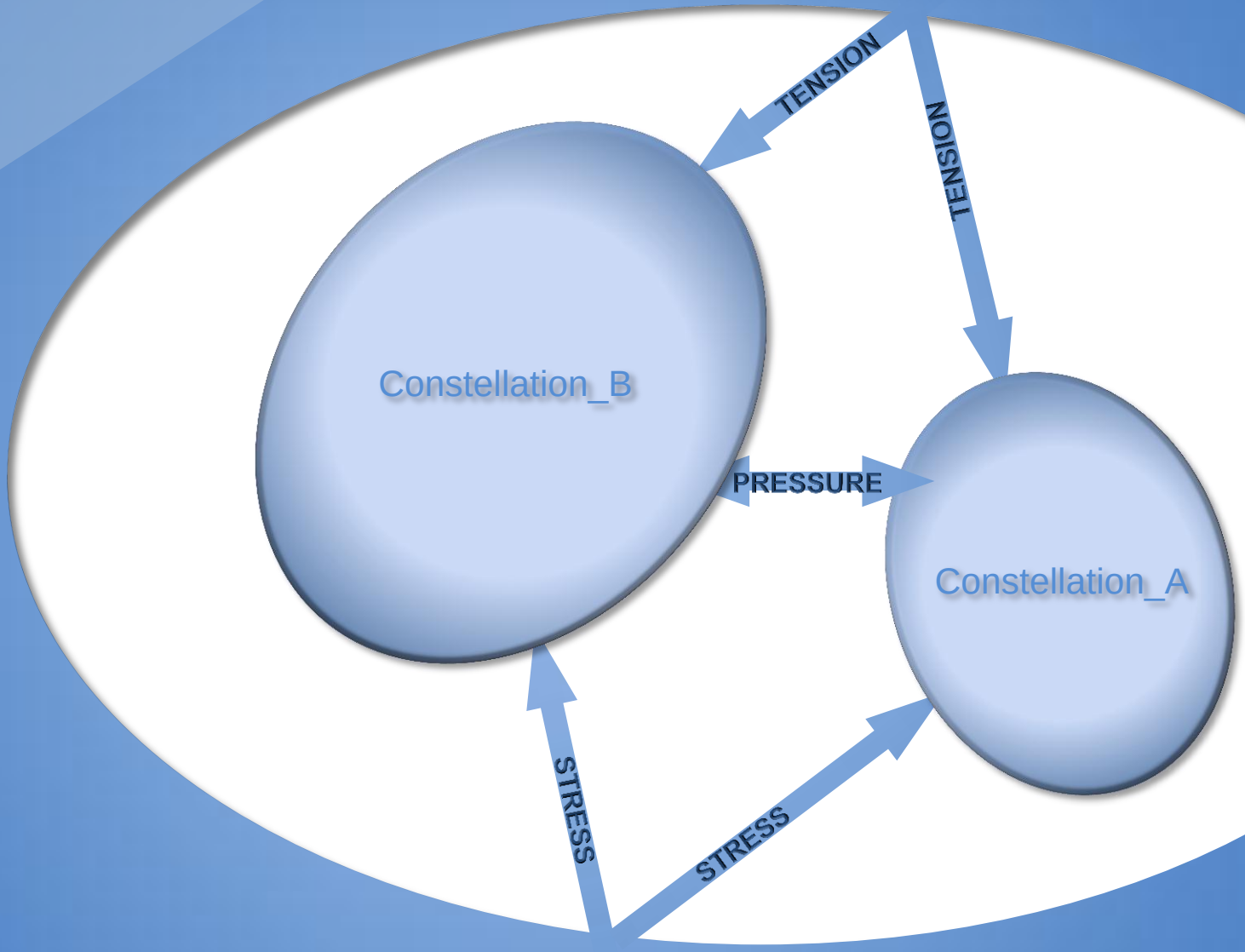
Constellations have power

- *a measure of the likelihood a need is met by a solution of that constellation*

Rigorous thought experimentation. What new power distributions *could* **result from strategic actions?**

Landscape

Sources of Tension



Societal Needs

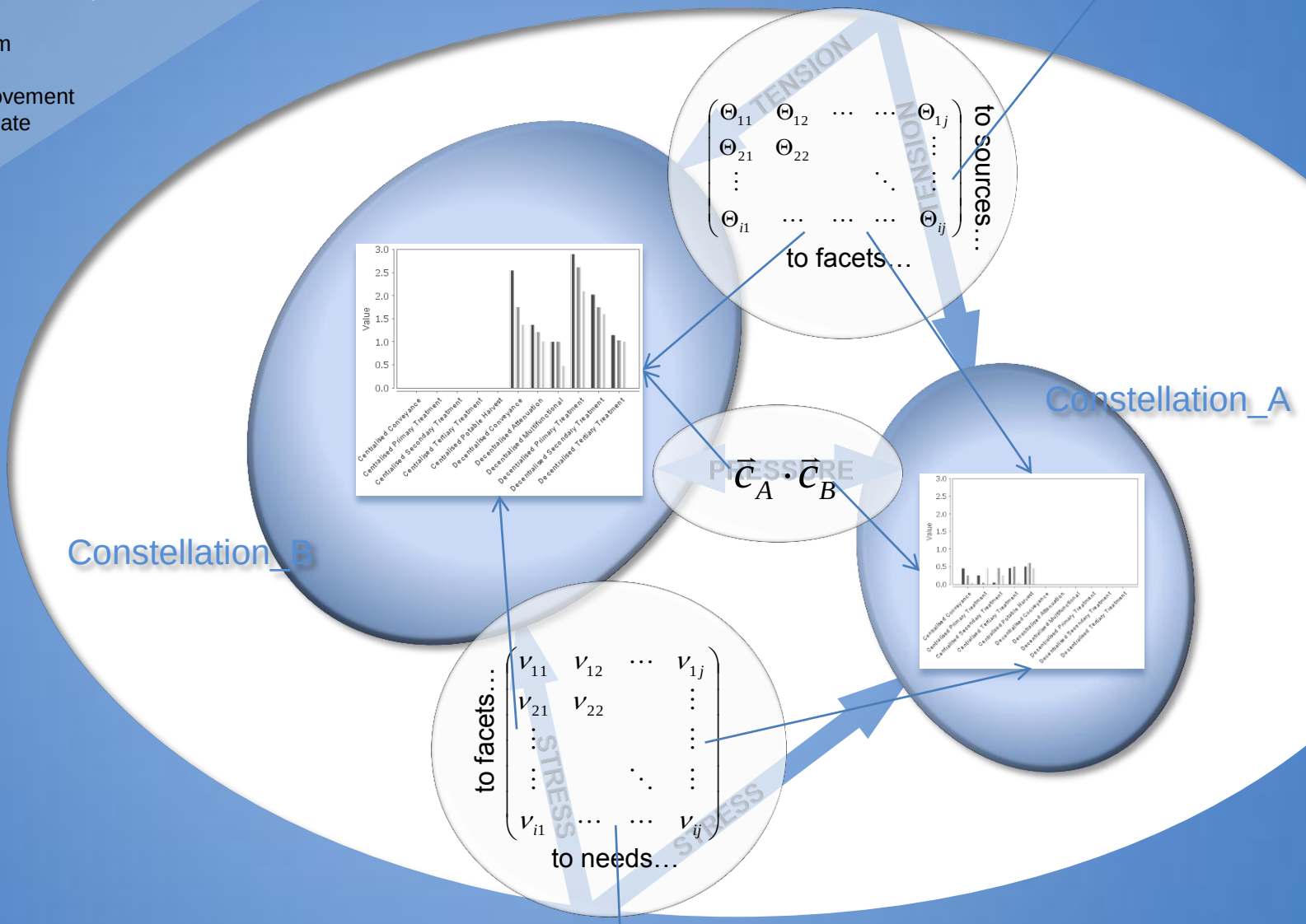
Landscape

Scenarios for and experiments with:

- Flood risk
- Environmentalism
- Drought
- Sustainability Movement
- Economical Climate

Sources of Tension

- Lack of Financial Resources



Societal Needs

- Potable Water
- Public Health
- Non-potable Water
- Property Protection
- Environmental Health
- Amenity
- Intergenerational Equity

FACETS: Institutions | Infrastructures

- **Facets** represent ways a societal system meets societal needs, i.e. urban water servicing solutions

- Facets have **TWO PARTS**:

  - **INSTITUTIONS** – knowledge and culture, norms and values, rules and regulations concerning urban water solutions
  - **INFRASTRUCTURES** – technologies and infrastructures involved in urban water solutions

- For both the ***institutions*** part as well as the ***infrastructures*** part a general **list for all urban water systems** is identified

- ***Each combination*** of an entry in the ***institutions*** list ***with*** one in the ***infrastructures*** list ***is a facet*** that could emerge under a certain scenario

Facets – Urban Water Solutions

Institutions

Cultural-Cognitive	Scientific research program / Industry-led R&D program Community learning	for	creating knowledge
	Legislative agenda Stakeholder engagement platform	for	creating policy
	Discourse and use of common language Capacity building programs Dissemination approaches	for	creating practice
	Science-industry collaboration	for	creating networks
Normative	Public recognition of identity Promotion of ethical associations	for	spreading values
	Industry endorsement Community endorsement	for	creating sanctions
	Documentation Professional networks	for	sharing norms
	Goals and agendas Vision articulation	for	creating policy
Regulative	Mandate Ban Limit Target	for	prescribing implementation
	Provision Markets Incentives Strategies and plans	for	mobilising resources

on

Infrastructures

	Lineage	Generation	
Centralised Conveyance	1	0	Centralised Drainage
Centralised Primary Treatment	2	0	
Centralised Secondary Treatment	2	1	
Centralised Tertiary Treatment	2	2	
Centralised Potable Harvest	2	3	
Decentralised Conveyance	3	0	Decentralised Drainage
Decentralised Attenuation	3	1	
Decentralised Multifunctional	3	2	
Decentralised Primary Treatment	4	0	
Decentralised Secondary Treatment	4	1	
Decentralised Tertiary Treatment	4	2	

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What goes in?

- **An INITIAL COMPOSITION of the urban water system**, the constellations in the system, the facets they are composed of and their values, representing the state at the beginning of the simulation

- **SCENARIOS for the LANDSCAPE** describing how outside influences on the urban water system change over the course of the intended simulation. They define the values (over simulation time) of NEEDS and SOURCES of Tension
  - Constraining influences are converted to sources of tension
  - Enabling influences lead to expression of societal needs

- **Policy EXPERIMENTS** introduced by the user either as
  - Different scenarios for the landscape, e.g. different scenarios for drought or floods
  - *Introduction of a facets at certain times, e.g. to do the experiment whether a certain urban water solution 'takes off' if the knowledge networks and practice are already institutionalised*

Societal Innovation

Conditions that drive societal innovation

- From outside the system – **Tension**
- From the needs expressed – **Stress**
- From competition within the system – **Pressure**

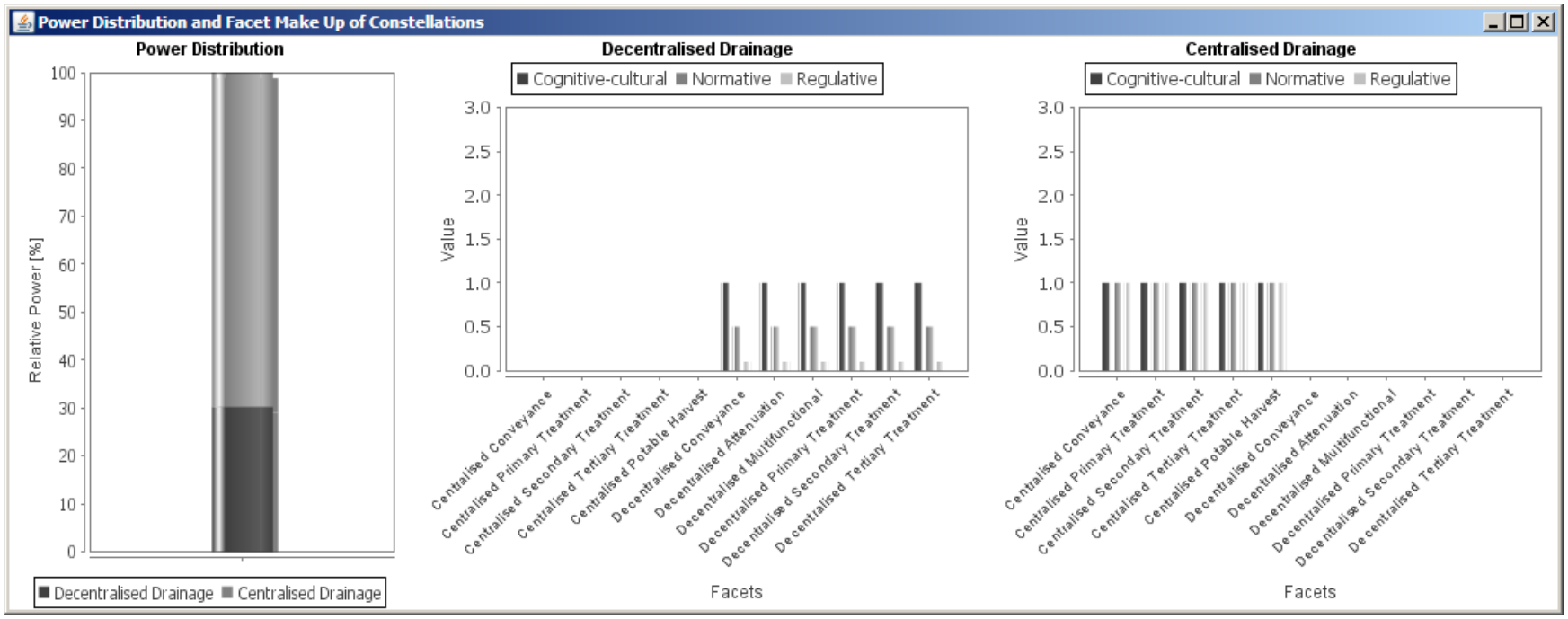
Patterns of societal innovation

- Emergence of alternatives
  - Top-down – **Reconstellation**
  - Bottom up – **Empowerment**
- Adaptation of present solutions
  - Within the regime – **Adaptation**

Six Possible Patterns

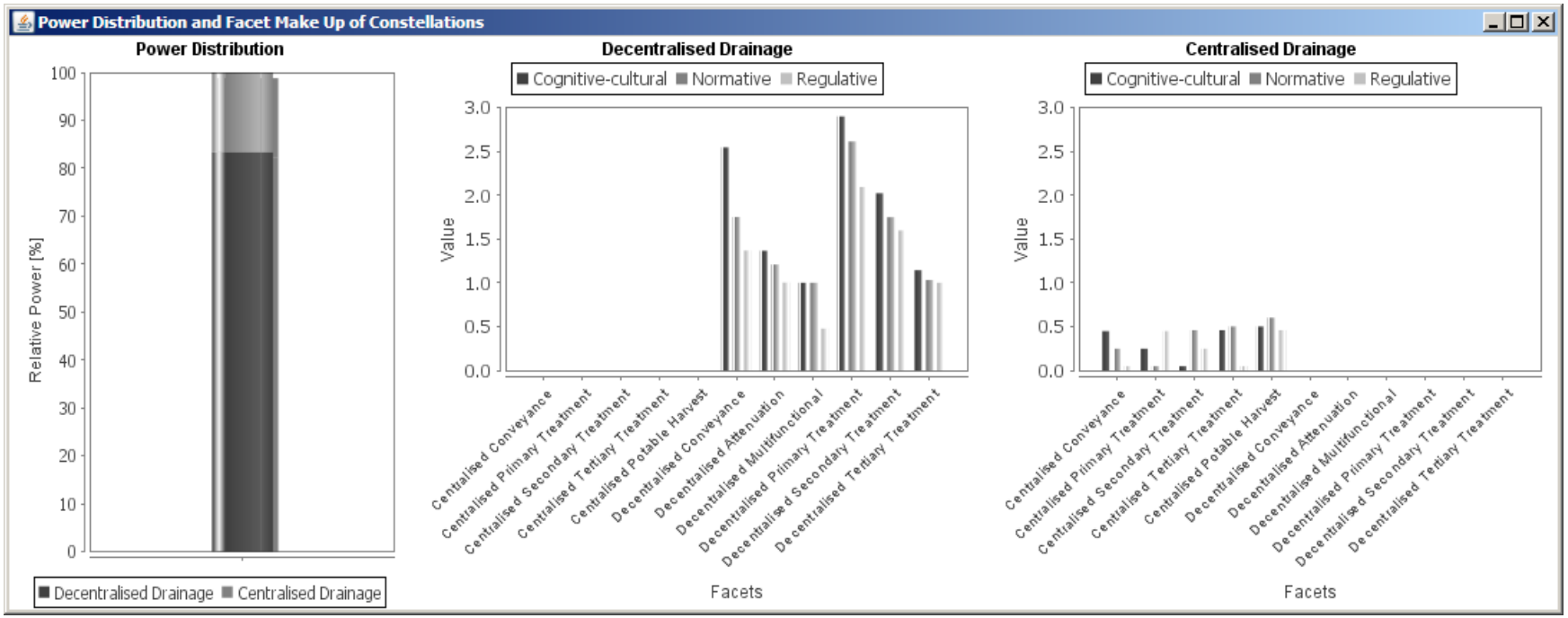
Emergence Patterns	Adaptation Patterns
• Reconstellation under Tension	• Adaptation under Tension
• Rec. / Emp. under Stress	• Adaptation under Stress
• Empowerment under Pressure	• Adaptation under Pressure

Modelling Societal Innovation



Initial conditions

Modelling Societal Innovation



After *Empowerment* under *Stress*

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Modelling Societal Innovation

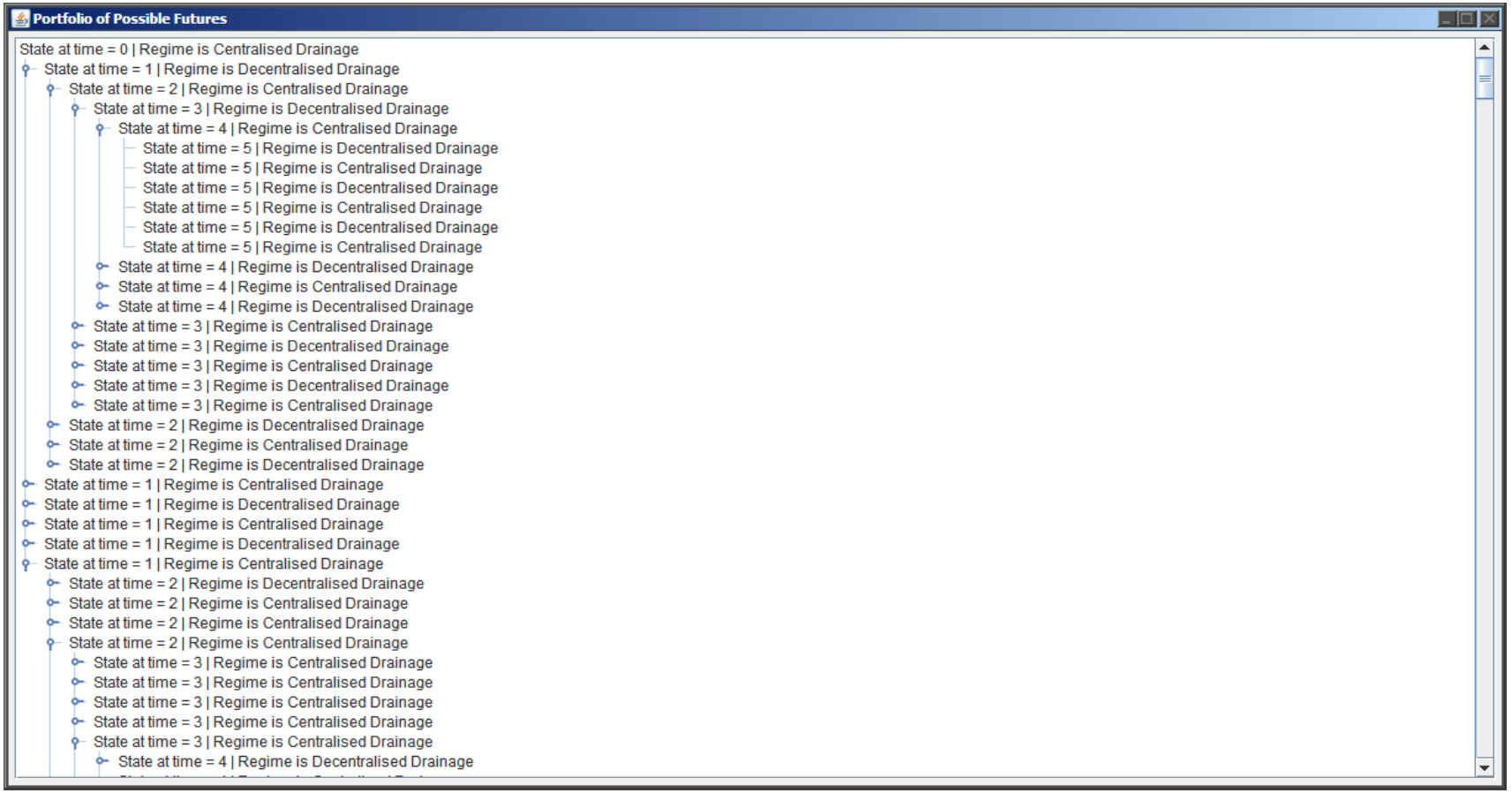
Consolidated Approach

- Interpret theory as causal and deterministic, take best approximation for certainty
- Each time, choose the most probable pattern, predict the most likely future

Exploratory Approach

- Interpret theory as causal, but probabilistic, assume no certain outcome
- Each time, consider all possible patterns, map out all possible futures
- This is not a statistical approach, no probabilities are assumed regarding the next patterns to emerge

Modelling Societal Innovation



After 5 time steps: ~7500 Possible Futures

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Modelling Societal Innovation

Many, many possible futures…

- Six possible patterns per time step, six times six, times six, etc.

Many similar futures

- Statistics on portfolio of futures reveals ‘typical’ futures

Interpretation and approach

- Many different futures of a limited number of types
- Most often eventuating type chosen as most likely future within DAnCE4Water simulation cycle

Future Work

Testing against theory and case studies

- Reproducing theoretically identified transition pathways
- Historical development of Scotchman's Creek stormwater system (Melbourne, Australia)
- Melbourne urban water servicing

Further development

- As a user-friendly tool for industry
- As part of participatory approaches to scenario making and strategic planning


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Thank You