From Aircraft Availability to FIFTY SHADES OF GREY WATER

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Mr David Peacock – Wessex Water

Overview

From defence to the water sector and beyond…

- Our approach - Costing for Availability
- Why a systems based approach
- Defence application
- Waste Water application
- Wrap up

COSTING FOR AVAILABILITY

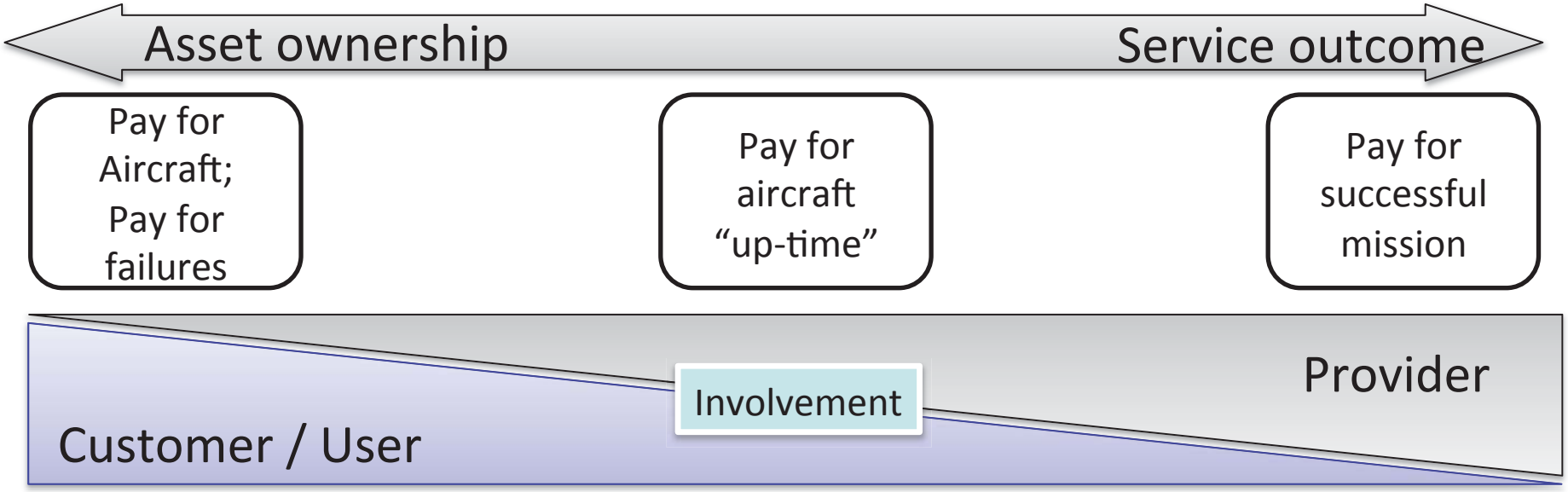
From defence to water sector …and beyond?

Availability-based contracts


http://www.guernseymodelclub.com

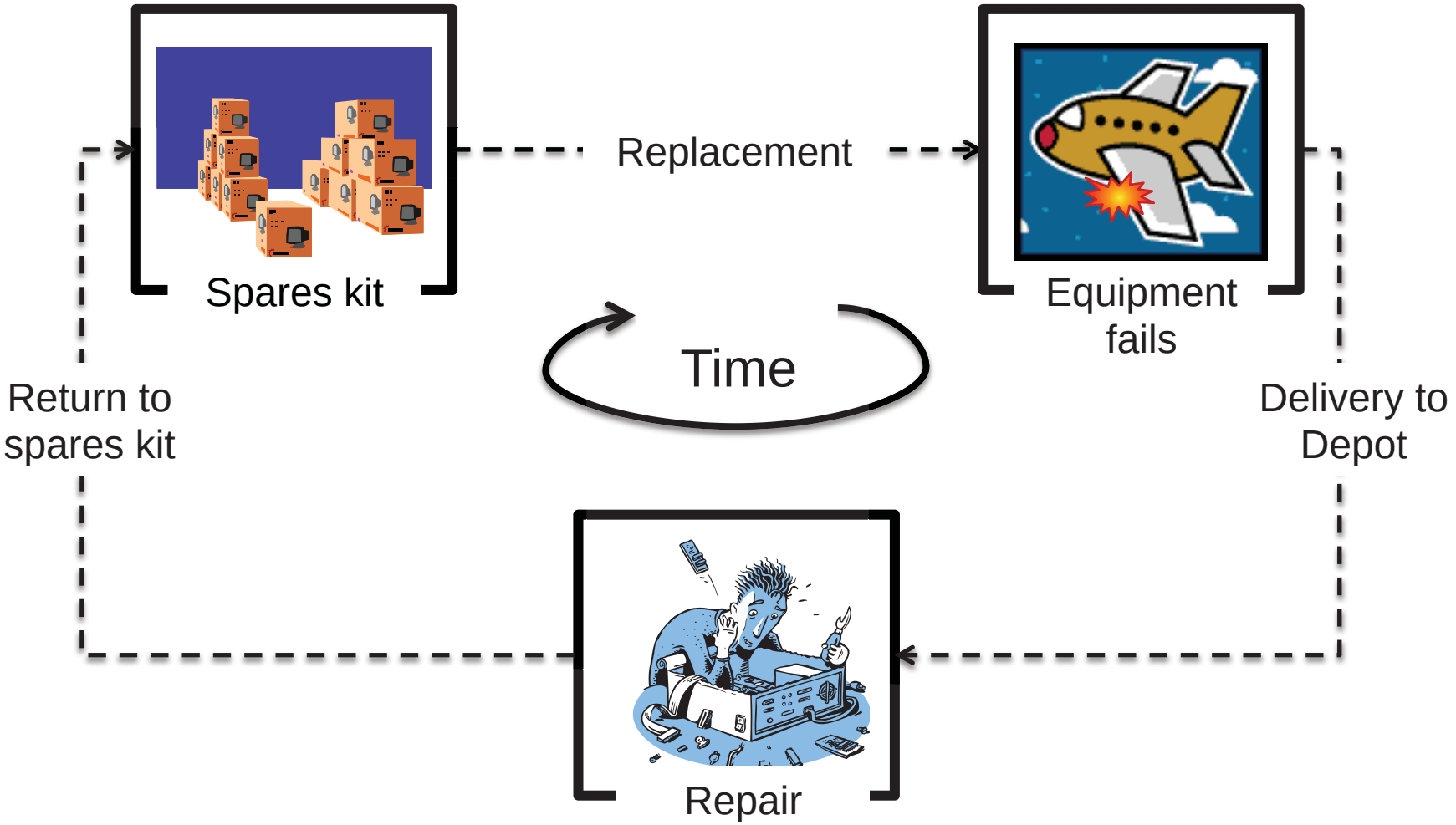

http://www.defenseprocurementnews.com/


http://3.bp.blogspot.com



How availability can be interpreted

Reliability, Availability, Maintainability (RAM)

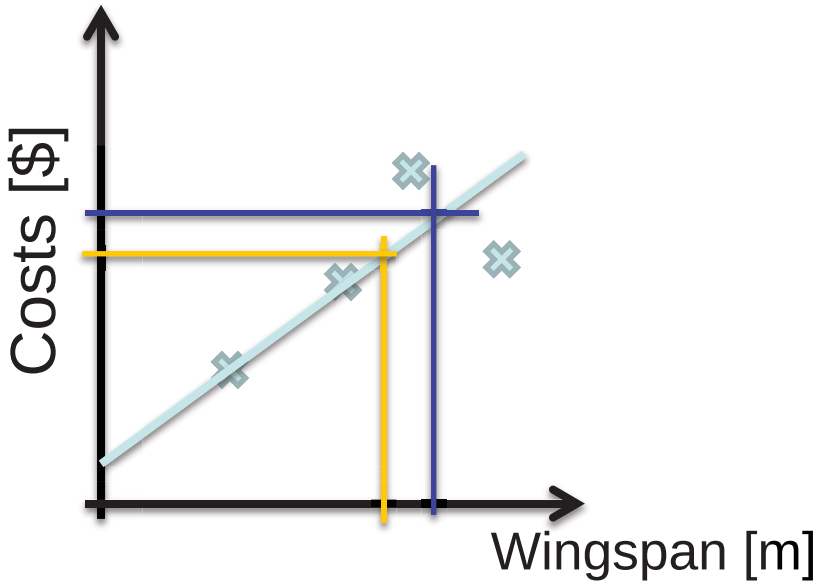


📖 Based on: B. de Neumann, “Life Cycle Cost models,” in ‚*Electronic Systems Effectiveness and Life Cycle Costing*, J. K. Skwirzynski, Ed, Berlin Heidelberg: Springer-Verlag, 1983, pp. 513–532.

In reality this is what you get!

Picture subject to copyright will be included in presentation

Often we use a ‘product’ attribute to estimate cost



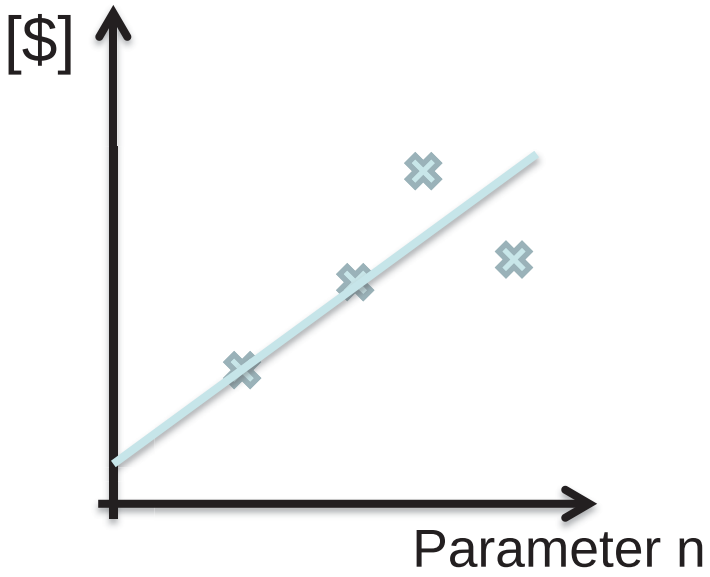
Or detailed bottom-up/build-up approach

PSS

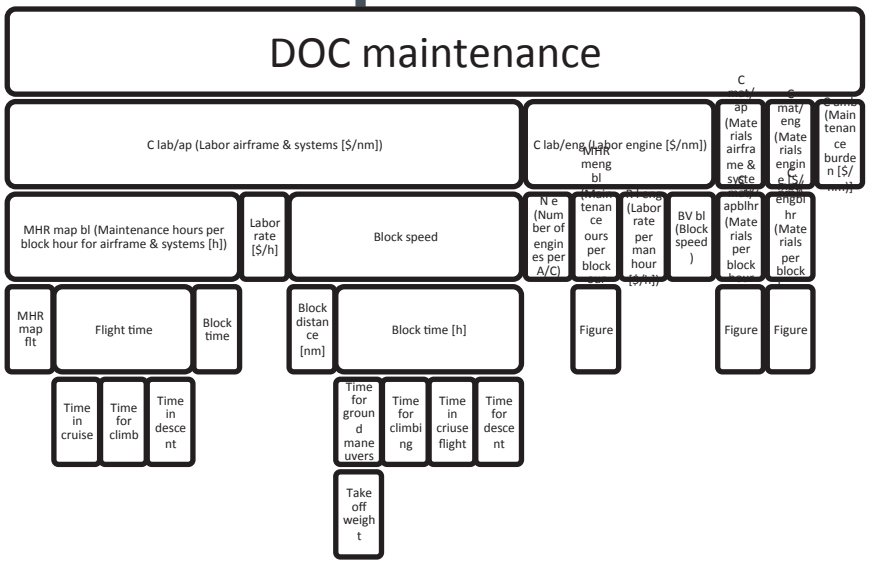
Aircraft availability provision

Picture subject to copyright

Top-Down



Bottom-up



Derived from: Roskam, Jan (1990): Airplane Design: Part VIII (Part 8). Airplane Cost Estimation: Design, Development, manufacturing, and Operating. 8 volumes. Lawrence, Kansas, USA

Top-down & bottom-up are not always helpful!

Miró

Chant Du Rossignol à minuit et la pluie matinale

(The Nightingale's Song at Midnight and the Morning Rain)

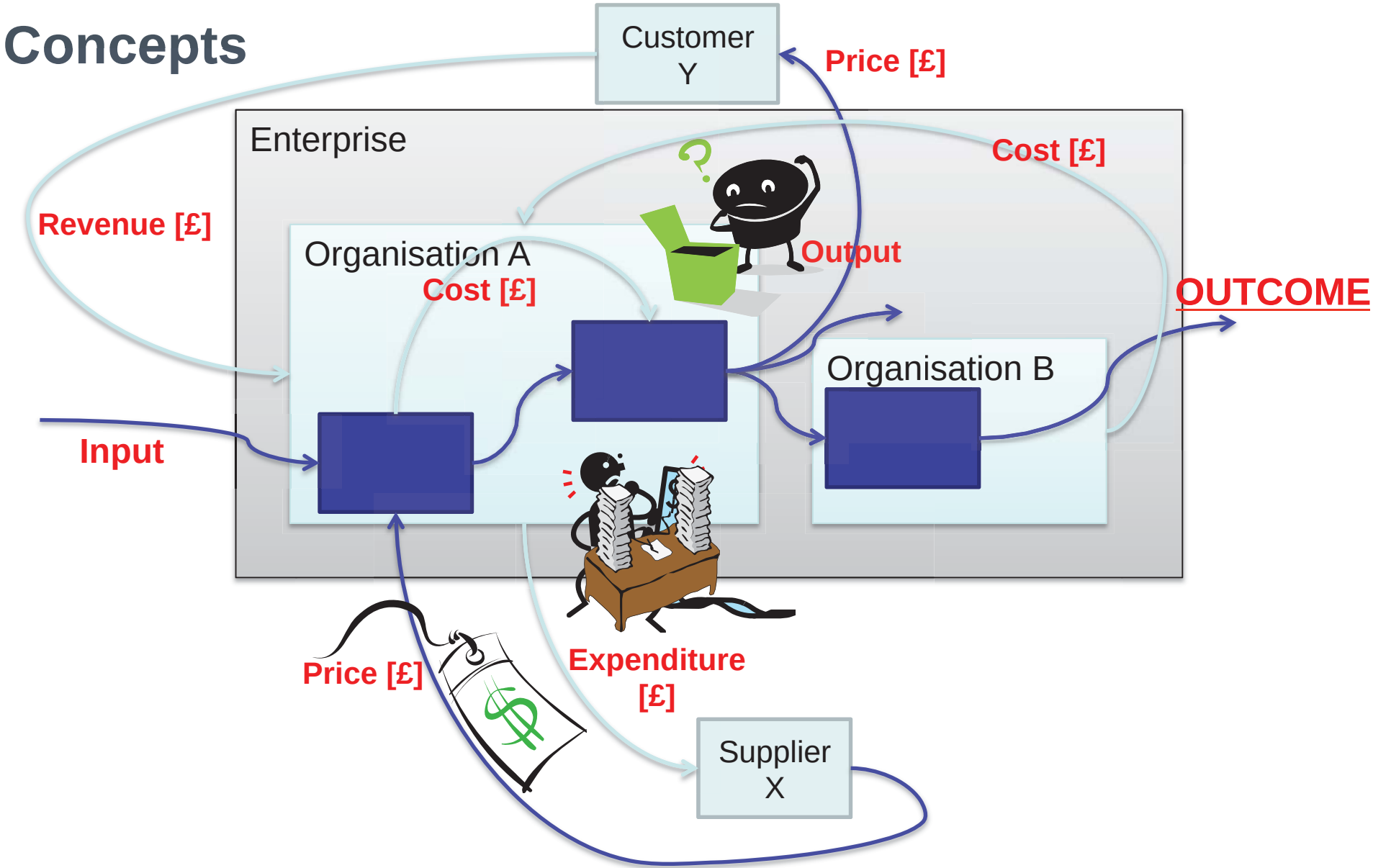
Wehrli, Ursus (2004): Kunst aufräumen. 1st ed. [Zürich], [Frankfurt a.M: Kein und Aber; Eichborn].

Top-Down

Bottom-up

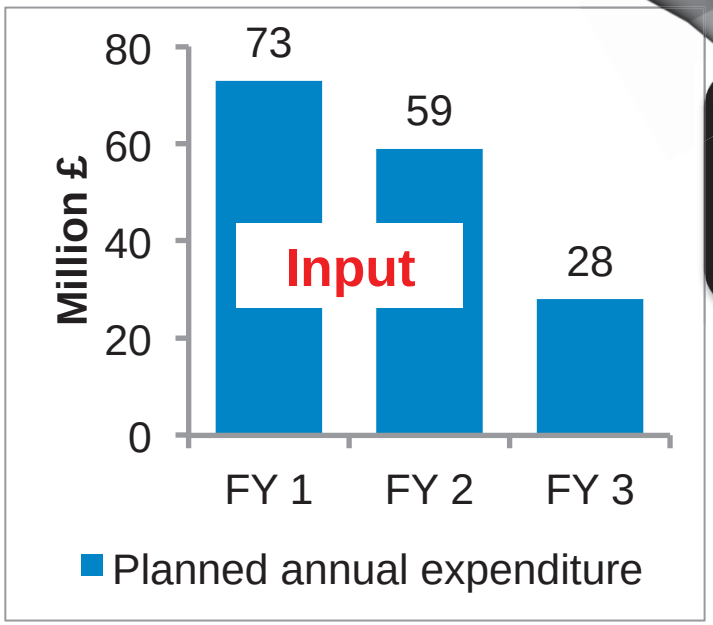
SYSTEMS APPROACH FROM CONCEPT TO END OF LIFE

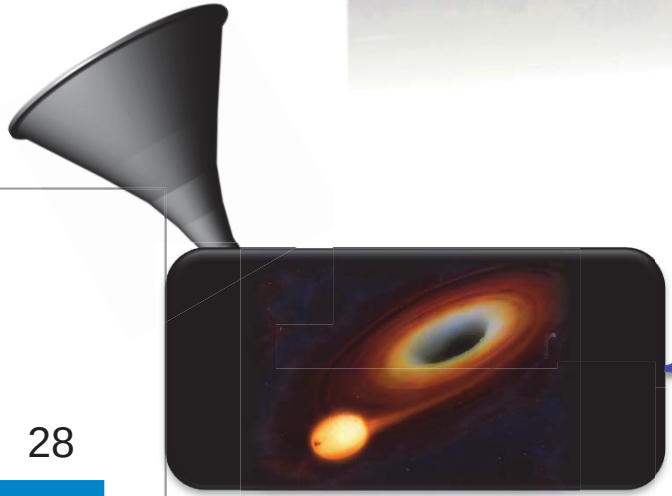
Different perspectives – so look at the system



Different perspectives on cost

Watchkeeper example*





http://www.askamathematician.com/wp-content/uploads/2012/02/black-hole-star-accretion.jpg

Output

£ 0.34 million/each
(54 UAVs)

*Hoyle, Craig (2013): UK reveals expenditure on delayed Watchkeeper programme. Flightglobal (Flight International). Available online at http://www.flightglobal.com/news/articles/uk-reveals-expenditure-on-delayed-watchkeeper-programme-380779/, checked on 1/8/2013.

Different perspectives on cost

Watchkeeper example

£ 160 million
[2013 - 2016]

Outcome

Deliver intelligence, surveillance, target acquisition and reconnaissance services in Afghanistan

Input

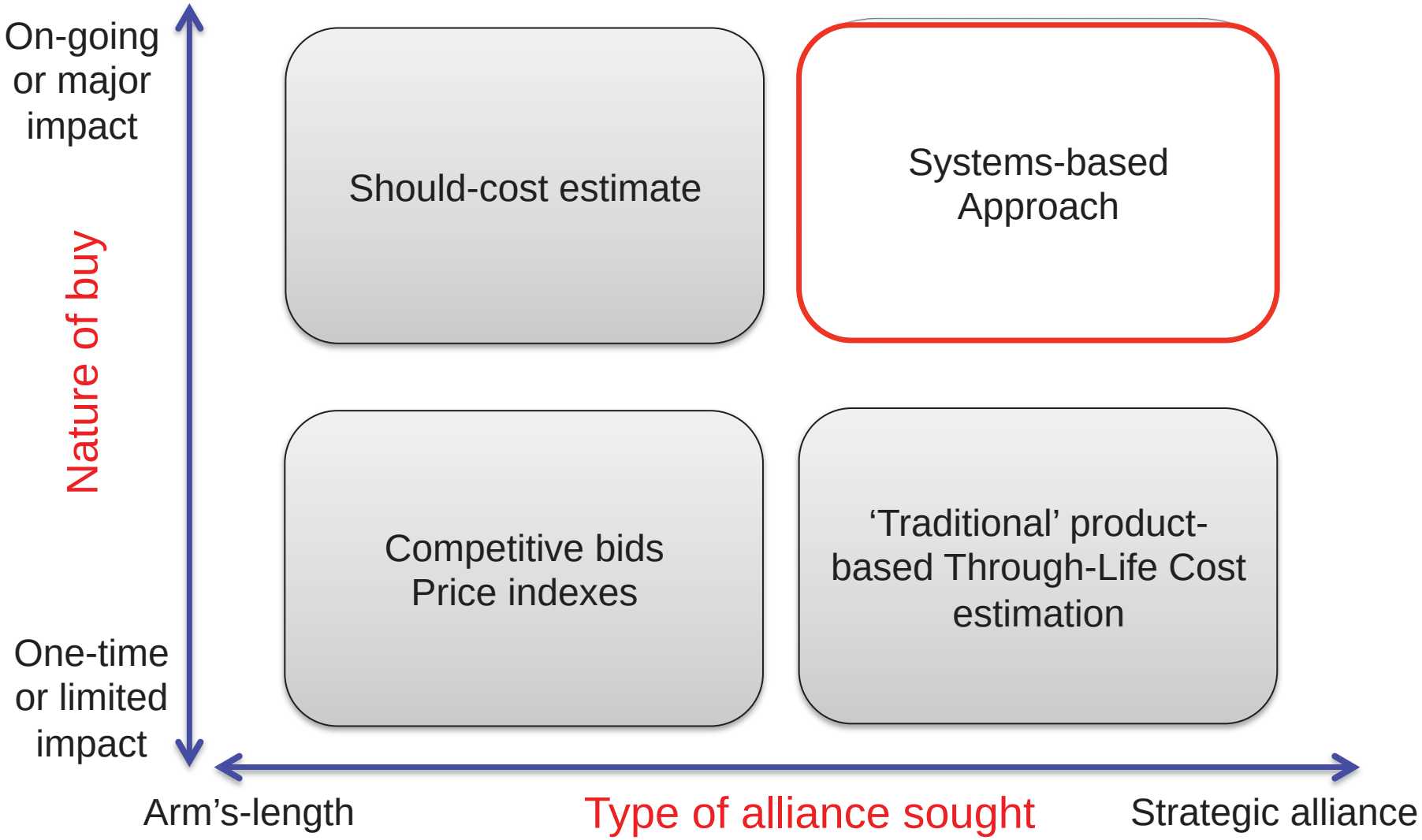
£ 61.3 million
[Sept. 2010 - Jan. 2013]

Comparison – Watchkeeper example

	Cost is an intrinsic product property	Cost results from cost drivers	Cost is an emergent property
Delivery	A UAV design.	A certified UAS.	Tactical intelligence.
Origin of costs	Wing span or weight of the individual UAV.	Extended time for certification.	Activities necessary before, during and after deployment.
Possibilities to take action	Reduce UAV size.	Expedite certification.	Manage activities.

Delivering an outcome = deliver a system

Purposes of cost estimation



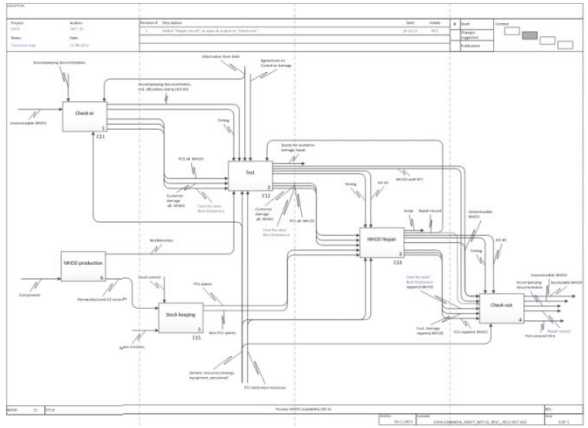
Source: Ellram (1996)

Using a systems approach

System Identification:
What is the phenomenon we deal with ?

Process mapping

IDEF0 & FRAM



Interviews

Insight from people
In the system

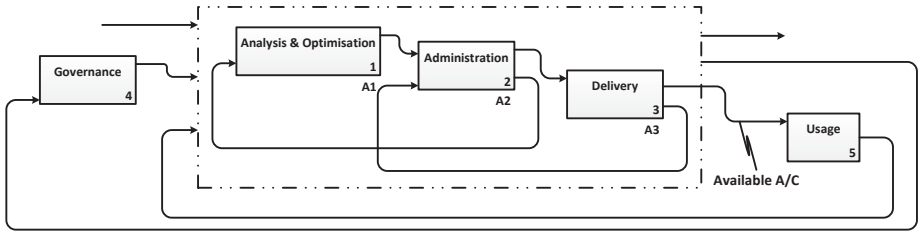
Document &
reliability analysis

Review repair reports &
appropriate data

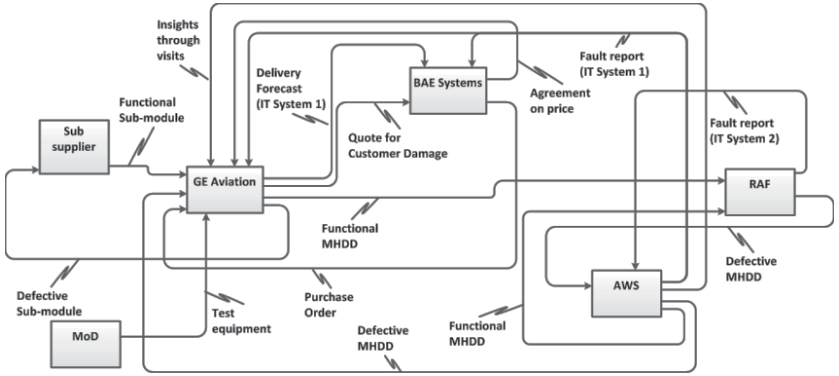
Relevant System: Elements and Relationships

The relevant System: Elements & Relationships

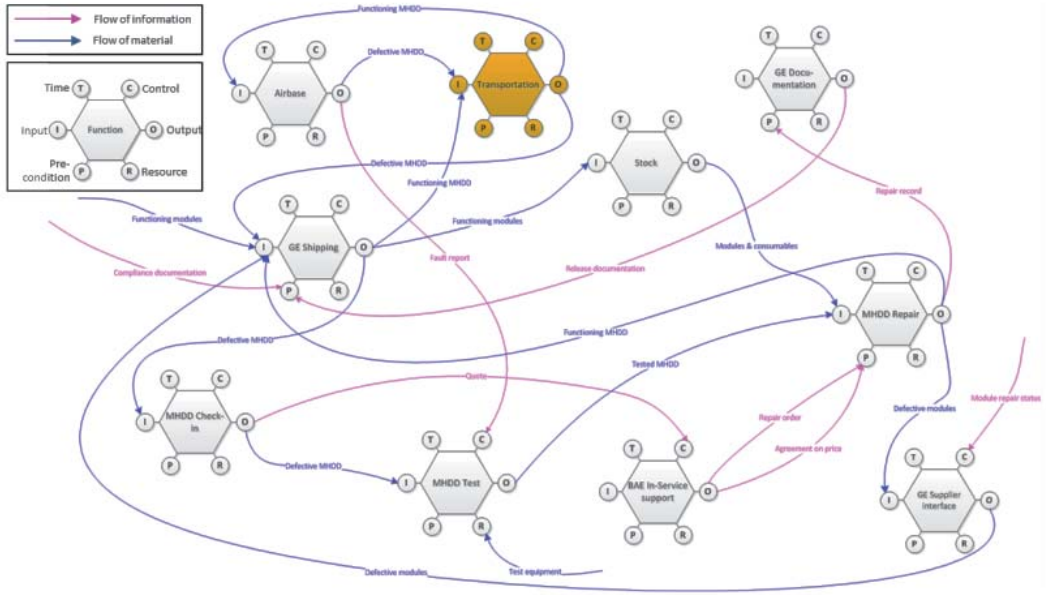
Functions



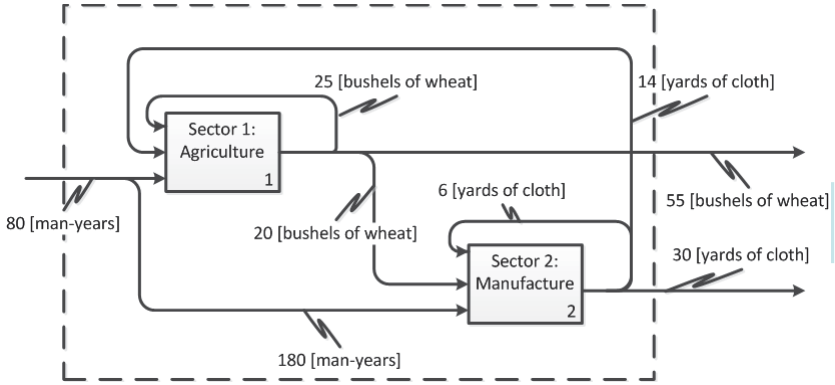
Organisations



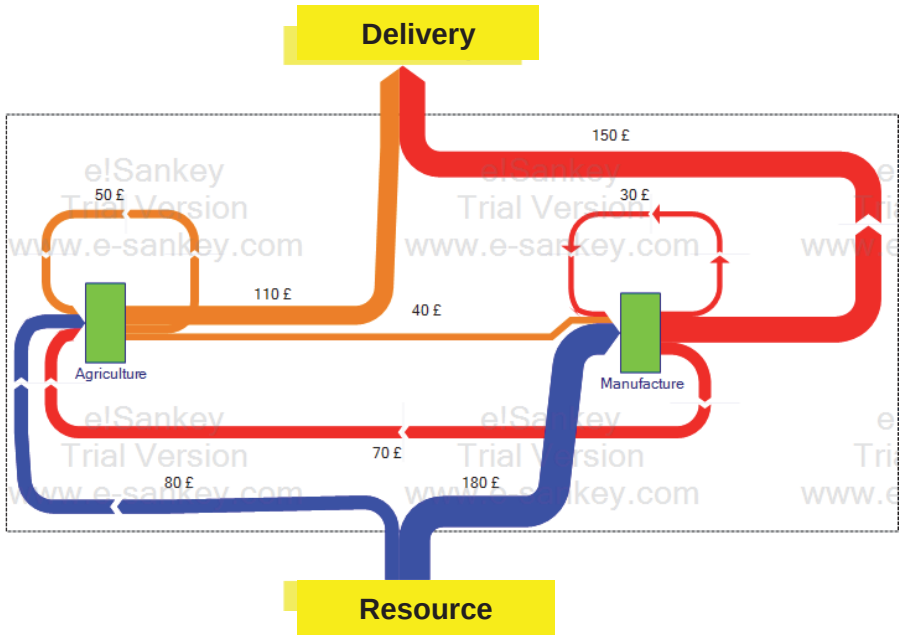
Scenarios



Qualitative and Quantitative Modelling



from \ *into*	Activity 1	Activity 2	Delivery (final)	Total output
Output 1	25	20	55	100
Output 2	14	6	30	50
Resources	80	180		

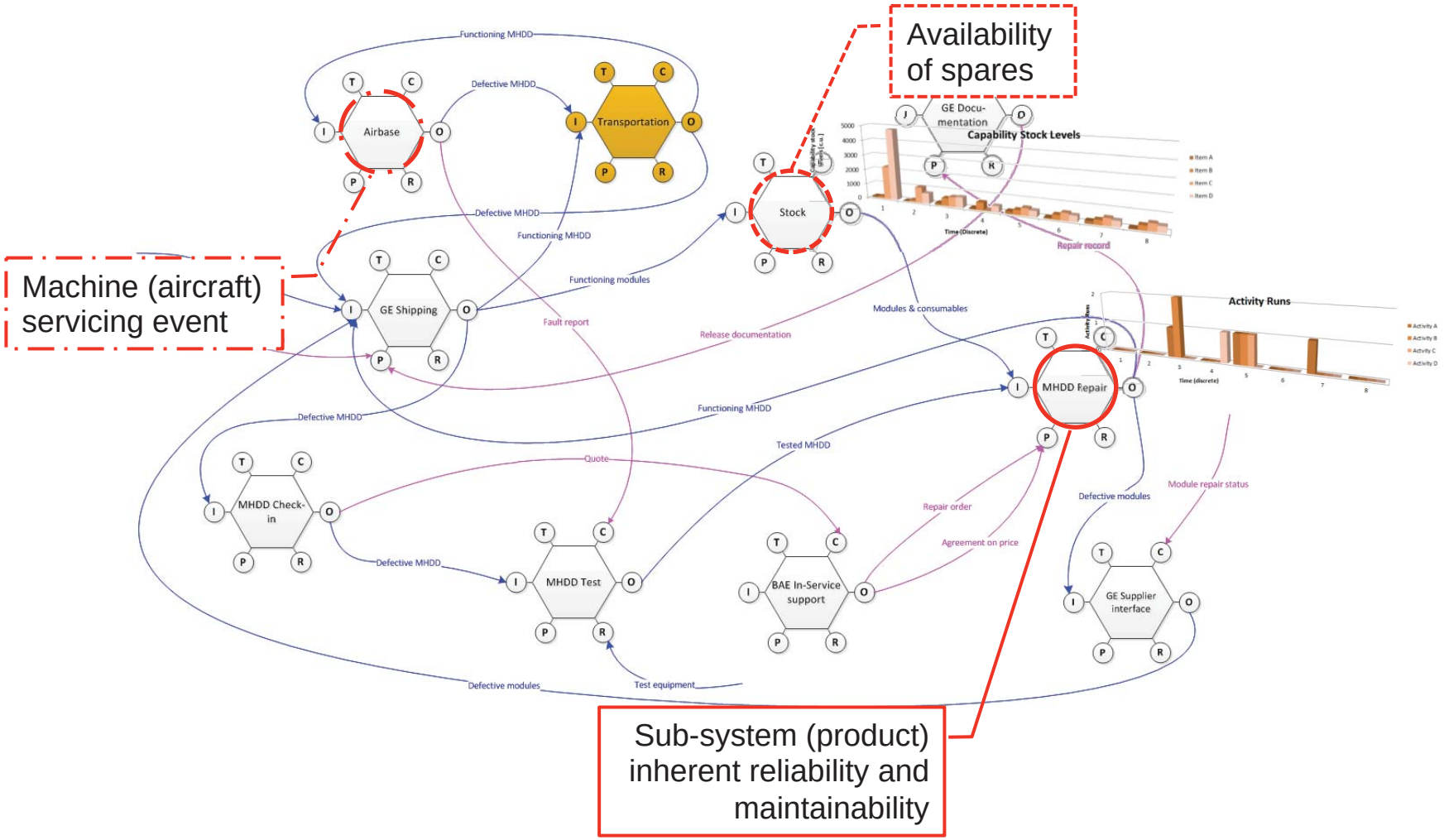


$$x = (I - A)^{-1}y$$

$$p^T = v^T(I - A)^{-1}$$

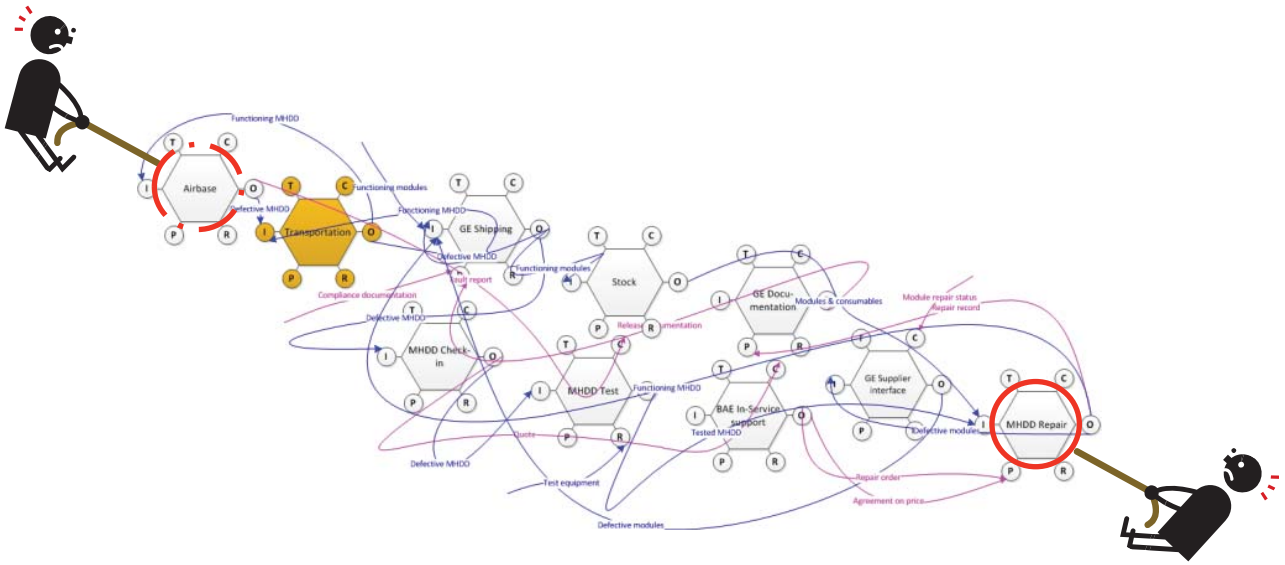
Estimation of the unit cost of each output delivered

Example results and context



Prevent Local Optimisation

Local optimisation on “servicing events”

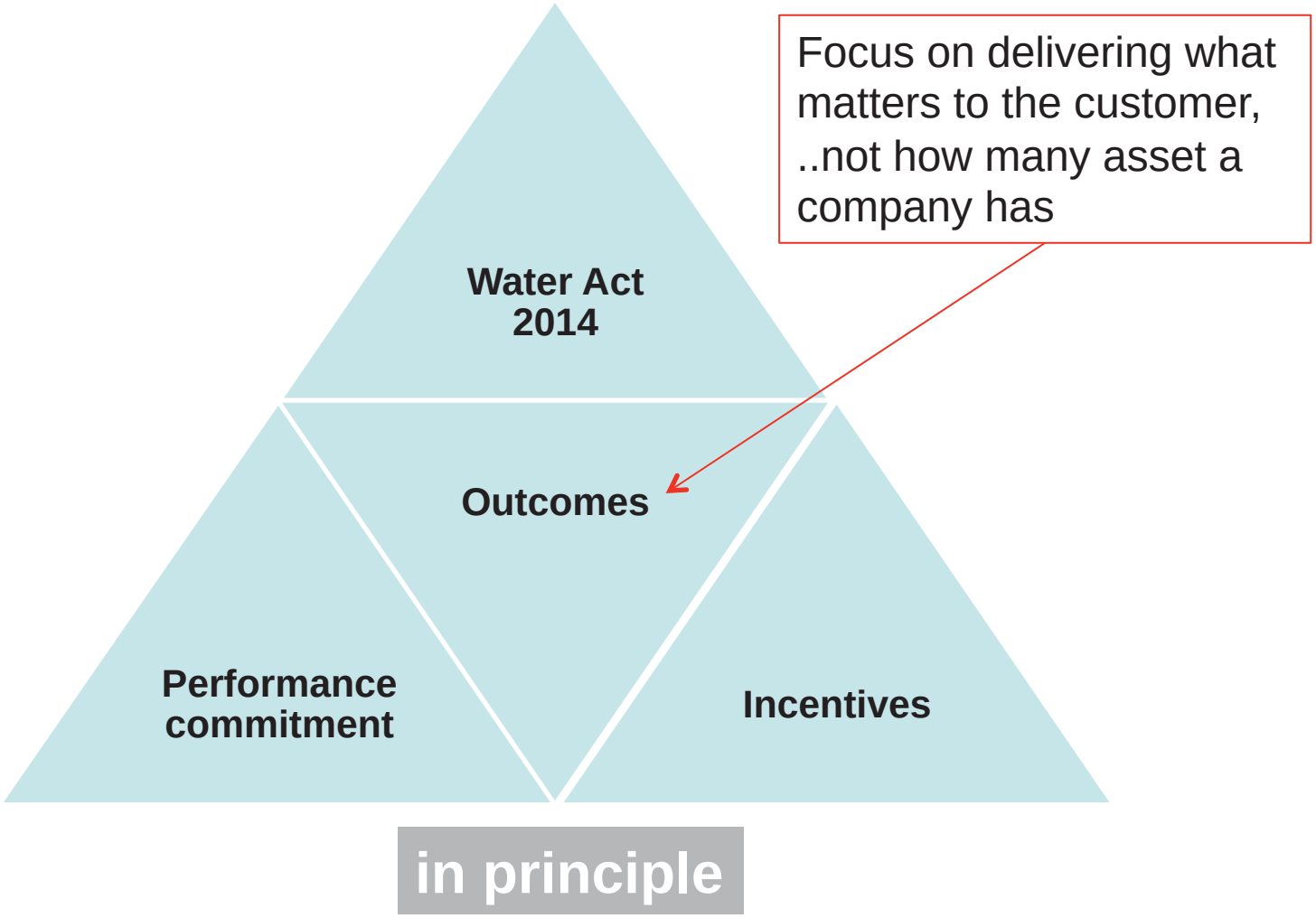


Local optimisation on “repair events”

TRANSFER APPROACH TO WATER SECTOR

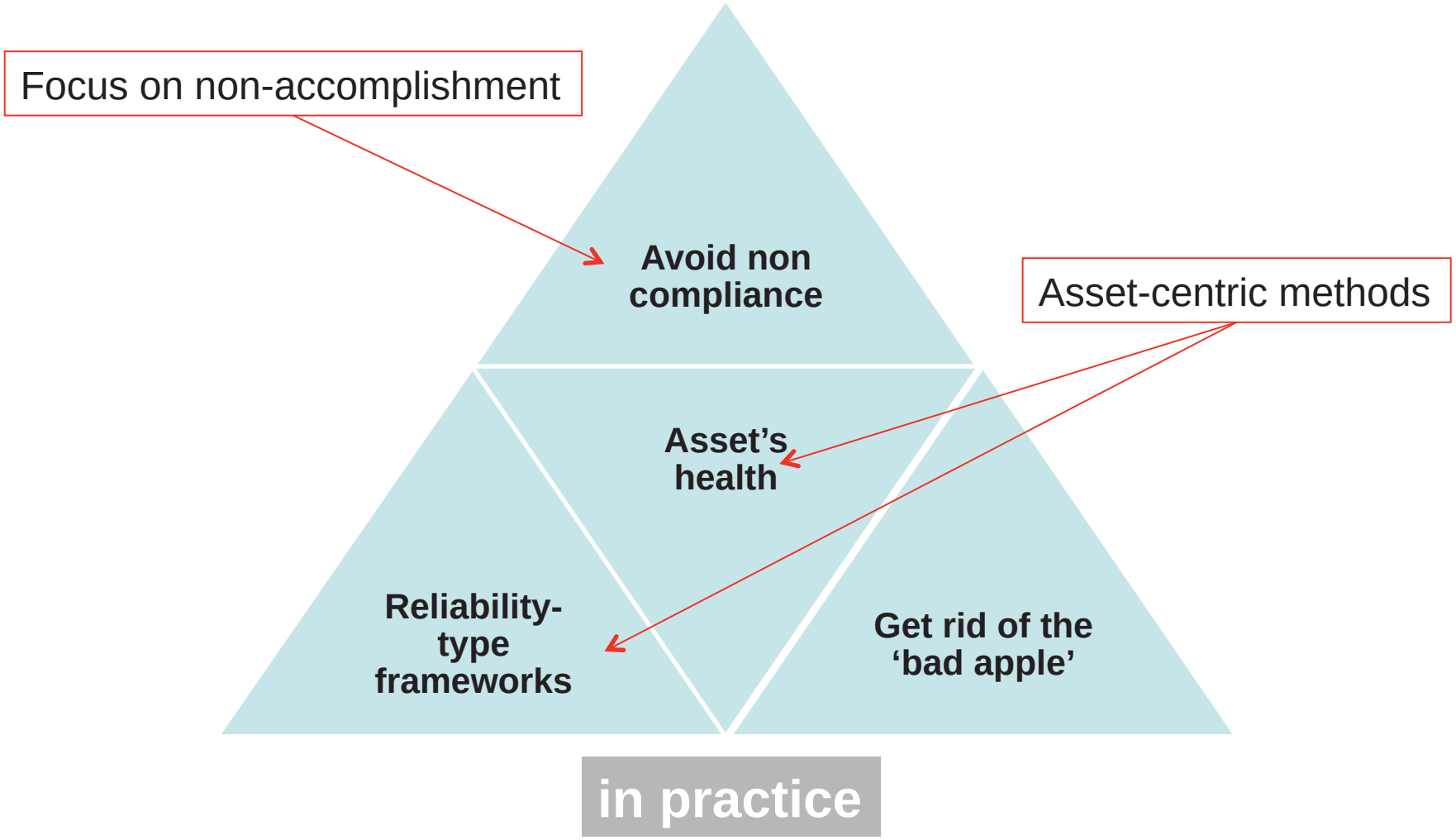
From defence to water sector …and beyond?

Outcome-based approach in water sector



From defence to water sector …and beyond?

Outcome-based approach in water sector



From defence to water sector …and beyond?

Outcome-based approach in water sector

Source: Wessex Water Plc

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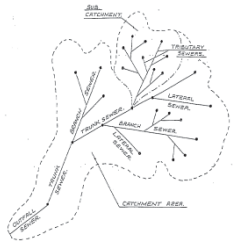


Source: Wessex Water Plc

Asset ownership ⟷ Service outcome

Pay for equipment; Pay for failures	Pay for WwTW "up-time"	Pay per area drained

Customer / User — Involvement — Provider

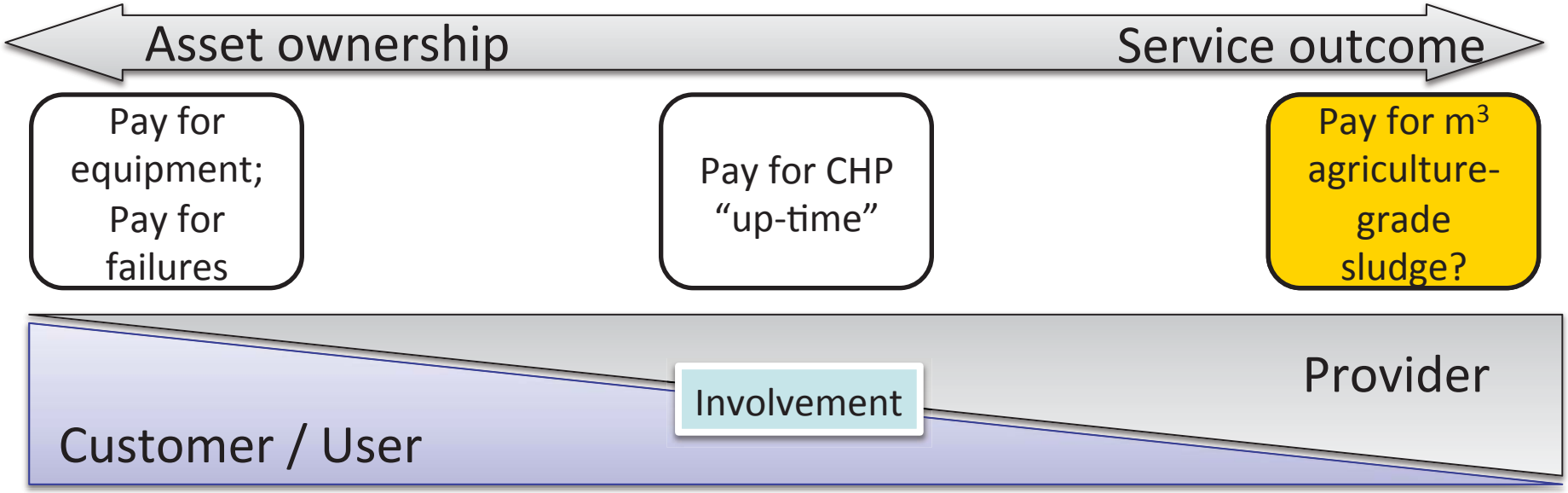
From defence to water sector …and beyond?

Outcome-based approach in water sector

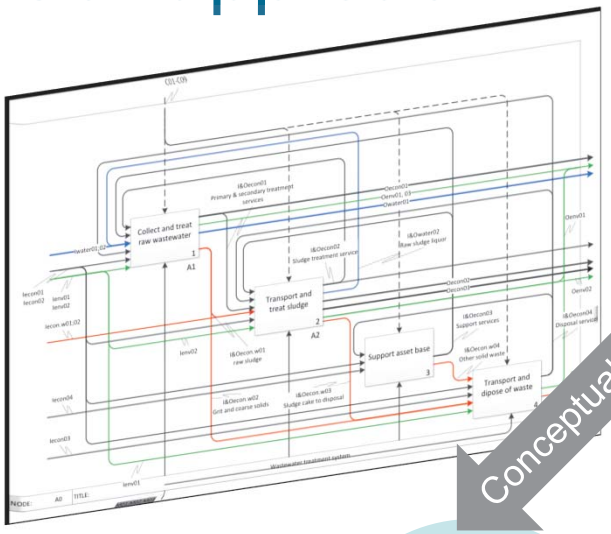
Source: Wessex Water Plc

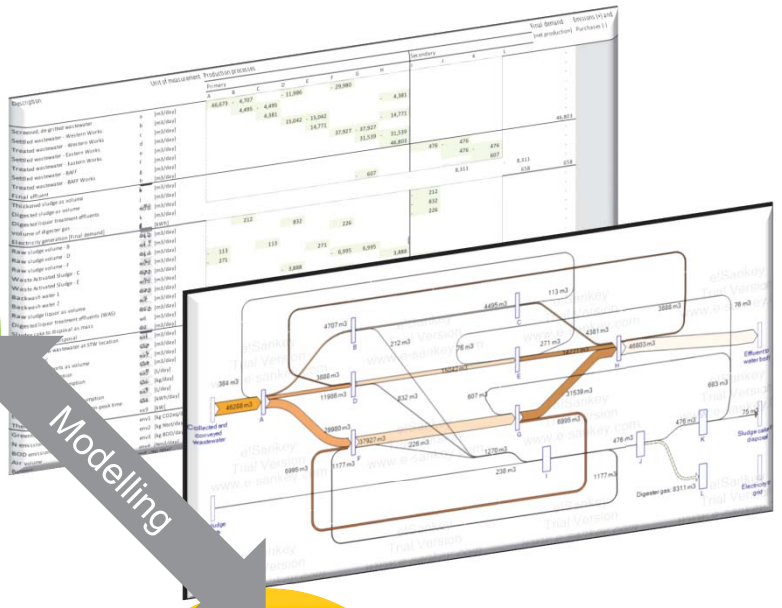
Source: Wessex Water Plc

Source: MS Clipart



Our approach





Conceptual model

Conceptualisation

Modelling

Reality, problem situation

Validation

Feedback

Feedback

Scientific model

IOA

$$x = (I - A)^{-1} y$$

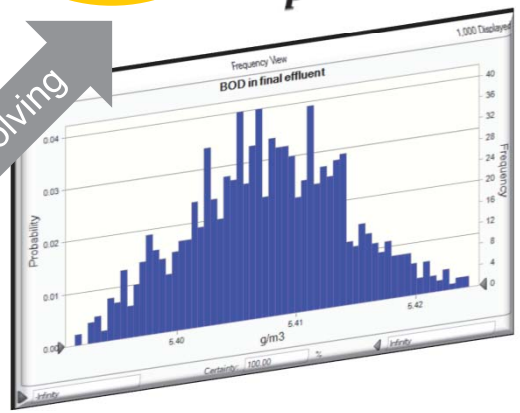
$$p = v(I - A)^{-1}$$

- Wastewater component concentration
- Integrated planning & costing
- Performance evaluation
  - Productivity; Efficiency; Effectiveness; Profitability; Sustainability

Implementation

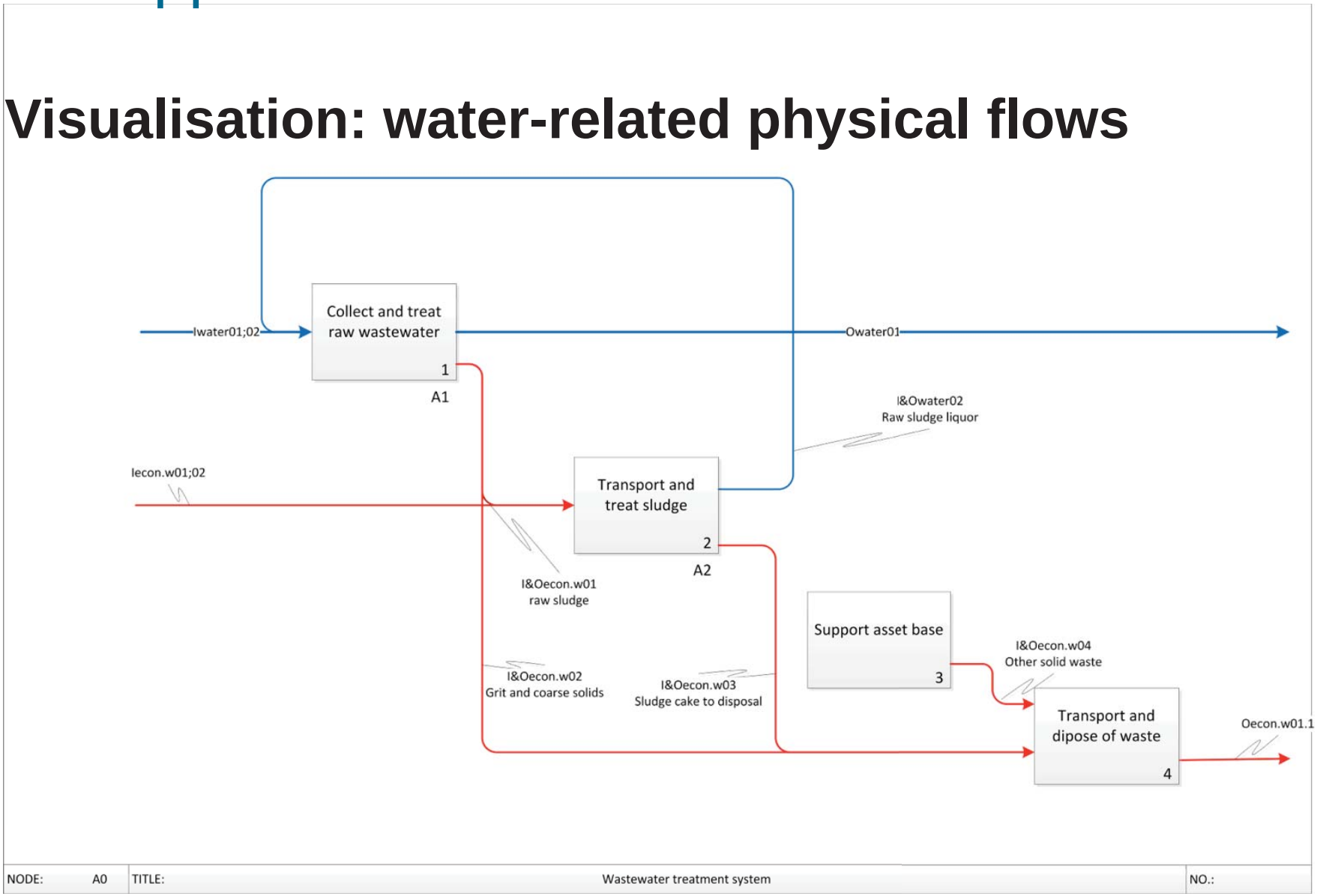
Solution

Model solving



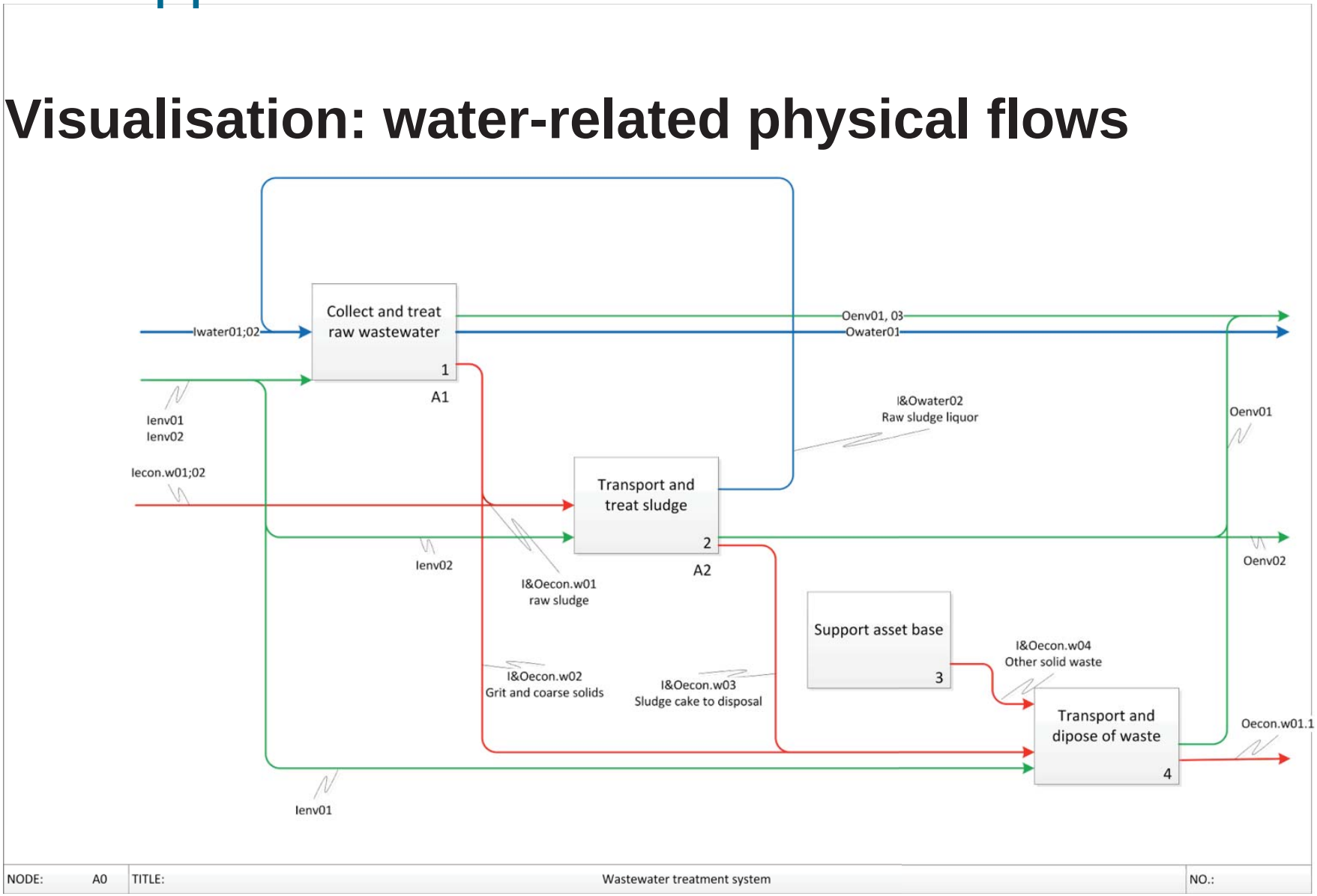
Our approach

Visualisation: water-related physical flows



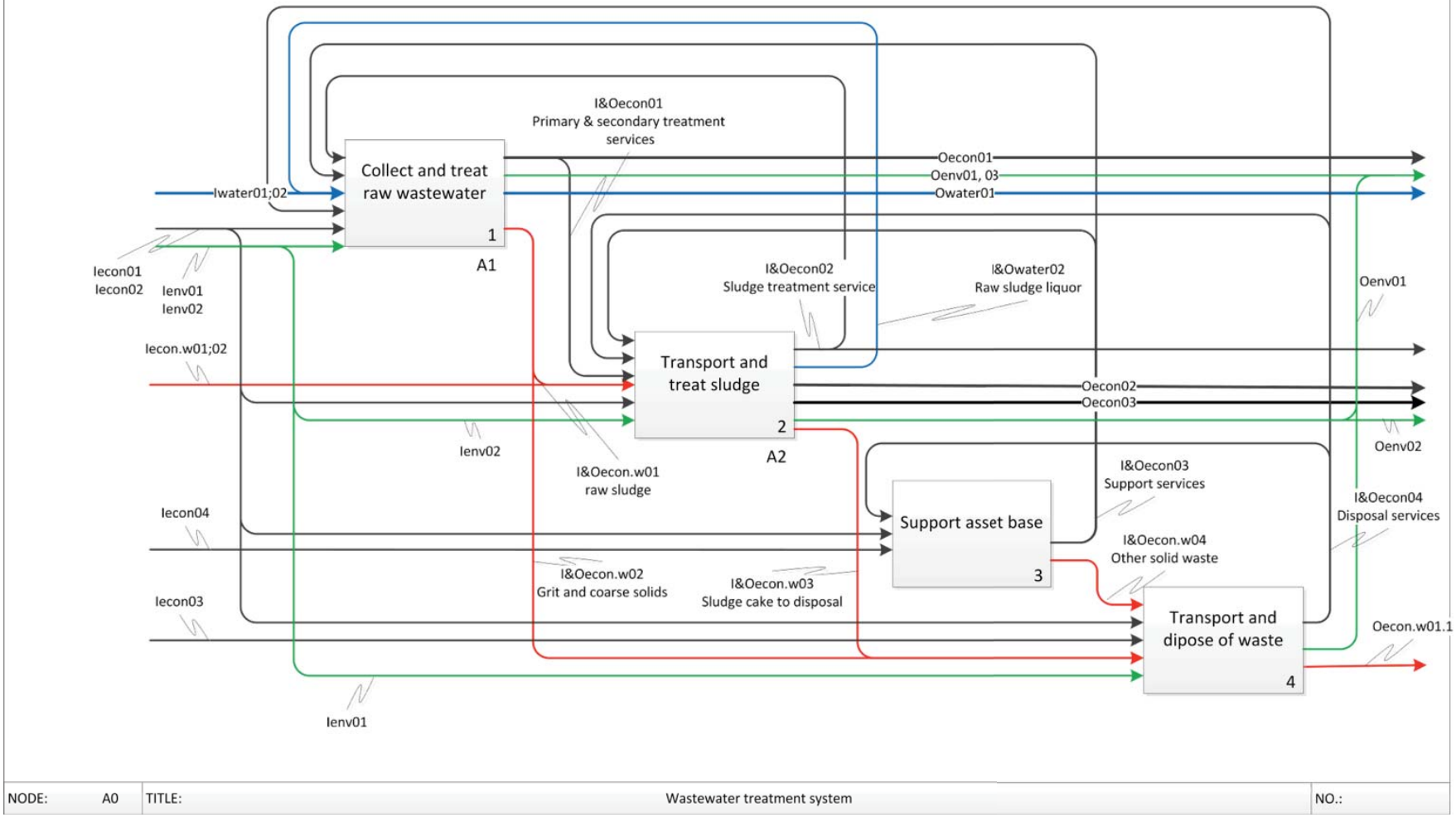
Our approach

Visualisation: water-related physical flows



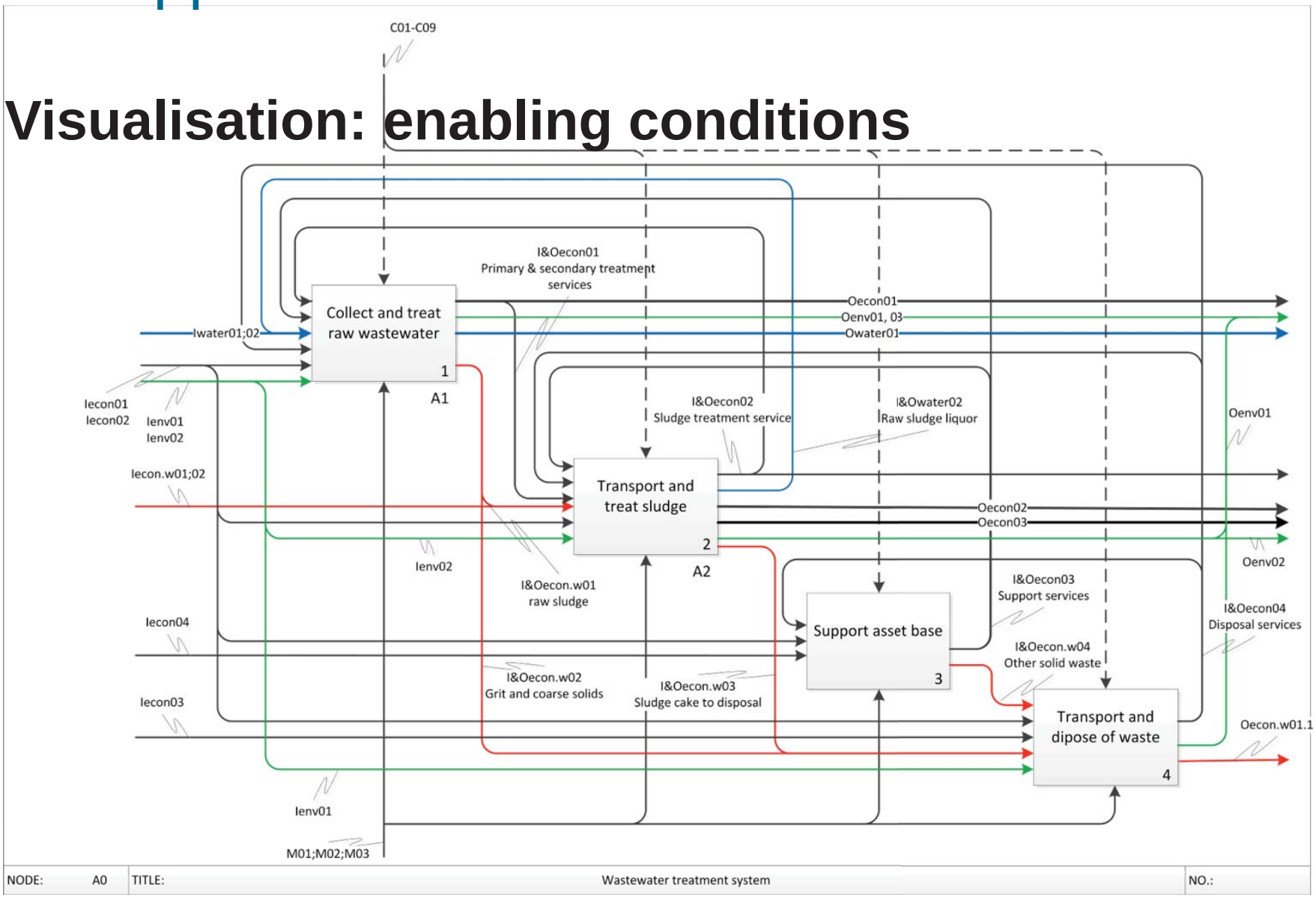
Our approach

Visualisation: economic flows



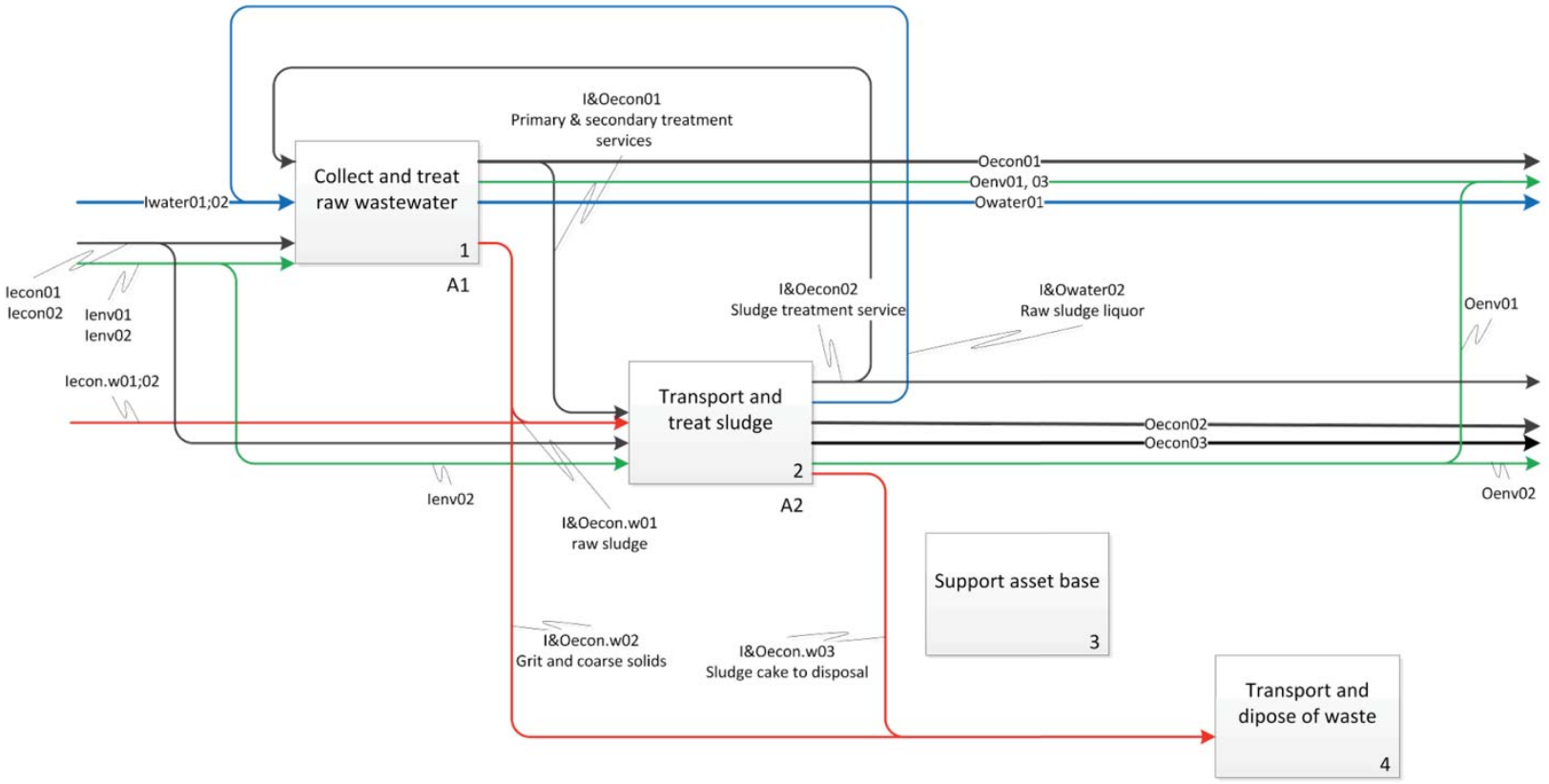
Our approach

Visualisation: enabling conditions



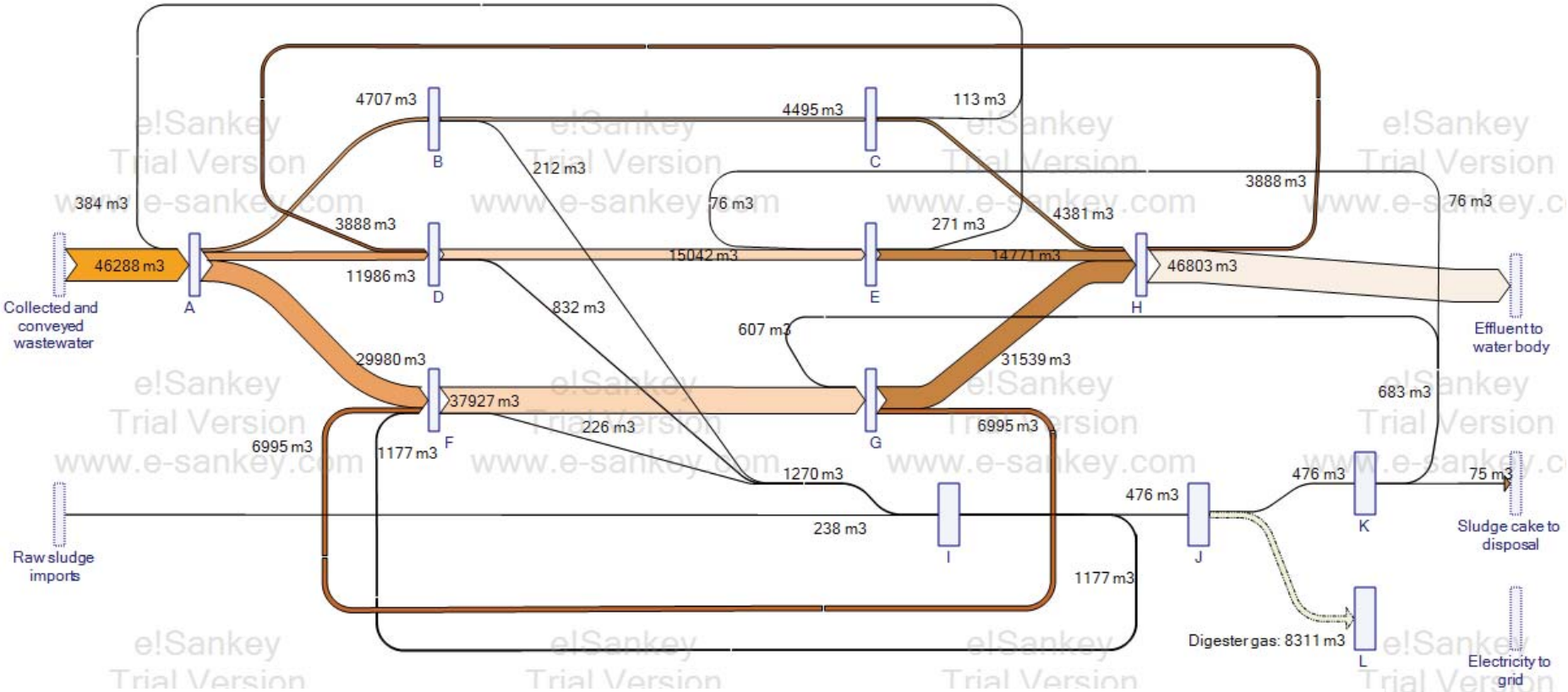
Suggested approach

Industrial Example



Application

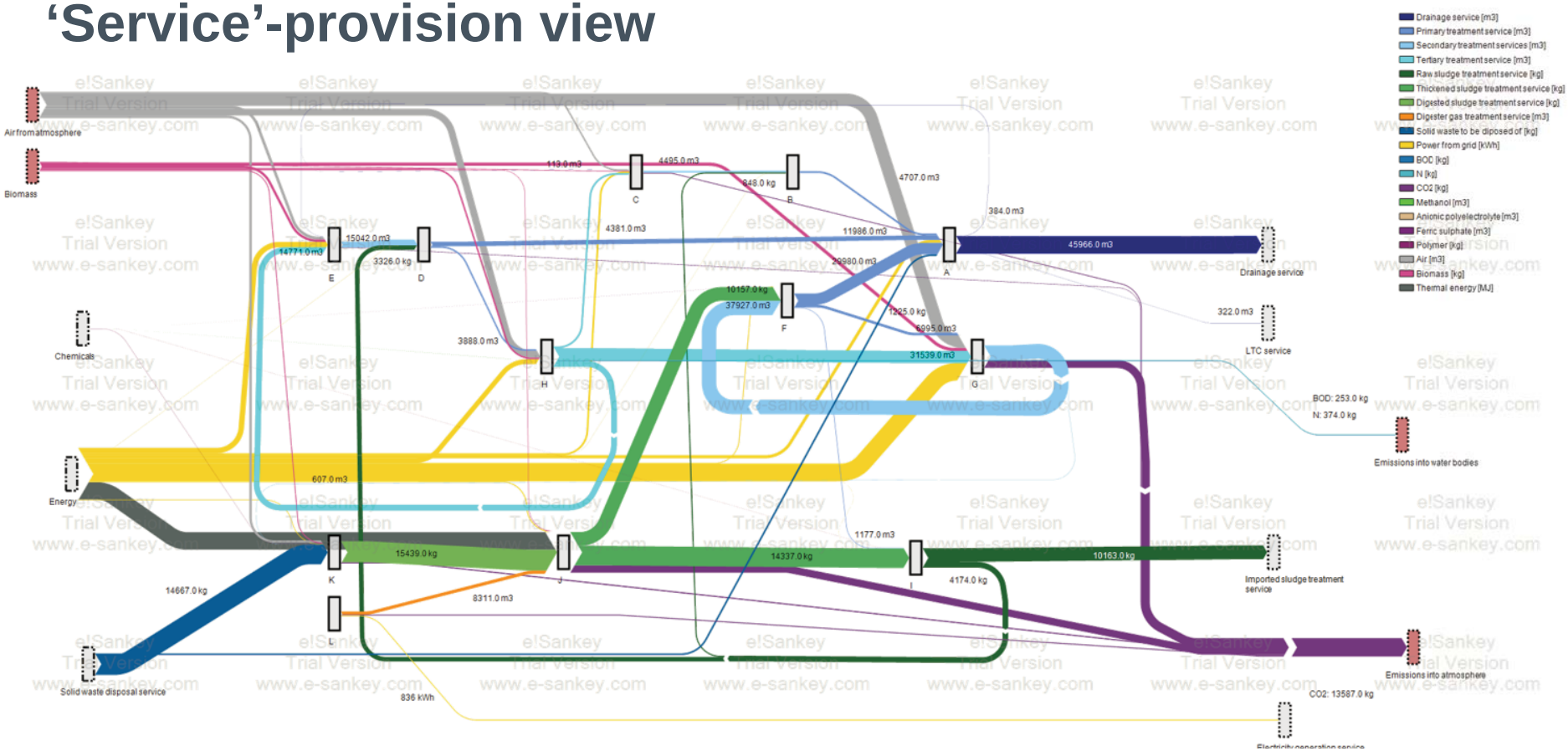
Material-flow view



A: Screen and de-grit raw wastewater
B: Remove solids through quiescent gravity settling - Western works
C: Remove organic matter by Activated Sludge - Western works
D: Remove solids through quiescent gravity settling - Eastern works
E: Remove organic matter by Activated Sludge - Eastern works
F: Remove solids through chemically-assisted primary settlement
G: Remove organic matter by Biological Aerated Flooded filters - BAFF
H: Remove nutrients and pathogens
I: Blend and thicken sludge
J: Generate digester gas
K: Dewater and treat liquors
L:Co-generate heat and power

Application

‘Service’-provision view



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Application

Wastewater component concentration

strength?

Final effluent

Waste to disposal

Intermediate outputs

Known technology

"Main" inputs and outputs

'Secondary' inputs and outputs

Internally recycled by-products

Known strength

'Exogenous' purchases – value added

Application

Cost evaluation

Unit cost?

Known technology

Final effluent

Waste to disposal

Intermediate outputs

"Main" inputs and outputs

'Secondary' inputs and outputs

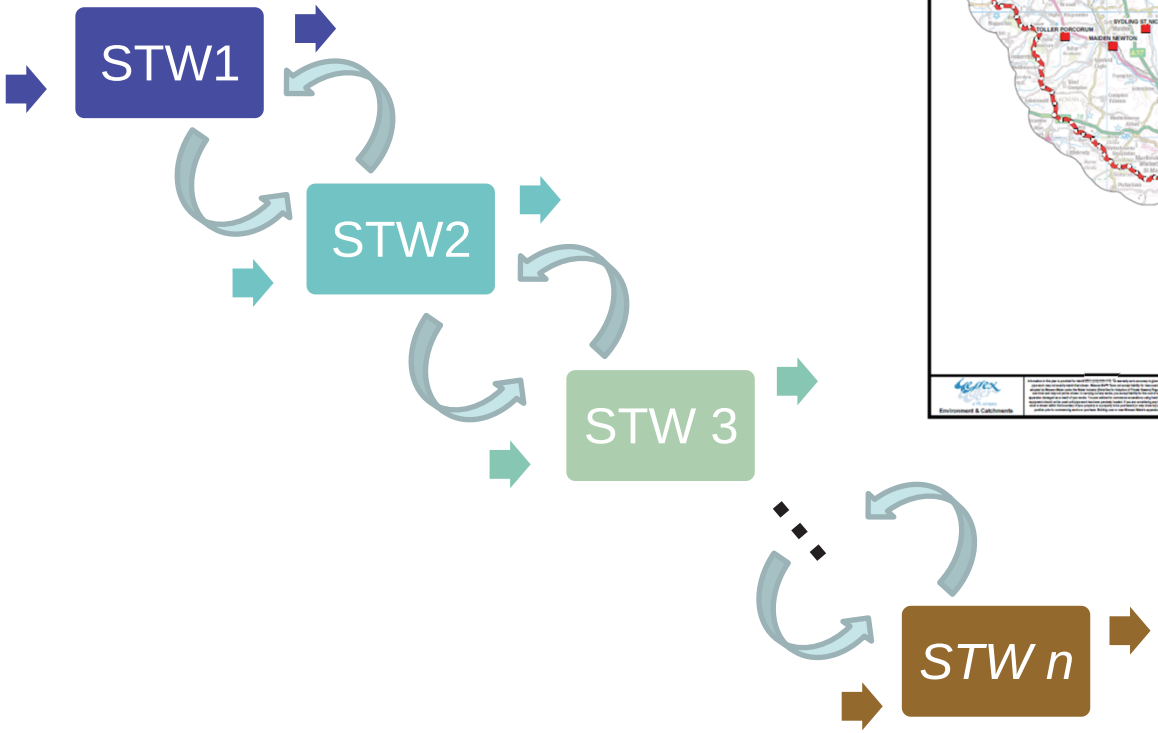
Internally recycled by-products

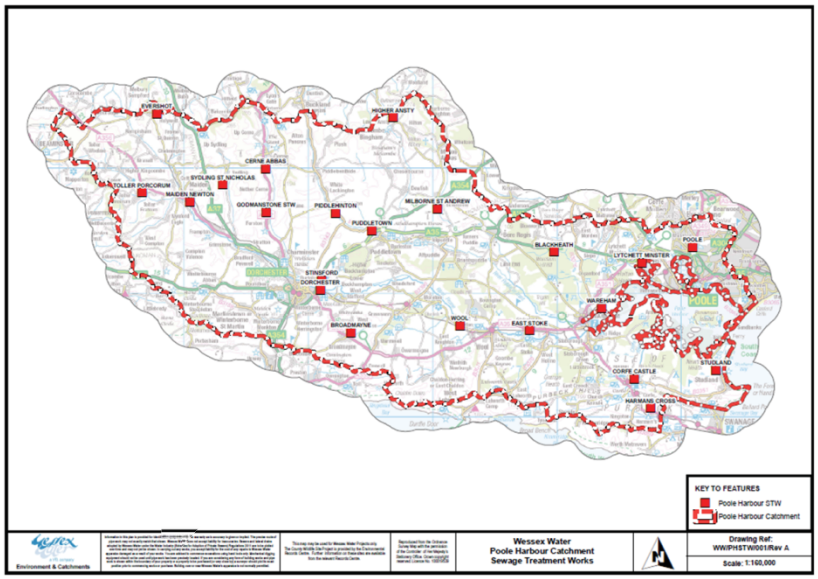
'Exogenous' purchases – value added

Known **price**

Application

Catchment-level management?



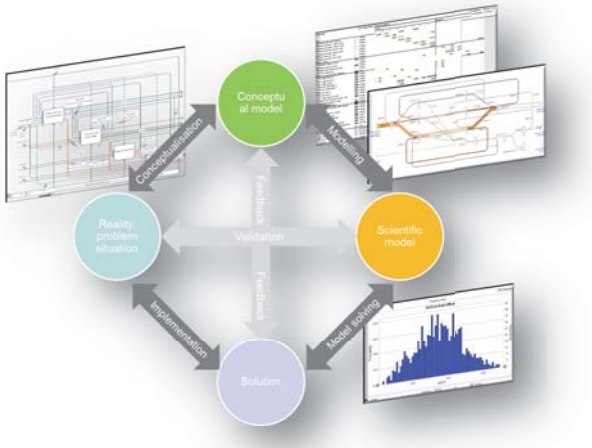


Wrap up

Outcome perspective:
Happening across sectors

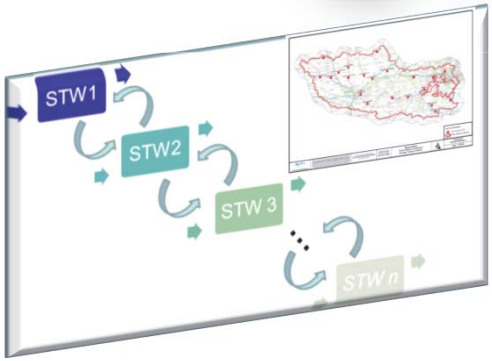
Rigorous modelling underpinning multi-faceted performance evaluation

- Service mapping;
- Consistent use of Mass balances;
- Historical data track record



Future research:

- Cross-sectorial applicability?
- Linking conceptual/scientific modelling
- Catchment-level analysis
- Exploit link with sustainability analysis



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http://www.defenseprocurementnews.com/

Source: Wessex Water Plc

https://commons.wikimedia.org

Thank you for your attention

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