25th anniversary
annual INCOSE
international symposium
Seattle, WA
July 13 - 16, 2015

A Novel Methodology for the Application of Middle-Out, Model-Based Systems Engineering Techniques for City Waste Management Systems Development

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EPSRC
Engineering and Physical Sciences Research Council

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Infrastructure BUsiness models, valuation and Innovation for Local Delivery

UNIVERSITY OF BIRMINGHAM

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Waste Hierarchy
(www.slwp.org.uk)

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	The Business?	Advantageous combinations of variables?	Guiding principles for execution?
How is value created?			
Who is value created for?			
What is the source of competence?			
How are things positioned strategically?			
How is value captured?			
What are time/size/ scope ambitions?			

Achieving sustainability through the business model

Morris et al, 2005, The entrepreneur's business model: toward a unified perspective

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Birmingham's Waste Management Infrastructure

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Requirement

To integrate current waste infrastructure in a sustainable way that can act as a foundation and testbed for innovation.

Solution

Models of the existing waste management infrastructure

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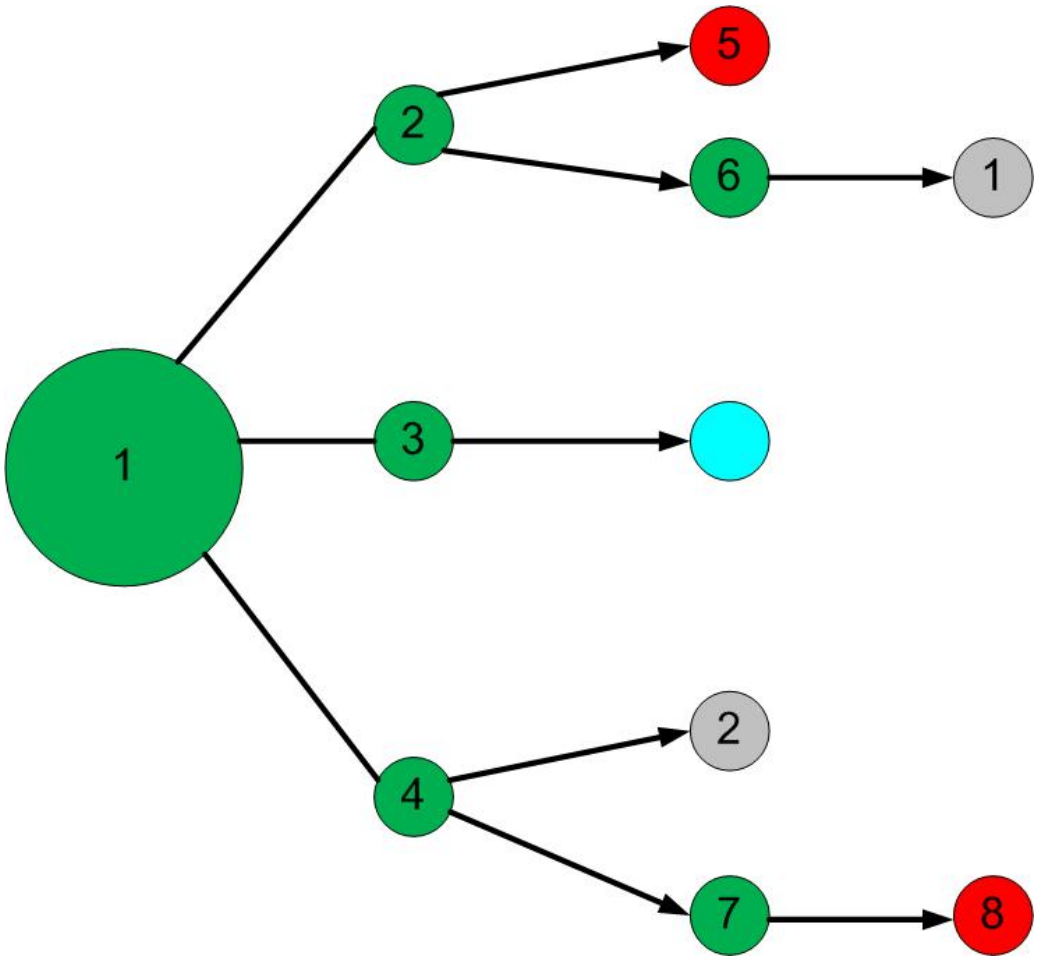

Modelling methodology – Stage 1

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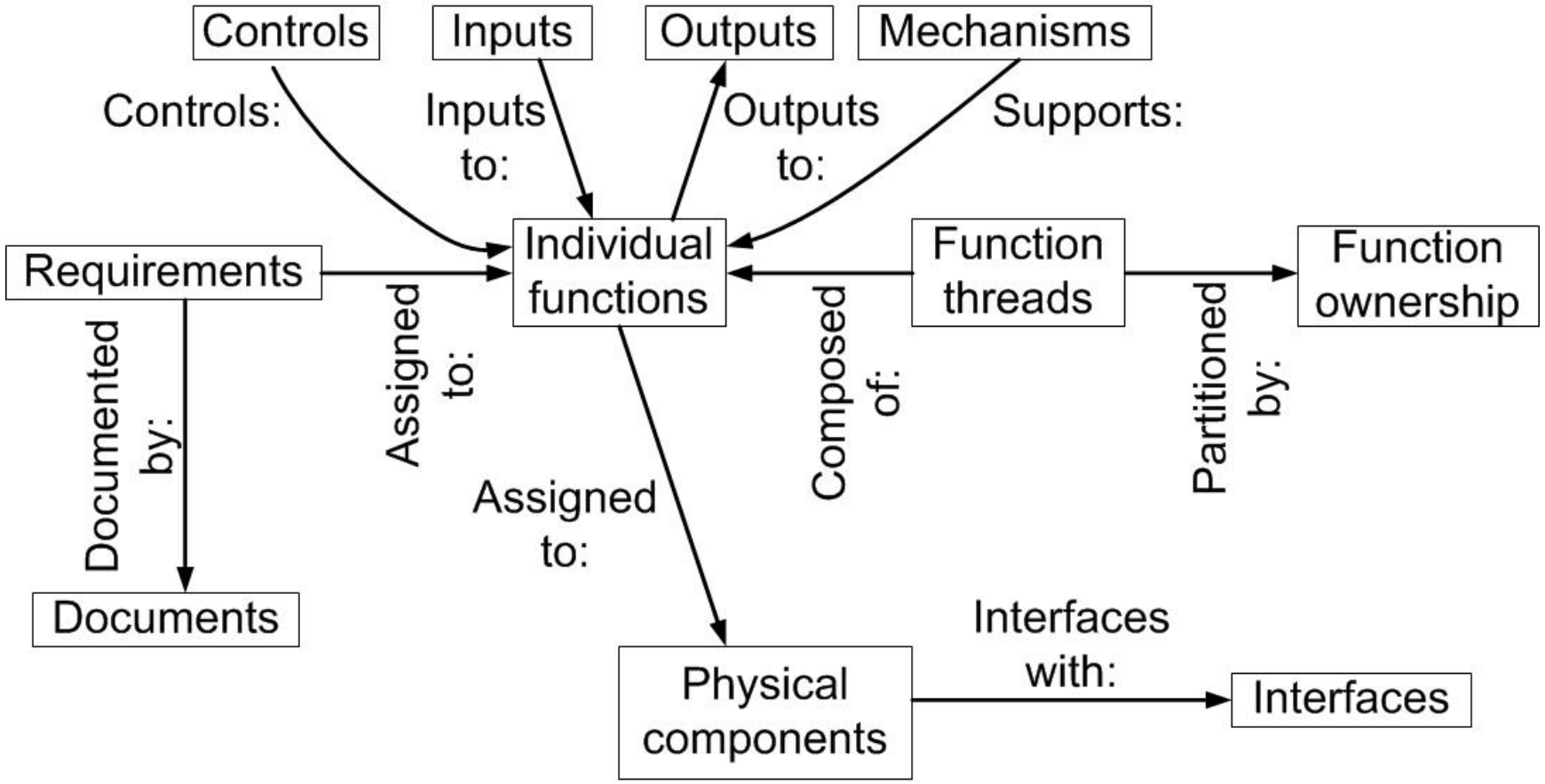

Modelling methodology – Stage 2

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Reverse engineering the waste system

- The methodology appears to produce objective and repeatable system models; but,
- Waste documentation is scattered and not well cross-referenced;
- Documentation is not system-oriented; data elicitation requires care;
- Disconnect between higher level documents (policy and strategy) and operational procedures.

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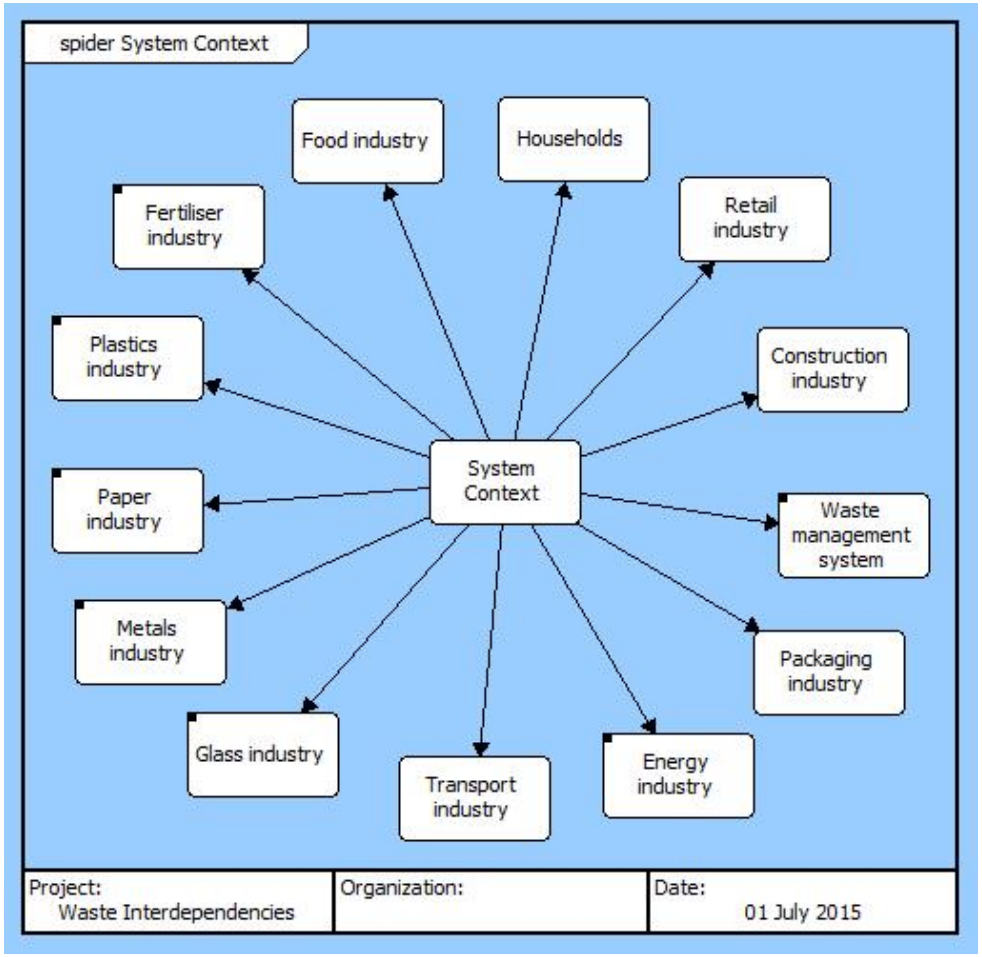

Waste model:
System-of-systems level

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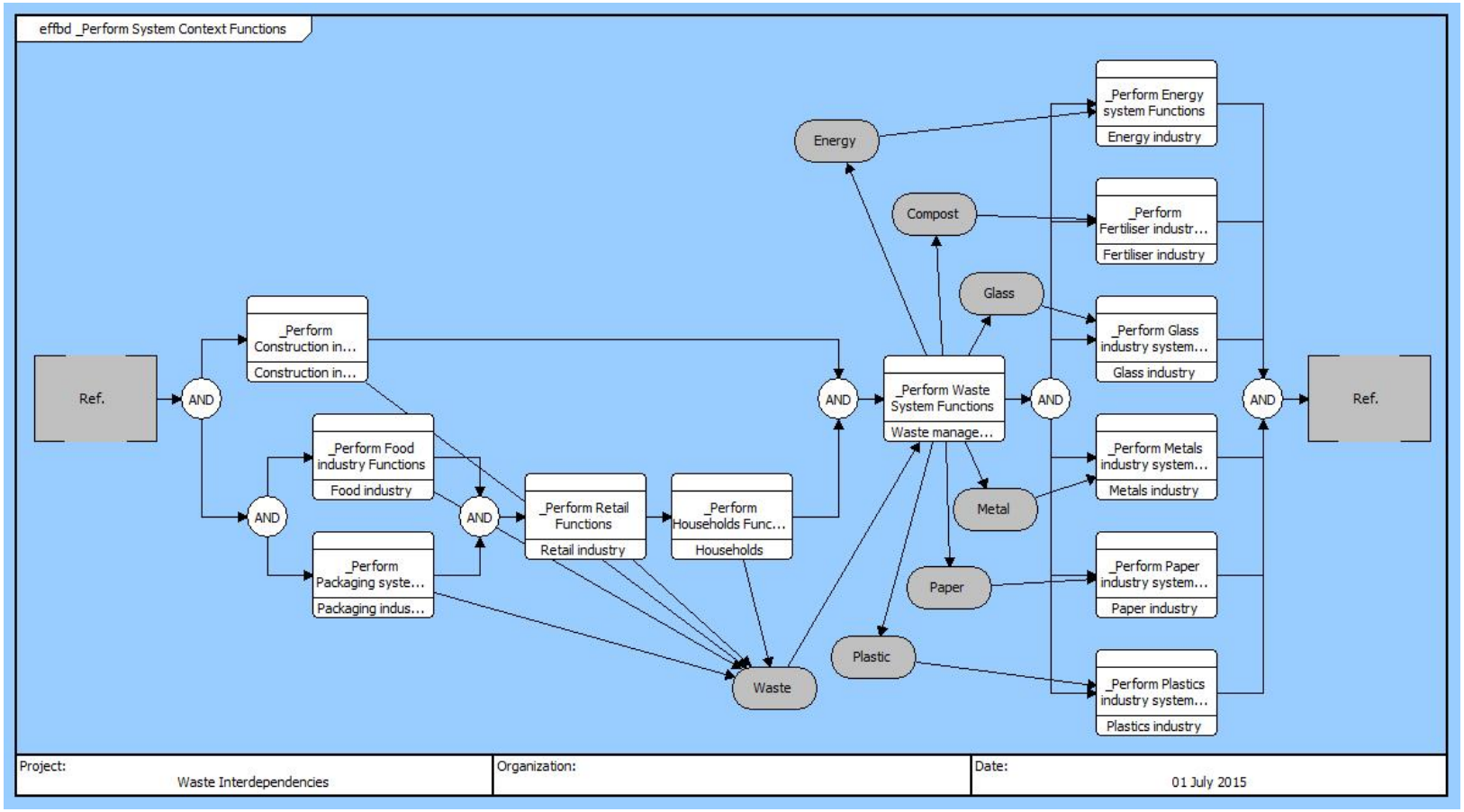

System-of-system inputs and outputs: identifying infrastructure interdependencies.

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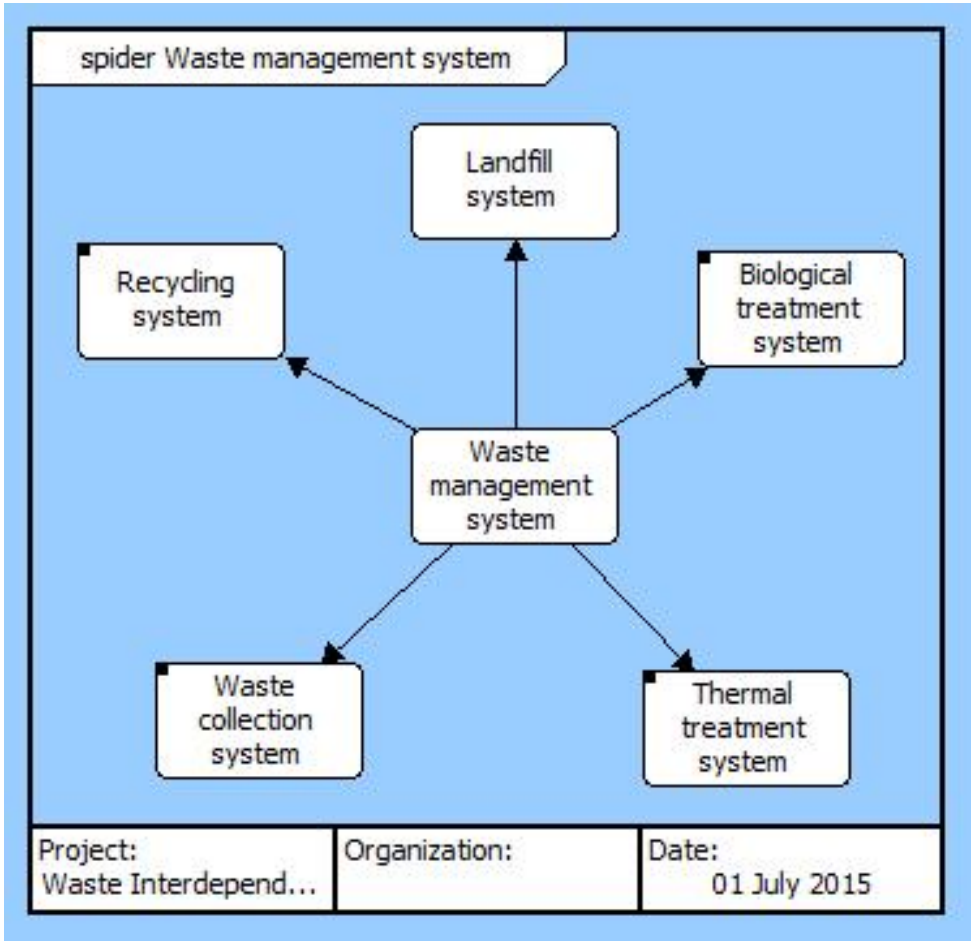

Waste model: System level

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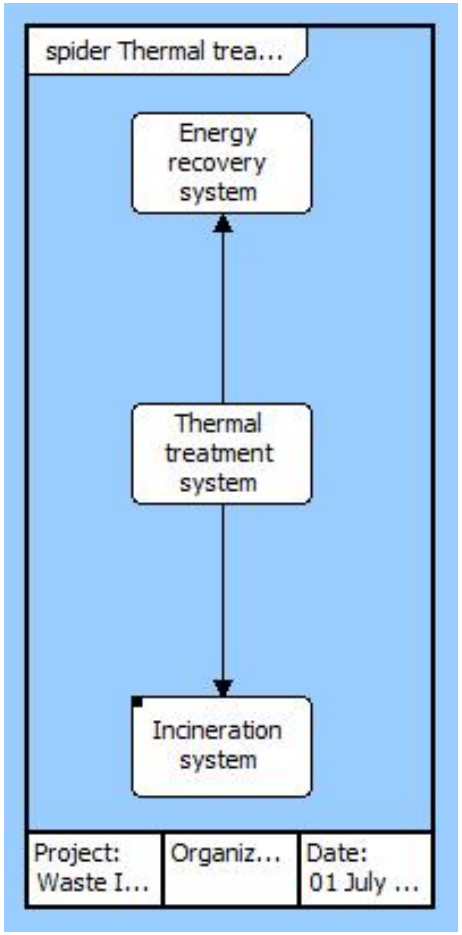

Waste model: Sub-system level

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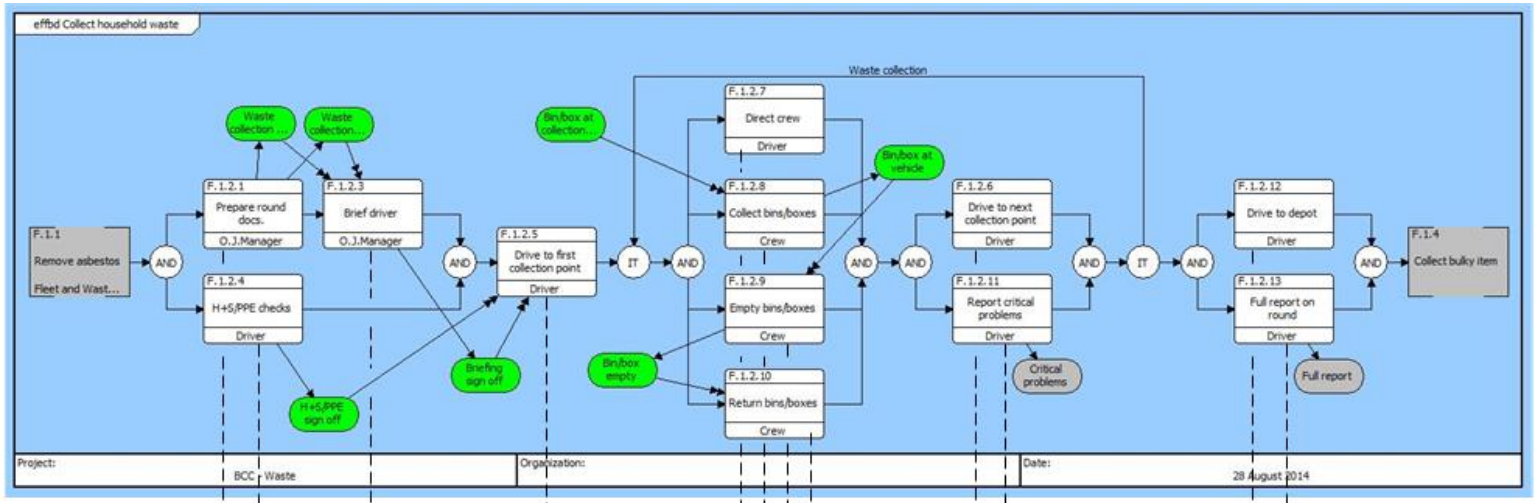

Employees						
Premises						
Transport						
Supplies						
Third Party						
Asset Rentals						
Re-charges						

Kerbside collection and cost categories

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Future research

- Complete the waste model plus models for other critical infrastructures;
- Explore the socio/technical interface based on Weaver's view of complexity:
  - Organised complexity: a sizable number of variables, interrelated into an organic whole
  - Disorganised complexity: very large number of variables, individual behaviour erratic or unknown, however, system as a whole has analysable average properties

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Thank you for listening

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