INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

On the Right Track

A Case for Applying Systems Engineering to Writing Transport Policy

The Authors

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Rhianne Evans

Clive Roberts

ATKINS

UNIVERSITY OF BIRMINGHAM

Centre for Railway Research and Education

Overview

- Introduction
- Government/ Industry recognition
- Previous work
- Motivation for this paper
- Analysis of a policy document
- Future work
- Discussion

Problem

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Difficult to interpret by those responsible for delivery

Gap between those who write and implement policy

Policy

Policy can shift and change suddenly

How to mitigate risk of changing policy?

Rail projects can take decades

Independent Review:

'Government and industry processes for setting objectives and strategies should be reformed to give a clearer line of sight between high-level policies and the delivery of outputs on the ground'

(McNulty, 2011)

Department for Transport:

'Late changes from Government to the scope of projects was a common driver of cost increases. We share many of the concerns set out in the Study and we believe that Government itself can take decisions more effectively to reduce cost pressures.'

(Department for Transport, 2012)

Systems Engineering:

'Articulating why Systems Engineering is important at the highest levels of an organisation, in terms that are powerfully relevant to top management and policy makers, is a crucial task'

(INCOSE IS, 2012)

Immigration:

'Communications between the Agency and Ministers and between senior managers and operational staff was poor. There was a lack of clarity in the language used with consequent ambiguity when decisions were converted to operational practice.'

(UKBA Investigation, 2012)

Previous Work

Automated Requirements Extraction

- Oliver Mason – English language
- Chris Bouch – Rail SE
- 'Requirement Extraction from Transport Policy Documents'
- Presented at Language Resources and Education Conference (LREC) 2012

Previous Work

Automated Requirements Extraction

9. Many European companies are world leaders in infrastructure, logistics, traffic management systems and manufacturing of transport equipment – but as other world regions are launching huge, ambitious transport modernisation and infrastructure investment programmes, it is crucial that European transport continues to develop and invest to maintain its competitive position.

10. *Infrastructure* shapes mobility. No major change in transport will be possible without the support of an adequate network and more intelligence in using it. Overall, transport infrastructure investments have a positive impact on economic growth, create wealth and jobs, and enhance trade, geographical accessibility and the mobility of people. It has to be planned in a way that maximises positive impact on economic growth and minimises negative impact on the environment.

11. Congestion is a major concern, in particular on the roads and in the sky, and compromises accessibility. In addition, transport infrastructure is unequally developed in the eastern and western parts of the EU which need to be brought together. There is increased pressure on public resources for infrastructure funding and a new approach to funding and pricing is needed.

Previous Work

Automated Requirements Extraction

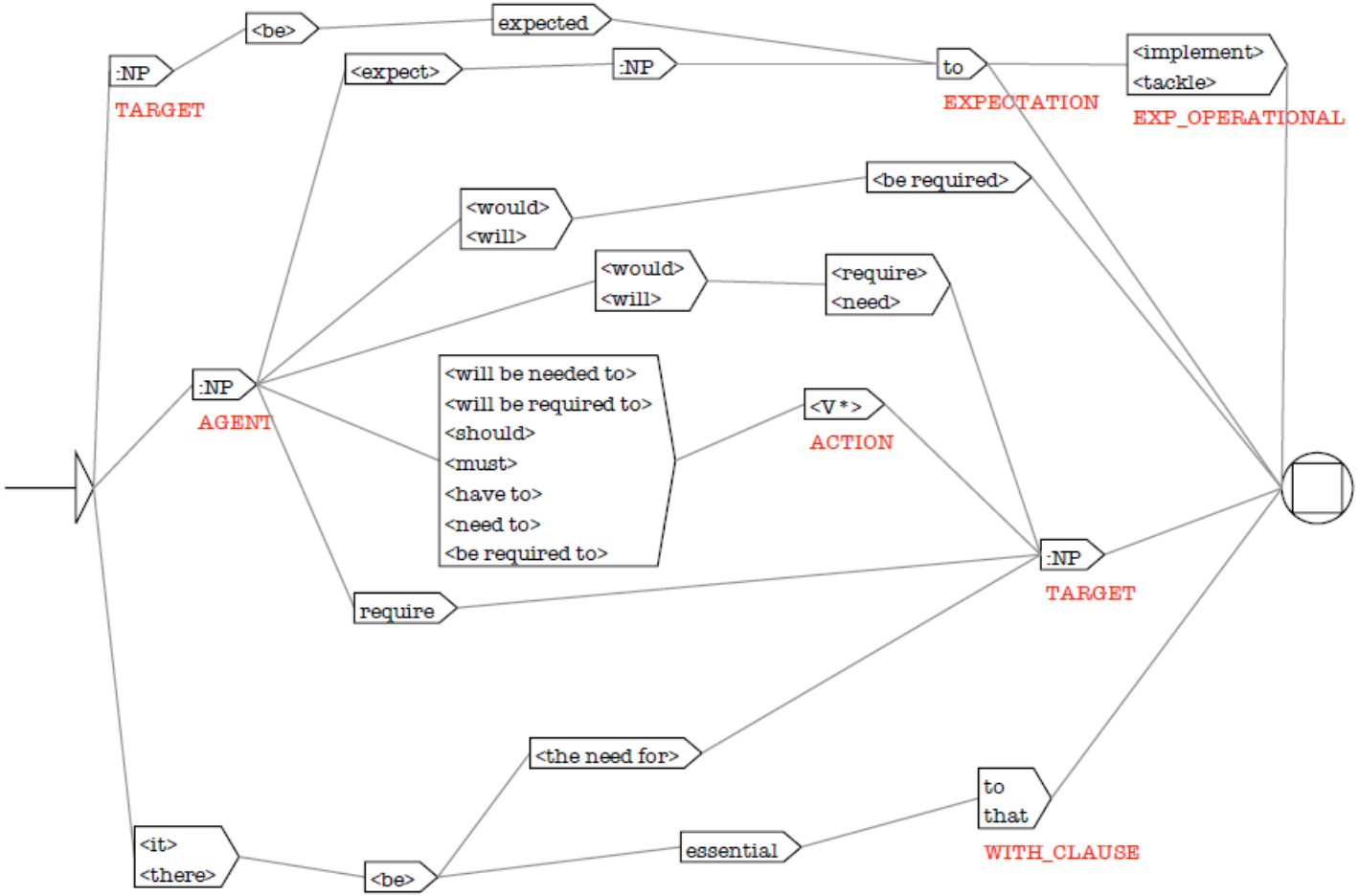
9. Many European companies are world leaders in infrastructure, logistics, traffic management systems and manufacturing of transport equipment – but as other world regions are launching huge, ambitious transport modernisation and infrastructure investment programmes, it is crucial that European transport continues to develop and invest to maintain its competitive position.

10. *Infrastructure* shapes mobility. No major change in transport will be possible without the support of an adequate network and more intelligence in using it. Overall, transport infrastructure investments have a positive impact on economic growth, create wealth and jobs, and enhance trade, geographical accessibility and the mobility of people. It has to be planned in a way that maximises positive impact on economic growth and minimises negative impact on the environment.

11. Congestion is a major concern, in particular on the roads and in the sky, and compromises accessibility. In addition, transport infrastructure is unequally developed in the eastern and western parts of the EU which need to be brought together. There is increased pressure on public resources for infrastructure funding and a new approach to funding and pricing is needed.

Previous Work

Automated Requirements Extraction



Previous Work

Automated Requirements Extraction

- Bottom up solution – attempts to identify poorly written requirements.
- Identifying requirements subjective process.
- Variable linguistic structure of requirements.
- Software disregards rationale, context, ADCs, traceability.

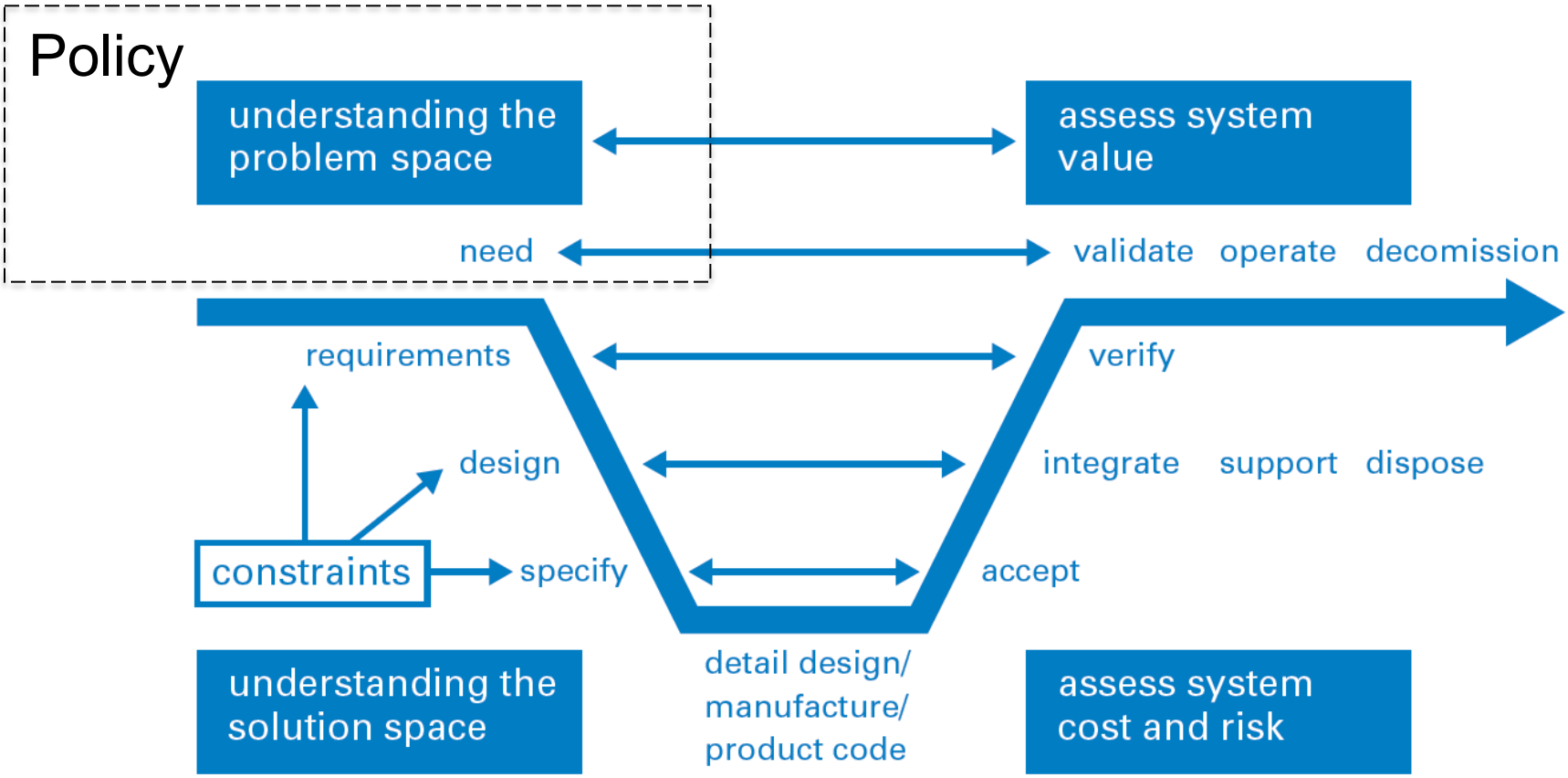
Motivation for Current Work

- Top down solution
- Adopting a Systems Engineering approach
- Improve how high level requirements are communicated
- Earlier in the lifecycle

Motivation for Current Work

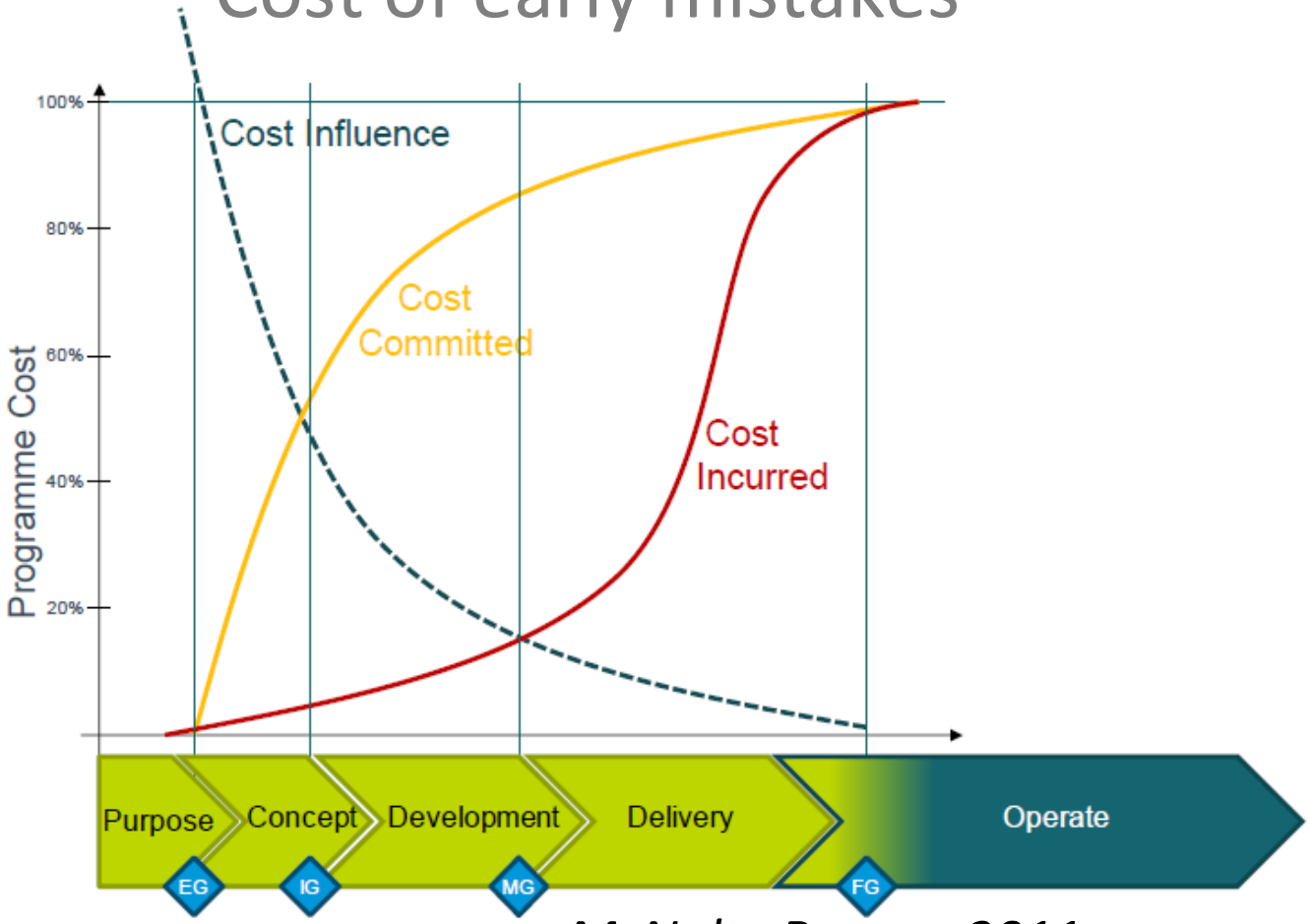
Policy in the life cycle

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013



Motivation for Current Work

Cost of early mistakes

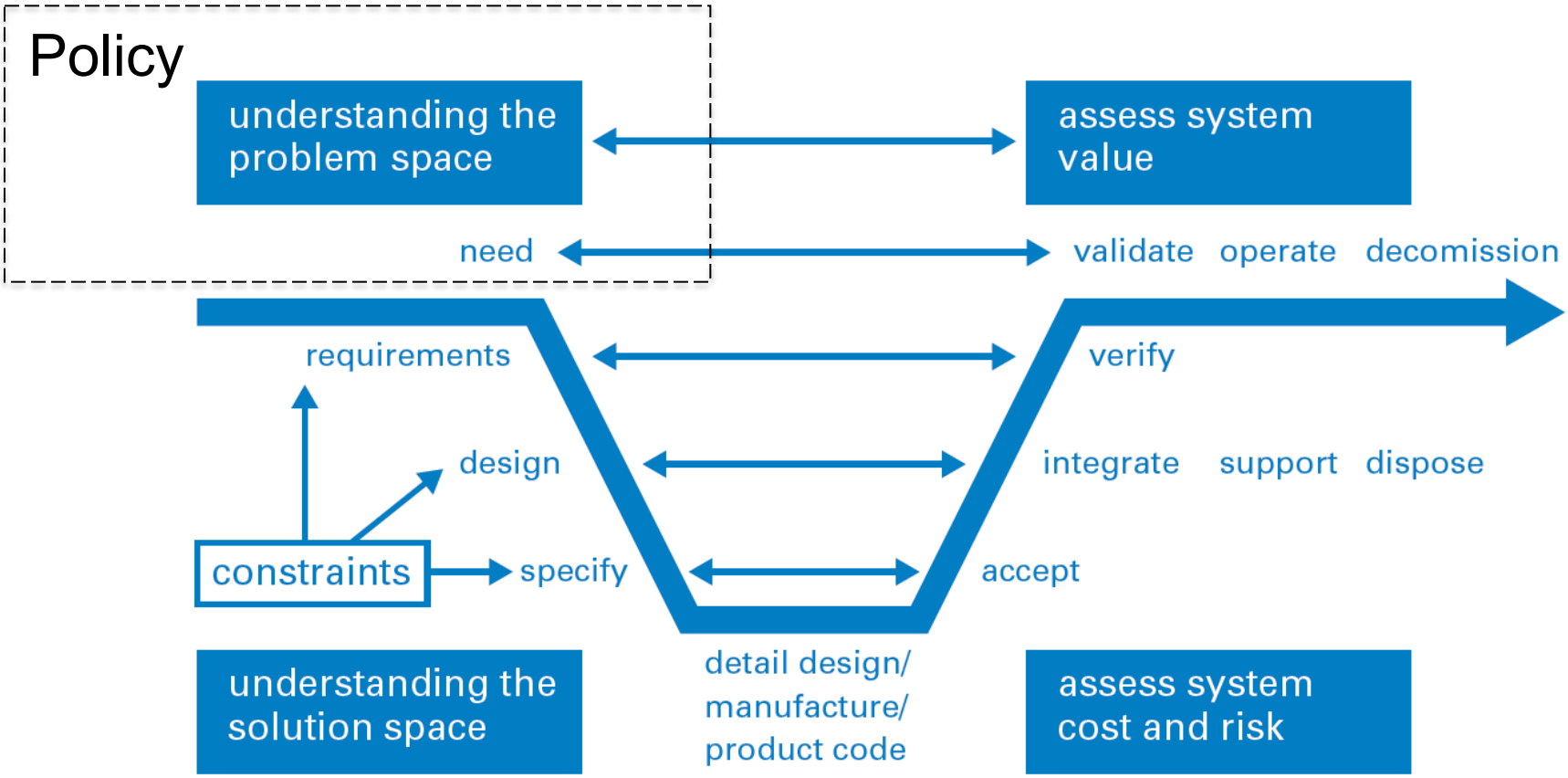


McNulty Report, 2011

Motivation for Current Work

Policy in the life cycle

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013



Documents

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Rail Technical Strategy

DfT Command Paper

McNulty Report

Technical Specification for Interoperability

EU White Paper

High Level Output Strategy

EU White Paper

- *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system.*
- Published in 2011
- Presents initiatives 'to build a competitive transport system that will increase mobility, remove major barriers in key areas and fuel growth and employment'
- Engineers have experienced difficulty in interpreting the document and identifying requirements.
- Direct implications for the railway systems of EU Member States

EU Division of Competences

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Exclusive

EU alone able to legislate and adopt binding acts in these fields.

Shared

EU and Member States authorised to adopt binding acts in these fields.

Supporting

EU can only intervene to support, coordinate or complement the action of Member States.

Transport

Requirements Elicitation

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

9. Many European companies are world leaders in infrastructure, logistics, traffic management systems and manufacturing of transport equipment – but as other world regions are launching huge, ambitious transport modernisation and infrastructure investment programmes, it is crucial that European transport continues to develop and invest to maintain its competitive position.

10. *Infrastructure* shapes mobility. No major change in transport will be possible without the support of an adequate network and more intelligence in using it. Overall, transport infrastructure investments have a positive impact on economic growth, create wealth and jobs, and enhance trade, geographical accessibility and the mobility of people. It has to be planned in a way that maximises positive impact on economic growth and minimises negative impact on the environment.

11. Congestion is a major concern, in particular on the roads and in the sky, and compromises accessibility. In addition, transport infrastructure is unequally developed in the eastern and western parts of the EU which need to be brought together. There is increased pressure on public resources for infrastructure funding and a new approach to funding and pricing is needed.

Itemisation

Paragraph	RQ Number	Requirement	Identifiers
9	18	It is crucial that European transport continues to develop and invest to maintain its competitive position.	crucial
10	19	It has to be planned in a way that maximises positive impact on economic growth and minimises negative impact on the environment.	has to
11	20	The eastern and western parts of the EU which need to be brought together.	need to
	21	A new approach to funding and pricing is needed.	needed

Comparison with good practice

Guidelines for good requirements	Danger signs for poor requirements
• Use simple direct sentences • Use a limited vocabulary • Identify the type of user who wants each requirement • Focus on stating results • Define verifiable criteria	• Ambiguity • Multiple requirements • Let-out clauses (such as if, when, unless) • Long rambling sentences • Designing the system • Mixing requirements and design • Mixing requirements and plans • Speculation • Vague, indefinable terms • Expressing possibilities • Wishful thinking

Alexander and Stevens, *Writing Better Requirements*

Observations

Subjectivity

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

'Freight shipments over short and medium distances (below some 300 km) will to a considerable extent remain on trucks.'

'Transport is fundamental to our economy and society.'

'Efficient transport is vital in making this happen.'

Observations

Multiple requirements

'The environmental record of shipping can and must be improved by both technology and better fuels and operations: overall, the EU CO2 emissions from maritime transport should be cut by 40% (if feasible 50%) by 2050 compared to 2005 levels.'

'It has to be planned in a way that maximises positive impact on economic growth and minimises negative impact on the environment.'

Observations

Absence of verifiable criteria

- Failure to specify verifiable criteria
- Frequent use of undefined quantities, such as *good, better, strong, efficient* etc.

'Effective action requires strong international cooperation'

Example: Ambiguity

'By 2030, the goal for transport will be to reduce GHG emissions to around 20% below their 2008 level'

'By 2030, a requirement will be set for the transport system to reduce GHG emissions to 20% below their 2008 level'

'The transport system shall reduce GHG emissions to 20% below their 2008 level by 2030'

Observations

Design

Rail, especially for freight, is sometimes seen as an unattractive mode. But examples in some Member States prove that it can offer quality service. The challenge is to ensure structural change to enable rail to compete effectively and take a significantly greater proportion of medium and long distance freight (and also passengers – see below). Considerable investment will be needed to expand or to upgrade the capacity of the rail network. New rolling stock with silent brakes and automatic couplings should gradually be introduced.

Observations

Design

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Problem

Rail, especially for freight, is sometimes seen as an unattractive mode. But examples in some Member States prove that it can offer quality service. The challenge is to ensure structural change to enable rail to compete effectively and take a significantly greater proportion of medium and long distance freight (and also passengers – see below). Considerable investment will be needed to expand or to upgrade the capacity of the rail network. New rolling stock with silent brakes and automatic couplings should gradually be introduced.

Observations

Design

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Problem

Need

Rail, especially for freight, is sometimes seen as an unattractive mode. But examples in some Member States prove that it can offer quality service. The challenge is to ensure structural change to enable rail to compete effectively and take a significantly greater proportion of medium and long distance freight (and also passengers – see below). Considerable investment will be needed to expand or to upgrade the capacity of the rail network. New rolling stock with silent brakes and automatic couplings should gradually be introduced.

Observations

Design

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Problem

Need

Rail, especially for freight, is sometimes seen as an unattractive mode. But examples in some Member States prove that it can offer quality service. The challenge is to ensure structural change to enable rail to compete effectively and take a significantly greater proportion of medium and long distance freight (and also passengers – see below). Considerable investment will be needed to expand or to upgrade the capacity of the rail network. New rolling stock with silent brakes and automatic couplings should gradually be introduced.

Requirements

Observations

Design

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Problem

Need

Rail, especially for freight, is sometimes seen as an unattractive mode. But examples in some Member States prove that it can offer quality service. The challenge is to ensure structural change to enable rail to compete effectively and take a significantly greater proportion of medium and long distance freight (and also passengers – see below). Considerable investment will be needed to expand or to upgrade the capacity of the rail network. New rolling stock with silent brakes and automatic couplings should gradually be introduced.

Design?

Requirements

Observations

Poor traceability

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Problem

Rail, especially for freight, is sometimes seen as an unattractive mode

Need

Enable rail to compete effectively and take a significantly greater proportion of medium and long distance freight and passengers

Requirements

Ensure structural change

Expand or upgrade the capacity of the rail network

Considerable investment will be needed

Design

New rolling stock with silent brakes and automatic couplings should gradually be introduced.

Observations

Implicit meaning

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

'The future prosperity of our continent will depend on the ability of all of its regions to remain fully and competitively integrated in the world economy'

'Curbing mobility is not an option'

Summary

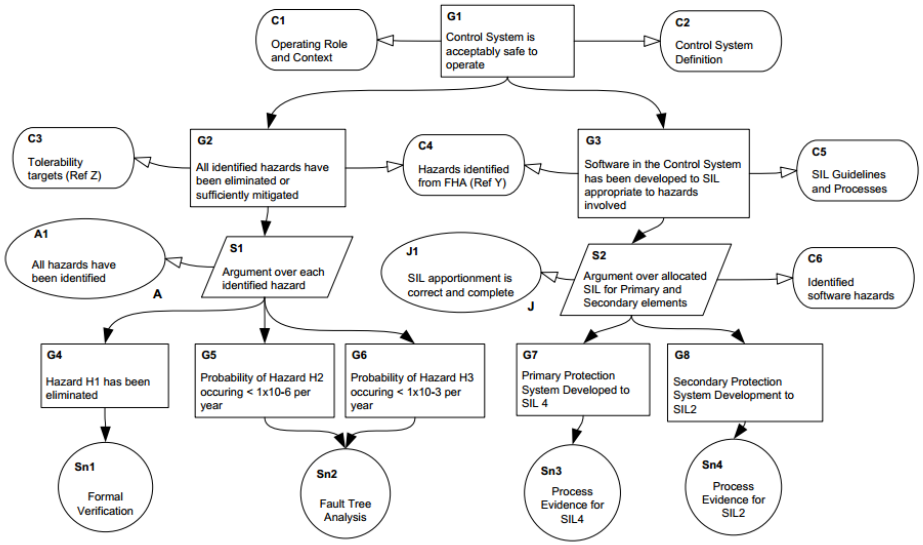
INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

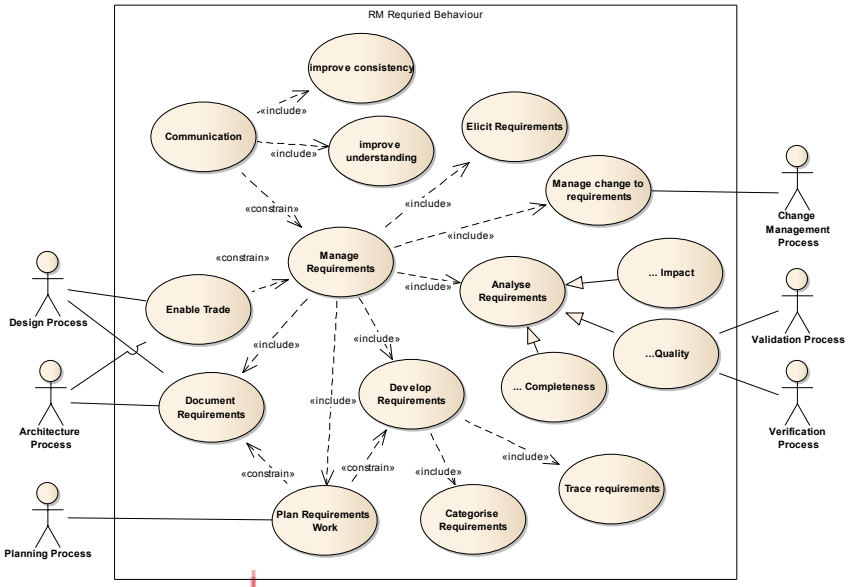
- Initial analysis shows flaws in the way which high-level political requirements are communicated.
- It suggests that processes for writing EU policy documents are not consistent with a Systems approach.
- High risk of project failure or misalignment with political objectives.

Further Work

Model-Based Requirements Engineering

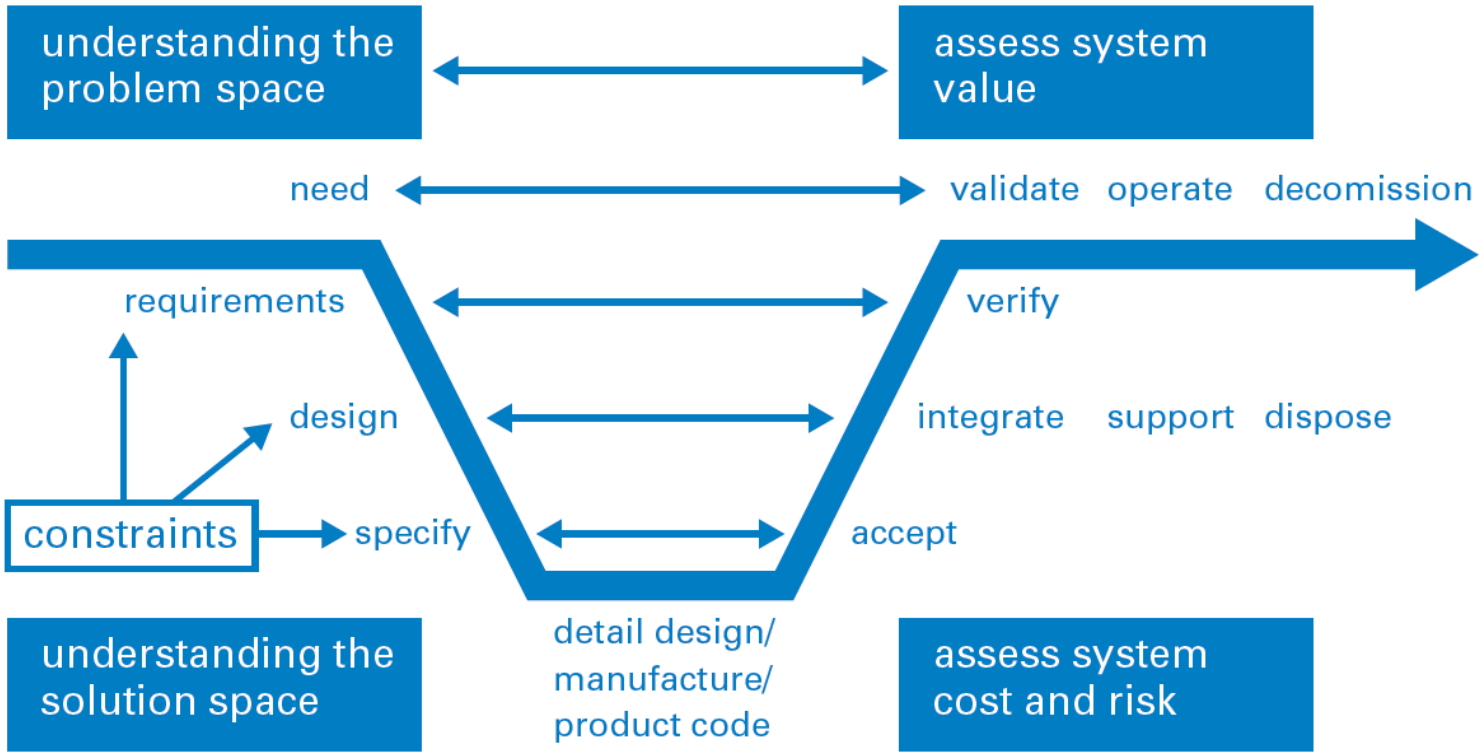
INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013





Further Work

Promoting Systems-Thinking

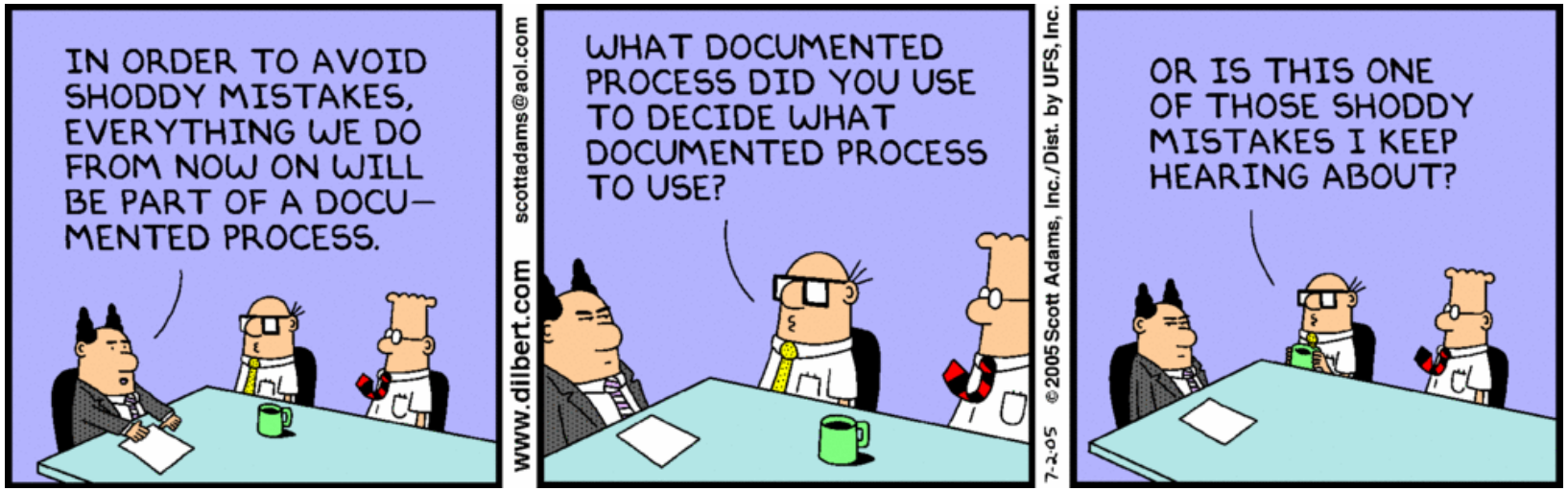


INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Further Work

Understanding the Processes

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013



Q&A and Discussion

Survey

INCOSE International Symposium
Philadelphia, PA
June 24-27, 2013

Please take the time to rate this presentation by submitting the web survey found at:

www.incose.org/symp2013/survey