26th annual INCOSE international symposium
Edinburgh, UK
July 18 - 21, 2016

Stuff Logistics!

Effective and Efficient Preparation for the Unforeseeable

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The Enterprise

Needs and solutions are considered as complex socio-technical Systems-of-Systems (SoS).

The solution's human elements close to the point of a systems utility often bear the brunt of compensating for gaps between the needs and the solution.

The Right Stuff …

Motivation:

To help system personnel close to the point of system utilisation address unforeseen events by capitalising on their ingenuity, resourcefulness and tenacity.

.

Provide them ‘something to work with’ to maintain their system “Fit-for-Purpose” to deal with the unforeseeable.

Stuff?

One definition …

“Matter, material, articles, or activities of a specified or indeterminate kind that are being referred to, indicated, or implied”

https://www.google.co.uk/?gws_rd=ssl#q=define+stuff

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Material
Energy
Information
(MEI)

https://www.google.co.uk/?gws_rd=ssl#q=define+stuff

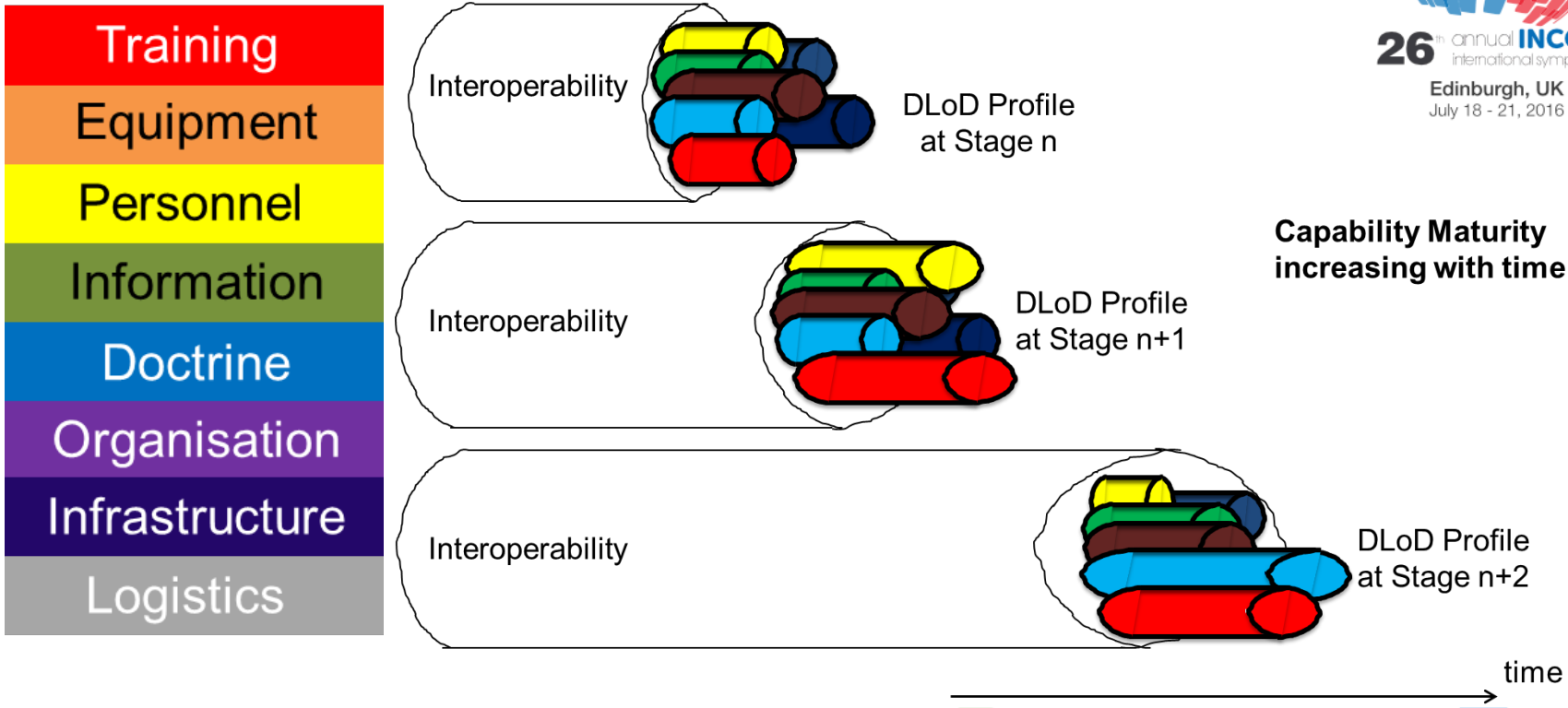
MEI Transfers

A SoS that does not achieve or maintain fitness-for-purpose because it cannot…

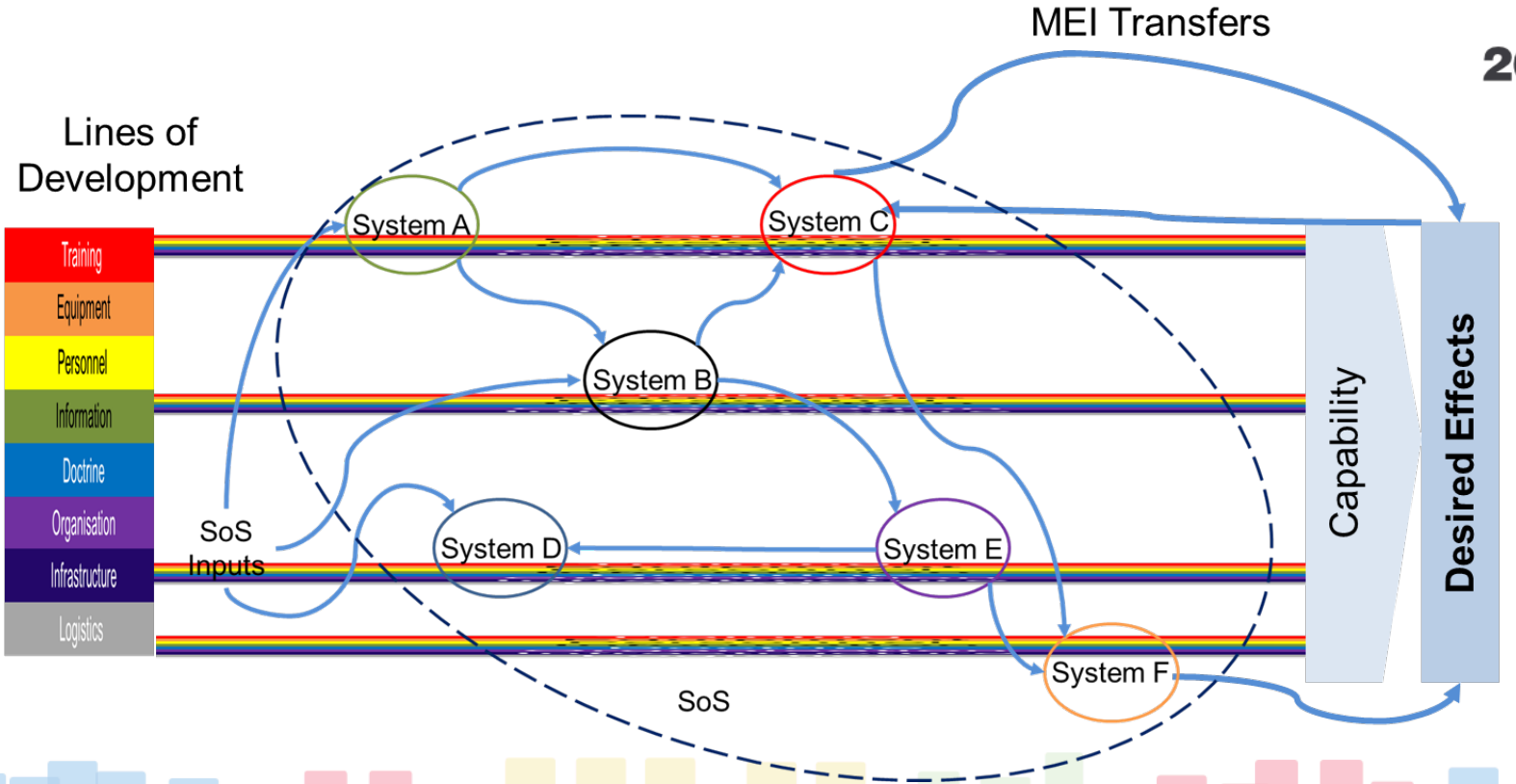
implement the *correct, timely* and *complete* transfer of Material, Energy and Information (MEI)…

between its constituents and with its external environment necessary to achieve a particular result.

Capability Components

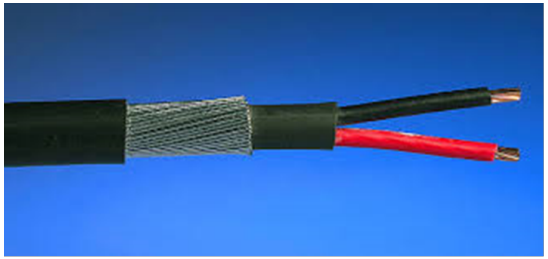


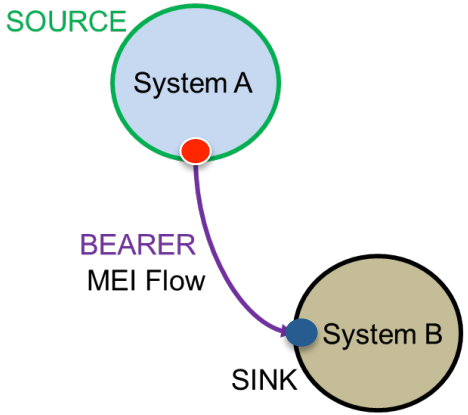
Capability & MEI Transfers



Simple SoS illustration

Here a Steel-Wire-Armoured (SWA) D.C. power cable is intended to transfer Energy from a source in one system via a bearer to a sink in another…

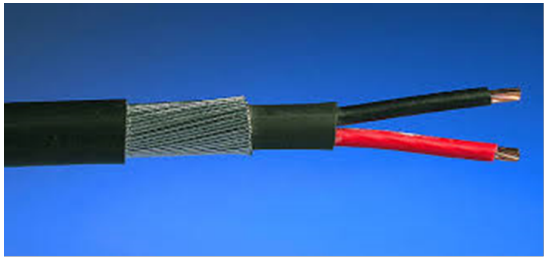


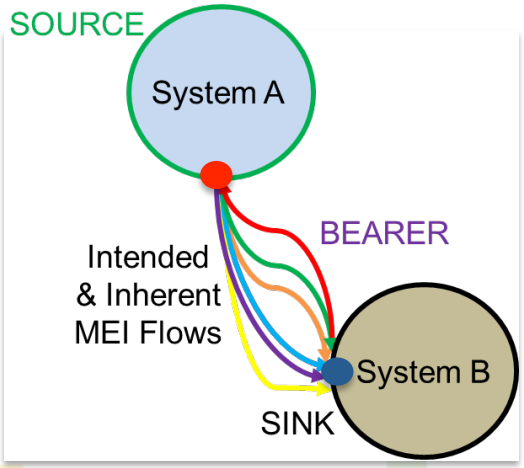


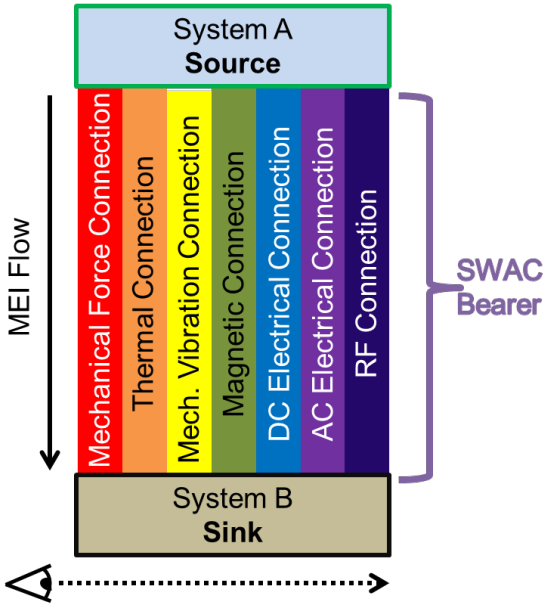
Source
Sink
Bearer
(SSB)

Not so simple SoS

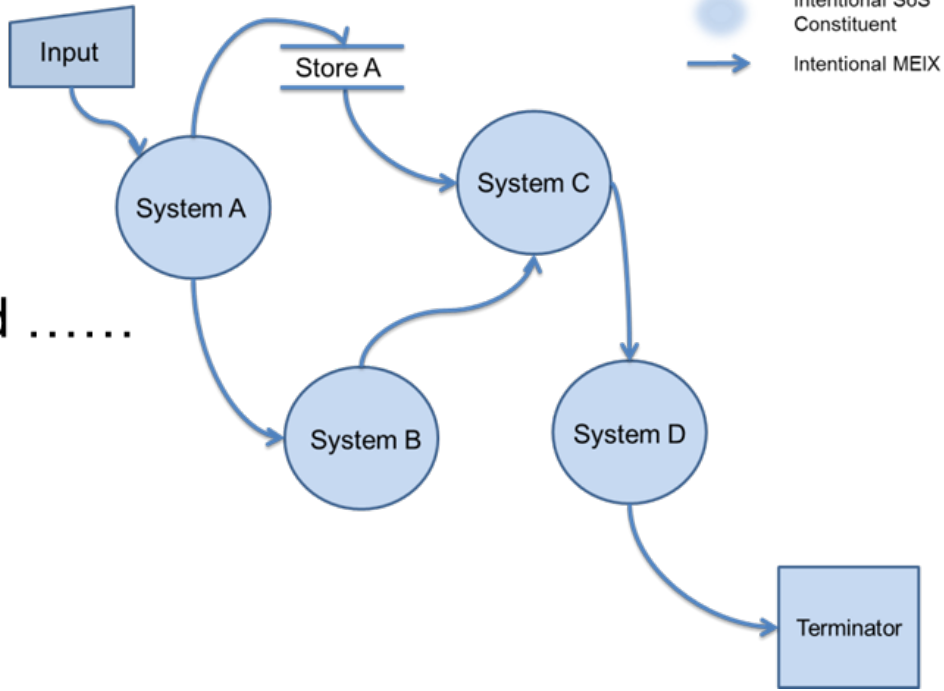
… but it also connects them mechanically, magnetically, thermally and A.C. couples them. Extending this…







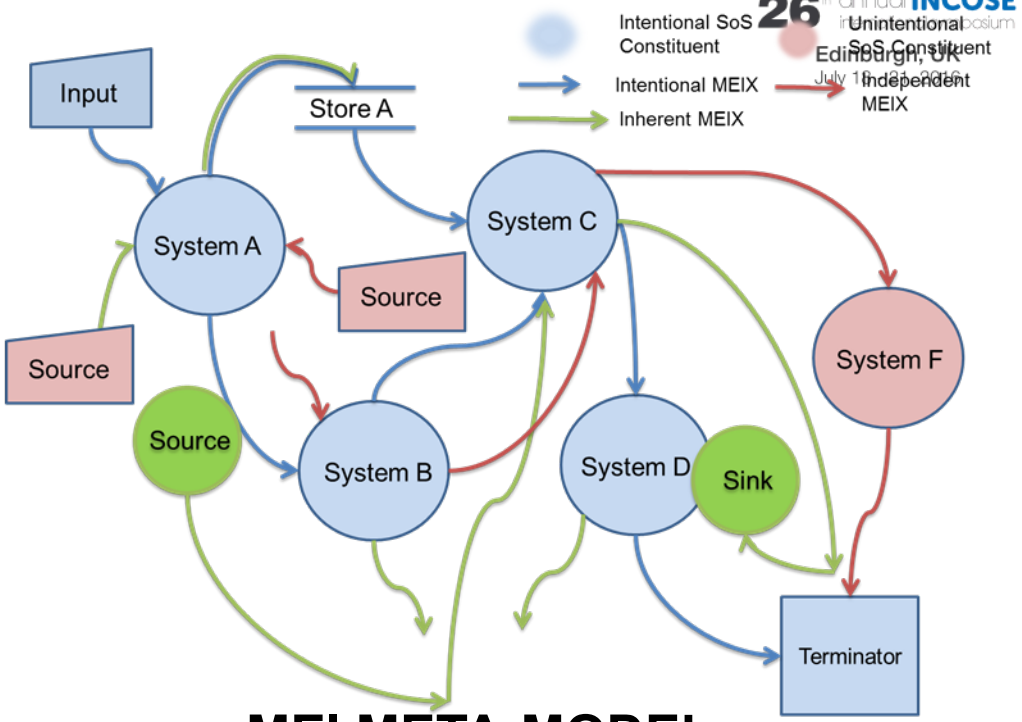
Intended MEI Transfers…



What we thought we had ……

..plus Inherent & Independents

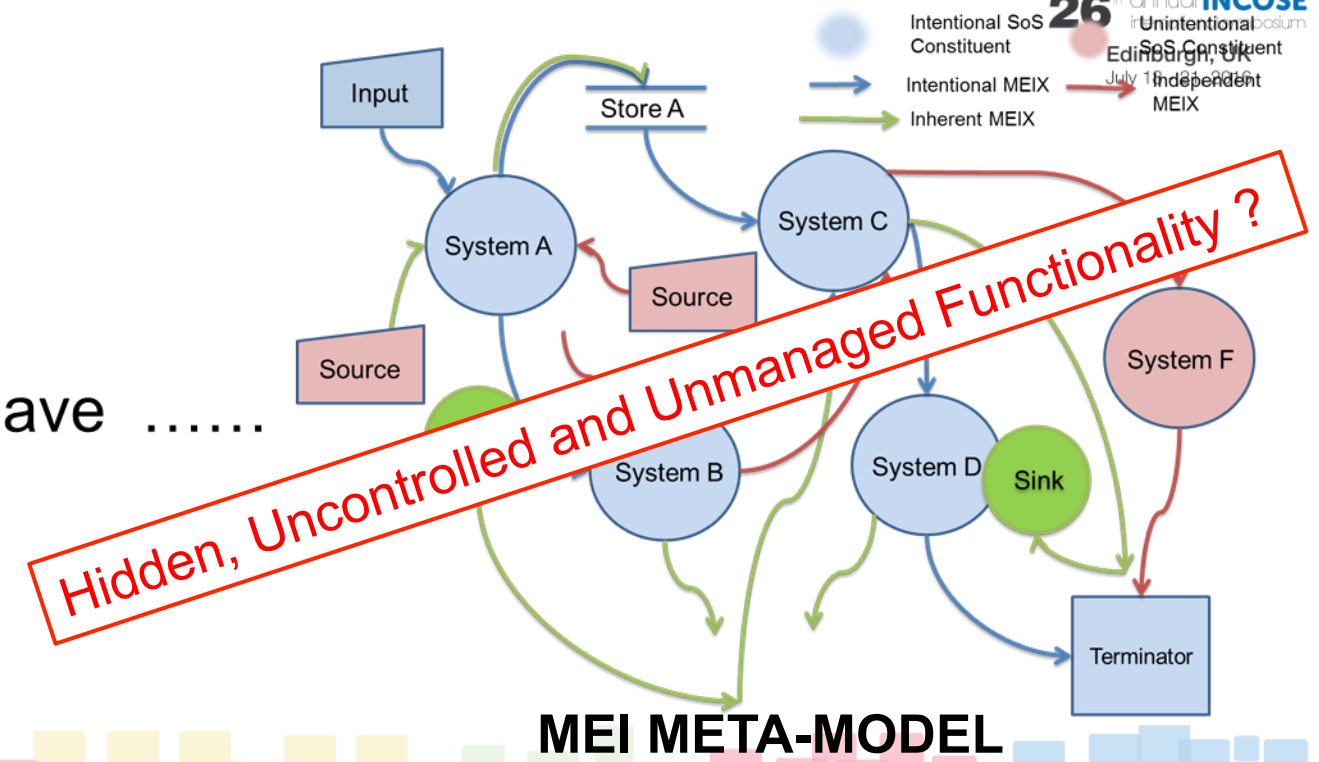
What we actually have ……



MEI META-MODEL

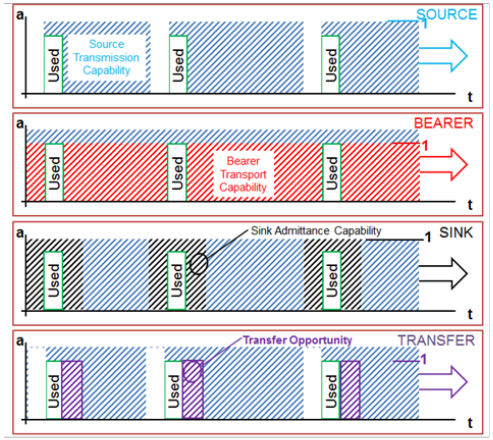
Risks! or Opportunities?

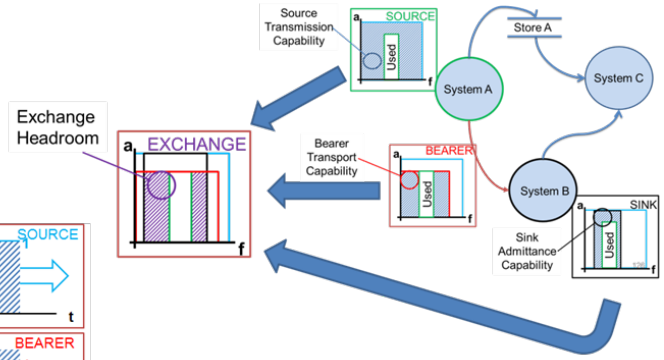
What we actually have ……

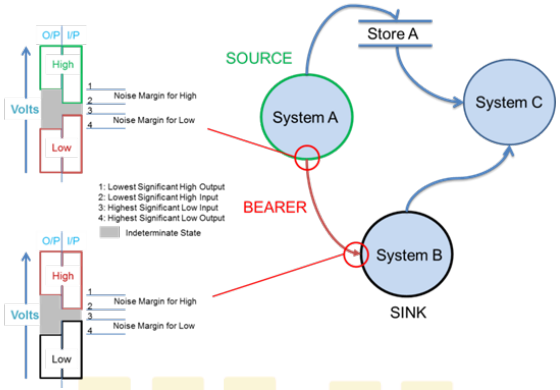


MEI META-MODEL

Risk or Opportunity



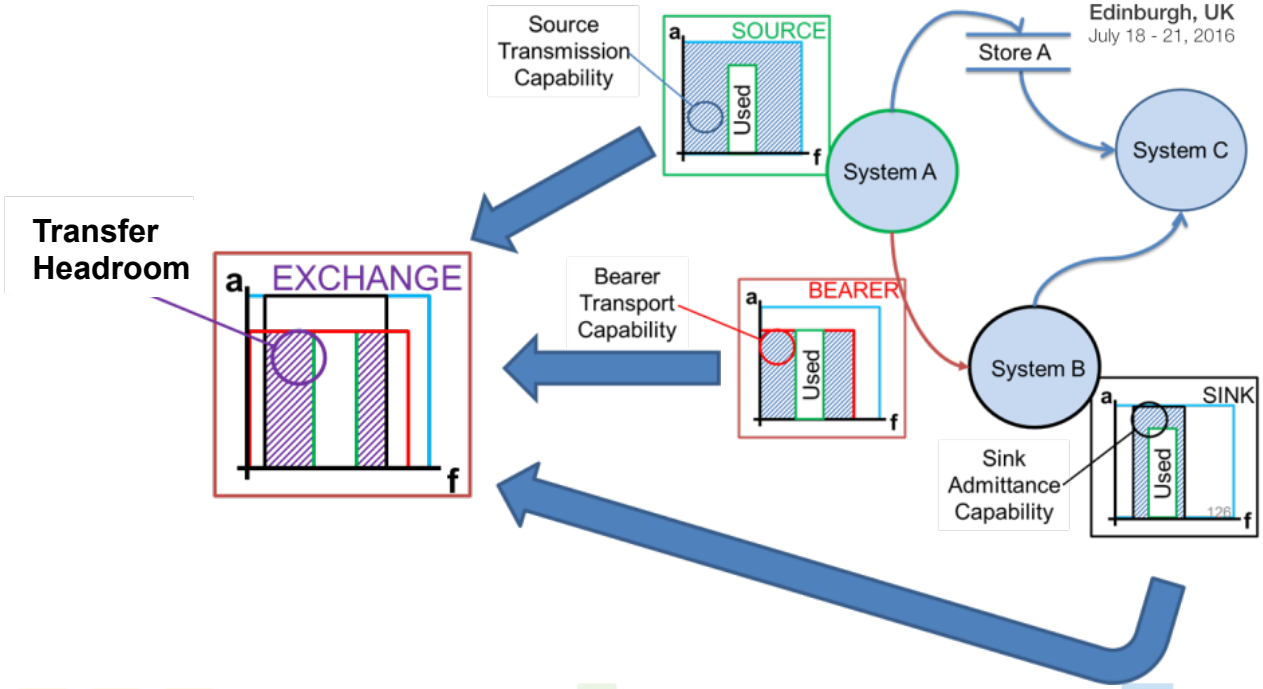




We need to determine if the MEI SSBs have the **Ability,** the **Opportunity** and the **Capacity** to be either problematic or an opportunity

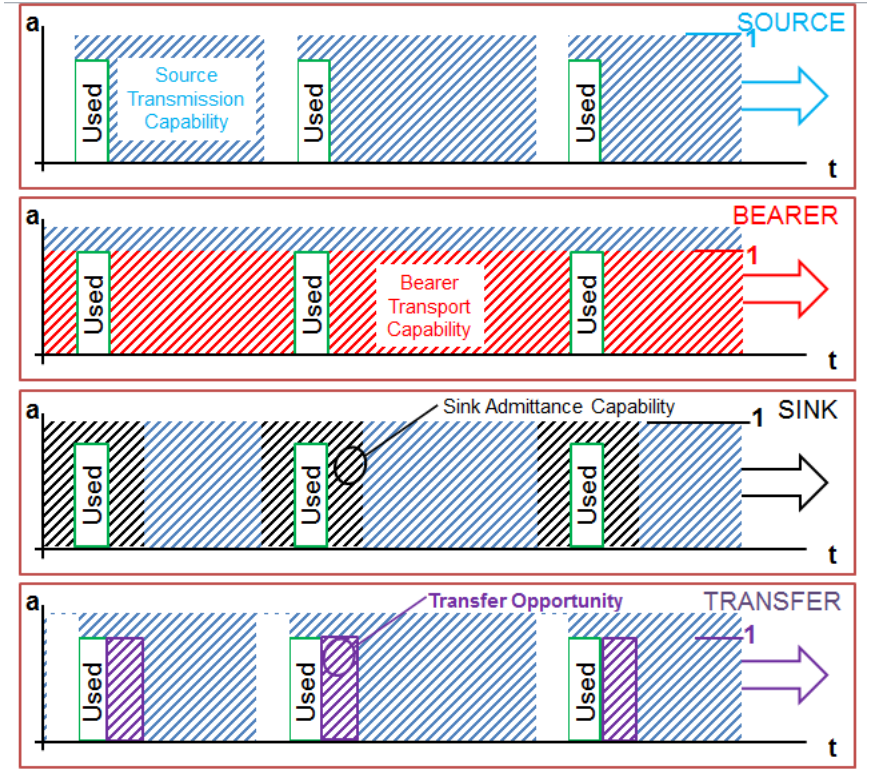
Ability: Frequency Domain

Bandwidth commonalities of MEI SSBs in the System of Interest (SoI) are determined by superposition of frequency responses



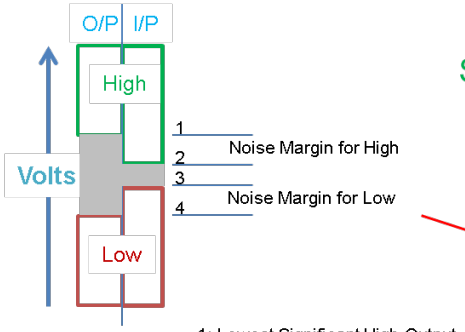
Opportunity: Time Domain

The MEI SSB connections are assessed to determine if they are synchronously active by superposition in the time domain



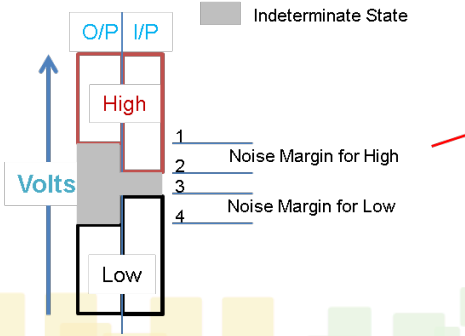
Capacity: Sensitivity Analysis

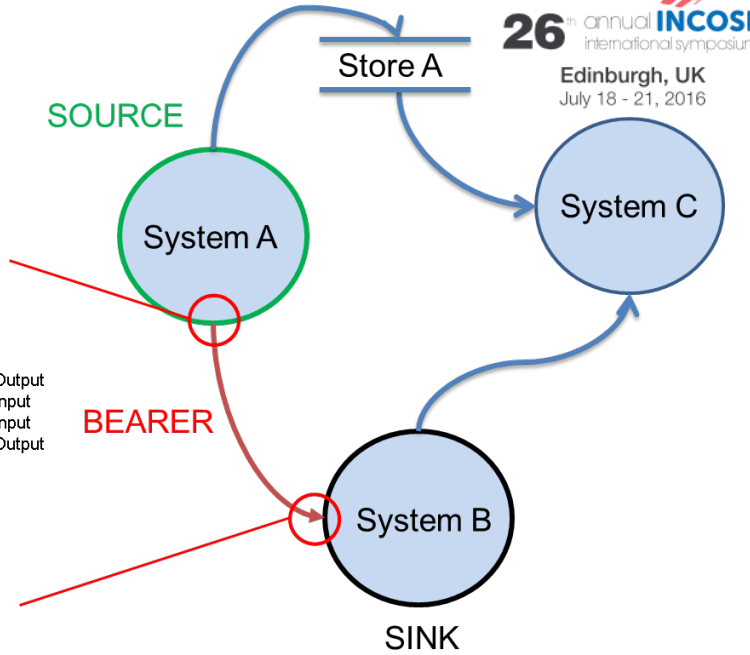
The MEI SSB connections are assessed to determine if they have sufficient transfer capacity to affect system operation



1: Lowest Significant High Output
2: Lowest Significant High Input
3: Highest Significant Low Input
4: Highest Significant Low Output

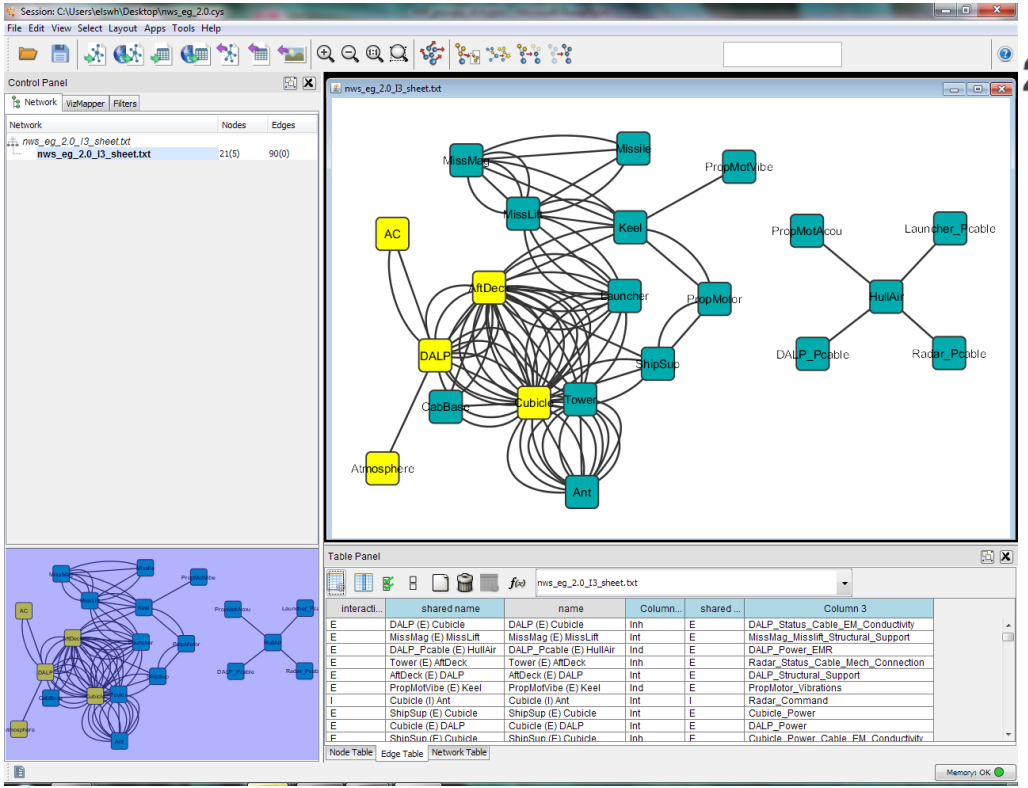
Indeterminate State



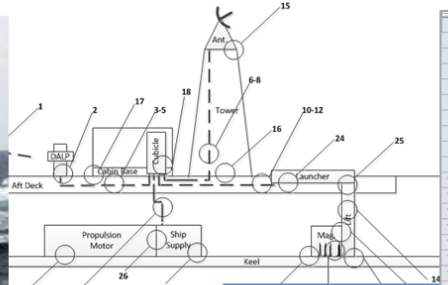


MEI Meta-Model

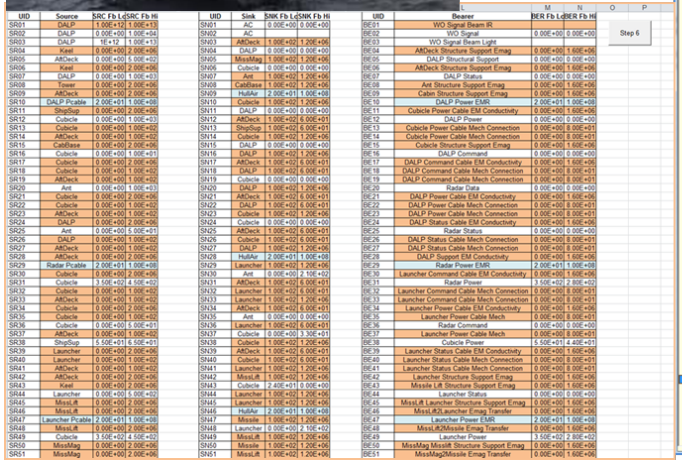
A PC-based concept demonstrator captured MEI SSB data and provided visual analytics

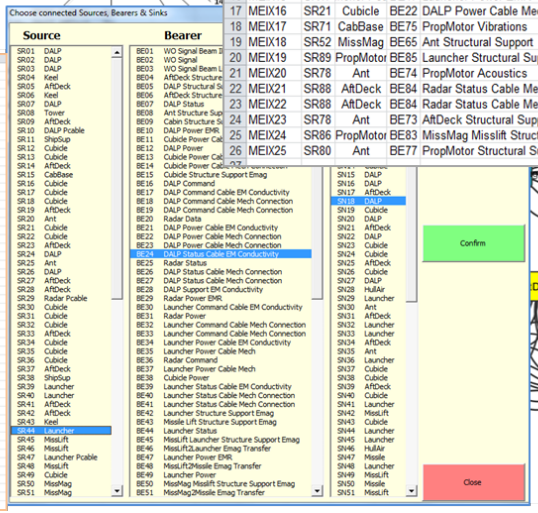


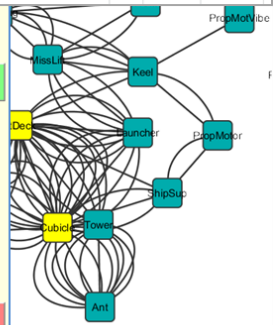
Big Data… Automation!



	A	B	C	D	E	F	G	H
1	UID	UID	Source	UID	Bearer	UID	Sink	Headroom
2	MEIX1	SR01	DALP	BE06	AftDeck Structure Support Emag	SN13	ShipSup	Yes
3	MEIX2	SR20	Ant	BE22	DALP Power Cable Mech Connection	SN24	Cubicle	No
4	MEIX3	SR13	Cubicle	BE17	DALP Command Cable EM Conductivity	SN17	AftDeck	No
5	MEIX4	SR35	Cubicle	BE37	Launcher Power Cable Mech	SN36	Launcher	No
6	MEIX5	SR24	DALP	BE31	Radar Power	SN22	DALP	Yes
7	MEIX6	SR48	MissLift	BE48	MissLift2Missile Emag Transfer	SN48	Launcher	No
8	MEIX7	SR27	AftDeck	BE30	Launcher Command Cable EM Conductivi	SN33	Launcher	No
9	MEIX8	SR38	ShipSup	BE30	Launcher Command Cable EM Conductivi	SN75	Ant	No
10	MEIX9	SR44	Launcher	BE71	Cubicle Structural Support	SN75	Ant	Yes
11	MEIX10	SR11	ShipSup	BE32	Launcher Command Cable Mech Connect	SN39	AftDeck	Yes
12	MEIX11	SR84	AftDeck	BE80	Radar Status Cable Mech Connection	SN76	PropMotor	No
13	MEIX12	SR18	Cubicle	BE19	DALP Command Cable Mech Connection	SN23	Cubicle	No
14	MEIX13	SR36	Cubicle	BE38	Cubicle Power	SN40	Cubicle	No
15	MEIX14	SR23	AftDeck	BE23	DALP Power Cable Mech Connection	SN21	AftDeck	No
16	MEIX15	SR47	ncher Pca	BE47	Launcher Power EMR	SN49	MissLift	No
17	MEIX16	SR21	Cubicle	BE22	DALP Power Cable Mech Connection	SN19	Cubicle	No
18	MEIX17	SR71	CabBase	BE75	PropMotor Vibrations	SN36	Launcher	No
19	MEIX18	SR52	MissMag	BE65	Ant Structural Support	SN47	Missile	Yes
20	MEIX19	SR89	PropMotor	BE85	Launcher Structural Support	SN42	MissLift	No
21	MEIX20	SR78	Ant	BE74	PropMotor Acoustics	SN42	MissLift	No
22	MEIX21	SR88	AftDeck	BE84	Radar Status Cable Mech Connection	SN50	Missile	Yes
23	MEIX22	SR88	AftDeck	BE84	Radar Status Cable Mech Connection	SN86	Launcher	No
24	MEIX23	SR78	Ant	BE73	AftDeck Structural Support	SN69	AftDeck	No
25	MEIX24	SR86	PropMotor	BE83	MissMag Misslift Structural Support	SN77	Cubicle	Yes
26	MEIX25	SR80	Ant	BE77	PropMotor Structural Support	SN73	HullAir	Yes

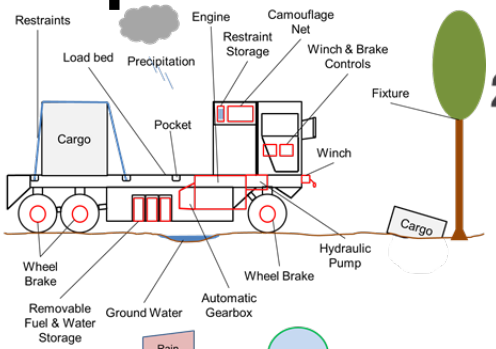


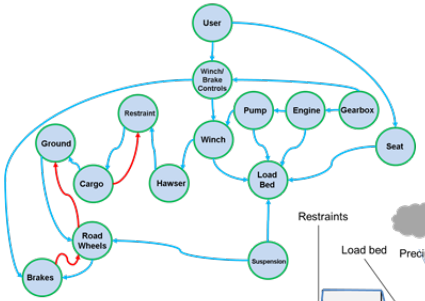


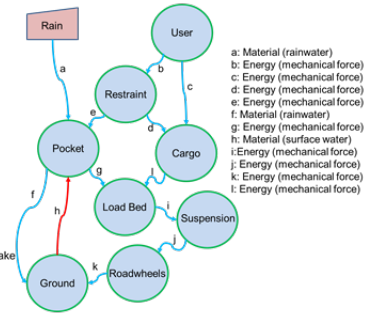


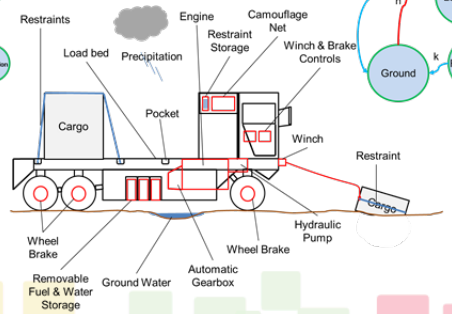
Royal Logistics Corps

Vehicles and scenarios showed undesirable effects of unintended MEI transfers and operators use of MEI transfer headroom









Opportunity Illustration

Lamp array indicates ship movement to landing aircraft

Modulation circuit put in during LED lamp update

An Unforeseen Event

- Carrier operations provide a military capability
- Political situation changes so manned aircraft operations become unacceptable

Fitness-for-Purpose Maintained

Lamp modulation brought into play as a part of a Urgent Operational Requirement (UOR) enabling restoration of inhibited military capability

Take-Aways

- Consider un-intended MEI SSBs and connections when actualising a design.

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- Examine for Risk & Opportunity, take appropriate action at an affordable scale and record it in the project technical data.

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- Find facets of MEI transfer thinking in your business & utilise for wider benefit

Questions?

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Maintaining Systems-of-Systems Fit-For Purpose

A method and process that identifies prospective exploitation of a composed System-of-Systems' (SoS) Material, Energy and Information **(MEI)** Sources, Sinks and Bearers **(SSB)** in order to equip it to maintain it Fit for Purpose **(FFP)** after experiencing *unpredictable changes* in operation, internal and/or external factors.

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Thank You!

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