Second International Engineering Systems Symposium 2009

Architecting C4I Systems

Presented by Ming Chun NG

Defence Science & Technology Agency

Picture Source http://www.saabsystems.com.au/Images/operability.jpg

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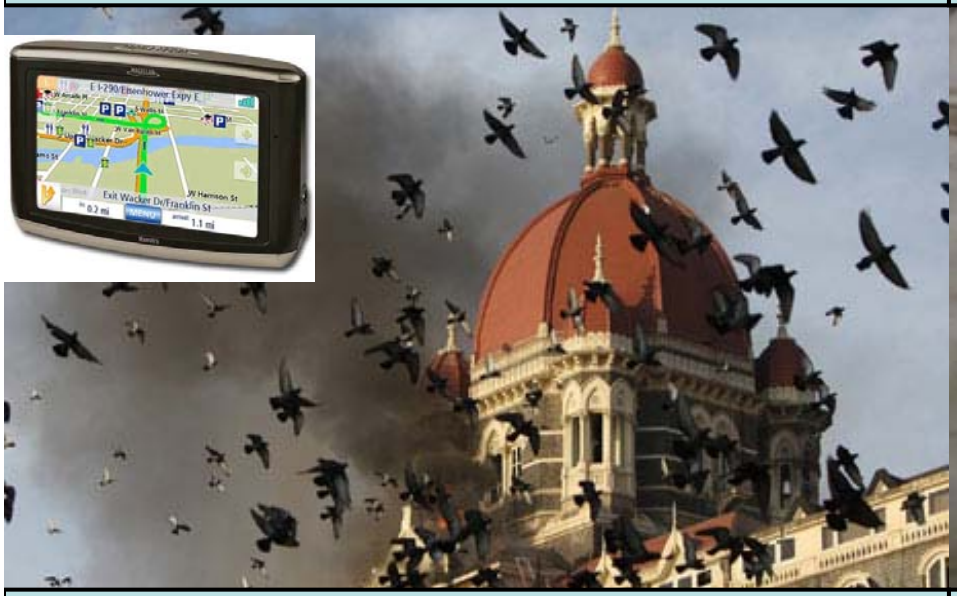
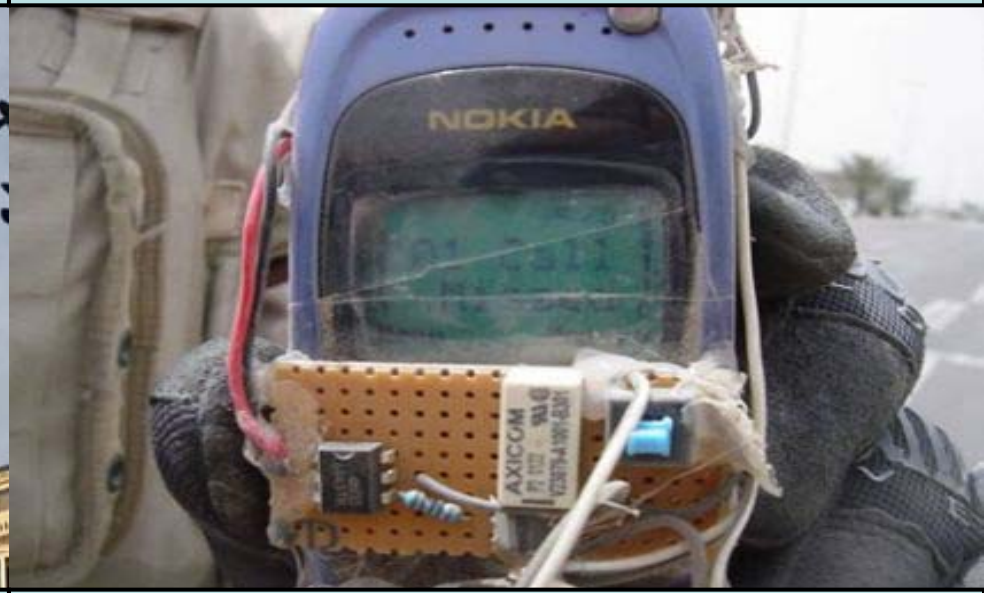
Multi-faceted and multi-dimensional security challenges

State-on-State Conflict

Pirate Attacks



Terrorism



Cellphone Bomb Detonator

Network-Centric Warfare Concept

Link up knowledge-enabled forces to create greater synergies and firepower.

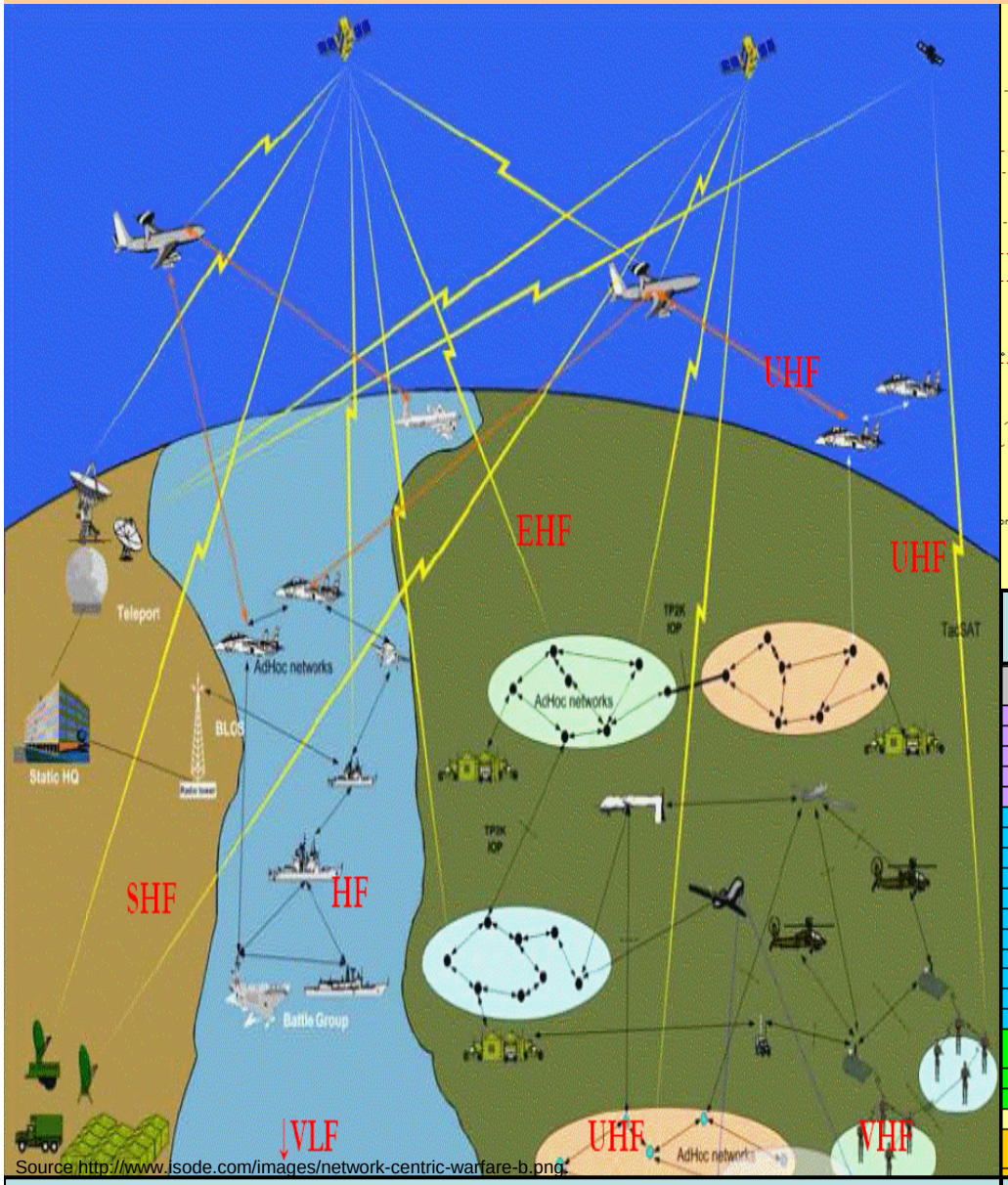
How to build a coherent C4I System-of-Systems?

Designing a C4I System-of Systems

Systems Architecting

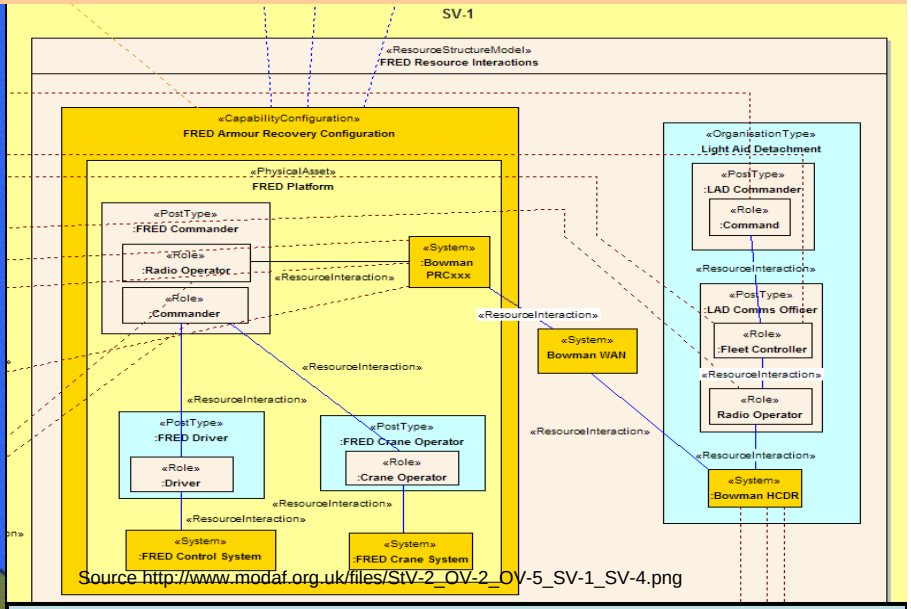
a C4I System-of-Systems.

Systems Architecting



Source http://www.isode.com/images/network-centric-warfare-b.png

Operational View



Source http://www.modaf.org.uk/files/StV-2_OV-2_OV-5_SV-1_SV-4.png

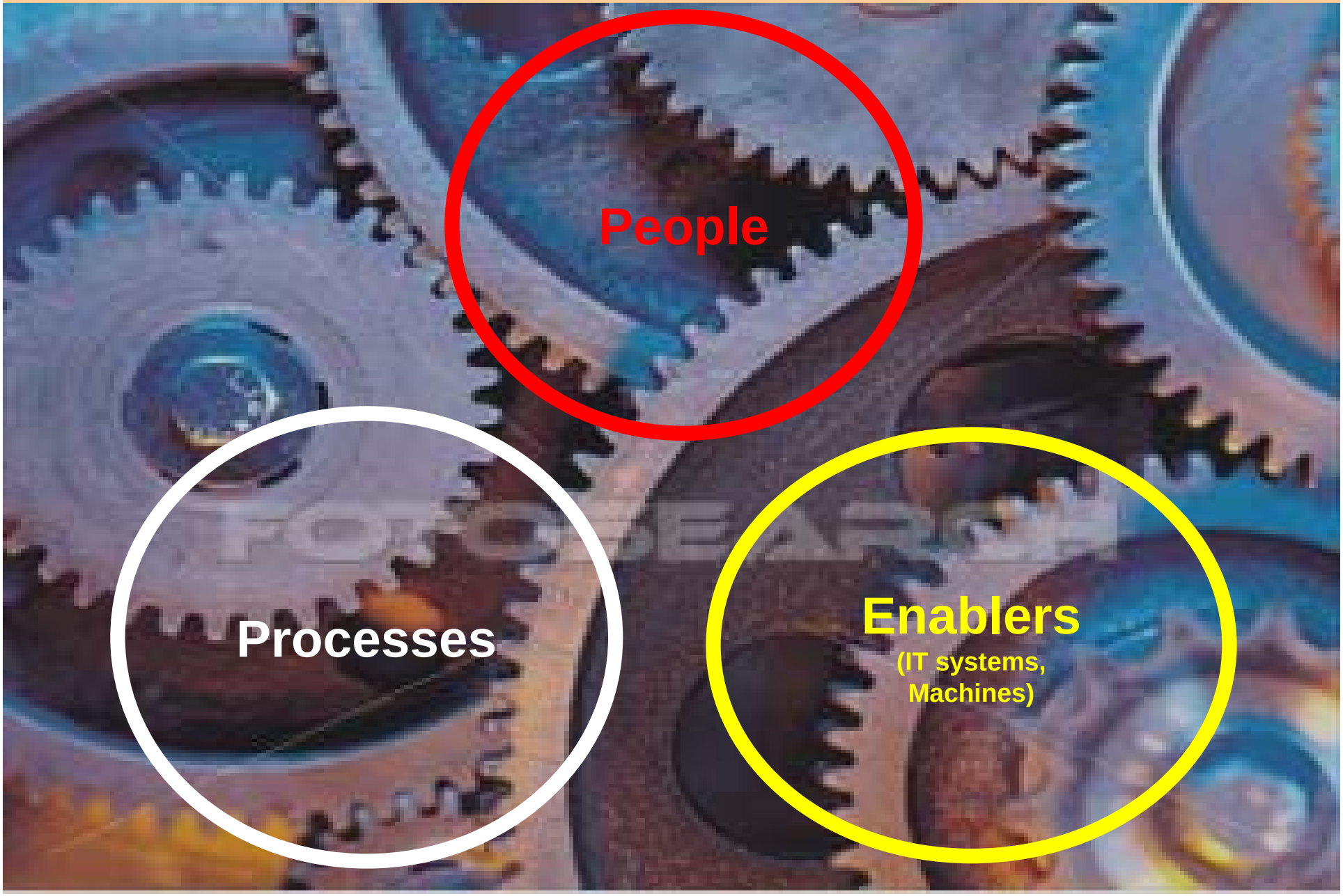
System View

JTA Service Area	Service	JTA Standard and Source Document
Information-Processing Standards	Higher Order Languages	
	Software Life-Cycle Process	
	Geospatial Data Interchange	
	Motion Imagery Data Interchange - Video	
	Distributed-Object Computing	
Information-Transfer Standards	Data Flow Network	
	Command and Control Information (C2I) Network	
	Physical Layer	
	Network Interface	
	Layer Management	
	File Transfer Standards	
	Remote Terminal Standards	
	Network Time Synchronization Standards	
	Web Services Standards	
	Connectionless Data Transfer	
	Transport Services Standards	
Information Modeling, Metadata, and Information Exchange Standards	Activity Modeling	
	Data Modeling	
	Object-Oriented Modeling	
Human Computer Interface	Mandates	
Information Security / Information Infrastructure Standards	Password Security	

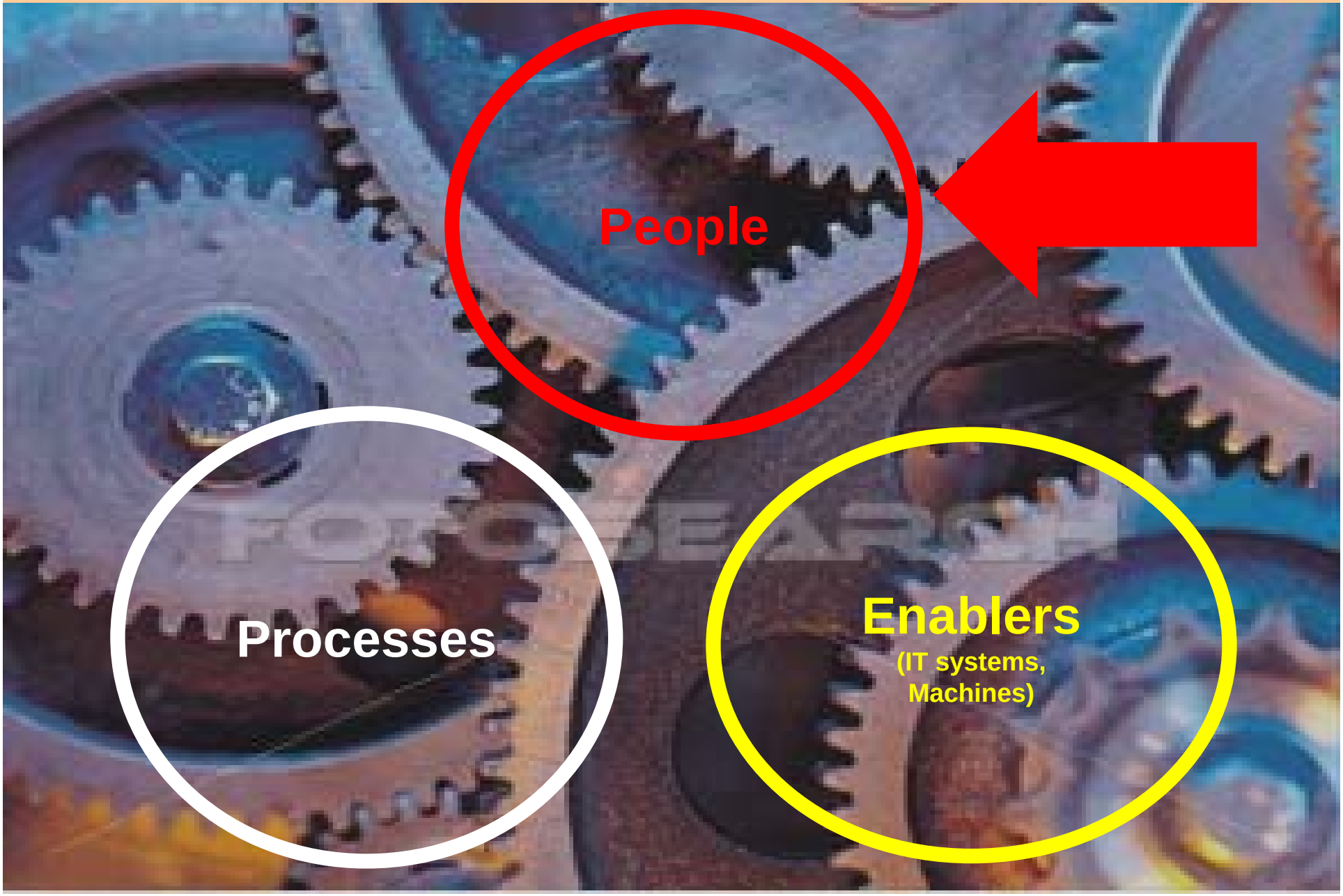
Source http://elamb.org/wp-content/uploads/2008/03/tv-1large.gi

Technical View

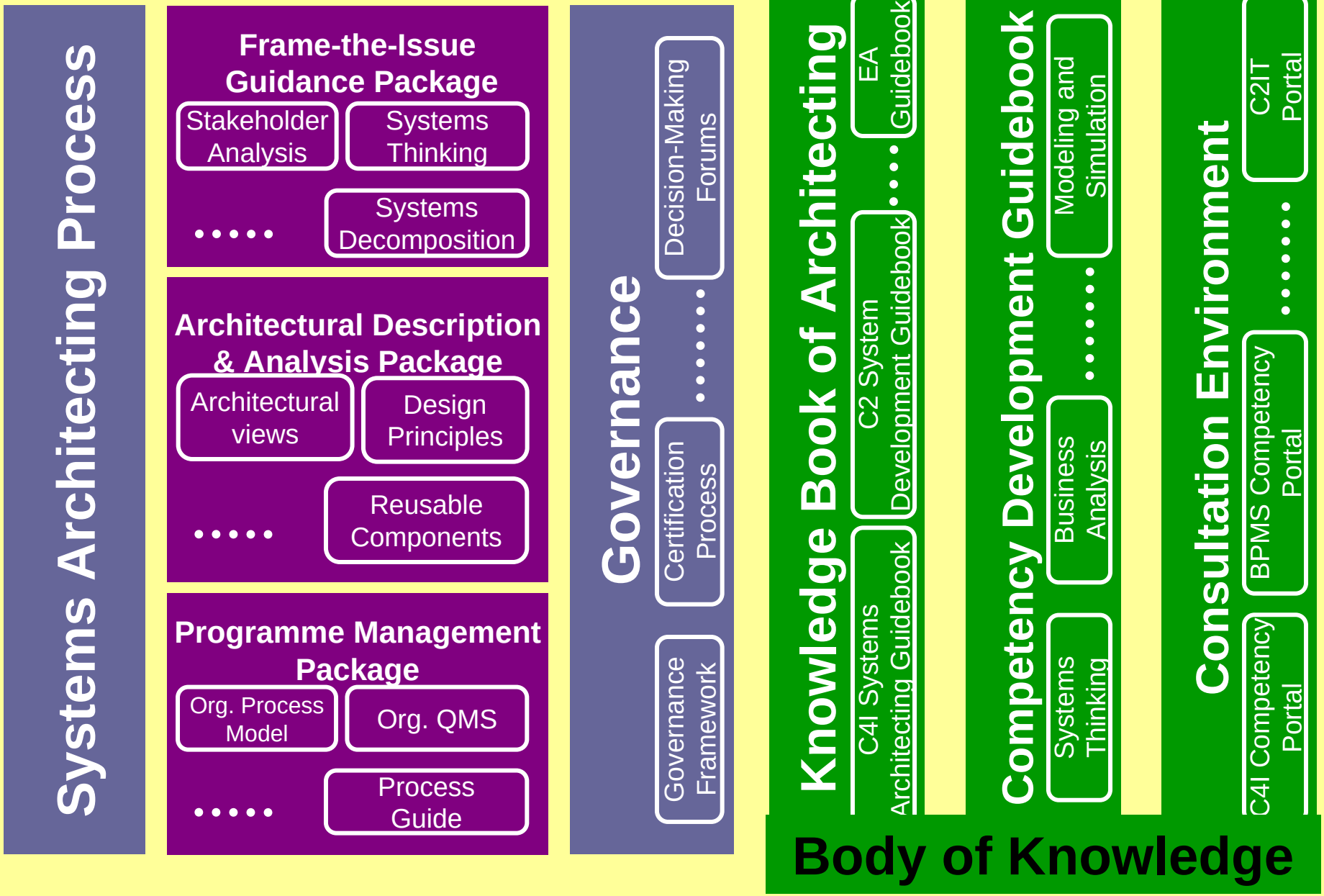
Systems Architecting



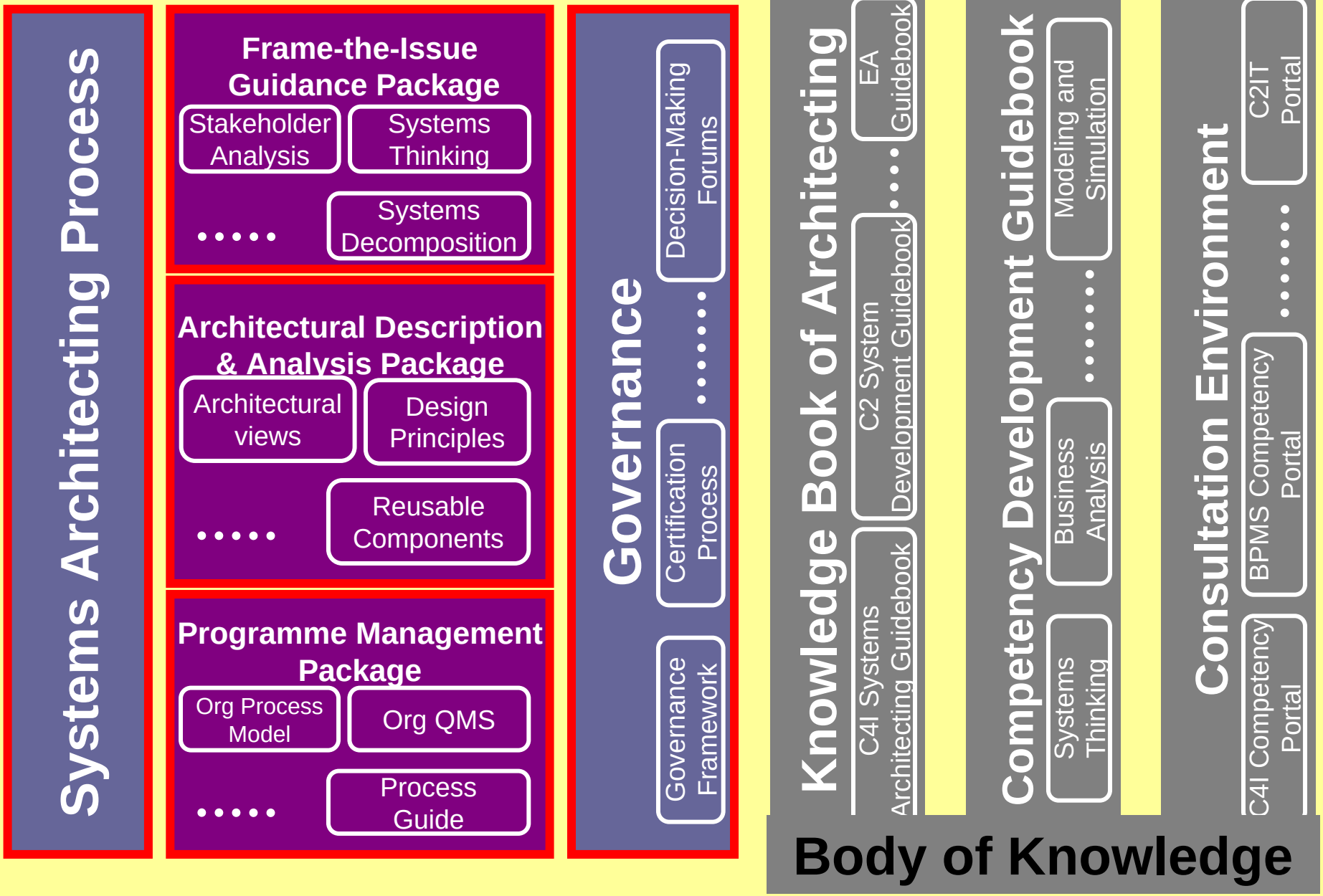
Systems Architecting – Both a Science & an Art



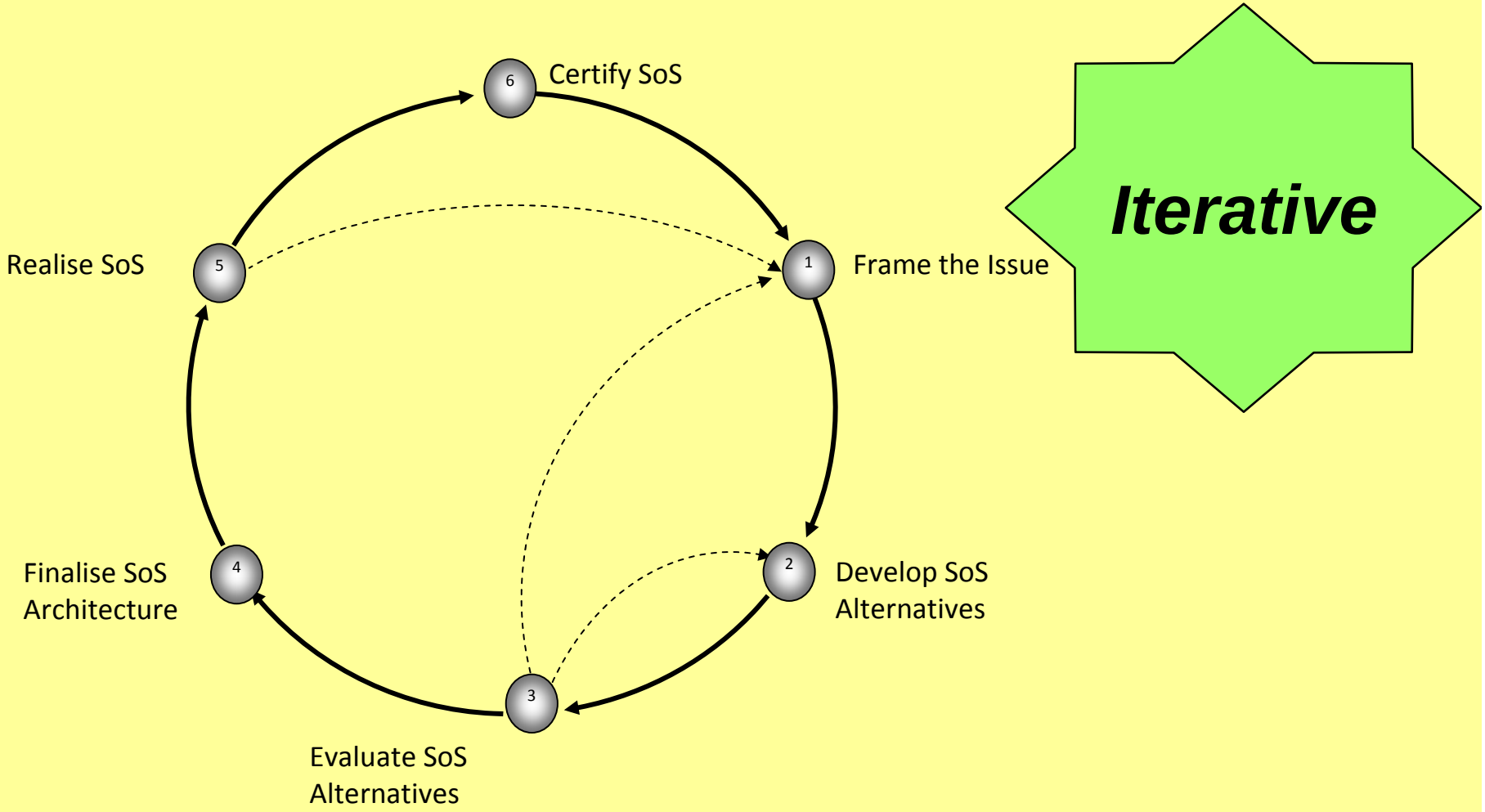
C4I Systems Architecting Framework



C4I Systems Architecting Framework

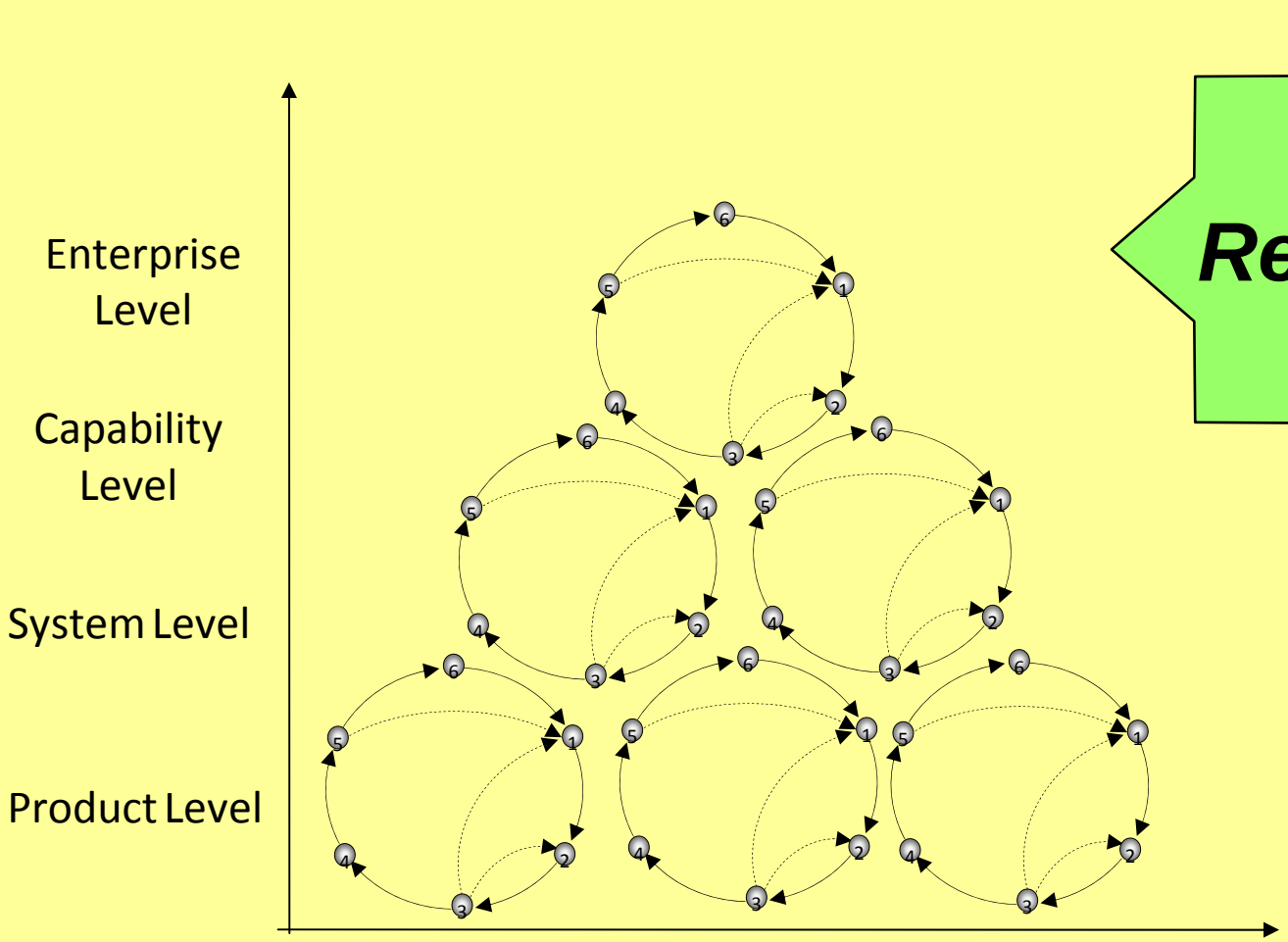


Systems Architecting Process



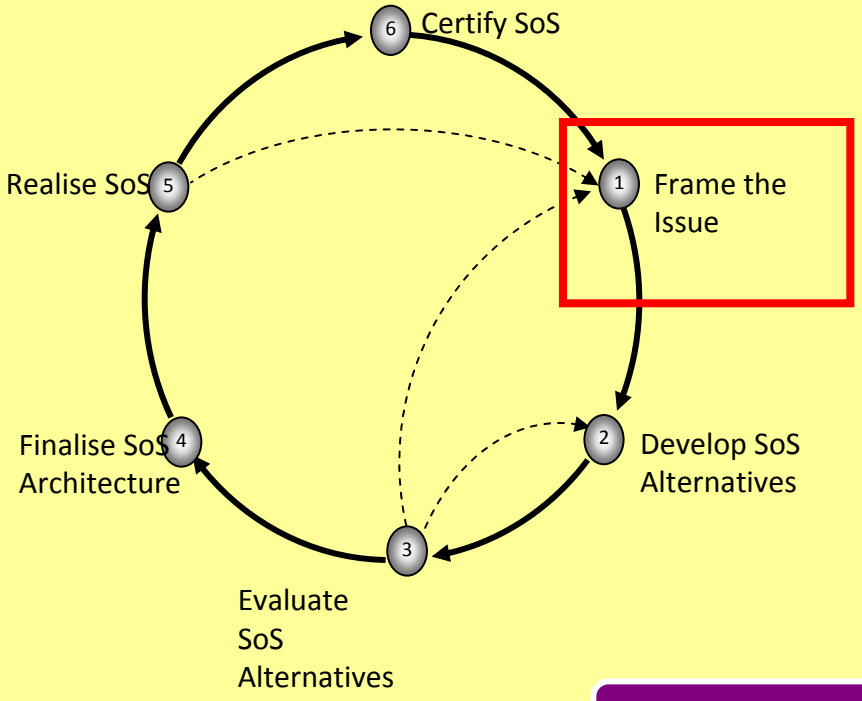
A Six-step Systems Architecting Process

Systems Architecting Process ...



Recursive

Understanding the Capability Gap



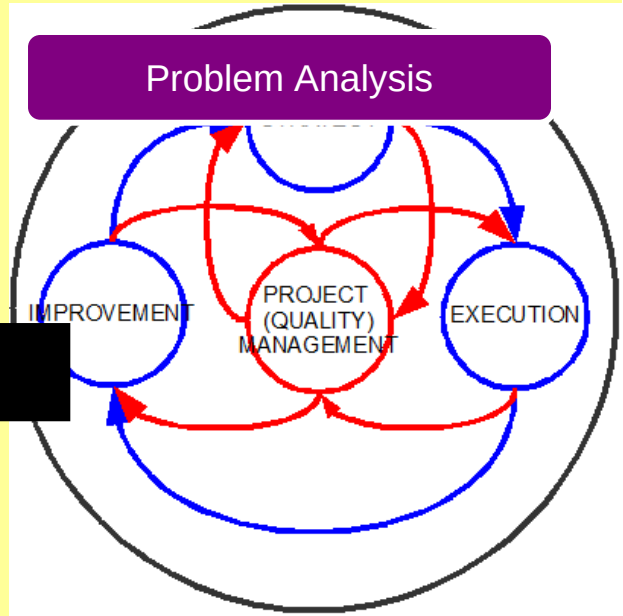
Frame-the-Issue Guidance Package

- Stakeholder Analysis
- Systems Thinking
- Systems Decomposition
- • • • •

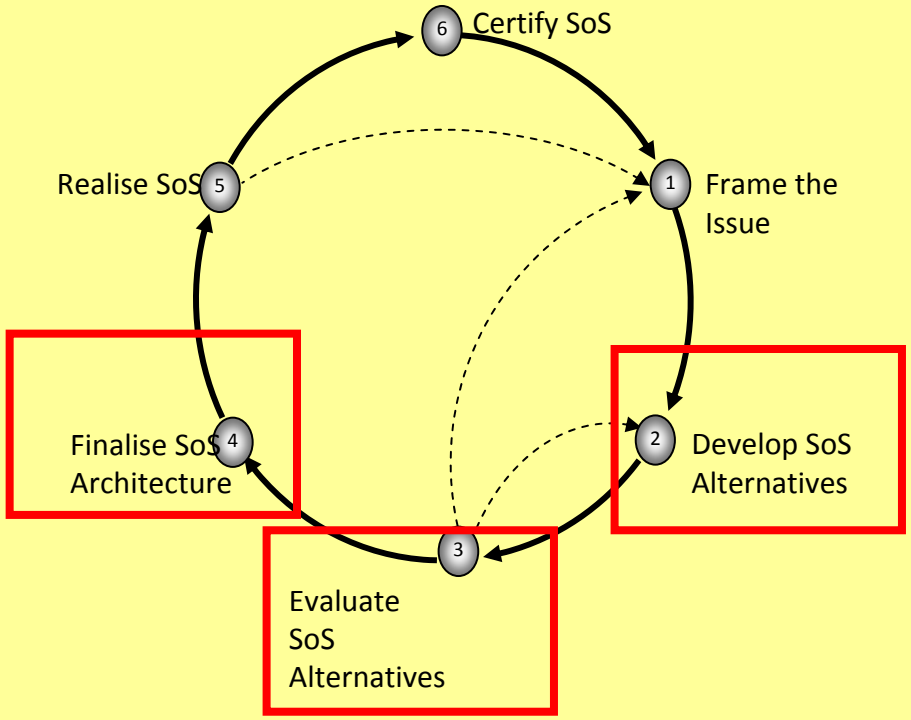
Capability Gap List

Stakeholder engagement

Problem Analysis

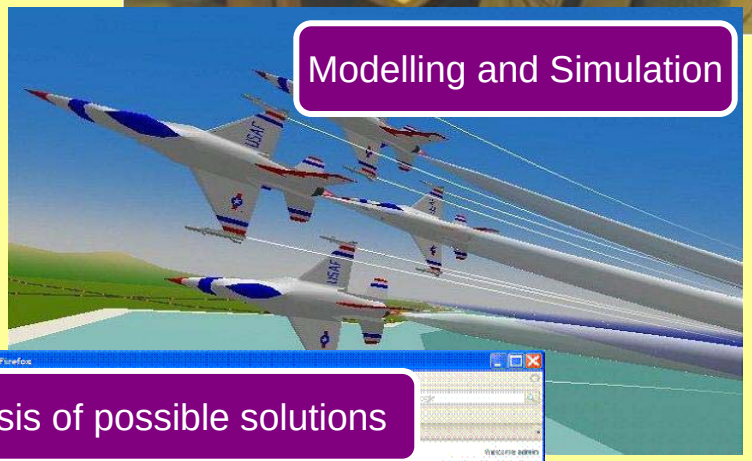


Devising the SoS Solution

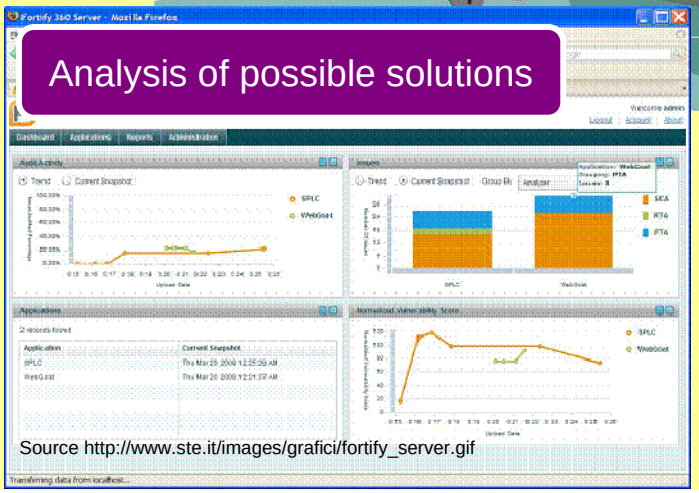


Solution Space Exploration

Modelling and Simulation

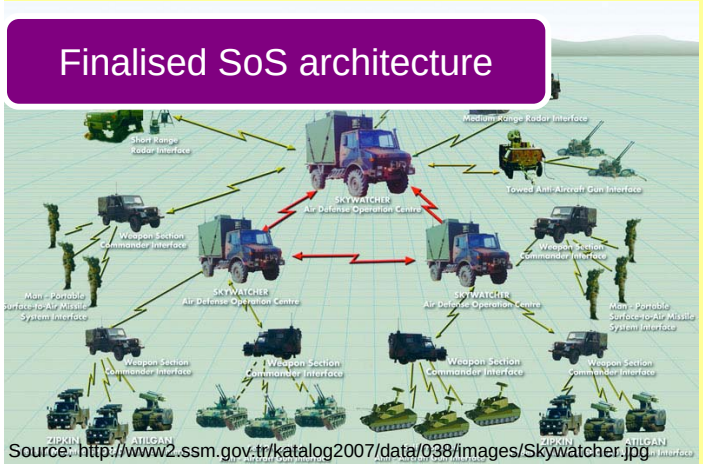


Analysis of possible solutions



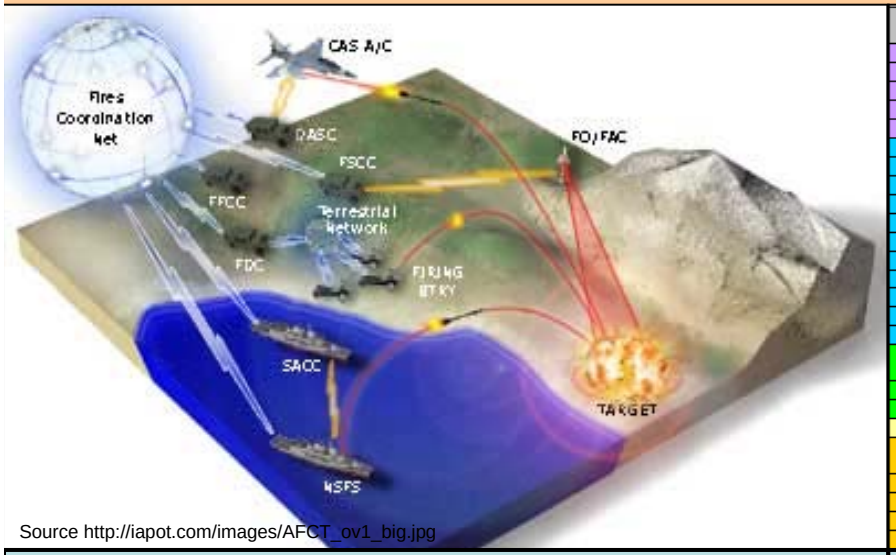
Source http://www.ste.it/images/grafici/fortify_server.gif

Finalised SoS architecture



Source: http://www2.ssm.gov.tr/katalog2007/data/038/images/Skywatcher.jpg

Examples of SoS Architectural Views



Source http://iapot.com/images/AFCT_ov1_big.jpg

Operational View

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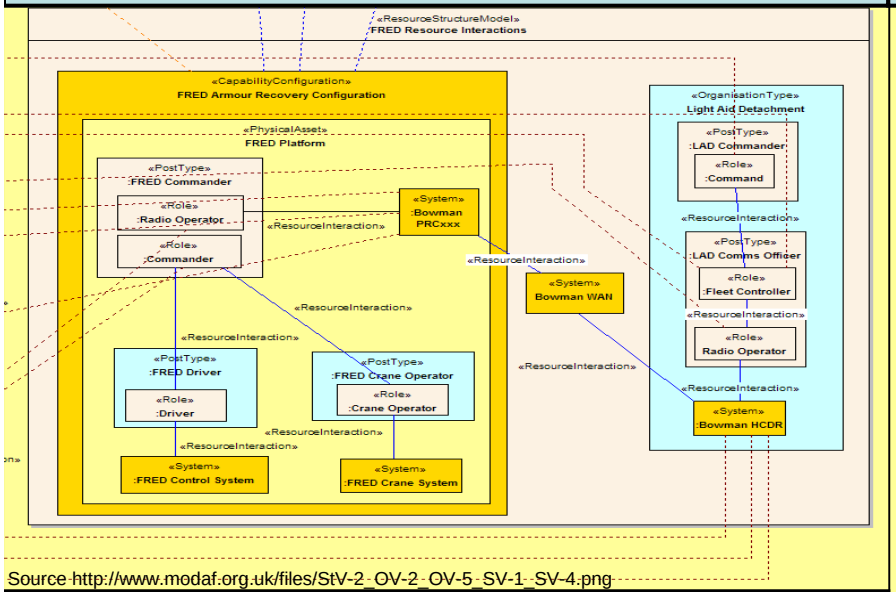
	Network Interface	
	Layer Management	
	File Transfer Standards	
	Remote Terminal Standards	
	Network Time Synchronization Standards	
	Web Services Standards	
	Connectionless Data Transfer	
	Transport Services Standards	
Information Modeling, Metadata, and Information Exchange Standards	Activity Modeling	
	Data Modeling	
	Object-Oriented Modeling	
Human Computer Interface	Mandates	
Information Security / Information Infrastructure Standards	Password Security	
	Application Software Entity Security Standards	
	Virtual Private Network Service	
	Intrusion Detection Service	
	Human-Computer Interface Security Standards	

Source http://elamb.org/wp-content/uploads/2009/03/tv-1large.gif

Technical View



Source http://www.modaf.org.uk/files/StV-2_OV-2_OV-5_SV-1_SV-4.png

System View

Architectural Description & Analysis Package

- Architectural views
- Design Principles
- Reusable Components
- .....

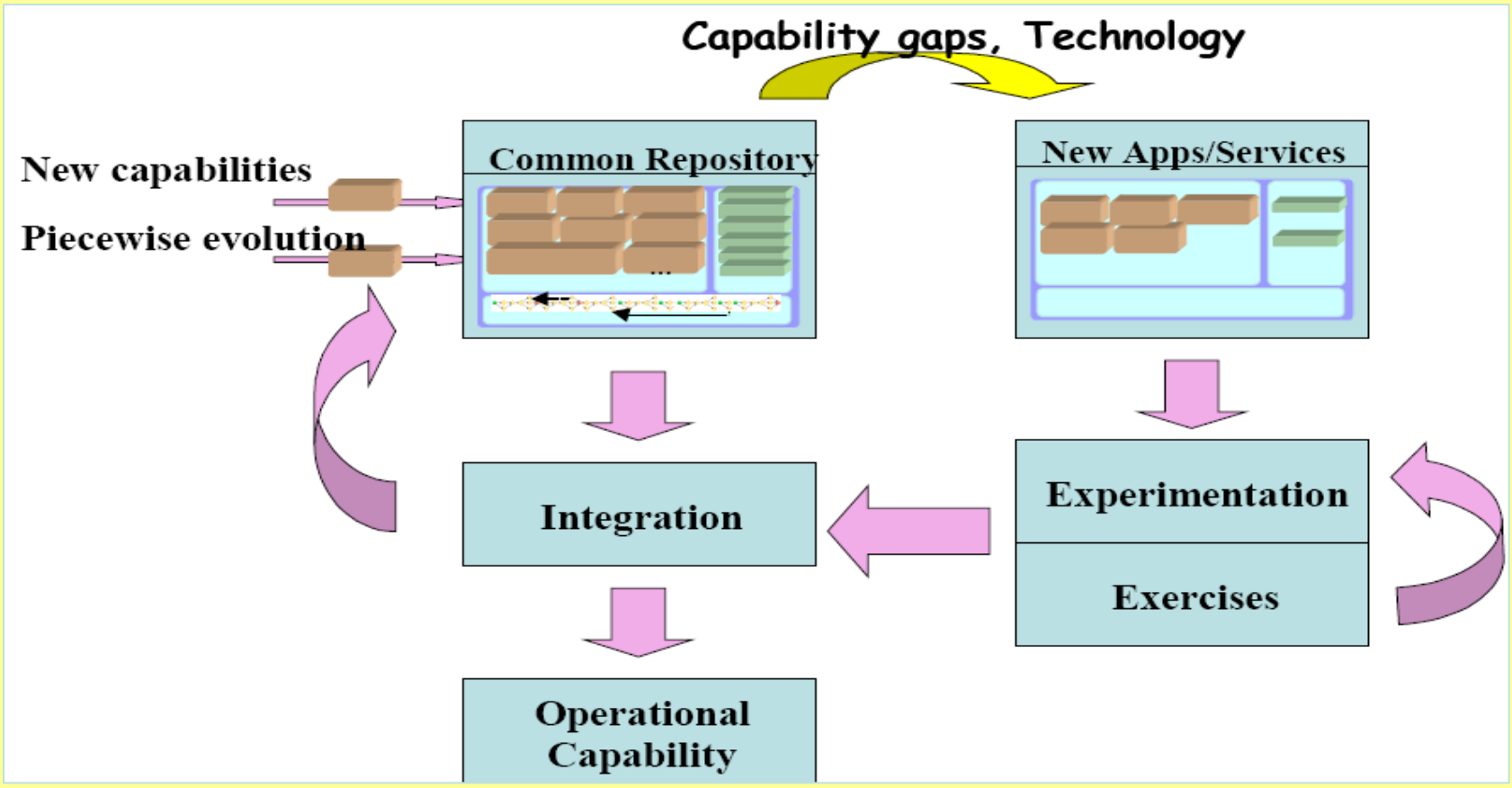
Devising the SoS Solution …

Speeding up the Development of Operational Capabilities

- Common Repository
- Service Oriented Architecture (SOA)
- Business Process Management Systems (BPMS)

Devising the SoS Solution …

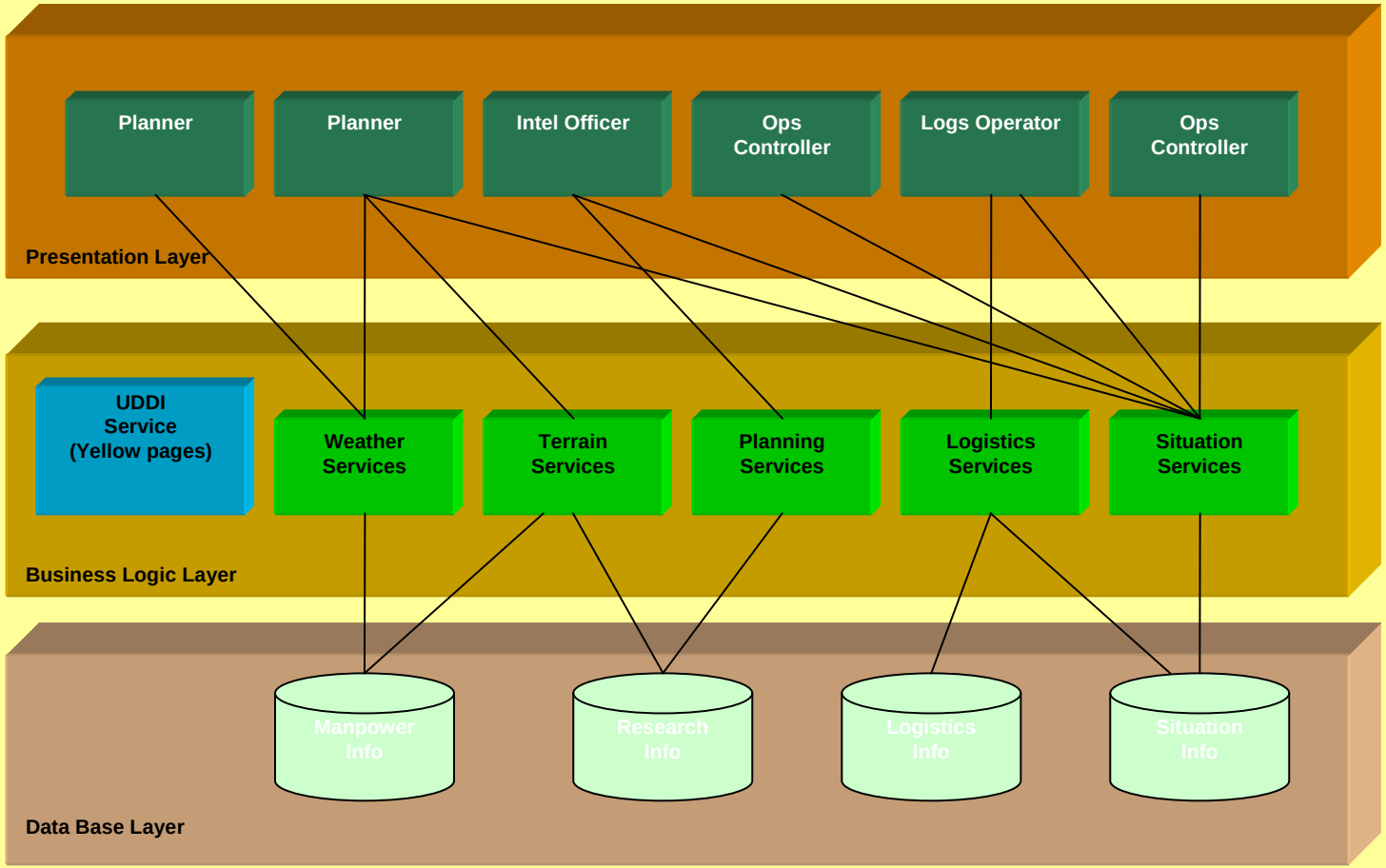
Common Repository



Process for Maintenance of Common Repository

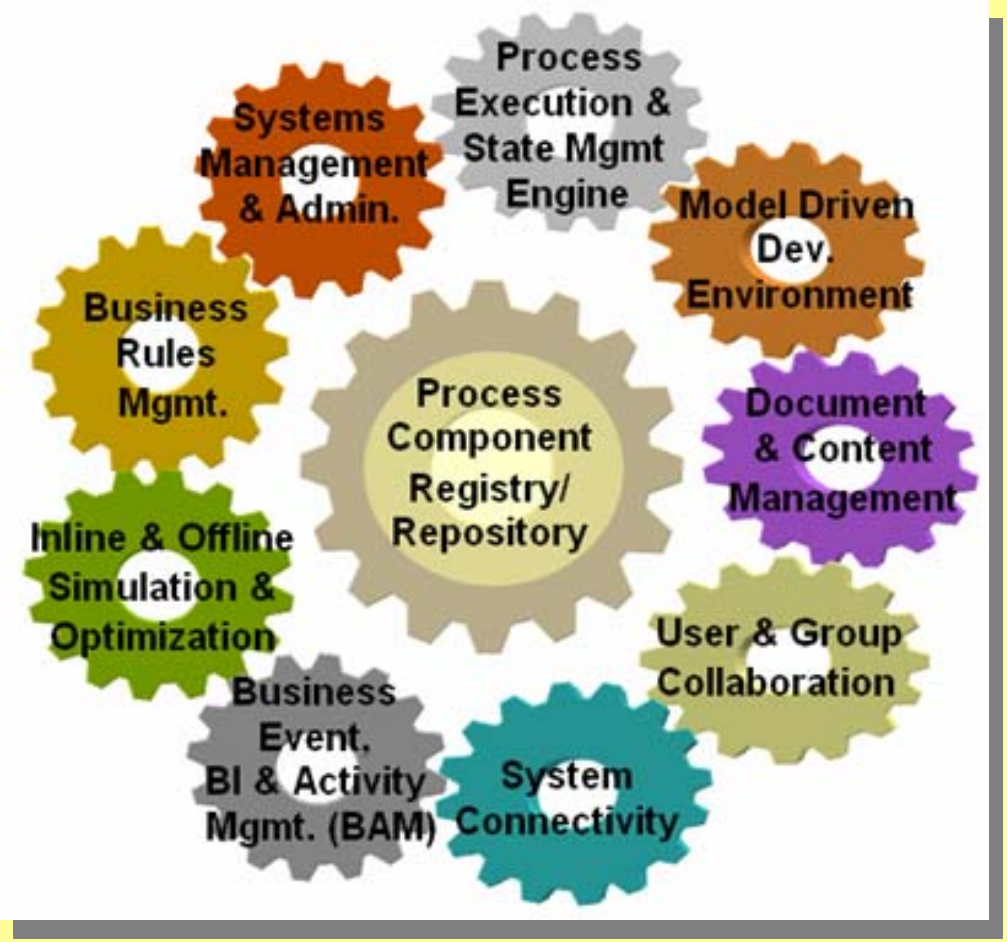
Devising the SoS Solution …

Service Oriented Architecture (SOA)



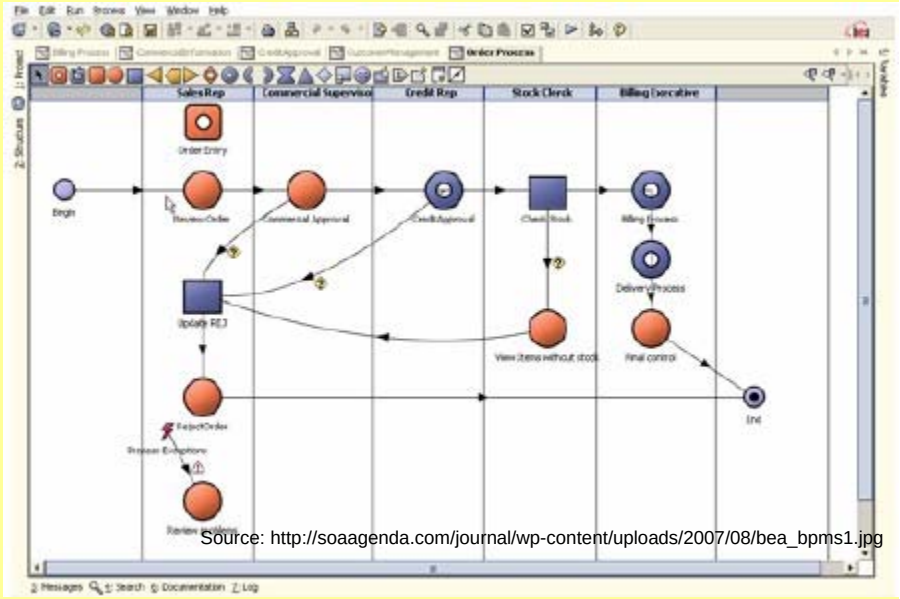
Devising the SoS Solution …

Business Process Management System



GARTNER's 10 components of BPMS

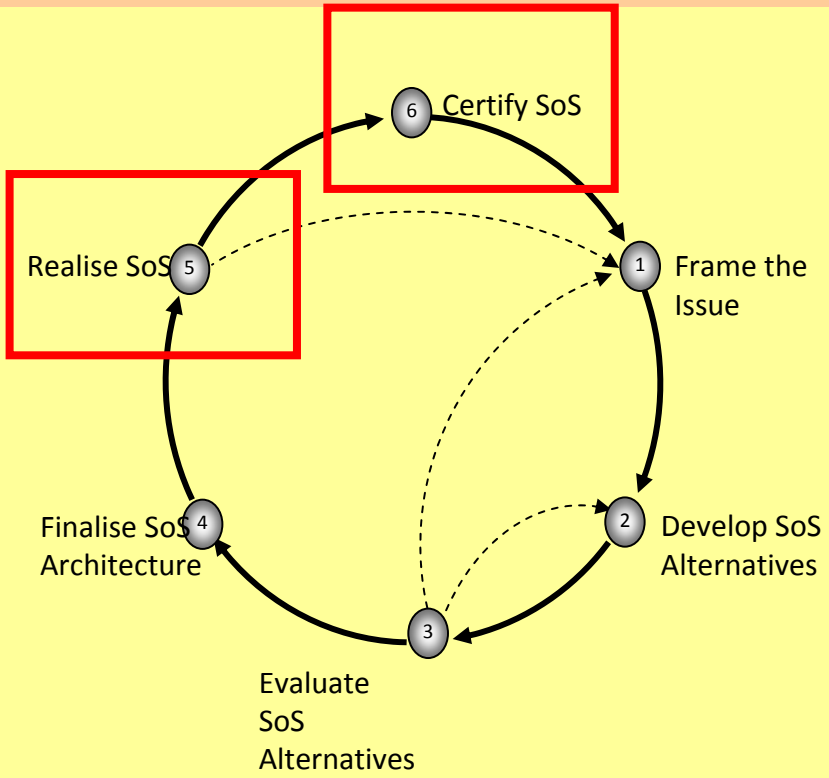
Source: GARTNER BPMS Summit 2008



Source: http://soaagenda.com/journal/wp-content/uploads/2007/08/bea_bpms1.jpg

Commercial BPMS: BEA Aqualogic

Developing and Certifying the SoS Solution



Solution Development

Solution Acquisition

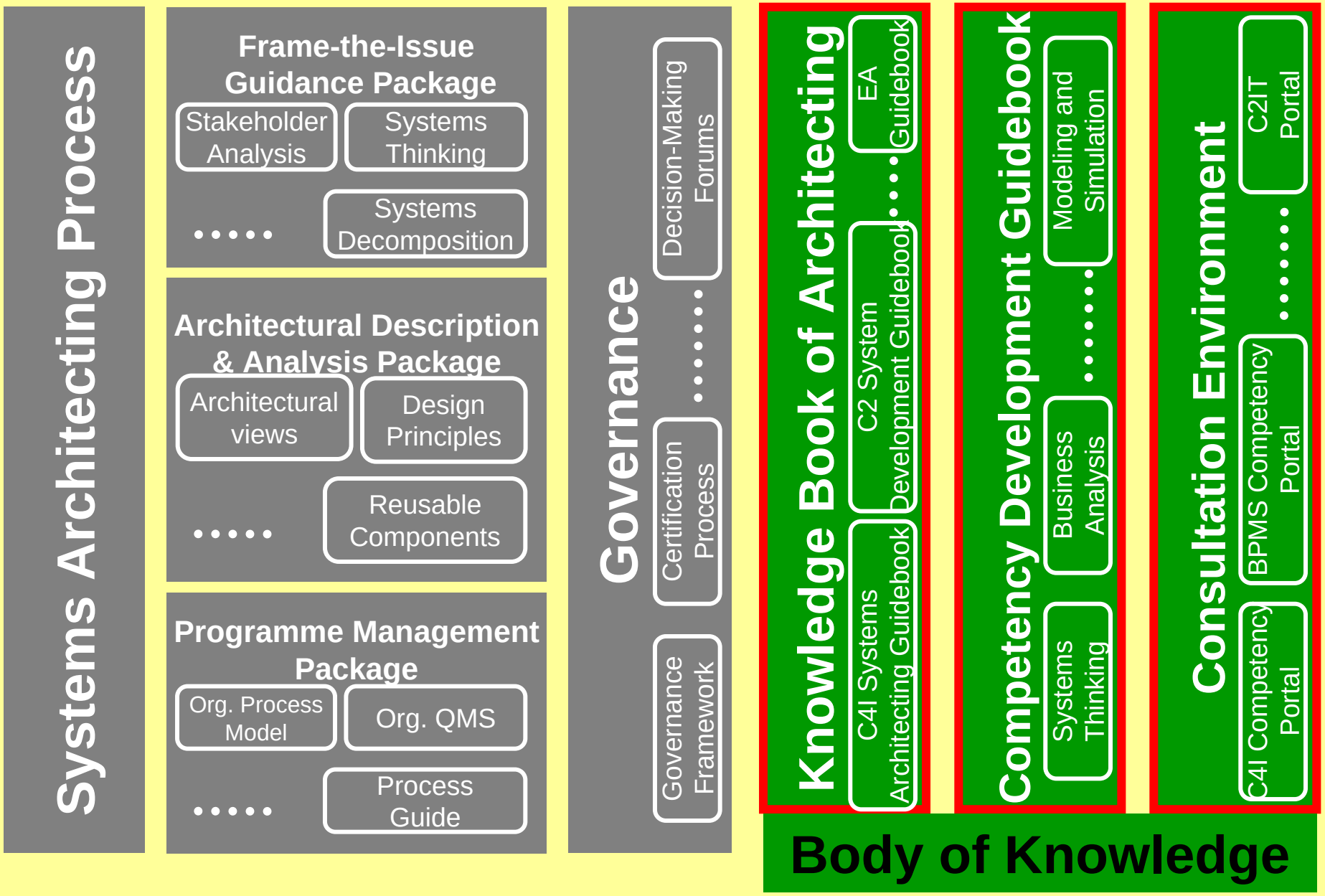
Systems Integration

Field Test and Ops Validation

Programme Management Package

Governance

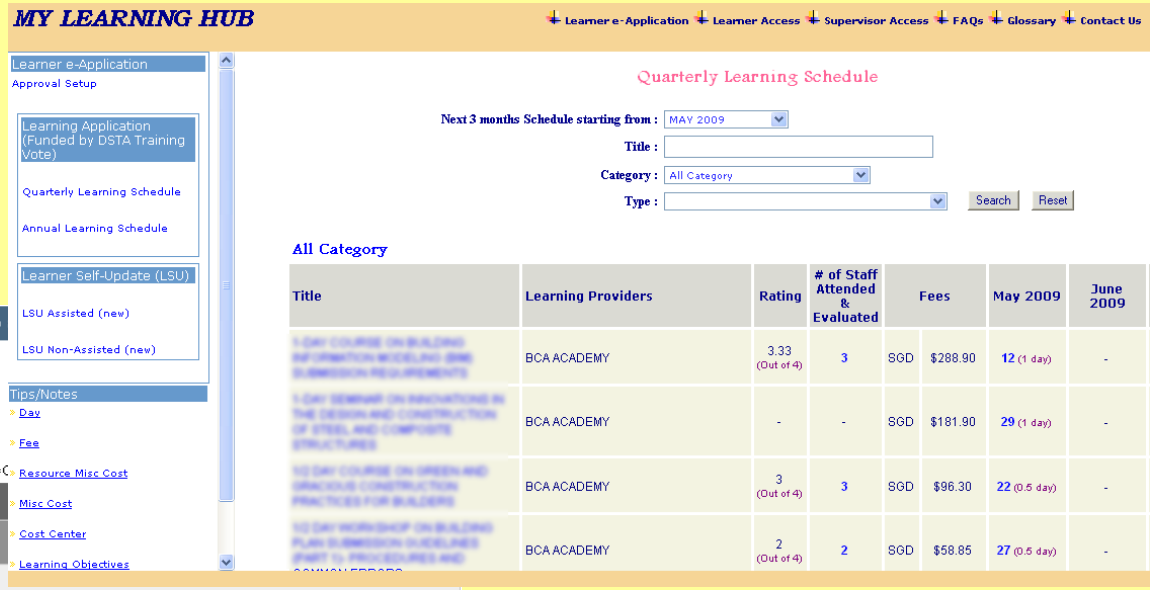
C4I Competency Development

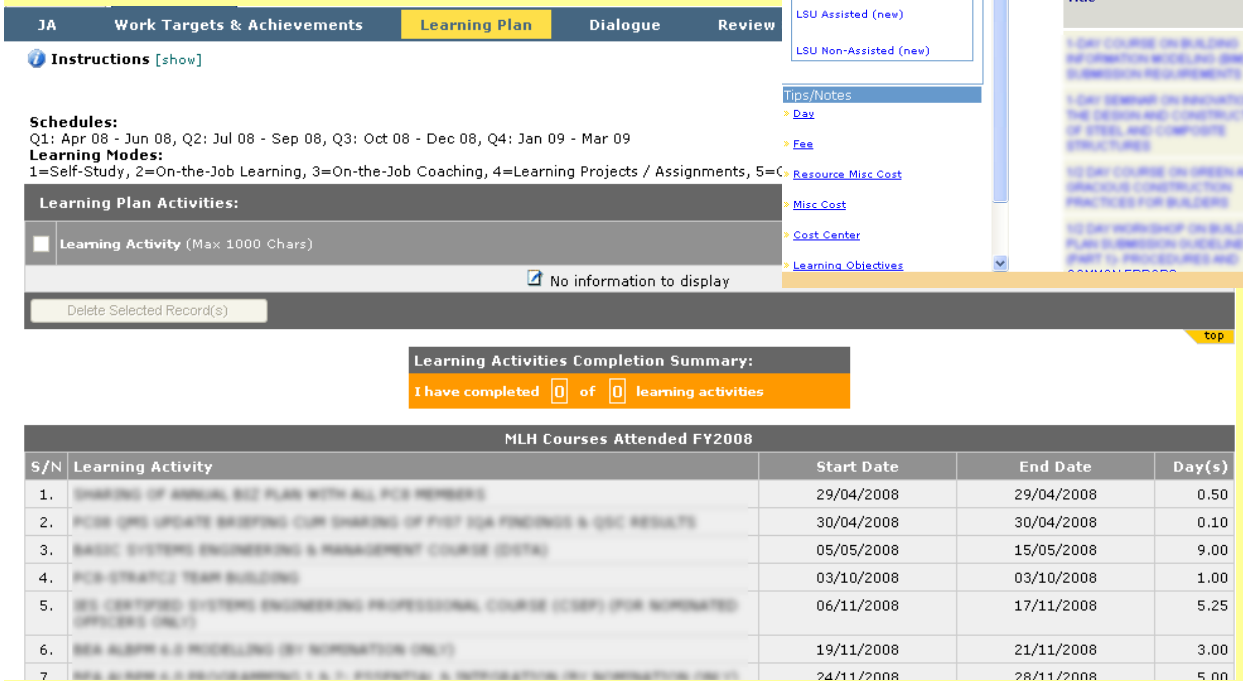


C4I Competency Development …

Annual Learning Plan for each individual

- systems design
- systems thinking
- business analysis

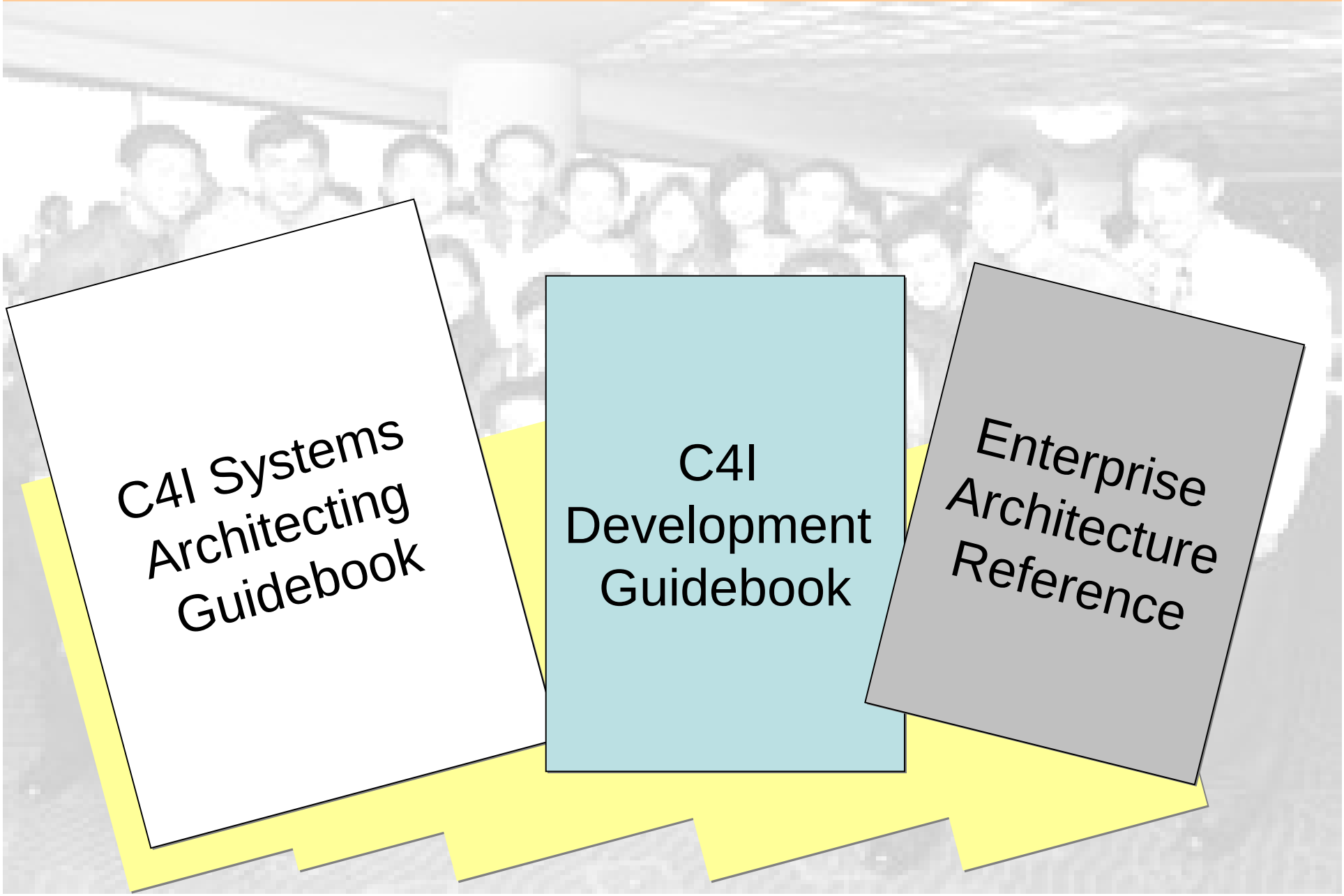




MLH Courses Attended FY2008

S/N	Learning Activity	Start Date	End Date	Day(s)
1.	[redacted]	29/04/2008	29/04/2008	0.50
2.	[redacted]	30/04/2008	30/04/2008	0.10
3.	[redacted]	05/05/2008	15/05/2008	9.00
4.	[redacted]	03/10/2008	03/10/2008	1.00
5.	[redacted]	06/11/2008	17/11/2008	5.25
6.	[redacted]	19/11/2008	21/11/2008	3.00
7.	[redacted]	24/11/2008	28/11/2008	5.00

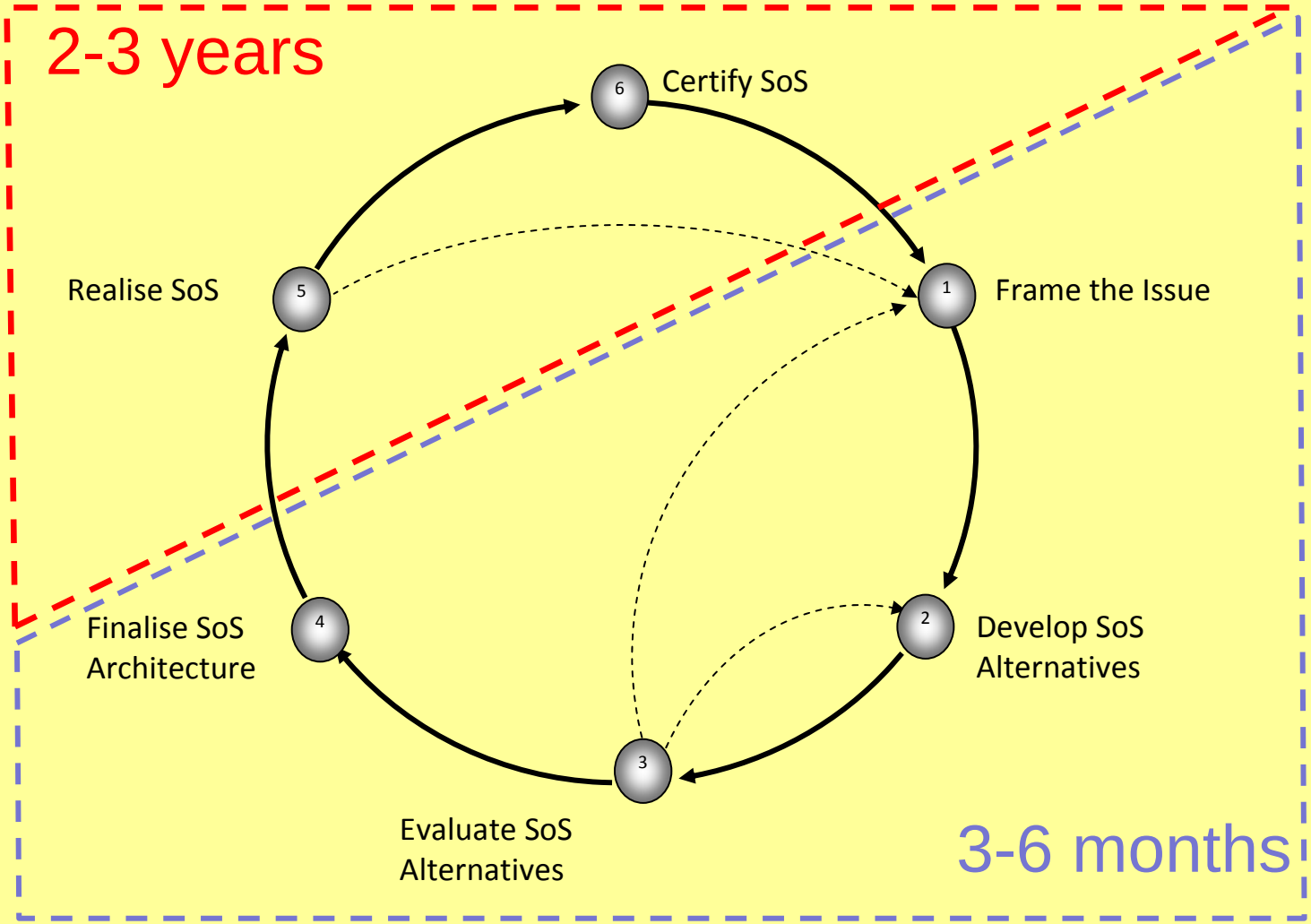
Books of Knowledge



C4I Competency Development ...

- Consultation Environment

The Values of the Systems Architecting Framework



The search for alternatives to harness state-of-the-art technologies for rapid development and fielding of new operational capabilities is a never ending business for C4I systems architects…