

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>

Multi-faceted and multi-dimensional security challenges



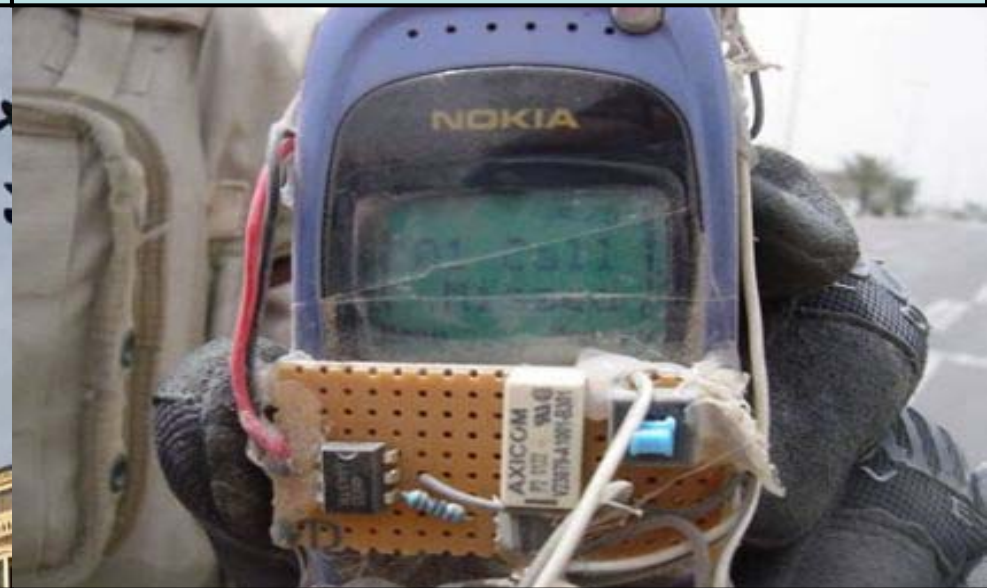
State-on-State Conflict



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?

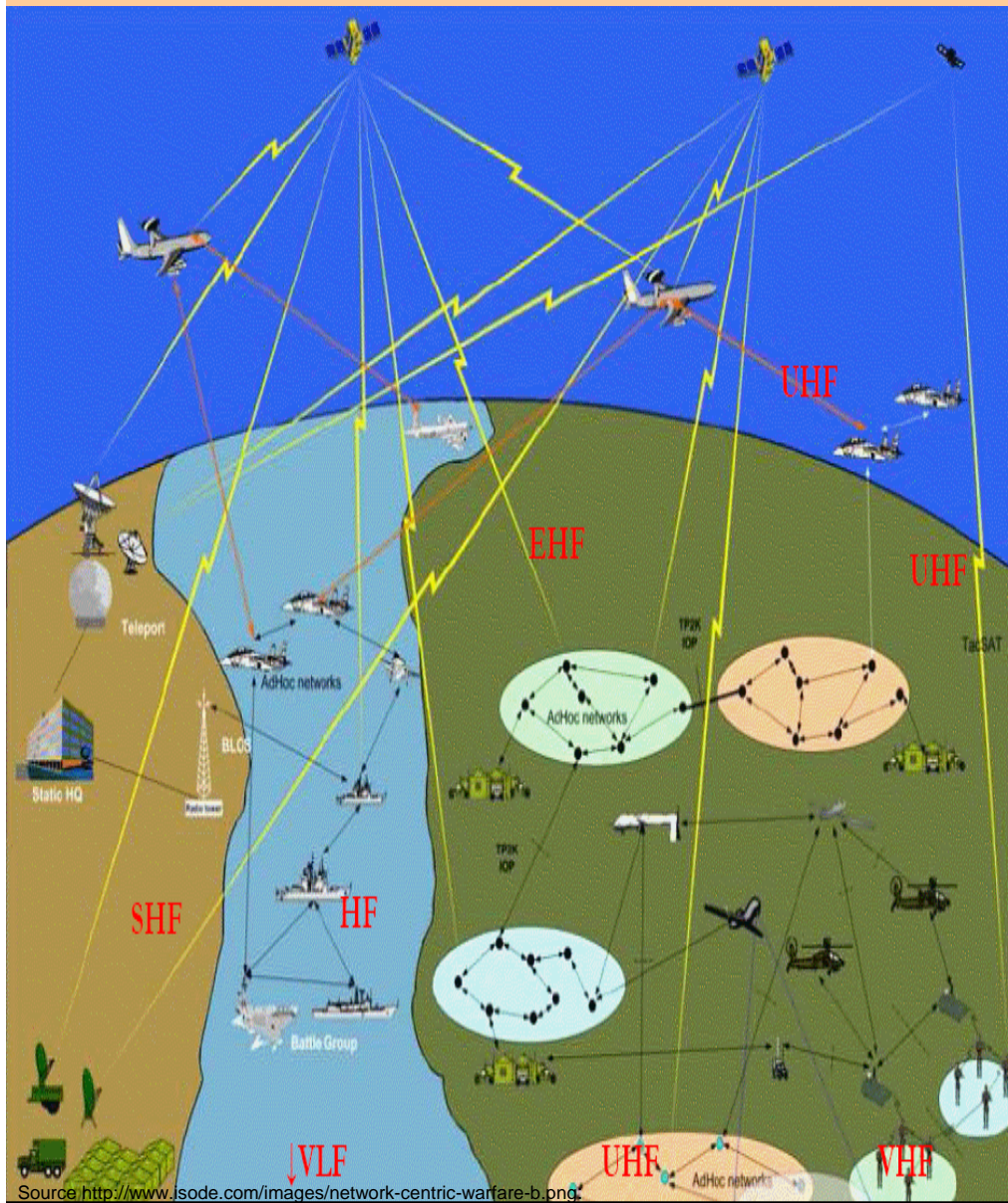


Designing a C4I System-of Systems

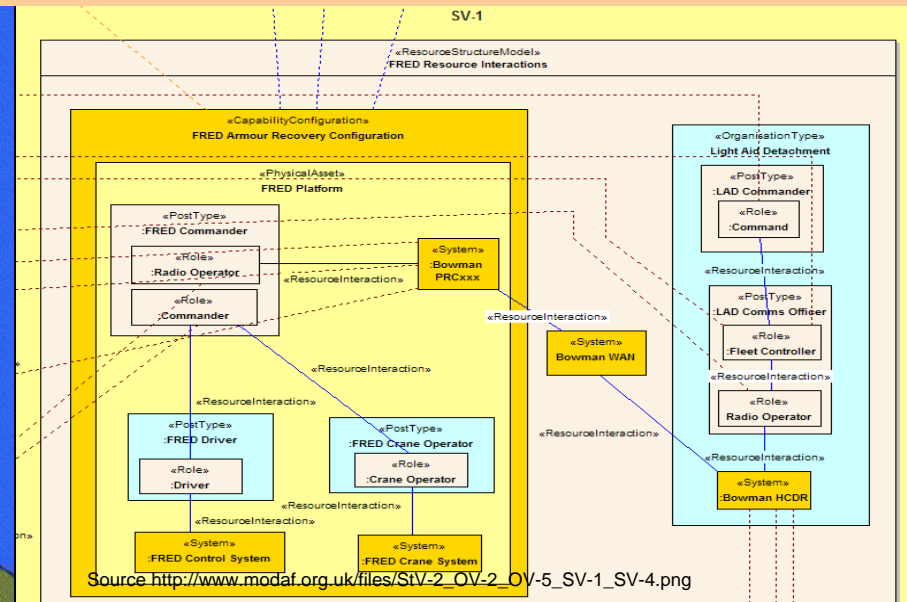


Systems Architecting a C4I System-of-Systems.

Systems Architecting



Operational View



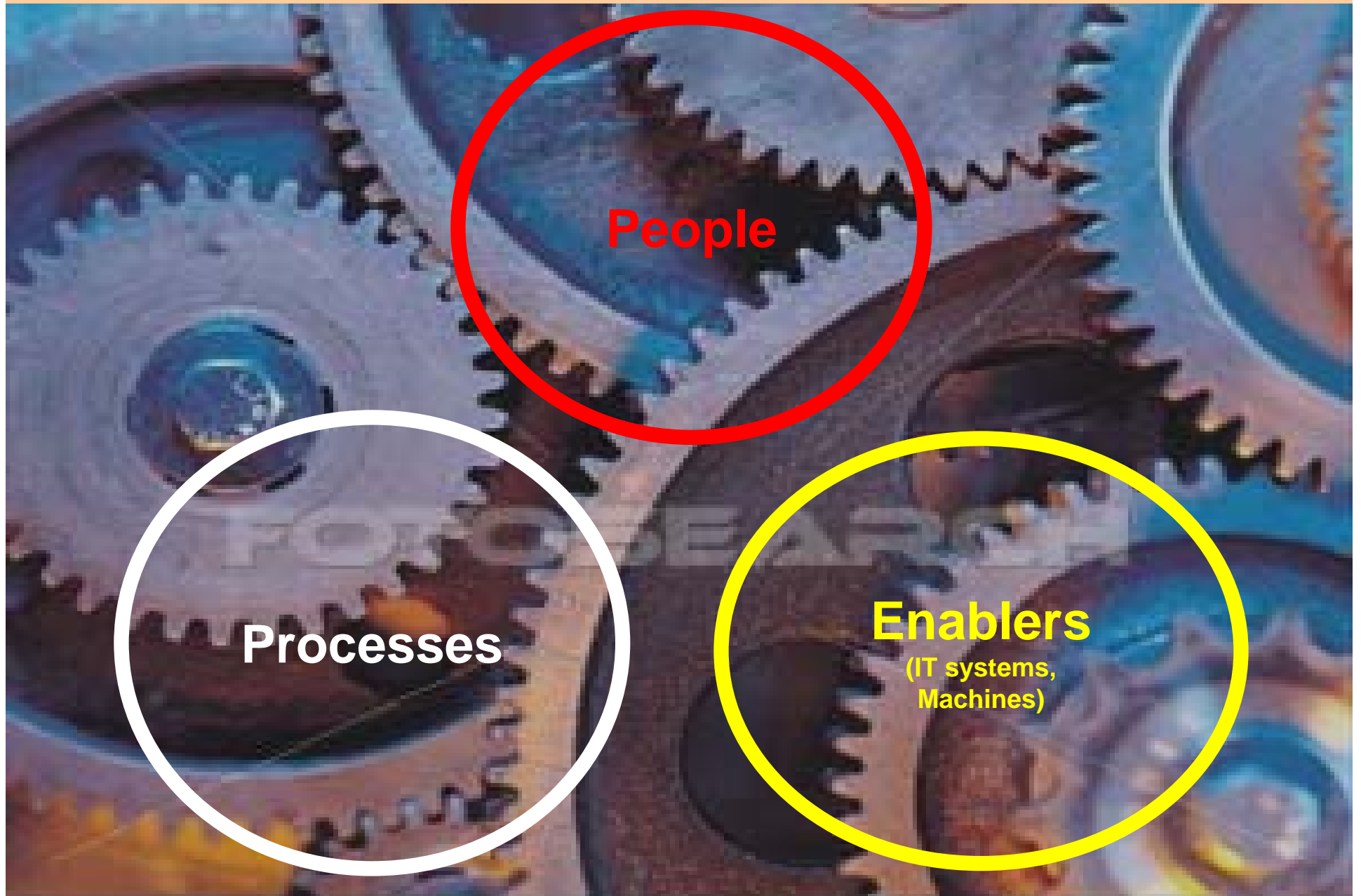
System View

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	
Information Modeling, Metadata, and Information Exchange Standards	Transport Services Standards	
	Activity Modeling	
	Data Modeling	
Human Computer Interface	Object-Oriented Modeling	
	Mandates	
Information Security / Information Infrastructure Standards	Password Security	

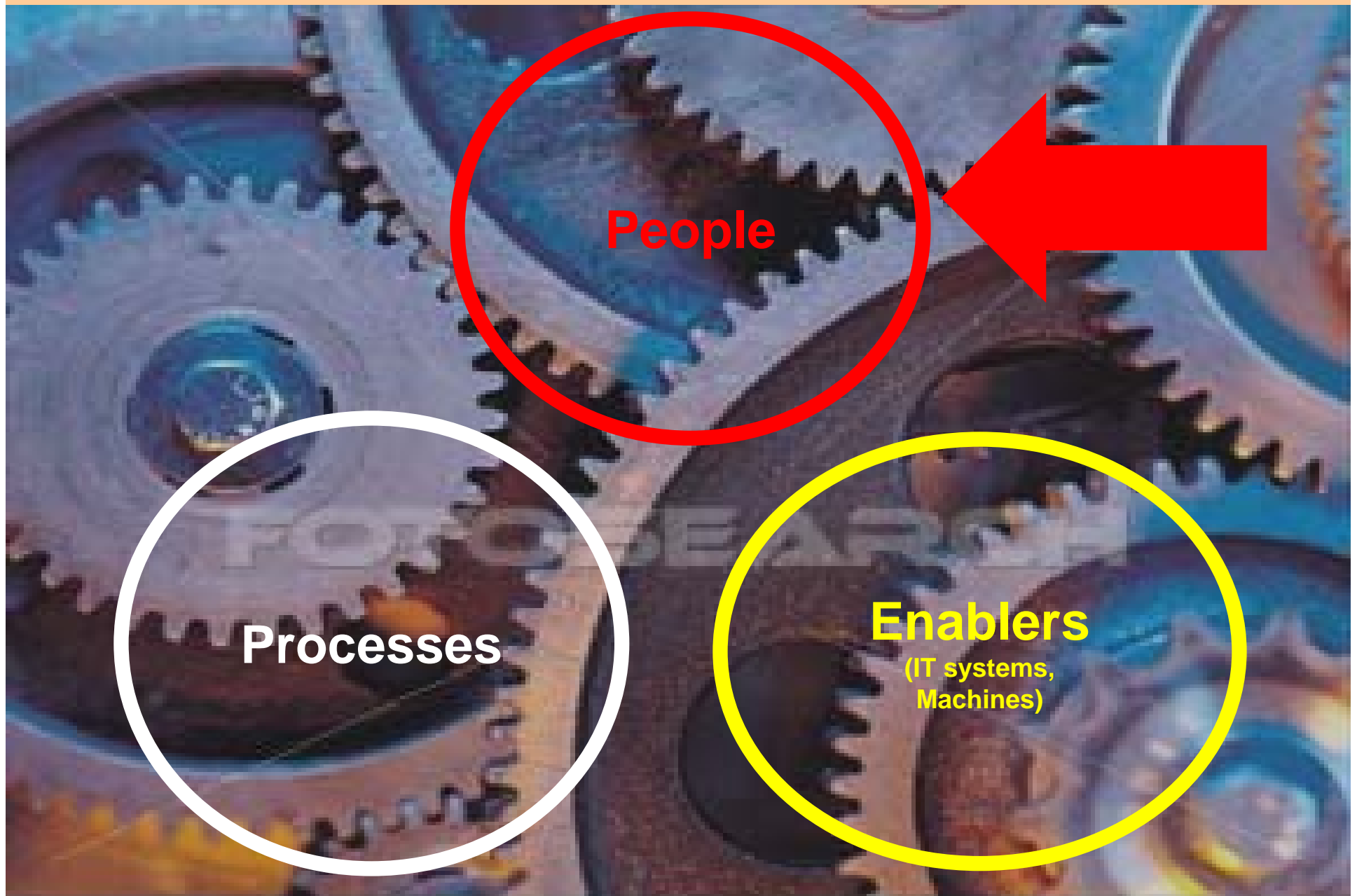
Source: <http://elamb.org/wp-content/uploads/2008/03/tv-1large.gif>

Technical View

Systems Architecting

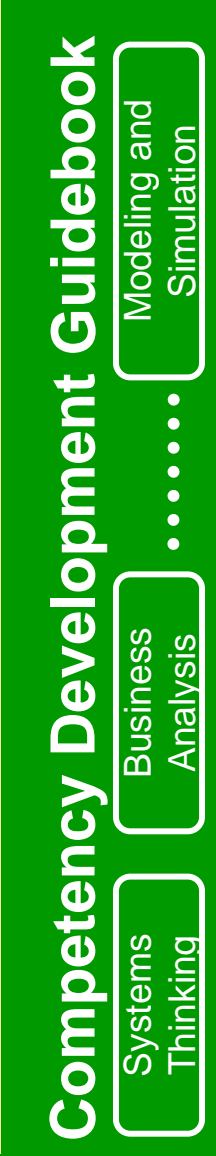


Systems Architecting – Both a Science & an Art



C4I Systems Architecting Framework

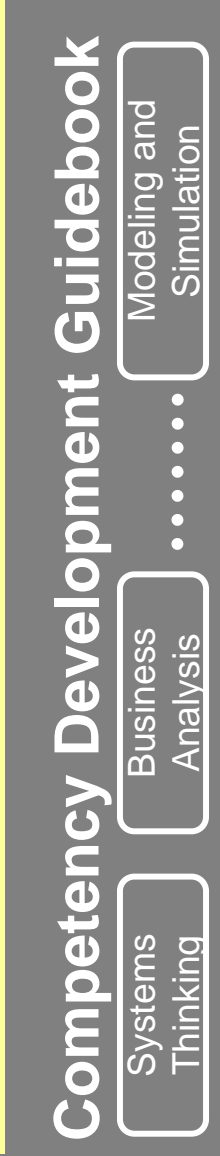
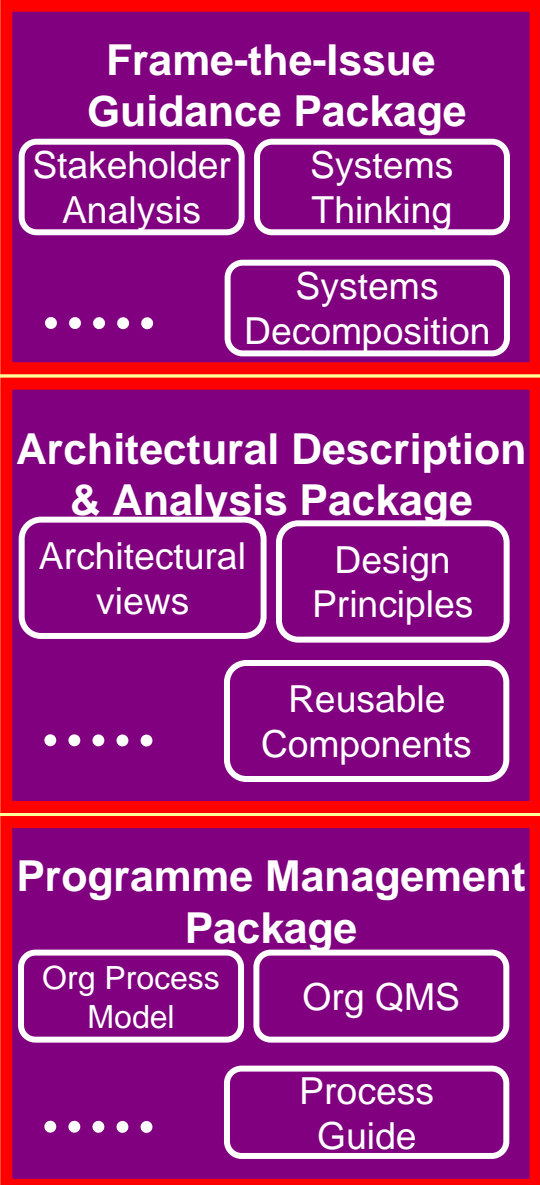
Systems Architecting Process



Body of Knowledge

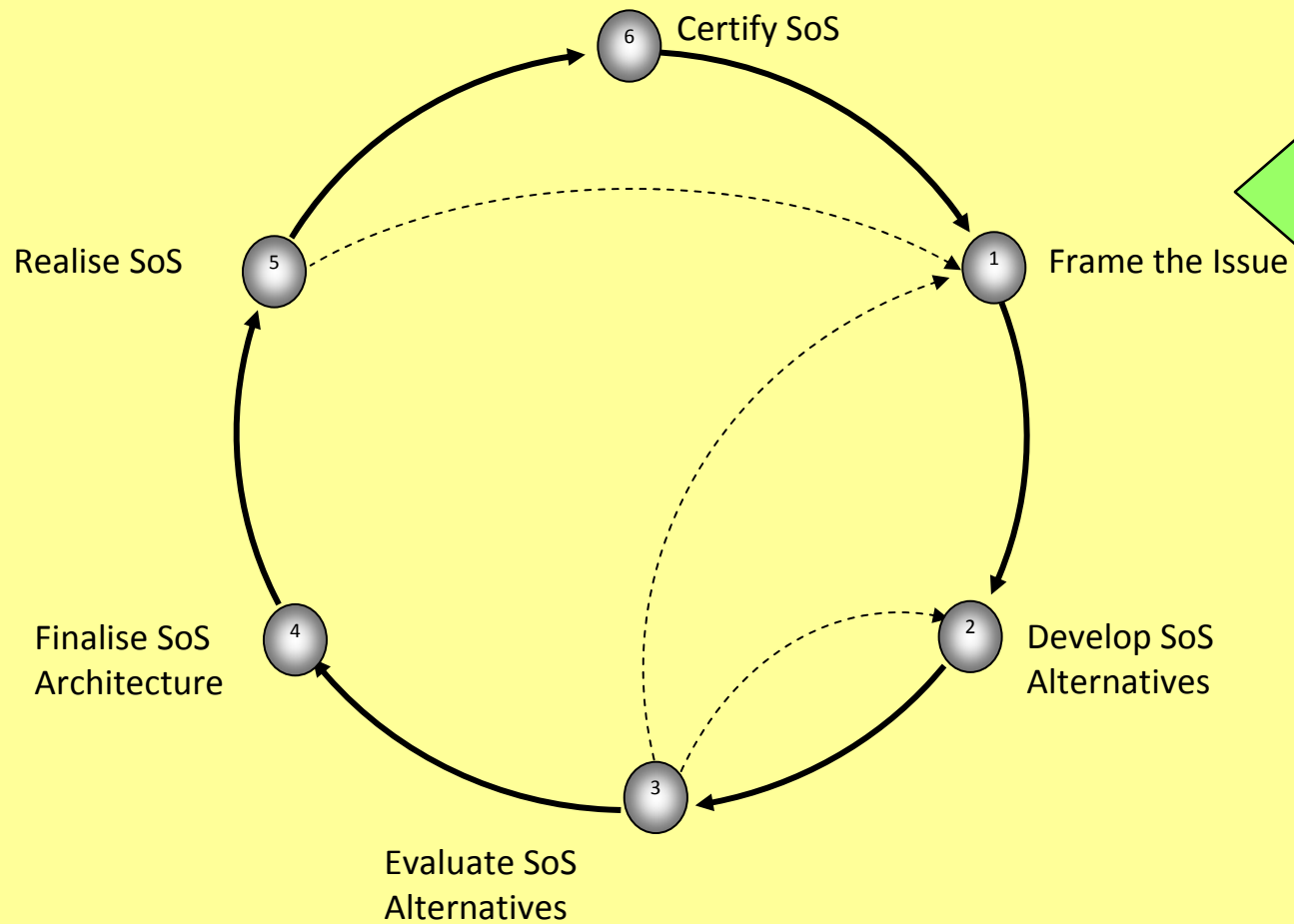
C4I Systems Architecting Framework

Systems Architecting Process



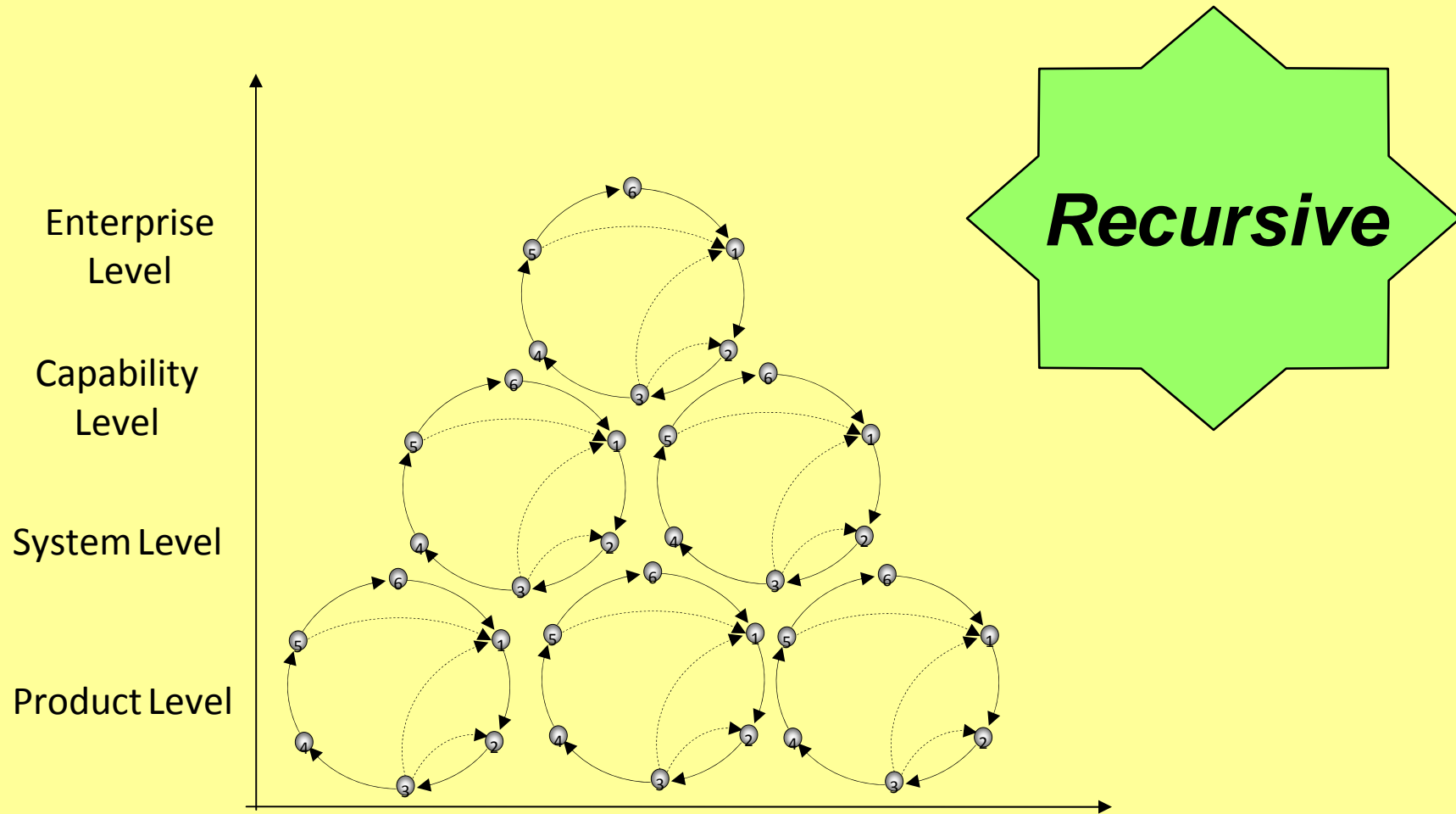
Body of Knowledge

Systems Architecting Process

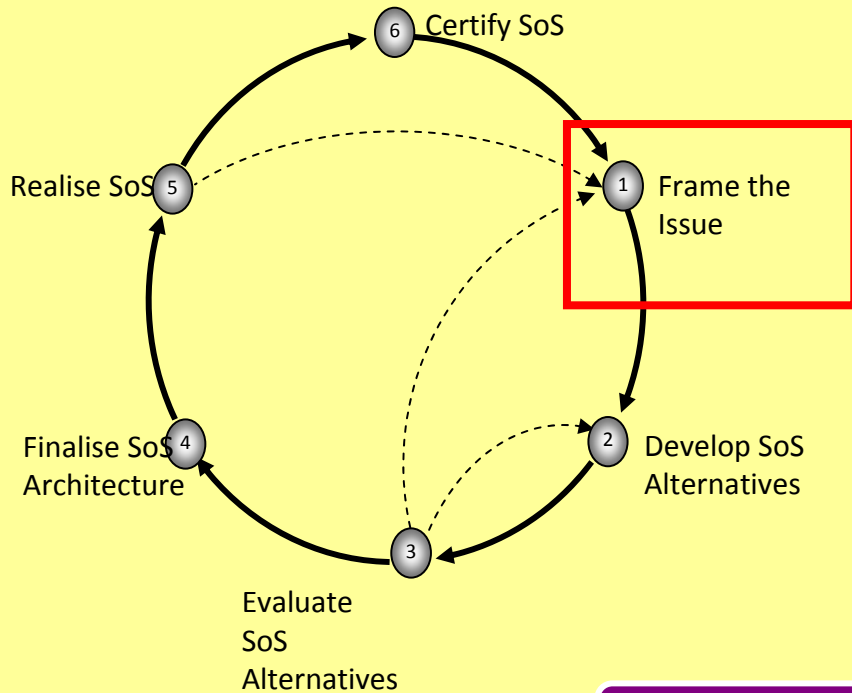


A Six-step Systems Architecting Process

Systems Architecting Process ...



Understanding the Capability Gap



Stakeholder engagement



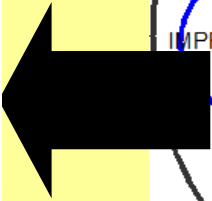
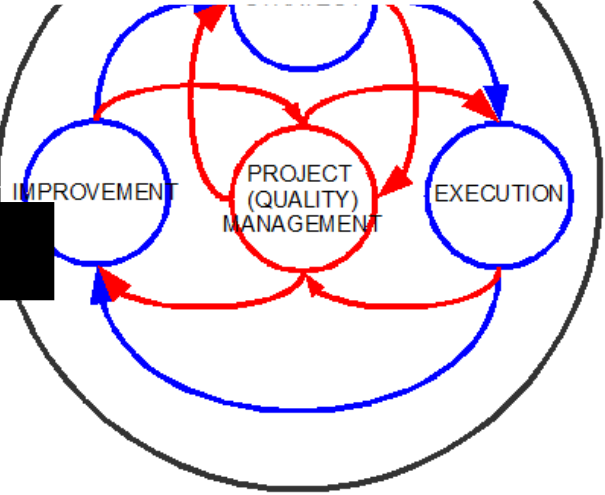
Frame-the-Issue Guidance Package

- Stakeholder Analysis
- Systems Thinking
- Systems Decomposition

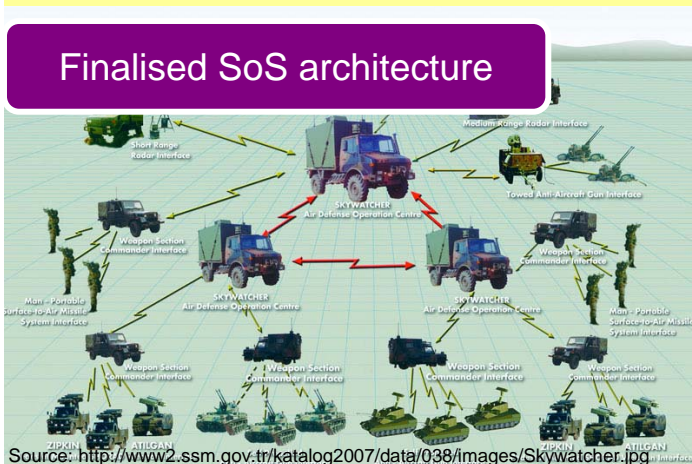
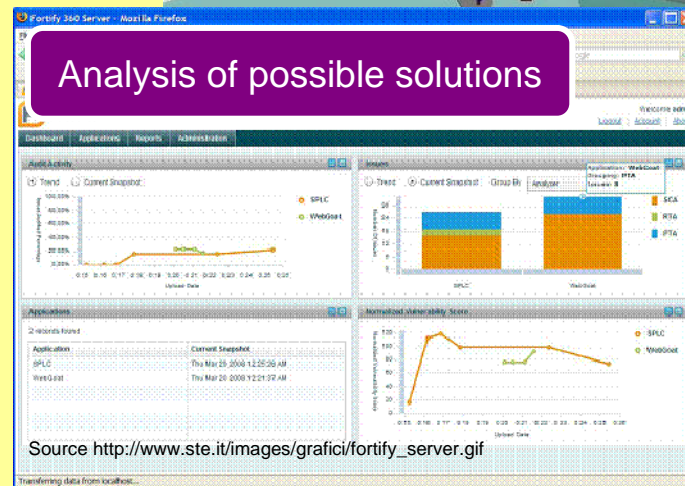
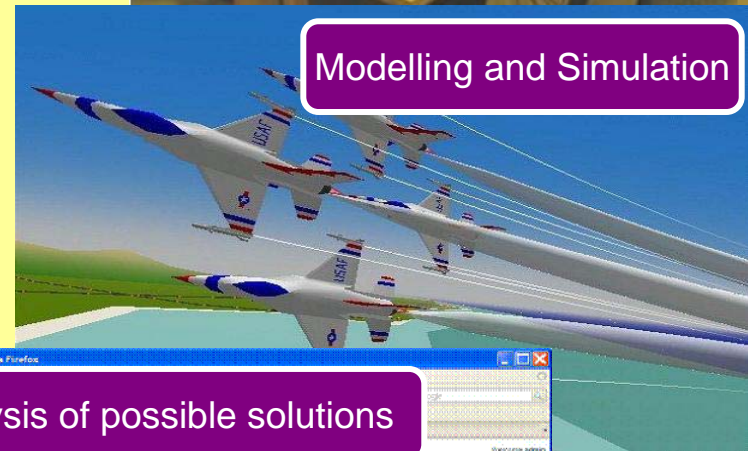
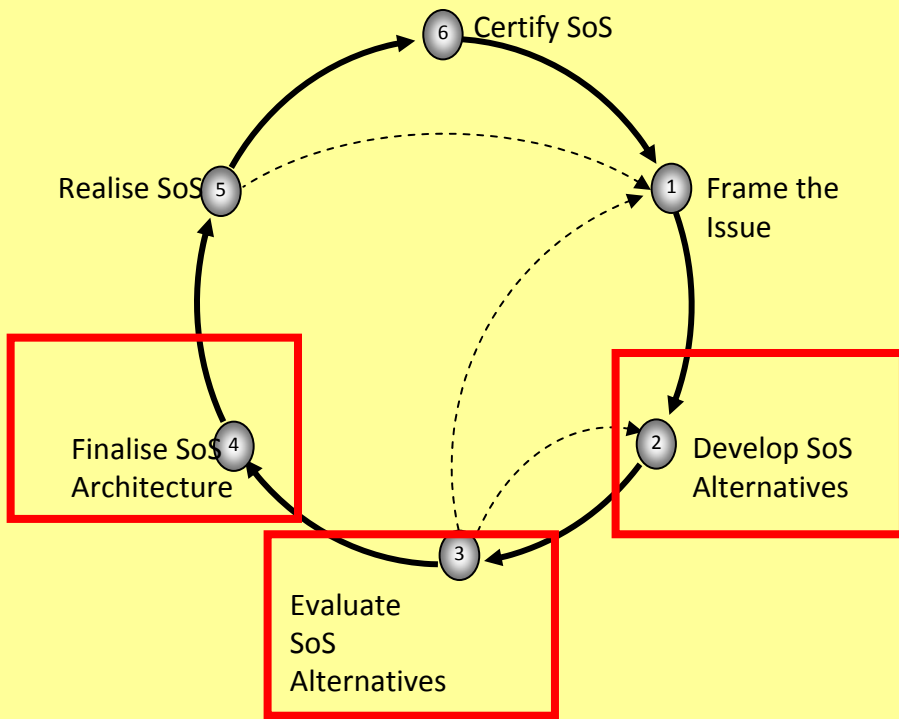
Capability Gap List



Problem Analysis

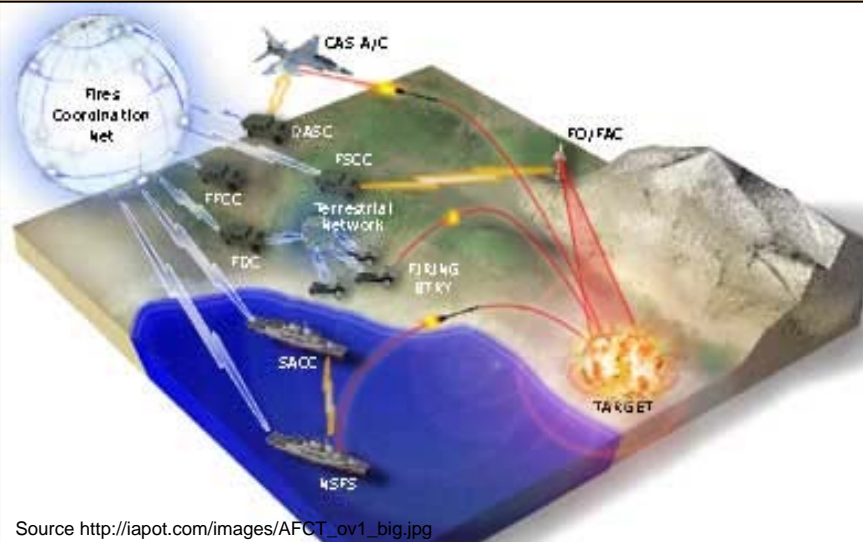


Devising the SoS Solution



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

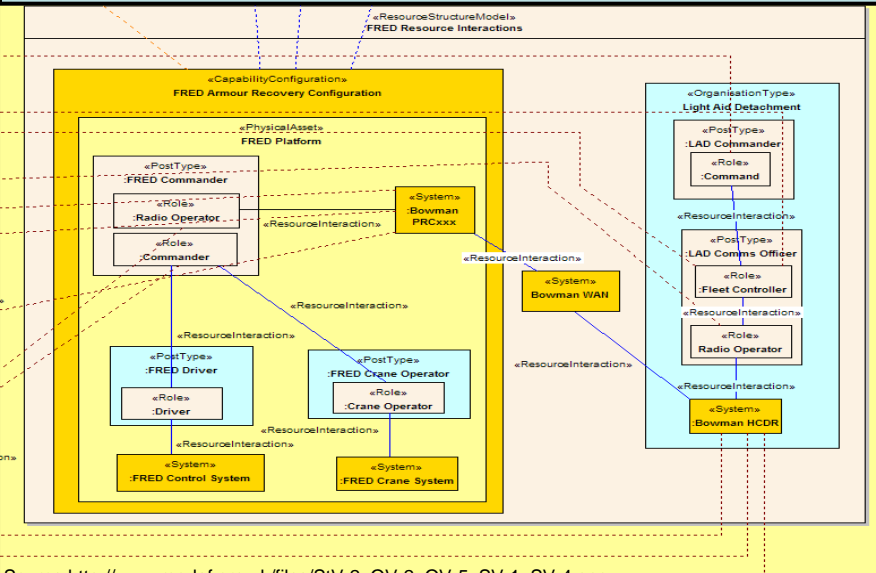
Examples of SoS Architectural Views



JTA Service Area	Service	JTA Standard and Source Document
Information-Processing Standards	Higher Order Languages	
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Human Computer Interface	Data Modeling	
	Object-Oriented Modeling	
Information Security / Information Infrastructure Standards	Mandates	
	Password Security	
Information Security / Information Infrastructure Standards	Application Software Entity Security Standards	
	Virtual Private Network Service	
	Intrusion Detection Service	
	Human-Computer Interface Security Standards	

Source <http://elamb.org/wp-content/uploads/2009/07/Standards-2009-07-14.pdf>

Operational View



System View

Technical View

Architectural Description & Analysis Package

Architectural views

Design Principles

•••••

Reusable Components

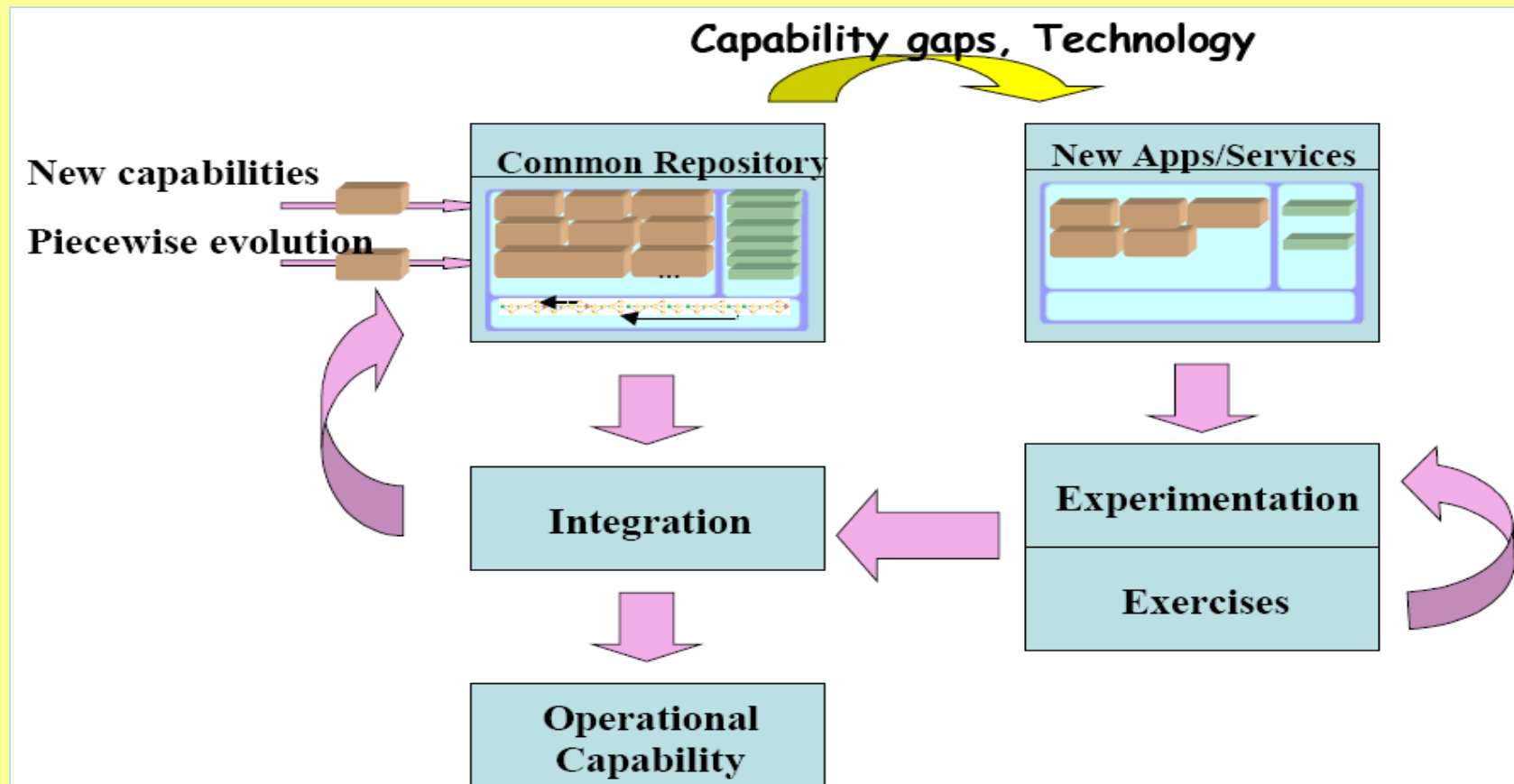
Devising the SoS Solution ...

Speeding up the Development of Operational Capabilities

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

Devising the SoS Solution ...

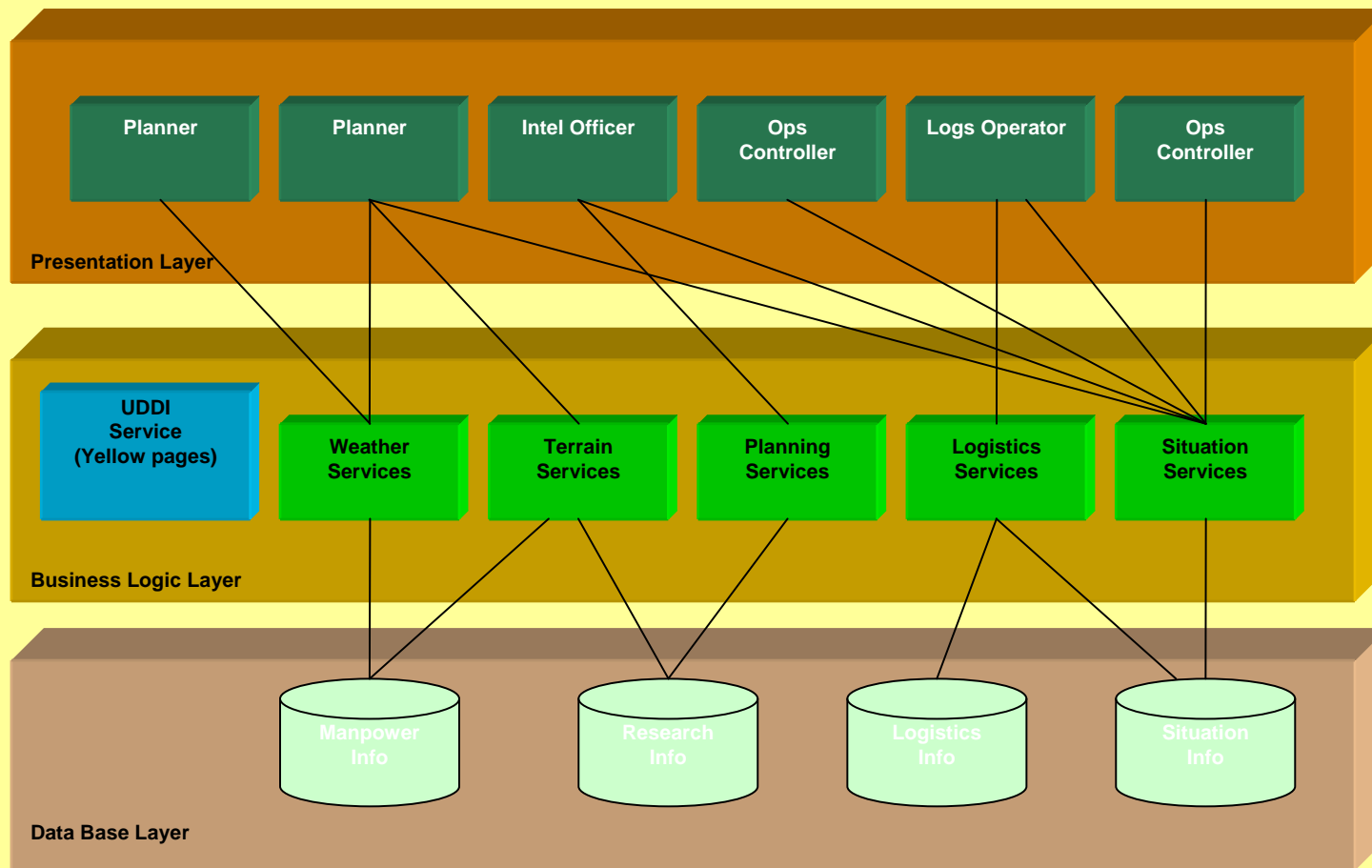
Common Repository



Process for Maintenance of Common Repository

Devising the SoS Solution ...

Service Oriented Architecture (SOA)



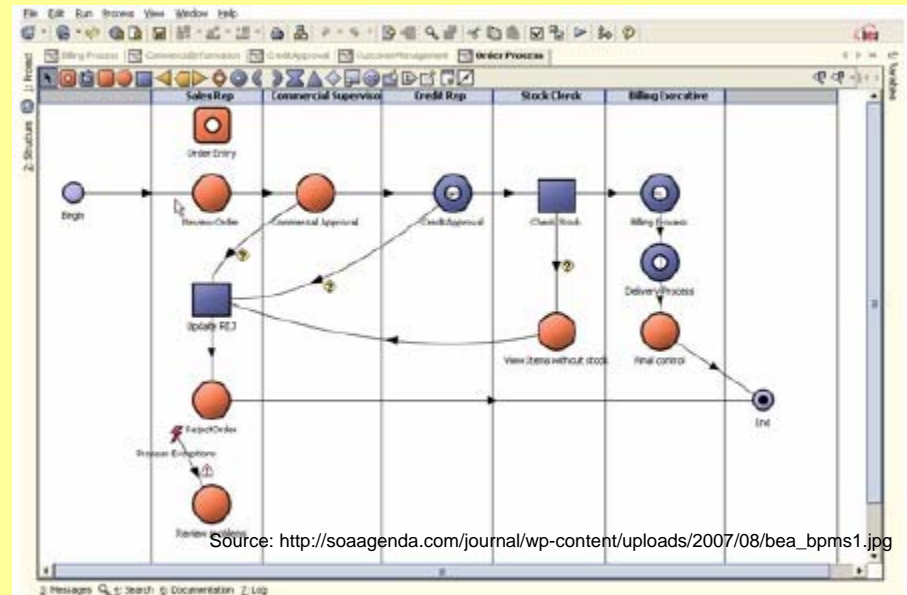
Devising the SoS Solution ...

Business Process Management System



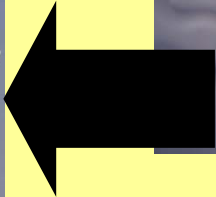
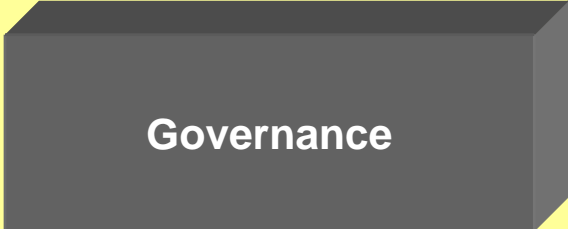
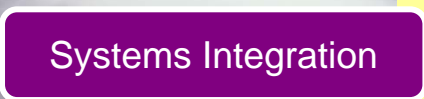
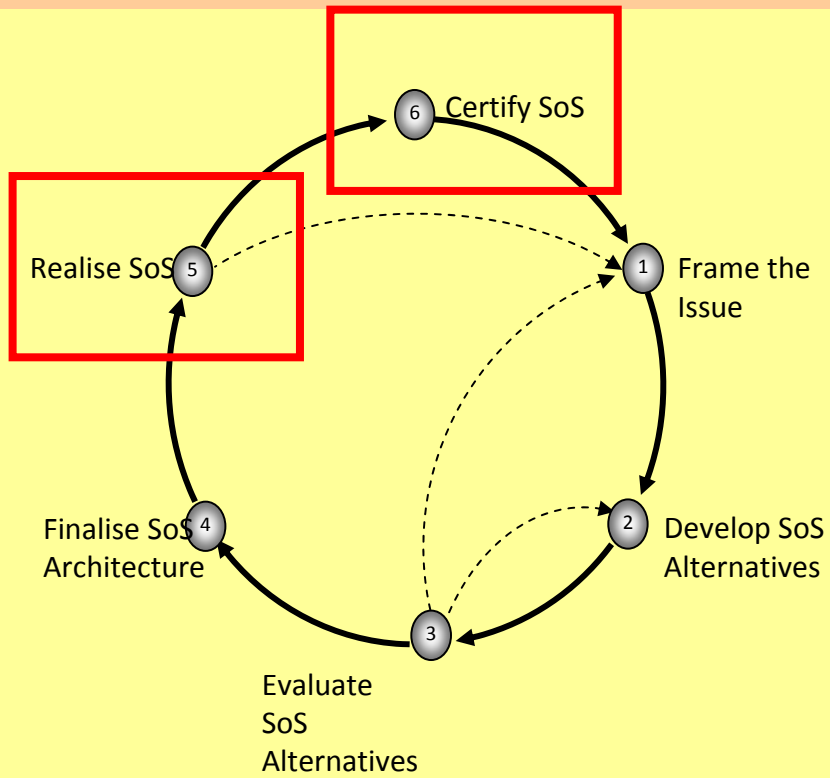
GARTNER's 10 components of BPMS

Source: GARTNER BPMS Summit 2008



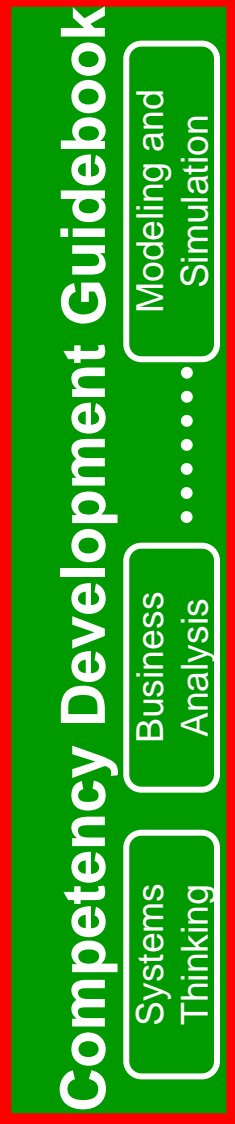
Commercial BPMS: BEA Aqualogic

Developing and Certifying the SoS Solution



C4I Competency Development

Systems Architecting Process



Body of Knowledge

C4I Competency Development ...

Annual Learning Plan for each individual

- systems design
- systems thinking
- business analysis

MY LEARNING HUB Learner e-Application | Learner Access | Supervisor Access | FAQs | Glossary | Contact Us

[Learner e-Application](#)
[Approval Setup](#)
[Learning Application \(Funded by DSTA Training Vote\)](#)
[Quarterly Learning Schedule](#)
[Annual Learning Schedule](#)
[Learner Self-Update \(LSU\)](#)
[LSU Assisted \(new\)](#)
[LSU Non-Assisted \(new\)](#)

Quarterly Learning Schedule

Next 3 months Schedule starting from:

Title:

Category:

Type:

All Category

Title	Learning Providers	Rating	# of Staff Attended & Evaluated	Fees	May 2009	June 2009
1 DAY COURSE ON BUILDING INFORMATION MODELING (BIM) REQUIREMENTS	BCA ACADEMY	3.33 (Out of 4)	3	SGD \$288.90	12 (1 day)	-
1 DAY SEMINAR ON INNOVATIONS IN THE DESIGNING AND CONSTRUCTION OF STEEL AND COMPOSITE STRUCTURES	BCA ACADEMY	-	-	SGD \$181.90	29 (1 day)	-
10 DAY COURSE ON GREEN AND SUSTAINABLE CONSTRUCTION PRACTICES FOR BUILDERS	BCA ACADEMY	3 (Out of 4)	3	SGD \$96.30	22 (0.5 day)	-
10 DAY WORKSHOP ON BUILDING PLAN TO PROCEED AND COMMON PRACTICE	BCA ACADEMY	2 (Out of 4)	2	SGD \$58.85	27 (0.5 day)	-

JA Work Targets & Achievements **Learning Plan** Dialogue Review

[Instructions \[show\]](#)

Schedules:
 Q1: Apr 08 - Jun 08, Q2: Jul 08 - Sep 08, Q3: Oct 08 - Dec 08, Q4: Jan 09 - Mar 09
Learning Modes:
 1=Self-Study, 2=On-the-Job Learning, 3=On-the-Job Coaching, 4=Learning Projects / Assignments, 5=...

Learning Plan Activities:

Learning Activity (Max 1000 Chars)

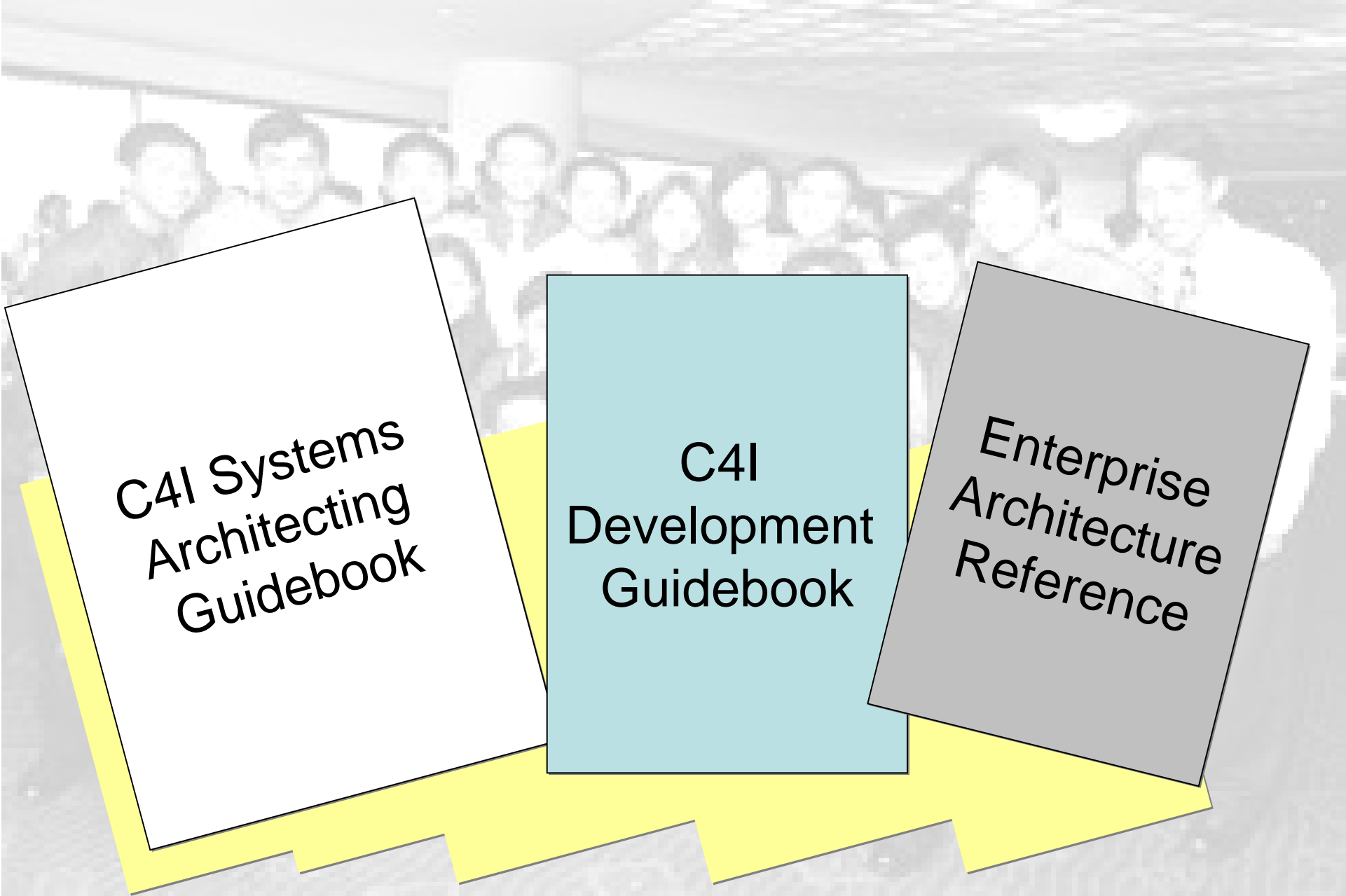
No information to display

Learning Activities Completion Summary:
 I have completed of learning activities

MLH Courses Attended FY2008

S/N	Learning Activity	Start Date	End Date	Day(s)
1.	SHARING OF ANNUAL BIZ PLAN WITH ALL PCB MEMBERS	29/04/2008	29/04/2008	0.50
2.	PCB QMS UPDATE BRIEFING CUP SHARING OF FY07 QCA FINDINGS & QSC RESULTS	30/04/2008	30/04/2008	0.10
3.	BASIC SYSTEMS ENGINEERING & MANAGEMENT COURSE (DSTA)	05/05/2008	15/05/2008	9.00
4.	PCB STRATEGY TEAM BUILDING	03/10/2008	03/10/2008	1.00
5.	ISO CERTIFIED SYSTEMS ENGINEERING PROFESSIONAL COURSE (CSEP) FOR NOMINATED OFFICERS ONLY	06/11/2008	17/11/2008	5.25
6.	SEA ALPHA 4.0 MOBILITY (BY NOMINATION ONLY)	19/11/2008	21/11/2008	3.00
7.	SEA ALPHA 4.0 MOBILITY (BY NOMINATION ONLY)	24/11/2008	28/11/2008	5.00

Books of Knowledge



C4I Systems
Architecting
Guidebook

C4I
Development
Guidebook

Enterprise
Architecture
Reference

C4I Competency Development ...

- Consultation Environment

The screenshot displays the eHabitat C4I Development Portal. At the top, there is a navigation bar with links for Home, Org Directory, Staff, and Apps. Below this is a search bar and buttons for Intranet, Glossary, and Staff. The main header reads "C4I Development Portal" with the tagline "Delivering You the Knowledge Power".

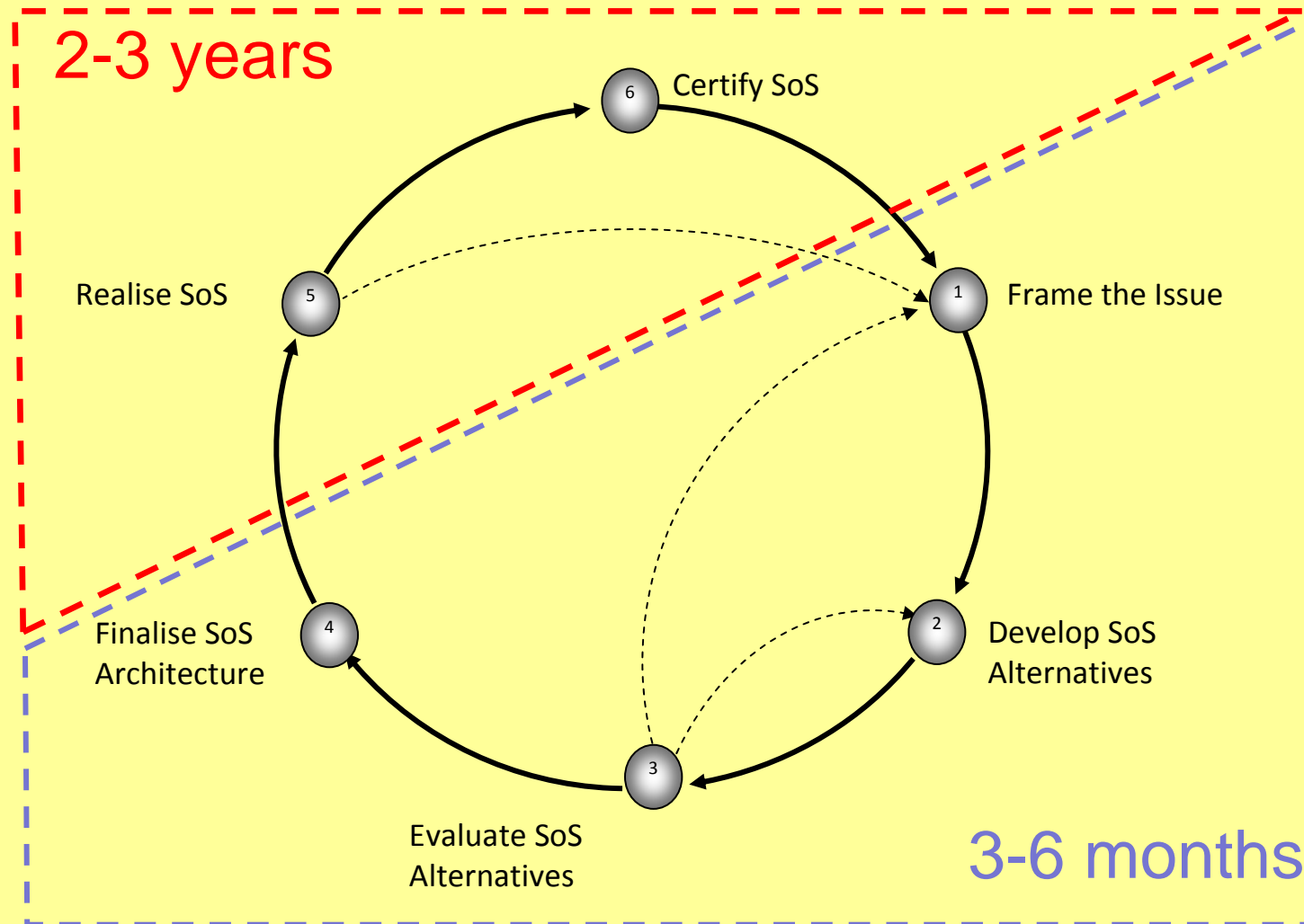
On the left side, there is a "Director Says" section featuring a portrait of a man and a "Programme Hub" icon. Below this is a vertical navigation menu with various links.

The central content area is titled "Software System Development" and includes a "Process" section with a flow diagram. The flow diagram consists of a horizontal line with seven circular nodes connected by arrows. The nodes are labeled as follows:

- Front-End Planning
- System Requirements Development
- Implementation
- Project Handing & Taking Over
- Operations & Support
- Project Planning
- Analysis & Design
- Deployment & Run-In
- End-of-Project Review
- System Retirement

Below the process flow, there is a section for "Work Instructions and Supporting Procedures" and another for "Forms and Templates".

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...

