
Analyzing C4ISR Architectures Through An Automated Data Analysis & Visualization Environment (DAVE)

PRESENTED BY:

Raymond J. Curts, PhD

Douglas E. Campbell, PhD

PRESENTED TO:

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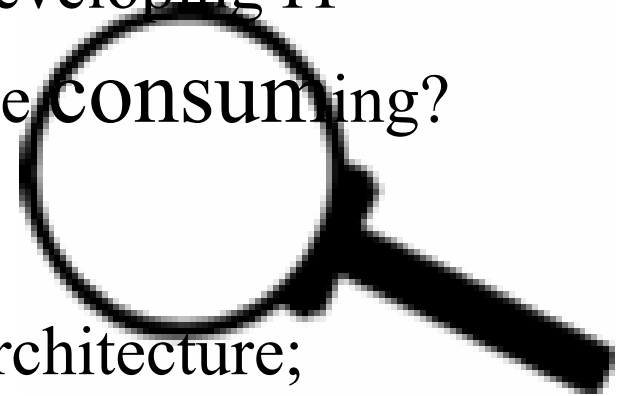
17 - 19 June 2003



- **Introduction / Background**
- **DAVE**
- **Object Oriented Paradigm & Architectural Atoms**
- **Summary**
- **Future Work**

In each successive military engagement we find another instance in which our fighting men and women have been unable to adequately plan, communicate and/or coordinate multi-service activities.

- Considering all that has been done over the past ten years or so ...
 - Why is the process of identifying and developing IT architectures so difficult, costly and time **CONSUMING**?
 - Why are we still struggling to:
 - ◆ **define** what exactly constitutes an architecture;
 - ◆ **identify** what type of architectures do and/or should exist;
 - ◆ **categorize** architecture concepts; and,
 - ◆ **develop** a long range plan for architecture development and maintenance?



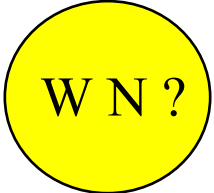
A Decade+ of Events

<1991 1992 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001

WSA&E
JITC Created

DSB GS
OPNAV 9410.6

CADM v 1.0
CAF v 2.0
OMB M-97-16
JCS 3-13
DoD JTA v 2.0



Desert Shield
Desert Storm
DoDD 8320.1

DSB R
DoD Enterprise Model
USAF SAB Info Arch
DoD 8320.1-M

NDIA Interoperability
GAO/NSIAD-98-73
PDD 62 / 63

DoDD 4630.5
DoDD 4630.8
DoDD TS3600.1
Croesus Strategies

DoD Arch Rev (IPSG)
CISA Established
CJCSI 6212.01A
JP 6-0 / 6-02

NDIA IA Study
JTA v 3.0 (Draft)
Bosnia
DoN ITI Arch (Draft)

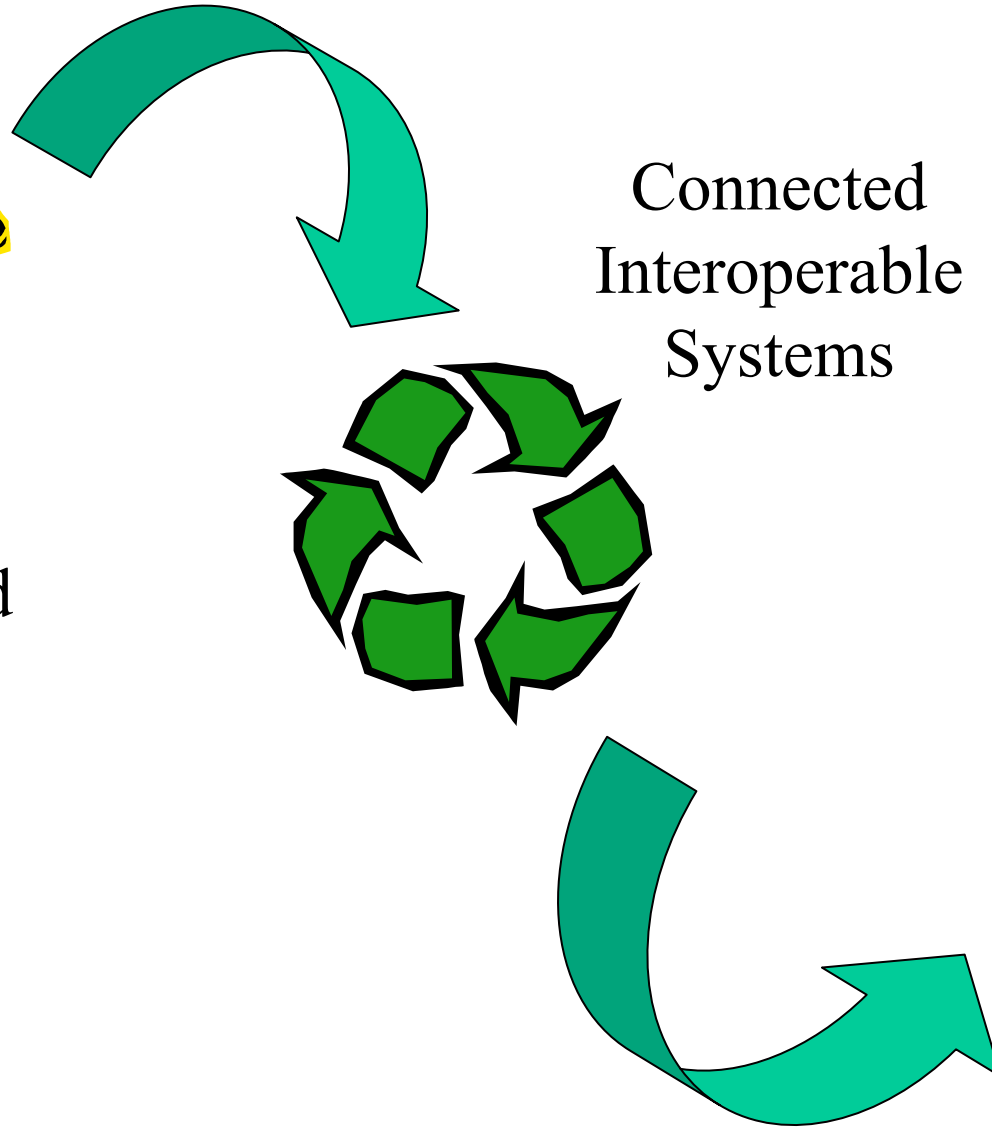
ITMRA
CJCSI 3210.01
CJCSI 6510.01A
PEO 13010
DoD JTA v 1.0
GAO/AIMD 96-110

AFCEA Spring
Intelligence
Symposium





A Well Designed
Architecture



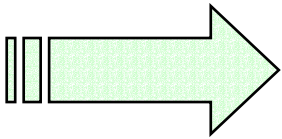
Connected
Interoperable
Systems

Distributed
Information



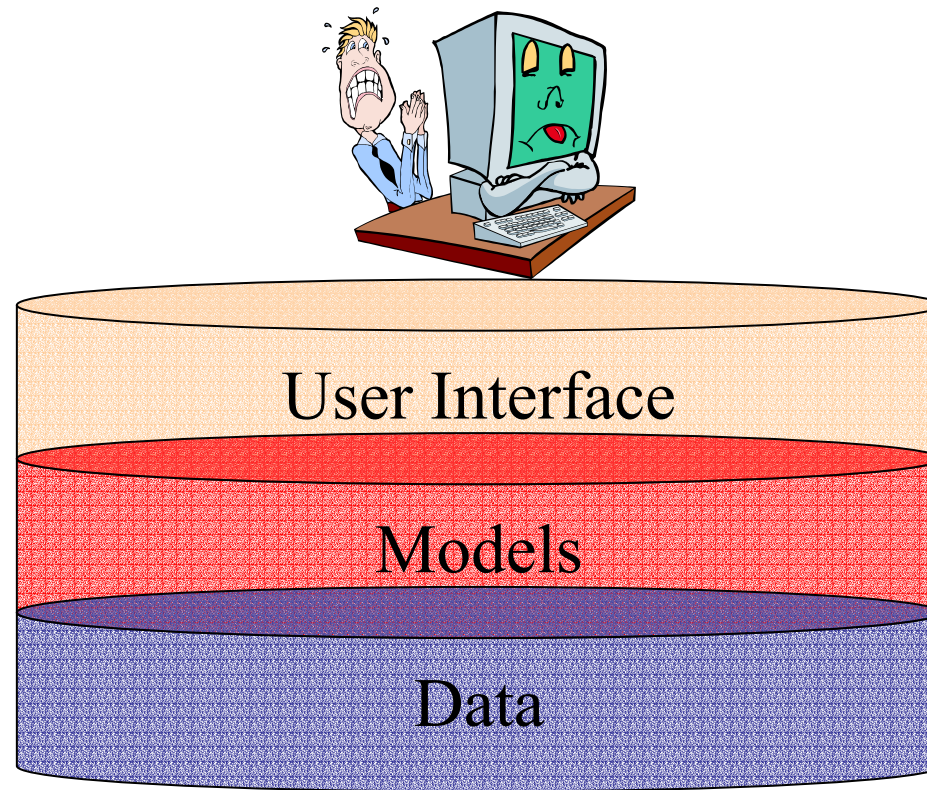
“... a representation, at a current or future point in time, of a defined ‘domain’ in terms of:

- its component parts;
- what those parts do;
- how the parts relate to each other; and,
- the rules and constraints under which the parts function.”



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The
Data Analysis
&
Visualization Environment
(DAVE)
Research Project

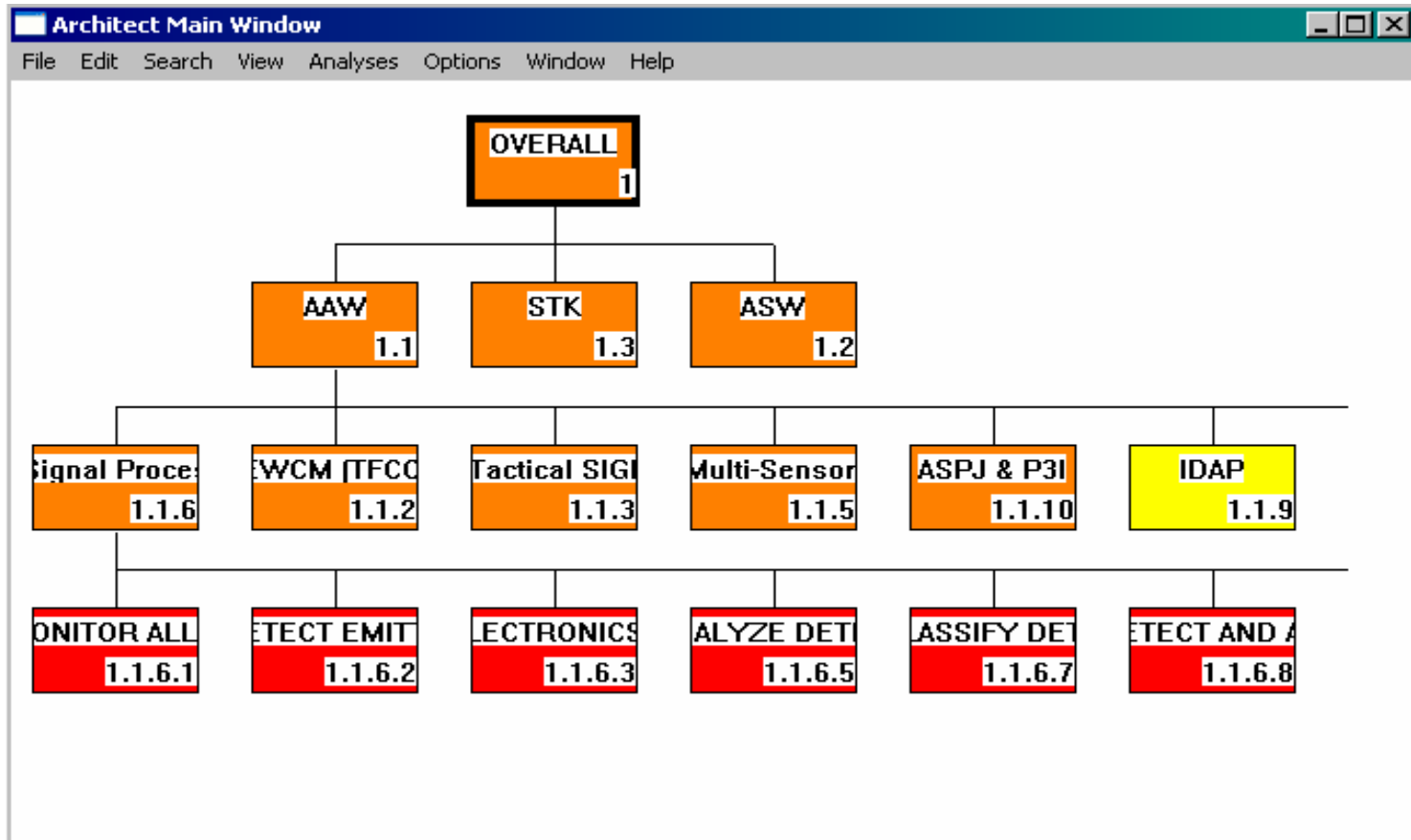


Architecture Data

Bx	Rx	Bname	O/D	Tier3	Ref_title	Wma	System	Imp	Cap	Plat	Arch	IOC	MSC	POM	D/I	C/N	Assumption
1	1	P-EPLN	D	EWC2	CONDUCT TACTICAL MISSION PLANNING	STK	TAMPS	3	4	A	W	1990	NPLR	C			TF organic systems. System needs update. Not a primary EW tool.
1	1	P-EPLN	D	EWC2	CONDUCT TACTICAL MISSION PLANNING	STK	TEAMS	5	4	A	W	1990	NPLR	C	D	C	TF organic systems. Requires update for EA-6B.
1	2	P-EPLN	D	ELINT	DEVELOP ELECTRONIC OOBs	AAW	EWRL	2	3	Z	W	1990	NPLR	C			Does not cover all spectrums/freqs needed for planning. Availability of input data.
1	2	P-EPLN	D	ELINT	DEVELOP ELECTRONIC OOBs	AAW	BGPHEs	5	4	M	+	2000	NPLR	C	D	C	Does not cover all spectrums/freq needed for planning.
1	2	P-EPLN	D	ELINT	DEVELOP ELECTRONIC OOBs	AAW	CDF	5	3	S	W	1990	NPLR	C	D	C	Data bases & TACINTEL. Good now but w on't handle the threat c.2010 w ithout significant upgrades. Comms only.
1	2	P-EPLN	D	ELINT	DEVELOP ELECTRONIC OOBs	AAW	OSIS	4	3	Z	W	1990	NPLR	C	D	N	Data bases & TACINTEL.
1	2	P-EPLN	D	ELINT	DEVELOP ELECTRONIC OOBs	AAW	ES-3A	5	4	A	W	1990	NPLR	C	D	C	Does not cover all spectrums/freq needed for planning.
1	2	P-EPLN	D	ELINT	DEVELOP ELECTRONIC OOBs	AAW	TENCAP	5	3	Z	W	1990	NPLR	C	D	C	Data bases & TACINTEL. Excellent capability but limited availability.
5	54	WD/G	D	EWC2	CONFIRM TARGET IDENTIFICATION IN REAL TIME	STK	CDF	5	4	S	W	1990	NPL	C	D	C	Requires radiating target.
5	54	WD/G	D	EWC2	CONFIRM TARGET IDENTIFICATION IN REAL TIME	STK	CILOP	5	5	A	+	2000	NPL	C	D	C	Confirmation of a detected emitter and or platform as a target is good.
6	66	H/F	D	Noise Jam	COUNTER ENEMY TERMINAL DEFENSE SYSTEMS	AAW	icit Rainbo	5	3	A	+	2000	NP	B	D	C	Limited accuracy
6	66	H/F	D	Noise Jam	COUNTER ENEMY TERMINAL DEFENSE SYSTEMS	STK	ASPJ & P3	5	3	A	+	2000	NP	B	D	C	Designed for terminal defense
6	71	H/F	O		EMPLOY DIRECTED ENERGY WEAPONS	AAW	EA-6B	3	5	A	W	1990	NPL	BDE			HARM only.

- Multi-Attribute Utility (MAU)
 - ✓ Importance / Capability
 - ✓ Functional Dependencies
- Sensitivity / What-If
- Cost Benefit
- Discrimination Analysis
 - ✓ Strength / Weakness
- Expert Systems (Rules)

Visualizing Architecture Data



Discrimination Analysis

Architect Main Window

File Edit Search View Analyses Options Window Help

Discrimination Listing

Selected Item Name: Multi-Sensor Integration

Selected Item ID: 1.5

Selected Item Score: 2.13 **Selected Item Deficit: 2.87**

Numeric ID	Name	Deficit Contribution	% Contribution
1.5.1	AAW	1.023	35.68
1.5.3	STK	1.015	35.39
1.5.2	ASW	0.830	28.93

OK Graph Print

Weakness Analysis

Discrimination Listing [X]

Selected Item Name: IDAP

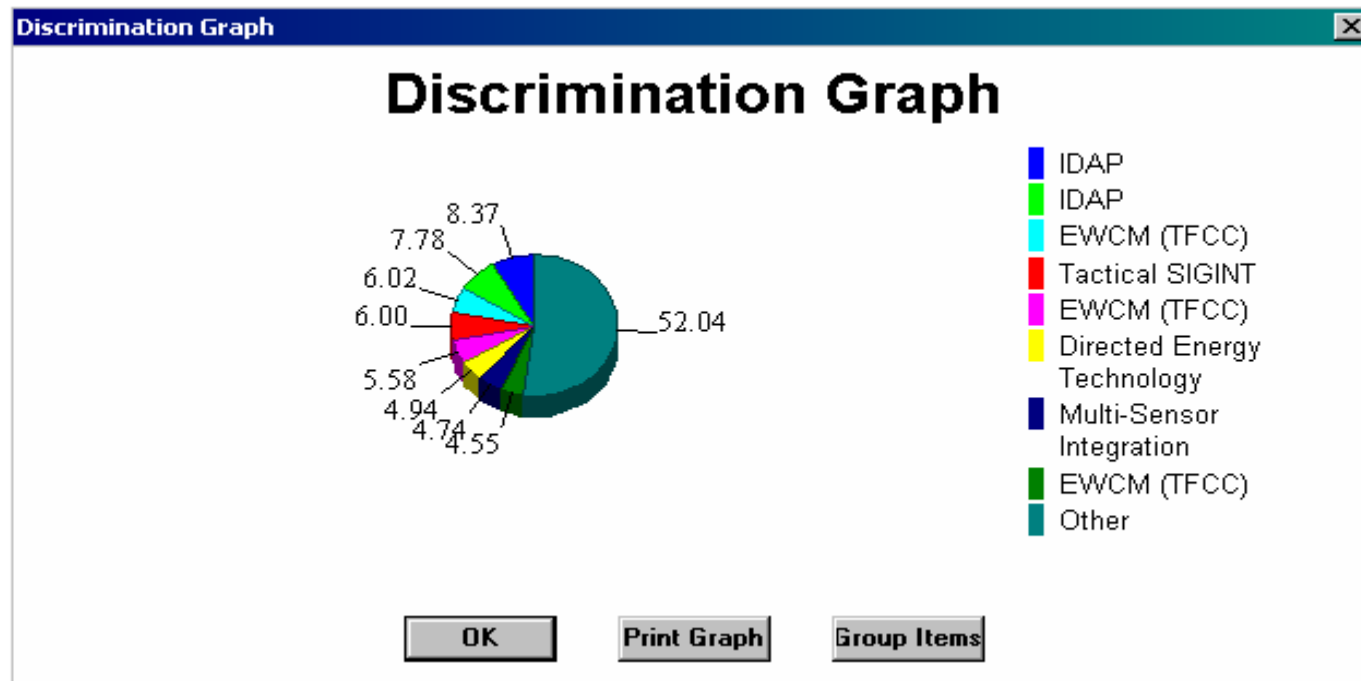
Selected Item ID: 1.1.9

Selected Item Score: 3.24 Selected Item Deficit: 1.76

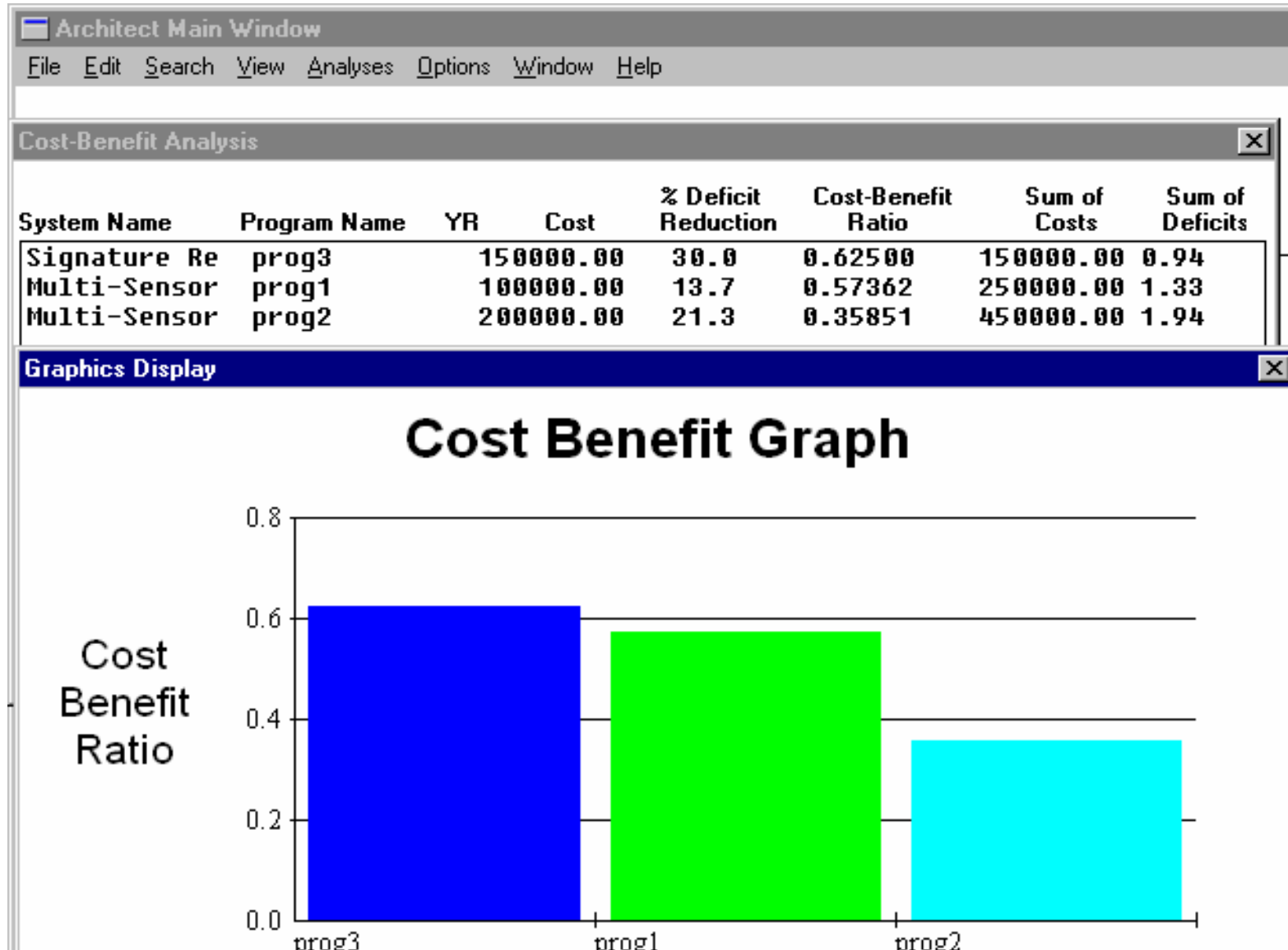
Numeric ID	Name	Deficit Contribution	% Contribution
1.1.9.20	EMPLOY AUTOMATED EW	0.186	10.60
1.1.9.19	ANALYZE SYSTEM VULN	0.186	10.60
1.1.9.8	PROVIDE WEAPONS DIR	0.186	10.60
1.1.9.7	CONFIRM TARGET IDEN	0.186	10.60
1.1.9.5	DESIGNATE TARGETS T	0.186	10.60
1.1.9.4	EMPLOY PLATFORM SEL	0.186	10.60
1.1.9.3	PROVIDE THREAT ACTI	0.186	10.60

OK Graph Print

Strength Analysis Graph

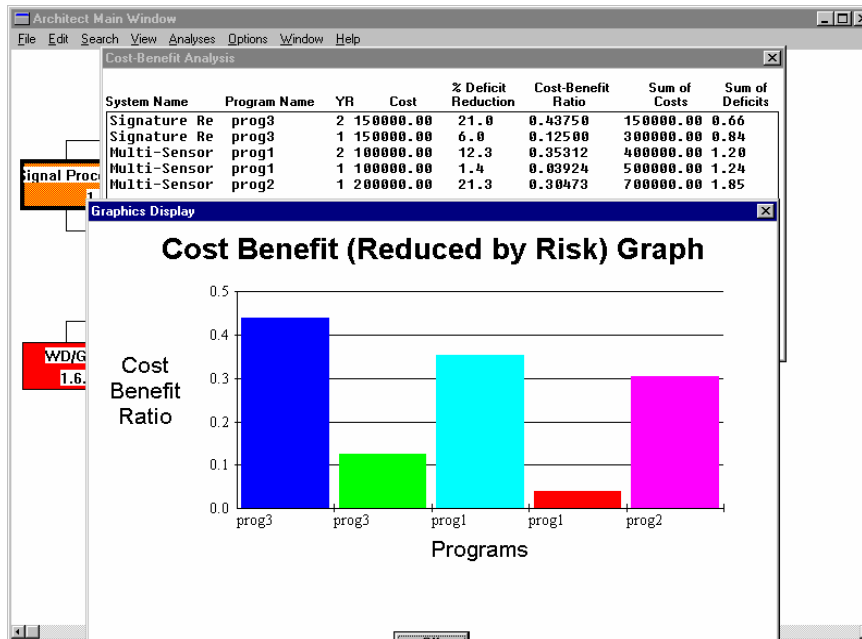
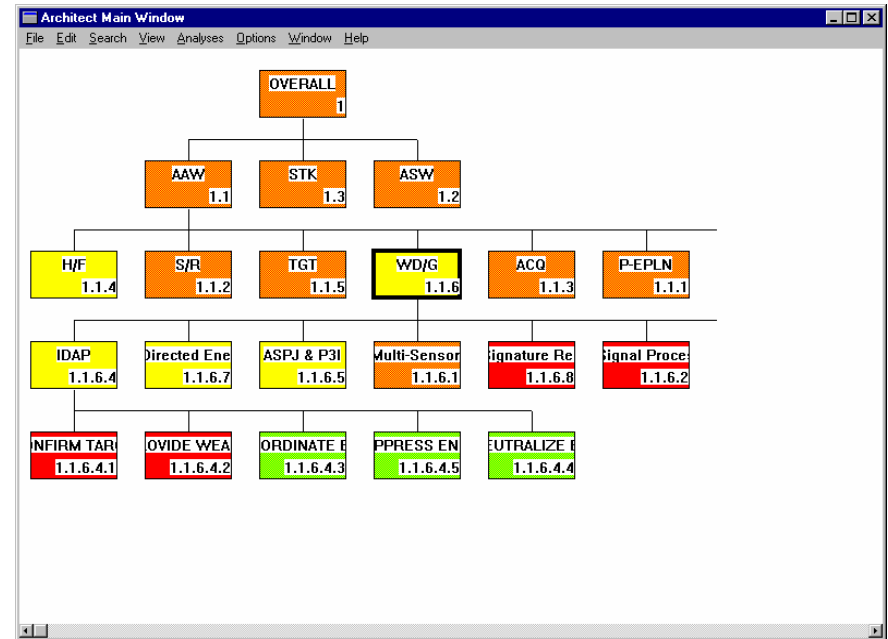


Cost Benefit Analysis

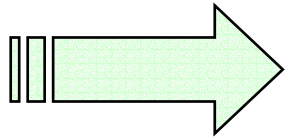


DAVE

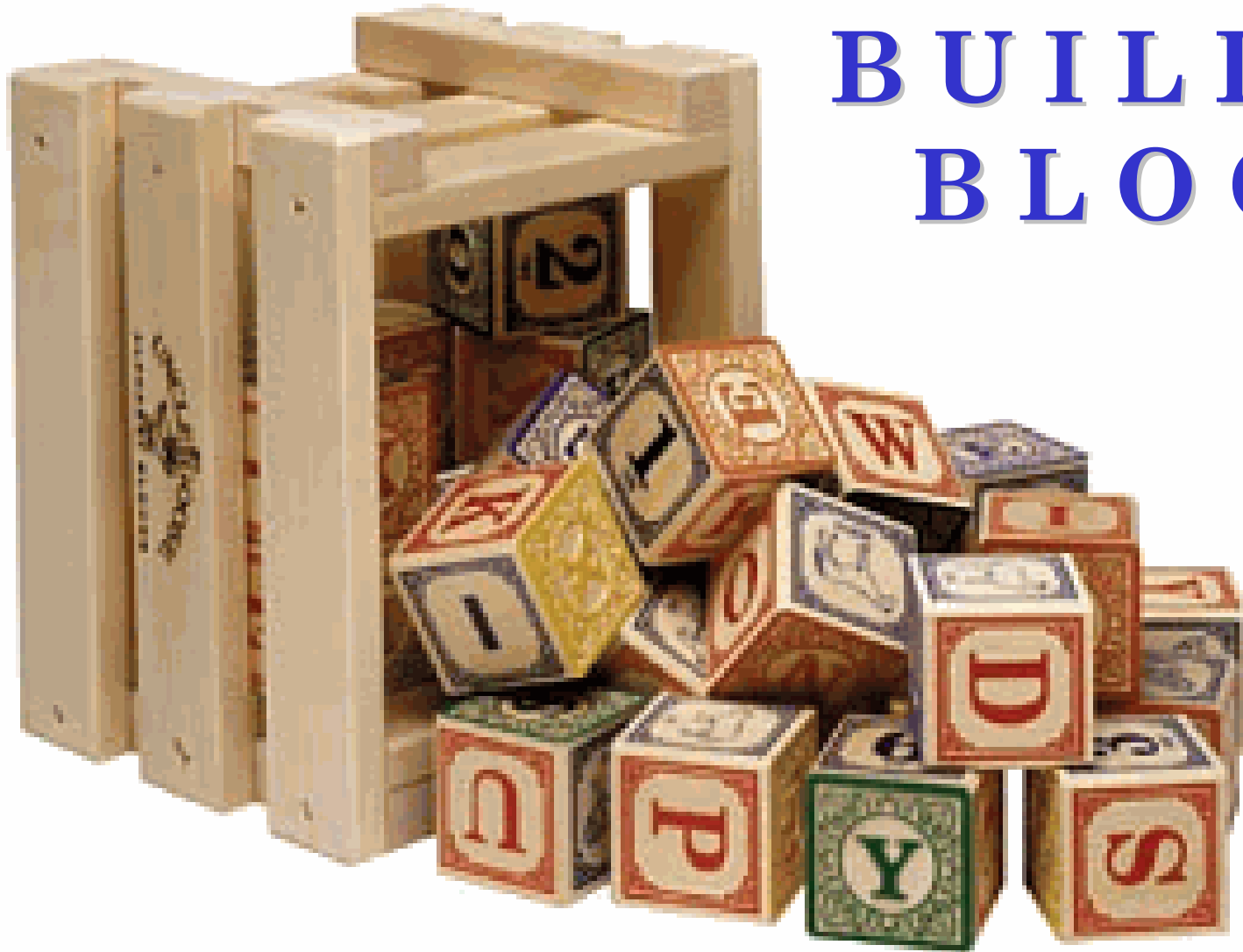
- Hierarchical View of
 - ✓ Requirements
 - ✓ Functions
 - ✓ Capabilities



- Supported by
 - ✓ Multi Attribute Utility (MAU) and Rule Based Algorithms to enable
 - Cost Benefit Analysis
 - What-If Analysis
 - Sensitivity Analysis

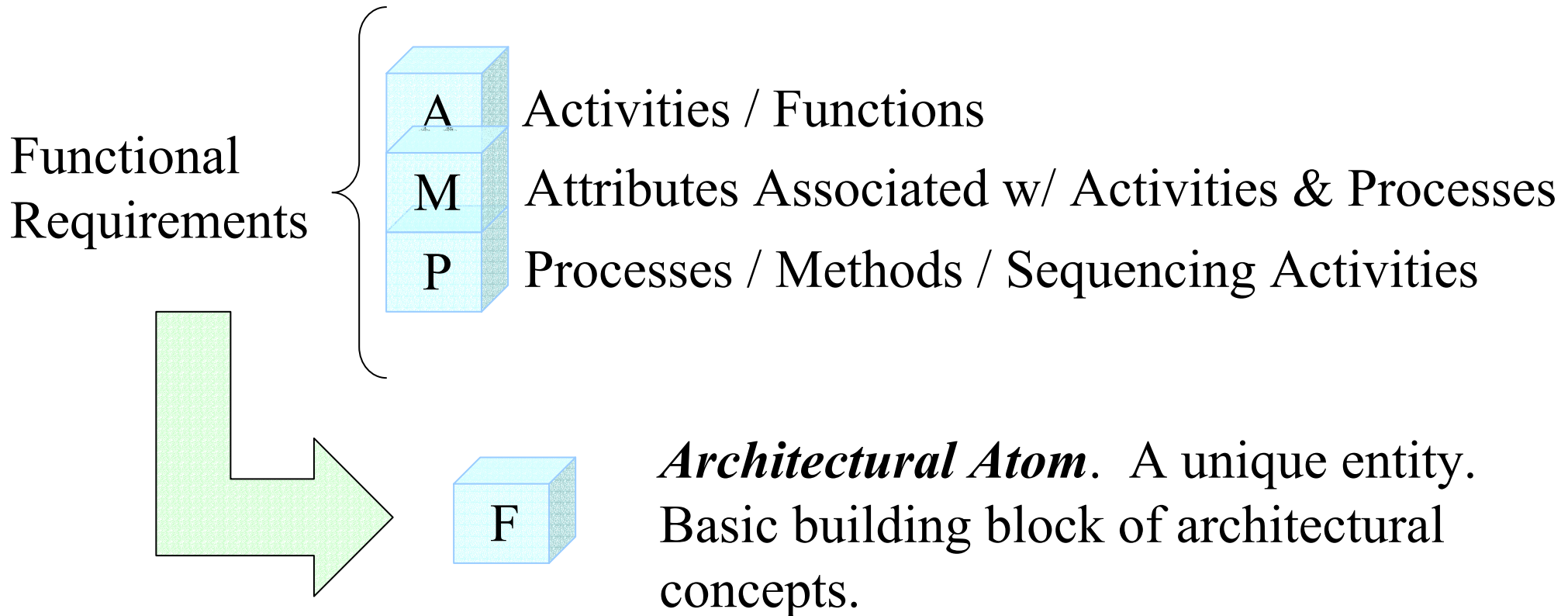


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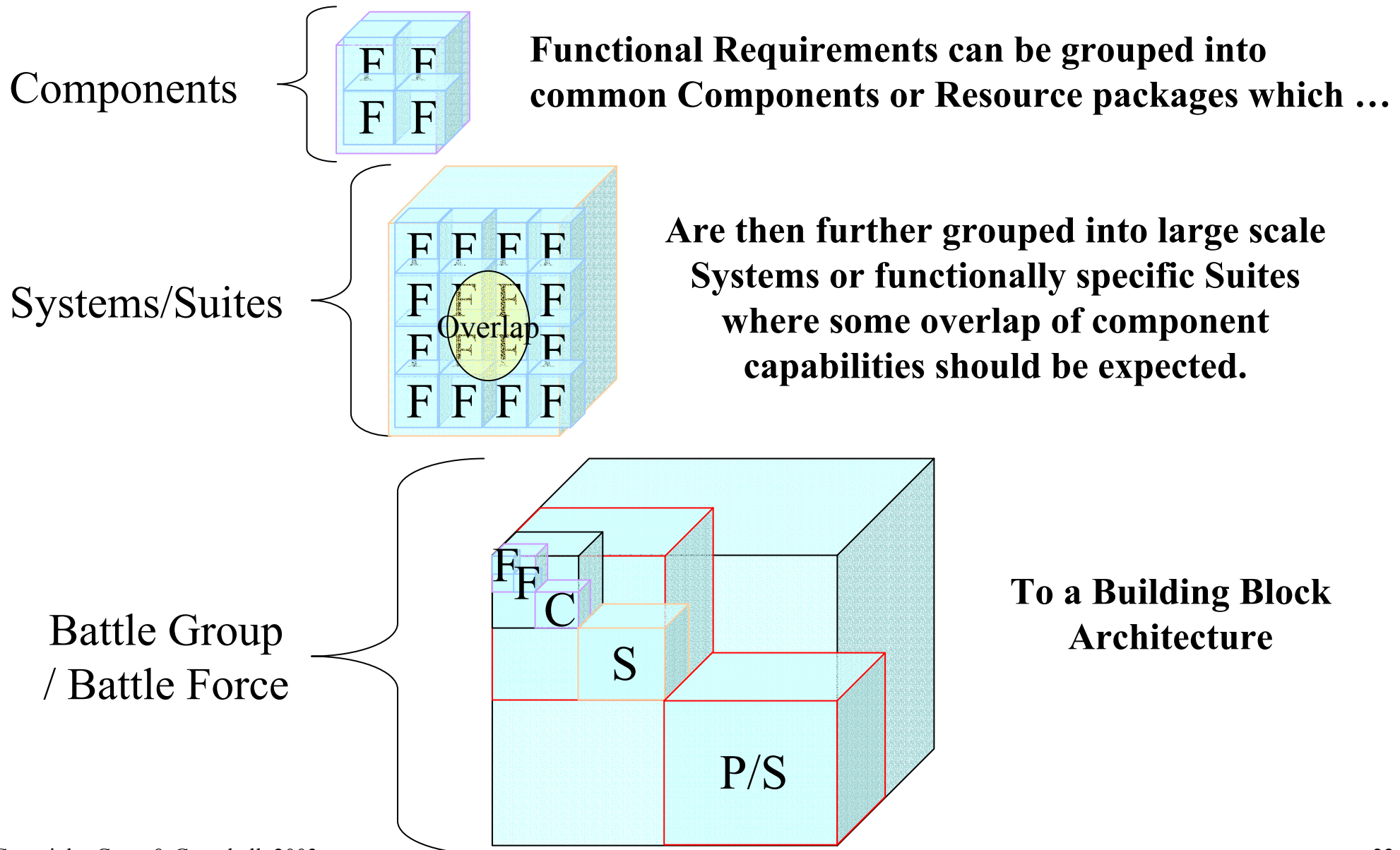


BUILDING BLOCKS

Playing With Architectural Atoms

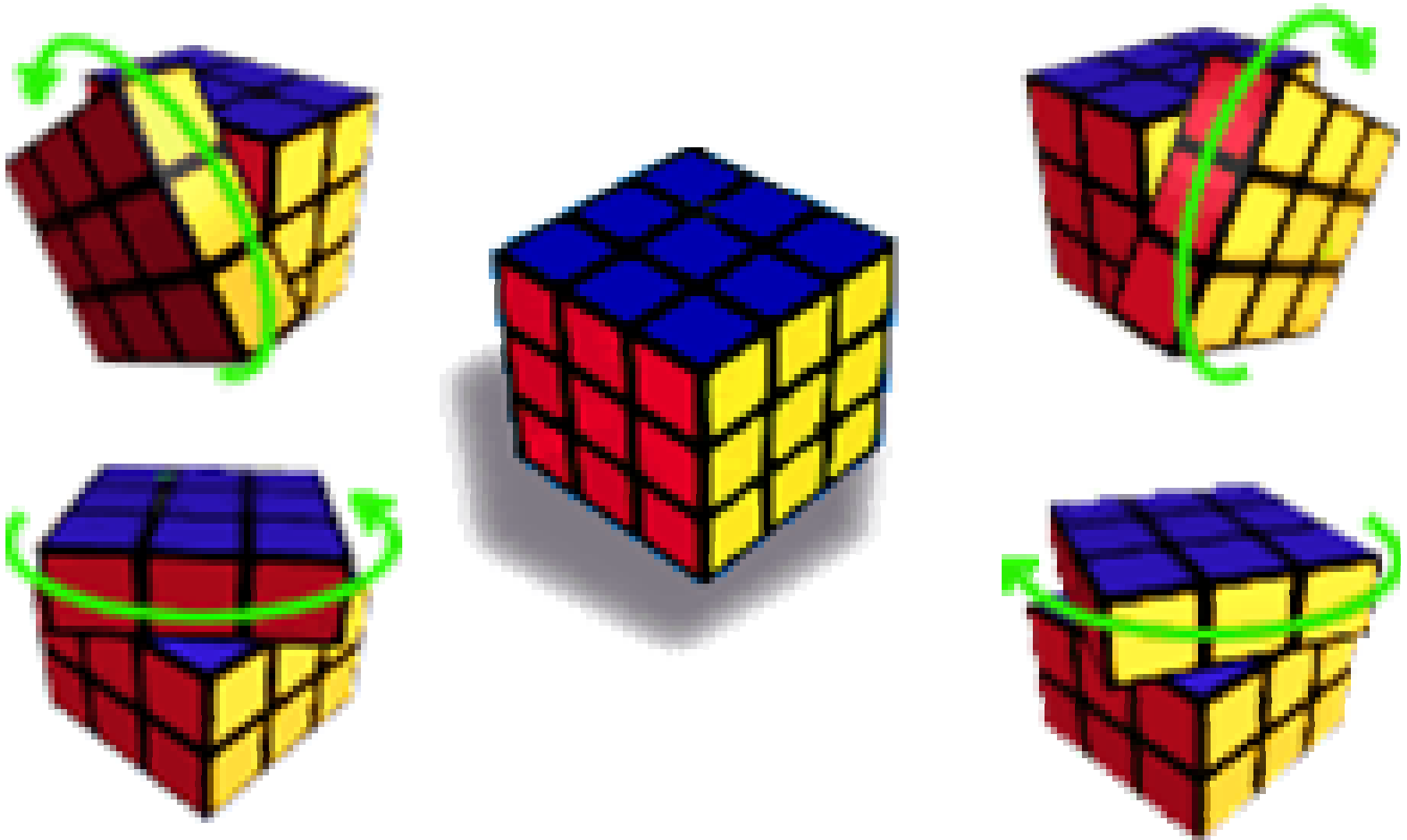


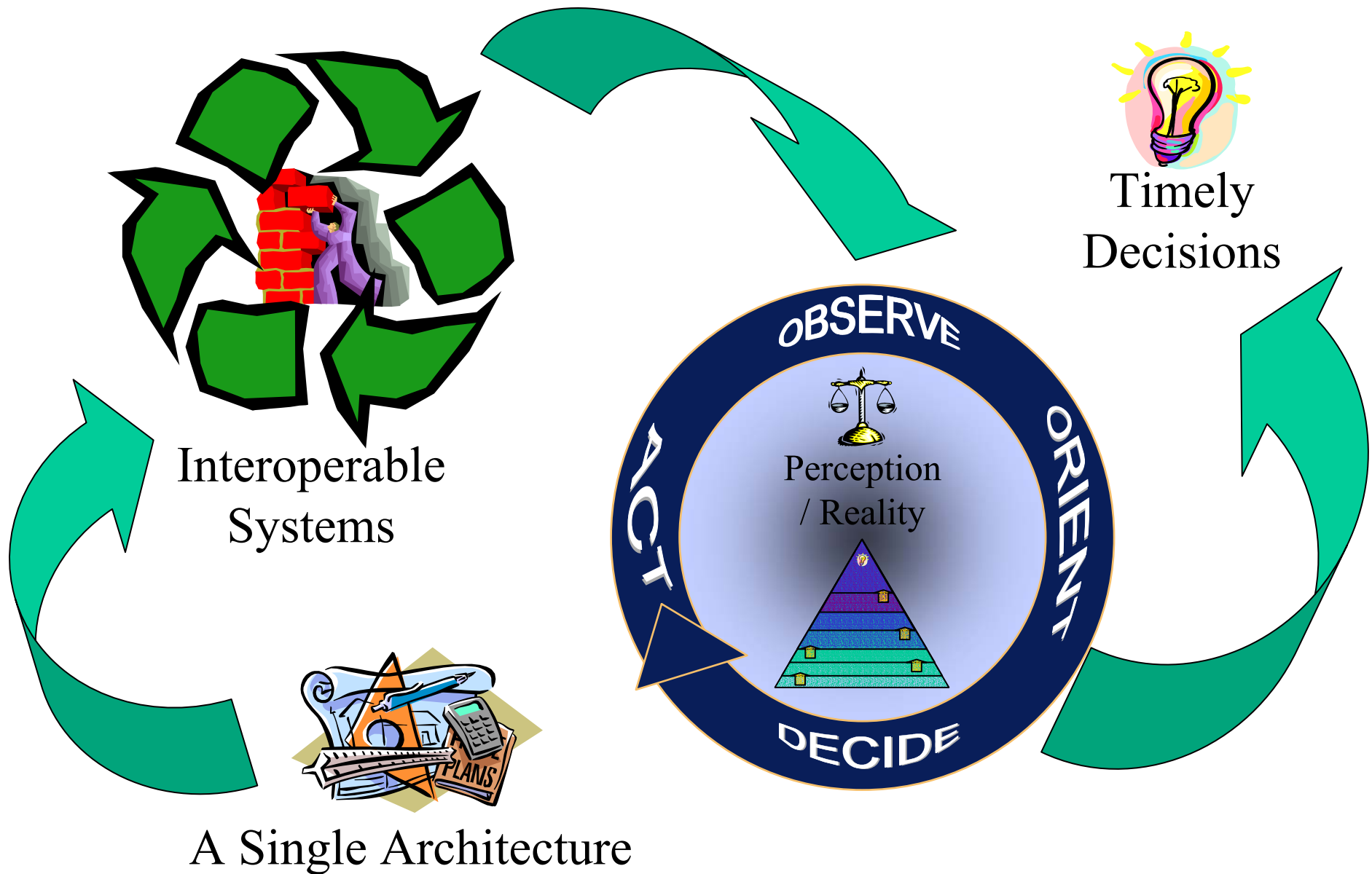
Functions, Components & Suites



- There can be many views of an Architecture but there is one and only one Architecture for any given entity.
 - Operational View
 - Organizational View
 - System (Physical) View
 - Technical View (Standards)
 - Functional View (Requirements / Capabilities)
 - Mission Capabilities Package View
- Operations are carried out by organizations and resourced by systems which combine functional capabilities into Mission Capability Packages.

Rubik's Architecture Cube





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- **DAVE**



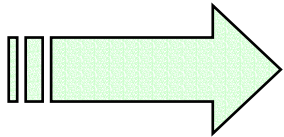
- **Object Oriented Paradigm & Architectural Atoms**

- **Summary**

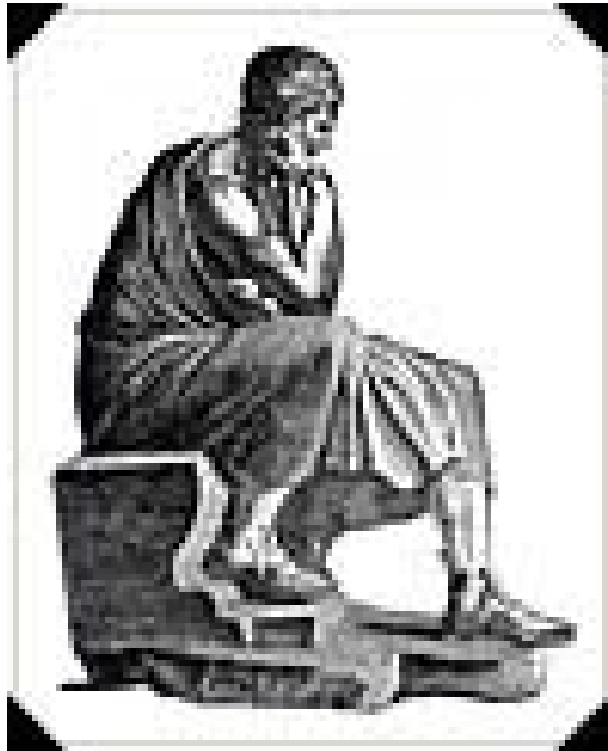
- **Future Work**

- **Fully integrated, interoperable systems can not be achieved without a plan - the Architecture**
- **Architectures can be fully integrated and interoperable**
- **Architecture data can be represented as a set of functional data elements**
- **Object Oriented methodology lends itself well to such data representation**
- **DAVE is a simple and easy way to view and explore architectures and architectural options**

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- **A number of upgrades, extensions and enhancements are planned for DAVE**
- **So far we have concentrated on functionality but it is clearly time to upgrade the GUI**
- **In addition, extensions are planned to add:**
 - **An Object Oriented data structure utilizing Architectural Atoms**
 - **Expert System Rule-Based Analysis**
 - **A more extensive MAU algorithms.**



Publius Syrus (42 B.C.)

It is a bad plan
that admits of no
modification.