MSE
MISSION SOLUTIONS ENGINEERING

Systems Assurance in the Age of Open Source Technology

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Mission Solutions Engineering

- Design, development, and integration of real-time software for the U.S. Navy's Aegis weapons system, and its derivatives, since 1969

- Embraced an Open Technology Development paradigm to support Navy Open Architecture initiatives

- Decade of experience in the evaluation, selection, integration and maintenance of OSS for Mission Systems development.

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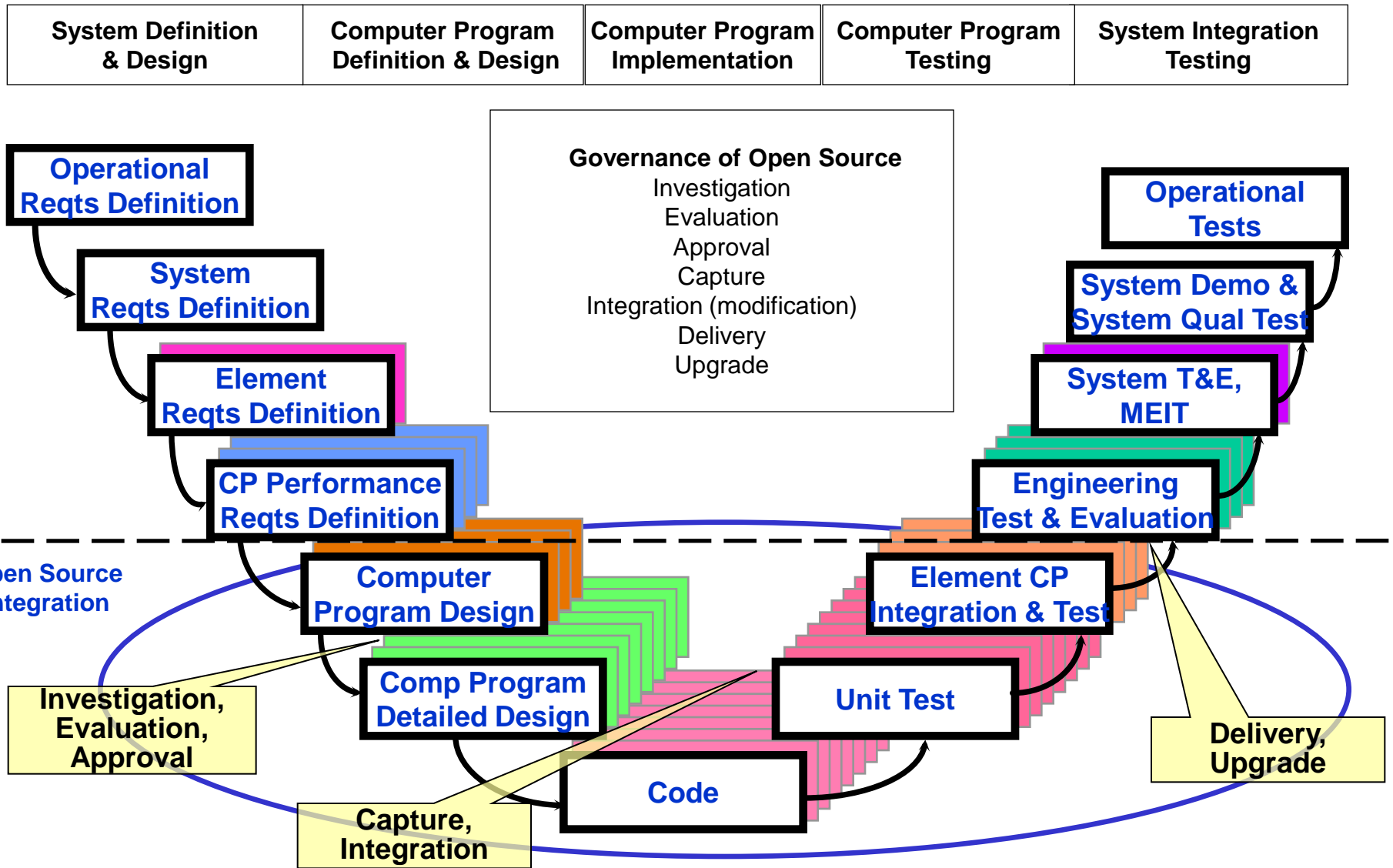
Set of Activities

- Governance
  - Adherence to well-defined processes

- Acquisition
  - Matching requirements with best-of-breed components

- Legal
  - Review and approval of Open Source license types

- Security
  - Engineering analysis to mitigate vulnerability risk

- Integration
  - Full life-cycle engineering activities

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Software Development Process

System Definition & Design	Computer Program Definition & Design	Computer Program Implementation	Computer Program Testing	System Integration Testing

Operational Reqts Definition

System Reqts Definition

Element Reqts Definition

CP Performance Reqts Definition

Governance of Open Source
Investigation
Evaluation
Approval
Capture
Integration (modification)
Delivery
Upgrade

Operational Tests

System Demo & System Qual Test

System T&E, MEIT

Engineering Test & Evaluation

Open Source Integration

Computer Program Design

Element CP Integration & Test

Investigation, Evaluation, Approval

Comp Program Detailed Design

Unit Test

Delivery, Upgrade

Code

Capture, Integration

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Applying Open Source Technology is an Organizational Effort

- Our Engineering Organization is tasked with the investigation, evaluation, and integration of Open Source software according to a strict set of criteria

- The Contracts Organization provides authorization for the use of Open Source software based on the type of license associated with the component

- An Open Source Library is maintained by our Configuration Management Organization as a "trusted source" for officially sanctioned Open Source components

Adopting New Development Processes

- Investigation
  - Based on system requirements, a search of available Open Source repositories is made to determine if a component exists that meets system needs

- Evaluation
  - Candidate Open Source component is subjected to internal tests and reviews
  - Licensing agreement is reviewed

- Approval
  - Candidate Open Source component is recommended for inclusion into the system architecture

- Capture
  - Official Download and CM of Open Source Product

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Adopting New Development Processes (cont.)

- Modification
  - Alterations to Open Source component due to locally encountered issues
- Delivery
  - Delivery of Open Source Product for use in the project
- Upgrade
 - Capture and subsequent re-delivery of the next generation of the Open Source component

Open Source Life Cycle
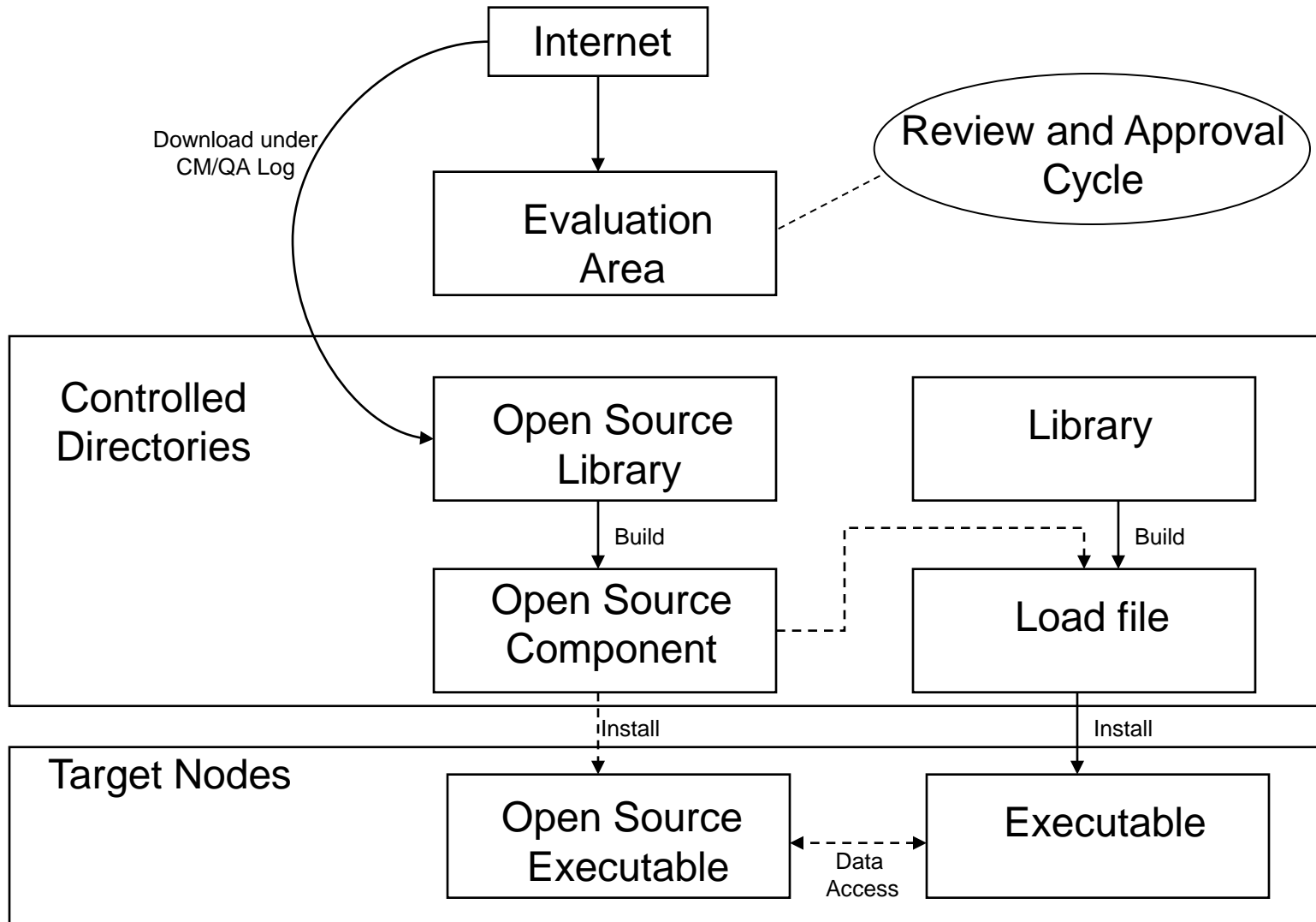
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Satisfying Requirements with Open Source Components
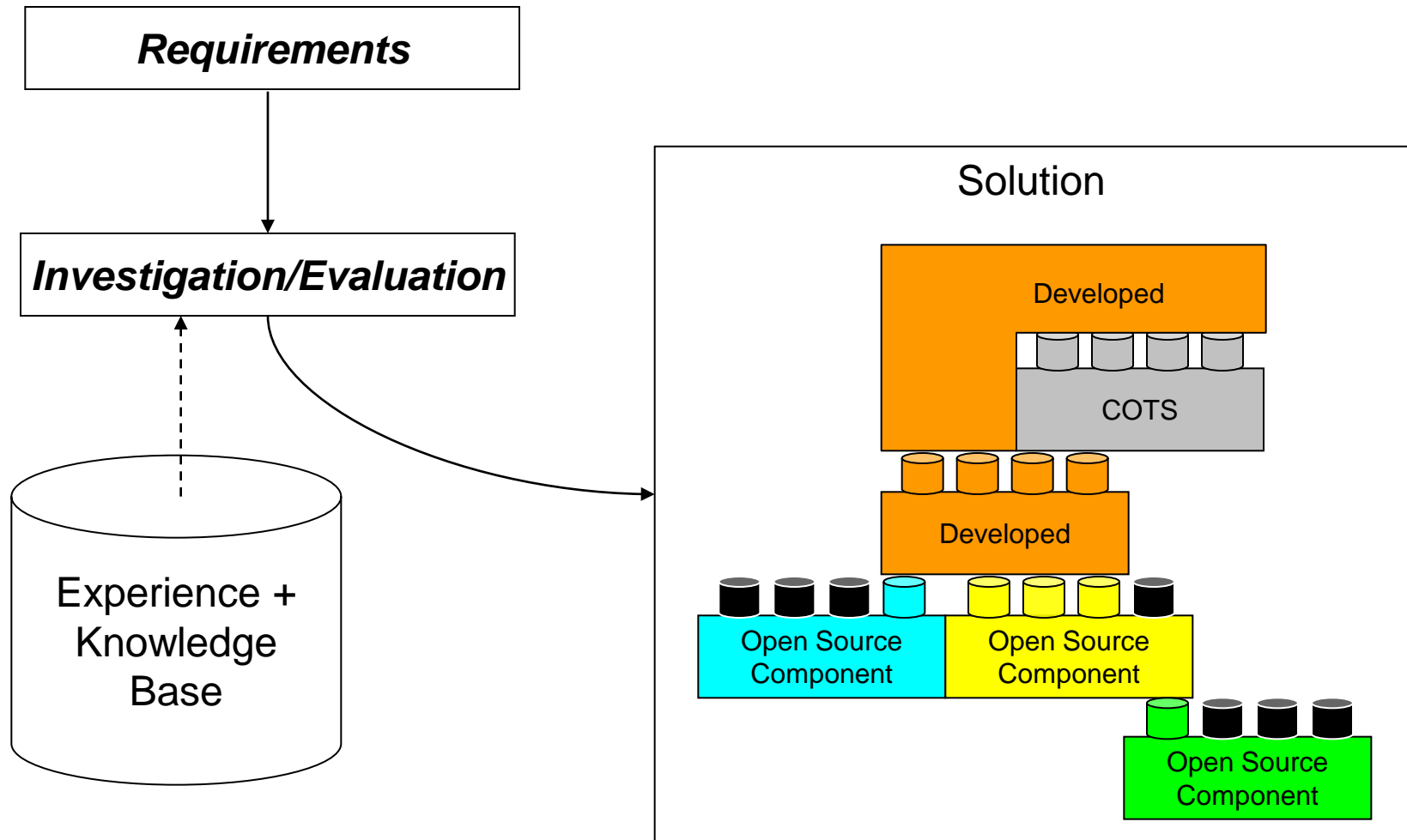
Where Does The Search Effort Begin?

- Thousands of Open Source projects are readily available for evaluation and use
  - Websites and projects are too numerous to mention

- Engineering expertise
  - Knowledge base within our center

- Leverage our Open Source Knowledge Community
  - Access to thousands of experienced employees worldwide

- Corporations are contributing to Open Source efforts
  - Open Source is no longer just the domain of hobbyists

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Selection Criteria Guideline

- Established project?

- License type?

- Security concerns?

- Actively maintained?

- Adequate support?

- Supported platforms?

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Beware: Open Source Licensing

- Although Open Source may be free, it is not completely free of restrictions
  - Unless the software has been placed in the public domain, access to Open Source software is subject to stated conditions of use, or license terms, determined by the owner

- Licensing is a complex issue
  - There are about 20 major license types in the Open Source community
  - Need to be aware of the restrictions associated with each

Open Source licenses must be carefully reviewed by area experts.

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License Terms
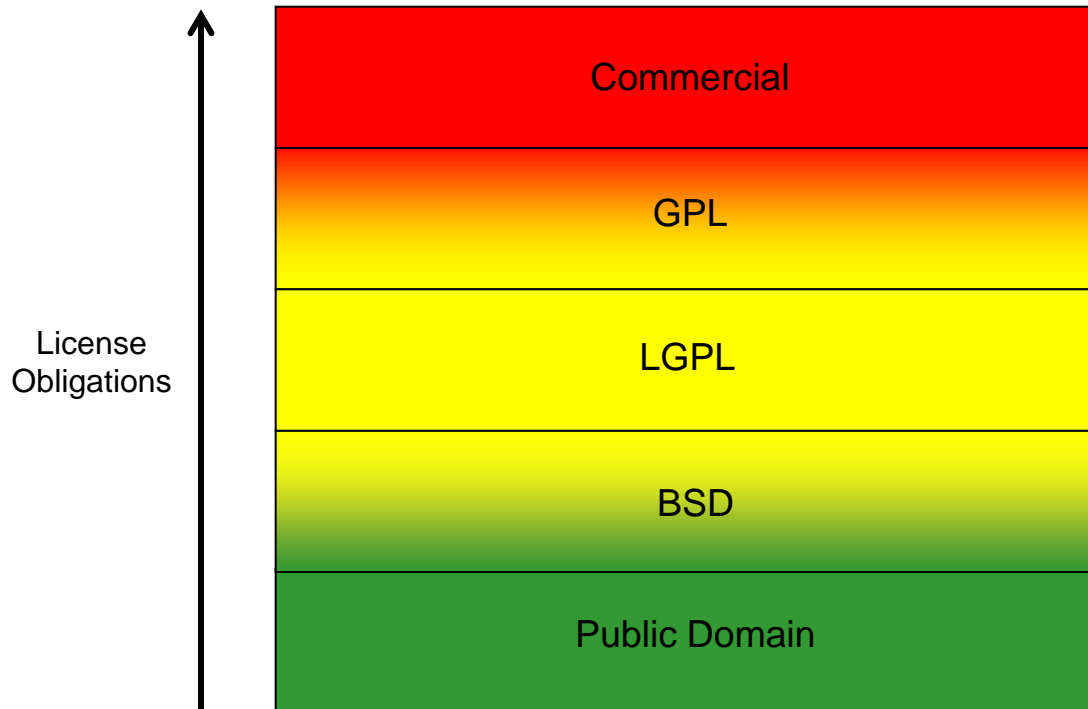
License Obligations ↑	Commercial	The chart represents the primary license types: Commercial, GPL, BSD and public domain. GPL and commercial carry the most license obligations but are at opposite ends of the proprietary scale regarding source code ownership and availability.
	GPL	
	LGPL	
	BSD	
	Public Domain	

Source: CSC *Open Source: Open for Business*

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Established Procedures

- Our process engages the Contracts organization for review and approval of each license
    - Also leverage the MSE Knowledge Community for guidance

- Additional steps
    - Create guidance document on license evaluation
    - Provide knowledge training on the various OSS license types
    - Create automated workflow for the review and approval process of OSS licenses
    - Establish a well-know list of OSS license types that are acceptable for organizational use

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Systems Assurance

- Ensure Security
  - Mitigate vulnerabilities

- Maintain Quality
  - Software stability

- Eliminate **F**ear **U**ncertainty **D**oubt
  - Embrace use of Open Source
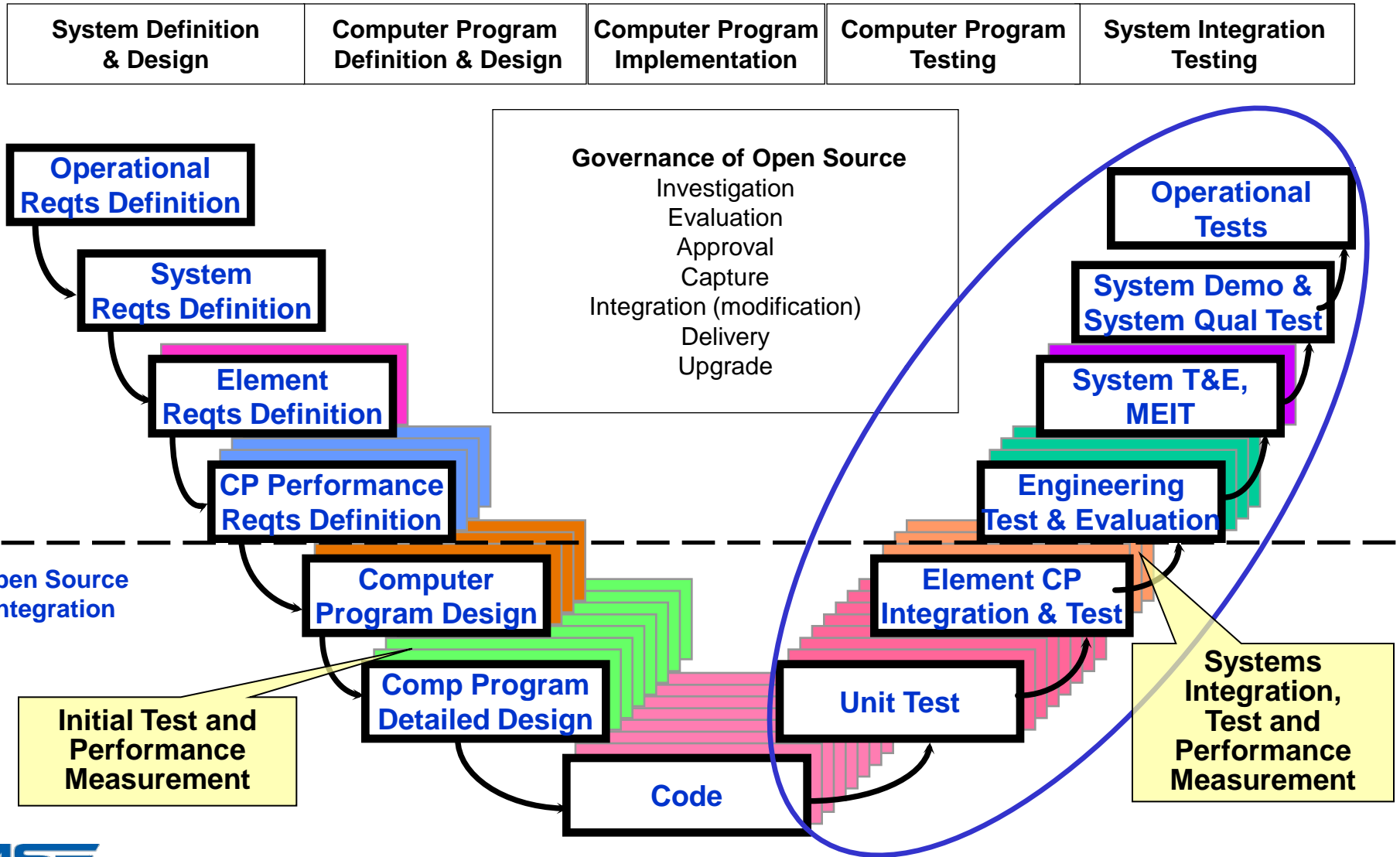
Security: Safety in Numbers

- Open Source and Security appear to be an oxymoron, but in fact are highly compatible
  - The very openness of the software ensure rigorous reviews and testing, bolstering security

- In practice, source code availability allows a large community of developers to inspect and review the code for security flaws

- Developers are driven by fame: finding a security weakness in a complex system is a challenging task that is recognized and lauded by peers.

Security and Safety Measures

- Virus Scans

- Backdoor checks

- Code Inspections

- Performance Tests
  - Memory consumption
  - CPU utilization
  - Process/Thread allocation

Multiple Testing Levels

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Initial Test and Performance Measurement

Systems Integration, Test and Performance Measurement

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Integration
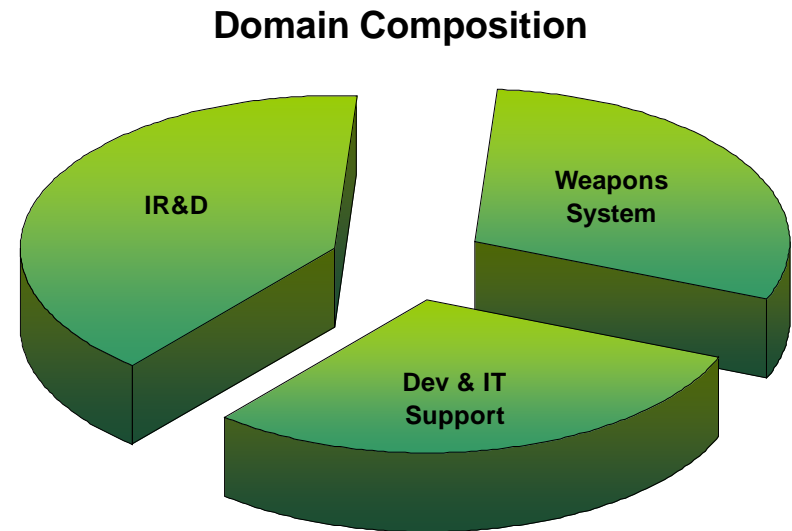 - **Full life-cycle engineering activities**
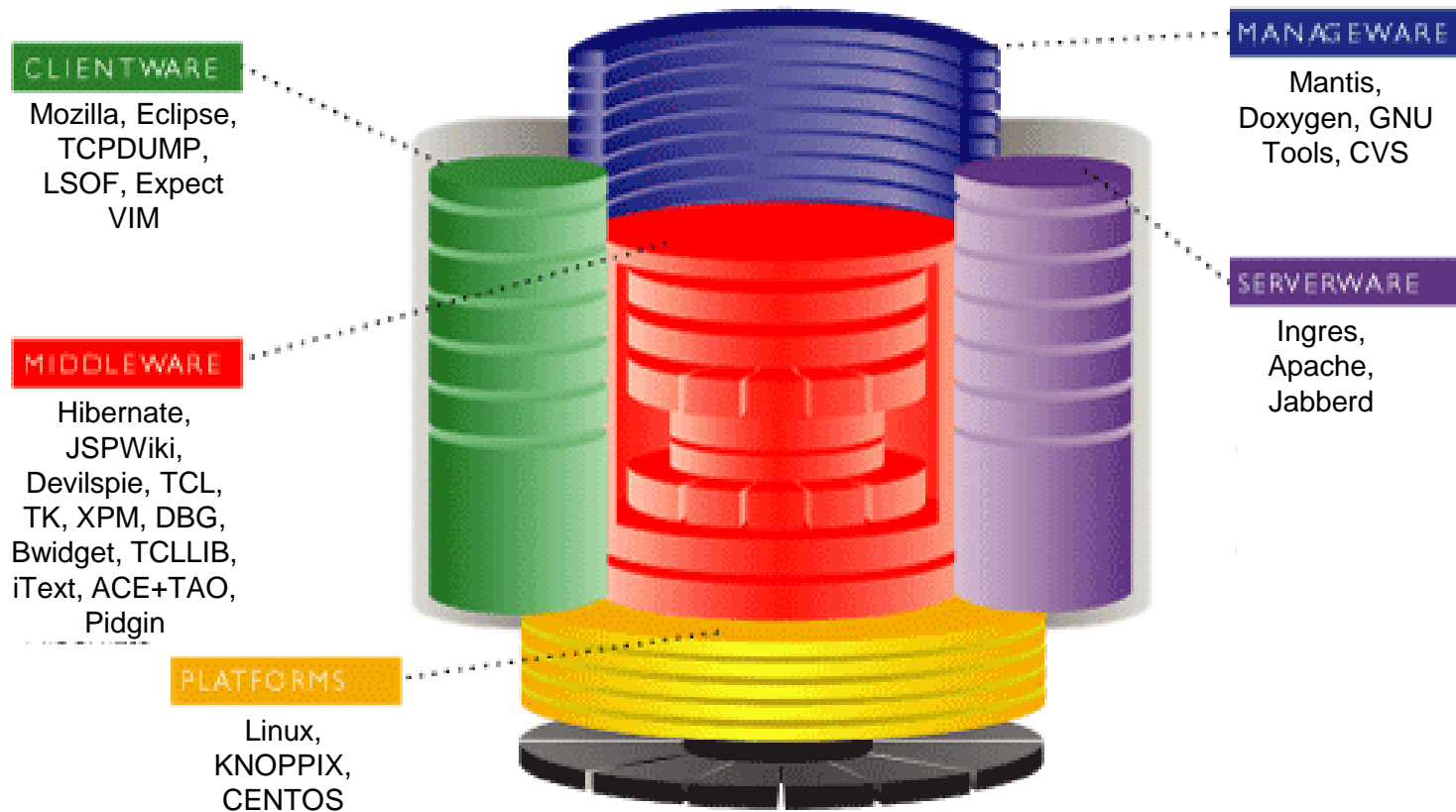
Open Source Case Studies

- MSE has successfully leveraged Open Source technology in the development and support of the AEGIS weapons system.

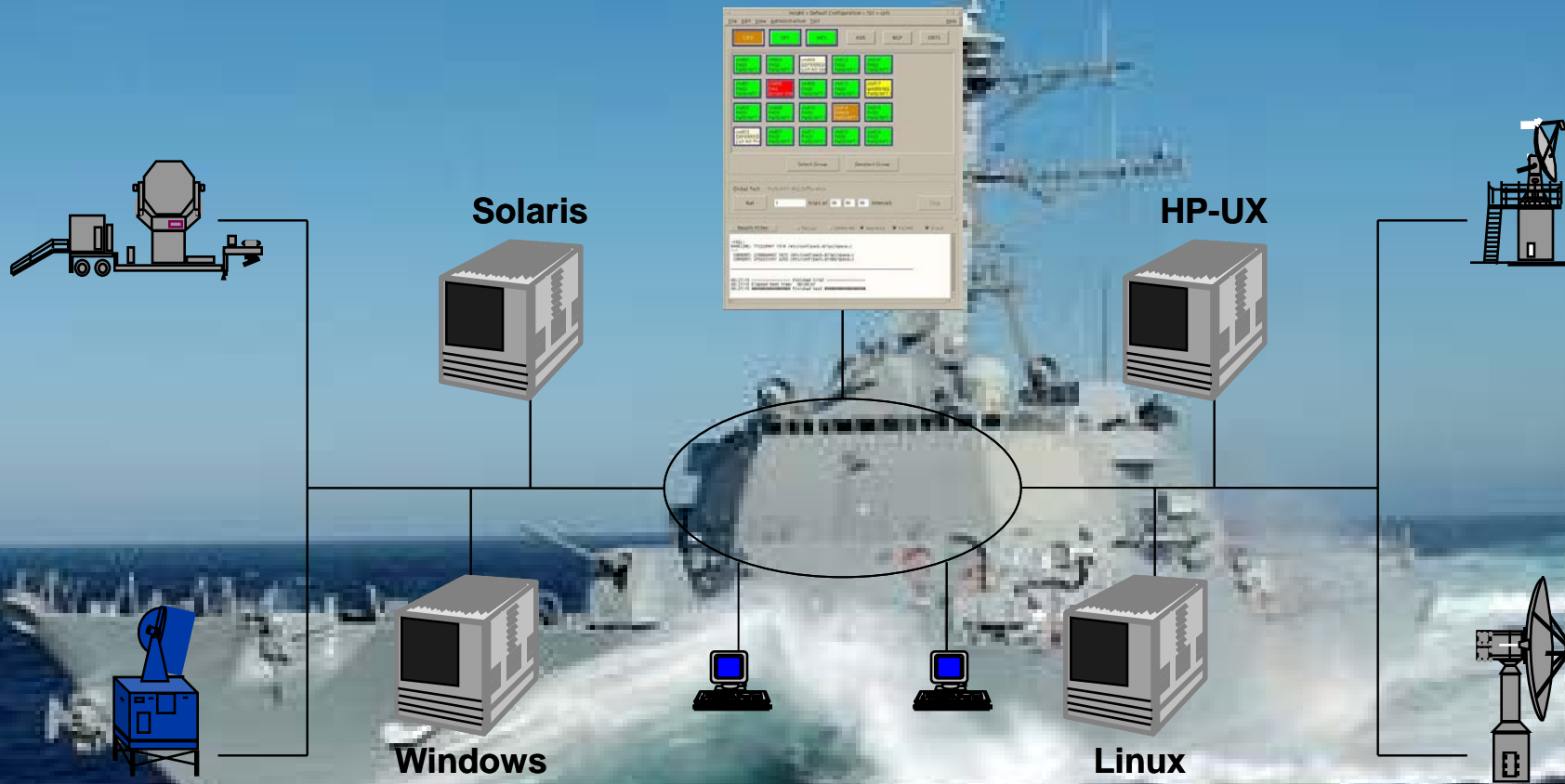# Open Source Allocation in Product Area Domains

- Integrated 90+ Open Source components on the Aegis program
  - 30% are deployed within the certified real-time weapons system
  - 40% are used on IR&D projects in support of future programs
  - 30% are used as development tools and IT support programs

Domain Composition

IR&D

Weapons System

Dev & IT Support

Sampling of Integrated Open Source Components

CLIENTWARE
Mozilla, Eclipse, TCPDUMP, LSOF, Expect VIM

MIDDLEWARE
Hibernate, JSPWiki, Devilspie, TCL, TK, XPM, DBG, Bwidget, TCLLIB, iText, ACE+TAO, Pidgin

PLATFORMS
Linux, KNOPPIX, CENTOS

MANAGEWARE
Mantis, Doxygen, GNU Tools, CVS

SERVERWARE
Ingres, Apache, Jabberd

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Insight: Distributed Systems Management Toolset

Solaris

HP-UX

Windows

Linux

A Migration to Open Architecture

Proprietary Systems

Manufactured hardware and developed software

Open Technology

Emphasis on COTS hardware and software integration

Computing System Management functions have become more complex with the adoption of COTS technology.

Application Management

- **Manage where applications are running**

- *Manage runtime state of the applications*

- *Manage recovery and reconfiguration*

- **Assess health status of the applications**

Equipment Management

- **Node/Server Management**
  - **Diagnostics**
  - **Performance Monitoring**

- **Network Management**

- **Asset Management**
  - **Validation and Verification**
  - *Software Distribution*

Fault Detection / Fault Isolation

Root Cause Analysis

Open Technology

- An Aegis ship not much different from a large-scale commercial data center.

- The weapons system is comprised of a standard operating environment with unique components not seen in commercial architectures.

Insight: Distributed Systems Management Toolset

- Highly configurable suite of open source, commercially available, and developed tools that perform system management functions across the enterprise

Development Site

Validation of the build environment

Test Facility

System validation, diagnostics, operability tests

Shipyard Integration

Deployed Systems

Runtime status monitoring, operability tests, diagnostics

Extensive Use Of Open Source Technology

- Over 40% of Insight is comprised of Open Source software
  - Permits selection of cost effective, best-of-breed solutions
  - Reduces development time
  - Allows for extensible functionality

Functional Composition

Developed

Commercial
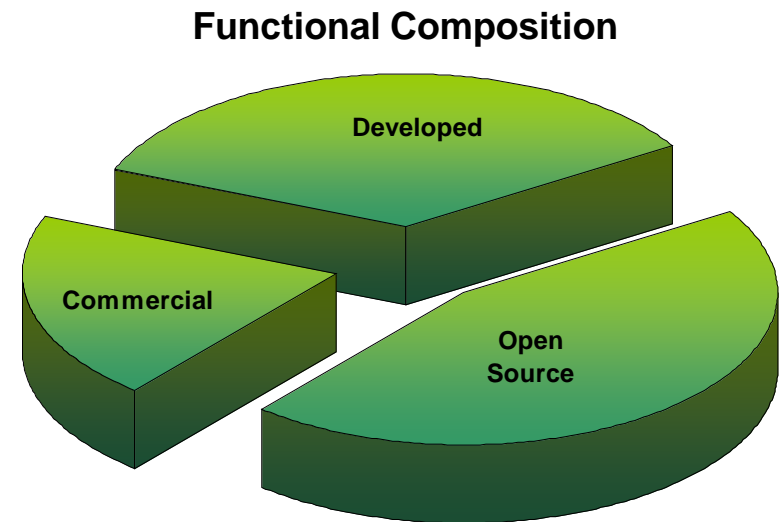
Open Source

> **Open Source is incorporated within every functional component of Insight.**

The Open Source Benefits For Insight

Sample cost and schedule

	Open Source		MSE Developed	
	Expect/TCL, XPM, DBG	LSOF, AIDE, TCPDUMP	Framework	Tools
Source Lines	102,266	38,417	10,238	8,812
Development Cost	$2,676,404*	$1,005,372*	$267,938*	$230,610*
Effort - Staff Months	227	85	23	19

*Costing number derived from industry standard numbers as determined by the SLOCCount estimation tool. Refer to http://www.dwheeler.com/sloccount for details.

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