GENERAL DYNAMICS
Land Systems

EXTENDING ENTERPRISE SYSTEMS FOR AN INTEGRATED LOGITICS MANAGEMENT ENVIRONMENT

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Introduction

- **A System Engineering approach wrapped with a Design For Six Sigma (DFSS) blanket of methodology to provide a means of designing and delivering an Integrated Logistics Management Environment for the collaboration and delivery of logistics information over a military support network.**

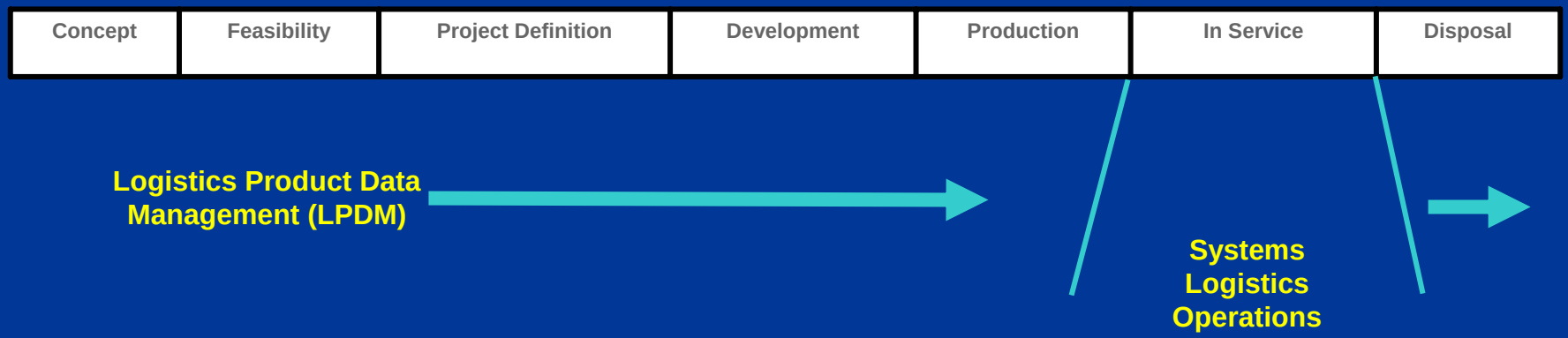
Large Scale, Sprawling Systems

- Stove pipes for product source and delivery
- Security, Limited access
- Funding Problems
- Heavy Payloads, Quick Access Demands
- Heavy, Traditional Process Driven methods
- Old, New Mil Standards
- Large Complex Legacy Systems
- New Technologies waiting to be exploited

Transitions to Deal With

- Old Technology, Legacy Processes
- Logistics maintainability models
- Today's technology without changing the development processes
- Streamlined delivery over Global Support Networks
- Containment to Military Networks with limited access
- Low time, cost
- High Demand, The Right Data at the Right Time

The Typical Full Product Life Cycle



(ILS) Has not changed 1388-2B MIL-Standard (circ 1973)

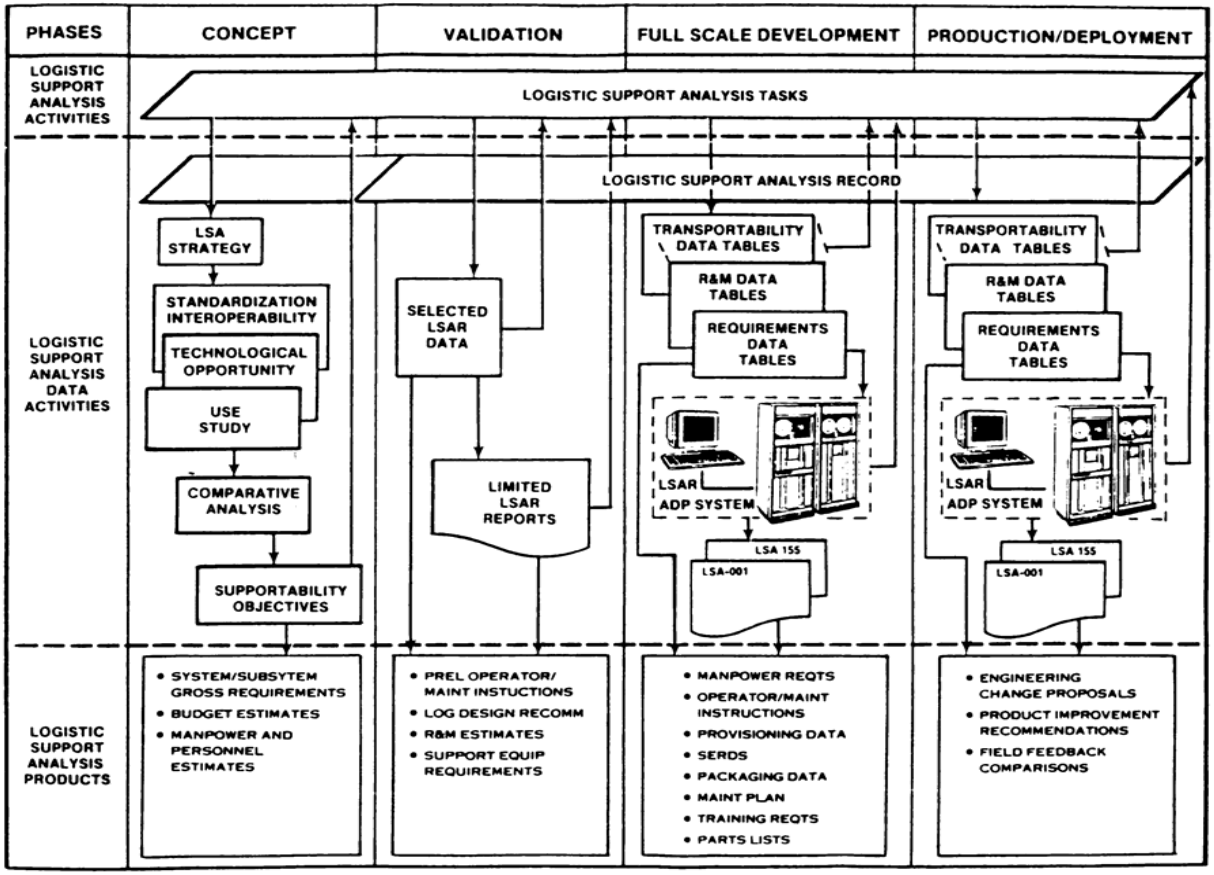
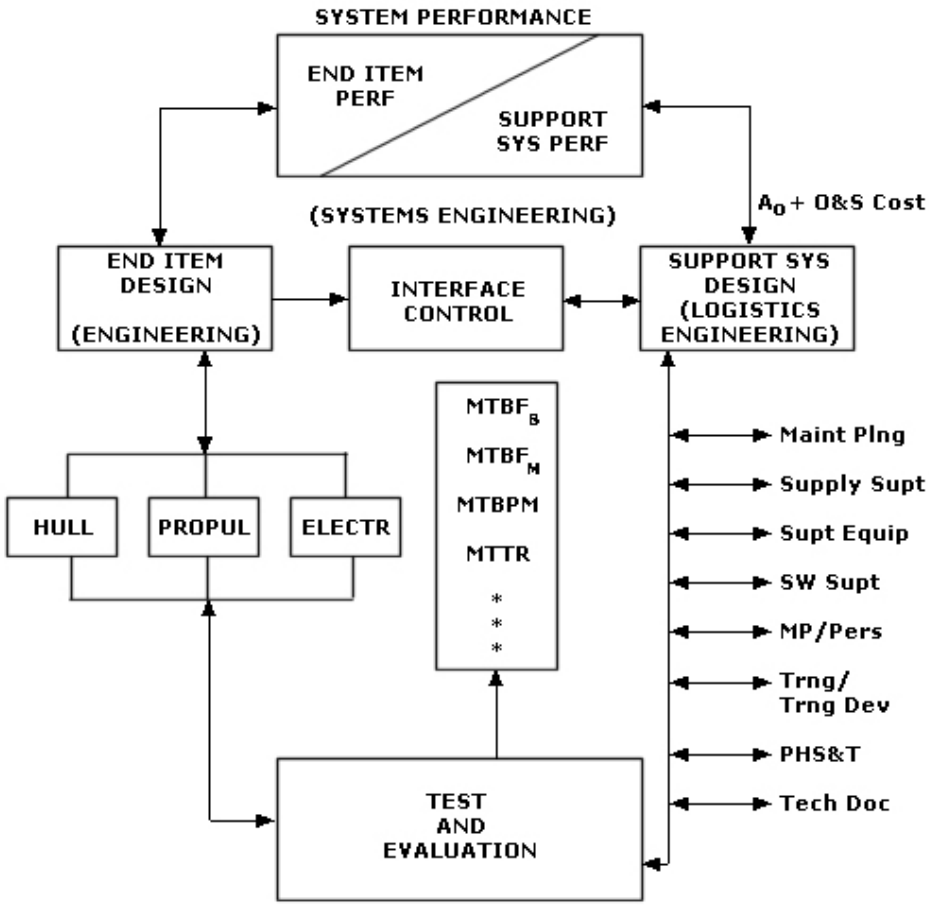


FIGURE 1. LSA data documentation process.

ILS – Integrated Logistics Support

- The ILS management process which facilitates development and integration of the 10 individual logistic support elements to specify, design, develop, acquire, test, field, and support systems. There are 10 ILS elements:
  - Maintenance planning
  - Supply support
  - Support and Test Equipment/Equipment support
  - Manpower and personnel
  - Training and training support
  - Technical data
  - Computer Resources support
  - Facilities
  - Packaging, Handling, Storage, and Transportation (PHS&T)
  - Design interface

Source Data Model and Outputs For Supportability (ILS Program)



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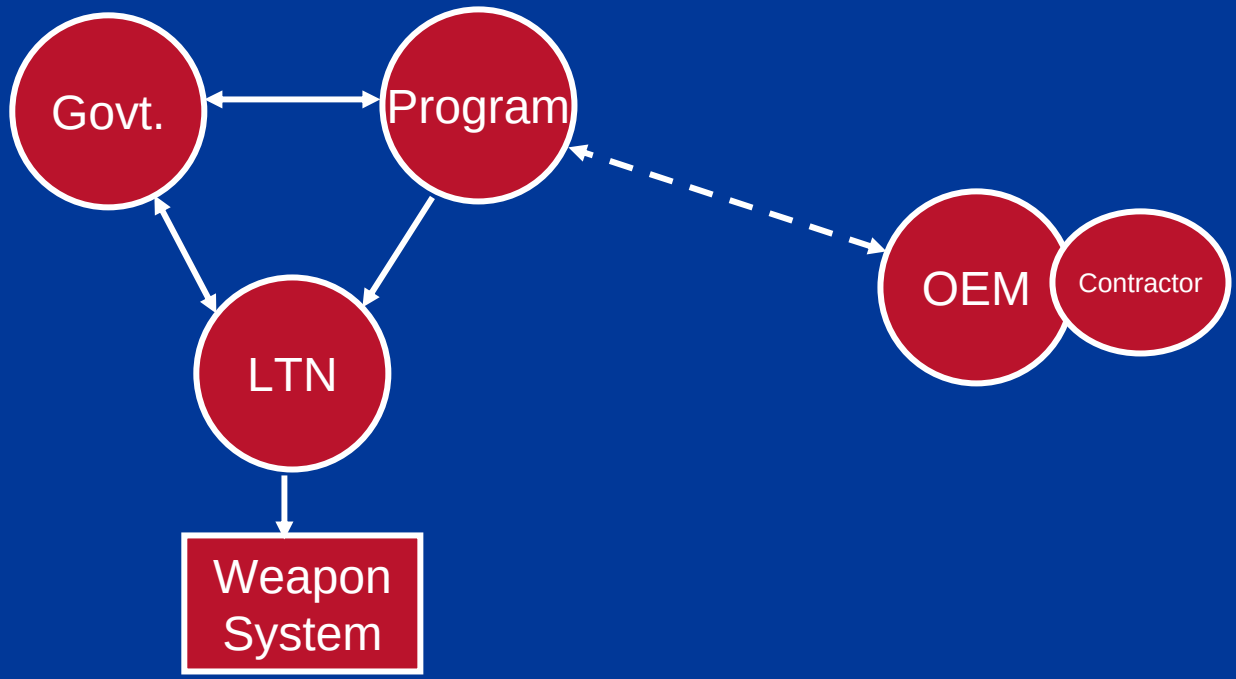
Products Delivered

- Technical manuals.
- Technical and supply bulletins.
- Transportability guidance technical manuals.
- Maintenance expenditure limits and calibration procedures.
- Repair parts and tools lists.
- Maintenance allocation charts.
- Preventive maintenance instructions.
- Drawings/specifications/technical data packages.
- Software documentation.
- Provisioning documentation.
- Depot maintenance work requirements.
- Identification lists.
- Component lists.
- Product support data.
- Safety critical parts list.
- Lifting and tie down pamphlet/references.
- Hazardous Material documentation.

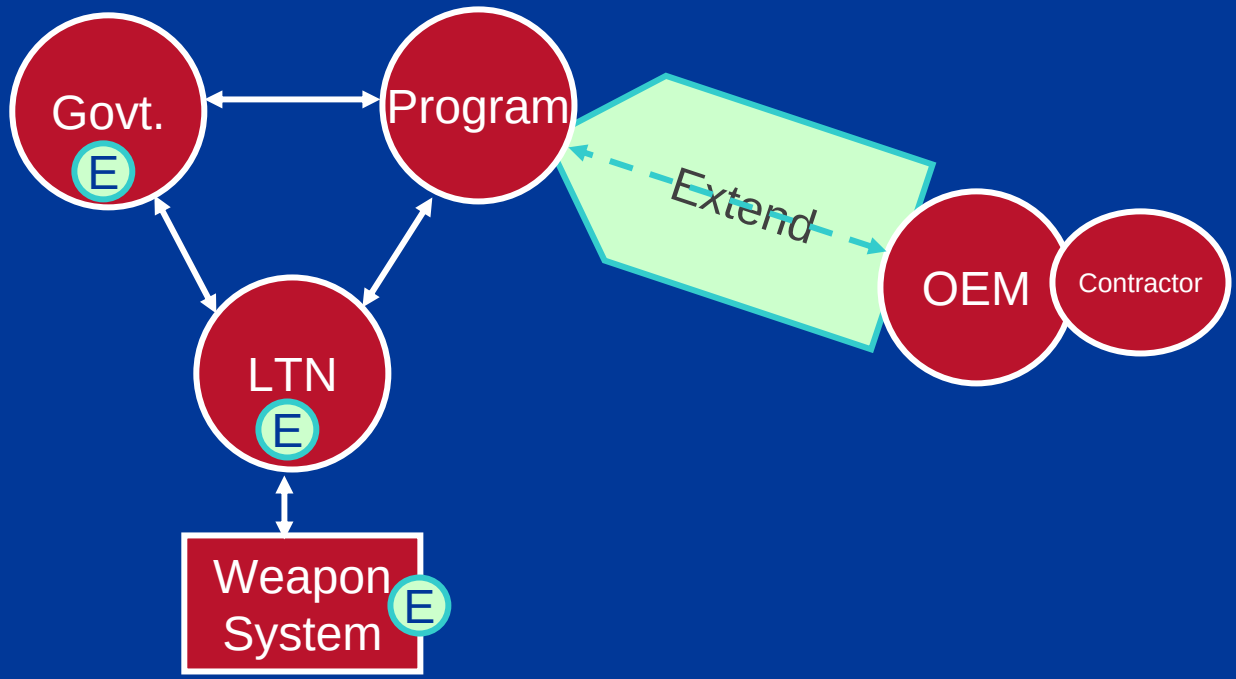
Typical Tools – Program to support ILS

ANALYSIS	CONTENT CREATION & CAPTURE	STORAGE AND MANAGEMENT	ASSEMBLY/ DATA TRANSFORM	PRODUCTION	DEPLOYMENT
•SLIC/SLICwave •PRO-E/UG •ProductView •COMPASS/Lite •IDE •ECARDS •ESCHER •CMWebstat •eXpress (Testability Modeling Tool)	•Arbortext Epic Editor •MsWord •Content@ XML/SGML Management & Multi-Channel Publishing •SLIC/SLICwave •IBM Mainframe (LS3Q) •TIPS-PC (MsWord/VBA/ VB/Access) •Autotrol Technical Illustration •ProductView •PRO-E •Adobe Illustrator •Adobe Photoshop •Authorware •QuickSilver (Packaging)	•Content@ •Documentum •Access •IBM Mainframe (LS3Q) •SLIC/SLICwave	•Omnimark •Perl •VB/VBA •Sed/Awk/Nawk •Unix Shell •Xychange •EMS2 RPSTL Editing Tool (ERET)	•Content@ •XPP (XML Publishing) •Epic •EMS2 Reformatter /Linker/Compiler •InfoLinker •Adobe Acrobat •IBM Mainframe (LS3Q) –LSA36 Delivery •MRP (Pricing) •WebFLIS (Prov NSN)	•Adobe PDF •EMS2 Runtime •InstallShield •Internet Explorer •Powerarchiver/ Winzip

The Enterprise, High-Level Military



The Enterprise, High-Level Military



Why? Products Delivered over Network

- Data is now capable of streaming and is considered developed in native format for delivery over a network. (serialization)
- Near-time access is required, updates as well.
- Publish-Subscribe methods is desired, only when I need it mentality
- Authentification, Security maintained easily
- Information Assurance can be applied
- Feedback to OEM

Attempts to Solve

- Replacing legacy systems with integrated COTS packages (like Baan, PeopleSoft, and SAP)
- Developing data and information warehouses
- Establishing central operational data stores or data clearinghouses
- Implementing Enterprise Portals
- Using Middleware
- Using XML
- Reengineering all applications to a single architecture
- All of these approaches have value and some will even provide at least temporary benefit. However, unless they are business-driven and model-based they are more likely to further compound the problems than provide a solution.

Design for Six Sigma (DFSS)

- The goal of DFSS is to create designs that are development efficient, capable of exceptionally high yields and are robust to process variations.

Design for Six Sigma (DFSS)

- *Capture Voice of Customer & Define Eng. Requirements*
  - Wants & needs tools
  - Customer use observations
  - Kano Analysis
  - Quality Function Deployment (QFD)
- *Develop Concepts and Select*
  - Pugh Matrix
  - Axiomatic Design
  - TRIZ
  - Failure Mode & Effects Analysis (FMEA)
- *Develop Detailed Design*
  - Systems Engineering
  - Function Models & FMEAs
  - Transfer Functions
- *Statistical Design*
  - Monte Carlo Analysis
- *Design for Robust Performance*
  - Design of Experiments
  - Robust Design
  - Design for Reliability
- *Design for Manufacturability*
  - Process Capability Databases
  - Statistical Tolerancing
- *Predict Quality*
  - DFSS Scorecards

Axiomatic Design

- Axiomatic design is systems design methodology using matrix methods to systematically analyze the transformation of customer needs into functional requirements, design parameters, and process variables.

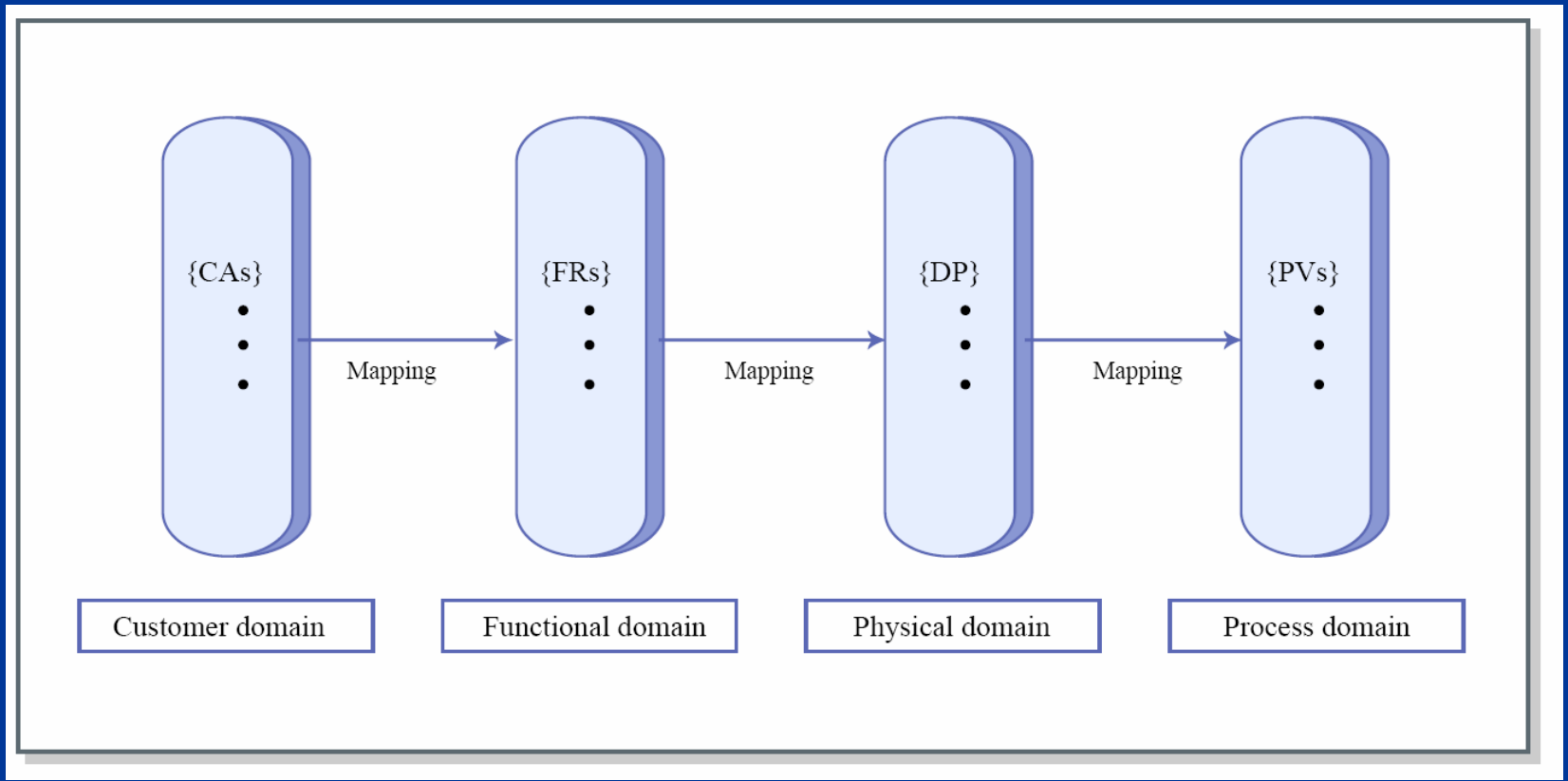
2 Principles of Axiomatic Design

- Axiom 1:The Independence Axiom
  - *Maintain the independence of the functional requirements (FRs)*
- Axiom 2:The Information Axiom
  - *Minimize the information content of the design*

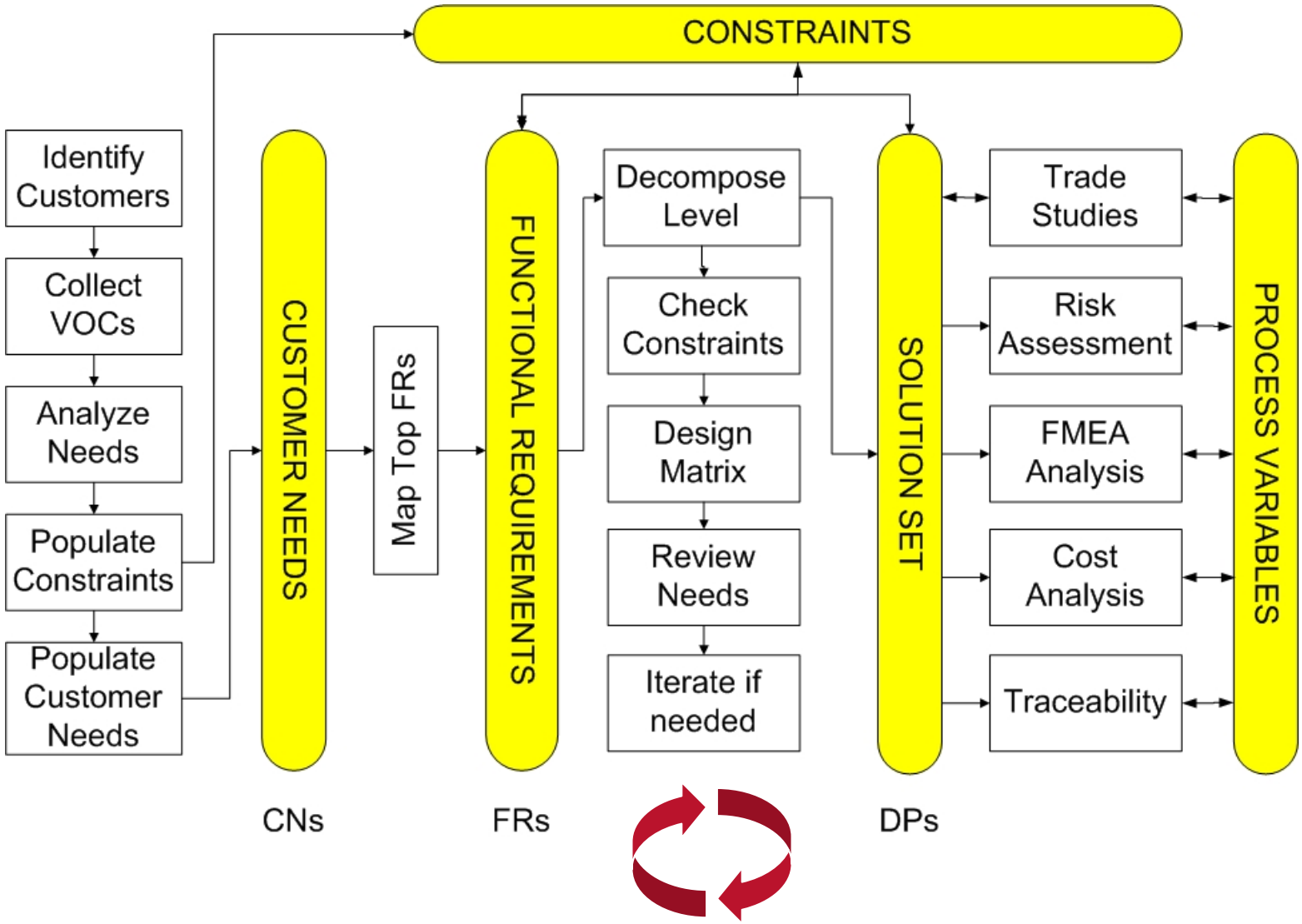
Key Axiomatic Design Definitions

- *Customer Needs (CN)*
  - Collection of statements expressed in the “voice of the customer” that express the customers’ perceptions of the design task
- *Functional Requirement (FR)*
  - Minimum set of independent requirements that completely characterize the functional needs of the product (or software, organizations, systems, etc.) in the functional domain
- *Constraint (C)*
  - Bounds on acceptable solutions
  - There are two kinds of constraints:
    - Input constraints
      - Imposed as part of the design specifications
    - System constraints
      - Imposed by the system in which the design solution must function
- *Design parameter (DP)*
  - Key physical (or other equivalent terms in the case of software design, etc.) variables in the physical domain that characterize the design that satisfies the specified FRs.

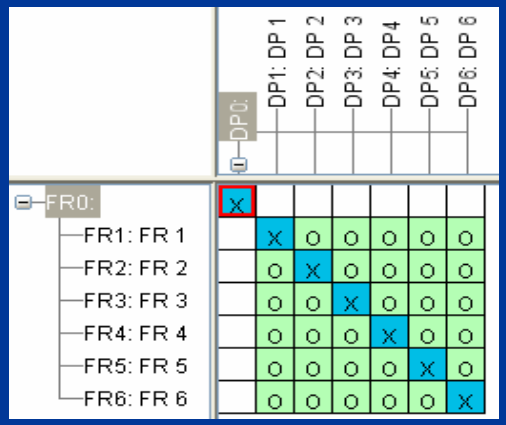
Four Axiomatic Domains



Overall Axiomatic Process



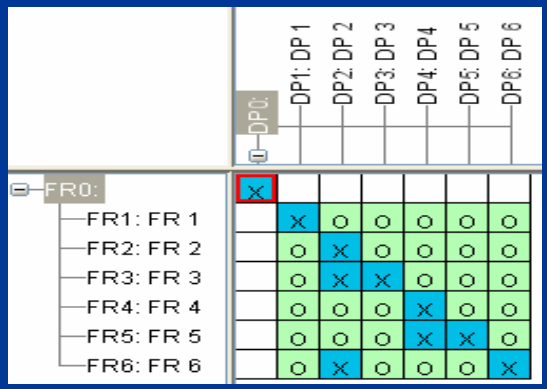
Three States of Functional Coupling



Uncoupled

Each DP uniquely satisfies a single FR

Order of Development and Function not important

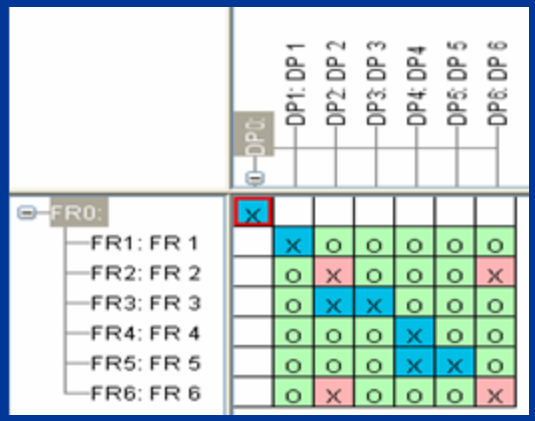


Decoupled

Some DP's impact more than one FR.

A Progressive Solution is possible

Order of Development and Function are important



Coupled

Some DP's impact more than one FR.

A Simultaneous Solution is required

Order of Development and Function are important and will require iterations

Axiomatic design:
Evaluate options using the independence axiom

The Independence Axiom:

Maintain independence between functional requirements

Coupled - *Unacceptable*

	DP.1	DP.2	DP.3
FR.1	X	X	X
FR.2	X	X	X
FR.3	X	X	X

Decoupled - *Acceptable*

FR.1	X	O	O
FR.2	X	X	O
FR.3	X	X	X

Uncoupled - *Desired*

	DP.1	DP.2	DP.3
FR.1	X	O	O
FR.2	O	X	O
FR.3	O	O	X

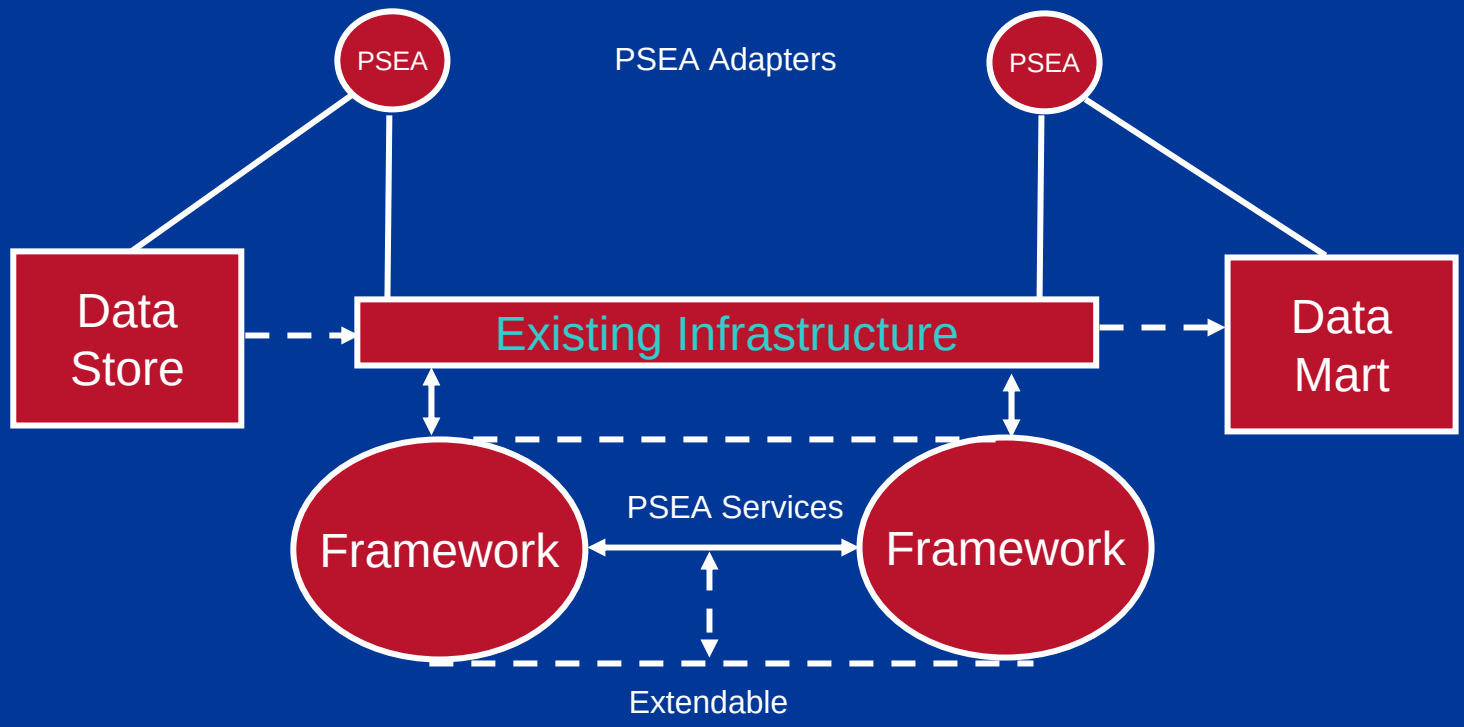
Analysis

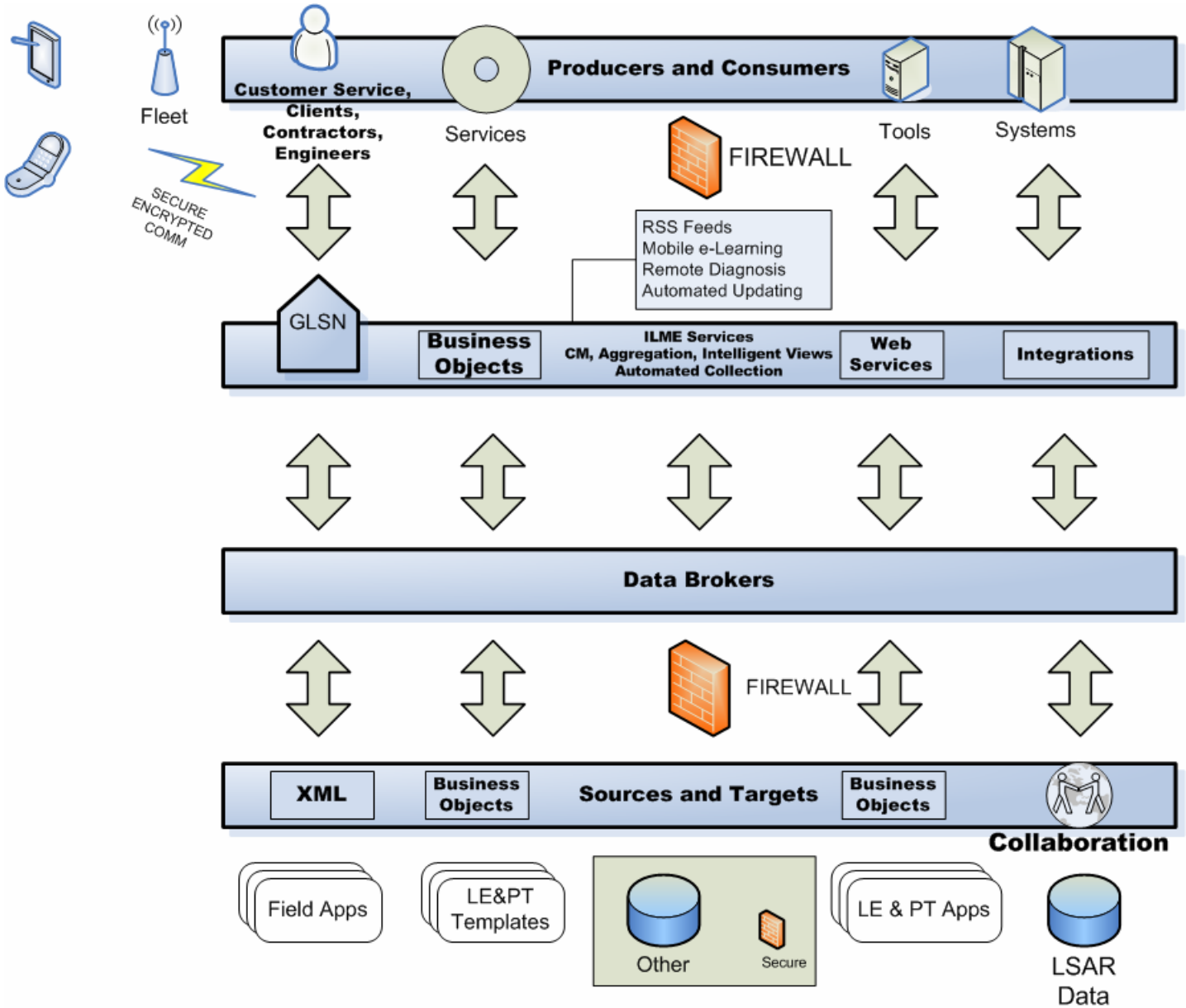
- Analysis from DFSS axiomatic design methods indicate the need for a point-point solution, (eliminate design coupling) specifically to meet the critical component requirements, however a technology which will expand (Design Parameter).
- A methodology of delivering just the interface to and from the components, streamed line for global access, performance in near-time and system delivered in less than a year time (Critical Key Parameters).
- A unique approach is required, which resulted in a new way for successful Application Integration and Deployment of Data with the demands specified.
- It is being called Point Service Enterprise Architecture (PSEA).
- Where a Point Service Enterprise Architecture links an enterprise's business architecture with its existing enterprise systems and applications utilizing existing software component frameworks that can be applied specifically to meet a business practice. Point-to-Point Application Services.
- .NET, J2EE, SOA Architectures, ect all are enabling technologies, it's the arrangement of the frameworks interfaced to existing systems with interlacing services over a business process.

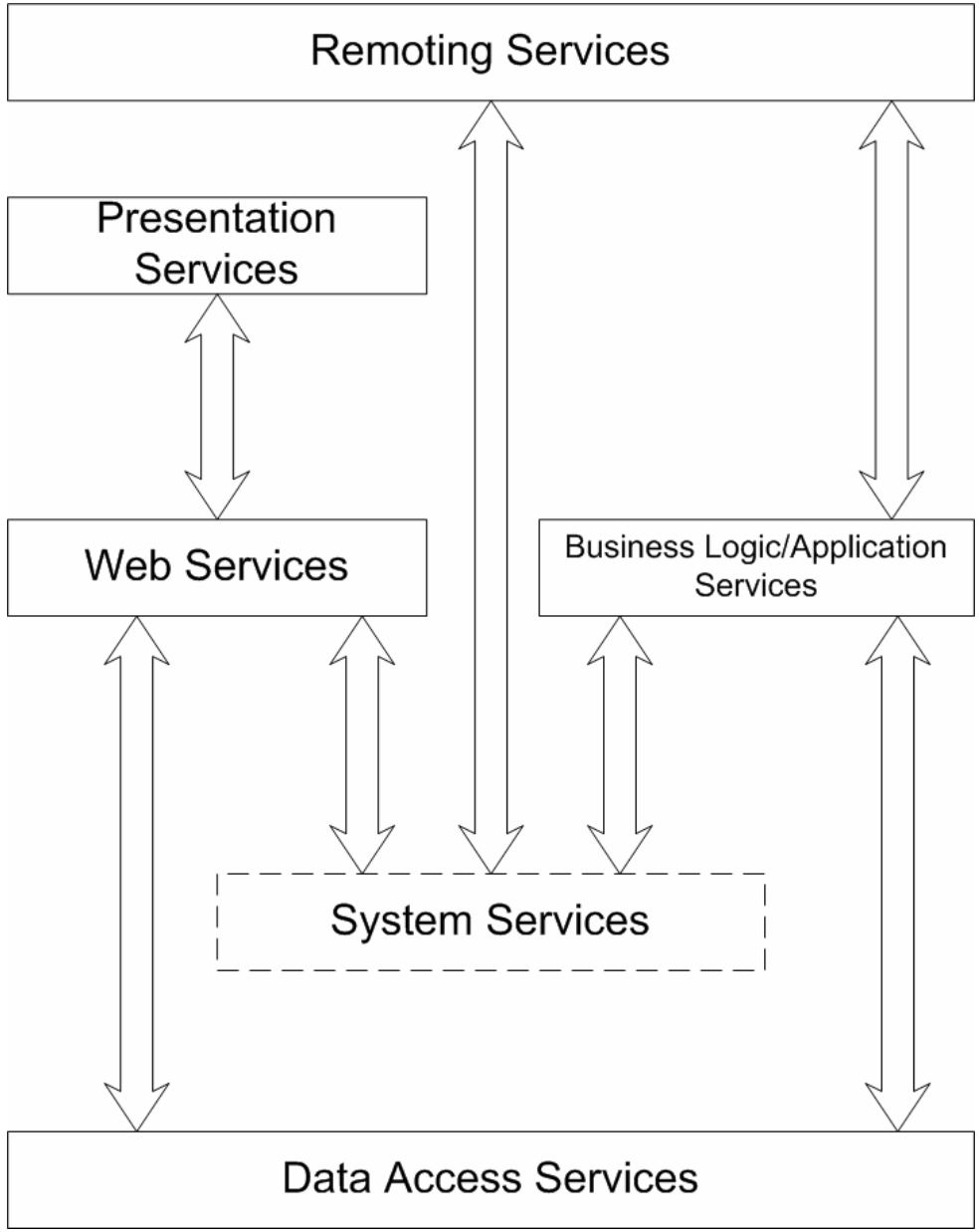
PSEA

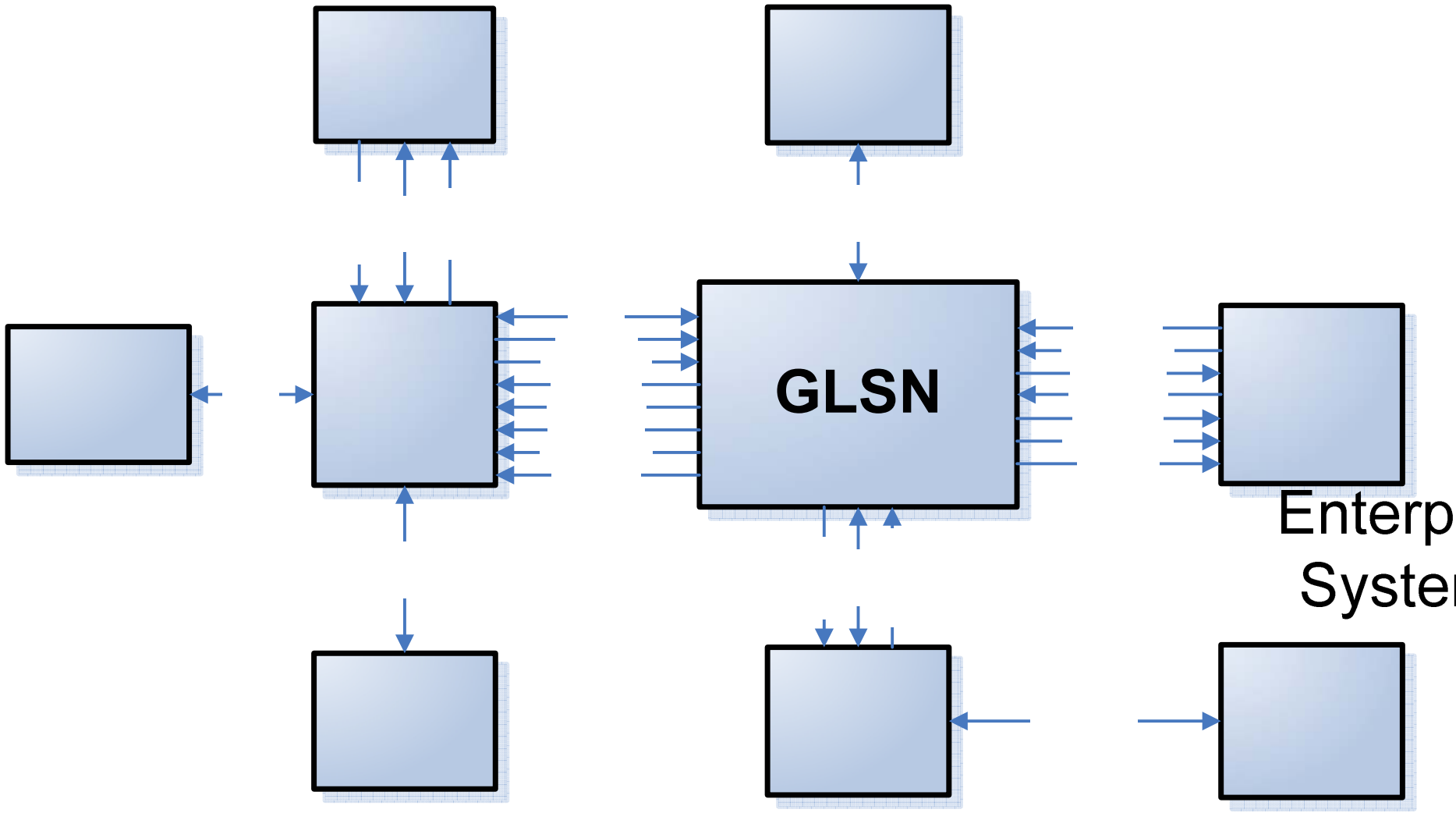
- A well-documented process architecture is critical, with a precise logical organization of information pertaining to the following elements:
  - Strategic goals, objectives, and strategies
  - Business rules and measures
  - Information requirements
  - Processes, systems and applications
  - Relationships between architecture elements
  - Technology infrastructure

PSEA High-Level









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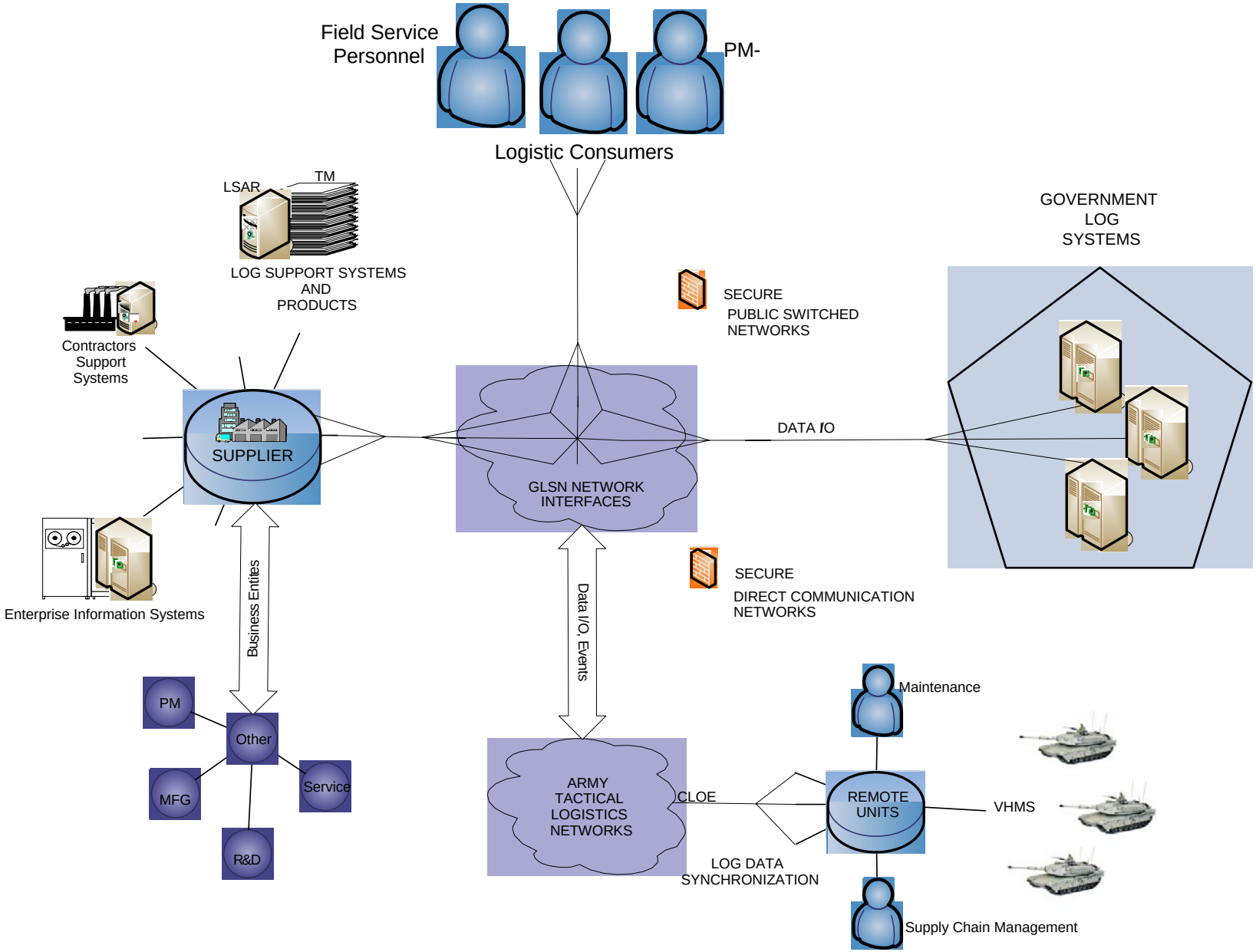

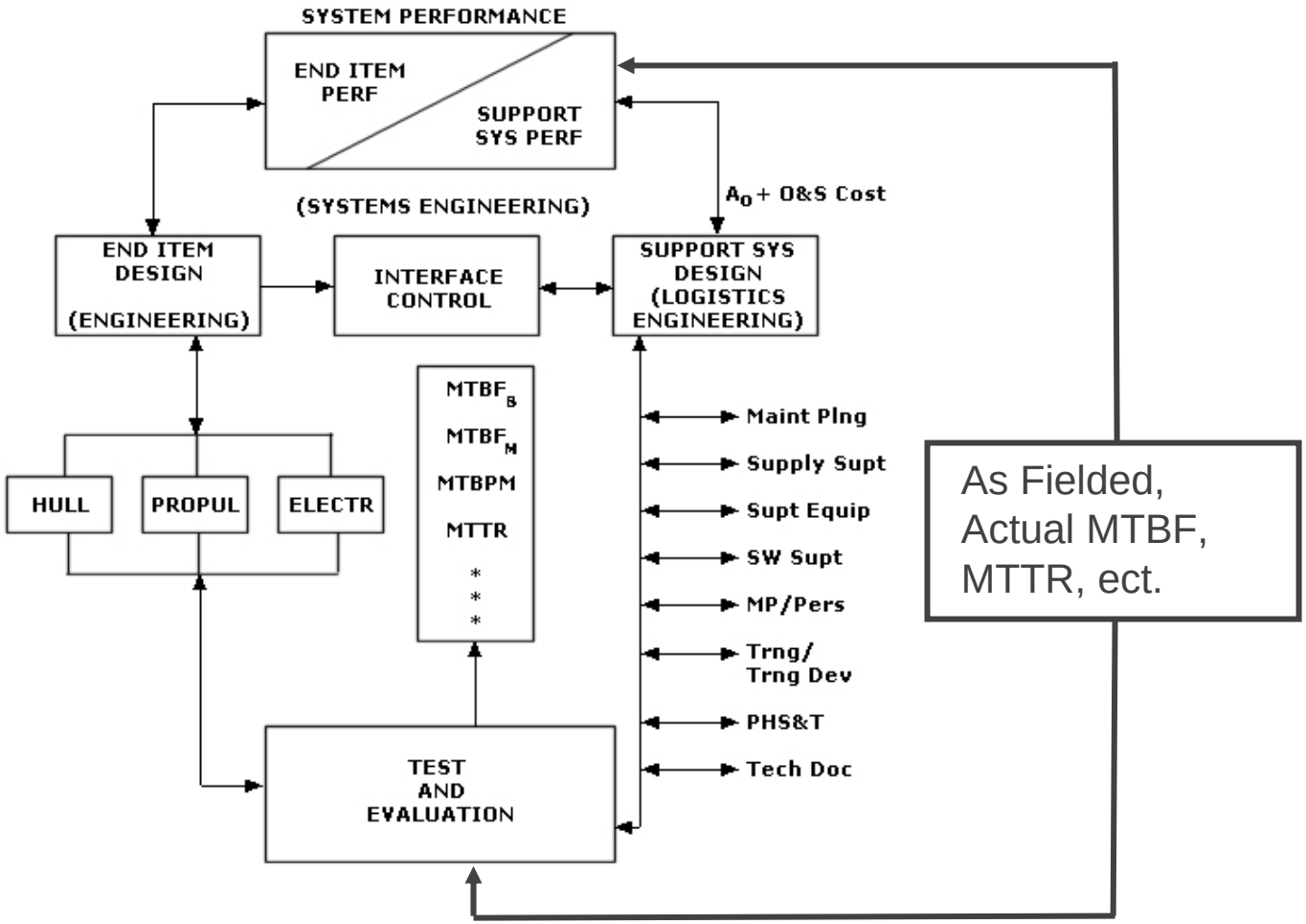
SYSTEM PERFORMANCE
END ITEM PERF
SUPPORT SYS PERF
(SYSTEMS ENGINEERING)
A_O + O&S Cost
END ITEM DESIGN (ENGINEERING)
INTERFACE CONTROL
SUPPORT SYS DESIGN (LOGISTICS ENGINEERING)
HULL
PROPUL
ELECTR
$MTBF_B$
$MTBF_M$
MTBPM
MTTR
*
*
*
Maint Plng
Supply Supt
Supt Equip
SW Supt
MP/Pers
Trng/ Trng Dev
PHS&T
Tech Doc
TEST AND EVALUATION
As Fielded, Actual MTBF, MTTR, ect.

Conclusion

- (PSEA) Point services allow enterprises to develop applications on globally distributed computing platform effectively.

- Modernization Efforts, bridging Contractor to Government:
- GLSN (Global Logistics Support Network)
- CLOE (Common Logistics Operating Environment)
- VHMS (Vehicle Health Management Systems

Questions, Other Information

- Whitepaper on PSEA is available
- Proven – GD Enterprise and Army

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