Measuring and Benchmarking DoD Applications Development Performance Using Systemic Analysis

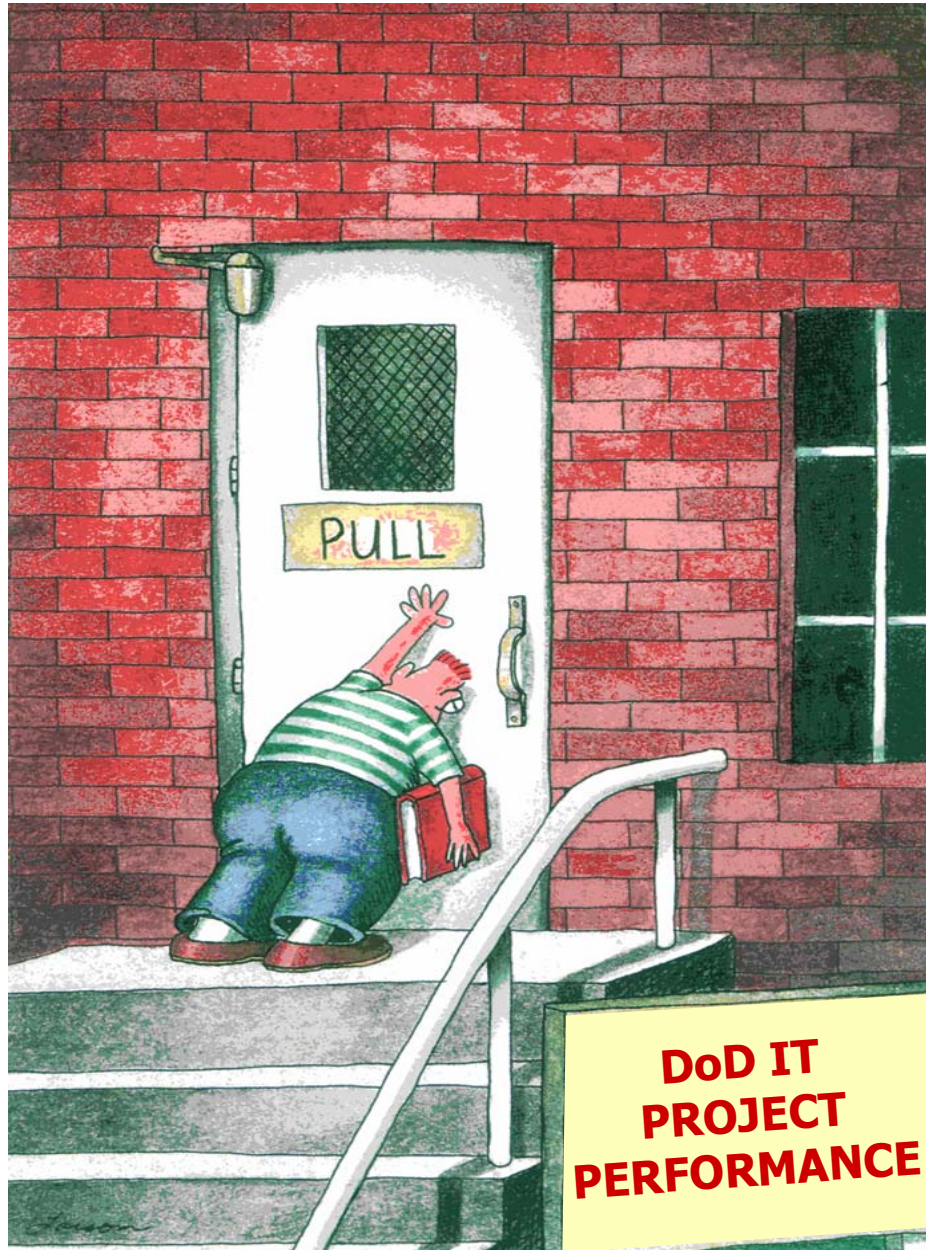**Measuring and Benchmarking the IT Function for Government
December 11, 2002**

**Jack McGarry
U.S. Army TACOM-ARDEC**

Acceptable Performance?

- *Up to 80% of the Functionality in DoD Information Technology Systems is Implemented in Software*

- *There is a Rapidly Growing Trend Towards Developing Highly Complex, Multi-Function, Integrated IT Systems*

- *49% of DoD IT Systems are Delivered Late or Over Budget*

- *23% of DoD IT Systems are Never Delivered*

Some Questions …

Why do we always seem to be trying to solve the same problems in our software intensive IT projects?

Are we focusing on the symptoms or the causes of our project issues?

How do we improve?

Presentation Outline

- *Overview*

- *Systemic Analysis Approach*

- *Systemic Analysis Results*

- *Summary and Questions*

Presentation Objectives

- *Convey what we have learned through a systemic "Cross Project" analysis of multiple software intensive DOD IT projects*

- *Identify some of the recurring factors that materially impact software intensive IT acquisition and development efforts*

- *Introduce the DoD's approach to Enterprise Project Performance Benchmarking*

Tri-Service Assessment Initiative

Tri-Service Assessment Activities

Individual IT Project Assessments

Systemic Analysis

- **Independent Expert Project Reviews**
- **Single Project Focus**
- **Objective - Improve Project Performance**

- **Cross-Project Analysis**
- **Enterprise Focus**
- **Objective - Benchmark Recurring Performance Factors**

Both Activities are Based on an Integrated Assessment Architecture

Why Are We Doing This?

- *To help DoD IT projects get better - both immediately and over the long term*

- *To identify recurring project problem and risk drivers*

- *To understand why these problems and risks exist*

- *To help determine what can be done to improve across the board performance*

Systemic Analysis Phases

Phase 1 - Complete July 2001

- *Top down analysis approach*
- *Initial models - proof of concepts*
- *Assessment architecture integration*
- *Initial data set - 10 assessments*

Phase 2 - Complete December 2002

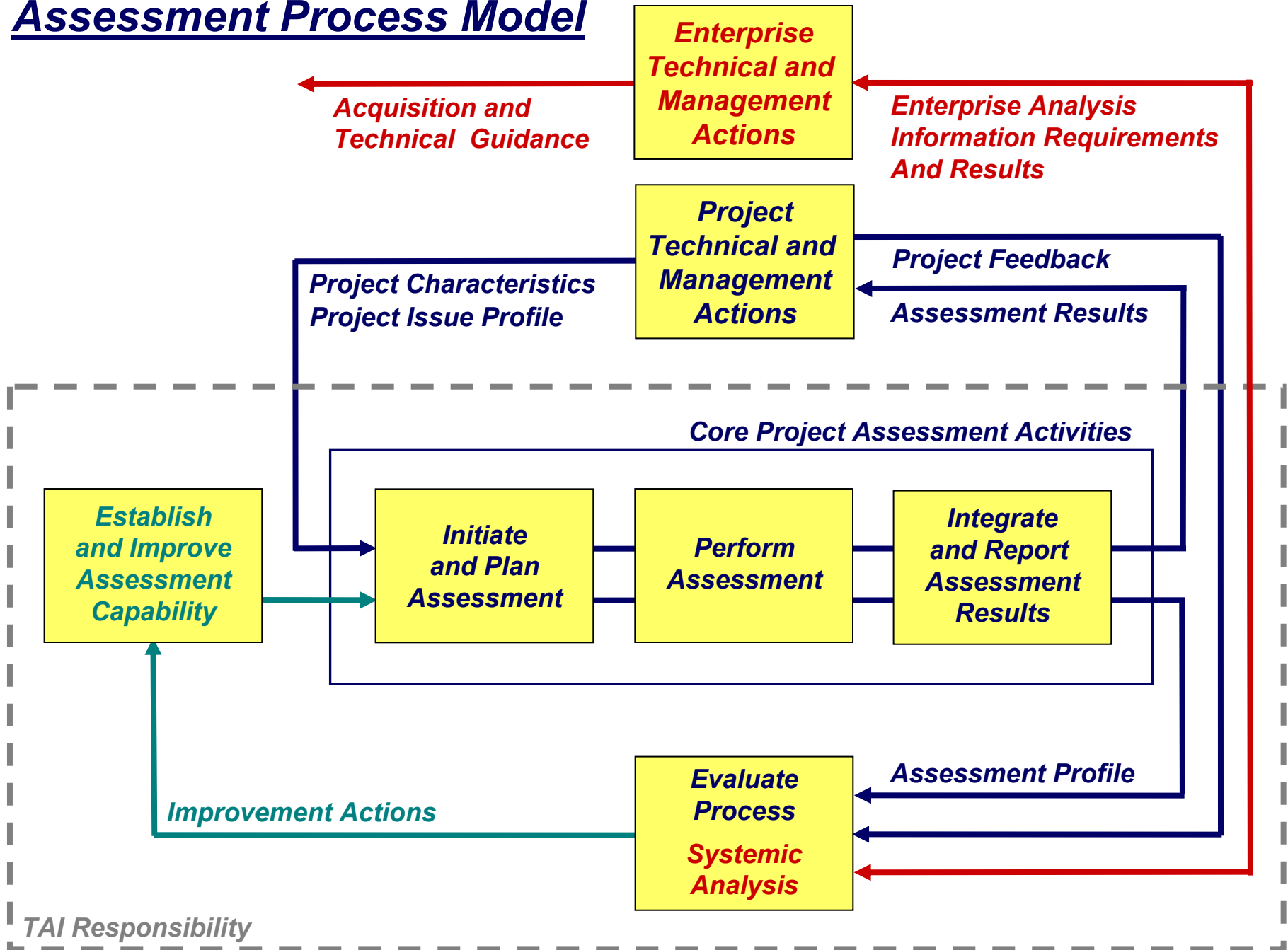- *Bottom up analysis approach*
- *Based on quantification of recurring issues and sequences*
- *Information driven analysis objectives*
- *Systemic database*
- *Extended data set - 23 assessments*

Phase 3 - Begins January 2003

- *Predictive issue pattern analysis*
- *Quantification of projected issue impacts*
- *Architecture and analysis process improvements*

Systemic Analysis Approach

Assessment Process Model

Enterprise Technical and Management Actions

Acquisition and Technical Guidance

Enterprise Analysis Information Requirements And Results

Project Technical and Management Actions

Project Characteristics Project Issue Profile

Project Feedback

Assessment Results

Core Project Assessment Activities

Establish and Improve Assessment Capability

Initiate and Plan Assessment

Perform Assessment

Integrate and Report Assessment Results

Improvement Actions

Evaluate Process

Systemic Analysis

Assessment Profile

TAI Responsibility

Assessment Information Model
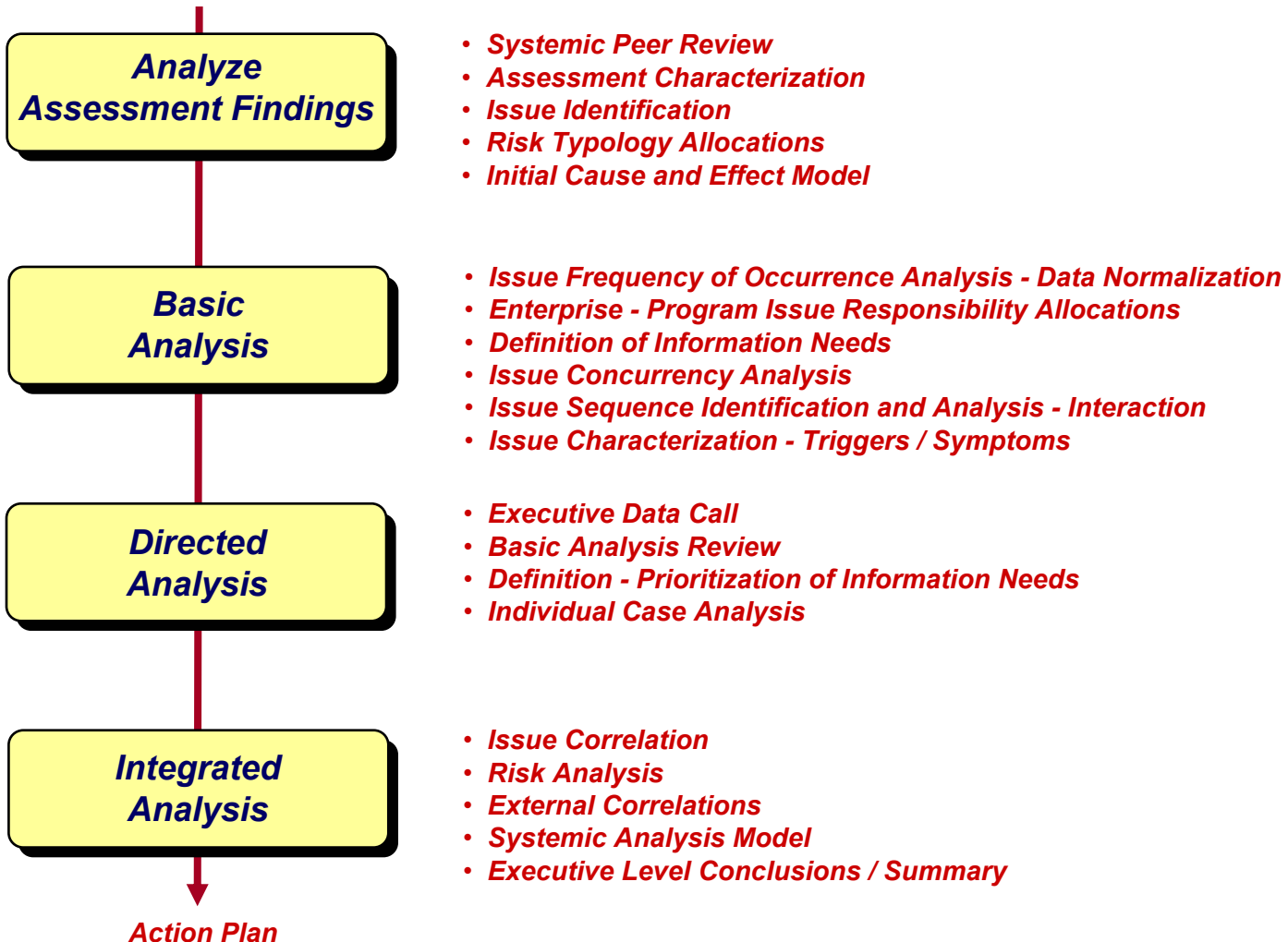
- *User / Customer*
- *Schedule*
- *Technical Product*
- *Technical Process*
- *Management*
- *Resources*
- *Financial*
- *Mission Requirements*
- *Environment*
- *Project Specific*

Management Issue Typology

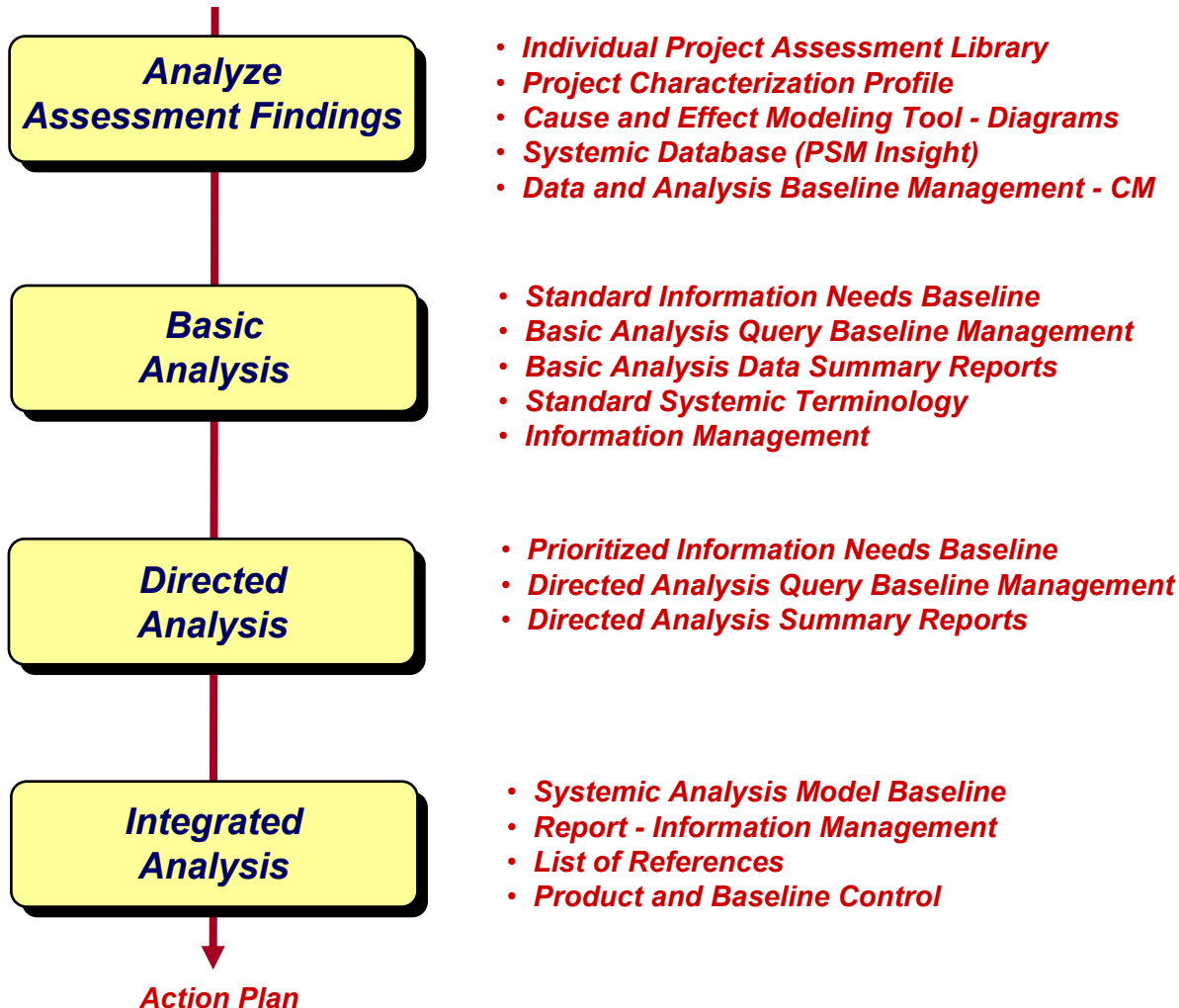| *Issue Category*	*Issue*	*Sub-Issue*
5. Management	*5.1 Acquisition Strategy/Process*	*5.1.1 Acceptability* *5.1.2 Feasibility* *5.1.3 Suitability*
	5.2 Project planning	*5.2.1 Acceptability* *5.2.2 Feasibility* *5.2.3 Suitability*
	5.3 Program & Project Management	*5.3.1 Organization* *5.3.2 Suitability* *5.3.3 Change Tolerance*
	5.4 Contracting and Subcontracting	*5.4.1 Conditions-Constraints* *5.4.2 Cost Accounting* *5.4.3 Progress Tracking* *5.4.4 Arrangements* *5.4.5 Timeliness* *5.4.6 Change Management*
	5.5 Communication	*5.5.1 Interfaces* *5.5.2 Openness* *5.5.3 Teamwork*

Systemic Analysis Process

Program Assessment Results

Analyze Assessment Findings

- **Systemic Peer Review**
- **Assessment Characterization**
- **Issue Identification**
- **Risk Typology Allocations**
- **Initial Cause and Effect Model**

Basic Analysis

- **Issue Frequency of Occurrence Analysis - Data Normalization**
- **Enterprise - Program Issue Responsibility Allocations**
- **Definition of Information Needs**
- **Issue Concurrency Analysis**
- **Issue Sequence Identification and Analysis - Interaction**
- **Issue Characterization - Triggers / Symptoms**

Directed Analysis

- **Executive Data Call**
- **Basic Analysis Review**
- **Definition - Prioritization of Information Needs**
- **Individual Case Analysis**

Integrated Analysis

- **Issue Correlation**
- **Risk Analysis**
- **External Correlations**
- **Systemic Analysis Model**
- **Executive Level Conclusions / Summary**

Action Plan

Systemic Data Management

Program Assessment Results

|	
Analyze Assessment Findings	• *Individual Project Assessment Library* • *Project Characterization Profile* • *Cause and Effect Modeling Tool - Diagrams* • *Systemic Database (PSM Insight)* • *Data and Analysis Baseline Management - CM*
Basic Analysis	• *Standard Information Needs Baseline* • *Basic Analysis Query Baseline Management* • *Basic Analysis Data Summary Reports* • *Standard Systemic Terminology* • *Information Management*
Directed Analysis	• *Prioritized Information Needs Baseline* • *Directed Analysis Query Baseline Management* • *Directed Analysis Summary Reports*
Integrated Analysis	• *Systemic Analysis Model Baseline* • *Report - Information Management* • *List of References* • *Product and Baseline Control*

Action Plan

List of Banned Words
(B-Words)

- **Infrastructure**
- **Paradigm**
- **Vision**
- **Stakeholder**
- **Overarching**
- **Taxonomy**
- **Meta - Anything**
- **Business Process Reengineering**
- **Disambiguate**

- **Seamless**
- **Ideate**
- **Mentor - Mentee**
- **Enplanement**
- **Disaggregate**
- **Processcentric**
- **Object Oriented**
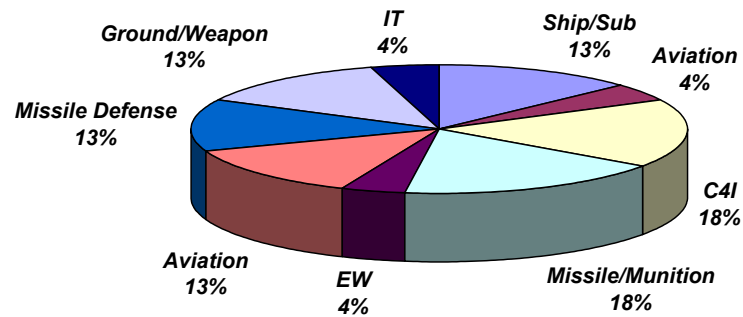- **Y2K (Retired)**
- **Better-Faster-Cheaper**
- **Acluistic**

Project Assessment Distribution
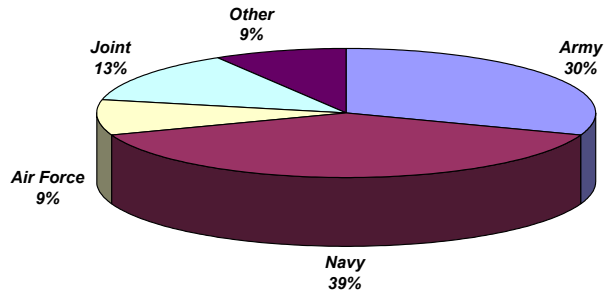
**Distribution of Project Assessments
by Service**
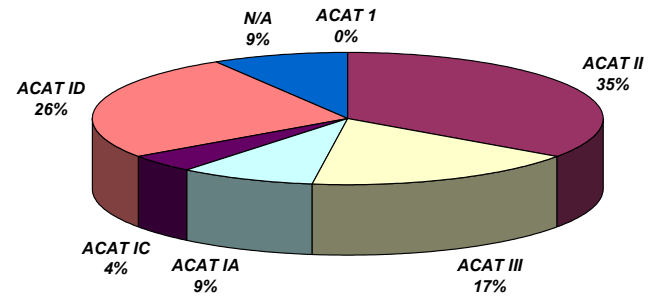
**Distribution of Project Assessments
by ACAT Level**

**Distribution of Project Assessments
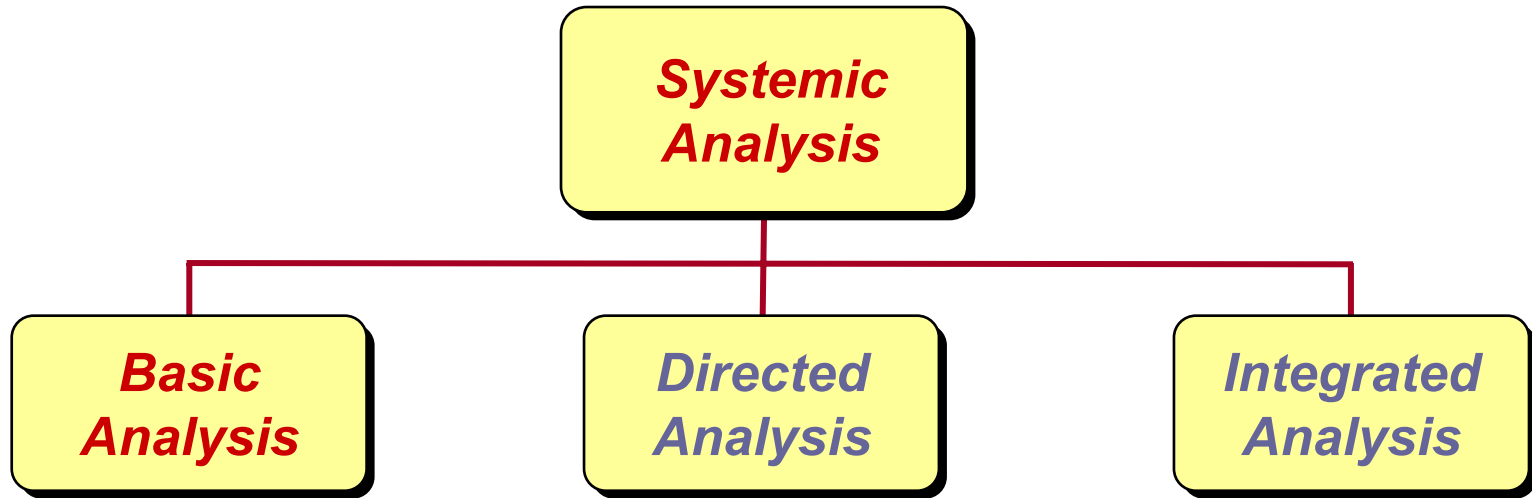by Domain**

Issue Quantification

What Was Counted

- **Identified Issues**
    - single issues
    - composite issues
- **Systemic Sequences**
- **Systemic Patterns**
- **Triggers and Symptoms**

Key Concepts

- **Issue** - area of concern that may impact achievement of project objectives (risk, problem, or uncertainty)
- **Vertical Analysis** - how many times an issue occurs
- **Horizontal Analysis** - issue predecessor / successor relationship counts - causes and effects

Systemic Analysis Results

Systemic Analysis

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- **Scope - All Issues**
- **General Information Needs**
- **General Issue Trends**
- **Project Distributions**
- **Vertical Analysis**
  - **Individual Issues**
  - **Responsibility Allocations**
- **Horizontal Analysis**
  - **Issue Sequences / Patterns**
  - **Triggers and Symptoms**
  - **Issue flow down**
- **Multiple Measures**
- **Multiple Typology Levels**
- **Quantitative Data Focus**

Basic Analysis Information Needs

- *What are the characteristics of the TAI assessment data set?*

- *What are the most frequently identified issues within DoD projects?*

- *At what level of responsibility do they occur?*

- *Which issues are most likely to occur together on a project?*

- *Are there recurring cause and effect issue patterns that appear across multiple projects?*

- *Which issues tend to be "causes" and which ones tend to be "effects"?*

- *What is the downstream impact of upstream causative issues?*

Identified Issues - Frequency of Occurrence

Identified Issue	% Assessments
Process Capability	91 %
Organizational Management	87 %
Requirements Management	87 %
Product Testing	83 %
Project Planning	74 %
Product Quality - Rework	70 %
System Engineering	61 %
Process Compliance	52 %
Project Schedule	48 %
Interoperability	43 %
Decision Making	43 %
Configuration Management	26%

Issue Responsibility Allocation

Identified Issues by Responsibility
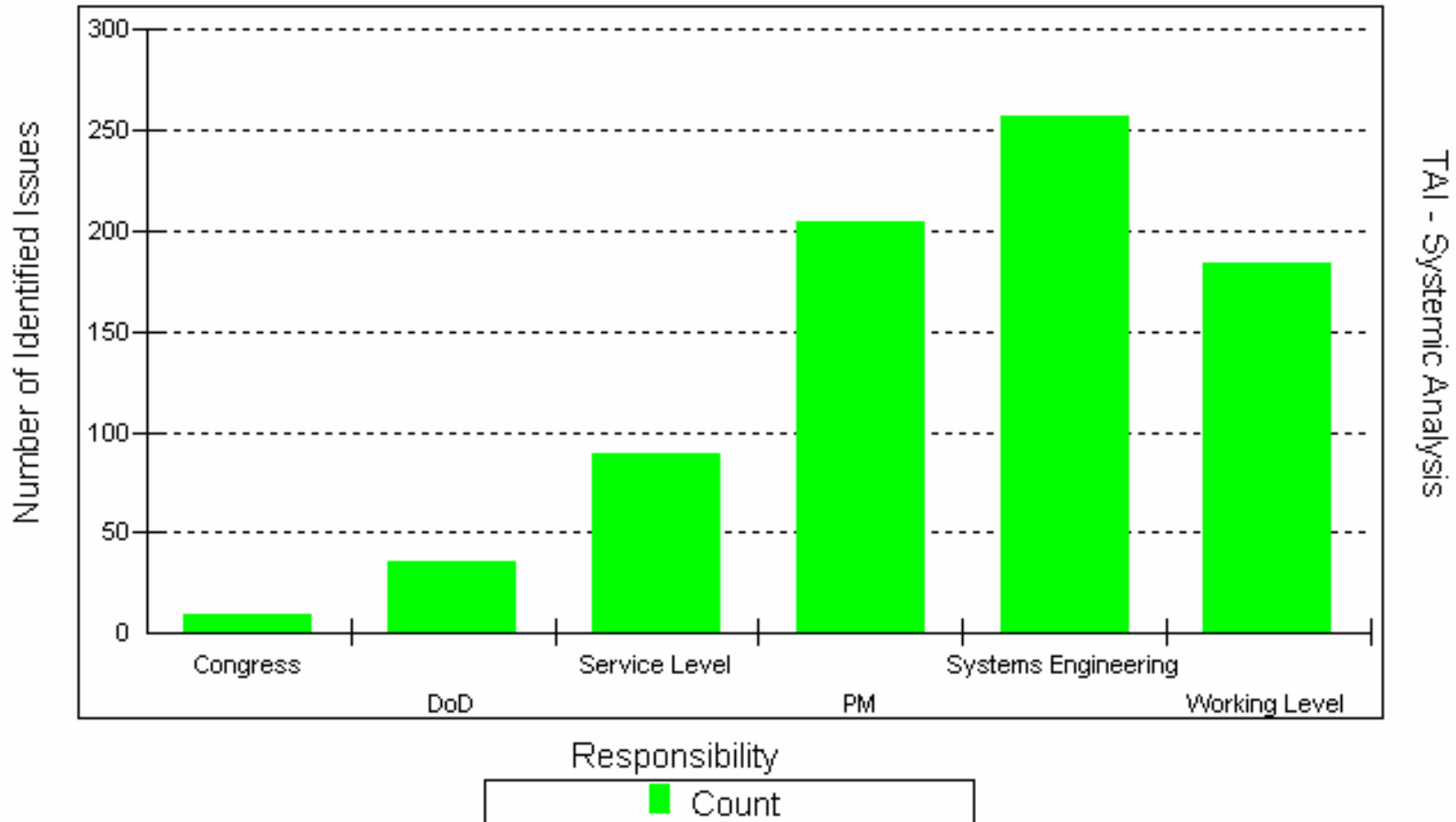
Recurring Issue Patterns

- *Systemic cause and effect analysis identified over 185 unique recurring issue sequences across the project base*

- *The diversity of the recurring issue sequences reinforces the complex nature of the interactions and relationships between identified issues*

- *The large number of issue sequences reinforces the need to focus attention on the causative, or triggering, issues*

- *The expected cause and effect issue relationships are clearly evident in the data*

Systemic Issue Pattern Example Premature Systems Deployment

4.1 High Turnover Rate

Symptoms Seen..
- **Over budget**
- **Late**
- **Poor Product Quality**
- **Miscommunication**
- **Costly Technology Refresh**
- **Poor Morale**
- **No Product Line Architecture**
- **Poor Interoperability**
- **Rework**

4.1 Staff Burnout

4.1 Inadequate Staff

1.3 Unplanned Move from Prototype to Operational System

3.1 Insufficient Funding

7. Poor Technical Decisions

7.2 Incomplete Requirements

6.2 Incomplete Testing

7.1 No robust Design

Cause and Effect Examples

- *<u>Requirements Management</u> problems result in:*
  - *Poor Product Quality*
  - *Product Rework*
  - *Progress Shortfalls*

- *<u>Organizational and Project Management</u> problems result in:*
  - *Inadequate Program Planning*
  - *Responsibility Conflicts*
  - *Poor Communications*
  - *Product Rework*
  - *Progress Shortfalls*

- *<u>Process Capability</u> problems result in:*
  - *Inadequate Testing*
  - *Poor Change Management*
  - *Poor Product Quality*
  - *Progress Shortfalls*

Triggers and Symptoms

Top 5 Trigger Issues	**Predominant Responsibility**
Process Capability	**SE, PM, Service**
Requirements Management	**SE, PM, Service, DoD, Working Level**
Organizational Management	**PM, SE, Service, DoD**
Customer Agenda	**Service, DoD, PM**
Product Architecture	**SE, PM**

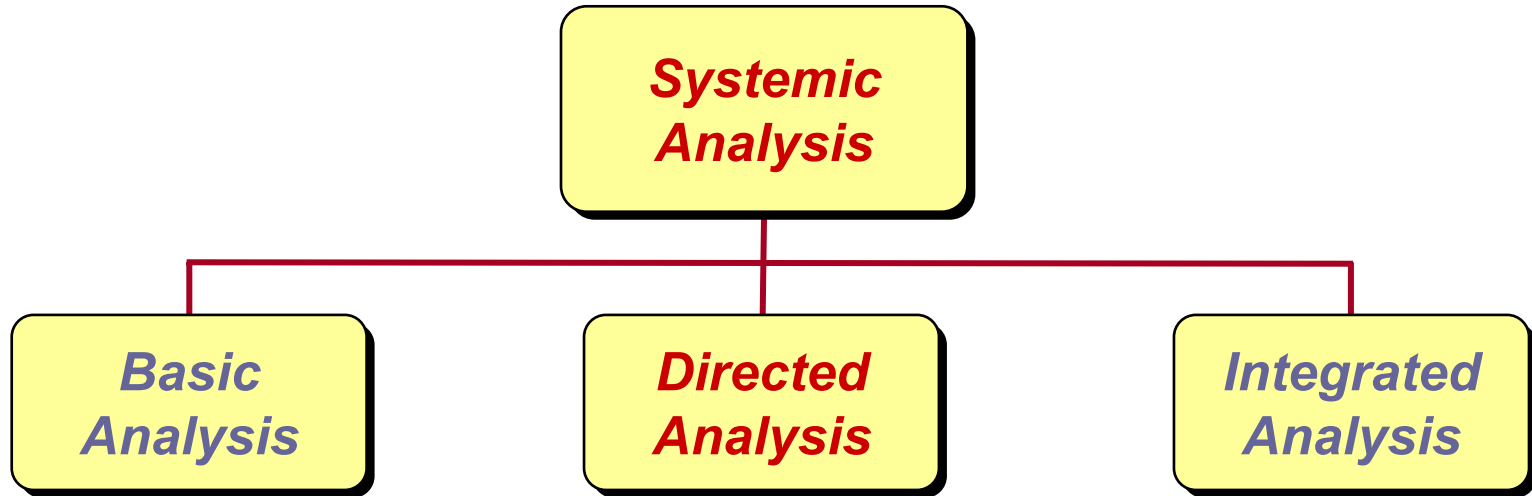| **Top 5 Symptom Issues**	**Predominant Responsibility**
Progress Shortfalls	**Working Level**
Technical Performance	**Working Level, SE**
Rework	**Working Level, SE, PM**
Usability	**Working Level, SE**
Cost	**Working Level, SE, PM**

Basic Analysis Summary

- *The current DoD project issue profile shows little positive impact from past corrective actions, initiatives, and policy*

- *The Program Manager and the Development Team must address the majority of the project issues, even if they are caused by enterprise level decisions or behaviors*

- *Causative issues multiply downstream*

- *The Program Team creates many of their own performance problems*

- *There are no "single issue" project performance drivers*

Systemic Analysis

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- **Scope - Specific Issues**
- **Prioritized Information Needs**
- **Executive Data Call**
- **Issue Case Studies**
- **In-Depth Analysis**
- **Quantitative and Context Data**

Phase 1 Directed Analysis Case Studies

- **Software Engineering Process (1H)**
- **Systems Engineering (2H)**
- **Software Testing (3H)**
- **Program Organization and Communication (4H)**
- **Program Interest and Visibility (5H)**

Software Engineering Process

Specific Information Needs

- *Is there a correlation between assessed process conformance, process capability, and project performance?*
- *What are the performance impacts of poor process capability?*

Analysis Approach

- **Compared 6.1 process conformance issues with 6.2 capability issues**

Analysis Results

- *91% of the assessments had process compliance issues (75% triggers)*
- *52% of the assessments had process conformance issues (63% triggers)*
- *Predominant deficiencies - requirements, risk / measurement, testing, systems engineering, change management*

Implications

- *Compliant organizations still have significant process performance shortfalls*
- *Compliance being used as an inadequate substitute for project capability*
- *"Fix on Fail" reactive management approaches are the norm (billiard ball model)*

Software Testing

Specific Information Needs
- *What are the predominant causes of late test and integration failures?*
- *Is testing adequate?*

Analysis Approach
- *Examined Basic Analysis results - concurrent issue analysis - patterns*

Analysis Results
- *83% of the assessments had testing related issues (53% triggers)*
- *Predominant deficiencies - lack of test time, facilities, testing cutbacks, poor test procedures*
- *73% of the projects with schedule problems had testing issues*
- *80% pf the projects with requirements problems had testing issues*

Implications
- *Testing adequacy is still traded for project schedule or budget*
- *Testing issues are both triggers and symptoms*
- *Testing of complex systems is an emerging concern*
- *Question - How can testing be so bad if process compliance is so good?*

Systemic Analysis

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- *"Big Picture" Analysis*
- *Executive Level Results*
- *Systemic Analysis Model*
- *Program Decision - Behavior Analysis*
- *New Issue Trends*
- *Gap Analysis*
- *Quantitative and Context Data*
- *External Data Sources*
- *Top-Level Recommendations*

Systemic Analysis Model

ENTERPRISE LEVEL   **PROGRAM LEVEL**

Congress	DoD	Service

Program Manager	Systems Engineering	Working Level

Program Decision Space

Acquisition Requirements
- Process
- Politics
- Strategy
- Assumptions

Policy Culture

Expectations
- Cost
- Schedule
- Performance
- Quality

Constraints
- Funding
- Resources
- Time
- Capability

Mission Allocation

Program Portfolio Management

Implementation Issues
- Complexity
- Capability
- Planning
- Program Trades
- Resource Allocation
- Management
- Organization
- Interoperability
- Conformance
- Leadership

Implementation Issues
- Process
- Product
- Information
- Capability
- Performance

ACQUISITION ENVIRONMENT
(Threats, Economy, Technology)

Executive Level Findings

- *Assessment results show <u>repeating trends</u>:*
    - *across assessed projects*
    - *regardless of project characteristics*
    - *over a long time period*

- *Project failure is related to a combination of <u>unrealistic enterprise constraints and expectations</u>, and <u>poor project execution</u>:*
    - *can be poor project execution alone*
    - *can be a mismatch between expectations and project execution capability*

Executive Level Findings (cont.)

- *Causative issues produce <u>different performance symptoms</u> in different projects*
  - *single issue can cause many symptoms*
  - *many unique issue combinations*
  - *relatively complex interactions*

- *Past enterprise-level corrective actions and associated policy have largely <u>focused on the symptoms</u> and not the causative issues*
  - *usually on a symptom by symptom basis*
  - *symptoms are perceived as causes of failure*

Prospective Solutions Must Address

- *"Change Tolerance" at all management levels*

- *Recognizing the interactive nature of both the decisions that are made and the resultant decision artifacts as represented by the identified Systemic Issues*

- *Creating and evaluating the necessary management and technical capabilities required to ensure:*
  - *overall DoD enterprise performance*
  - *specific and unique project performance*

- *New approaches to requirements management through improved systems engineering*

Prospective Solutions Must Address

- *The <u>incentives - disincentives</u> creating the behaviors inherent in the systemic issues*

- *<u>Back to "capability" basics</u> - recognition that process conformance is only part of the solution*

- *Establishing an acquisition environment where an <u>achievable project plan</u> is not constrained to inevitable performance limiting trade-off decisions (constraints management)*

What We Learned

- *Focus on performance improvement*
- *Enterprise performance is a composite of project performance*
- *Use a common architecture for project and systemic evaluation*
- *Address a wide scope of issues and issue sources*
- *Risk management and measurement processes are critical*
- *Flexibility is important – typology not taxonomy*
- *Relate subjective and quantitative information*
- *Information needs drive the analysis process*
- *Frequency of occurrence counts are just the first step*
- *Data integrity – data integrity – data integrity*
- *Consistent terminology*

Summary

- *Systemic analysis based on real project assessment results provides a unique opportunity to use actual data to make a difference*

- *The causes of project performance shortfalls are extremely complex - improvement strategies and associated action plans must address this complexity*

- *As an Enterprise we need to start by re-addressing the IT performance issues we thought we were already fixing*

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