INTRODUCTION TO KNOWLEDGE SYSTEMS

INTRODUCTION

Purpose:

Describe prototype Knowledge Systems (KS) that build on expertise and expert judgment.

Overview:

- Definitions of Information Integration Technologies (I^2) and Knowledge Systems.
- Descriptions of the range of Knowledge Systems.

INTRODUCTION

Why Build a Knowledge System?

We've developed:

- representations of the system,
- diagrams of the problem-solving methods,
- models for the data, elicitation tools,
- quantifications of expert judgment,
- methods to combine diverse information sources, and
- what-if questions.

How are we going to organize and keep track of all of this?

INTRODUCTION

Why Build a Knowledge System?

To provide distributed communities with electronic access to the information, methods and tools they seek to perform their problem solving/decision making.

To rapidly evolve knowledge in dynamic Science and Technology (S &T) environments

THESE KNOWLEDGE SYSTEMS

Are not your typical web page:

- Customized to experts'/communities' cognition and culture.
- Focused on a particular problem.
- For eliciting expertise and expert judgment.

Are not your typical IM/KM for business:

- Adapted to dynamic, evolving S & T environments.
- Collaboratively designed or designed by users for themselves using our guidance, methods, and tools.

WHAT ARE KNOWLEDGE SYSTEMS?

Information Integration Technology:

Tools, systems, methods, and guidelines for integrating data and knowledge to support problem solving and decision making.

A Knowledge System is an example of I^2 Technology:

- a web-based electronic repository that has been customized to the cognition and culture of technical communities
- to bring together their data and knowledge
- in structured, quantitative ways, and may include
- the methods and tools that they need to solve problems and make decisions.

Really Deadly Missile System - Netscape

File Edit View Go Communicator Help

- Really Deadly Missile System
- Archive Prototype
- Problem Solving Prototype

WHAT IS INTEGRATED?

Data, Information, and Knowledge

- Explicit to Tacit Knowledge (Expertise)
  - Explicit – already codified and stored, e.g. electronic archives.
  - Implicit (tacit) – embedded in practice and mental models of individual and communities of practice. Typically communicated interpersonally.
- Sources – simulations, experiments, observations, and expert judgment
- Judgments of experts or communities of practice
- Time – past, present, future ("what ifs")
- Types and Levels of Representation – data, meta data; component, subsystem, and system
- Qualitative, quantitative, and degrees of uncertainty

HOW IS IT INTEGRATED?

Mechanisms for integration:

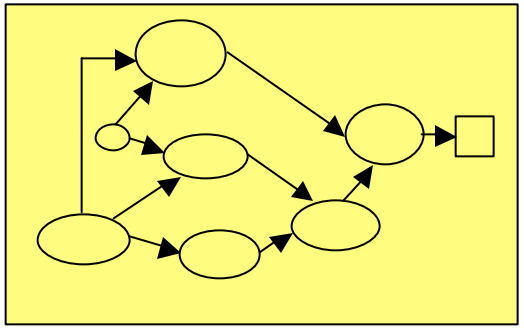
- structural
- quantification and statistical analyses

Roles of expertise, expert judgment and other sources of data.

ROLE OF EXPERTISE AND EXPERT JUDGMENT

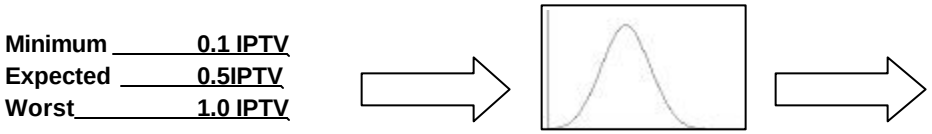
Expertise, ***a model, representation of the problem or problem-solving process,***

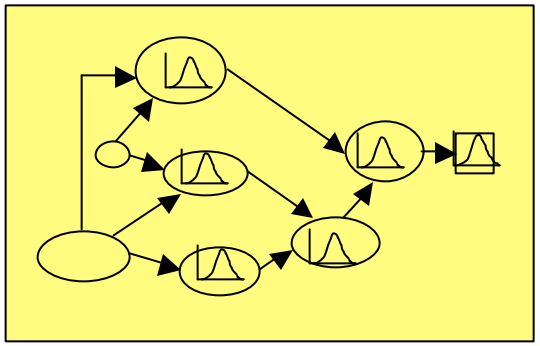
- **becomes the structure of the Knowledge System.**



Expert Judgment, ***expert's estimates in response to a problem,***

- **becomes the content of the structure.**





RANGE OF KNOWLEDGE SYSTEMS

Vary on degree of integration:

- sources and types of information.

  Examples: All data is integrated.
  All sources and types of information are integrated.

- location of tools, methods, and guidelines for performing analysis and decision making on the information.

  Examples: Tool, methods, and guidelines are offline.
  Tools, methods, and guidelines are integral part of the Knowledge System.

EVOLUTION OF INFORMATION INTEGRATION TECHNOLOGIES

RANGE OF KNOWLEDGE SYSTEMS

Vary according to:

- their focus (archival or problem-solving processes).
- who elicits the expertise and expert judgment, analysts or users themselves.
- range of explicit to tacit knowledge captured.
- whether the KS (content and structure) is static or revised continuously on line.
- degree of automation of processes, such as analysis.

RANGE OF KNOWLEDGE SYSTEMS

Example: Archival Focus

Slapper Detonator Knowledge Base

For: the DoD, Army, Navy, Air Force.

Purpose: To electronically gather the knowledge from the DOE weapon labs for the DoD.

Repository for static, archival information.
Decision making occurs mainly outside the KS.

ARCHIVAL KNOWLEDGE SYSTEM

The following are unclassified, sanitized snapshots of screens from the classified Slapper Detonator Knowledge System.

SNAPSHOT OF ARCHIVE

Home page and user responsibilities

SNAPSHOT OF ARCHIVE

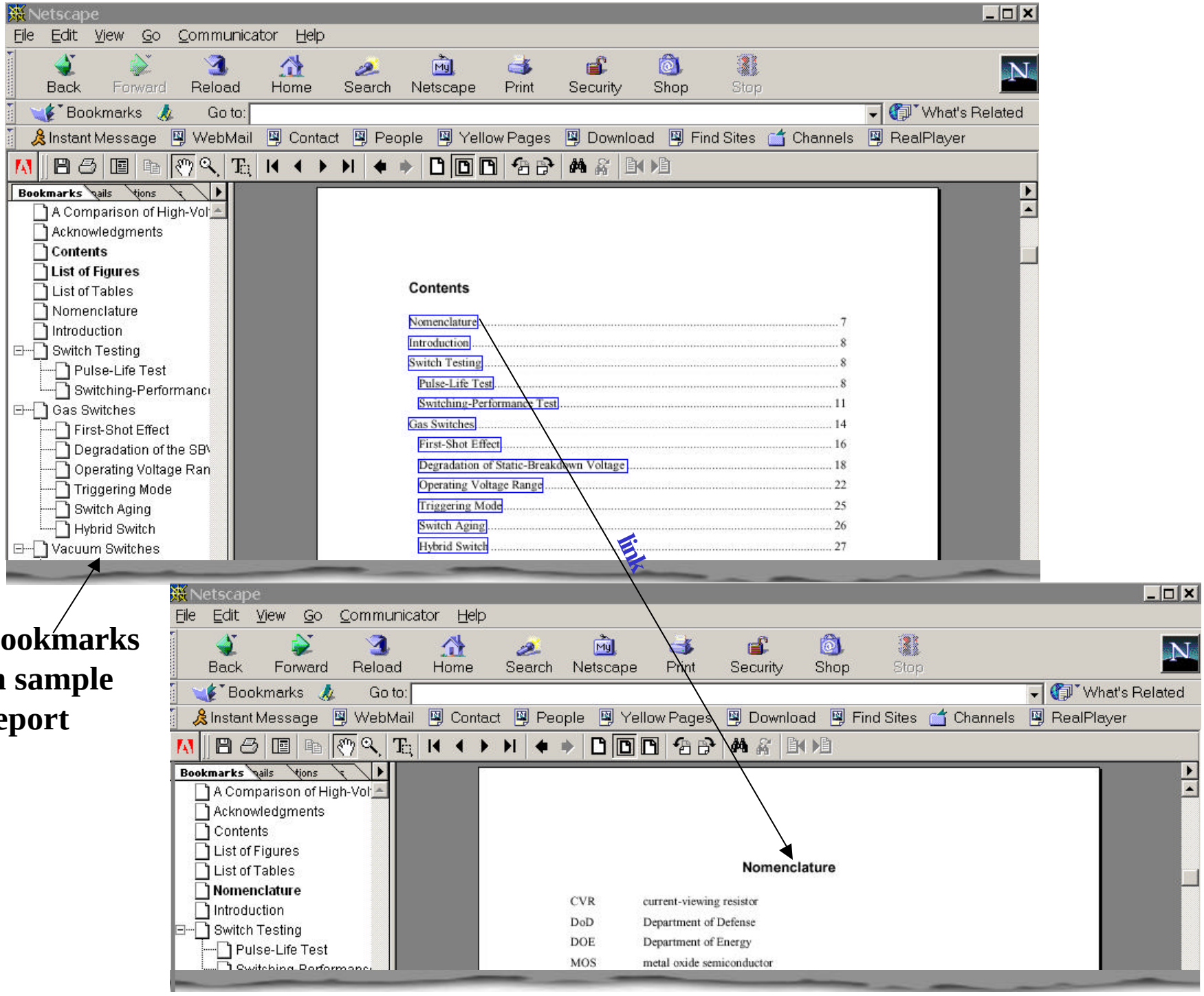
Definition & Organizing Structure

SNAPSHOT OF ARCHIVE

Switches and Capacitors Holding Bin

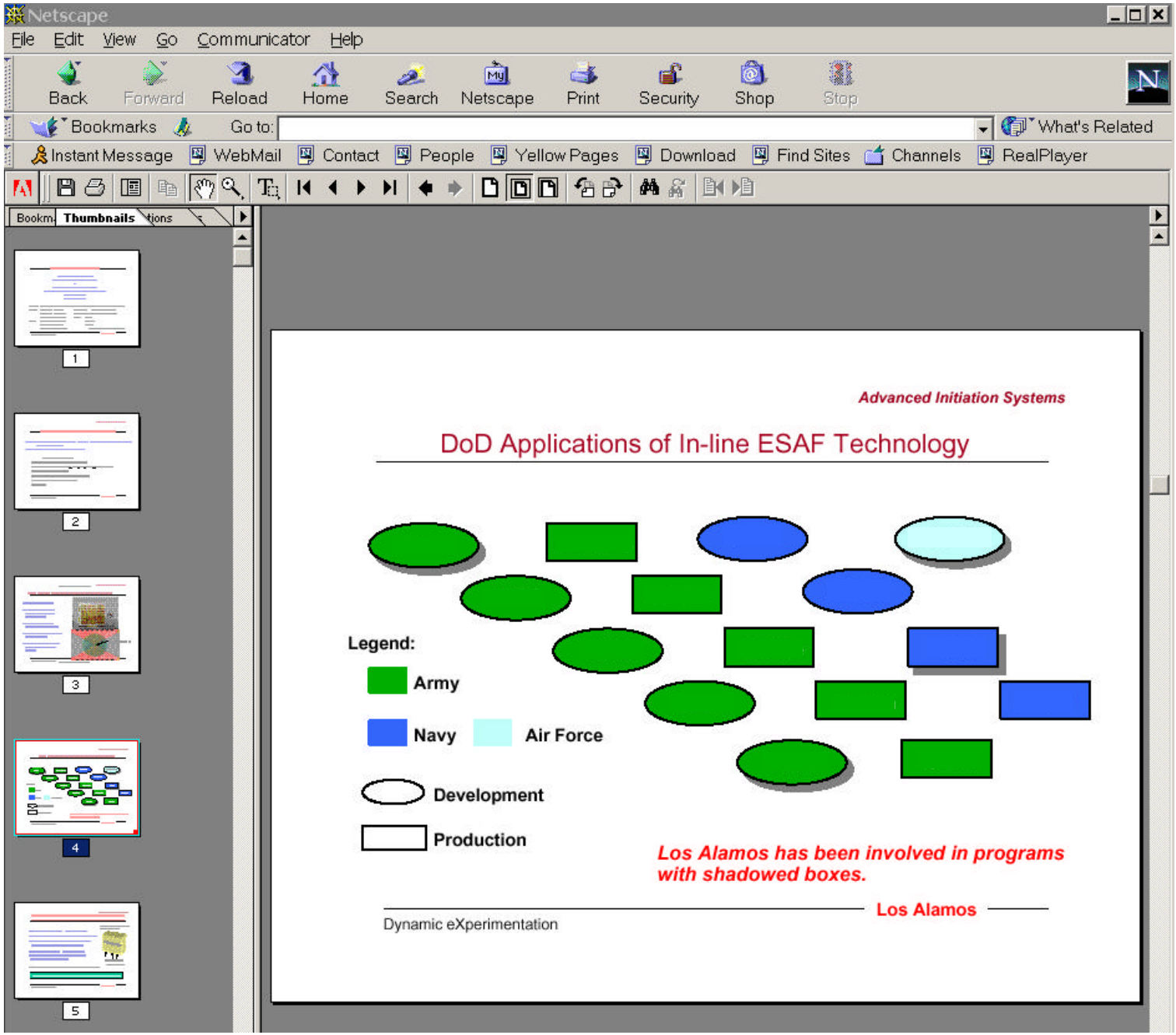
SNAPSHOT OF ARCHIVE

Technical Coordinating Group Meetings



Bookmarks in sample report

Thumbnails in sample presentation



ARCHIVAL KNOWLEDGE SYSTEM

This viewgraph is deliberately left blank.
Course attendees will be shown an unclassified snapshot of the interface to the executable slapper simulation code.

ARCHIVAL KNOWLEDGE SYSTEM

- **Who elicits expertise** – advisor expert and analysts during biannual meetings.
- **Explicit (archival) knowledge** – ranging from formal reports to informal presentations.
- **KS contents are static** – revised biannually and disseminated by CD via classified mail channels.
- **Little automation of processes** – except for new interface to executable slapper simulation code.

RANGE OF KNOWLEDGE SYSTEMS

Example: Problem-Solving Focus

Automotive Logbook
For: a multi-national automotive company.

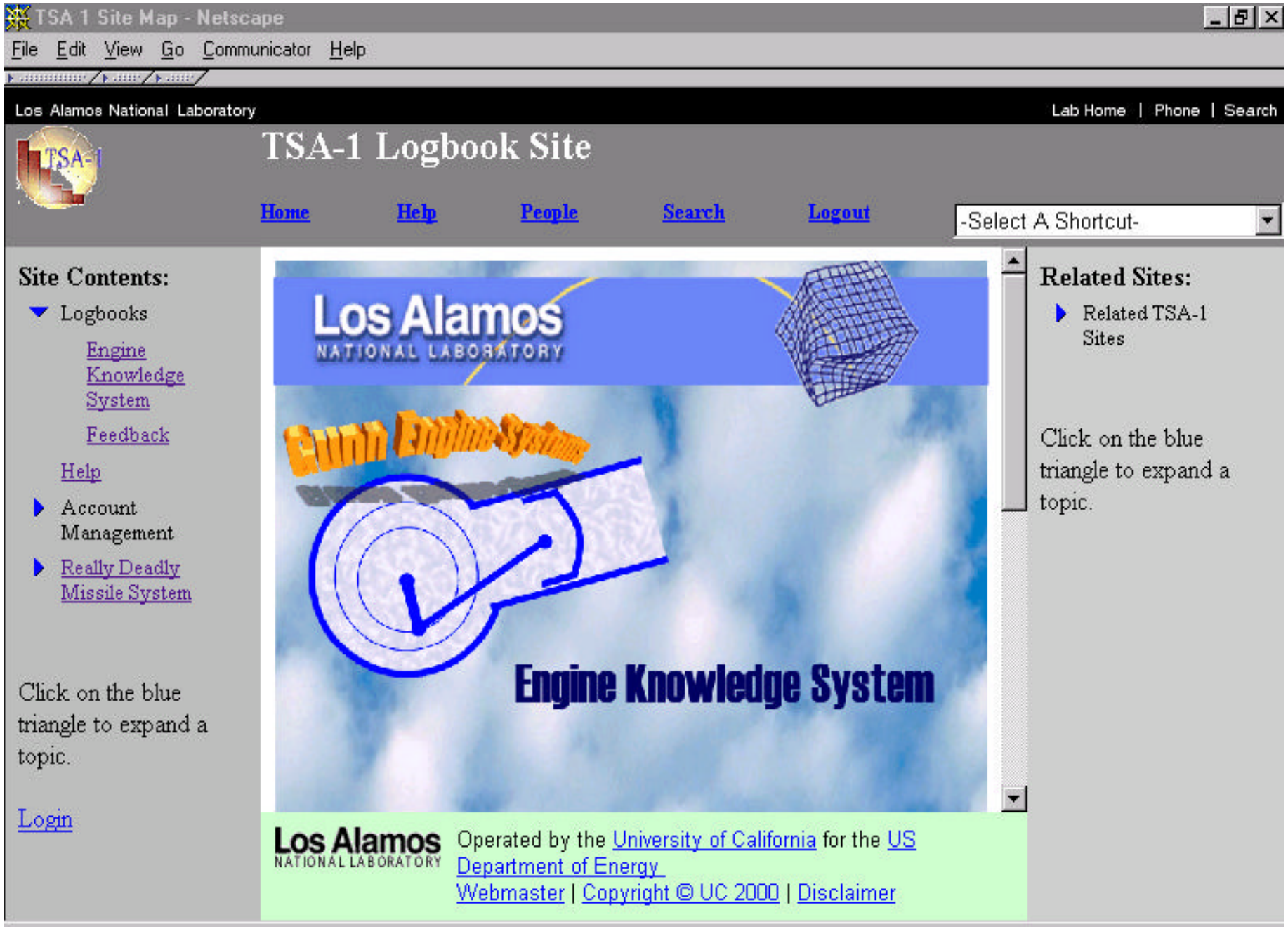
Purpose: To bring together the information and elicitation instruments for predicting engine-system reliability.

Integrates a wide variety of evolving information.

Problem solving/decision making will occur within the KS, when it is a production version.

PROBLEM-SOLVING KNOWLEDGE SYSTEM

- **Who elicits expertise and judgments** – experts themselves.
- **Explicit to implicit knowledge** – expert judgment to test data, warranty data as available.
- **KS is dynamic** – contents and structure revised continuously on-line by experts themselves.
- **Automation of processes** – underway, analytical tools in a separate but integrated knowledge system. Will pull information for running analytical tools.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010. Cover Memo
020. Subject Matter Expert Teams
030. Reliability Logic Flow Diagram
040. Work Sheets
050. Summary Spreadsheets
060. Failure Mode Summary
070. LANL Reliability Characterization
080. Reliability Growth Plan
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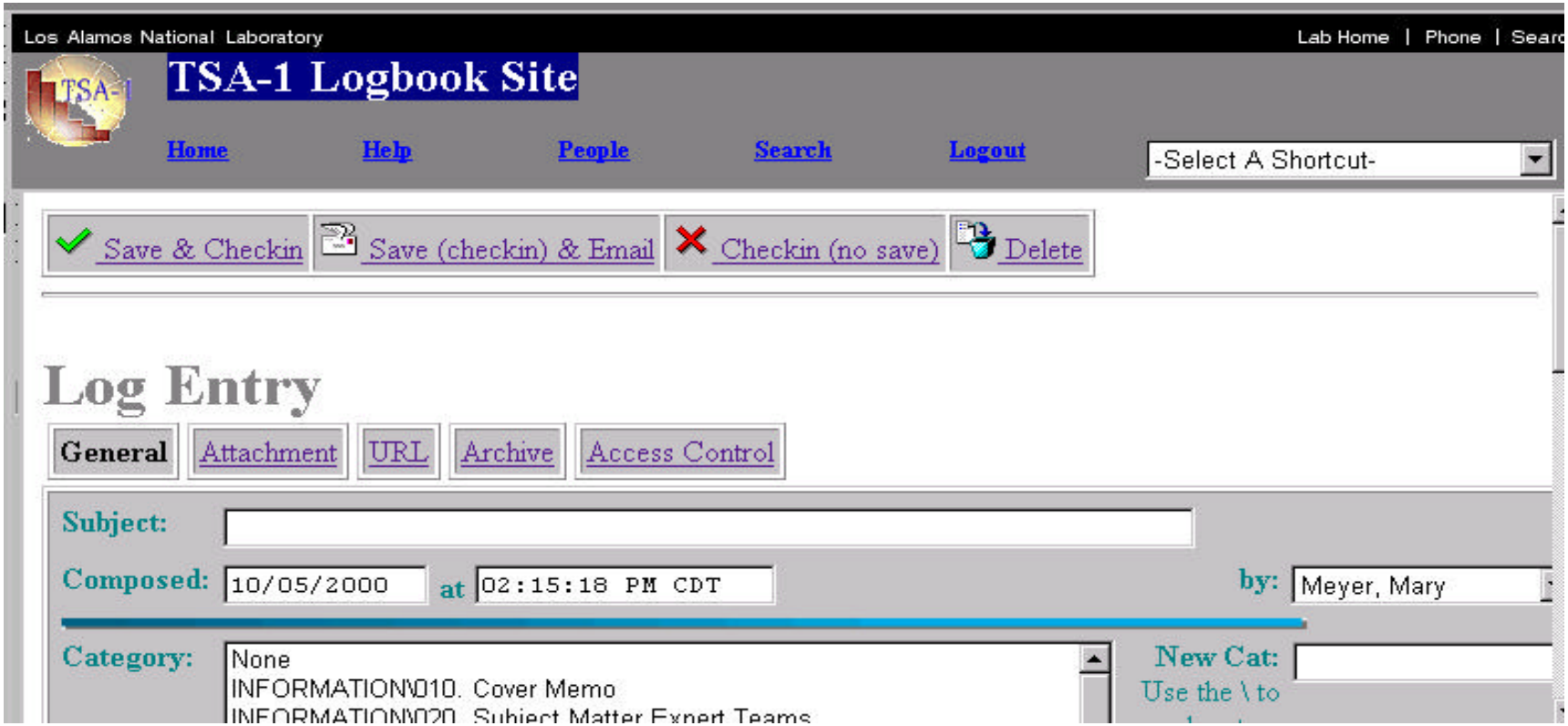
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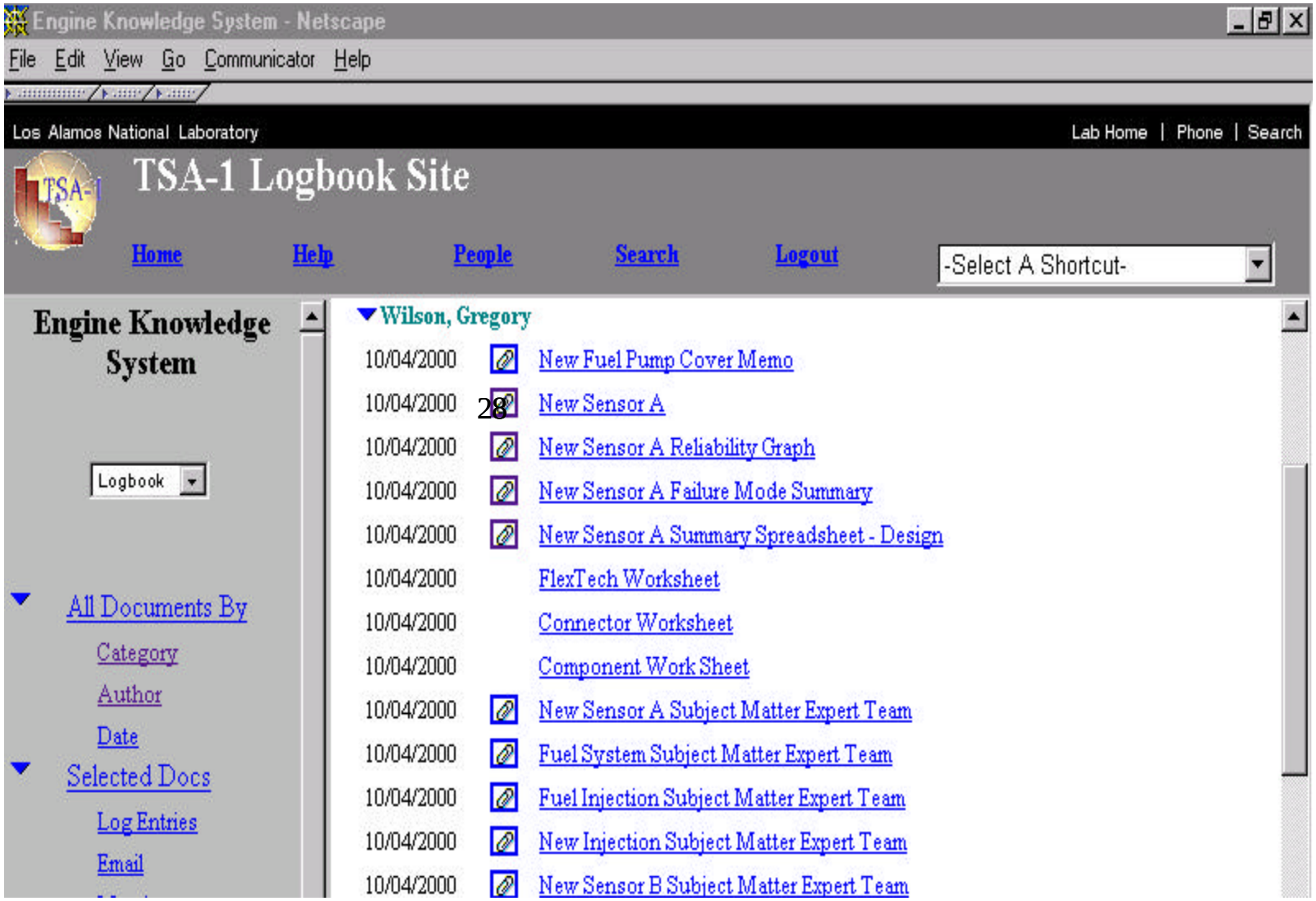
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10/04/2000 New Sensor A
10/04/2000 New Sensor A Reliability Graph
10/04/2000 New Sensor A Failure Mode Summary
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10/04/2000 FlexTech Worksheet
10/04/2000 Connector Worksheet
10/04/2000 Component Work Sheet
10/04/2000 New Sensor A Subject Matter Expert Team
10/04/2000 Fuel System Subject Matter Expert Team
10/04/2000 Fuel Injection Subject Matter Expert Team
10/04/2000 New Injection Subject Matter Expert Team
10/04/2000 New Sensor B Subject Matter Expert Team

Snapshot of Automation Prototype

File Applications IDL Help

Los Alamos NATIONAL LABORATORY

and

ENGINE SYSTEMS COMPANY

Prototype to Automate

Performance & Reliability Evaluation and
Design by Information Combination &Tracking

Engine Systems

FUEL SYSTEM

FUEL INJECTOR

NEW SENSOR A

NEW FUEL INJECTOR

OVERVIEW

NEW SENSOR B

USERS GUIDE

NEW FUEL SYSTEM

QUIT

ACCESS KNOWLEDGE BASE

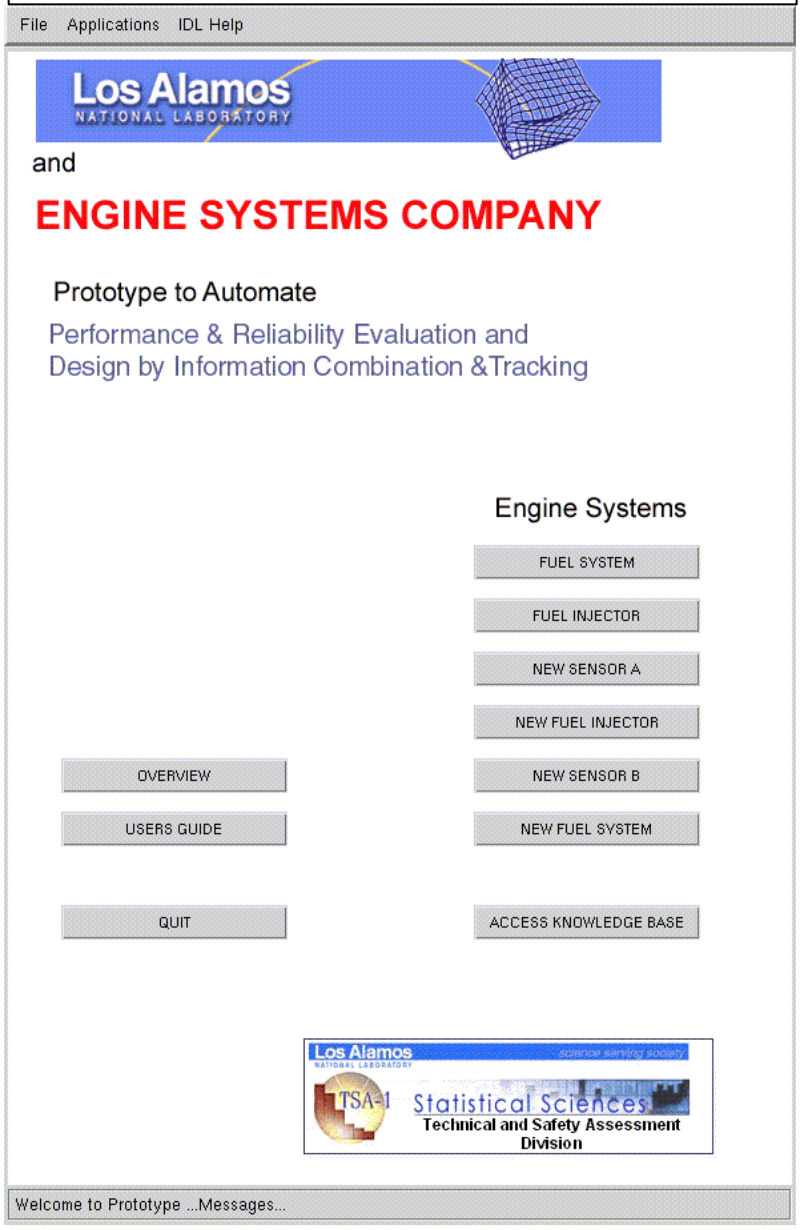
Los Alamos NATIONAL LABORATORY science serving society

TSA-1 Statistical Sciences

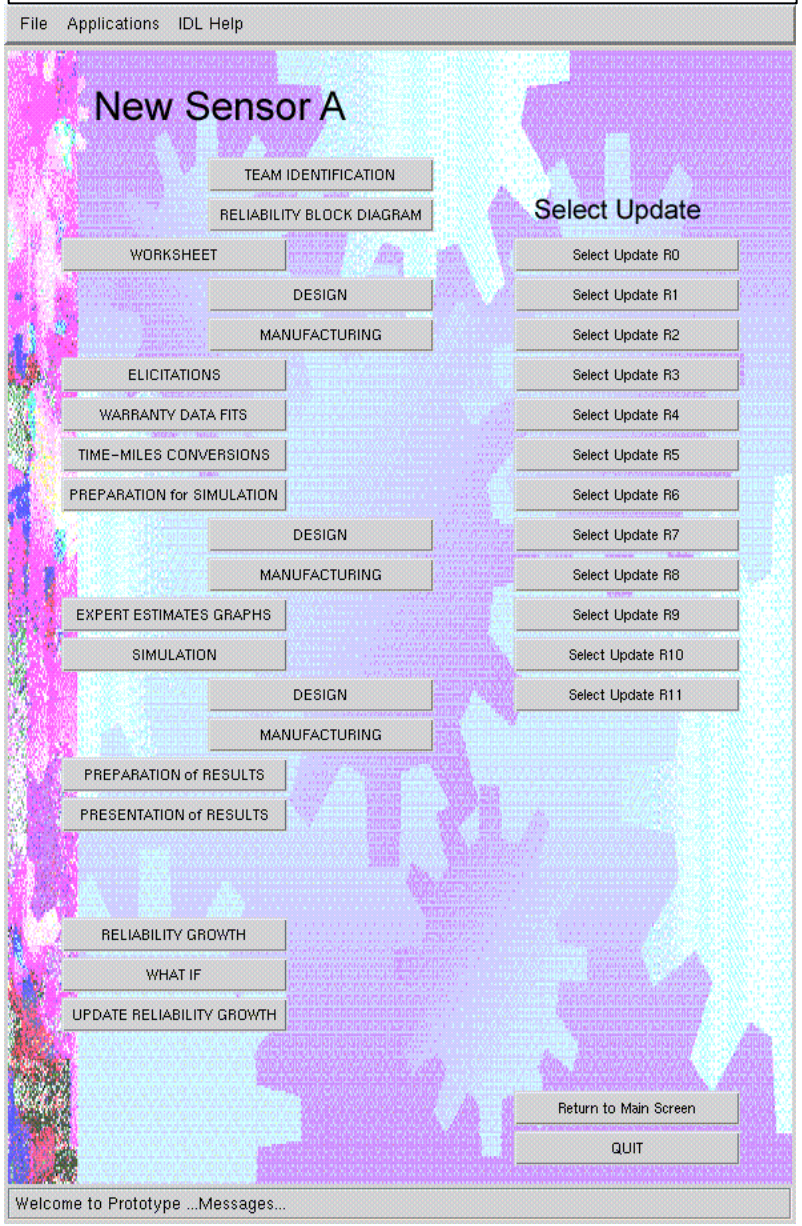
Technical and Safety Assessment Division

Welcome to Prototype ...Messages...

Snapshot of Automation Prototype

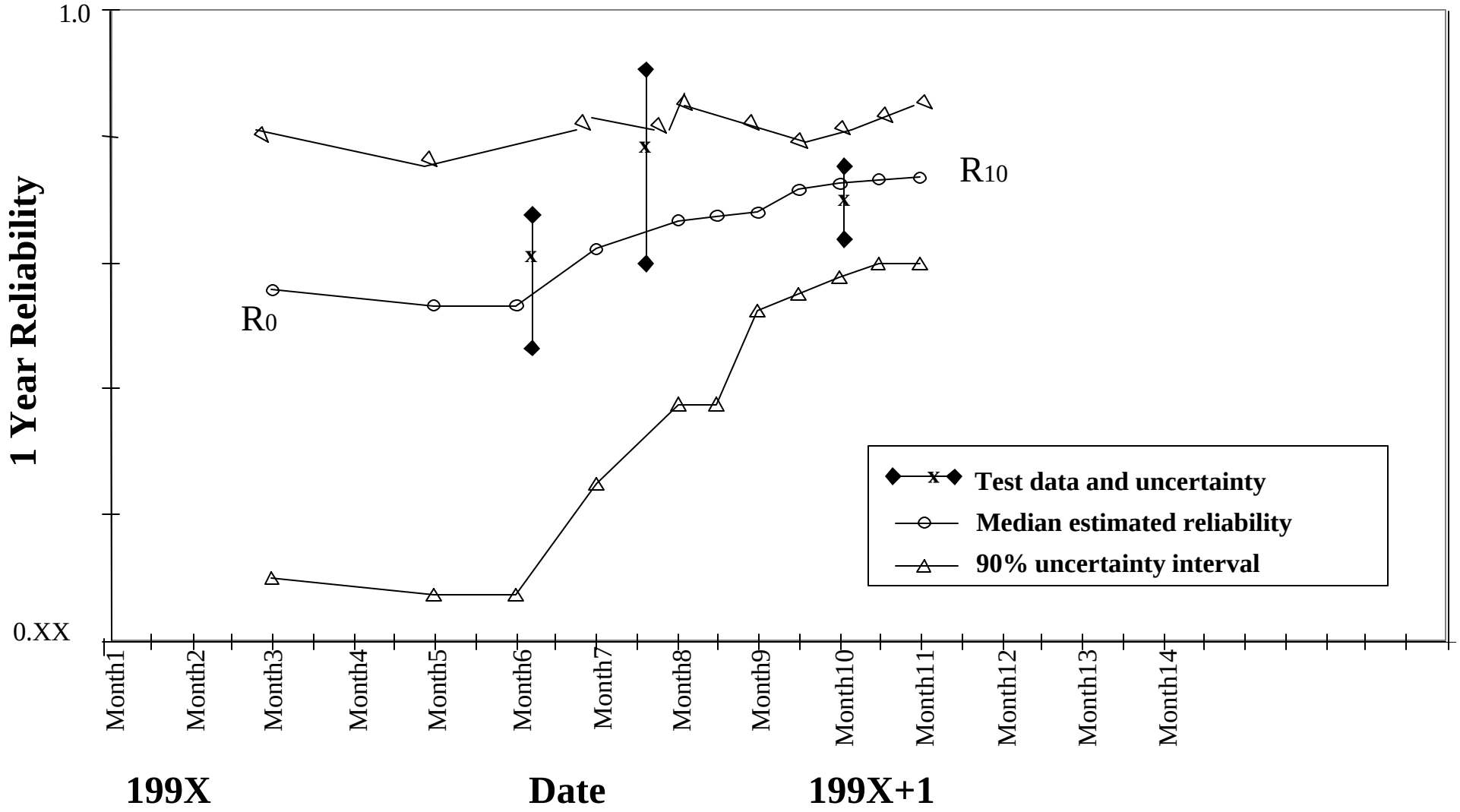


Snapshot of Automation Prototype



Snapshot of Automation Prototype

New Sensor Reliability Tracking



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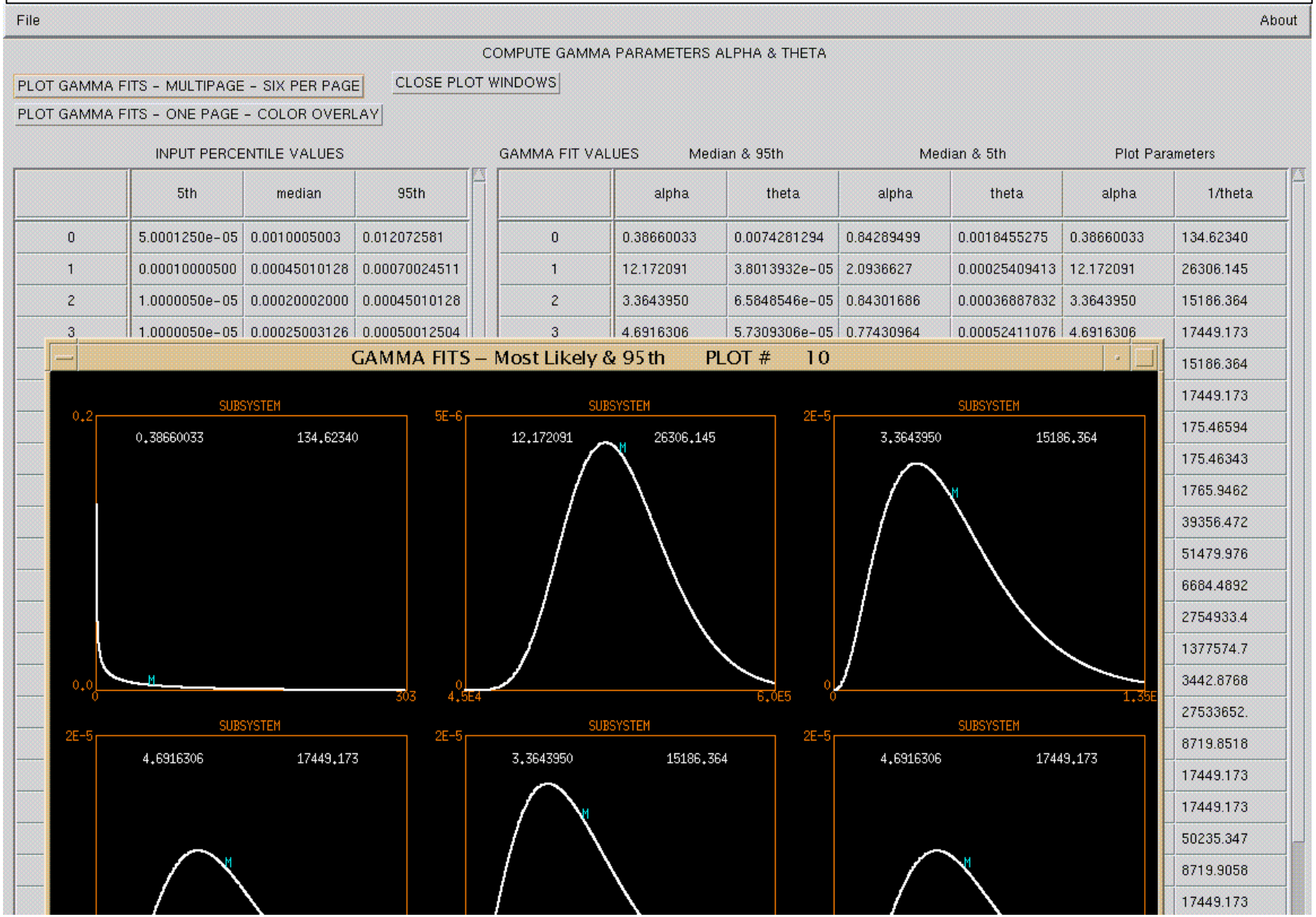

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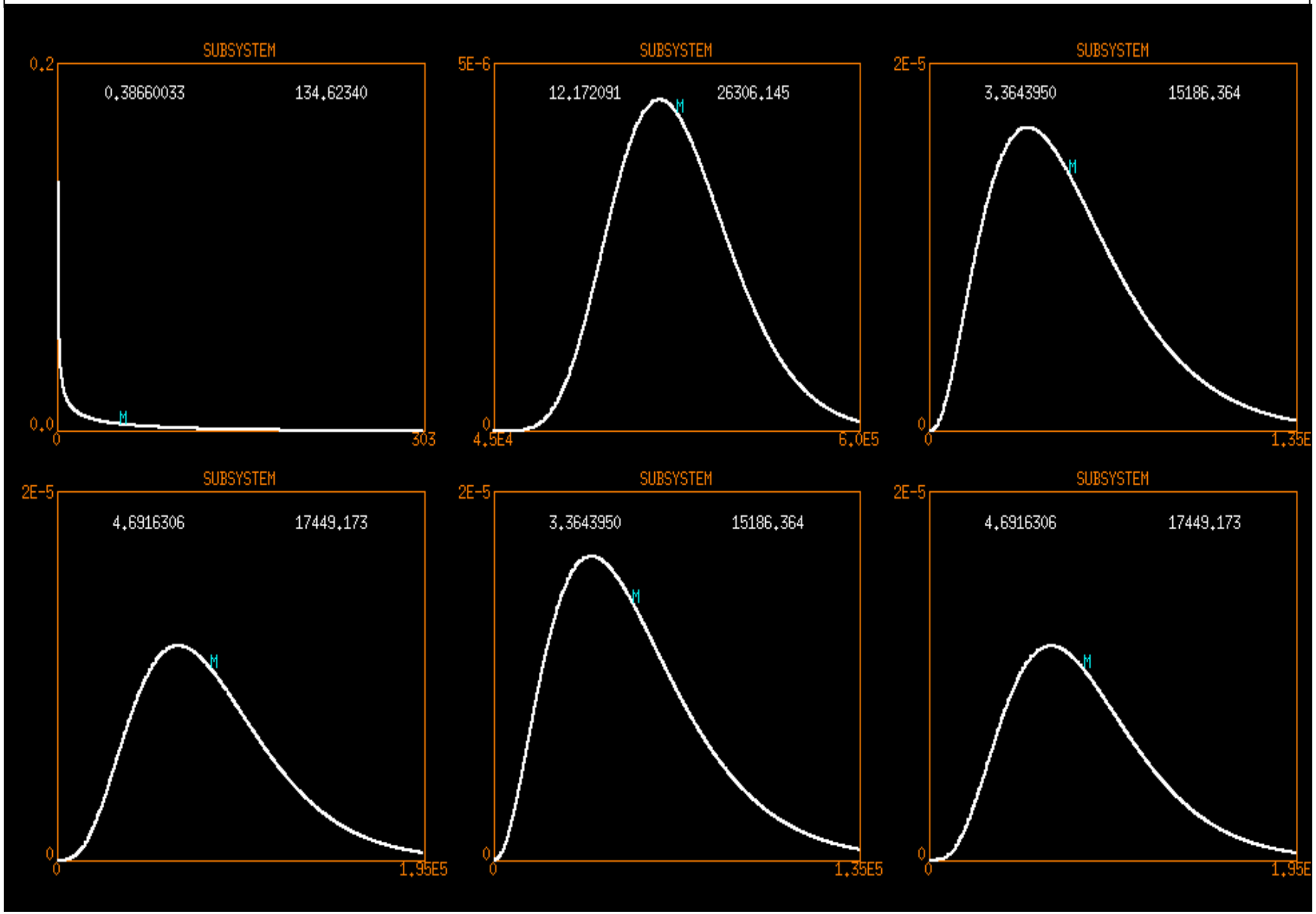

SUMMARY

Knowledge Systems:

- are web-based electronic repositories that have been customized, cognitively and culturally, to the technical communities to bring together their data and knowledge.
- are created from the expertise, expert judgment and other data.
- integrate data to knowledge by structural and analytical means.
- reflect the decision making needs of user and the state of their knowledge.
- range from Archival to Problem-Solving foci.

To be continued
after lunch

“Creating Knowledge Systems”