



The AAAI'00 ILLS Workshop And Some Related LL Efforts



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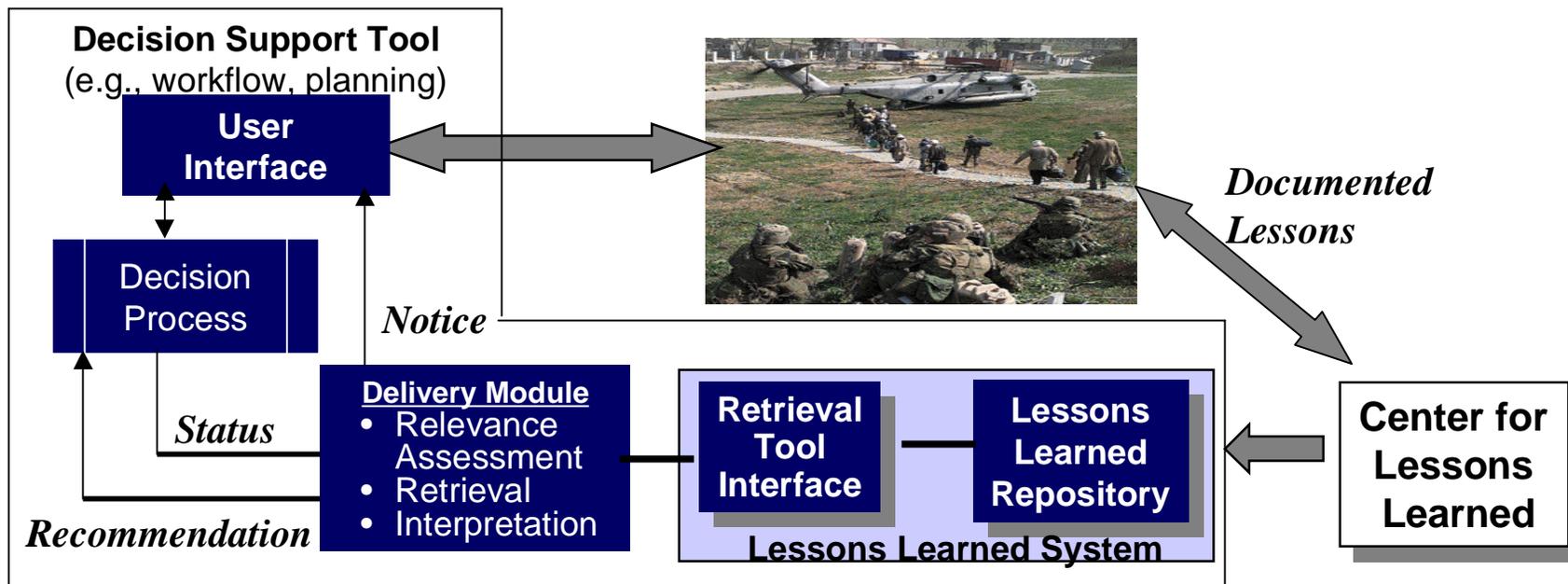




Previous Thesis (SELLS Mtg, 4/00)



Existing standalone “pull” tools for disseminating lessons cannot optimally support experiential knowledge sharing in an organization. An embedded, push tool that shifts the burden of lesson reuse from user to computer will help.



Earl Hughes: “Only feasible if software is being used.”



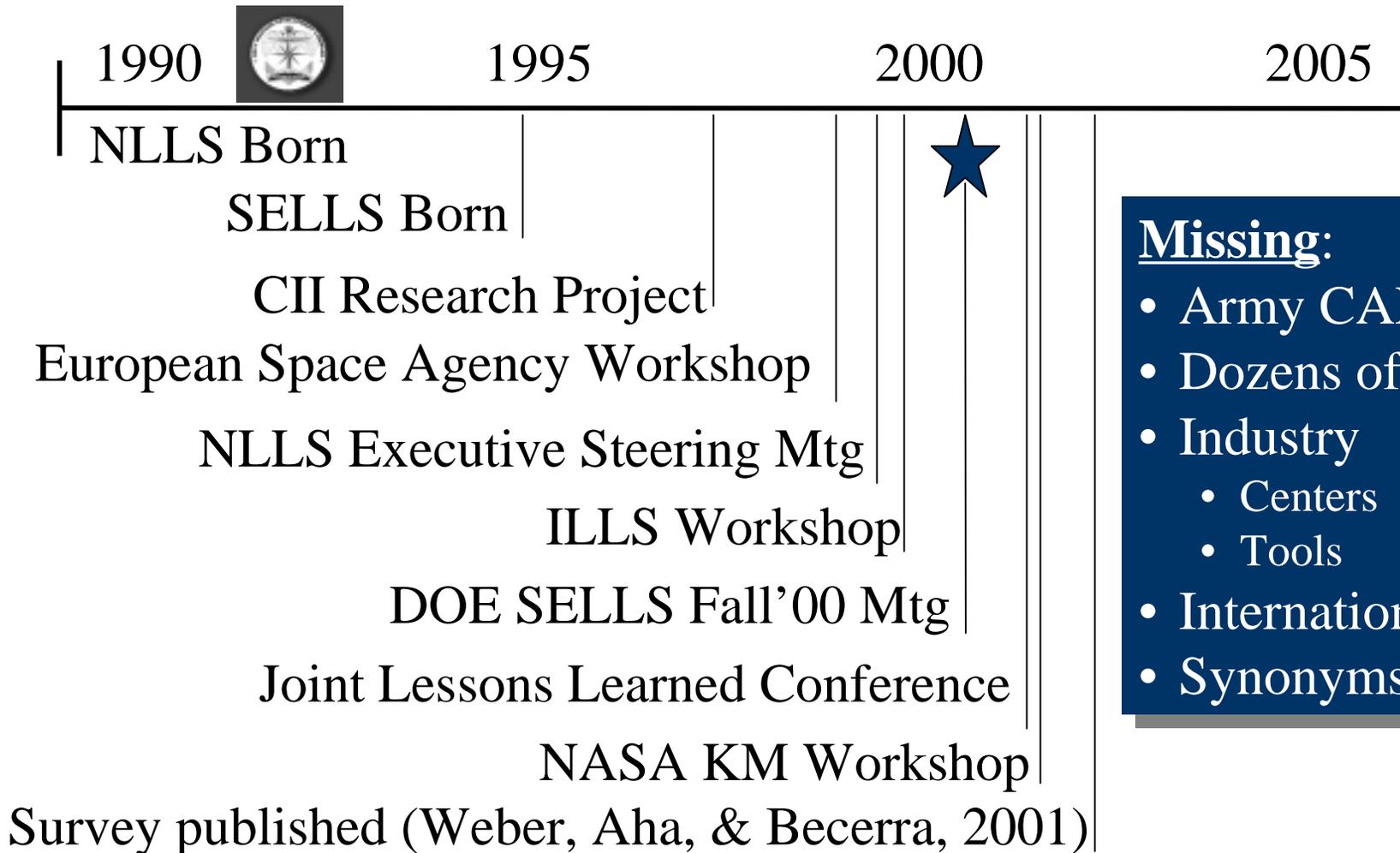
Outline



- **Perspective on the LL Community**
- **Intelligent Lessons Learned Systems Workshop**
 - Objectives
 - Events
 - Selected contributions
- **Related Events**
 - The World Wide Joint Lessons Learned Conference
 - The NASA Knowledge Management Workshop
- **LL Projects at NRL**
- **Summary**



Perspective on the LL Community: A Biased View (Fall 2000)



Missing:

- Army CALL Ctr
- Dozens of others
- Industry
 - Centers
 - Tools
- International
- Synonyms



Intelligent Lessons Learned Systems: A Workshop at AAI'00



The first meeting designed for sharing knowledge between LL practitioners and Artificial Intelligence (AI) researchers.

Co-Chairs: David W. Aha, Rosina Weber (UW/NRL)

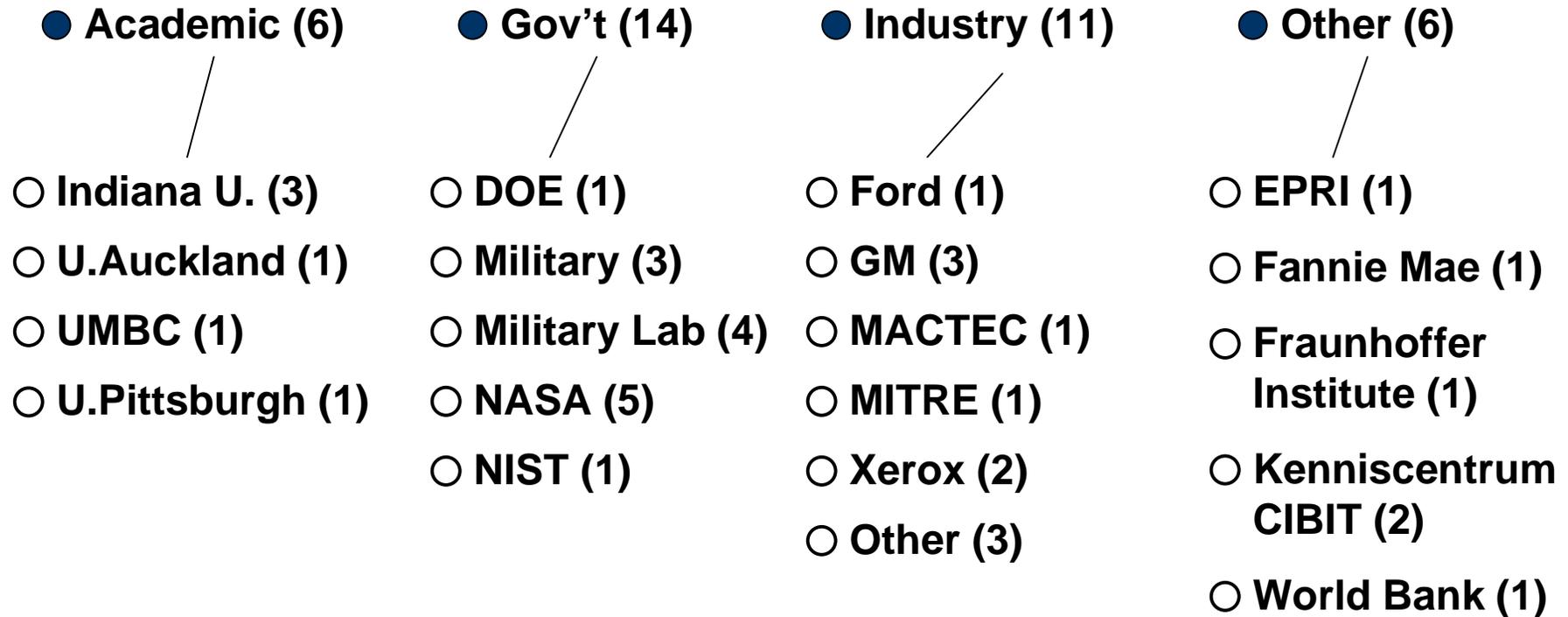
31 July 2000; Austin, TX; 37 attendees

- Objectives
- Events
- Selected contributions



Summary of Attendees

● 37



Not your typical distribution for a AAAI workshop



Example Organizations Investing in LL Centers

Air Force

- Air Combat Command Center for Lessons Learned
- **Center for Knowledge Sharing Lessons Learned**
- Automated Lessons Learned Capture and Retrieval System (ALLCARS)

Army

- Center for Army Lessons Learned (CALL)
- Center for Engineers Lessons Learned (CELL)
- Medical Lessons Learned (AMEDD)
- US Army Europe - Lessons Learned Operating System

Coast Guard: Lessons Learned and Best Practices

Joint Forces: **Joint Center for Lessons Learned, JULLS**

Marine Corps: Marine Corps Lessons Learned System (MCLLS)

Navy

- **Navy Lessons Learned System (NLLS) @ NWDC**
- **Combined Automated Lessons Learned (CALL @ NAWCAD)**
- Naval Facilities Engineering Command Lessons Learned System

Non-Military

- Construction Industry Institute
- **DoE: SELLS (e.g., Project Hanford)**
- European Space Agency
- **General Motors**
- J.M. Huber
- **NASA Lessons Learned Information System**
- NASA-Goddard: RECALL (Reusable Experience with CBR for Automating Lessons Learned)
- N.E.C.
- United Nations: UN Lessons Learned in Peacekeeping Operations
- **World Bank**



Workshop Objectives

- **LL Practitioners:**

- Identify status of deployed LL processes & systems
- Explain LL Knowledge Management issues

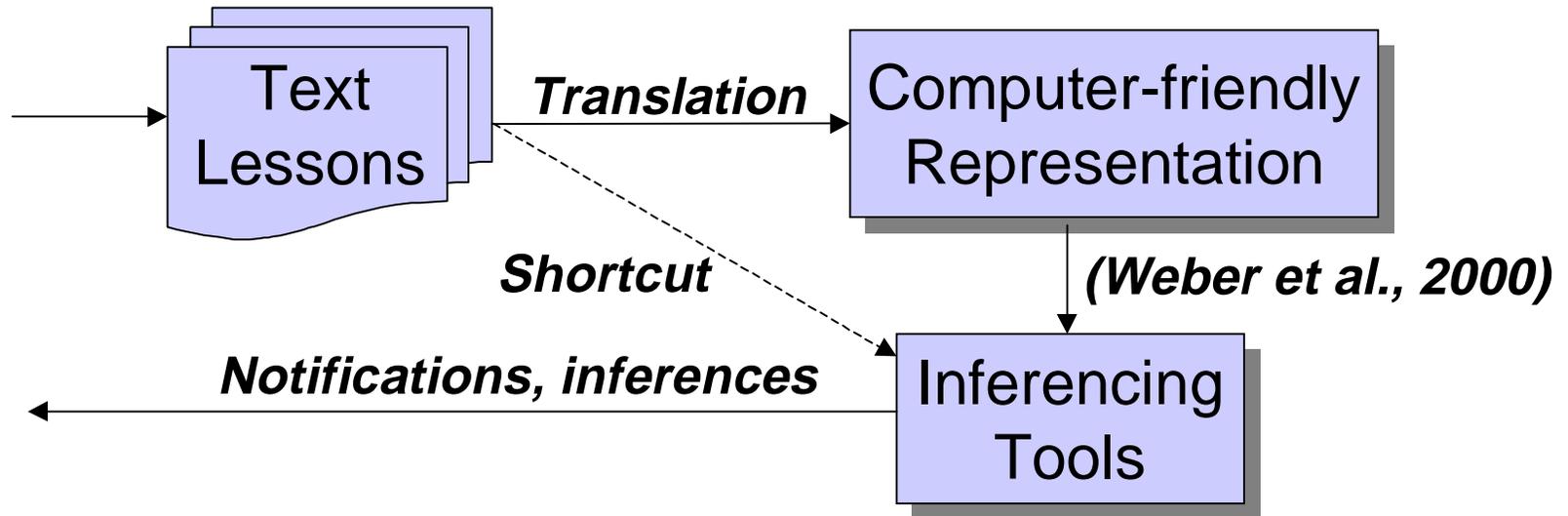
- 2. **AI Researchers:**

- Identify status of potentially useful AI approaches
- Relate approaches to LL processes/systems

To harness AI, need to focus on representation of lessons that software can use to help people promote knowledge sharing. In this context, text fields are problematic.



Challenges of Harnessing AI



- Identifying how inferencing can help
- Choosing the representation
- Defining the translation process



Workshop Events



Focus: Technology rather than organizational dynamics

- Invited talks: 5 (DOE, U. Pittsburgh, 2*Navy, Industry)
- Paper presentations (5)
- Panels (2: Distinguishing LL Processes from CBR, Reflections)
- Poster session (7)
- Discussion Periods (4)
 - A. Defining Lessons Learned Processes and Systems
 - B. Relating Rule-Based & Case-Based Approaches for LLPs
 - C. Extracting Lessons Learned: How can AI Help?
 - D. Supporting ILLS with Integrated Reasoning Techniques



Selected Contributions

● 17

● Practitioners (4)

● AI Researchers (13)

DOE (1)

- Bickford (Hanford)

Military (2)

- Moorman (NLLS)
- Gherlone (2nd Fleet)

Military Lab (1)

- Lucas (JCLL)

● Applied (4)

● Theoretical (9)

- Watson (HVAC)
- Everett (Xerox)
- Moussavi (World Bank)
- Kruizinga (Esprit Projects)

- Weber (Survey)
- Ashley (Textual CBR)
- Foltz (Latent semantic analysis)
- Leake (WWW search)
- Tautz (Software eng.)
- Wildberger (MBR/CBR)
- Eilerts (Ontologies)
- Mani (Briefing production)
- Knight (WWW/KM system)



Navy Lessons Learned System

POC: CDR John Moorman

1991- (NWDC @ Newport, RI)

- Provide instantaneous knowledge to support quality decision making
- Remedial Action Program (RAP): Forum for issue resolution of LL

System Requirements

- Joint compatibility (Joint, Navy, USMC, USAF)
 - Standardized process/representation
 - Simple submission process (IIP)
- Navy-wide access (full-text search)
 - SIPRNET weekly
 - CD-Rom quarterly (~49,000 unclassified entries)

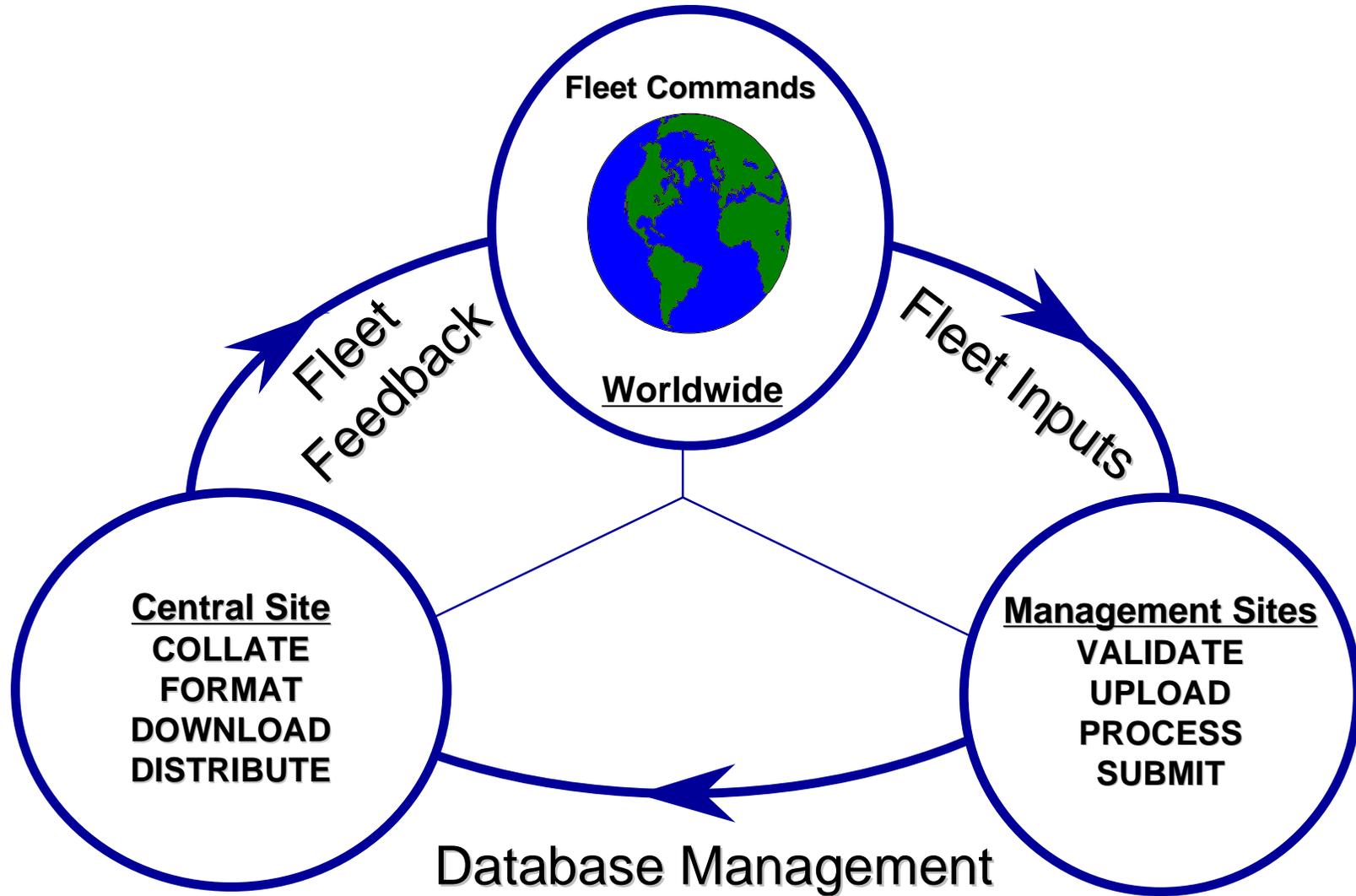
Database Scope

Level: Operational/Tactical

Topics: Legal, Admin, Logistics, etc...



NLLS Process





CD-Rom Version

NAVY LESSONS LEARNED SYSTEM (NLLS)
MAY 2000
volume 00-02

NEW
Click "New" to find out how to comment on a Lessons Learned, Summary Report, Port Visit Report, or RAP Item.

NLL HELP
SOFTWARE UPDATE
NLL INFORMATION
HELP

NAVY ACTIVE ≤ 2 years	NAVY INACTIVE > 2 years	NAVY ACTIVE/INACTIVE	
USMC ACTIVE	USMC INACTIVE	USMC ACTIVE/INACTIVE	RAP ACTIVE
JOINT ACTIVE	JOINT INACTIVE	JOINT ACTIVE/INACTIVE	RAP INACTIVE
USAF	USCG	COMBINED (USN/USMC/JOINT/USAF/USCG) ACTIVE	

My Computer



Lesson Input: The IIP Program



Edit Lessons Learned

Add **Delete** **First** **Back** **Fwd** **Last** **Print** **Text** **Tasks** **Submit** **Exit**

ID #: 31318-60242 Record: 00002 of 00004 in fbe1

UNCLASSIFIED

TITLE OF LESSON: PORT VISIT REPORT TO (NAME OF PORT, COUNTRY)

CLASSIFICATION DATA:

Class & Dist. Limit(s): UNCLASSIFIED (None) (None)

Derived from: Declass:

OPERATION/EXERCISE DATA:

OPEX Name: Date: / /

SUBMITTING & RECOMMENDED ACTION COMMANDS:

Submitting Command: Phone - DSN: -

Point of Contact: - COMM: () -

Action Command:

WHEN DONE HERE: Use "Text" button to add text fields, then "Tasks" button to add tasks.

For a lesson learned, the title should reflect the subject area, the nature of the problem and success or difficulty in dealing with it.

For a summary report, the title should be the word "SUMMARY - " (already entered) followed

UNCLASSIFIED



Comments on the NLLS



Influential

- Several contributors: Centralized management of lessons
- Parts copied by NATO, USAF, JCLL, others
- Remedial Action Program for lesson insertion

Concerns

- Repository is not “purely” lessons; too broad in scope?
- Unfortunately, standalone “pull” tools are rarely used
- No utility measures employed



Concerns of the 2nd Fleet NLLS POC

(LCDR Joe Gherlone, Jr.)



- Tactical officer is disconnected from the NLLS
- Tracking usage is difficult
- Classification (unclass./classified) is a problem
- Collection and dissemination
 - Large email traffic, but only a few are on LL
 - Wants help to automate lesson collection
- Command review:
 - Encourages *informal* comments on lessons
 - Wants automation to use context to id changes and cue people to enter lessons.



Joint Center for Lessons Learned



Roadmap for the Joint Center for Lessons Learned (Lucas & Aha, 2000)

Objective:

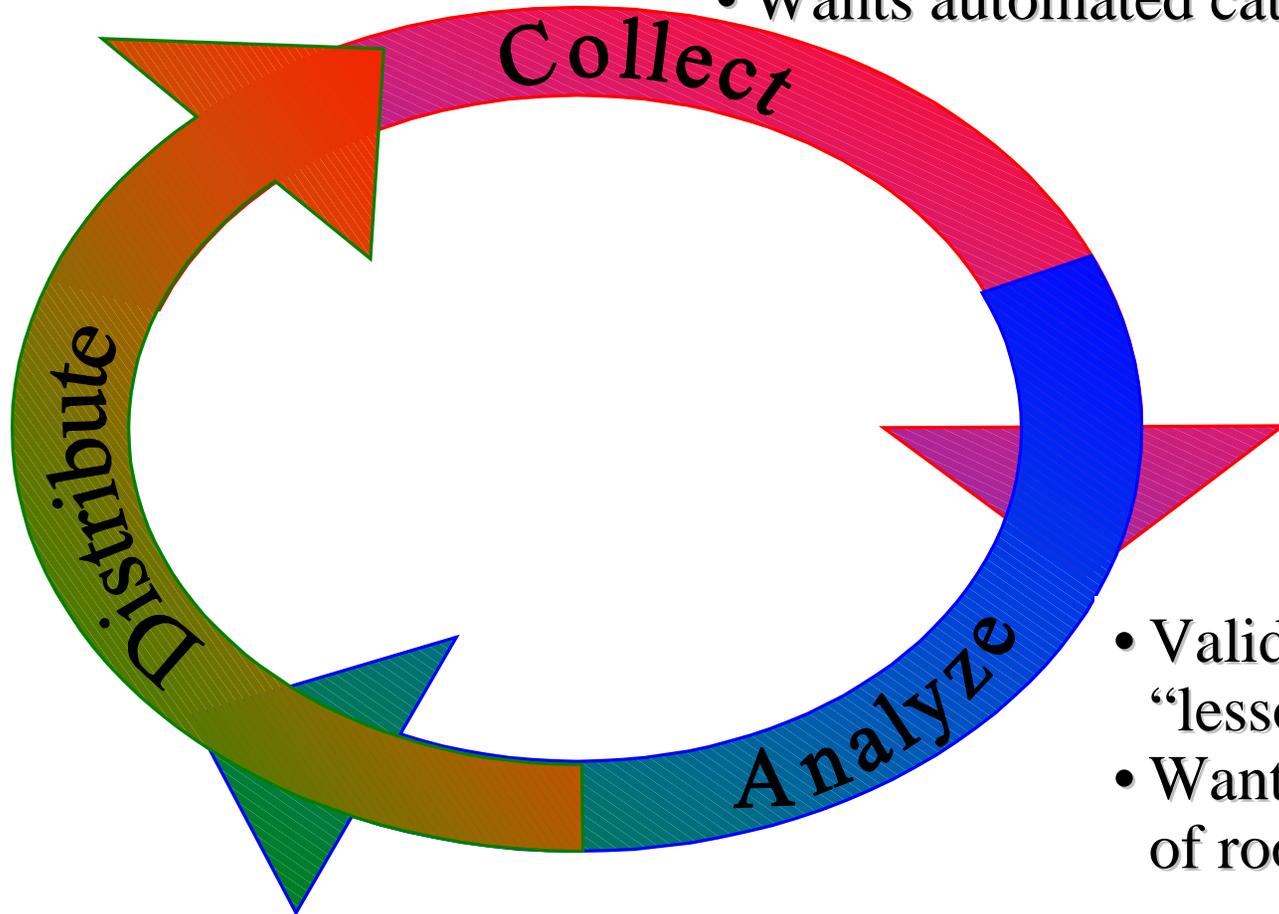
- **General:** Facilitate organizational sharing of experience to achieve optimum organizational performance.
- **Specific:** Collect, analyze, and distribute joint info and LL from operations, exercises, training events and other sources to enhance the combat effectiveness and interoperability of joint forces.



Joint Lessons Learned Process

- Support analysis process
- Wants AI automation
- Wants automated categorization

- Support Decision Analysis
- Wants a “push” capability



- Validating “lessons”
- Wants capture of root causes



Cool Air (Western Air)

Lessons Learned During HVAC Installation (Watson, 2000)

Heating, ventilation, and A/C

System capabilities:

- Reduce installation spec/quote from 5+ to 2 days
- Reduce margin of error on quotes
- Reduce burden on subject matter experts at headquarters

Method: (using case-based reasoning (CBR))

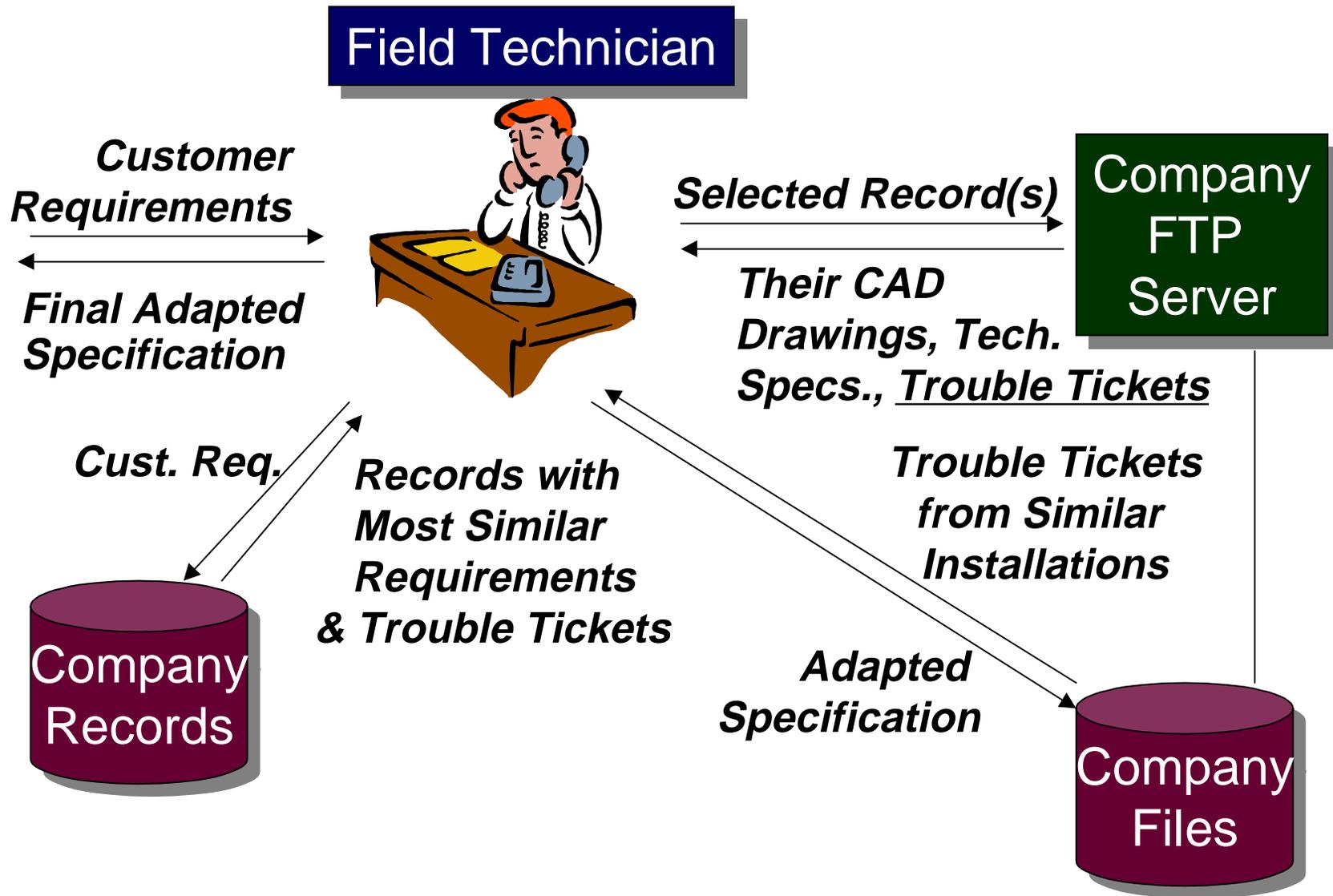
- Capture and reuse ~14,000 HVAC designs & specifications

Problem:

- Lessons learned were not being applied
- i.e., Engineers had to actively “pull” (search and retrieve) LL



Cool Air and LL Dissemination





Eureka (Xerox)

KM World Co. of 1999

Resolving Redundancy: A Recurring Problem in a LL System (Everett & Bobrow, 2000)

System capabilities:

- Exchanges tips on photocopier & printer repair
 - Tips are <problem,cause,solution> triplets in text form
 - 30,000 tips

Method:

- User control (collection, expert validation, dissemination)

Problem: Dissemination and management

- Many redundant tips exist (e.g., 15 pairs from 650 tips)
- Also, many stored tips become “stale” over time



Eureka: Potential Solutions

Eureka = A focused document collection

Failed solutions:

- Rigid input format (refused by technicians/users!)
- Information retrieval methods (poor match for this data)

Possible successful solution?

- Knowledge-intensive approach
 - Deep parsing
 - Automatic generation of conceptual knowledge representations
- Development of an ongoing maintenance policy



Survey on LL Systems



Categorizing Intelligent LL Systems (Weber, Aha, & Becerra-Fernandez, 2000)

- Processes
- Systems
- Open Issues



Survey: Categorizing LL Processes

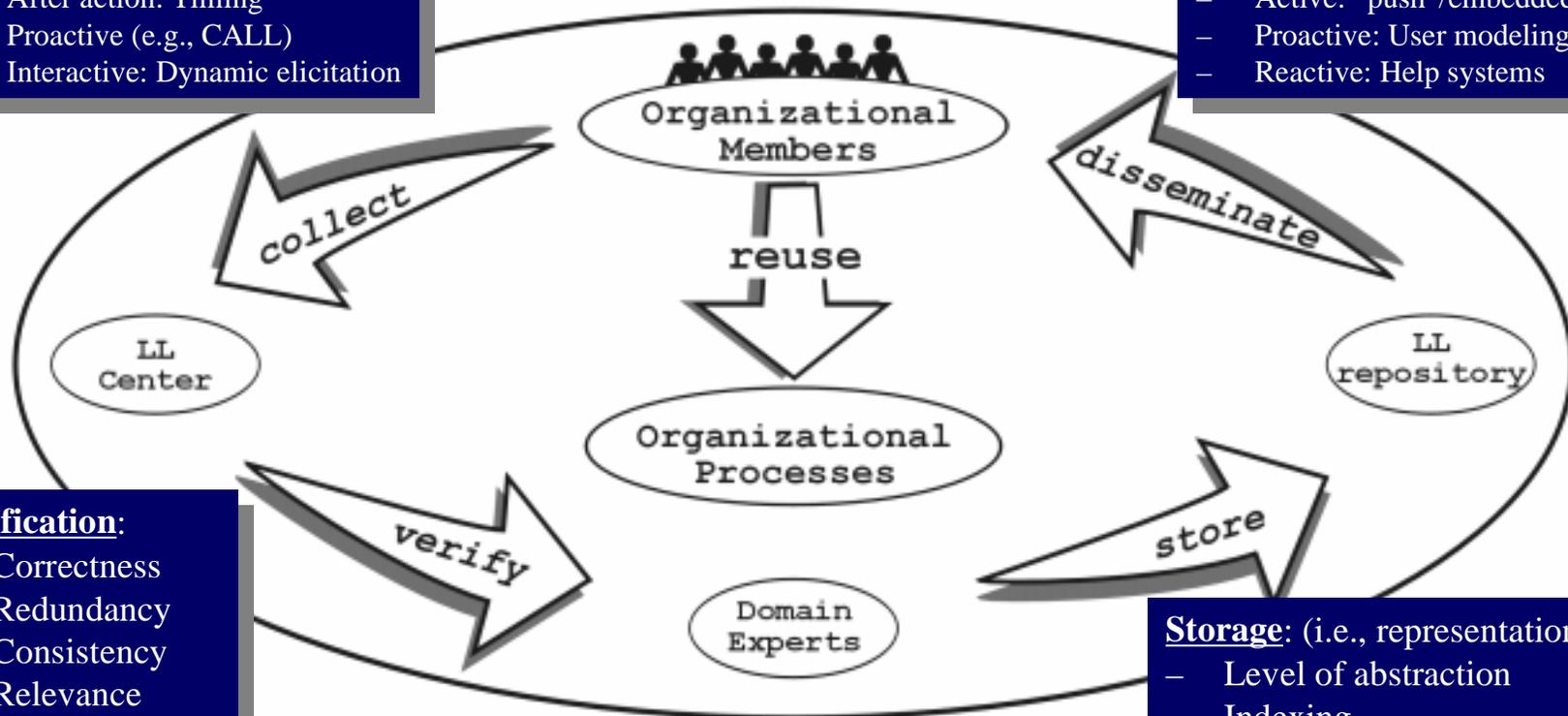


Collection:

- Passive: Manual
- Reactive: Interviews
- After action: Timing
- Proactive (e.g., CALL)
- Interactive: Dynamic elicitation

Dissemination:

- Passive: “pull”
- Active casting (e.g., list server)
- Active: “push”/embedded
- Proactive: User modeling
- Reactive: Help systems



Verification:

- Correctness
- Redundancy
- Consistency
- Relevance

Reuse:

- Browsable: Lessons are displayed
- Executable: Optional execution

Storage: (i.e., representation)

- Level of abstraction
- Indexing
- Formatting
- Media
- Task-specific representations



Survey: Categorizing LL Systems



- **Content:** Pure (40%) vs. Mixed (60%)
- **Role:** Managerial, Technical, Planning
- **Purpose & scope:** Task, Organization, Community
- **Duration:** Permanent, Temporary
- **Organization type:** Rigid vs. Adaptable
- **Architecture:** Standalone vs. Embedded
- **Attributes & format:** Mostly text
- **Confidentiality:** Unclassified vs. Classified/Restricted



Survey: Some Open Issues



Issue: Addressed by:

Level of abstraction	Ashley (Effects on Indexing)
Obsolete lessons	Lucas (JCLL “culling”)
Textual lessons	Ashley (Textual CBR)
Information retrieval	Foltz (Latent Semantic Analysis)
Maintenance	Everett & Bobrow (Redundancy)



Textual Case-Based Reasoning



Applying Textual CBR & Information Extraction in LL Systems (Ashley, 2000)

Lesson = <problem, solution>

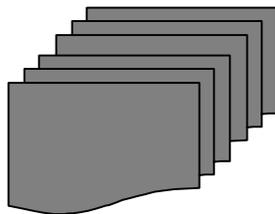
**Challenging for
IR Methods**

LL System:

- Retrieval
- Assessment
- Adaptation

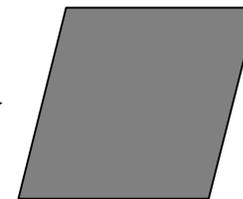
AI Research: Automation

- Induction of indices
- Retrieve relevant cases
- Highlight relevant parts of cases



Lessons: Text Documents

?

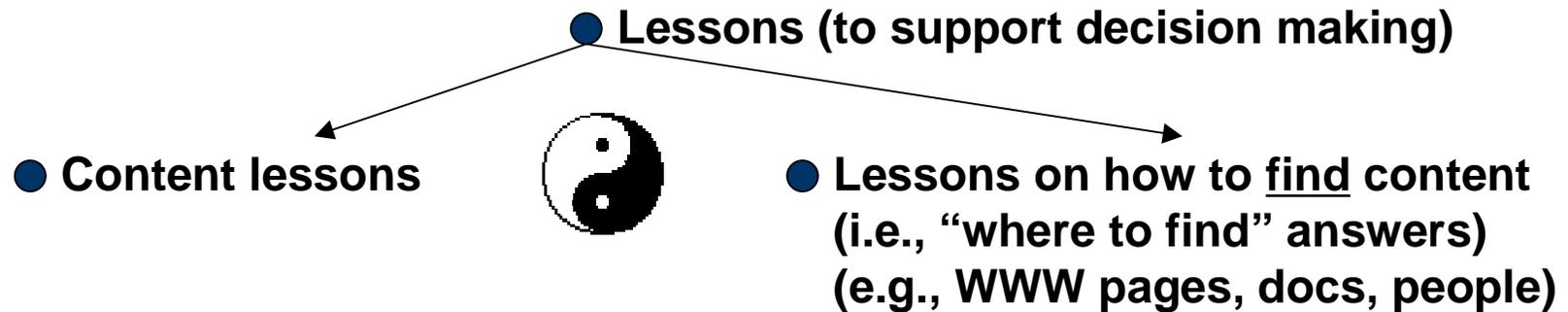


***Internal Representation
that Promotes Reuse***



CALVIN: Just-in-Time Info Retrieval

Capture, Storage, and Reuse of Lessons about Information Resources: Supporting Task-based Information Search (Leake et al., 2000)



Lesson Representation:

Manually entered {
Automatically extracted

- Task
- Topics
- Content: A path/sequence of (filtered) keyword sets
 - One set extracted per WWW page browsed
 - Only use user-defined number of “most frequent” keywords
- Resourc(es) to search

$$\text{Similarity}(L1, L2) = \sum_{i \in \{\text{Task, Topics, Content}\}} w_i |L1_i \cap L2_i|$$



CALVIN: Summary



Principles:

- Integrate LL collection & dissemination into the task process
- Collect lessons from:
 - Monitoring user task performance
 - Optional user-initiated elicitation
- Monitor task process to provide “just-in-time” retrieval
 - A proactive “push” system for lesson dissemination

Implications:

- **Search** for information/lessons should not be ignored
 - Lessons can express **how to find information**
- Allow users to annotate “search” lessons with content?
 - e.g., using concept maps



Related Events

- **World Wide Joint Lessons Learned Conference**

- 1-2 November; Hampton, VA
- First such conference held by the Joint Services (JCLL)
- Shares goals towards an (inter)national LL organization

2. **NASA Knowledge Management Workshop**

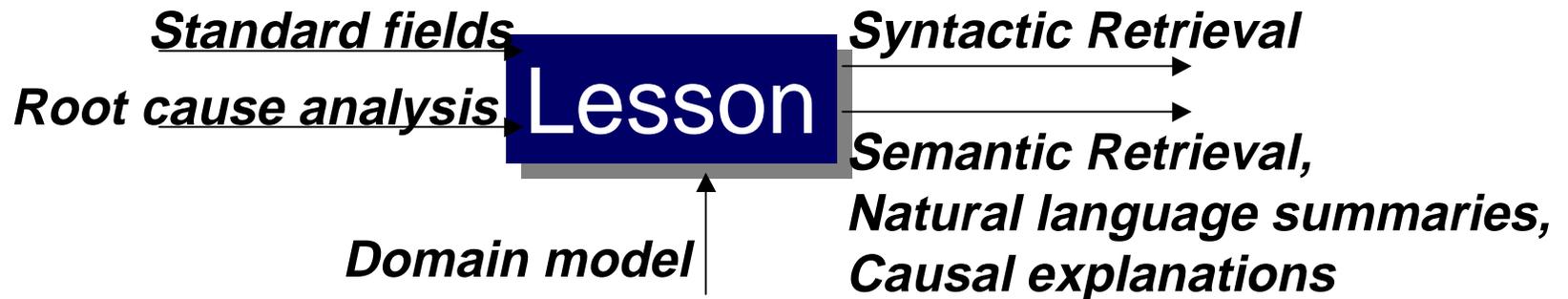
- 14-15 November; Williamsburg, VA
- Goal: Provide information on NASA KM's Initiatives
 - KM Portal
 - Expertise Finder
 - Revamp NASA's LLIS



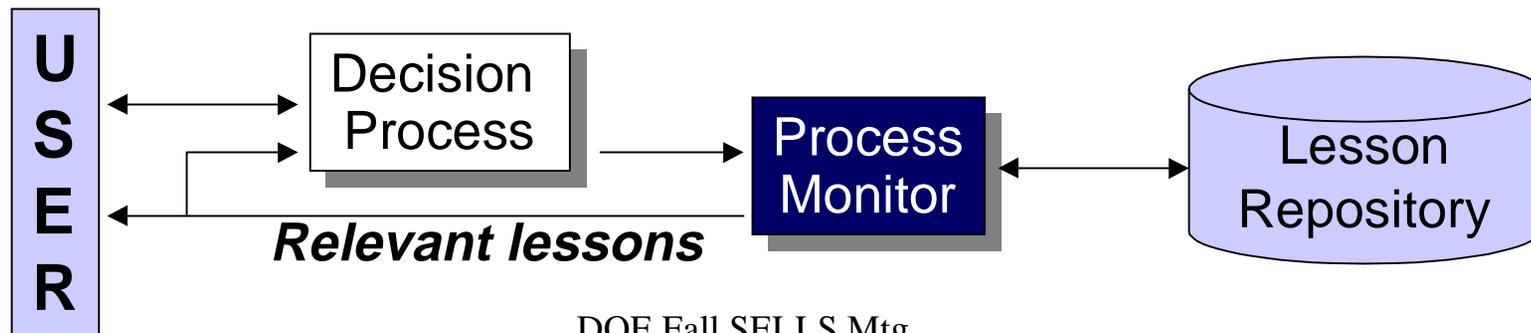
LL Projects at NRL

1. Navy/Joint Lessons Learned Systems

Collection: Navy/Joint IIP tools



Dissemination: Joint training tools

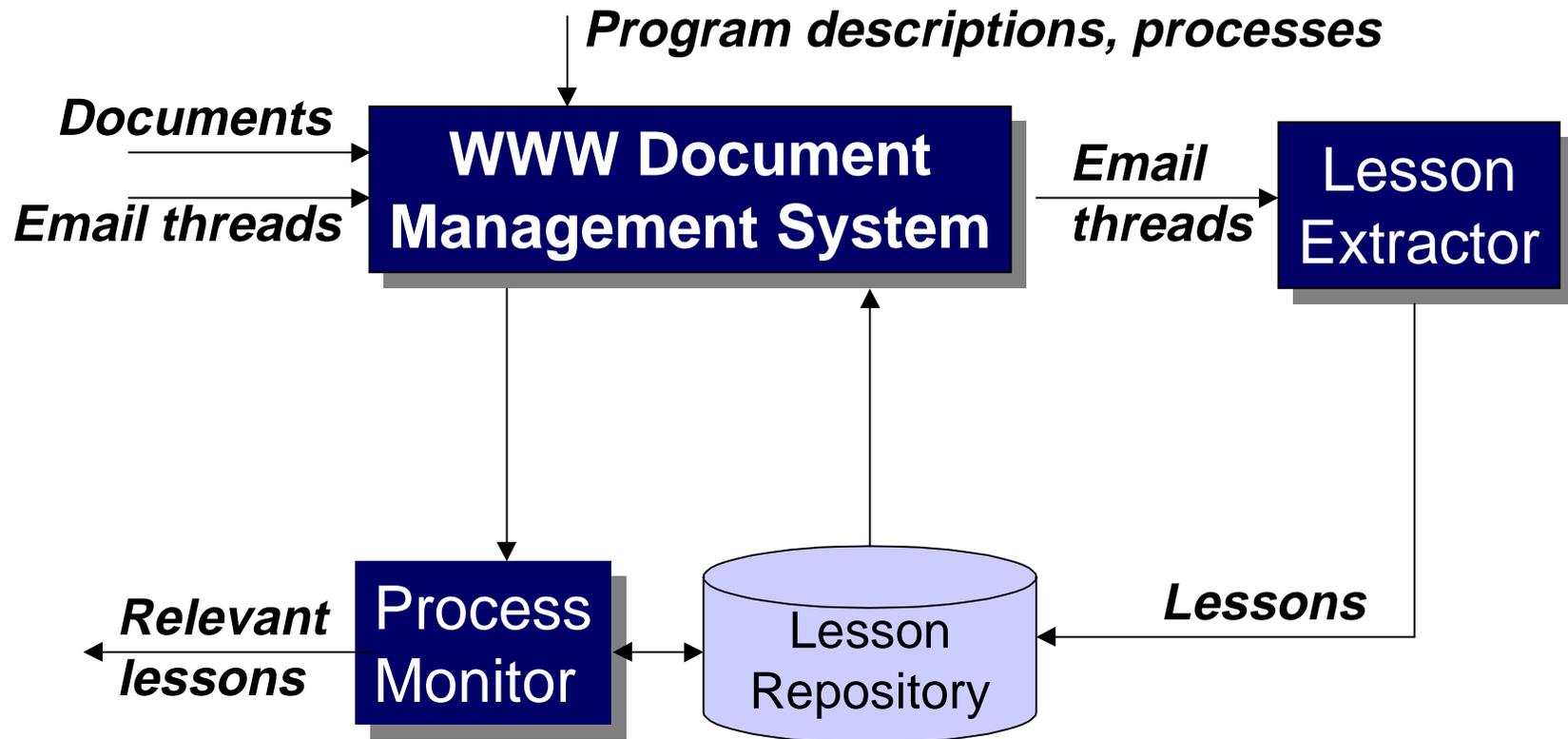




LL Projects at NRL (cont)



2. NASA Design for Safety Program





Summary

1. Differing perspectives:

- Practitioners
- AI researchers

2. Several overlapping concerns:

- Lessons as text documents
- Search
- Maintenance

3. Potential of artificial intelligence:

- Representation focus: Promoting reuse
- Tools: Collecting, validating, disseminating
- Models to support inferencing
- Push: Requires embedding in decision making processes
- Integration w/ other relevant knowledge sources



Thank you!



For more information:

- www.aic.nrl.navy.mil/AAAI00-ILLS-Workshop
- www.aic.nrl.navy.mil/~aha/lessons



International Conference on CBR



30 July – 2 August 2001
Vancouver, BC (Canada)
Premiere CBR meeting
Industry Day
Exhibition
~5 Workshops
Great social schedule!

www.iccbr.org/iccbr01

Chair: Qiang Yang

Program Chairs: David W. Aha, Ian Watson

Stresses: Applications, cognitive science, distributed systems, electronic commerce, knowledge management, machine learning, maintenance, medicine, visualization, WWW integrations



Workshop Motivation

- Joint Center for LL (R. Lucas): Problems identified
 - Strong belief of need for knowledge management solutions
 - Subsequent contacts: DoE, NASA-GSFC, NAVFEC, USAFCKS
- Literature survey
 - Construction Industry Institute (D. Fisher et al., 1998)
 - SELLS meetings/workshops (Dept. of Energy)
 - 1999 European Space Agency's Alerts and LL Workshop
 - Some KM and related publications

Weber, R., Aha, D.W., & Becerra-Fernandez, I. (2000). Intelligent lessons learned systems. To appear in *Expert Systems with Applications*.



Lessons & Lessons Learned



Lesson: A *validated* record extracted from a (positive or failure) experience with a previous decision process that others in an organization can *reuse* to reinforce a positive result and/or avoid a failure (Secchi et al., 1999).

Lesson Learned: The change resulting from applying a lesson that *significantly* improves a targeted process

Lesson Learned System: Software that supports a LLP.

Intelligent Lesson Learned System: A LL system that incorporates artificial intelligence techniques.



Example Lesson (from JULLS)



JULLS Number: 72162-67624
Overall Classification: UNCLASSIFIED
Opex Name: TANDEM THRUST 93
Originator of Lesson Learned: JECG

5. (U) **OBSERVATION:** An ODA on a low-visibility special recon mission was used to implement a **NEC** involving notional U.S. citizens. **SOF** MH-53 helicopters were used to evacuate personnel from Tinian. The original plan called for a SOC qualified MARFOR to accomplish this operation with the clandestine assistance of the **SOF** personnel.

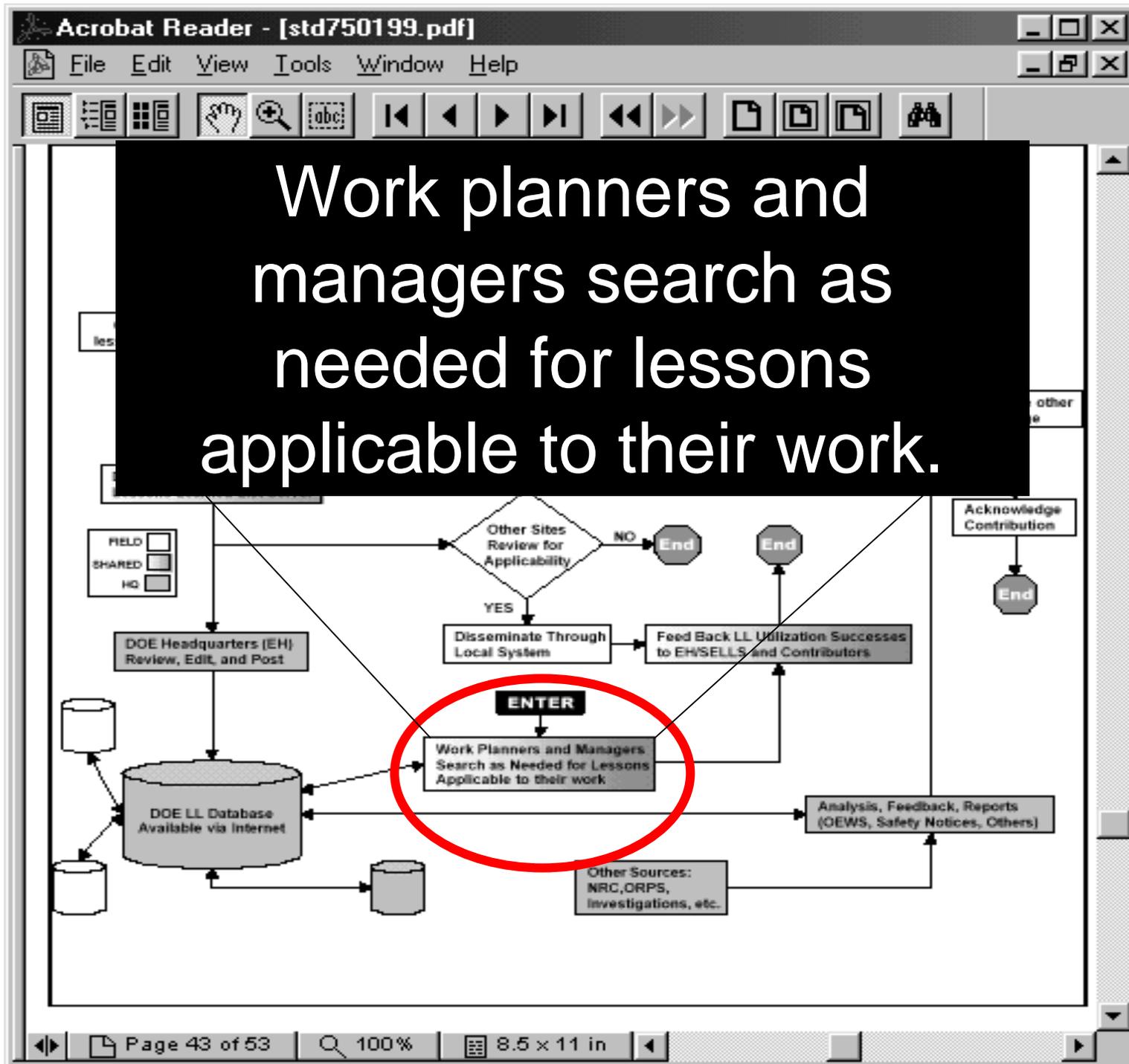
6. (U) **DISCUSSION:** Using covert **SOF** personnel and helicopters to implement a **NEC** comprises these assets if high-visibility conventional forces are not also utilized in the operation. An alert OPFOR commander would question exactly how the forces assisting with the **NEC** got on the island, if no conventional forces were inserted. He ought to be able to infer that **SOF** were involved, which compromises them.

7. (U) **LESSON LEARNED:** The CJTF must be made aware that, if he implements a plan that uses only visible **SOF** on a **NEC** without conventional forces being on the scene, this increases the risk to clandestine **SOF** personnel performing missions supporting his campaign plan.

8. (U) **RECOMMENDED ACTION:** Clandestine **SOF** assets on low-visibility missions generally should not be used alone to perform a **NEC** where they can be observed by the OPFOR.

9. (U) **COMMENTS:** The CJTF should use low-visibility **SOF** assets alone on a **NEC** only when the cost of leaving U.S. citizens in harm's way (possibly as hostages) exceeds the risk that compromised **SOF** personnel may not be able to accomplish their missions. (72162-67624)

Observation Date: 23-Jul-93





Proposal: Intelligent Lessons Delivery

(Weber et al., 2000)

