Human-Centered Intelligent Flight Surgeon Console

Progress Report

October 24, 2002

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Outline

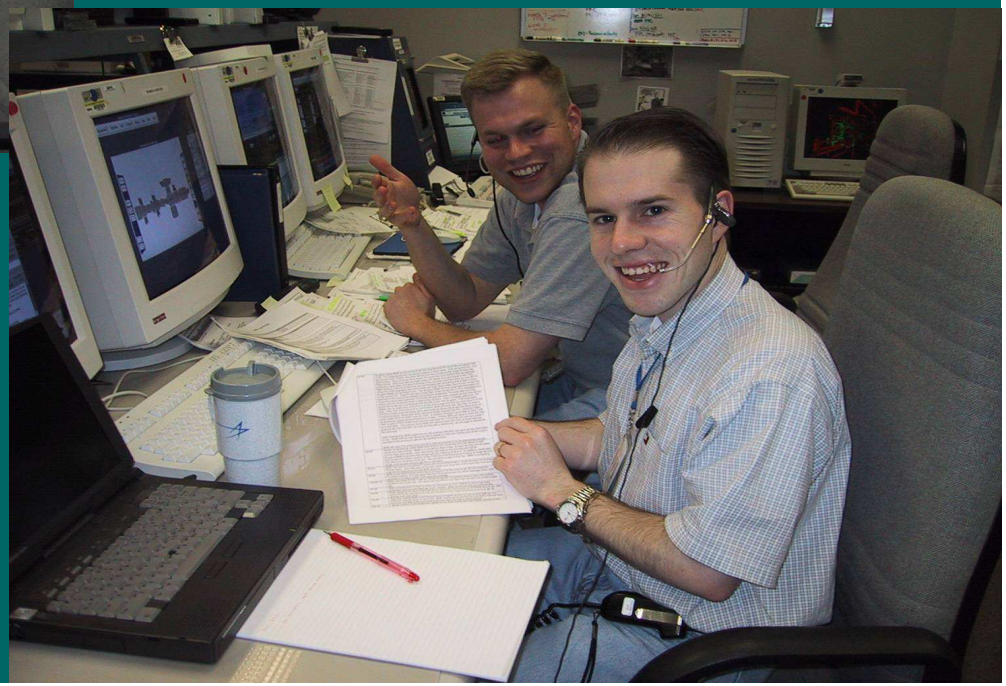
- Introduction
- Methodology
- Project Life Cycle
- Selected Sub-Projects since Feb 2002
  - Lognotes
  - Brahms Modeling
  - Workit
- Design Iteration
- Conclusion
- List of Publications and Presentations

Introduction

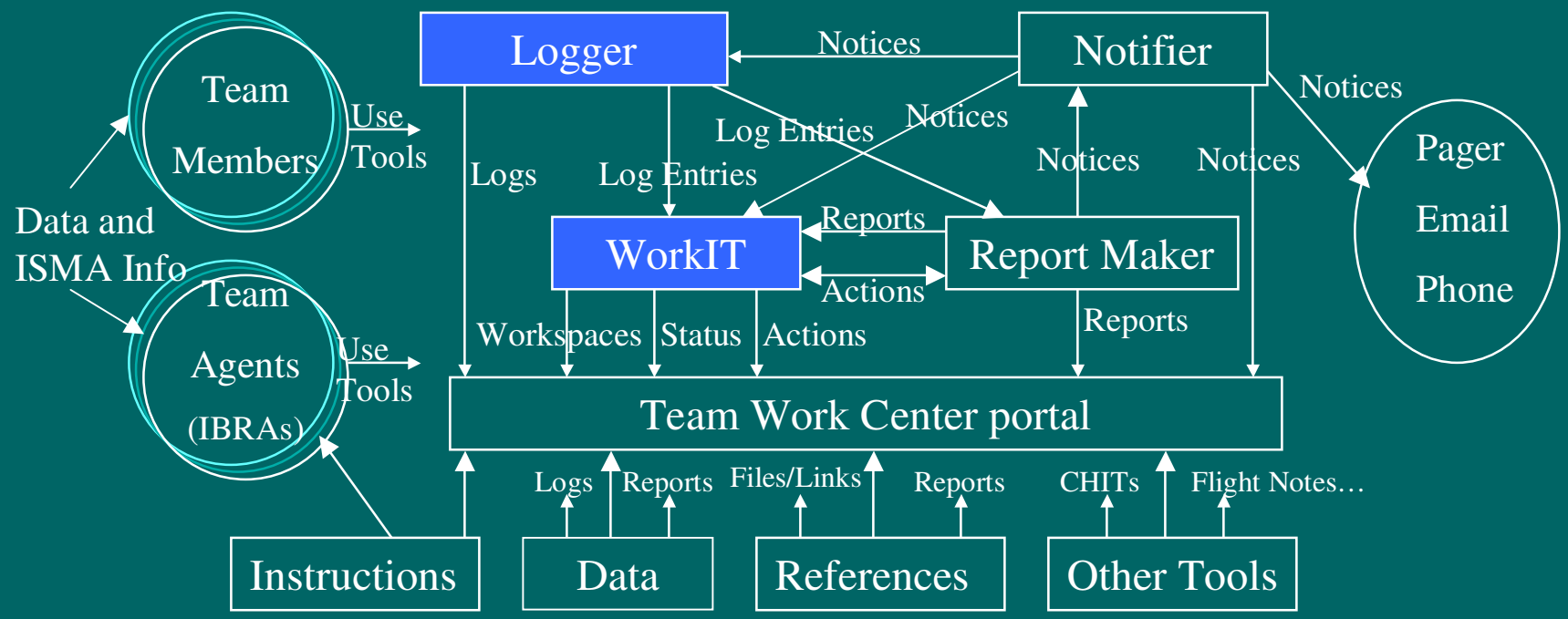
- The Biomedical Engineer's console is situated in a complex environment
  - Multiple agents and artifacts distributed across space and time
  - Collection of information is difficult to retrieve

BMEs responsible for

- the technical and operational support of medical events
- continuous logging and archiving of events generated throughout the BMEs' shifts



Linked Tools for Agents and Team Members



A team member enters content once, for use in multiple places

Hu ed Information Design

User Analysis: identify cognitive characteristics of existing and potential users, such as expertise and skills, knowledge base, age, education, cognitive capacities and

Task Analysis: identify system functions that have to be performed procedures and actions to be out, information to be pattern and dynamic

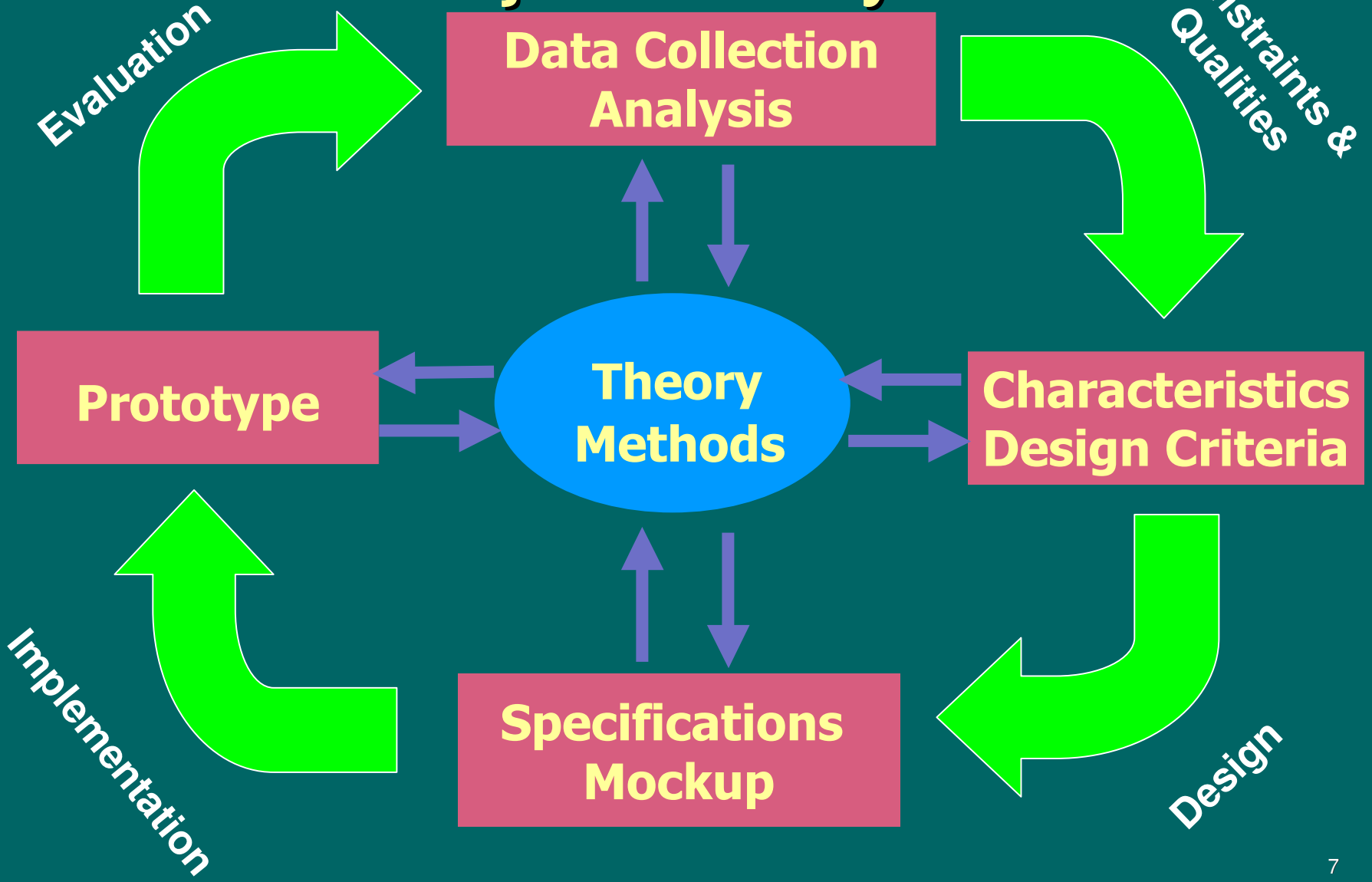
Representational the best informati and the best inform structure for a given the interaction betwee systems is in a direct intera mode.

Distributed User Analysis: analyze division of labor,

Distributed Task Analysis: time

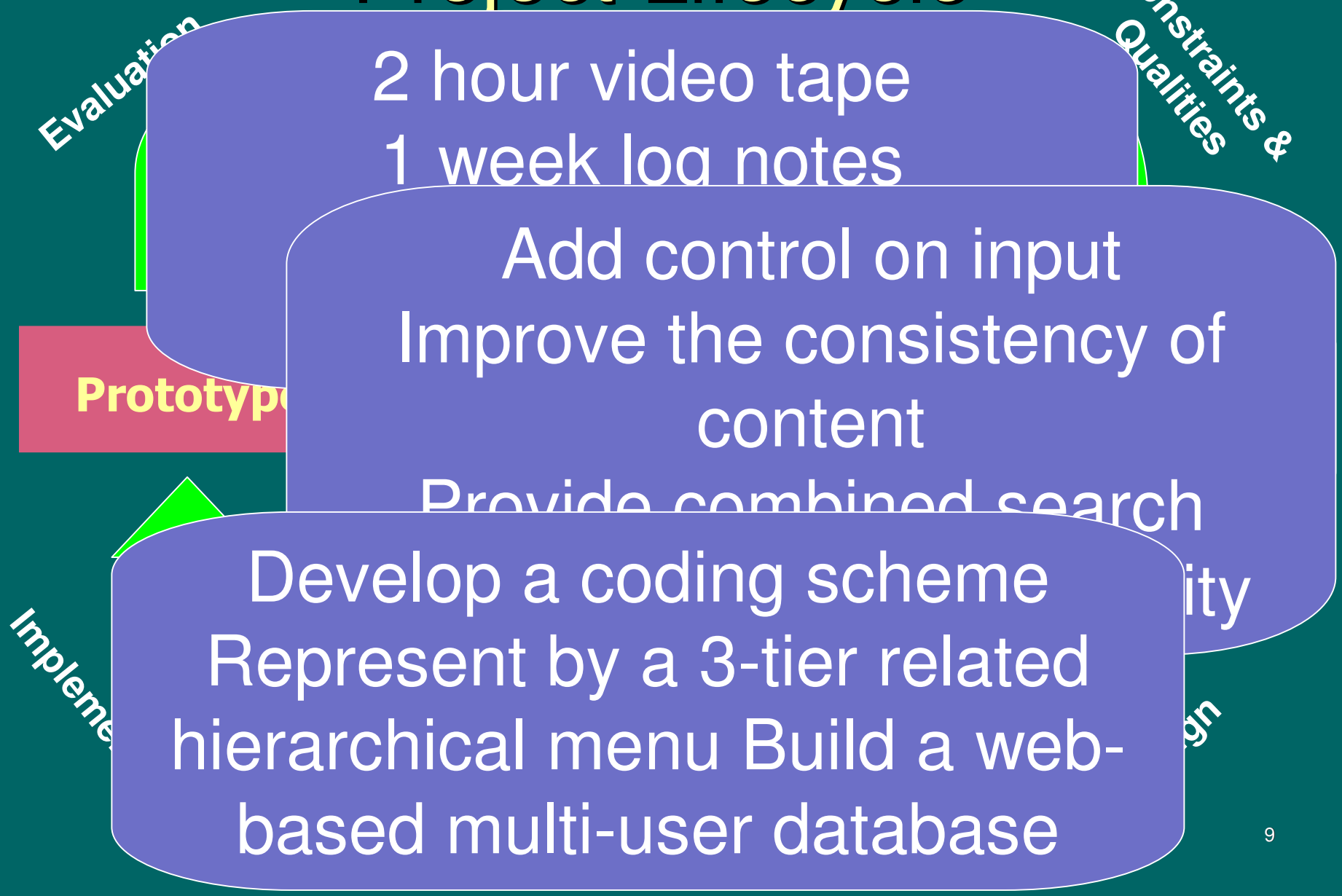
Contents for System Implementation:
Functional Abstraction Hierarchy; user profiles; hierarchical task structure; information flow diagrams; task-specific, event-related, and context-sensitive information displays; interface design recommendations; and so on.

Project Lifecycle



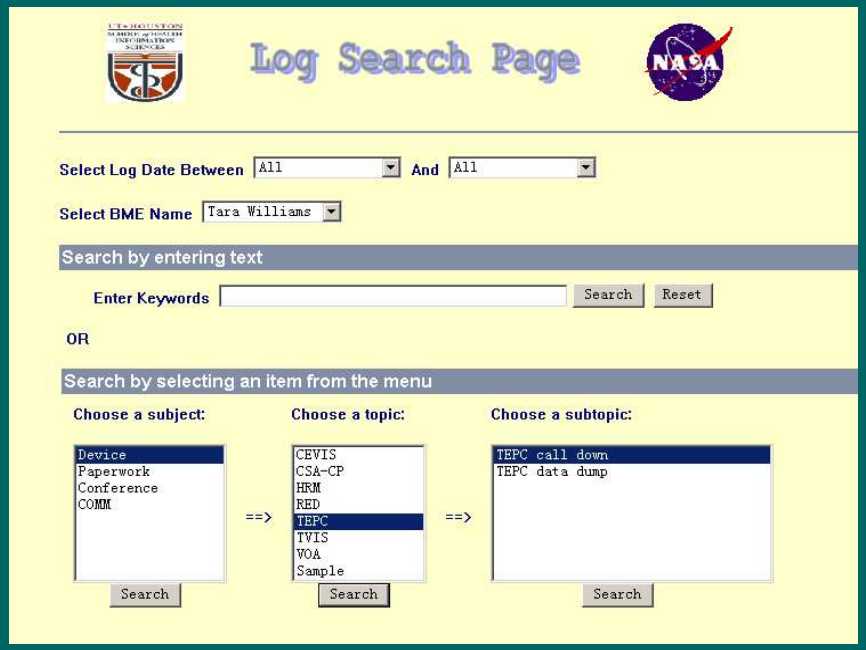
Lognotes

Project Lifecycle



Search Interface

- An adequate search interface can reduce cognitive work load.
- Related menus allow selection at every level of hierarchy
- One menu controls the contents of the others
- Well developed coding scheme increases the accuracy of search



New format and search results

Console Window Help

Event_ID	Log_Date	Log_Time	BME_Name	Event
2	10/19/2001	5:09:00 AM	Tara Williams	Space Weather called: 10 meV protons possible through 15:00 UT on 19th. BME paged Steve
3	10/19/2001	5:15:00 AM	Tara Williams	Steve Johnson returned page, with the location at which the ISS is now, it is not a concern righ
4	10/19/2001	5:29:00 AM	Tara Williams	Steve Johnson is on his way in. He doesn't think that there is anything to worry about but he
5	10/19/2001	5:58:00 AM	Tara Williams	The crew is in the Soyuz and all the hatches are closed. They are ready for the
6	10/19/2001	6:09:00 AM	Tara Williams	Steve Johnson in MCC.
7	10/19/2001	7:03:00 AM	Tara Williams	Steve J. > Surgeon: We may reach alarm levels at around 16:30 UT, but don't think so at t
8	10/19/2001	7:13:00 AM	Tara Williams	Crew > MCC-M: We were told not to change the scrubbing cartridges and now we have a pp
9	10/19/2001	7:16:00 AM	Tara Williams	Per our FR 13.2.2-3 the NASA SMAC is 10mmHg for 1 & 24-hr exposure but when levels stabilize ove 7.6 mmHg, measures must be taken to low
10	10/20/2001	7:20:00 AM	Tara Williams	FD > ECLSS: Do you have a portable CO2 removal system? ECLSS: Yes. FD: Can it be brought into soyuz? ECLSS is looking.
11	10/20/2001	7:26:00 AM	Tara Williams	ECLSS > FD: Fan needs UOP so it cannot go into the Soyuz.
12	10/20/2001	7:30:00 AM	Tara Williams	CAPCOM > ECLSS: what is your estimate on the level it will be at at ingress? ECLSS: By my calculations it should be at 7.5 mmHg.
13	10/20/2001	7:32:00 AM	Tara Williams	CDM in LAB1D4_A2, all hatches are closed so there is no way they would go get it.
14	10/20/2001	7:41:00 AM	Tara Williams	Surgeon informed BME that the crew waived CO2 training...
15	10/20/2001	7:48:00 AM	Tara Williams	Conference, MCC-M > crew: How is CO2 now? Crew: A little bit lower than 5mmHg.
16	10/20/2001	7:55:00 AM	Tara Williams	Steve Johnson is leaving MCC. No Flight Note was required because we did not cross any
17	10/20/2001	8:34:00 AM	Tara Williams	ISO > BME: They are working on the stowage note for Tuesday and saw that we have TE
18	10/21/2001	8:41:00 AM	Tara Williams	BME sent an email to Rhonda and Mark about the TEPC procedure and requested that the
19	10/21/2001	9:15:00 AM	Tara Williams	SO called and requested that BME take a look at CIIN873 which contains the locations for
20	10/21/2001	9:24:00 AM	Tara Williams	Crew is wearing their suits. They performed fit check and there are no problems. Volody
21	10/21/2001	9:31:00 AM	Tara Williams	ISS is in undocking altitude.
22	10/21/2001	9:38:00 AM	Tara Williams	MCC M > Crew: The medical group informed us that they stopped getting medical data fro
23	10/21/2001	9:40:00 AM	Tara Williams	MCC-M > Crew: OK we have FE-1 medical data but none from the CDR. Crew: you should
24	10/21/2001	9:43:00 AM	Tara Williams	Space Weather called: Major Flare M5 at 09:41UT. BME paged Steve J.
25	10/22/2001	9:48:00 AM	Tara Williams	Steve Johnson called back, no action at this time.
26	10/22/2001	10:13:00 AM	Tara Williams	FD went around the room for GO for undocking.
27	10/22/2001	10:20:00 AM	Tara Williams	FD asked HSG to relay what the CO2 was at 2.205 at 9:05 GMT.
28	10/22/2001	10:48:00 AM	Tara Williams	Soyuz has separated from ISS.
29	10/22/2001	11:03:00 AM	Tara Williams	Jodi Waks in MPSR
30	10/22/2001	11:10:00 AM	Tara Williams	Soyuz id docked.
31	10/22/2001	11:51:00 AM	Tara Williams	BME spoke with ISO about the TEPC Data D/L. BME looked at the CHeCS hardware on-orb
32	10/22/2001	12:00:00 PM	Jodi Waks	Waks on console. Williams out of MPSR. (FD: Jeff Hanley, CC: Ginger Kerrick)
33	10/22/2001	12:02:00 PM	Jodi Waks	Surgeon going to planning meeting.
34	10/22/2001	1:19:00 PM	Jodi Waks	Look at OCA 715 0800 report and go green when happy. BME went green.
35	10/22/2001	1:52:00 PM	Jodi Waks	Review 293 on O-292-297 and go green. BME checked all links and activities and went gre
36	10/22/2001	2:32:00 PM	Jodi Waks	SRAG on console.
37	10/22/2001	2:46:00 PM	Jodi Waks	BME emailed Al and Chris with the times for the PPC and PFC this weekend. Chris will be in
38	10/22/2001	3:01:00 PM	Jodi Waks	SVA called and BME relayed 12:36 local. SVA relayed that Chris may prefer video. We hav
39	10/23/2001	3:05:00 PM	Jodi Waks	Review 294 and go green. BME looked at Sunday, PFC and PPC are good.
40	10/23/2001	3:11:00 PM	Jodi Waks	LRP called Surgeon about Reflotron. For next week all 6 CM are going to have blood taken
41	10/23/2001	3:11:00 PM	Jodi Waks	Also from the planning meeting this morning. Arena would like the Russian's TVIS informati
42	10/23/2001	3:14:00 PM	Jodi Waks	Chris Flynn will be the Surgeon on call this weekend.
	10/23/2001	3:21:00 PM	Jodi Waks	BME talked to Alan and he said the on-orbit list only has assembly level information, meani
	10/23/2001	3:31:00 PM	Jodi Waks	BME talked to Howard Better about the TEPC part numbers. Howard looks at the drawings

Search Results of TEPC from Database

Search Result

select Log_Date, Log_Time, BME_Name, Event from LogNotes where BME_Name='Tara Williams' and Event like '%%tepc%%' ORDER BY Log_Date, Log_Time ASC

Log_Date	Log_Time	BME_Name	Event
10/20/2001	8:34:00 AM	Tara Williams	ISO > BME: They are working on the stowage note for Tuesday and saw that we have TEPC Data D/L. The part numbers in the procedure don't match what is in the database. BME told them to go ahead and use what they have in the database. ISO also asked if the callout of the SM under hardware required still applied. BME explained that it was missed and should not still be in the procedure.
10/21/2001	8:41:00 AM	Tara Williams	BME sent an email to Rhonda and Mark about the TEPC procedure and requested that the Ops Team Lead fix the errors.
10/21/2001	9:15:00 AM	Tara Williams	SO called and requested that BME take a look at CIIN873 which contains the locations for our hardware for the TEPC Data D/L. She had some blanks and requested BME扭 help.
10/22/2001	11:51:00 AM	Tara Williams	BME spoke with ISO about the TEPC Data D/L. BME looked at the CHeCS hardware on-orbit list from engineering (I placed a copy in the Expedition 3 Book) and part numbers do not match what is in the TEPC procedure. BME also looked at the IMS Database and the part numbers in there did not match what was in the procedure either (there was more info in the database on TEPC stuff than in the on-orbit list). Anyhow, BME and ISO discussed which cables should be installed on the MEC and BME thinks that it should be the power and the power/data cable that are installed on the MEC. ISO would like to know to update it in the database. Please see email in bmeiss account and respond to ISO.

Log Notes stored in SQL Server Database

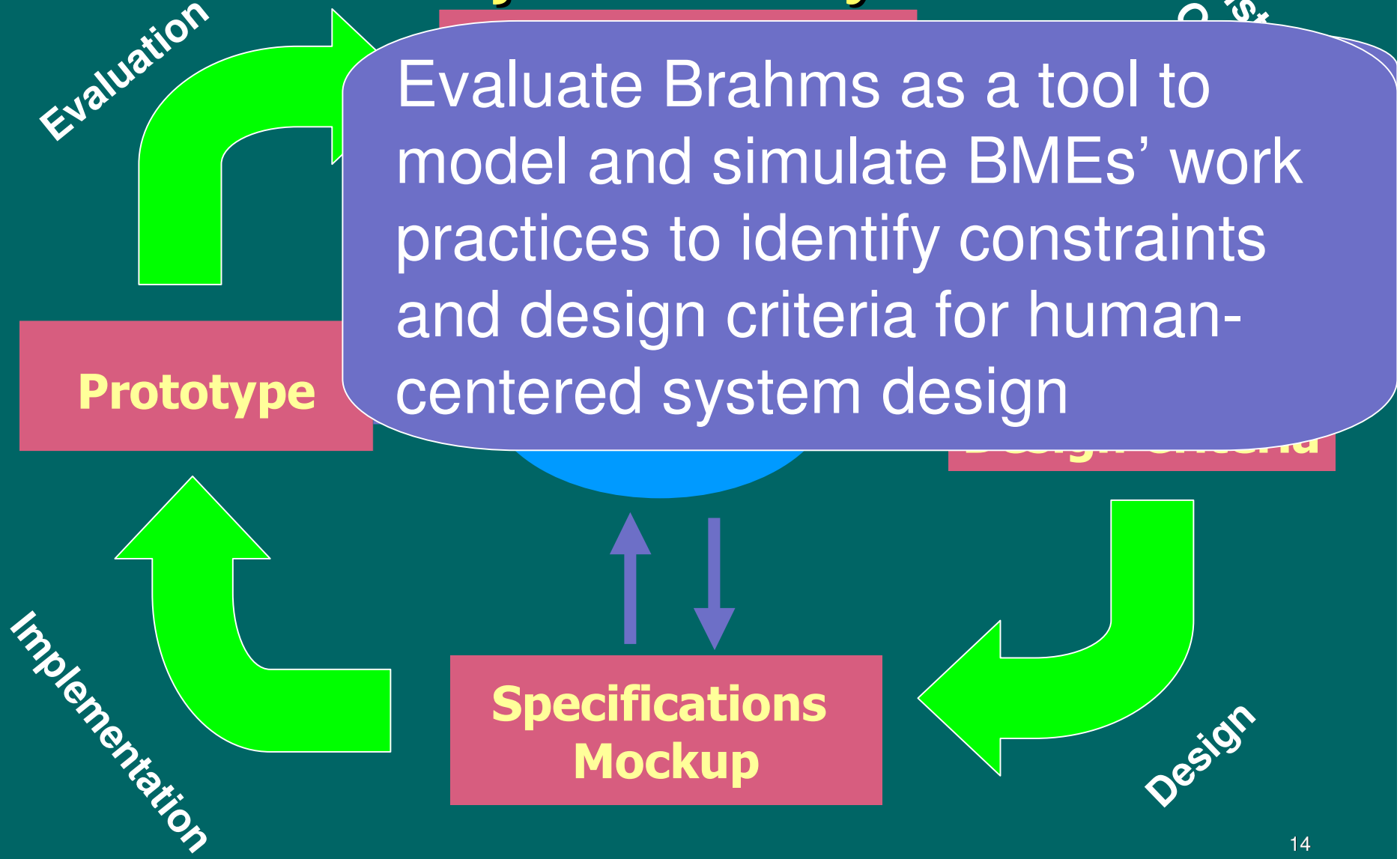
Brahms Modeling

Brahms Project: Objective

- Part of Analysis/Data Collection phase
- Apply Brahms as a model-based approach to
  - understand the complex human-computer social dynamics that exist within the BME domain
  - Identify design constraints
- Investigate potential benefits of Brahms for further analyses in SMART

Brahms

Project Lifecycle



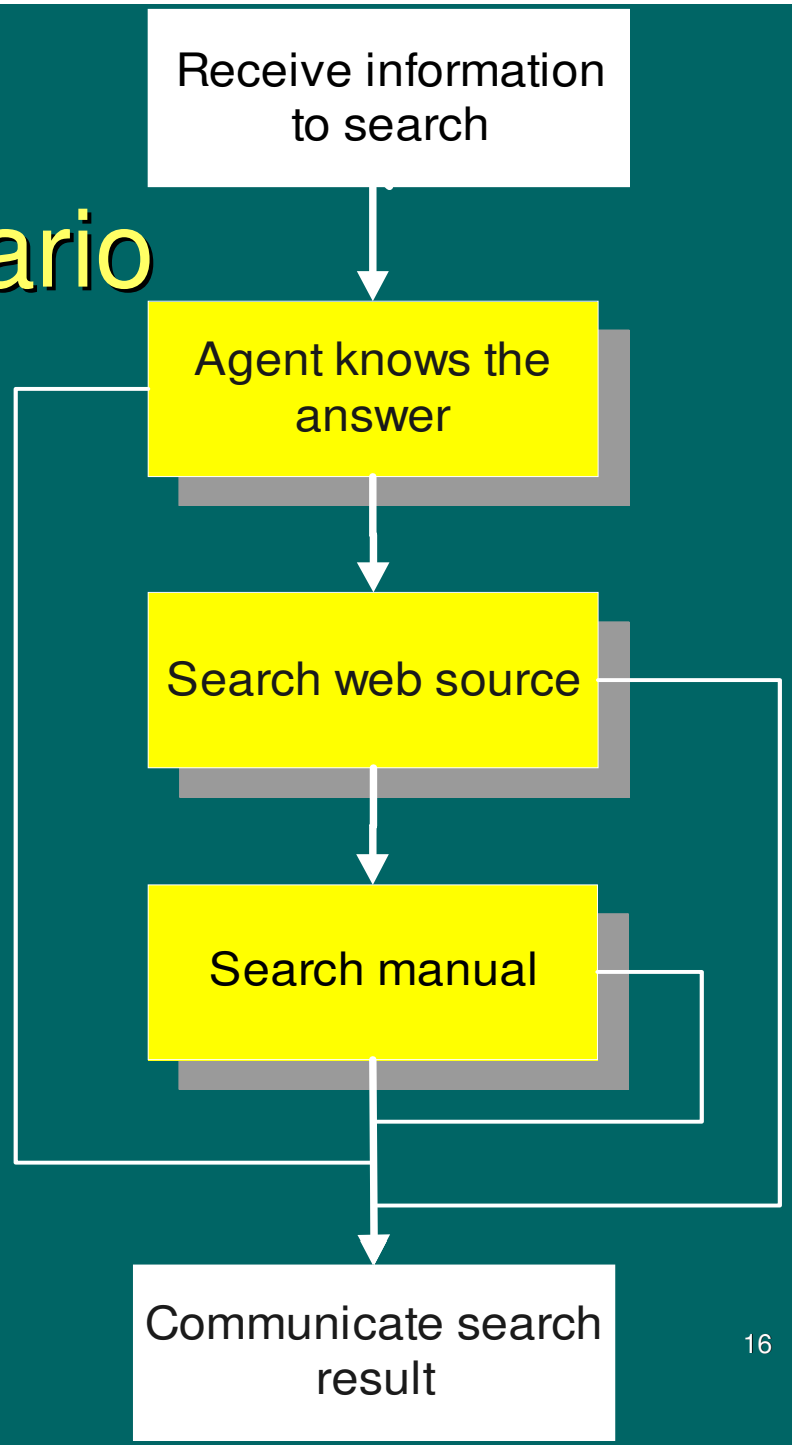
Evaluate Brahms as a tool to model and simulate BMEs' work practices to identify constraints and design criteria for human-centered system design

Brahms Project Methodology

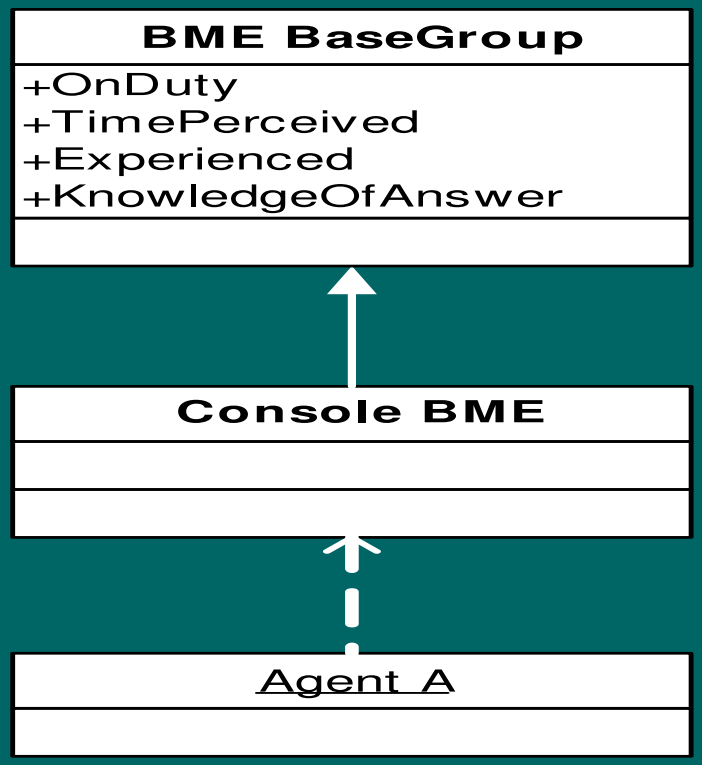
- Work practice operational methodology:
  - Observed and analyzed the work practice of BME utilizing knowledge resources
  - Created formal models of work practice
  - Compiled and simulated the work practice
  - Observed the simulation

Brahms Project: Simulation Scenario

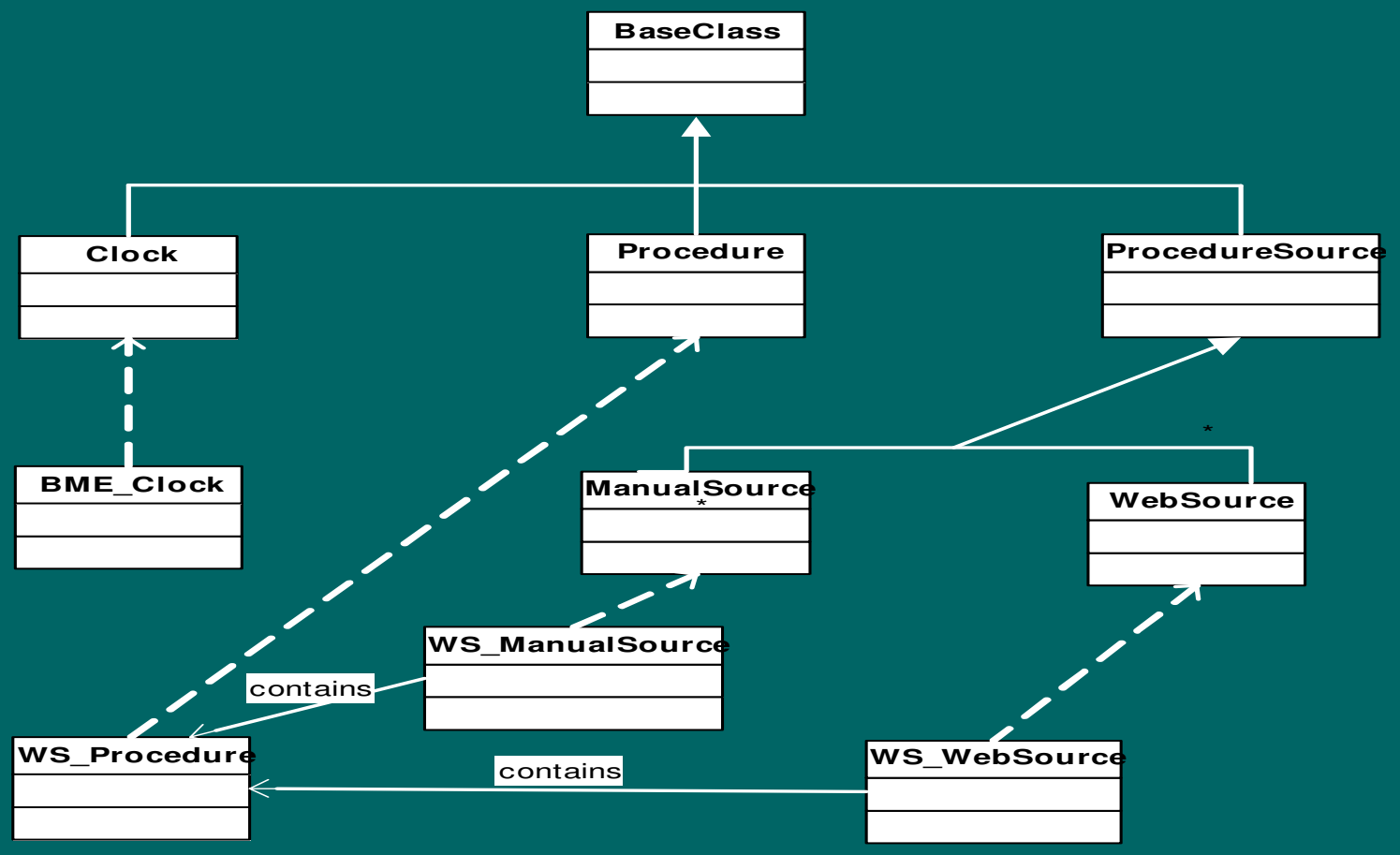
- BME's Issue handling activity
  - BME is asked to find the water sampling procedure.
  - If BME is unable to recall the procedure from memory, then he searches the web for an online document.
  - If BME does not find it online, then BME searches the manual on the bookshelf.



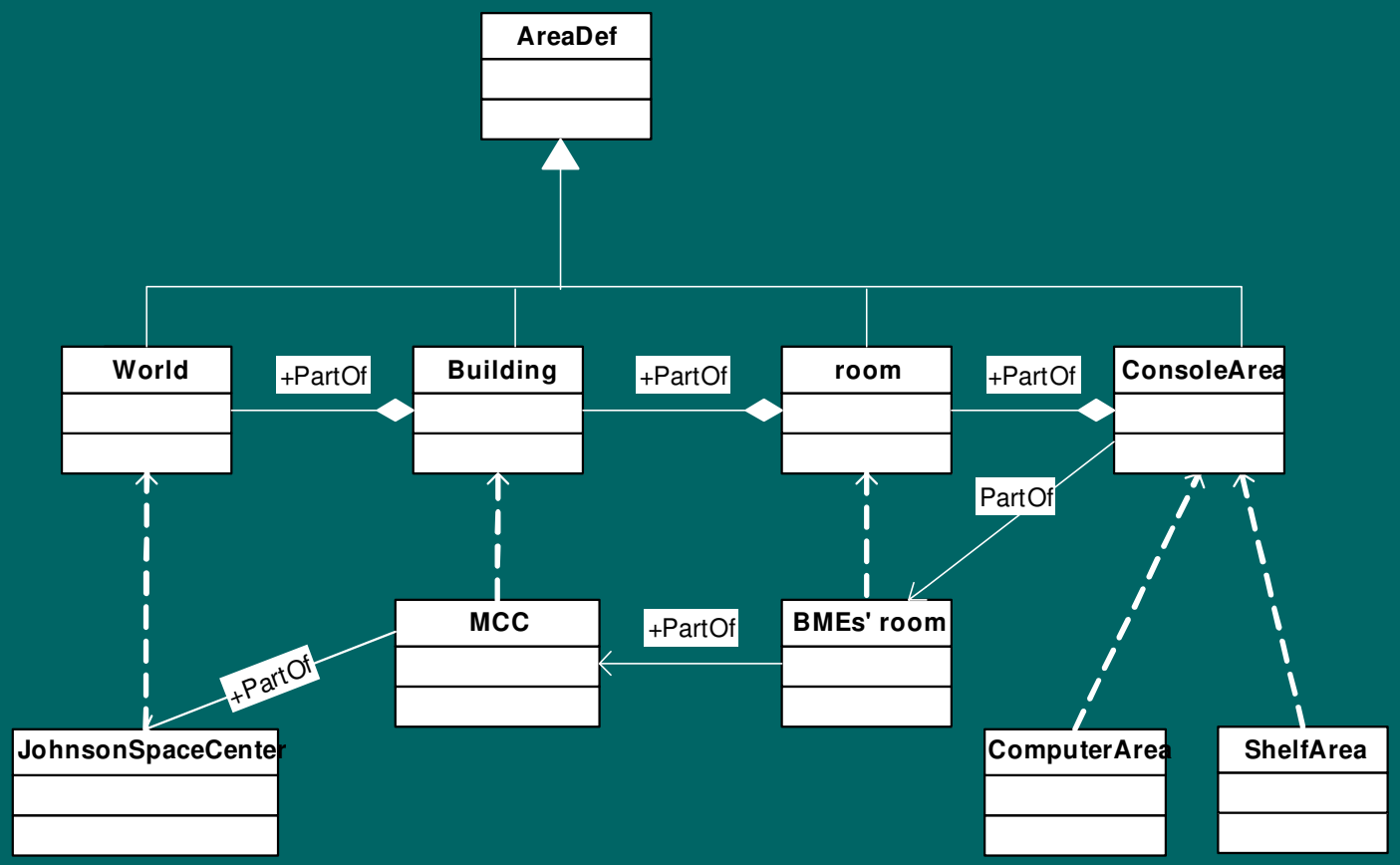
Agent Model Design



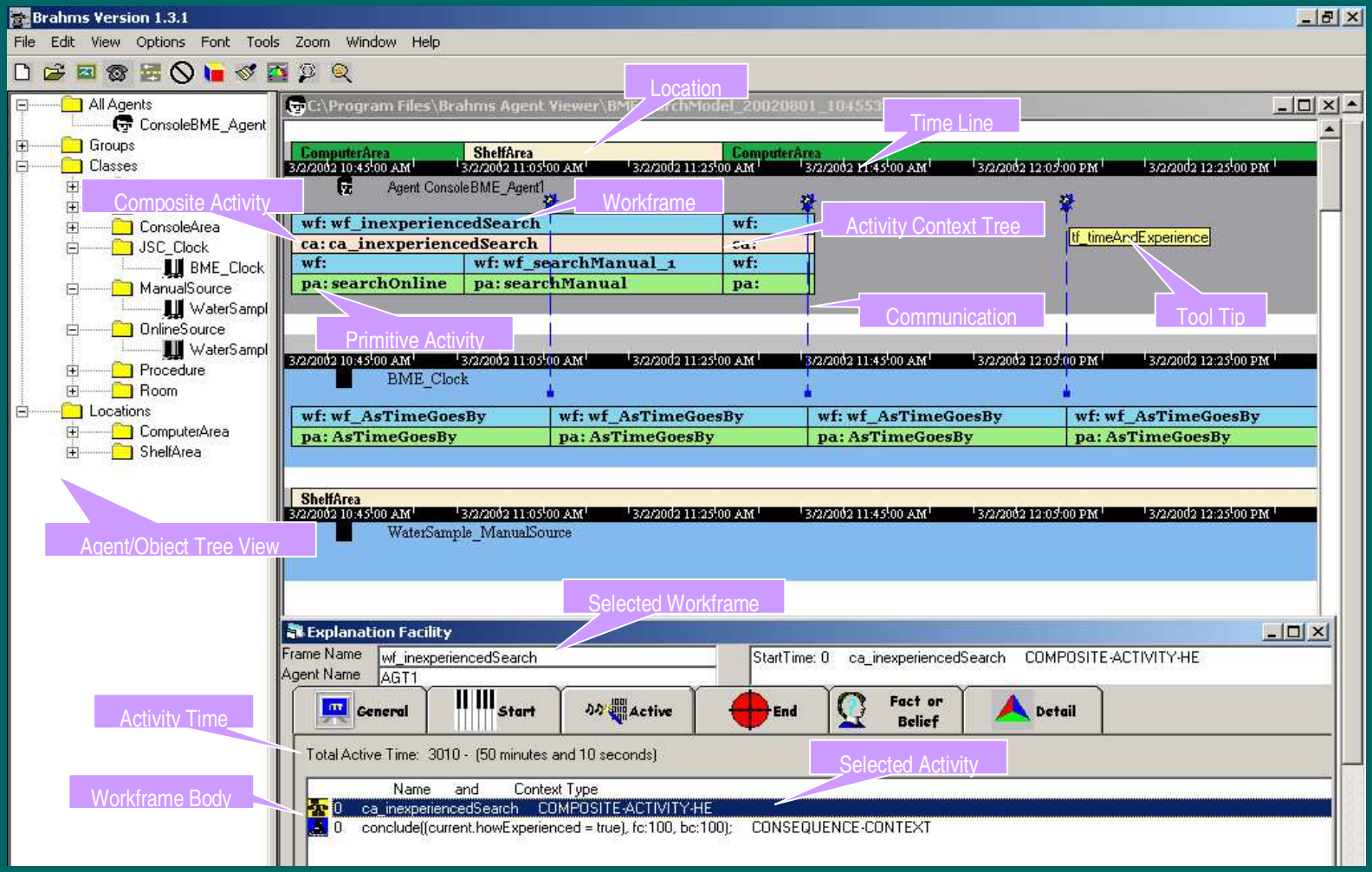
Object Model Design



Geography Model Design



Agent Viewer Screenshot



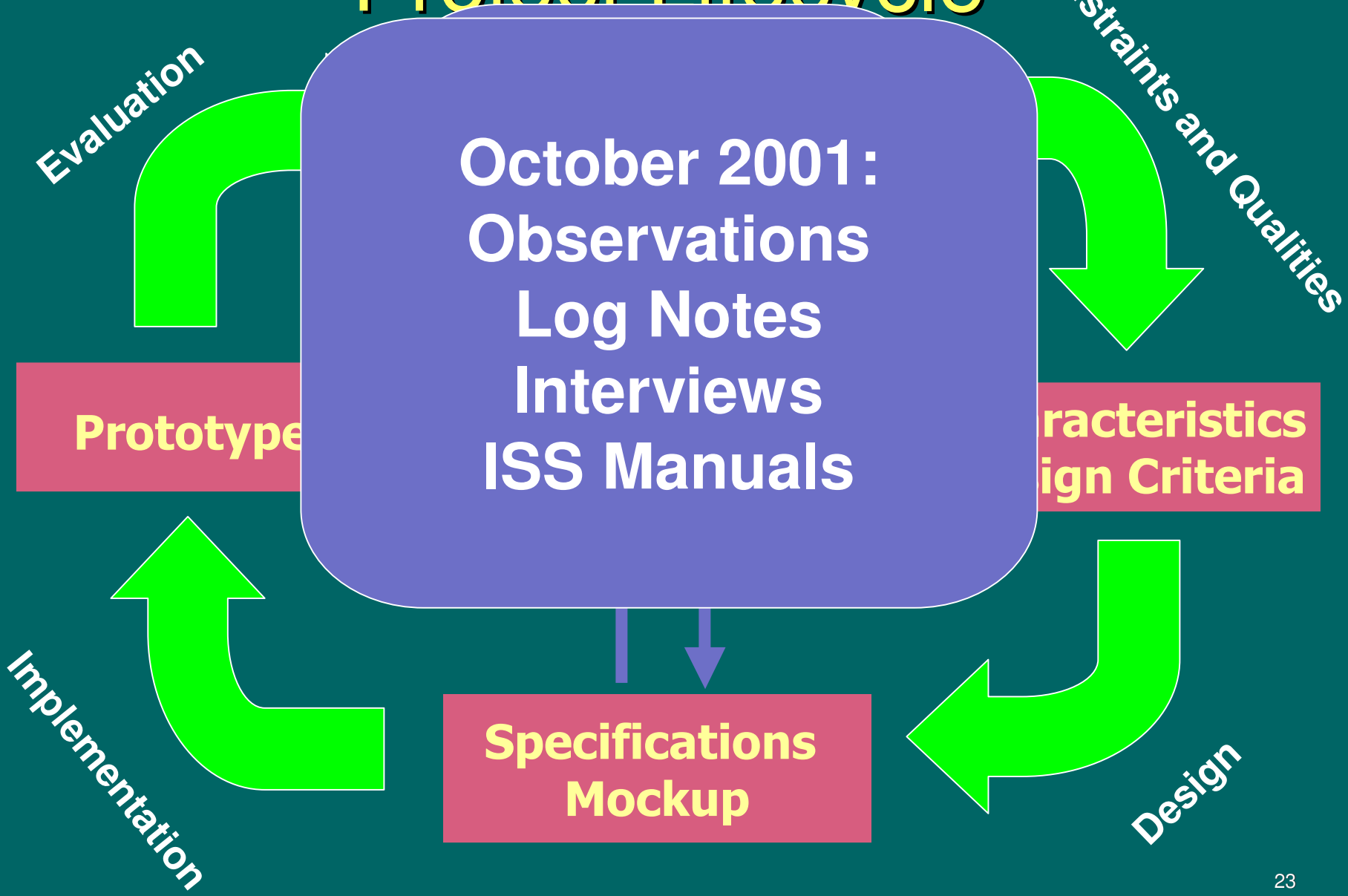
Brahms Project: Summary

- A higher level of analysis may be more applicable for this investigation
- Time/cost benefit analysis revealed modeling is not cost-effective for domains where constraints can be inferred directly and time/resources investment is relatively small
- Brahms will probably be very useful in situations where subtle and complex interactions may be undetected within the system
- Brahms modeling process leads to a deeper understanding of the complex environment

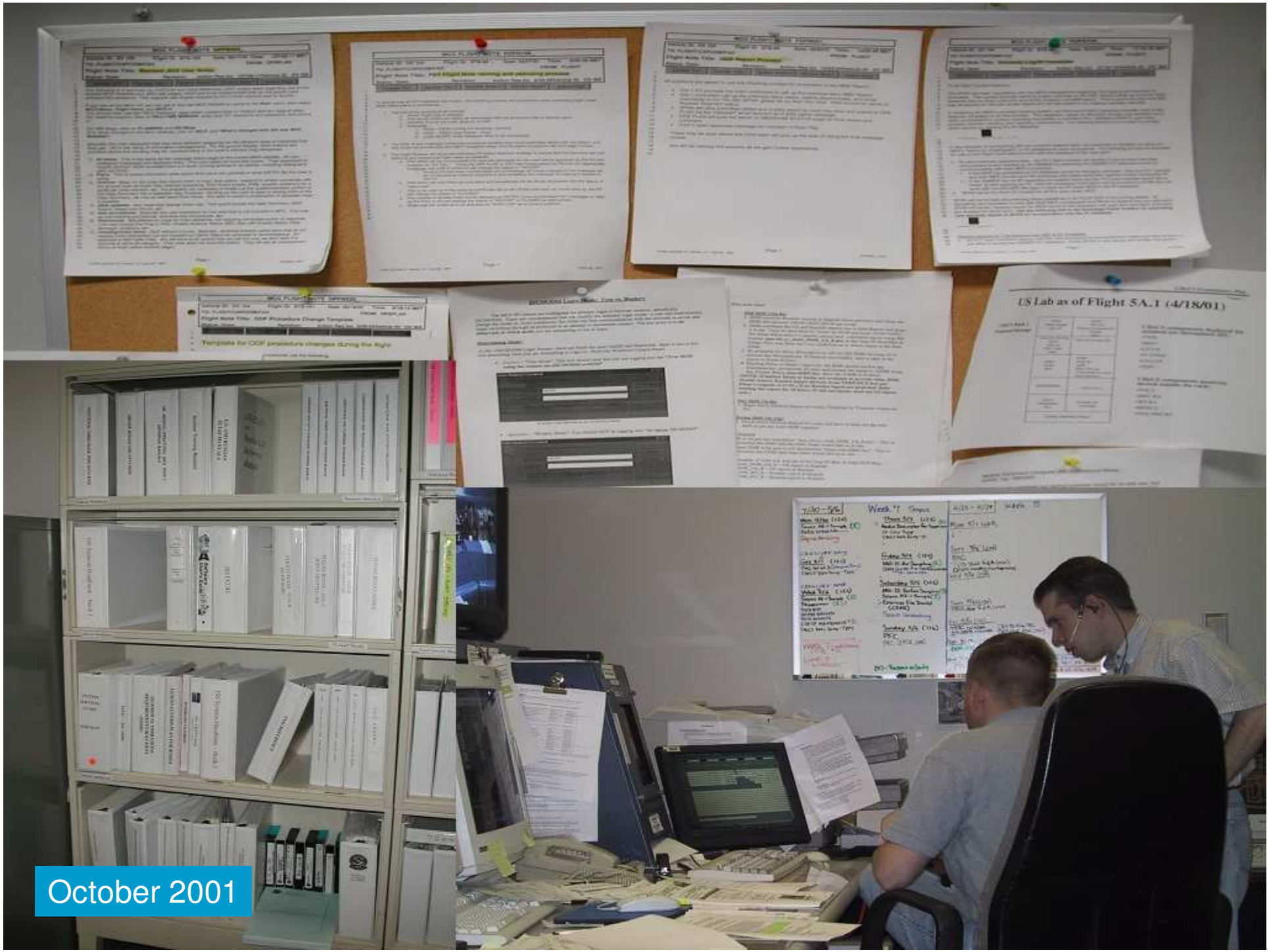
Workit

WorkIT

Project Lifecycle

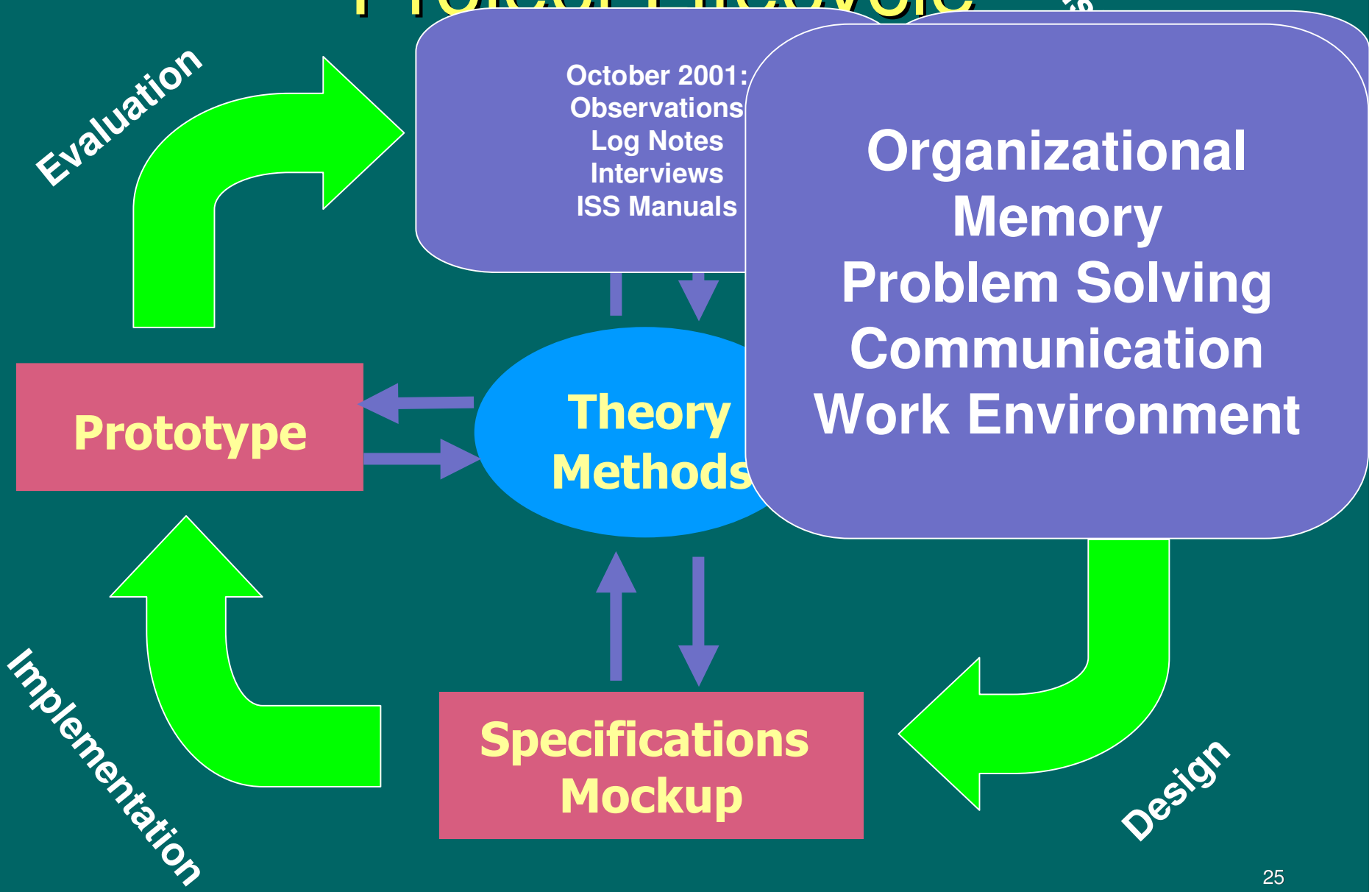


October 2001:
Observations
Log Notes
Interviews
ISS Manuals


US Lab as of Flight 5A.1 (4/18/01)
October 2001

WorkIT

Project Lifecycle



Constraints and Qualities

Organizational Memory

- Informal knowledge not adequately captured
- Formal knowledge not framed within context
- Limited successful searchability of information

Problem Solving

- Requires the interaction and exchange of information across multiple agents distributed across time and space dimensions
- Contingent upon receiving information from multiple sources
- Involves multiple sub-issues nested within a main issue
- Repeated problem solving for routine tasks

Constraints and Qualities

Communication

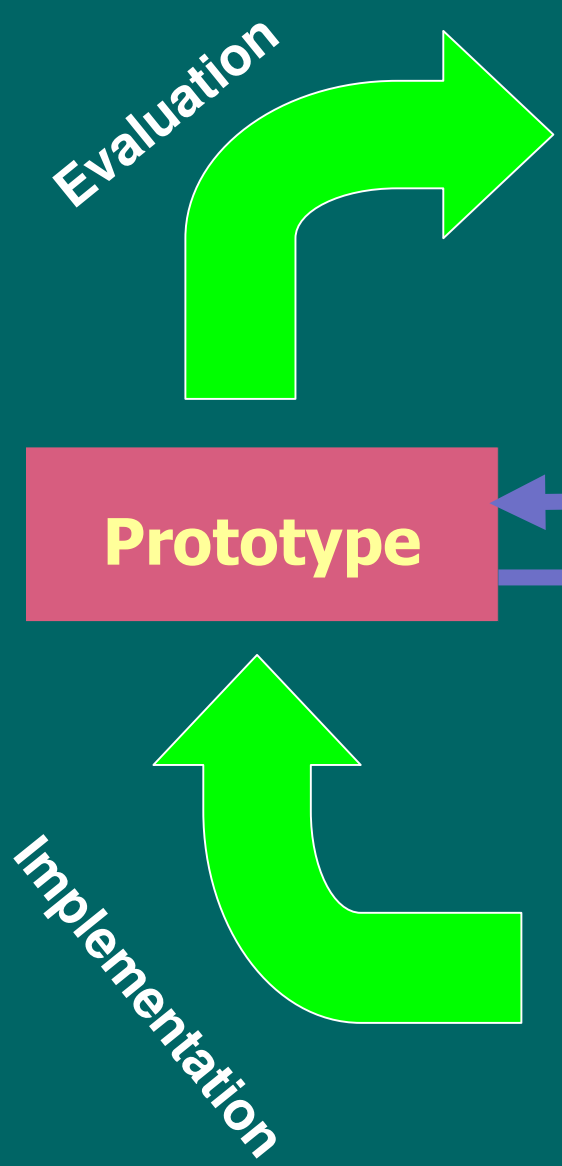
- BME's function as an "information relay station"
- Information is relayed across various mediums
- Minimal information shared across the groups
- Significant number of the group uniformed
- Most frequent communication pattern is one-to-one to a large distributed group

Work Environment

- Numerous interactions requiring a high-level of multi-tasking
- Highly interruption-oriented work environment

WorkIT

Project Lifecycle



Capture informal knowledge
Frame formal knowledge within context
Decrease interruptions
Increase search and retrieval
Increase information sharing
Minimize repeated problem solving for routine tasks
Redirect one-to-one to group communication patterns

TEPC Issues Identified

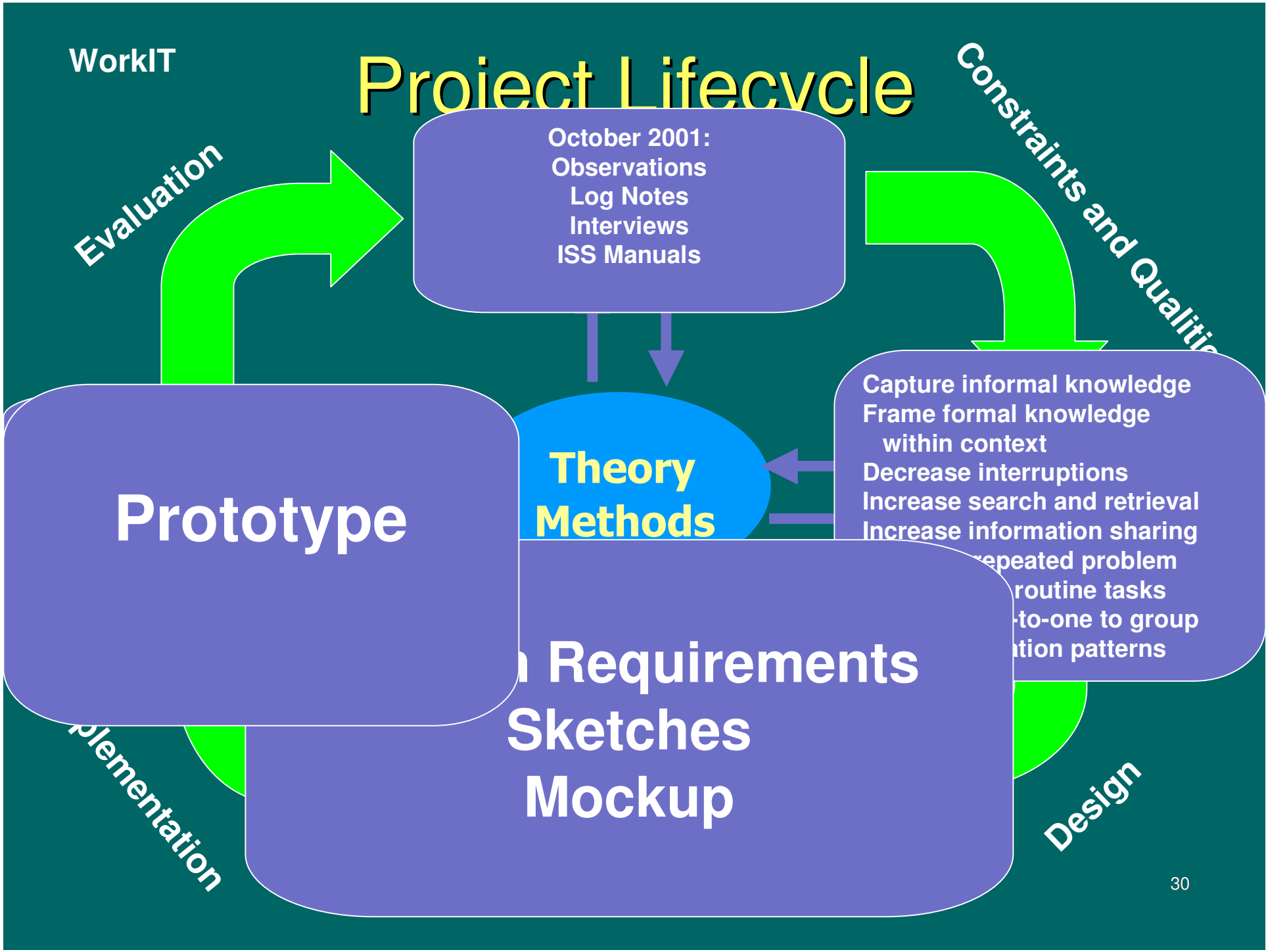
BMEs thought that a similar problem had occurred previously with TEPC but they were uncertain about the nature of the problem, and who, how or if the problem was resolved

Characteristics of Design Criteria

- Capture informal knowledge
- Frame formal knowledge within context
- Increase information sharing across groups
- Minimize repeated problem solving with routine tasks
- Increase search and retrieval capabilities

WorkIT

Project Lifecycle



Initial Prototype

WorkIT - Workspace Contents - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://kria.jsc.nasa.gov/hcaast/test/document_main.cfm?WD=1078&Cat=ALL Go

WorkIT

Home | Workspaces Add | Actions Add | CHITs Add Help | Feedback | Admin | Logout

K. Johnson / SURGEON

Search

TEPC Data Download Unsuccessful / SURGEON

Advanced

Workspace
* Description
* Actions/Items
* Actions
* Items

Add to Workspace
* Action
* File/Link
* CHIT

Filter Items
* ALL
* CHIT
* Plot/Log
* Graphic
* Analyses
* MtgNotes
* FltRule
* Post-Flt

WORKSPACE ACTIONS/ITEMS

Actions

Due Date	ID	Title	Assigned To	Status	Priority
10/25/01	1	BME downlink file stored on MEC		Closed	Medium
01/02/02	2	Engineering assessment of downlinked file		Open	Medium
01/31/02	3	Search UF-1 MEC for missing files		Open	Medium

Global

Discipline	Category	Item Name	Created By	Creation Date	View	Demote
SURGEON		Day 297 timeline	Kathy Johnson	02/07/02	View	

Internal

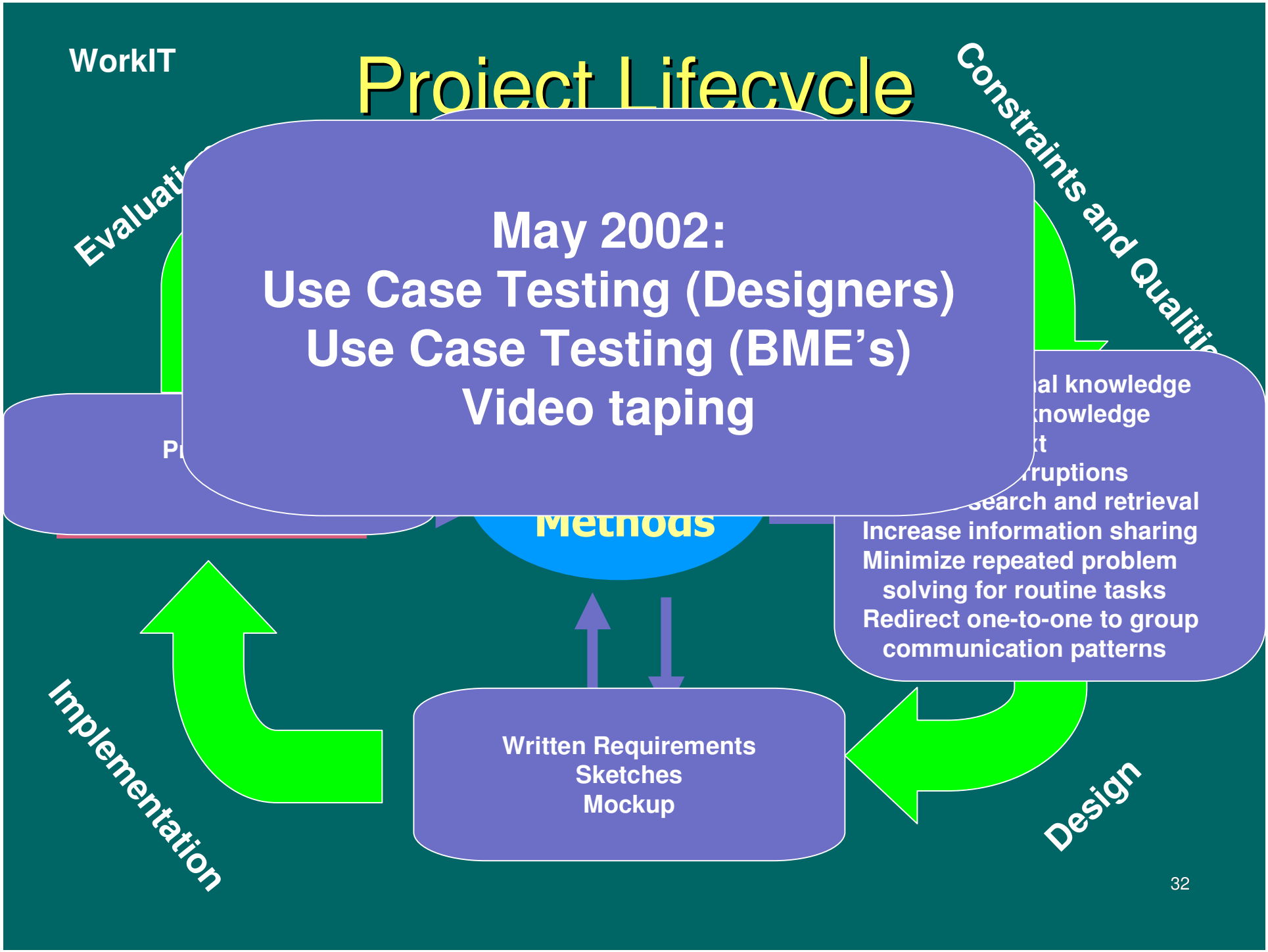
Discipline	Category	Item Name	Created By	Creation Date	View	Promote /Demote
SURGEON	Analyses	TEPC specs	Kathy Johnson	01/24/02	View	
SURGEON		Medical Operations Book	Kathy Johnson	02/07/02	View	

Private

None

WorkIT

Project Lifecycle



First Evaluation

- May 2002
- Use Case testing by design group
- Use Case testing on non-BME's (HCAAST members) – video taped
- Use Case testing on 2 BME's
- Plan
  - Leave the tool with the BME's and have a focus group
- Actual
  - Problems evident, decided not to waste any BME time
- Video tape analysis

WorkIT

Pr

Evaluation

Prototype

Implementation

Capture informal knowledge
Frame formal knowledge within context
Decrease interruptions
Increase search and retrieval
Increase information sharing
Minimize repeated problem solving for routine tasks
Redirect one-to-one to group

Written Requirements
Sketches
Annotated Screen Shots

ed

WorkIT Requirement

Legends on CREATE and MODIFY Workspace Pages

- Place new "+" legend for five fields (and old *Required field legend) on right
- Also place "*Required field" legend on right, similarly, on all Create, Add and Modify pages for actions, workspaces, files and links, and on ADMIN:Add User page
- Title format for + is same as for * (e.g., "Significance: +" on same line in beige area)

Workspace Name: *

Mission ID: N/A

Priority: N/A

Status: Open

Keyword:

Target Resolution Date: *(mm/dd/yy)*

Problem/Issue/Event Description: +

Significance: +

Cause: +

Resolution/ Recommendations: +

Tracking/Post-Closure: +

Workspace ID: * MMACS110

Discipline: * MMACS

POC: * Jane Malin

Date Created: * *(mm/dd/yy)* 06/10/02

Date Last Modified: * *(mm/dd/yy)* 06/10/02

*Required field

+First entry in field is added to Workspace Status Log

Submit Cancel Reset

Revision to WorkIT Rqmt Style

File/Link Search Screen

1. Change pull-down selector to "File/Link"
2. Make the fields match the "View File/Link Screen"

   Remove Mission ID field

Address http://kria.jsc.nasa.gov/hcaast/test/search.cfm?SearchType=2 Go Links

WorkIT

Home | Workspaces Add | Actions Add Help | Feedback | Admin | Logout

K. Johnson / SURGEON

Search

Advanced

ADVANCED SEARCH 1

Start Search Cancel Reset

Search For: File/Link

Item Title:

2

Date Uploaded From: (mm/dd/yy)

POC:

Date Uploaded To: (mm/dd/yy)

Category:

File/Link Description:

Comments Log:

Start Search Cancel Reset

Requirements Communication

- Use Screen Shots/Sketches
- Revision made sure to include URL address (indicating page and parameters)
- Items numbered and linked to locations on the page

- Developer then turned these into his own ToDo list – more emphasis on the implications for the implementation

Developer's ToDo List

6-27-02 Complicated OR To Do List OR Hard Stuff

① Create new filters for all places where Actions are listed
Filter On: All, OPEN/IN WORK, CLOSED, Assigned to Me, POC is me
not just delay to rev 3?

② Create new filters for all pages where Workspaces are listed
ToDo
Filter: ALL, OPEN/IN WORK, CLOSED.

③ Selected filter on above requirements is red and non-clickable
ToDo this will require custom behaviour for Explorer.
same as for other filters?

④ All titles stay blue when selected and lose underlines.
-again this will require custom behavior for the links.

⑤ Add new "Modify Action" column with link to Modify Action page from all Action lists.
ToDo

⑥ Add Sort on "Assigned To" columns of all Action screens
rev 3?

Use of WorkIT for Design

- Track documentation (design requirements, artifacts, etc.)
- Track actions

WorkIT Design Workspace

K. Johnson / TESTGRP Home | TeamWorkCenter | Logger | Help | Feedback | Admin | Logout

All Actions /

Search

All Workspaces / TESTGRP Home / WorkIT Design and Test Workspace (Open) | Advanced Search

WORKSPACE HOME | View Description

Select Action Filter : ALL Open In Work Closed

Actions

Create Action

Due Date	Status	Priority	Title	ID	Assigned To
01/09/02	Closed	Low	Discuss Left Bar for Admin/Feedback	SURGEON1121A	Johnson, Kathy ; Malin, Jane ; Malin, Jane ; Overland, David
	Open	Medium	**Append order on comments**	MMACS1135A	Johnson, Kathy ; Malin, Jane ; Overland, David
10/10/02	Closed	Medium	New entries in Update Status and Tasks	TESTGRP1229A	Johnson, Kathy ; Malin, Jane ; Overland, David
10/10/02	Closed	High	Problem with Logs Scrolling	TESTGRP1234A	WorkITDesign, Maln-Jhnsn-Ovrlnd
10/10/02	Closed	Medium	Back button for view action	ECLSS1236A	WorkITDesign, Maln-Jhnsn-Ovrlnd
10/10/02	Closed	Medium	Delete action returns to all actions page	MMACS1239A	WorkITDesign, Maln-Jhnsn-Ovrlnd
10/10/02	Closed	Medium	Set default action assignee to POC?	TESTGRP1243A	WorkITDesign, Maln-Jhnsn-Ovrlnd
10/10/02	Closed	Medium	When submit modify file/link should go to view	MMACS1244A	WorkITDesign, Maln-Jhnsn-Ovrlnd
	Open	Medium	**Mission ID error**	MMACS1247A	WorkITDesign, Maln-Jhnsn-Ovrlnd
	In Work	Medium	Alphabetical sort of actions should not be case sensitive	TESTGRP1246A	WorkITDesign, Maln-Jhnsn-Ovrlnd
10/10/02	Closed	Medium	Tasks by Due Date header misleading	ECLSS1237A	WorkITDesign, Maln-Jhnsn-Ovrlnd
10/10/02	Closed	High	Links to TWC and Logger	MMACS1238A	WorkITDesign, Maln-Jhnsn-Ovrlnd
	Open	Medium	**Resizing window hides buttons on the right on a few pages**	TESTGRP1258A	WorkITDesign, Maln-Jhnsn-Ovrlnd
	Open	Medium	**Session variable needed to prevent redundant logins**	TESTGRP1260A	WorkITDesign, Maln-Jhnsn-Ovrlnd
	Open	Medium	**Workspace Date Last Modified**	ECLSS1295A	WorkITDesign, Maln-Jhnsn-Ovrlnd

Files/Links Select: ALL Analyses Data MtgNotes Paperwork Procs/Rules Specs/Pics | Add File/Link

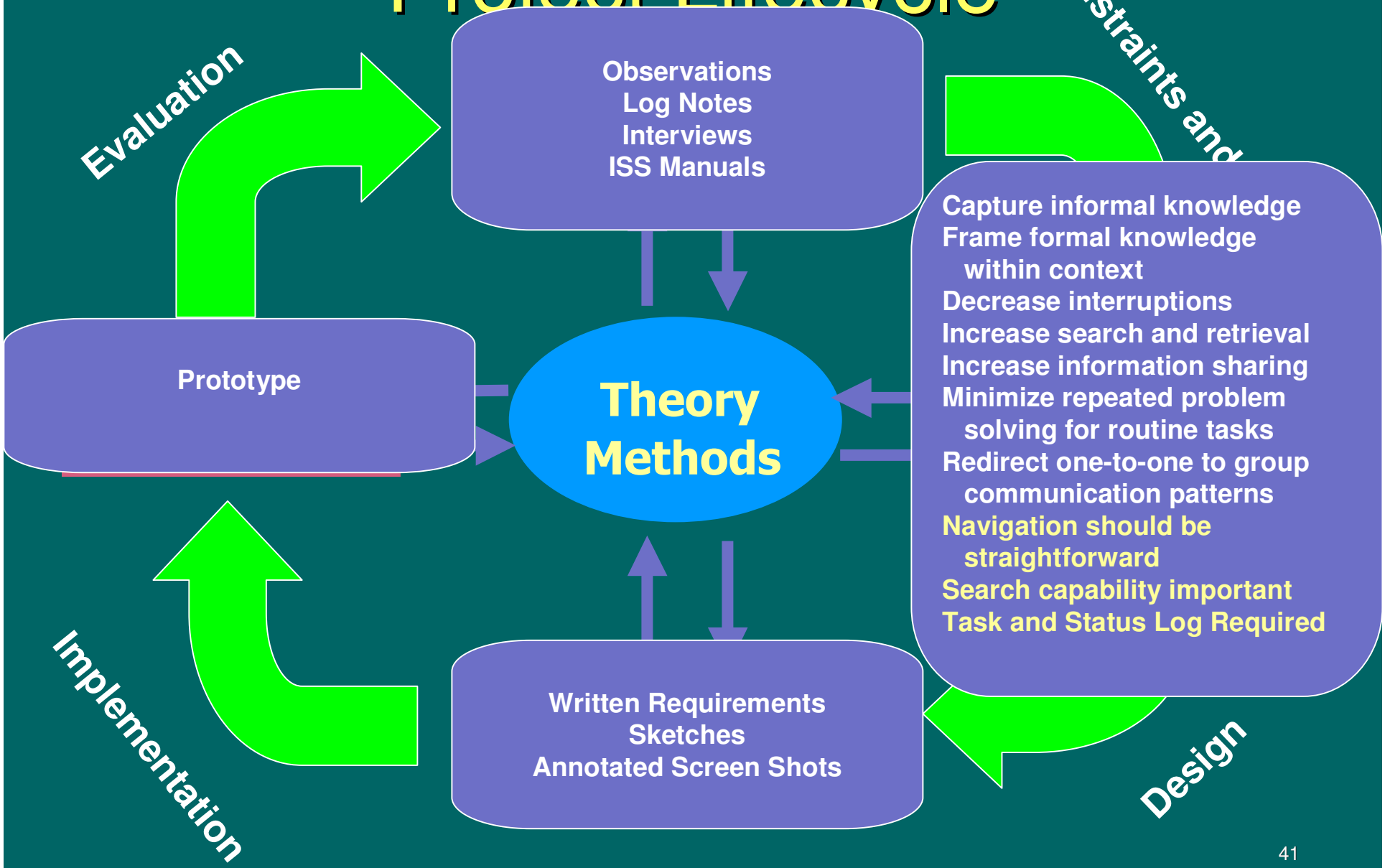
Global Files/Links

Date Created	Category	Demote	View	Title	Discipline	Created By
12/05/01	Analyses		DESCR	Integrated Tools for Mission Operations Teams and Software Agents	TESTGRP	Malin, Jane
08/02/01	Analyses		DESCR	Mission Operations Team Tools: Collect and Share Information and Enable Software Assistants	TESTGRP	Malin, Jane
02/14/02	Analyses		DESCR	Creating a Team Archive during Fast-paced Anomaly Response Activities in Space Missions	TESTGRP	Malin, Jane
10/16/02	MtgNotes		DESCR	Release Notes for WorkIT 2.0	SURGEON	Taylor, Kevin
10/16/02			DESCR	Release Notes for WorkIT 2.1	SURGEON	Taylor, Kevin
04/29/02			DESCR	WorkIT Release 1.0	SURGEON	Taylor, Kevin

http://kria.jsc.nasa.gov/hcaast/test/action_view.cfm?DID=11358&Nav=Dmain | Internet

WorkIT

Project Lifecycle



Second Prototype

WorkIT

K. Johnson / SURGEON Home | TeamWorkCenter | Logger | Help | Feedback | Admin | Logout

All Actions /

Search

All Workspaces / SURGEON Home / TEPC Data Download Unsuccessful (Open)

Advanced Search

WORKSPACE HOME | View Description

Select Action Filter : ALL Open In Work Closed

Actions

Create Action

Due Date	Status	Priority	Title	ID	Assigned To
10/25/01	Closed	High	BME downlink file stored on MEC	SURGEON1316A	*BME, console
01/02/02	Closed	Medium	Engineering assess downlinked file and provide assessment	SURGEON1317A	
01/31/02	Closed	Medium	Engineering search hard disk of returned UF-1 MEC for missing TEPC data files	SURGEON1318A	
02/08/02	Closed	Medium	Engineering files found on MEC	SURGEON1319A	

Files/Links

Select: ALL Analyses Data MtgNotes Paperwork Procs/Rules Specs/Pics

Add File/Link

Global Files/Links

Date Created	Category	Demote	View	Title	Discipline	Created By
02/07/02			DESCR	Day 297 timelineb	SURGEON	Johnson, Kathy
02/07/02			DESCR	Medical Operations Book - see pg 572 for TEPC procedures	SURGEON	Johnson, Kathy
04/30/02	Graphic		DESCR	TEPC specification	SURGEON	Johnson, Kathy

Internal Files/Links

Date Created	Category	Promote /Demote	View	Title	Discipline	Created By
04/18/02			DESCR	IFI-MER-00624 TEPC Data Download Unsuccessful	SURGEON	Johnson, Kathy
04/30/02			DESCR	TEPC data transfer procedure	SURGEON	Johnson, Kathy

Private Files/Links

Date Created	Category	Promote	View	Title	Discipline	Created By
06/17/02			DESCR	tepc procedure	SURGEON	Johnson, Kathy

Status Log

Update Status

10/25/01 On 10/24/01, the crew notified the ground that the TEPC data download to the MEC was interrupted/unsuccessful. The ground will downlink the partial data file to the ground for assessment.

Tasks Log

Update Tasks

[10/25/01 by kjohnson] ; BME downlink file stored on MEC Due: 10/25/01

[10/25/01 by kjohnson] ; Engineering assess downlinked file and provide assessment Due: 01/02/02

[01/04/02 by kjohnson] ; Engineering search hard disk of

Main Changes in Prototype

- Changed navigation
  - No left menu bar
  - Bread crumbs at top
- Search
  - Additional search functionality
- Task and Status Log Addition
  - Identified as key element to enable functionality already available for BME's

Conclusions

- Framework has been successfully applied to the development of products
- With proper tracking of intermediate results, the project lifecycle is able to be simultaneously used in all stages
- Methods for iterative evaluation and design are evolving into very useful tools
- Empirical studies identified problems that were addressed in the design and implementation of tools

Next Steps

- Evaluate WorkIT, Logger, Report Maker, Team Work Center
- Migrate tools to a production environment
- Continue observation and evaluation
- Refine methods
- Refine tools

List of Publications & Presentations

- Publications
  - Zhang, J., Patel, V. L., Johnson, K. A., Malin, J., & Smith, J. W. (2002). Designing human-centered distributed information systems. *IEEE Intelligent Systems, 17* (5), 42-47.
  - Zhang, J., Johnson, K. A., Malin, J., & Smith, J. W. (2002). Human-centered information visualization. *Proceedings of International Workshop on Dynamic Visualization and Learning*.
  - Malin, Jane T., Johnson, K., Molin, A. and Schreckenghost, D. 2002. Integrated tools for mission operations teams and software agents. In *Proceedings of the 2002 IEEE Aerospace Conference* (CD). IEEE Aerospace Conferences, Manhattan Beach CA.
- Unpublished Papers
  - Rinkus, S., & Gong, Y. (2002). *Visual Representation of the Numeric Bioenvironmental Data Display of the International Space Station's Flight Surgeon Console*. Unpublished Report.
  - Gong, Y.,Rukab J.,Zhang, T. (2002). *Design and Development of a Search Interface for an Information Gathering Tool*. Unpublished Report.
  - Gong, Y.,Rukab J.,Zhang, T. (2002). *Ethnographic and computational study of a distributed information system*. Unpublished Report.

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  - Rinkus, S., & Gong, Y. (2002). *Visual Representation of the Numeric Bioenvironmental Data Display of the International Space Station's Flight Surgeon Console*. AMIA 2002.
  - Johnson, K, Zhang, J., Smith, J., Rinkus, S., Rukab, J., Gong, Y., & Zhang, T. (2002) *Human-centered design and evaluation methods for software*. UT-Houston Research Day 2002.
  - Johnson, K., Zhang, J., Smith, J. (2001) *Design of the Flight Surgeon Console at NASA Johnson Space Center*. UT-Houston Research Day 2001.
  - Rukab, J., Zhang, K., Gong, Y. (2002). *Ethnographic and Computational Study of a Distributed Information System.* UTH Research Day.
  - Zhang, K., Rukab, J., & Gong, Y, (2002). *Design and Development of a Search Interface for an Information Gathering Tool.* UTH Research Day.
  - Rinkus, S., Johnson, K. A., & Zhang, J. (2002). *Application of a Human-Centered Distributed Information Design Methodology In the Design of a Collaborative Workspace*. UTH Research Day.
  - Zhang, J. (2002). *Human-centered intelligent flight surgeon console*. Columbia University.