Identifying Needs &
Establishing Requirements

Chapter 7

Overview of Slides

- Requirements
- Data Gathering
- Data interpretation and analysis
- Ethnography
  - Video Tape (Analyze workplace before introducing new technology)
  - Online Collaboration
    - Transcript, Replay, Analysis

- "Statement about an intended product that specifies what is should do or how it should perform." p204
- Example using Volere template (p. 205)

Requirement #: 75	*Requirement type: 9*	*Event/use case #:6*

*Description: **The product shall issue an alert if a weather station fails to transmit readings.***

*Rationale: **Failure to transmit readings might indicate that the weather station is faulty and needs maintenance, and that the data used to predict freezing roads may be incomplete.***

*Source: **Road Engineers***
*Fit Criterion: **For each weather station the product shall communicate to the user when the recorded number of each type of reading per hour is not within the manufacturer's spcified range of the expected number of readings per hour.***

*Customer Satisfaction: **3***   *Customer Dissatisfaction: **5***
*Dependencies: **None***   *Conflicts: **None***
*Supporting Materials: **Specification of Rosa Weather station***
*History: **Raised by GBS, 28 July 99***

Kinds of Requirements

- Functional
  - What the product should do
- Data
  - Type, volatility, size/amount, persistence, accuracy and value of amounts of data
- Environmental
  - *Physical* (e.g.,need protective clothing?)
  - *Social* (e.g., does data need to be shared?)
  - *Organizational* (e.g, good user support available?)
- User Requirements
  - e.g., Expert? Novice?
- Usability
  - e.g., effectiveness, efficiency, safety, utility, …

- System for use in a university's self-service cafeteria that allows users to pay for their food using a credit system

Functional: The system will calculate the total cost of purchases.

Data: Access to the price of products in cafeteria.

Environmental: Cafeteria users will be carrying a tray and will most likely be in a reasonable rush. Physical environment will be noisy and busy, and users mayb e talking with friends and colleagues while using system

User: Majority of users likely to be under 25 and comfortable with technology.

Usability: Easy, memorable, efficient, and deal easily with user errors

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- Control functioning of nuclear power plant

Functional: Monitor temperature of the reactors.

Data: Need access to temperature readings.

Environmental: Physical environment uncluttered. Protective clothing?

User: Well-trained engineer or scientist who is competent to handle technology

Usability: Outputs from the system, especially warning signals and guages, must be clear and unambiguous.

Requirements

- System to support distributed design team, e.g., for car design.

> ***Functional:*** Communicate info between remote sites
>
> ***Data:*** Must have access to design info that will be captured in a common file format (such as AutoCAD)
>
> ***Environmental:*** Physically distributed over a wide area. Files and other electronic media need to be shared. System must comply with available communication protocols and be compatible with network technologies.
>
> ***User:*** Profession designers, who are likely to spend time learning to use the system. Design team may be multi-lingual.
>
> ***Usability:*** High priority to keep error rate low.

Data-Gathering

- Questionnaires
- Interviews
- Focus groups and workshops
- Naturalistic observation
- Studying documentation

Basic guidelines for data-gathering

- Involve all the stakeholder groups
- Involve more than one representative of each stakeholder group
- Use combination of data gathering techniques
- Support the data-gathering sessions with suitable props, such as task descriptions and prototypes (if available)
- Run a pilot session if possible to ensure that your data-gathering session is likely to go as planned.
- Design data-capture exercise to collect the data you want
- How the data is recorded is very important.

Data Gathering: Ethnography

- Video Tape Technology
  – Analyze workplace before introducing new technology
- Online Collaboration
  – Transcript, Replay, Analysis
  – VesselWorld as an example

Ethnography

- Relation between developing a descriptive understanding of human behavior and design artifacts that ostensible support the activities described.
- Ethnography emphasizes "natives' point-of-view", holism, and natural setting
  – Period of field work where ethnographer becomes immersed in activities of people studied
    • Either: Fly-on-the-wall or full participant
  – Involves observation, informal interviewing, and participation in the ongoing events of community
  – Through extensive contact develop descriptive understanding of observed behaviors
    • Includes interpretation of meaning of activities

Principles of Ethnography

- *Natural setting*
  – Study behavior in natural settings (field work)
- *Holism*
  – Behavior can only be understand in larger social context
- *Descriptive*
  – How people behavior not how they ought to behave
- *Members point of view*
  – Study behavior from point of view of those studied

Data-gathering: Ethnography and video tape

Understanding Practice: Video as a Medium for Reflection and Design

Lucy A. Suchman and Randall H. Trigg
Design at Work: Cooperative Design of Computer Systems,
LEA 1991

Work as Situated Activity

- Work in particular times, in particular places, and in relation to specific social and technological circumstances
  - From this perspective, the organization of work is a complex, ongoing interaction of people with each other and with technologies that are available to them.
- Development of artifacts and work practices go hand-in-hand

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Design and Use

- Where technologies are designed at a distance from the situation of their use, as most are, there is an inevitable gap between scenarios of use and users' actual circumstances
- What we see consistently is that the closeness of designers to those who use an artifact (including the possibility that designer and user are one and the same) directly determines the artifact's appropriateness to its situation of use.

Ethnographic and Interaction Analysis
(p. 210)

- Ethnography involves the careful study of activities and relations between them in a complex social setting.
- Interaction analysis is concerned with detailed investigations of interaction of people with each other and with the material environment
- Identify routine practices, problems, and possibilities for development within a gi9ven activity or setting.
  - Ideal is naturally occuring occasions of work activity
- Video-based interaction analysis affords a powerful corrective to our tendency to see in a scene what we expect to see (p. 212)

What to record

- Setting-oriented record
- Person-oriented record
- Object-oriented record
- Task-oriented record

How they work

- Content log of entire video tape
- Identify issues
- Transcribing of talk of interesting segments of tape
- Collections: instances of interaction that one wants to see as a class
- Who participates (multiple perspectives): designers, people who know about interaction analysis, people who know intricacies of practice in a given domain (domain expert)

Airline Operations Room

- Complexes: periods lasting approximately an hour, when all of the gates belonging to the airline fill with incoming plans, transfers are made between the gates, and then all of the planes depart. (8 per day)
- Info needed to coordinate this work is on a paper document called "complex sheet"
- Example of breakdown
  – Complex sheet not designed to show the movement of aircraft (from one gate to another)
  – Complex sheet only covers one complex at a time

Design of artifact for task environment: Complex Sheet
(Suchman and Trigg, 1991)
(Goodwin & Goodwin, 1996)

- Reproducible representation
- A template
- A medium
- An enduring record
- Stands in for situations out on the ramp
- Shared object for communication between people during the course of their complex activities
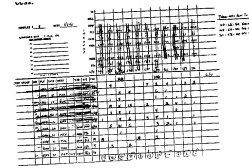
Coordinating Representation

Breakdown revisited (p. 209)

- Have to make changes to complex sheet after it has been copied and distributred to ramp and gate crews.
  – Difficult to do, so wait to last minute before distributing complex sheet
- The complex sheet must be changed to represent a state of affairs unanticipated in its orginal design.

Ethnography

Ethnographic Analysis of Online Collaboration

- Motivation
- Transcript & Replay
- Analysis
- Re-Design
- VesselWorld Project
  – Groupware Toolkit (Landsman)
  – Analysis Techniques and Tools (Feinman)
  – Adaptive Component (Introne)

Computer-Mediated Cooperation

- Groupware system supports groups of people engaged in a common task (or goal)
  – Provide an interface to shared environments
  – Facilitate communication, coordination, and collaboration of group effort
- Groupware provides *representational system*

Representational System

1. A set of representational media available to the participants.
2. A set of internal or external, private or shared, representations
3. A set of procedures for communicating, recording, modifying, transcribing, and aligning multiple, partial representations of the shared context.

Classroom
2. Chalkboard, books, student notebooks, laptops,
3. What is on the chalkboard versus what is in the notebook
4. Students take notes; power point slides are posted on class website

Why Re-Design Representational System?

- System is not a fixed point
  - Usage changes over time
  - Other technology is changing
    - So want to integrate palm pilot with some other application you use
- Need info on how system is used from users
  - Debug reports; user feedback; experimenter feedback; whining and complaining
    - Incomplete, inaccurate
- Suppose you could replay how the system is used
  - Greater fidelity
  - Feel for big picture

Basic Methodology

- Online practice is grounded in the representational system provided by a groupware system.
- Transcripts are collected of online user behavior.
- Identify weak spots in the representational system
- Re-design representational system
  - Introduce new coordinating representations.
  - Leverage coordinating representations to add adaptive components.

Ethnographic Analysis of VesselWorld Use

- Need to collect transcripts of online behavior
- Need to be able to replay transcripts

Complete Transcripts

- Representational system frames how the users think and act within the domain.
- Domain actions are composed of one or more user interface actions
  - In VesselWorld, making a plan is a *domain action*
  - The pointing, clicking, and typing you do to make the plan are *user interface actions*
- Complete Transcripts
  - Captures both doman actions and user interface action
  - Contains info sufficient to recreate the state of thee application at each point in time

Playback Application

- Basic functionalities (Think of VCR)
  1. Replay the transcript.
  2. Stop the play of the transcript.
  3. Vary speed at which the transcript is replayed.
  4. Rewind the play of the transcript.
  5. Annotate the transcript
  6. Produce aggregate information like a count of the number of domain and or user/interface actions of a given type
- Additional desirable capabilities
  - Automatically stop replay when certain kinds of domain actions are occurring
  - Return to a specific point in time in the transcript

Replay
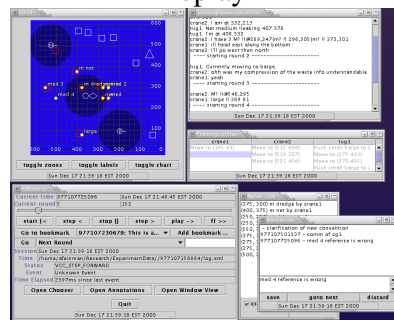
Analysis of Transcript

- User Interface Actions
  - Analyze representational work
- Domain action
  - Analyze the talk of the users
    1. Recurrent Activities
    2. Referential Structure

Representational Work

- Access and storage characteristics of representation
- Transcription
  - Process by which representation in one medium is transferred to another
- Alignment
  - Two different representations are brought into alignment
- Articulation
  - Cost of communicating to another actor (at the level of keystroke)

Representational Work

Rules	Representational Work
If waste discovered then report it via chat channel	Transcription from WorldView to Chat for one participant.
If waste reported then place marker on map to record info (size & location) and confirm info was received.	Transcription to markers for two other participants.
If tug reports equipment for waste then record info on marker.	Transcription to markers for both cranes.
If removing a small waste, report plan in textual chat.	Transcription from plan window to chat for one crane.
Create plans for lifting large wastes in textual chat.	Transcription of plans for both cranes to and from Chat to plan window.
If preparing to lift waste then check properties of waste.	Access waste properties.
To check the properties of a waste, either recall from memory or check markers.	Access waste properties.

Analysis of Talk

1. Recurrent activities
2. Cognitive load

Analysis of Recurrent activities by analyzing their talk

- Talk & Action
  - Cooperating actors require communication to stay coordinated
- Talk more for cooperative actions that are hard to do
- Recurrent activities produce recurrent conversations
  - Also structure

Maintain Consistent Representation of Shared Domain Objects

- Report
- Confirm
- Review
- Repair

- Waste at 554,41 is small, dredge
- New XL! At 200 431
- I guess I'll sweep the bottom, west to east
- [all] remove marker at 100,425
- 8 clicks for me to hit BB
- I'll grab sX at 500 275
- The first on the barge is sX
- w8ting
- killed sX at 500,275
- I still and 2 or 3 moves till I get there
- I'm waiting at SW corner
- I have a leaker on my hands

Review

1. Crane1: center is clean – nothing in the center 4 quads
2. Crane2: ok, we forgot the west, I didn't get down that far
3. Tug1: 600-400 square is clean, I don't have to worry about tit?
4. Crane2: correct, that's where I started
5. Crane2 about 100 N of sb
6. Tug1: okay cool, grabbing the sb

Repair

1. TUG1: mX at 400 125
2. CRANE1: medium at 392 127
3. CRANE1: that's got to be the same one
4. TUG1: yep
5. TUG1: that's an mX
6. CRANE2: so you guys are in S?
7. TUG1: yes
8. …
9. CRANE1: I'm going to trash the mX on the BB

Structures Produced to Organize Talk

- Notational conventions
- Marker Check procedure
- Adjacency pairs for close coordination

- Size of waste
  - xl (extra large), l (large), m (medium), s(small)
- Equipment
  - X (no equipment), D (dredge), N (net)
- The location is indicated by a x and y coordinates 400 125.
- Examples
  - "mX at 400 125"
  - "mN at 150 200"
  - "xl D at 200 425"

Marker Check

1. Crane1: [ALL] ok I will dump all the markers ok with every1?
…
2. Crane1: Legend: [Sm|L|XL] – [Ni [no id'd] Net | Dr]
3. Crane1: from south east clockwise
4. Crane1: [Sm-Ni 50,0][Sm-Net 150,25][Sm-Ni 350,150][Sm-Ni 550,50] [Sm-Ni 600,100] That's all south of equator. NORTH coming up.
5. Tug1: 97441 and 72,368 already ID'd
6. Crane2: 350,150 is barge, isn't it?
7. Crane2: that's the problem
8. Crane2: stop dump I was there to… that's the Sbarge at 350,150
9. Crane2: confirm with TUG
10. Crane1: [xL-Ni 475,425][Sm-Ni 450,450][Sm-Ni 525,500][Sm-Ni 250,500][XL-Ni 200,475] [Sm-Net 100,425][Xi-net 75,375][Sm-Ni 25,575]
11. Crane1:
12. Crane1:
13. Crane1: -- END – Tug, confirm you have all those

14. Tug1: large barge at 400,325
15. Crane2: repeat: I say the sbarge ar 350,150, not a small waste
16. Crane2: [TUG] where are the small barges?
17. Crane1: [c2] – you sure? If you saw that, ok ill cancel as waste
18. Crane1: of yeah tug can tell us
19. Tug1: 350,150 is small barge
20. Crane2: ok, 12 wastes and no problems, let's get back to work
21. Crane1: okdoke. Still sweeping west

Adjacency pairs for close coordination

1. Crane1: sub lift
2. Crane2: LL
3. Crane2: k
4. Crane2: sub load
5. Tug1: the next XL needs nothing
6. Crane1: k
7. Crane2: ok, then XLD right?
8. Crane2: sub Lift
9. Tug1: yep
10. Crane1: k
11. Crane2: sub load
12. Crane1: k
13. Crane2: sub sep
14. Crane1: sep

Analysis of Cognitive Load by analyzing their talk

- Track referential structure;
  - Measure how long a particular topic is relevant
    - Difficult to access from chat
    - Maybe provide alternate representation
  - Measure how frequently the users talk about a particular topic
    - Maybe need better organization of information relevant to that topic

Re-Design Representational System

Coordinating Representation

At Airport
- itinerary
- monitors
- boarding pass
- drivers license
- Signs for airlines
- Clock
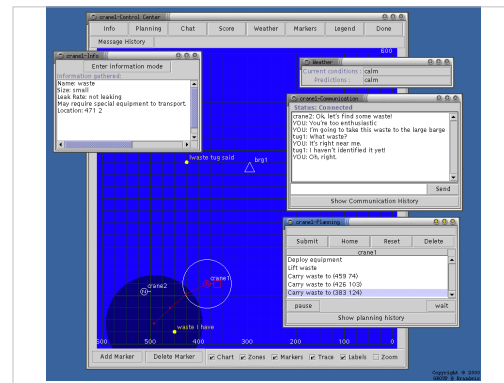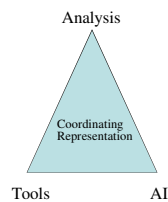
Coordinating Representation

- Ubiquitous in everyday world
  - Stop sign; scene at airport
- Representation specifically designed to fix recurrent problem of coordination
  - Functions to simplify co-referencing, timing of joint actions, exchange of information …

Three Coordinating Representations

- Establishing references for, and exchanging information about, shared domain objects and their status
- Timing of closely coupled cooperative activities
- High-Level Planning

Object List

Timing of closely coupled cooperative activities

High-Level Planning

Evaluation

- Compare groups with/without Coordinating Representations
- Training + 10 hours of problem-solving
- 3 groups without & 3 groups with CR's

  ° 49% improvement in clock time
  ° 38% reduction in the number of events generated
  ° 57% reduction in the amount of electronic chatting
  ° 61% reduction in total errors

- The high-level planning CR was not used

Why wasn't high-level planning CR used?   Cognitive Load

Iota Type	% seen	Refs	Lifespan	Density
Plan	57%	3.4	12.0	28.5%
Waste	17%	6.6	168.7	3.9%
Repair	8%	3.0	4.8	62.5%
Location	8%	2.6	62.6	4.2%
Barge	4%	11.9	294.0	4.0%
Vessel	4%	3.1	183.6	1.7%
Convention	2%	5.5	109.5	5.0%

- Plan iotas have short lifespan, high density
- Waste iotas have long lifespan, low density
- Locations have moderate lifespan, low density
- Repairs have very short lifespan, very high density

Technology

- Deploy initial system.
- Collect transcript of usage of system over time.
- Replay and analyze transcript.
- Introduce CR's.
- Add adaptive components for sharing information.

- THYME
  – Seth Landsman
- SAGE+
  – Seth Landsman
- Analysis methods, tools, and visualization
  – Alex Feinman
- Leverage CR's for intent recognition.adaptive component
  – Josh Introne