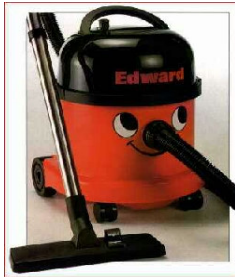# Task Analysis

---

# Task Analysis

Methods to analyze people's jobs:

- what people do
- what things they work with
- what they must know

---

# Example

---

# Task analysis

**Hierarchy description ...**

0. in order to clean the house
   1. get the vacuum cleaner out
   2. get the appropriate attachment
   3. clean the rooms
      3.1. clean the hall
      3.2. clean the living rooms
      3.3. clean the bedrooms
   4. empty the dust bag
   5. put vacuum cleaner and attachments away

... and plans
   Plan 0: do 1 - 2 - 3 - 5 in that order. when the dust bag gets full do 4
   Plan 3: do any of 3.1, 3.2 or 3.3 in any order depending
                     on which rooms need cleaning

**N.B. only the plans denote order**

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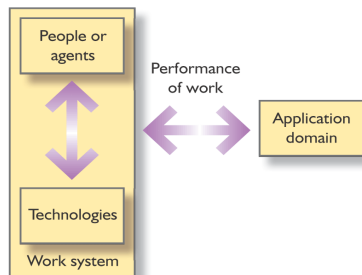
Task analysis is concerned with the performance of work by a work system.

A **task** is a **goal** together with some ordered set of **actions**

---

# Two characteristics of a task

- The logic– the sequence of steps that need to be undertaken by a work system to achieve a goal

- The cognitive aspects – the cognitive processes the work system will have to undertaken in order to achieve a goal.

## Different aims

- To understand the nature of the work: analysis should be independent from the devices

- Evaluation: achieve of the work, device dependent

## Three interacting components

- Task requirements
- Task environment
- Task behaviour

## Task analysis methods

- Task decomposition
  - splitting task into (ordered) subtasks
- Knowledge based techniques
  - what the user knows about the task and how it is organized
- Entity/object based analysis
  - relationships between objects, actions and the people who perform them
- lots of different notations/techniques

## Task Decomposition

Aims:
 describe the actions people do
 structure them within task/subtask hierarchy
 describe order of subtasks

## Generating the hierarchy

1 get list of tasks
2 group tasks into higher level tasks
3 decompose lowest level tasks further

Stopping rules
 How do we know when to stop?

Is "empty the dust bag" simple enough?

## Example Hierarchical Task Analysis

0.  In order to borrow a book from the library
    1.   go to the library
    2.   find the required book
         2.1 access library catalogue
         2.2 access the search screen
         2.3 enter search criteria
         2.4 identify required book
         2.5 note location
    3.   go to correct shelf and retrieve book
    4.   take book to checkout counter

## Example Hierarchical Task Analysis (plans)

plan 0: do 1-3-4. If book isn't on the shelf expected, do 2-3-4.

plan 2: do 2.1-2.4-2.5. If book not identified do 2.2-2.3-2.4.

## Example Hierarchical Task Analysis (graphical)
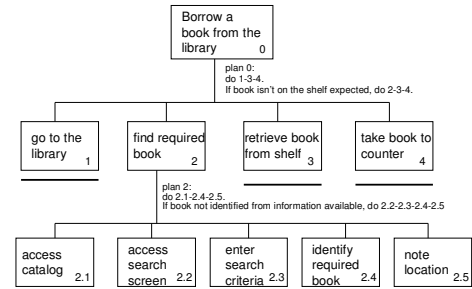
## The HTA Analysis is able to

- Express the system's goals more explicity
- Identify appropriate features of the context with more precision
- Establish methods for accomplishing the overall goal

## Different ways to explain a task

- imagine asking the user the question:
  what are you doing now?
- for the same action the answer may be:
  typing ctrl-B
  making a word bold
  emphasising a word
  editing a document
  writing a letter
  preparing a legal case

## Identify information for task analysis

- Decisions made in the execution of component sub-tasks
- Trigger conditions for sub-task execution
- Objective or goal of each sub-task
- Performance criteria for each sub-task
- Information required by each sub-task
- Knowledge employed in making decision
- Knowledge of system employed in performing sub-tasks

## Other methods for task analysis

- Knowledge based analysis
- Task Description Hierarchy (TDH)
- GOM

# Knowledge Based Analyses

Focus on:

Objects      – used in task
Actions      – performed
Taxonomies  – hierarchical descriptions

Aim: understand the knowledge needed to perform a task

# Classification

- Spatial location
- Coordinate to reach a goal,
- Grouping under functions
- No necessary to have mechanically connection
- One object can fall into more than one categories

# Task Description Hierarchy (TDH)

Three types of branch point in taxonomy:

XOR – normal taxonomy
        object in one and only one branch
AND – object must be in both
        multiple classifications
OR – weakest case
        can be in one, many or none

# Larger TDH example

```
kitchen item AND
/____shape XOR
/    |____dished  mixing bowl, casserole, saucepan,
/    |              soup bowl, glass
/    |____flat    plate, chopping board, frying pan
/____function OR
     {____preparation    mixing bowl, plate, chopping board
     {____cooking    frying pan, casserole, saucepan
     {____dining XOR
          |____for food   plate, soup bowl, casserole
          |____for drink  glass
```

N.B. '/|{' used for branch types.

# Data collection and presentation

- Activity (raw or coded) plus time
- Time study: raw event/time record.
- Process charts – how material and people are moving
- Gantt charts – graphical description of activities in time
- Link charts – sequences of eye fixations

# Methods

- Observation
- Questionnaires
- Interviews
- Specific techniques to answer questions
- Rating scales

## Uses for task information

- System design/evaluation
- Training design/evaluation
- Interface design/evaluation
- Job/team design
- Personnel selection
- System reliability analysis

## GOMS

- Goal operated methods of selection roles

- GOMS analysis is a description, or model, of the knowledge"how to do it".

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## GOMS

Goals
– what the user wants to achieve

Operators
– basic actions user performs

Methods
– The way to decompose a goal into subgoals/operators

Selection
– means of choosing between competing methods

## GOMS example

```
GOAL: CLOSE-WINDOW
.   [select GOAL: USE-MENU-METHOD
            .    MOVE-MOUSE-TO-FILE-MENU
            .    PULL-DOWN-FILE-MENU
            .    CLICK-OVER-CLOSE-OPTION
         GOAL: USE-CTRL-W-METHOD
            .    PRESS-CONTROL-W-KEYS]

For a particular user:

   Rule 1: Select USE-MENU-METHOD unless another
           rule applies
   Rule 2: If the application is GAME,
           select CTRL-W-METHOD
```

## Limitations

- GOMS
  - Prespecified goals
  - Routine tasks
  - Discription of high level
  - Individuals

## Variants of GOMS

- Keystroke-Level Model (KLM)
- Natural GOMS Language (NGOMSL)

## Slide 1: CMN-GOMS / KLM

**CMN-GOMS**

```
GOAL: EDIT-MANUSCRIPT
 .  GOAL: EDIT-UNIT-TASK ...repeat until no more unit tasks
 .  .  GOAL: ACQUIRE UNIT-TASK ...if task not remembered
 .  .  .  GOAL: TURN-PAGE ...if at end of manuscript page
 .  .  .  GOAL: GET-FROM-MANUSCRIPT
 .  .  GOAL:EXECUTE-UNIT-TASK ...if a unit task was found
 .  .  .  GOAL: MODIFY-TEXT
 .  .  .  .  [select: GOAL:  MOVE-TEXT* ...if text is to be moved
 .  .  .  .             GOAL:  DELETE-PHRASE ...if a phrase is to be deleted
 .  .  .  .             GOAL:  INSERT-WORD] ...if a word is to be inserted
 .  .  .  .  VERIFY-EDIT

*Expansion of MOVE-TEXT goal
GOAL: MOVE-TEXT
 .  GOAL: CUT-TEXT
 .  .  GOAL: HIGHLIGHT-TEXT
 .  .  .  [select**:  GOAL: HIGHLIGHT-WORD
 .  .  .  .             .  MOVE-CURSOR-TO-WORD
 .  .  .  .             .  DOUBLE-CLICK-MOUSE-BUTTON
 .  .  .  .             .  VERIFY-HIGHLIGHT
 .  .  .  .             GOAL: HIGHLIGHT-ARBITRARY-TEXT
 .  .  .  .             .  MOVE-CURSOR-TO-BEGINNING      1.10
 .  .  .  .             .  CLICK-MOUSE-BUTTON            0.20
 .  .  .  .             .  MOVE-CURSOR-TO-END            1.10
 .  .  .  .             .  SHIFT-CLICK-MOUSE-BUTTON      0.48
 .  .  .  .             .  VERIFY-HIGHLIGHT]             1.35
 .  .  GOAL: ISSUE-CUT-COMMAND
 .  .  .  MOVE-CURSOR-TO-EDIT-MENU 1.10
 .  .  .  PRESS-MOUSE-BUTTON                            0.10
 .  .  .  MOVE-MOUSE-TO-CUT-ITEM                        1.10
 .  .  .  VERIFY-HIGHLIGHT                              1.35
 .  .  .  RELEASE-MOUSE-BUTTON                          0.10
 .  GOAL: PASTE-TEXT
 .  .  GOAL: POSITION-CURSOR-AT-INSERTION-POINT
 .  .  .  MOVE-CURSOR-TO-INSERTION-POINT               1.10
 .  .  .  CLICK-MOUSE-BUTTON                           0.20
 .  .  .  VERIFY-POSITION                              1.35
 .  .  GOAL: ISSUE-PASTE-COMMAND
 .  .  .  MOVE-CURSOR-TO-EDIT-MENU 1.10
 .  .  .  PRESS-MOUSE-BUTTON                           0.10
 .  .  .  MOVE-MOUSE-TO-PASTE-ITEM 1.10
 .  .  .  VERIFY-HIGHLIGHT                             1.35
 .  .  .  RELEASE-MOUSE-BUTTON                         0.10
                            TOTAL TIME PREDICTED (SEC)  14.38

**Selection Rule for GOAL: HIGHLIGHT-TEXT:
  If the text to be highlighted is a single word, use the
  HIGHLIGHT-WORD method, else use the HIGHLIGHT-ARBITRARY-TEXT method.
```

**KLM**

Moving text with the *MENU-METHOD*

| Description | Operator |
|---|---|
| Mentally prepare by Heuristic Rule 0 | M |
| Move cursor to beginning of phrase | P |
| (no M by Heuristic Rule 1) | |
| Click mouse button | K |
| (no M by Heuristic Rule 1) | |
| Move cursor to end of phrase | P |
| Shift-click mouse button | |
| (one average typing K) | K |
| (one mouse button click K) | K |
| Mentally prepare by Heuristic Rule 0 | M |
| Move cursor to Edit menu | P |
| (no M by Heuristic Rule 1) | |
| Press mouse button | K |
| Move cursor to Cut menu item | |
| (no M by Heuristic Rule 1) | |
| Release mouse button | K |
| Mentally prepare by Heuristic Rule 0 | M |
| Move cursor to insertion point | P |
| Click mouse button | K |
| Mentally prepare by Heuristic Rule 0 | M |
| Move cursor to Edit menu | P |
| (no M by Heuristic Rule 1) | |
| Move cursor to Paste menu item | P |
| (no M by Heuristic Rule 1) | |
| Release mouse button | K |

## Slide 2: CMN-GOMS / NGOMSL

**CMN-GOMS**

```
GOAL: EDIT-MANUSCRIPT
 .  GOAL: EDIT-UNIT-TASK ...repeat until no more unit tasks
 .  .  GOAL: ACQUIRE UNIT-TASK ...if task not remembered
 .  .  .  GOAL: TURN-PAGE ...if at end of manuscript page
 .  .  .  GOAL: GET-FROM-MANUSCRIPT
 .  .  GOAL:EXECUTE-UNIT-TASK ...if a unit task was found
 .  .  .  GOAL: MODIFY-TEXT
 .  .  .  .  [select: GOAL:  MOVE-TEXT* ...if text is to be moved
 .  .  .  .             GOAL:  DELETE-PHRASE ...if a phrase is to be deleted
 .  .  .  .             GOAL:  INSERT-WORD] ...if a word is to be inserted
 .  .  .  .  VERIFY-EDIT

*Expansion of MOVE-TEXT goal
GOAL: MOVE-TEXT
 .  GOAL: CUT-TEXT
 .  .  GOAL: HIGHLIGHT-TEXT
 .  .  .  [select**:  GOAL: HIGHLIGHT-WORD
 .  .  .  .             .  MOVE-CURSOR-TO-WORD
 .  .  .  .             .  DOUBLE-CLICK-MOUSE-BUTTON
 .  .  .  .             .  VERIFY-HIGHLIGHT
 .  .  .  .             GOAL: HIGHLIGHT-ARBITRARY-TEXT
 .  .  .  .             .  MOVE-CURSOR-TO-BEGINNING      1.10
 .  .  .  .             .  CLICK-MOUSE-BUTTON            0.20
 .  .  .  .             .  MOVE-CURSOR-TO-END            1.10
 .  .  .  .             .  SHIFT-CLICK-MOUSE-BUTTON      0.48
 .  .  .  .             .  VERIFY-HIGHLIGHT]             1.35
 .  .  GOAL: ISSUE-CUT-COMMAND
 .  .  .  MOVE-CURSOR-TO-EDIT-MENU 1.10
 .  .  .  PRESS-MOUSE-BUTTON                            0.10
 .  .  .  MOVE-MOUSE-TO-CUT-ITEM                        1.10
 .  .  .  VERIFY-HIGHLIGHT                              1.35
 .  .  .  RELEASE-MOUSE-BUTTON                          0.10
 .  GOAL: PASTE-TEXT
 .  .  GOAL: POSITION-CURSOR-AT-INSERTION-POINT
 .  .  .  MOVE-CURSOR-TO-INSERTION-POINT               1.10
 .  .  .  CLICK-MOUSE-BUTTON                           0.20
 .  .  .  VERIFY-POSITION                              1.35
 .  .  GOAL: ISSUE-PASTE-COMMAND
 .  .  .  MOVE-CURSOR-TO-EDIT-MENU 1.10
 .  .  .  PRESS-MOUSE-BUTTON                           0.10
 .  .  .  MOVE-MOUSE-TO-PASTE-ITEM 1.10
 .  .  .  VERIFY-HIGHLIGHT                             1.35
 .  .  .  RELEASE-MOUSE-BUTTON                         0.10
                            TOTAL TIME PREDICTED (SEC)  14.38

**Selection Rule for GOAL: HIGHLIGHT-TEXT:
  If the text to be highlighted is a single word, use the
  HIGHLIGHT-WORD method, else use the HIGHLIGHT-ARBITRARY-TEXT method.
```

**NGOMSL**

```
Method for goal: Move text
  Step 1.  Accomplish goal: Cut text.
  Step 2.  Accomplish goal: Paste text.
  Step 3.  Return with goal accomplished.

Method for goal: Cut text
  Step 1.  Accomplish goal: Highlight text.
  Step 2.  Retain that the command is CUT, and
           accomplish goal: Issue a command.
  Step 3.  Return with goal accomplished.

Method for goal: Paste text
  Step 1.  Accomplish goal: Position cursor at insertion point.
  Step 2.  Retain that the command is PASTE,
           and accomplish goal: Issue a command.
  Step 3.  Return with goal accomplished.

Selection rule set for goal: Highlight text
  If text-is word, then accomplish goal: Highlight word.
  If text-is arbitrary, then accomplish goal: Highlight arbitrary text.
  Return with goal accomplished.

Method for goal: Highlight word
  Step 1.  Determine position of middle of word.
  Step 2.  Move cursor to middle of word.
  Step 3.  Double-click mouse button.
  Step 4.  Verify that correct text is selected
  Step 5.  Return with goal accomplished.

Method for goal: Highlight arbitrary text
  Step 1.  Determine position of beginning of text.
  Step 2.  Move cursor to beginning of text.
  Step 3.  Click mouse button.
  Step 4.  Determine position of end of text. (already known)
  Step 5.  Move cursor to end of text.
  Step 6.  Shift-click mouse button.
  Step 7.  Verify that correct text is highlighted.
  Step 8.  Return with goal accomplished.

Method for goal: Position cursor at insertion point
  Step 1.  Determine position of insertion point.
  Step 2.  Move cursor to insertion point.
  Step 3.  Click mouse button.
  Step 4.  Verify that correct point is flashing
  Step 5.  Return with goal accomplished.

Method for goal: Issue a command
  Step 1.  Recall command name and retrieve from LTM the menu name for it,
           and retain the menu name.
  Step 2.  Recall the menu name, and move cursor to it on Menu Bar.
  Step 3.  Press mouse button down.
  Step 4.  Recall command name, and move cursor to it.
  Step 5.  Release mouse button.
  Step 6.  Forget menu name, forget command name, and
           return with goal accomplished.
```