

Interaction Design

Desktop

Matthias Rauterberg
Department Industrial Design
Technical University Eindhoven
g.w.m.rauterberg@tue.nl

12-DEC-2005

Key references/literature 1:

D.J. Mayhew (1992) Principles and guidelines in software user interface design. Prentice Hall.

chapter 9: dialog styles - direct manipulation.

ISO/FDIS 9241 (1997) Ergonomic requirements for office work with visual display terminals (VDTs).

Part 16: [direct-manipulation dialogues](#).

S. Weinschenk & S.C. Yeo (1995) [Enterprise-wide GUI Design](#).

Key references/literature 2:

W.O. Galitz (1989) Handbook of screen format design. QED Information Sciences Inc.
chapter 5: data entry screens.
chapter 6: inquiry screens.

D.J. Mayhew (1992) Principles and guidelines in software user interface design. Prentice Hall.
chapter 5: dialog styles - fill-in forms.

ISO/FDIS 9241 (1997) Ergonomic requirements for office work with visual display terminals (VDTs).
Part 12: presentation of information.

Dimensions of interaction styles

- Initiation
 - Degree to which initiation of the dialogue rests with the computer or the human user.
- Dialogue flexibility
 - number of ways in which a user can perform given functions.
- Degree of automation
 - Amount of work accomplished by the system in response to a single user command.
- Complexity of action space
 - Number of different options available to the user at any given point in the dialogue.
- Complexity of perception space
 - Degree to which the interactions absorbs the memory and reasoning power of the user.
- Interaction style and user type

[taken from [Smith&Mosier, 1986](#)]

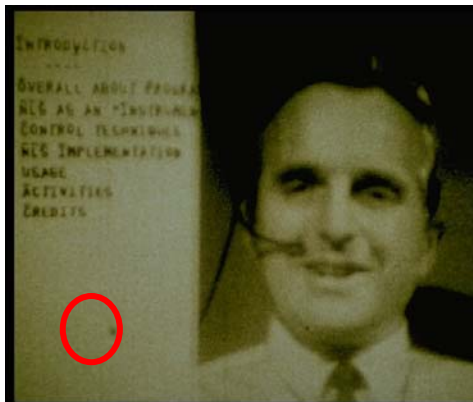


SketchPad, Ivan Sutherland, MIT, 1963

[see also [HCI History](#)]

(c) M. Rauterberg, TU/e

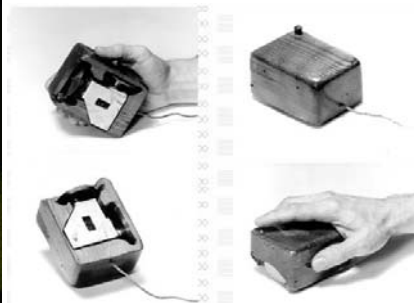
5/79



NLS, Douglas Engelbart, Stanford Research Institute, 1968

[see also [HCI History](#)]

(c) M. Rauterberg, TU/e



First Mouse
D. Engelbart & W. English, 1964



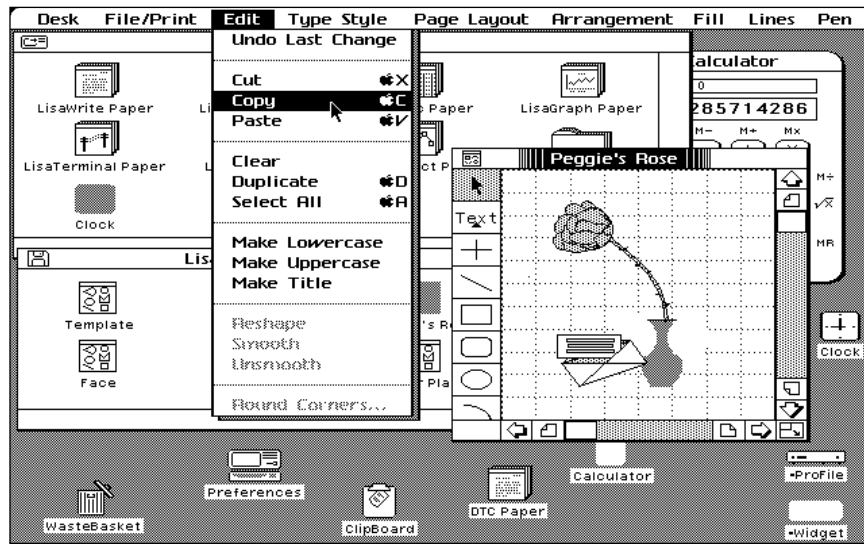
6/79

Star, Xerox, 1981



(c) M. Rauterberg, TU/e

Lisa Desktop, Apple, 1982



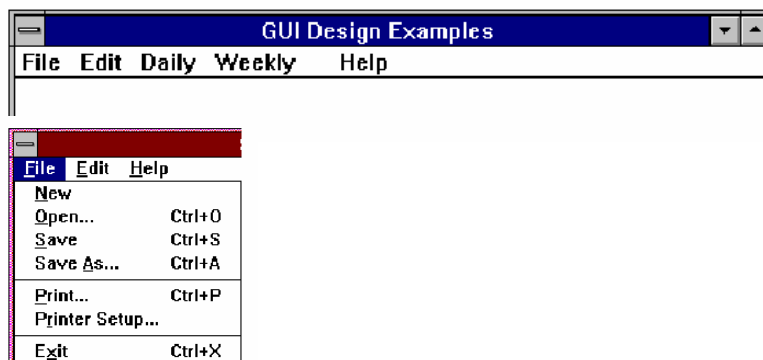
(c) M. Rauterberg, TU/e

How to design Desktop Interfaces (DI)?

- Menu structure (I.e. pull-down menus)
- discrete and partially continuous actions
- WIMP = Windows, Icons, Mouse, Pointing
- ‘desktop’ is NOT ‘direct manipulation’
- the ‘desktop’ metaphor does NOT fit to all application domains

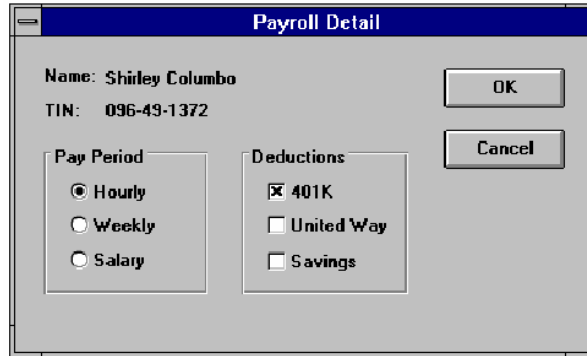
Menus

Menus play two critical roles in graphical user interfaces. In Desktop Interfaces the **menu bar** is the major form of navigation through the interface and the **pull-down menus** convey the mental model to the user in a snapshot.



Dialog Box






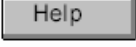
Graphical user interfaces communicate with users through **controls**. The usability of your initial design depends a great deal on how you use controls. **Push buttons** are the primary way that users navigate from **dialog box** to dialog box. Use push buttons to convey to users the major actions for a particular box. Users should be able to glance at a dialog box and know what to do there, and what to do next, based on the names and placement of the push buttons.



(c) M. Rauterberg, TU/e

11/79

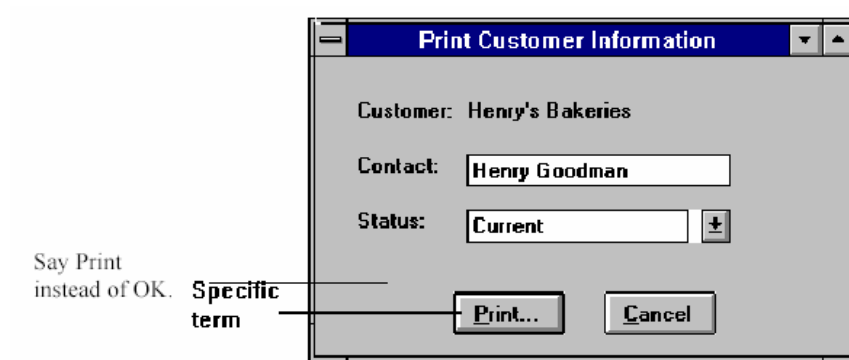
Push Buttons (1)

Use this label:	To do this:	Use this mnemonic
	Makes changes and closes the window	O
	Does not make changes and closes the window	C
	Closes the window when changes can't be canceled	L
	Resets to defaults, leaves window open	R
	Makes changes, resets to defaults, leaves window open	P
	Opens online help document to particular location	H

(c) M. Rauterberg, TU/e

12/79

Push Buttons (2)

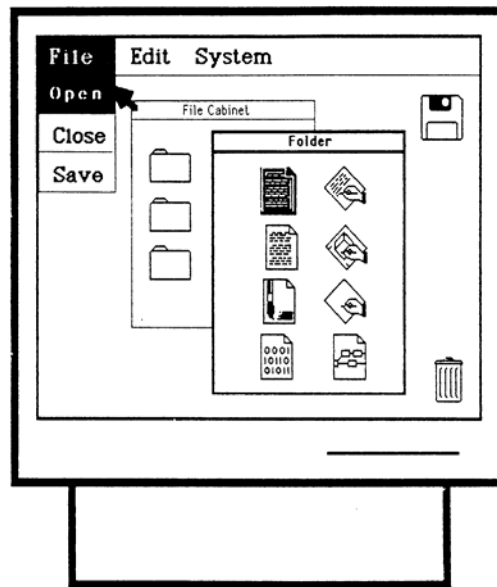


Windows Shortcuts

- Copy: **Ctrl+C** Cut: **Ctrl+X** Paste: **Ctrl+V**
- Undo: **Ctrl+Z** Save: **Ctrl+S**
- Switch to another open program: **Alt+Tab**
- Open or close Start menu: **Ctrl+Esc** or **Windows key**
- Move up a directory level in Windows Explorer: **Backspace**
- In Explorer or dialog box, rename selected folder or file on the desktop: **F2**
- In Explorer, search: **F3** or **Ctrl+F**
- In Explorer, refresh: **F5**
- Open My Computer: **Windows+E**
- Search for a file in a new window: **Windows+F**
- Show desktop (push again to restore windows): **Windows+D**



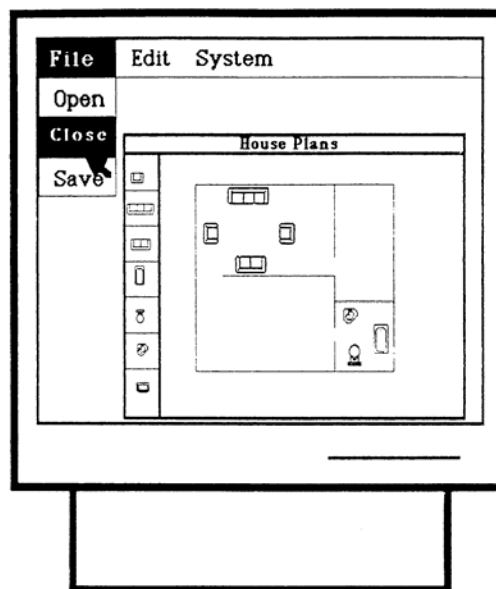
Desktop: example (1)



(c) M. Rauterberg, TU/e

15/79

Desktop: example (2)



(c) M. Rauterberg, TU/e

16/79

Desktop Interface (1): advantages

- Easy to learn and remember
- Direct, intuitive, "wysiwyg": allows user to focus on task semantics rather than on system semantics and syntax
- Flexible, easily reversible actions
- Provides context and instant, visual feedback
- Exploits human use of visual/spatial cues and motor behaviour
- Low typing requirements and visual feedback means less opportunity for user input error (and less error messages)

Desktop Interface (2): disadvantages

- Can be inefficient for high frequency experts, especially touch typist, and when there are more actions and objects than can be fit on one screen
- may be difficult to design recognizable icons for many objects and actions ('what is it' versus 'where is it')
- icons take more screen 'real estate' than words

Desktop Interface (3)

- Most appropriate for:
- Knowledge and experience
 - low typing skills
 - low system experience
 - low task experience
 - low application experience
 - high frequency of use of other systems
 - low computer literacy
 - job and task characteristics
 - low frequency of use
 - little or no training
 - discretionary use
 - high turn over rate
 - low task importance
 - low task structure

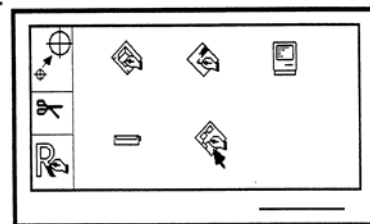
(c) M. Rauterberg, TU/e

19/79

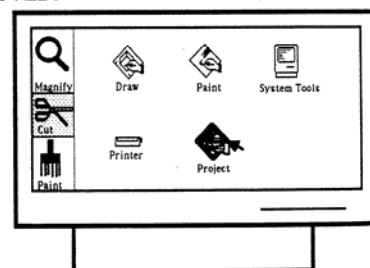
Desktop Interface (4)

Guideline:
accompany icons
with names

POOR:



IMPROVED:

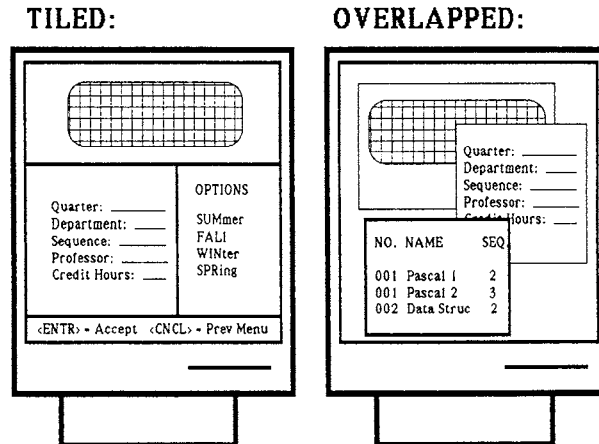


(c) M. Rauterberg, TU/e

20/79

Desktop Interface (5)

Guideline:
choose
appropriate
windowing
strategy



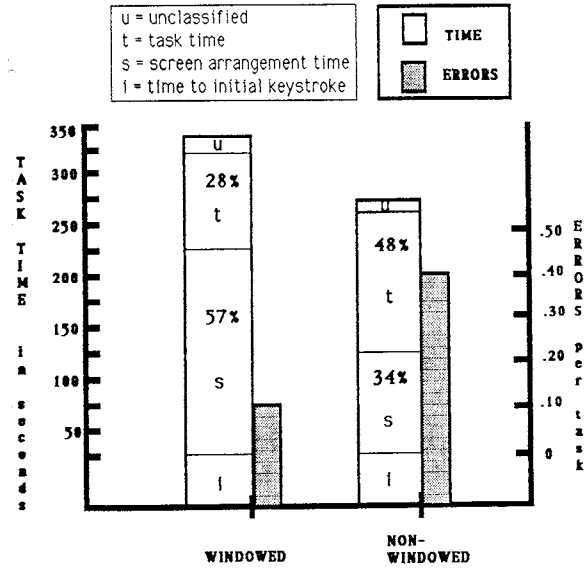
Desktop Interface (6)

- **Windowing uses:**
 - quick context switching with place-saving
 - work in one, monitor another
 - cut and paste
 - compare
 - show more detail, preserve context
 - give command, see results
 - get HELP, preserve context
 - display same object in different forms
- **Windowing types:**
 - system-controlled
 - user-controlled, tiled
 - user-controlled, overlapping

Desktop Interface (7)

Windowing:
experimental study

[S.E. Davies, K.F. Bury and M.J. Darnell (1985) [An experimental comparison of a windowed vs. a non-windowed operating system environment](#). Proceedings of the Human Factors Society 29th Annual Meeting, pp. 250-254]



(c) M. Rauterberg, TU/e

Desktop Interface (8)

Windowing:
experimental study

[K. Gaylin (1986) [How are window used? Some notes on creating an empirically based windowing benchmark task](#). Proceedings CH'86, ACM, pp. 96-100]]

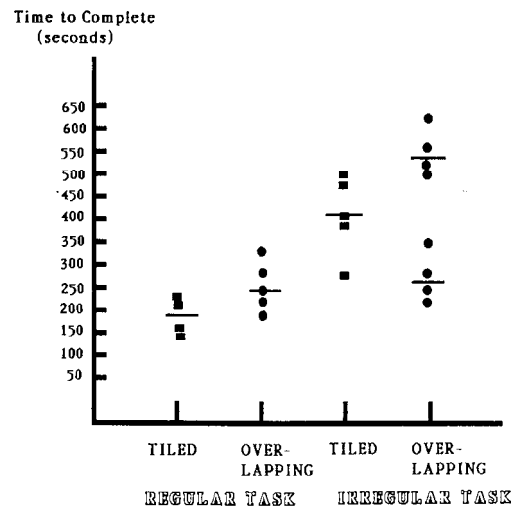
	% TOTAL COMMANDS	
	TOTAL SESSION	LOGIN ONLY
NAVIGATE	59.5	32.4
OPEN	10.6	18.1
CREATE	7.5	17.1
DELETE	8.3	2.9
MOVE	4.3	17.1
RESIZE	2.0	12.4
OTHER	7.8	

(c) M. Rauterberg, TU/e

Desktop Interface (9)

Windowing:
experimental study

[S.A. Bly and J.K. Rosenberg (1986) [A comparison of tiled versus overlapping windows](#). Proceedings CHI'86, ACM, pp. 101-106]



(c) M. Rauterberg, TU/e

25/79

Desktop Interface (10)

- **Windowing design guidelines:**
 - design easy to use and learn window operations (complexity of windowing interfaces should NOT cancel out advantages).
 - minimise the number of window operations necessary to achieve a desired effect.
 - make navigation between windows particularly easy and efficient to do.
 - make setting up windows particularly easy to remember.
 - provide salient visual cues to identify 'active' window.
 - provide a consistent 'user model' of windows (window is an object OR workspace OR dialog box).
 - allow overlapping when displays are unpredictable, screens are small, and users are fairly frequent and experienced.
 - in overlapping windowing, provide powerful commands for arranging windows on the screen in user-tailorable configurations.

(c) M. Rauterberg, TU/e

26/79

Layout of the Form (1)

- Not too much on a Form
 - Split, logically, over several Forms
 - hide/reveal controls
- Information in centre of visual field is most likely to be seen.
 - Put important info in obvious positions

Layout of the Form (2)

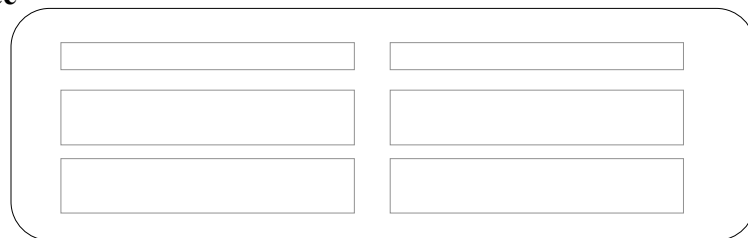
- Arrange controls in a logical sequence
 - especially for data entry
 - work from left - right, top-bottom
 - consistency of layout over Forms
 - e.g. “exit” button in same position on all Forms
- Arrange order using “Tab-key”
- Set Focus after major operation
 - e.g. after pressing a Command button when loading/returning to a Form
 - clear text boxes on data entry forms?

Generic Rule: Balance

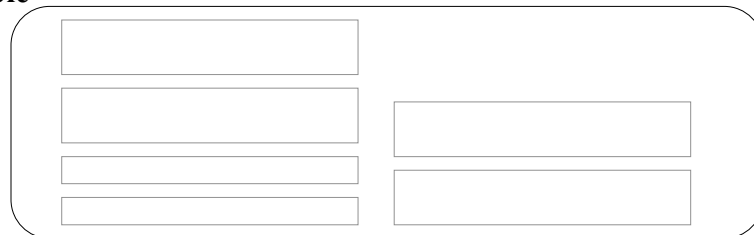
- Equal weight of screen elements
 - Left to right, top to bottom
(! ONLY true for Western cultures)

see the following presentation for more background information on this rule:
[“Perception, Cognition, Action”](#)

Balance

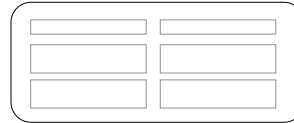


Unstable



Generic Rule: Balance

- Left column processed
- Right column noted
as same



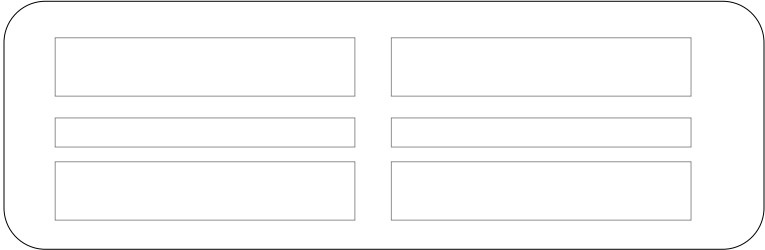
- Both columns need to
be understood by
visual processing
system



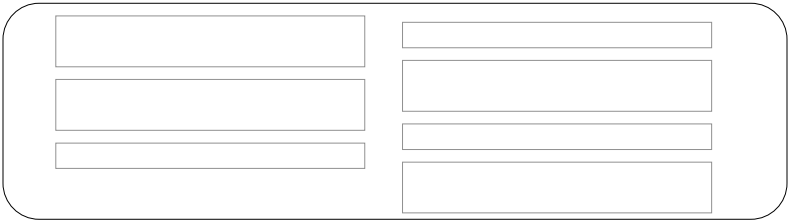
Generic Rule: Symmetry

- Replicate elements left and right of the
center line

Symmetric



Asymmetric

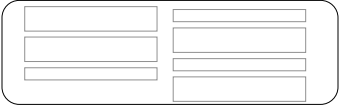


Generic Rule: Symmetry

- Left column processed - Right column noted as same



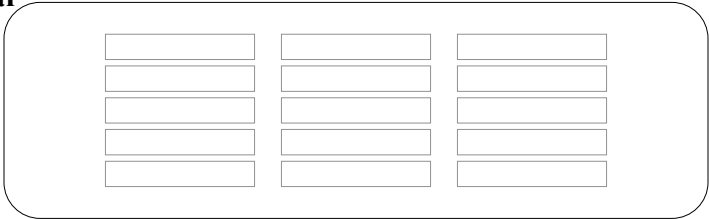
- Both right & left columns processed plus relationship of right to left



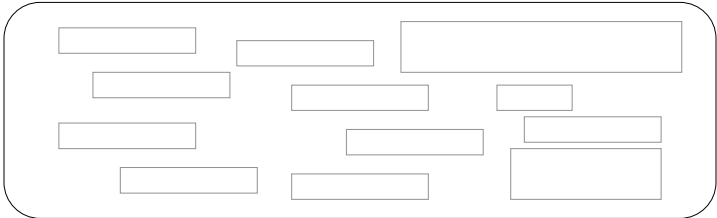
Generic Rule: Regularity

- Create standard and consistent spacing on horizontal and vertical alignment points

Regular

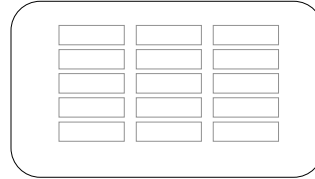


Irregular

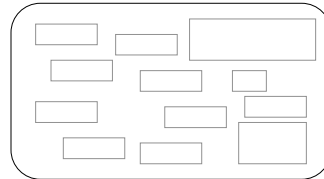


Generic Rule: Regularity

- Left column processed
- 2 right columns
noted as same



- Location & size of
each object processed



Generic Rule: Predictability

- Put things in predictable locations on the
screen

Predictable

A dialog box with a rounded top-left corner. At the top left is an 'Icon' button. To its right is a text field containing 'Search for Programming Info'. Below this is a menu bar with 'File', 'Edit', 'View', 'Insert', 'Window', and 'Help'. Under the menu bar is the text 'Enter Keywords:'. Below this text are three text input fields containing 'JAVA', 'ASP', and 'C++'. At the bottom are two buttons: 'OK' and 'Cancel'.

Spontaneous

A dialog box with a rounded top-right corner. At the top left is an 'OK' button. At the top right is an 'Icon' button. In the center is the text 'Enter Keywords:'. Below this text are three text input fields containing 'JAVA', 'ASP', and 'C++'. Below these fields is a menu bar with 'File', 'Edit', 'View', 'Insert', 'Window', and 'Help'. At the bottom are two buttons: 'Search for Programming Info' and 'Cancel'.

Generic Rule: Predictability

- User expects title & menu bar on top of screen
- Visual scene needs to be completely processed - objects not in expected places

A dialog box with a rounded top-left corner. At the top left is an 'Icon' button. To its right is a text field containing 'Search for Programming Info'. Below this is a menu bar with 'File', 'Edit', 'View', 'Insert', 'Window', and 'Help'. Under the menu bar is the text 'Enter Keywords:'. Below this text are three text input fields containing 'JAVA', 'ASP', and 'C++'. At the bottom are two buttons: 'OK' and 'Cancel'.

A dialog box with a rounded top-right corner. At the top left is an 'OK' button. At the top right is an 'Icon' button. In the center is the text 'Enter Keywords:'. Below this text are three text input fields containing 'JAVA', 'ASP', and 'C++'. Below these fields is a menu bar with 'File', 'Edit', 'View', 'Insert', 'Window', and 'Help'. At the bottom are two buttons: 'Search for Programming Info' and 'Cancel'.

Generic Rule: Sequentiality

- Guide the eye through the task in an obvious way
 - The Eye is attracted to:
 - bright elements over less bright
 - Isolated elements over grouped
 - graphics before text
 - color before monochrome
 - saturated vs. less saturated colors
 - dark areas before light
 - big vs. small elements
 - unusual shapes over usual ones



Sequential

Membership Form

Name:	<input type="text"/>	Dues:	<input type="text"/>
Address:	<input type="text"/>	Pubs:	<input type="text"/>
City:	<input type="text"/>	Total:	<input type="text"/>
State:	<input type="text"/>		
Zip:	<input type="text"/>	<input type="button" value="OK"/>	<input type="button" value="Cancel"/>

Random

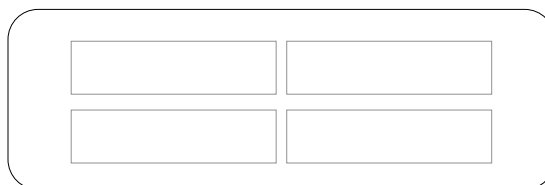
Membership Form Name:

Address:	<input type="text"/>	Pubs:	<input type="text"/>
Dues:	<input type="text"/>	State:	<input type="text"/>
Zip:	<input type="text"/>	City:	<input type="text"/>
		Total:	<input type="text"/>

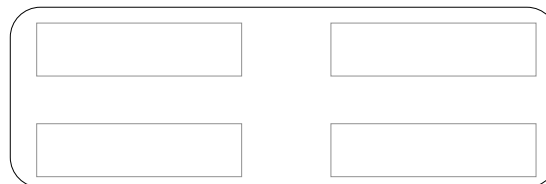
Generic Rule: Unity

- Make items appear as a unified whole (for visual coherence)
 - Use similar shapes, sizes, or colors
 - Leave less space between screen elements than at the margin of the screen

Unity

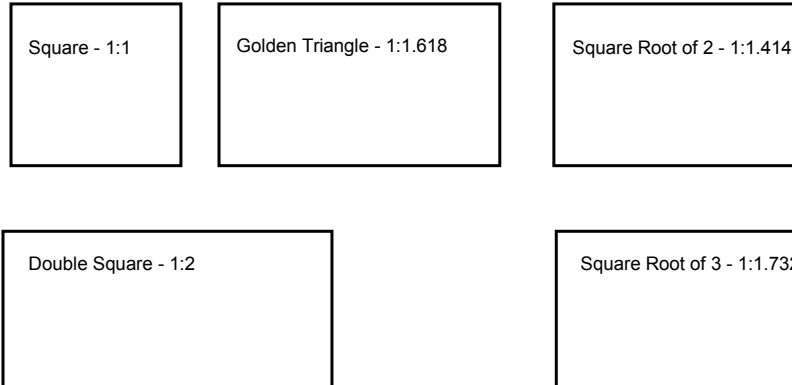


Fragmentation



Generic Rule: Pleasing Proportions

- Create groupings of data or text by using aesthetically pleasing proportions



Generic Rule: Simplicity

- Minimize the number of aligned points
 - Use only a few columns to display screen elements
- Combine elements to minimize the number of screen objects
 - Within limits of clarity

Generic Rule: Simplicity

- Only four alignments need to be processed

Membership Form

Name: Dues:

Address: Pubs:

City: Total:

State:

Zip:

- A total of nine alignments need to be processed

Membership Form

Name:

Address: Pubs:

City: Total:

State:

Zip:

Simple

Size:

Preserve Proportions

% of original height

% of original width

Complex

Size:

Uniformity: Preserve Proportions

Height: % of original

Width: % of original

Generic Rule: Groupings

- Use visual arrangements to provide functional groupings of screen elements
 - Align elements in a group
 - Evenly space elements in a group
 - Provide separation between groups
- Use additional group elements sparingly
 - color & borders add complexity

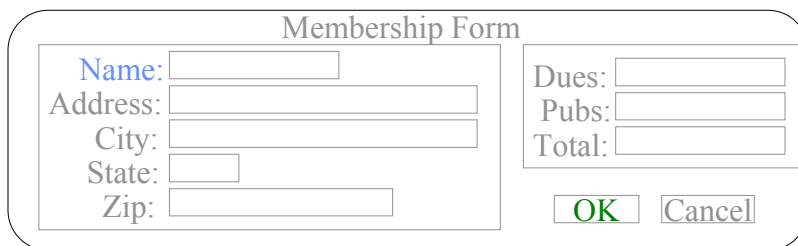
Generic Rule: Simple Grouping

- Similar elements aligned vertically
- Vertical distance between similar objects small

The image shows a dialog box titled "Membership Form" with a rounded border. It contains several input fields arranged in two columns. The left column has fields for "Name:", "Address:", "City:", "State:", and "Zip:". The right column has fields for "Dues:", "Pubs:", and "Total:". The "Name:" label is in blue. At the bottom right, there are "OK" and "Cancel" buttons. The vertical alignment of the labels and fields in each column is consistent, and the vertical spacing between the fields in each column is small.

Generic Rule: Boxed Grouping

- Boxes add additional complexity to form
- Spatial arrangement adequate



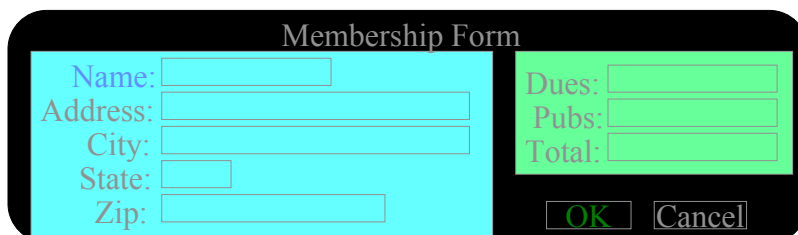
A screenshot of a 'Membership Form' with a rounded rectangular border. The form is divided into two main sections by a vertical line. The left section contains labels for 'Name:', 'Address:', 'City:', 'State:', and 'Zip:', each followed by a text input field. The right section contains labels for 'Dues:', 'Pubs:', and 'Total:', each followed by a text input field. At the bottom right of the form are two buttons labeled 'OK' and 'Cancel'.

(c) M. Rauterberg, TU/e

51/79

Generic Rule: Background Grouping

- Color adds additional visual complexity
- Spatial arrangement adequate



A screenshot of a 'Membership Form' with a rounded rectangular border. The form is divided into two main sections by a vertical line. The left section has a light blue background and contains labels for 'Name:', 'Address:', 'City:', 'State:', and 'Zip:', each followed by a text input field. The right section has a light green background and contains labels for 'Dues:', 'Pubs:', and 'Total:', each followed by a text input field. At the bottom right of the form are two buttons labeled 'OK' and 'Cancel'.

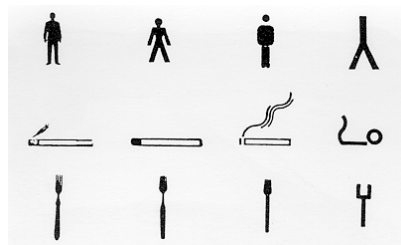
(c) M. Rauterberg, TU/e

52/79

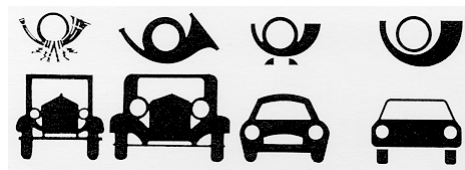
Design Guidelines

- Be consistent
- Allow shortcuts
- Offer feedback
- Organize in logical groups (screens)
- Provide simple error handling
- Provide reversible actions







Historical Trends for Icon Design



- Four different levels of abstraction can be found over the last 80 years.
- Actual icons get more abstract compared to the past.



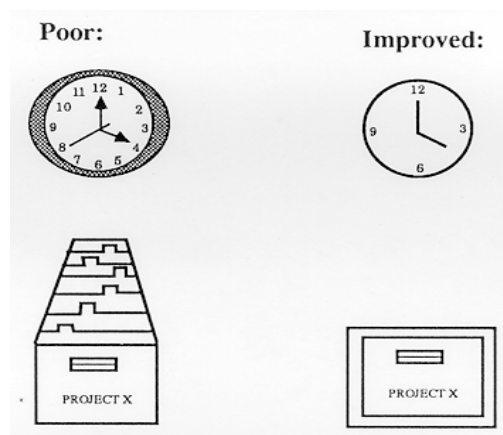
The Meaning of Icons

Responses to	Predicted Group Membership					
	Air transportation	Waiting room	Drinking water	Restaurant	Women's washroom	Telephone
	<u>62.5</u>	2.1	0.0	6.3	12.5	16.7
	10.4	<u>43.8</u>	4.2	14.6	16.7	10.4
	0.0	12.5	<u>50.0</u>	14.6	6.3	16.7
	2.1	20.8	31.3	<u>18.8</u>	14.6	12.5
	0.0	16.7	10.4	39.6	<u>20.8</u>	12.5
	8.3	6.3	14.6	4.2	20.8	<u>45.8</u>

- The numbers in the table mean the percentage of all collected answers; each intended answer is underlined.

[see Caron, J.P., Jamieson, D.G. & Dewar, R.E.: [Evaluating pictograms using semantic differential and classification technique](#). Ergonomics 23(2), 1980, p. 142]







Redesign of Icons (1)



- Design Principle:
 - avoid excessive detail in icon design.

[see Deborah J. Mayhew, Principles and Guidelines in Software User Interface Design (1992) pp.316-331]





































Redesign of Icons (2)

































	Poor:	Improved:	
STATUS:			
Planned	 Job #1 Install Pole	 Job #1 Install Pole	<ul style="list-style-type: none"> Design Principles: <ul style="list-style-type: none"> design the icons to communicate object relations and attributes whenever possible; accompany icons with names.
In progress	 Job #1 Install Pole	 Job #1 Install Pole	
Complete	 Job #1 Install Pole	 Job #1 Install Pole	

[see Deborah J. Mayhew, Principles and Guidelines in Software User Interface Design (1992) pp.316-331]

(c) M. Rauterberg, TU/e

57/79

REFERENTS	ABSTRACT SYMBOLS	CONCRETE SYMBOLS	PROPOSED SYMBOLS
1. Achieve Dial Tone			
2. Answer Ringing Call			
3. Call Log			
4. Conference			
5. Dialpad			
6. Drop			
7. Help Specific			
8. Help System			
9. HFAI			
10. Hold			
11. Message			
12. Music On Hold			

REFERENTS	ABSTRACT SYMBOLS	CONCRETE SYMBOLS	PROPOSED SYMBOLS
13. Mute			
14. Notes			
15. Phone Call Active			
16. Retrieve			
17. Ringer Select			
18. Speakerphone			
19. Speed Dial			
20. Store			
21. Switch Control	Hook		
22. Transfer Call			
23. Volume			

[taken from Dominic Paul T. Piamonte (2000): [Using Multiple Performance Parameters in Testing Small Graphical Symbols](#). Doctoral thesis, Institutionen för Arbetsvetenskap Avdelningen för Industriell ergonomi. • ISSN: 1402-1544]

(c) M. Rauterberg, TU/e

58/79

Recognition rates in percent (first rows, bold-faced: above 67%) and certainty ratings (second rows) for the 23 Referents by subjects from Philippines and Sweden (N=100).

Note:
Phil. = Philippines,
Swed. = Sweden.






















[taken from
Dominic Paul T. Piamonte (2000): Using
Multiple Performance Parameters in Testing
Small Graphical Symbols.
Doctoral thesis, Institutionen för
Arbetsvetenskap Avdelningen för Industriell
ergonomi.
• ISSN: 1402-1544 • ISRN: LTU-DT--00/02--SE]

Referents	Abstract Icons		Concrete Icons		Proposed Icons	
	PHIL.	SWED.	PHIL.	SWED.	PHIL.	SWED.
1. Achieve Dial Tone	24	20	26	38	22	26
	2.72	2.64	3.68	3.74	3.06	3.20
2. Answer Ringing Call	12	8	60	16	58	34
	3.62	2.56	4.58	4.20	4.38	4.02
3. Call Log	50	14	26	22	42	52
	3.40	3.36	3.36	3.02	2.80	3.24
4. Conference	78	94	96	96	96	92
	4.82	5.60	5.56	5.18	5.60	5.60
5. Dialpad	86	82	86	90	80	92
	4.78	5.42	5.02	6.06	5.22	5.82
6. Drop	34	28	38	26	34	26
	3.46	2.78	3.80	3.72	3.98	3.50
7. Help Specific	20	42	64	36	38	46
	2.32	2.94	4.22	2.28	3.74	4.88
8. Help System	34	14	20	46	34	32
	2.38	3.42	3.70	3.52	4.06	5.12
9. HFAI	24	44	30	06	38	20
	2.68	3.40	2.66	4.02	2.80	2.40
10. Hold	34	58	48	60	80	58
	2.88	3.12	4.48	3.28	4.78	3.96
11. Message	36	24	20	10	90	74
	4.60	4.12	4.20	4.68	5.08	4.52
12. Music On Hold	96	92	92	90	88	92
	5.24	5.54	6.24	5.84	5.78	5.32
13. Mute	68	62	60	72	46	56
	4.14	4.06	4.12	5.10	3.70	4.22
14. Notes	46	60	58	38	78	76
	3.90	3.38	4.96	6.06	4.98	5.02
15. Phone Call Active	46	26	34	52	46	44
	3.50	3.16	3.74	3.90	4.32	3.32
16. Retrieve Call	70	22	44	16	10	8
	4.16	3.32	3.64	3.12	2.62	2.34
17. Ringer Select	44	56	86	90	84	86
	3.44	3.60	5.96	5.14	5.36	5.56
18. Speed Dial	52	42	74	34	70	62
	4.14	3.22	4.50	3.74	3.60	4.08
19. Speakerphone	62	72	90	80	72	84
	5.60	4.78	5.44	5.14	4.98	4.64
20. Store	46	50	38	30	52	24
	3.58	2.92	4.00	2.92	2.82	3.20
21. Switch Hook Control	28	48	20	22	44	20
	2.64	2.22	3.46	2.54	3.32	3.14
22. Transfer Call	42	28	76	70	90	30
	3.34	3.30	5.30	3.84	5.48	3.30
23. Volume	90	96	80	94	80	88
	5.50	5.42	5.06	6.06	5.62	5.68

(c) M. Rauterberg, TU/e

59/79

Graphical symbols used in the main studies as based on Böcker (1993) for the European Telecommunications Standards Institute (ETSI, 1993).

	Camera	Document Camera	Handsfree	Micro- phone	Selfview	Still Picture	Video- Phone
SET 1							
	[1]	[4]	[7]	[10]	[13]	[16]	[19]
SET 2							
	[2]	[5]	[8]	[11]	[14]	[17]	[20]
SET 3							
	[3]	[6]	[9]	[12]	[15]	[18]	[21]

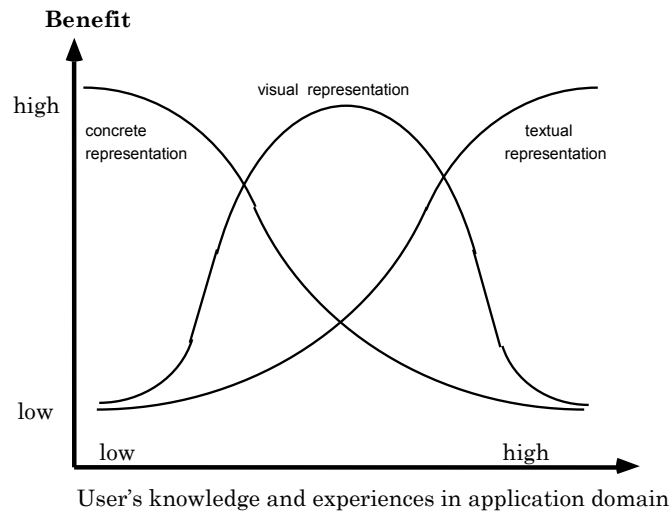
Best videophone symbols when combining hit rates, false alarms (confusions) and missing values (no answers), per country. Numbers indicate Symbol Set.

Referent	Best performing symbols for each referent tested using the three symbol sets (Sets 1, 2 and 3)						
	Ind.	Mal.	Phil.	Thai.	S.L.	Swe.	USA
Camera	1	1	1	1	1	1	1
Doc. Camera	1	1 & 3	1	1 & 3	1	1	1
Handsfree	1	1 & 3	1 & 2	1	3	1	1
Microphone	1 & 3	1 & 3	3	1	3	1	1
Selfview	3	1	1	1	2	1	1
Still Picture	1	1	1	1	3	3	1
Videophone	1	1	1	1	1	3	1

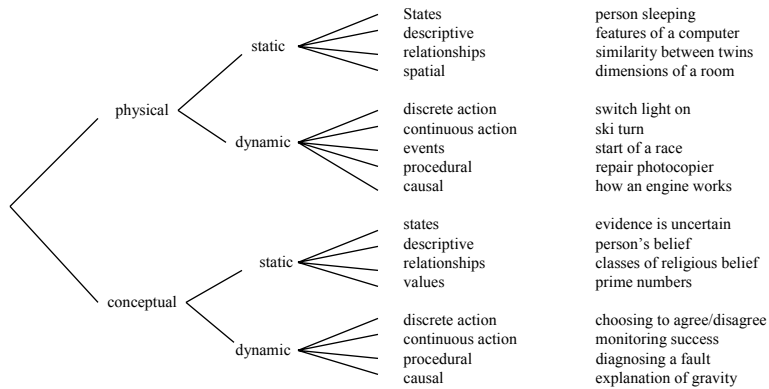
Legend: Ind. = Indonesia, Mal. = Malaysia, Phil. = Philippines, Thai. = Thailand, S.L. = Sri Lanka, Swe. = Sweden, U.S.A. = United States of America.

(c) M. Rauterberg, TU/e

60/79






Information types



Media selection and combination

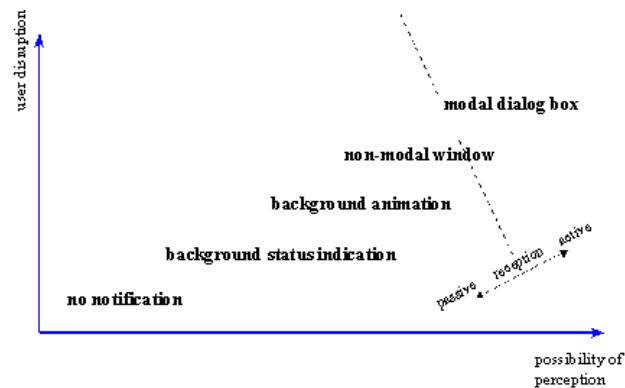
Information type	Preferred media selection	Example
Physical	Realistic still or moving image	Photo of a person
Conceptual	Text or speech, designed image	Explain sales policy
Descriptive	Text, speech, realistic image	Chemical properties
Spatial	Realistic/designed image	Diagram of a building
Value	Text/tables/numeric list(s)	Pressure reading
Relationship	Designed images, graphs, charts	Histogram of rainfall/month
Procedural	Image series, text	Evacuation instructions
Discrete action	Still image	Make coffee
Continuous action	Moving image	Monoeuvres while skiing
Events	Sound, speech	Fire alarm
States	Still images, text	Photo of weather conditions
Causal	Still & moving image, text, speech	Video of rainstorm causing flash flood

Examples for media design

	representational	abstract
visual	<ul style="list-style-type: none"> concrete picture, e.g.  	speed → speedometer, e.g. 
	<ul style="list-style-type: none"> signified symbol, e.g.  	danger → alarm flasher, e.g. blue light of a police car
auditory	<ul style="list-style-type: none"> verbal speech, e.g. "Stop the machine!" 	speech, e.g. "Attention, please!"
	<ul style="list-style-type: none"> spatial onomatopoeia and mimic, e.g. <i>event generated sound pattern</i> 	tone, e.g. beep-beep-beep...

[taken from Rauterberg, M. (1998). [About the importance of auditory alarms during the operation of a plant simulator](#). *Interacting with Computers*, vol. 10(1), pp. 31-44]

Feedback of system status information



Desktop Interface: design guidelines

- provide alternative interface for high frequency, expert user
- choose a consistent icon design scheme:
 - depict 'before and after'
 - depict tool
 - depict action
- accompany icons with name/labels
- provide visual feedback for position, selection and movement, and physical feedback for modes!

Summary (1)

USER PROFILE

DIALOG STYLE

	MENU	FILL-IN FORMS	QUESTION & ANSWER	COMMAND LANGUAGE
User Psychology: ATTITUDE	Negative	Negative Neutral	Negative	Positive
MOTIVATION	Low	Low Moderate	Low	High
Knowledge & Experience: TYPING SKILL	Low	Moderate High	Moderate High	Moderate High
SYSTEM EXPERIENCE	Low	Low Moderate	Low Moderate	High
TASK EXPERIENCE	Low	Moderate High	Low	High
APPLICATION EXPERIENCE	Low	Low Moderate	Moderate	High
USE OF OTHER SYSTEMS	Frequent	Moderate Frequent	Moderate Frequent	Infrequent
COMPUTER LITERACY	Low	Moderate High	Low	High

Summary (2)

USER PROFILE

DIALOG STYLE

	FUNCTION KEYS	DESKTOP	NATURAL LANGUAGE
User Psychology: ATTITUDE	Negative	Negative	Negative
MOTIVATION	Low	Low	Low
Knowledge & Experience: TYPING SKILL	Low	Low	High
SYSTEM EXPERIENCE	Low	Low	Low
TASK EXPERIENCE	Moderate High	Low	High
APPLICATION EXPERIENCE	Moderate	Low	Low
USE OF OTHER SYSTEMS	Low	High	High
COMPUTER LITERACY	Moderate High	Low	Low

Summary (3)

Job & Task Characteristics FREQUENCY OF USE	DIALOG STYLE		
	FUNCTION KEYS	DESKTOP	NATURAL LANGUAGE
Job & Task Characteristics	Low	Low	Low
PRIMARY TRAINING	Little or no	Little or no	Little or no
SYSTEM USE	Discretionary	Discretionary	Discretionary
TURNOVER RATE	Moderate	High	High
OTHER SYSTEMS			
TASK IMPORTANCE	Moderate	Low	Low
TASK STRUCTURE	Low Moderate	Low	Low

(c) M. Rauterberg, TU/e

69/79

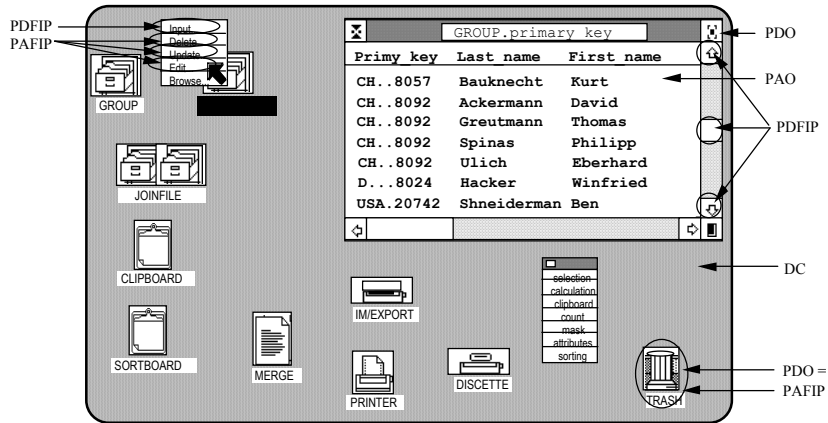
Summary (4)

Job & Task Characteristics FREQUENCY OF USE	DIALOG STYLE			
	MENU	FILL-IN FORMS	QUESTION & ANSWER	COMMAND LANGUAGE
Job & Task Characteristics	Low	Moderate High	Low	High
PRIMARY TRAINING	Little or no	Little or no	Little or no	Formal
SYSTEM USE	Discretionary	Discretionary	Discretionary	Mandatory
TURNOVER RATE	High	Low Moderate	High	Low
OTHER SYSTEMS		Paper Forms		
TASK IMPORTANCE	Low	Moderate	Low	High
TASK STRUCTURE	High	High	High	Low

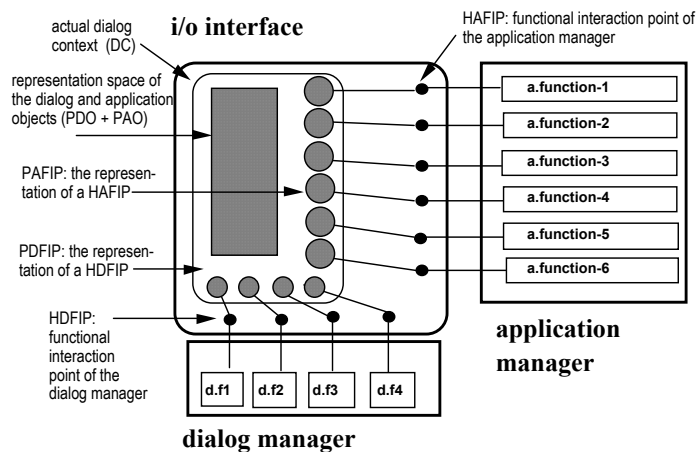
(c) M. Rauterberg, TU/e

70/79

Direct-manipulation Interface



Direct-manipulation Interaction



Modern GUI Interface



(c) M. Rauterberg, TU/e

73/79

About HCI in general:

L. Barfield: The user interface - concepts & design. Addison Wesley, 1993.
P. Booth: An introduction to Human-Computer Interaction. Lawrence Erlbaum, 1990.
A. Dix, J. Finlay, G. Abowd, R. Beale: Human-Computer Interaction. Prentice, 1993.
L. Macaulay: Human-Computer Interaction for Software Designers. Thomson, 1995.
D. Norman, S. Draper: User centered system design. Lawrence Erlbaum, 1986.
J. Preece, Y. Rogers, H. Sharp, D. Benyon, S. Holland, T. Carey: Human-Computer Interaction. Addison Wesley, 1994.
B. Shneiderman: Designing the user interface. Addison Wesley, 1997, 3rd edition.

About design principles:

C. Brown: Human-Computer Interface design guidelines. Ablex, 1989.
W. Galitz: Handbook of screen format design. QED, 1989.
C. Gram, G. Cockton (eds.): Design principles for interactive software. Capman & Hall, 1996.
D. Hix, R. Hartson: Developing user interfaces. Wiley, 1993.
ISO 9241 (Part 10: Dialogue principles, Part 12: Presentation of information, Part 14: Menu dialogues, Part 15: Command dialogues, Part 16: Direct manipulation dialogues, Part 17: Form fill-in dialogues)
D. Mayhew: Principles and guidelines in software user interface design. Prentice, 1992.

About usability evaluation methods:

J. Dumas, J. Redish: A practical guide to usability testing. Ablex, 1993.
D. Freedman, G. Weinberg: Walkthroughs, Inspections, and technical reviews. Dorset, 1990.
ISO 9241 (Part 11: Guidance on usability, Part 13: User guidance)
A. Monk, P. Wright, J. Haber, L. Davenport: Improving your Human-Computer Interface: a practical technique. Prentice Hall, 1993.
J. Nielsen, R. Mack (ed.): Usability inspection methods. Wiley, 1994.

About Design:

D. Norman: The psychology of everyday things. Basic Books, 1988.

(c) M. Rauterberg, TU/e

74/79

References for Guidelines

Articles and Books

- Grudin, Jonathan. "[The Case Against User Interface Consistency](#)." *Communications of the ACM*, October 1989.
- [Microsoft Windows User Experience, Official Guidelines for User Interface Developers and Designers](#). Redmond, WA: Microsoft Press, 1999. (USBN: 0735605661)

Organizations

- [ACM Special Interest Group on Computer-Human Interaction \(SIGCHI\)](#): The largest organization of UI practitioners.
- [German HCI Group](#): A specialist group of the German Computer Society.
- [Human Factors and Ergonomics Society](#).
- [Usability Professionals Association](#): See their consultant directory for contract resources.

Other Online Resources

- [Microsoft User Experience and UI Design Resources](#) [<http://msdn.microsoft.com/ui/>]
- [Useit.com](#) [<http://www.useit.com/>]

ISO TC 159 SC4 Ergonomics of Human System Interaction

WG1 is responsible for ISO 7249 and ISO 9355 which deal with fundamentals of **displays** and **controls** rather than HCI.

WGs 2 to 5 are responsible for ISO 9241 (see later slide).

WG 5 is developing a standard dealing with the ergonomics requirements of multi-media interfaces ISO NP 14915 - see later slide.

WG 6 is concerned with how ISO 9241 can be used and with ISO 13407 **Human-Centred Design of Interactive Systems**.

WG8 is concerned with ISO 11064, (see [Table h621-2](#)) on the *ergonomics* design of **control centres**, which include process plant control centres, security control centres and other, frequently safety critical control centre applications.

Part 1	Principles for the design of control centres
Part 2	Principles of control suite arrangement
Part 3	Control room layout
Part 4	Workstation layout and dimensions
Part 5	Displays and controls
Part 6	Environmental requirements for control rooms
Part 7	Principles for the evaluation of control centres
Part 8	Ergonomics requirements for specific applications

ISO/IEC JTC1 SC18 WG9 User System Interfaces and Symbols

Joint Technical Committee (JTC1) deals with standards in the field of information technology.

Sub committee 18 (SC18) is responsible for standards for **Document Processing and Related Communication**.

Working Group 9 is developing standards in keyboard layout, symbols and user interfaces which have relevance beyond the strict domain of document processing.

It has sub-groups working on **Keyboard Layout, User Interfaces and Symbols**.

ISO/IEC 9995 is a multi-part standard dealing with keyboard layout which replaces a number of existing standards (see [Table h621-3](#)). It includes a keyboard layout for multiple Latin alphabet languages and a layout for letters used on a numeric keyboard. It should be noted that WG9 deals with the layout of keyboards, not with the key operation or other ergonomic features which are the responsibility of WG3 of TC 159 SC4.

Part 1	General principles governing keyboard layouts
Part 2	Alphanumeric Section
Part 3	Complementary layout of the alpha-numeric zone of the alpha-numeric section
Part 4	Numeric Section
Part 5	Editing Section
Part 6	Function Section
Part 7	Symbols used to represent functions
Part 8	Numeric zone of the numeric section, allocation of letters

HCI Standards

ISO methods 9241 (ISO 9000 series standards address quality)

Ergonomic requirements of VDT - both hardware and software in 17 parts:

- Introduction
- Guidance on task requirements
- Visual Display requirements
- keyboard requirements
- workstation layout and postural requirements
- environmental requirements
- display requirements with reflections
- requirements for displayed colours
- requirements for non-keyboard input devices
- Dialogue Principles
- Usability Specification
- Presentation of Information
- User Guidance and Help
- Menu Dialogues
- Command Dialogues
- Direct Manipulation Dialogues
- Form-filling Dialogues

Task Design - ISO 9241-2

The application of ergonomic principles ... is essentially the integration of task design with the design of software - where well designed tasks

- provide for the application of an appropriate variety of skills;
- ensure that the task performed are identifiable as whole units of work rather than fragments
- provide sufficient feedback on task performance in terms meaningful to the user

**ISO 14915 Multimedia User Interface Design -
Ergonomic Requirements for human-centered multimedia interfaces**

Status

Part 1	Design Principles and Framework	DIS
Part 2	Multimedia Control and Navigation	CD
Part 3	Media Selection and Media	DIS
Part 4	Domain Specific Interfaces	WI