



10 stages for successful HMI design



Hints and tips

> At each stage, you will find advice and design rules to follow in this section to obtain the best result.

HMI?

The HMI, -Human Machine Interface- is a means of communication between the user and the machine and acts as an interpreter. The HMI adapts the logic of the machine to that of the user to avoid any misinterpretation during exchanges of information.

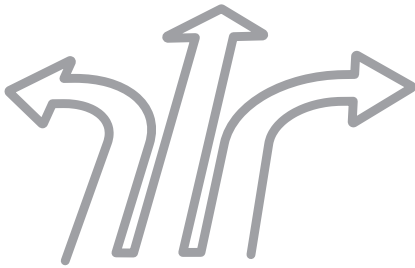
Method

To successfully design and build effective, professional HMIs, it is important to follow the stages described in this design guide step by step.

- 1. Define the architecture** >
Identify, organise, name
- 2. Structure the content** >
Create the menus
- 3. Establish the principles for navigation** >
Organise the access paths
- 4. Structure the page layout** >
Define the page typologies
- 5. Create content** >
Build the block diagram on the home page
- 6. Add dynamics** >
Choose buttons and active zones
- 7. Highlight** >
Use icons, pictures and colours
- 8. Make it legible** >
Adjust light and contrasts
- 9. Create texts and dialogue tools** >
Make them legible and visible
- 10. Create a dialogue box** >
Create clear messages



1 Define the architecture



💡 Hints and tips

- > Classify the most useful information first,
- > Classify the levels of information in order of importance from the user's point of view.

Architecture?

Organise the content to help the user find what he or she is looking for quickly.

Method

1. **Identify the content** which will be displayed in this interface,
2. **Categorise:** organise the content into similar functions,
3. **Name** the groups of functions.

Identify the content

- Make an inventory of all the functionalities required for your application to function.
- Predict all the possible situations which may arise, consider all the uses which may be made of the HMI and give a precise description of all the possible situations with which the application will be confronted: installation, servicing, maintenance, restarting, change of procedure, etc.

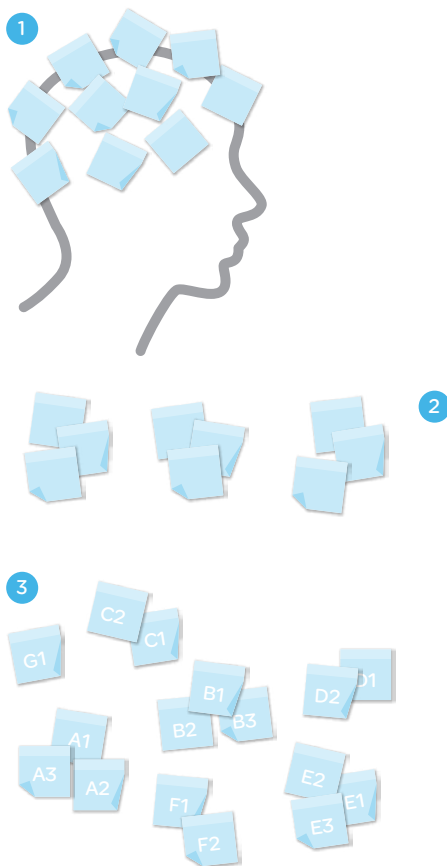
⚠️ It is important to **compile a comprehensive list of the situations** in order to create a logical architecture: adding a forgotten function at a later stage may unbalance the architecture and complicate navigation.

Categorise

- Create functional groups, organise them into classes of similar functions or tasks. E.g. diagnostics, alarms, manual commands, settings, etc.
- Also list the sub-groups which exist within the categories. e.g. all the actions and data which will contribute to the diagnosis.
- Include a home page. If this page includes a block diagram, mark the locations where the functions may potentially be activated.

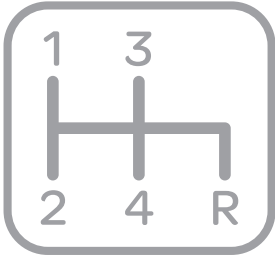
Name

- Name the groups of functions. The names selected for these functions will make up the menus of the HMI.
- Choosing a name which is familiar to the users –and not to the designer- is more effective for understanding and recognition. The closer the name of the category is to the user's universe, the more relevant the HMI will be, as the user will not waste time looking for functions.





2 Structure the menu content



Hints and tips

- > Create the tree structure,
- > Make the information accessible in 3 clicks,
- > Finalise the menus.

Menus?

Organise the groups of functions into a logical structure and use this to create menus.

Method

Create the tree structure

Organise the information into a logical tree structure in which the user will find his or her familiar universe.

Make the menus

Comply with the 7 by 3 rule to make the information accessible in 3 clicks.



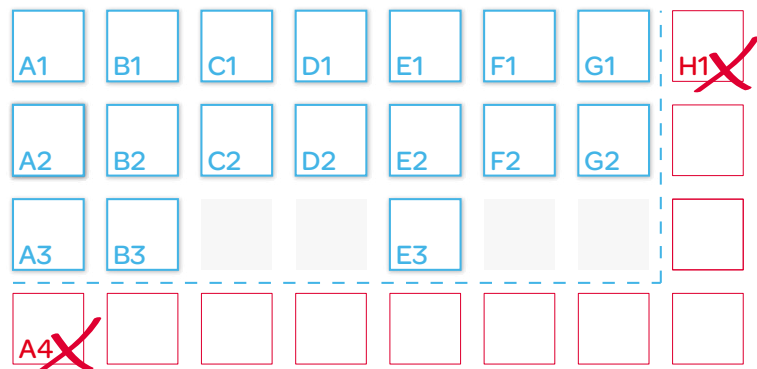
Once these menus are defined they never change and appear on every screen in the same position.

Create the tree structure

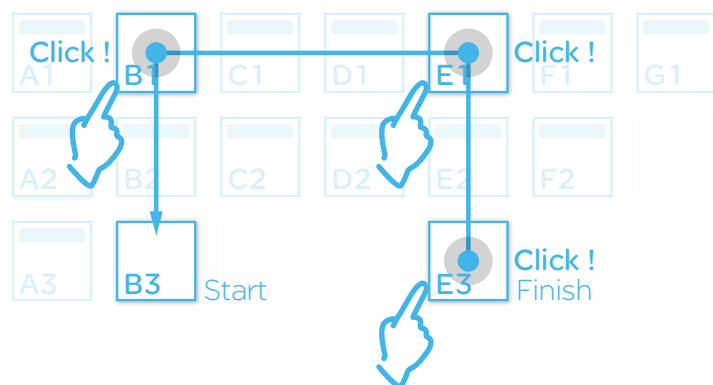
- Build the structure, organising the menus into a tree structure. This stage involves defining the access path to each of the functions.

Create the menus

- Comply with the 7 by 3 rule:



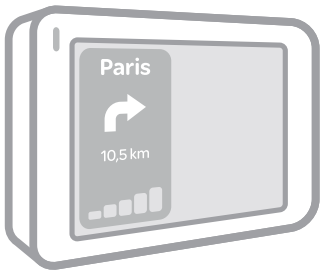
Establish a tree structure based on the names of the categories previously defined, complying with a **maximum of 7 horizontal levels** and **3 levels deep**: the information is thus available in 3 clicks.





3

Establish the principles for navigation



Navigation?

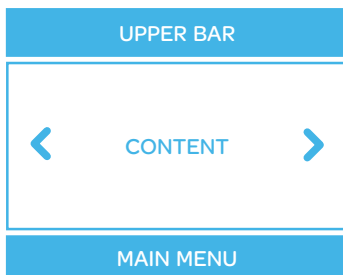
Define the elements authorising the links between the screens and allow the user to move easily from one to the other. During this stage access to the machine's functions is constructed so that the user always knows where he/she is, where he/she has come from and where he/she can go.

Method

1. List the navigation elements,
2. Group the main navigation elements in the main menu,
3. Place the generic functions in the upper bar,
4. Choose from the components library the words, symbols and icons used to navigate from the bars and/or block diagrams.

[> see chapter 5](#)

Example of navigation zones



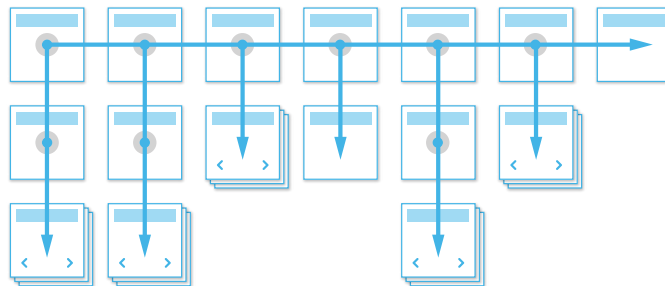
💡 Hints and tips

- > At all times the user must be able to:
 - log in or log out,
 - access the home page,
 - switch function or task,
 - move to the previous or next step,
 - change page within the same task,
 - access the generic navigation functions,
 - situate him or herself clearly.
- > Do not use scrolling.

List the navigation elements,

These are all the elements used to access information regarding the system or the machine. They must make it possible for the user to position him/herself and find his/her upstream and downstream path at all times, i.e. to know his/her position in the interface at all times.

Create the access paths



Group together the main navigation elements

They are used to move from one function to the other and are typically functions such as: commands, alarms, etc. They are placed in the main menu.

Place the generic functions

They correspond to the system's internal functions such as: access to help, connection, language, etc. They are generally grouped in the upper bar with the title of the application, the logo or the brand and the status bar (zone displaying the configured mode, status of the installation, time and any alerts).

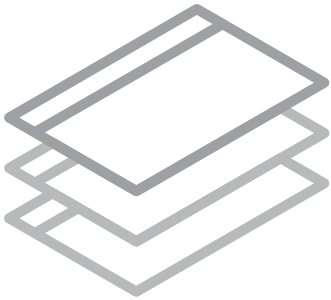
Choose the components

The arrows symbolising the previous screen or next screen functions are taken from the library. They often appear on either side of the content. There is no scroll bar. Long items of information are spread over several screens and can be accessed using the page buttons.

i The home page can be accessed either from the main menu or the upper bar in the generic functions group.



4 Structure the page layout



Page layout?

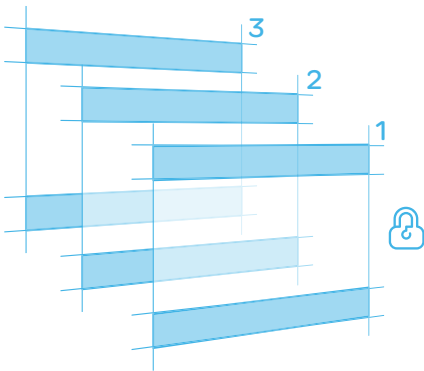
Organise the permanent elements on the page in logical way and finalise the locations.

Method

1 - Define the page typologies

2 - Define the page layout : choose the locations for the fixed or repetitive elements which will be set once and for all for each page typology.

Keep the same page layout from one page to another.



💡 Hints and tips

- > Define the page typologies,
- > Allow an obvious visual distinction to be made between the different kinds of zones or functions,
- > Keep the same page layout from one page to another.

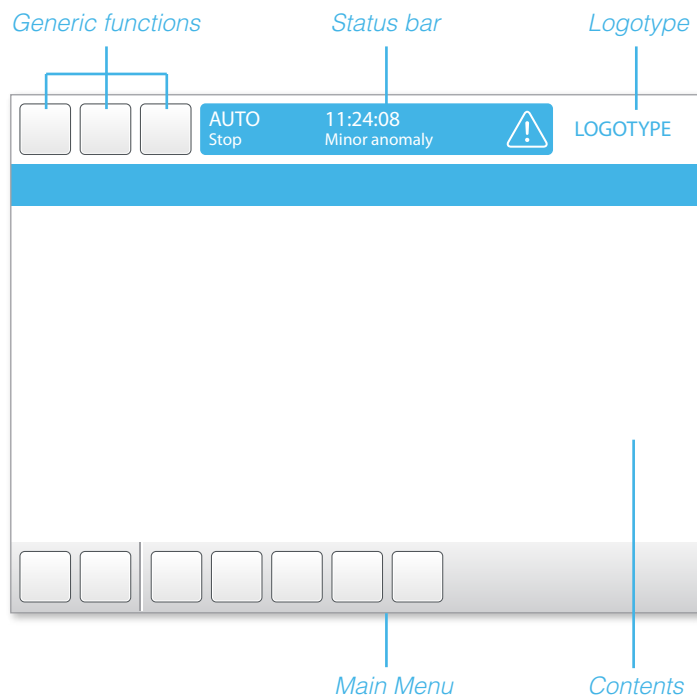
Define the page typologies

Identify the typologies: home page, function page, window page, etc.

Define the page layout

Make an inventory of all the fixed or repetitive elements to appear on the pages:

- upper bar: logo, status bar and generic functions,
- content,
- main menu.



- Rigorousness in the composition of the page layout ensures consistency from one page to another, and therefore a legible, clear interface.
- Strict consistency from one page to another aids memorisation and allows the user to create habits quickly. Working is more pleasant and operations quicker.



5 Create content: the block diagram



Block diagram?

The block diagram, in the form of a photograph or a drawing, allows all the functions of the machine to be viewed at a glance. You are advised to use it on the interface home page as an introduction. It can be interactive, i.e. give direct access to certain tasks or functions.

The active zones of the diagram give access either:

- to a page giving details of part of the machine
- a function or task concerning the zone selected on the machine.

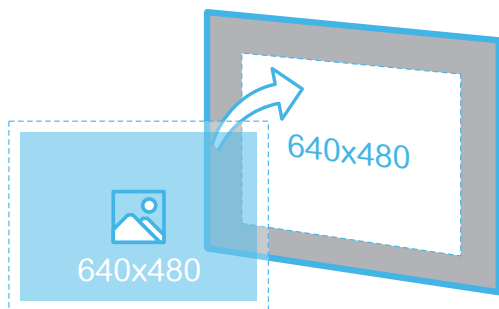
Method

Select the illustration (diagram or photo) which is most realistic for the operators.

Define the active zones and differentiate them visually from those which are not.

The active zones must not overlap or be superimposed.

The resolution of the imported image must be at least equal to the screen resolution (in number of pixels).



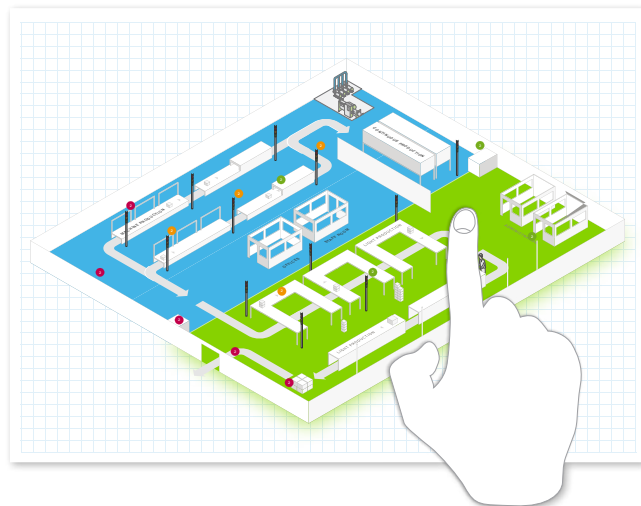
Hints and tips

- > Use a realistic view corresponding to what the user actually sees,
- > Place the diagram of the machine or the block diagram in the "content" space on the home page,
- > Restrict the number of active zones and place them far enough apart to facilitate touch navigation.

Choose the illustration

- Choose the illustration from the library or use your image after inserting it into the library,
- Opt for the user's view point if possible,
- Define the active zones,
- Differentiate the zones visually using colours or fill patterns,
- Use neutral shades to avoid interfering with the clickable elements giving machine status information and/or operating information.

Physical representation of the installation



Logical representation of the installation

ST1 █ █ █ █ █ 1.05	ST2 █ █ █ █ █ 1.05	ST3 █ █ █ █ █ 1.45	ST4 █ █ █ █ █ 2.08	ST5 █ █ █ █ █ 1.05
ST6 █ █ █ █ █ 0.00	ST7 █ █ █ █ █ 0.00	ST8 █ █ █ █ █ 0.00	ST9 █ █ █ █ █ 5.75	ST10 █ █ █ █ █ 0.95
instantaneous cd 12.55		P/H		average cd 2.15
				P/H



6 Add dynamics



Dynamics?

The commands are executed using buttons or active zones, which are dynamic elements of the HMI. They authorise movement within the HMI and give access to all the information.

Method

1- **Select the buttons** in the library, according to type: text, icon, validation, etc. and their size. Look in the library for the size of button suitable for the label you wish to give it.

2- **Determine the active zones** and adjust their size to the selectable object.

The appearance of the button or zone reveals its status:

- in raised relief for an enabled button
- in sunken relief for an activated button
- greyed out for a disabled button
- framed zone = active zone

Enabled



Activated



Disabled



💡 Hints and tips

- > Assign a single button to each command,
- > Remain consistent and uniform:
 - the same command is always activated with the same button, located in the same place,
 - consistency with regard to the size, shape, status or type of button.
- > Place the commands sufficiently far apart to avoid operating errors.

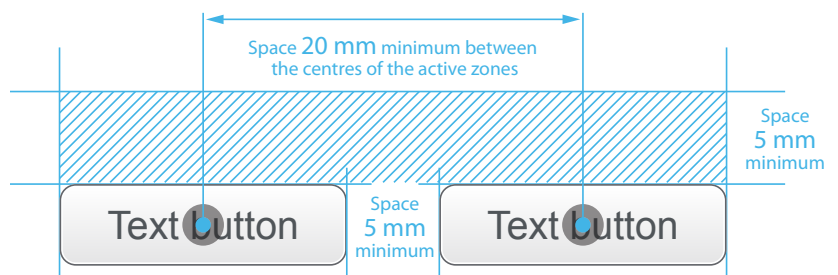
Choose the button

- Always choose the same button for the same function: identical appearance, size, shape and colour.
- Adjust the size of the button to its content, text or icon.
- Ensure you choose one which corresponds to the size of your screen, of at least the minimum size required to ensure visibility.
- Comply with good usage practices
 - Tabulation: use a text button with the name of the selected function
 - Return to the home page: text button or icon button
 - Navigation to next and previous pages: arrow buttons
 - Paging within the same function when information is spread over several pages: page number
 - Validation or confirmation: buttons with OK/Cancel or Yes/No.

Define the active zones

Place the clickable zones far enough apart to ensure they do not overlap (as users often wear gloves).

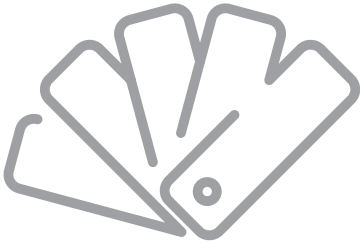
- Calculate a space of **20mm minimum** between the centres of each button or active zone,
- Ensure there is a space of **5mm minimum** between the buttons,
- Offer a stylus if the touch screen is too small to allow the recommended size of button to be used.





7

Highlight: image & colour



💡 Hints and tips

- > Limit the use of icons to standard functions e.g. home, help, etc.
- > Adapt the illustration to the size of the screen,
- > Limit the number of colours to 5 or 6,
- > Ensure your colour code is consistent.

Highlighting?

The icons, images and colours are the static elements used to aid understanding or illustrate a concept.

They improve both the visibility of the elements and their legibility.

Method

Recover from the library:

- the vectorial images,
- the icons dedicated to the HMI.

Use colours to make the titles stand out, or to attract attention to the alarm or malfunction buttons.

Use the common sense colour codes:

- green for normal operation, on,
- orange/yellow for alerts,
- red for faults and off,
- blue for non-critical information.

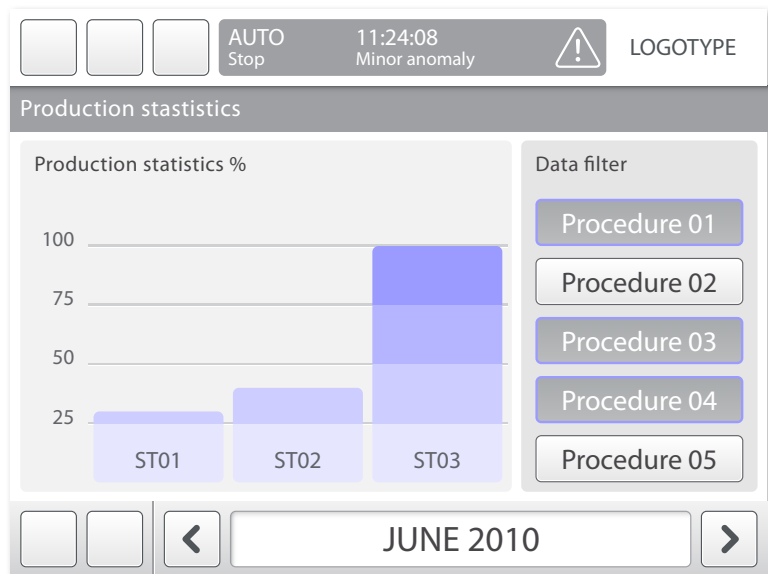
Application of the status colours to the icons



Select the colours

- Highlight the dynamic content using colour, limiting your choice to a maximum of 5 or 6 colours to avoid a "rainbow" effect.
- ⚠️ Use the meaning of the standard colour codes.
- Create your own code with the same colour for the same type of application. This code must have clear meaning for the user with no ambiguity.

Use of a colour to reveal important information



Status colour references



Status	Preview	Example	Four colour printing (%)				Pantone®	Screen display			Web Hexadecimal
			Cyan	Magenta	Yellow	Black		Red	Green	Blue	
OK			78	0	100	0	-	0	172	40	#00AC28
Alert			0	10	92	0	-	255	222	0	#FFDE00
Error			0	84	75	0	Warm Red C	231	71	60	#E7473C
Information			75	0	0	0	298C	66	180	230	#42B4E6



8

Make it legible adjust the contrasts



💡 Hints and tips

- > Opt for a dark text on a light background,
- > Always test the choice of colour.

Contrasts?

The levels of contrast improve the legibility of the information and allow you to use the intensity of the colour to make it stand out better.

Method

Use a font with dark letters on a light background.

Adjust the contrasts, opting for:

- neutral tones and low contrast for the static elements,
- coloured shades and stronger contrasts for the dynamic elements.

Adjust the shades in the foreground and background to give maximum legibility.

Text colour:
White
Background colour:
SE Sky Blue

Text colour:
SE Dark Gray
Background colour:
SE Sunflower Yellow

Text colour:
Black
Background colour:
SE Sky Blue

Text colour:
SE Spruce Green
Background colour:
E Sunflower Yellow

Test the choice of colours online

- Check that people with colour-blindness can distinguish between the colours sufficiently well: [VischeckURL](#) or [Color Vision](#)
- Check the colour harmonies: [Color Scheme Designer](#)
- Validate the colour contrast by entering the colour reference for the foreground and that of the background: [Color Contrast Check](#)

Result of a "colour contrast check" test

Foreground Colour:

474548

Red:

Green:

Blue:

Hue (*):

Saturation (%):

Value (%):

Background Colour:

FFD100

Red:

Green:

Blue:

Hue (*):

Saturation (%):

Value (%):

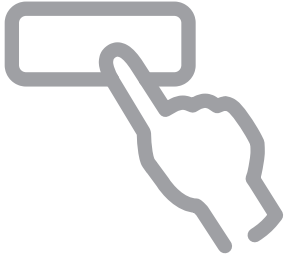
Results

This is example text. **Some of it bolded.**
Some of it italicized.

Brightness Difference: (>= 125)	128.98
Colour Difference: (>= 500)	396
Are colours compliant?	sort of
Contrast Ratio	6.5
WCAG 2 AA Compliant	YES
WCAG 2 AA Compliant (18pt+)	YES
WCAG 2 AAA Compliant	NO
WCAG 2 AAA Compliant (18pt+)	YES



9 Create texts and dialogue tools



Texts and dialogue tools?

The texts give the user the information he/she requires at the right moment.

The dialogue tools guide the user in the dialogue by distinguishing the clickable elements from those which are not.

Method

Use a consistent structure and vocabulary. It is important to remain consistent with the rest of the interface.

Adapt the size of the characters to the content of the information and the ease with which it can be read at a distance:

- Distance < 50cm / interaction: parameters, settings, navigation,
- Distance > 50cm / viewing: control information, monitoring.

Create the dialogue tools (there are 3):

- interaction button, "OK" type or navigation button,
- input field for customising on a white background,
- numerical and alphanumerical keyboards.

! Always offer the possibility to correct data.



💡 Hints and tips

- > The background:
 - Adopt the user's vocabulary,
 - Only provide information which is directly useful.
- > The form:
 - Use normal characters: neither animated text nor texts consisting solely of capitals or italics,
 - Adjust the size of the characters to the reading distance.

Create texts which are easy to read

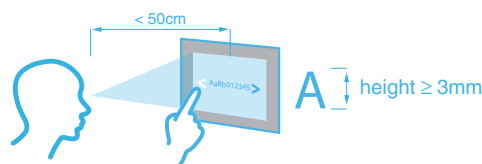
- Write short, precise texts, reduced to the bare essential,
- Be positive for quick comprehension,
- Opt for the active form, which is direct and unambiguous,
- Remain focused on the tasks and functions,

Make the dialogue tools legible and visible

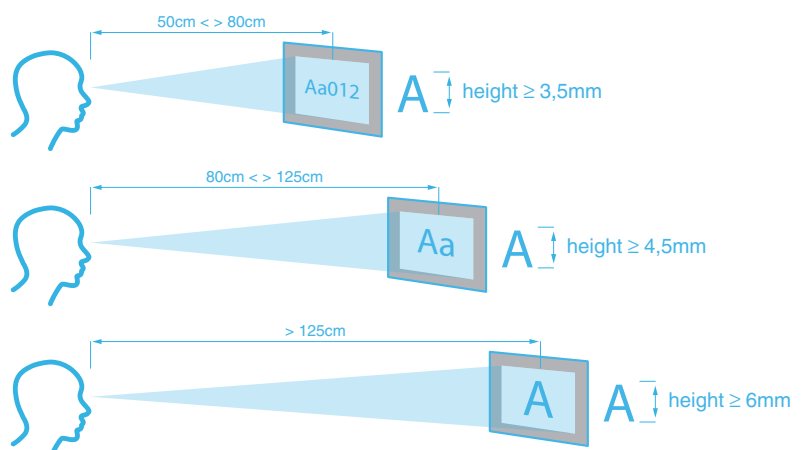
- Differentiate the dialogue tools by the background colour:
 - white: active, to allow a value to be changed
 - grey: disabled, to be chosen when the information must not be modified by the user.
- Indicate the numerical keyboard by a pop-up representing a keyboard, and select the numerical or alphanumerical keyboard depending on the type of data to be input.

Adjust the size of the font to suit the reading distance.

Distance less than 50cm : Interaction

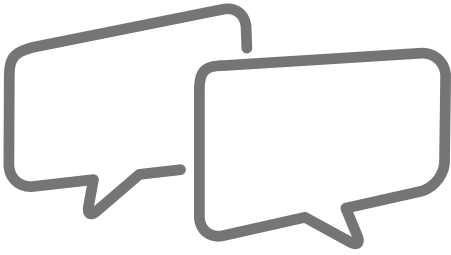


Distance greater than 50cm : Viewing





10 Create a dialogue box



Dialogue box?

A dialogue box opens when the user makes an error or the system detects that the machine is not operating correctly.

They allow the system to dialogue with the user by informing him/her of an error, an alarm, some information or a validation message.

Method

1. Construct a standard dialogue box with the fixed elements: shape, size of window, position and size of the pictograms, the buttons and the text zone.
2. Create the 4 screens for the dialogue boxes: error, alarm, information, validation.
3. Write messages according to the usage contexts.

Hints and tips

- > Do not use abbreviations or cut words,
- > Only provide information which is directly useful,
- > Ensure that opening the window does not interrupt the task,
- > Ensure the interface returns to the previous screen when the dialogue box closes.

Choose the message

- ✘ The error message: be explicit, and go beyond simply informing the user of the anomaly by offering a solution.
- ⚠ The alarm message: used to inform the operator of abnormal operation or direct the user towards a solution.
- ℹ The information message is used if the user needs to take a new element into account: e.g. if a new action is available.
- ✔ The validation or confirmation message warns the user that his/her action has been correctly taken into account: e.g. a deletion.

Incorrect value

Please re-enter the value using the keyboard.

[> further information...](#)

The conveyor belt at station 5 is jammed.

Check that no object is blocking it.

[> further information...](#)

The configuration data has been taken into account.

[> further information...](#)

Do you want to change the equipment settings?

Create texts which are easy to read

- Be affirmative for quick comprehension,
- Opt for the active form, which is direct and unambiguous,
- Remain focused on the tasks and the functions,
- Be constructive and non-critical,
- Write complete messages, without cutting any words or abbreviating unless you offer access to more detail by via a suitable button (details, more info, etc.)



+ Find out more...

How to avoid operator errors?

To avoid input errors:

- Display the relevant unit of measurement,
- Give the maximum length of text which can be input.

To confirm an action:

- Give immediate feedback, with a validation message,
- Give the progress status of a process currently running.

How to ensure the operator is always in control?

Always include the OK function to start a process, confirm an order or after entering data.

Give the user the possibility to cancel, interrupt or delete.

Bibliography

- > The Design of Everyday Things - **Donald A. Norman**
- > Don't make me think: A common sense approach to web usability – **Steve Krug**
- > Usability Engineering - **Jakob Nielsen**
- > Designing the user Interface : strategies for effective human-computer interaction - **Ben Schneiderman** - 5th edition
- > Inmates Are Running the Asylum: Why High-Tech Products Drive Us Crazy & How to Restore the Sanity - **Alan Cooper**
- > Designing Interactions - **Bill Moggridge**
- > About Face 3: The Essentials of Interaction Design - **Alan Cooper, Robert Reimann, and David Cronin**
- > Designing for the Digital Age: How to Create Human-Centered Products & Services - **Kim Goodwin**