Cognitive representations

To Gate **D8** which way to go?

Rome, Fiumicino airport 2014

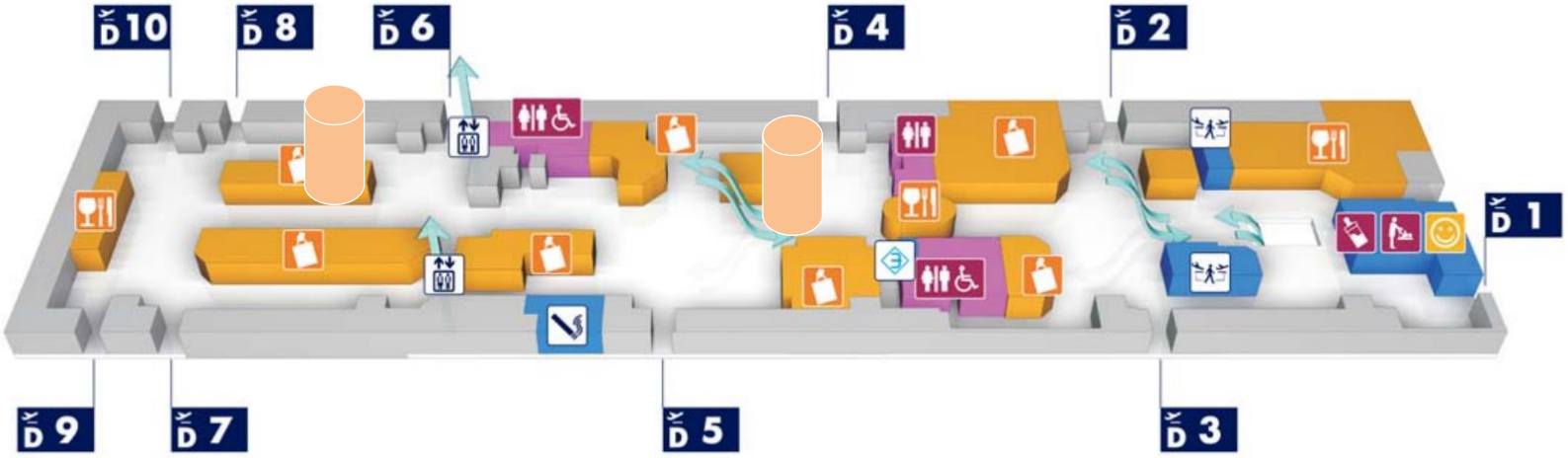
Cognitive
schemas, representations maps or images?

People make predictions based on spatial, logical or other constructs

The solution to the traveler's puzzle

choosing any side will finally made no difference

but a hurried traveler is overly stressed

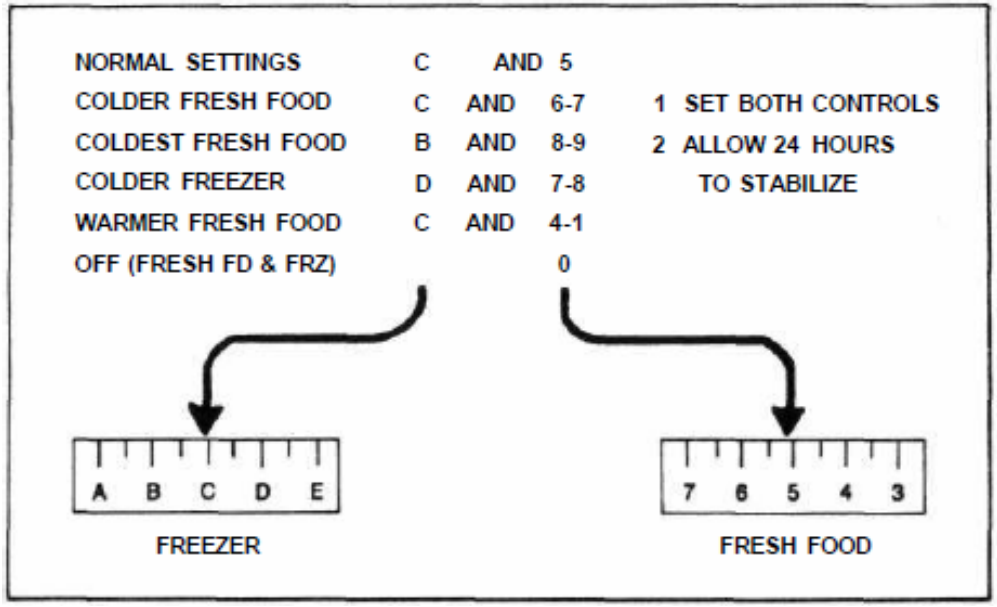


What was the problem with this particular signage?

An inconsistent conceptual model – inability to form a coherent cognitive map

Cognitive representations – an example

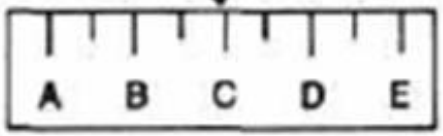
A typical two compartment refrigerator. Below is the temperature control panel for the FRESH FOOD compartment and FREEZER



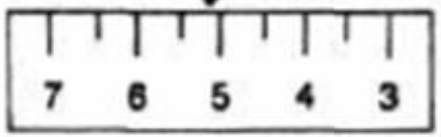
Suppose the Freezer is too cold and the fresh food compartment just right. How would you adjust the controls so as to make the freezer warmer and keep the rest intact?

NORMAL SETTINGS	C	AND	5
COLDER FRESH FOOD	C	AND	6-7
COLDEST FRESH FOOD	B	AND	8-9
COLDER FREEZER	D	AND	7-8
WARMER FRESH FOOD	C	AND	4-1
OFF (FRESH FD & FRZ)			0

1 SET BOTH CONTROLS
2 ALLOW 24 HOURS TO STABILIZE

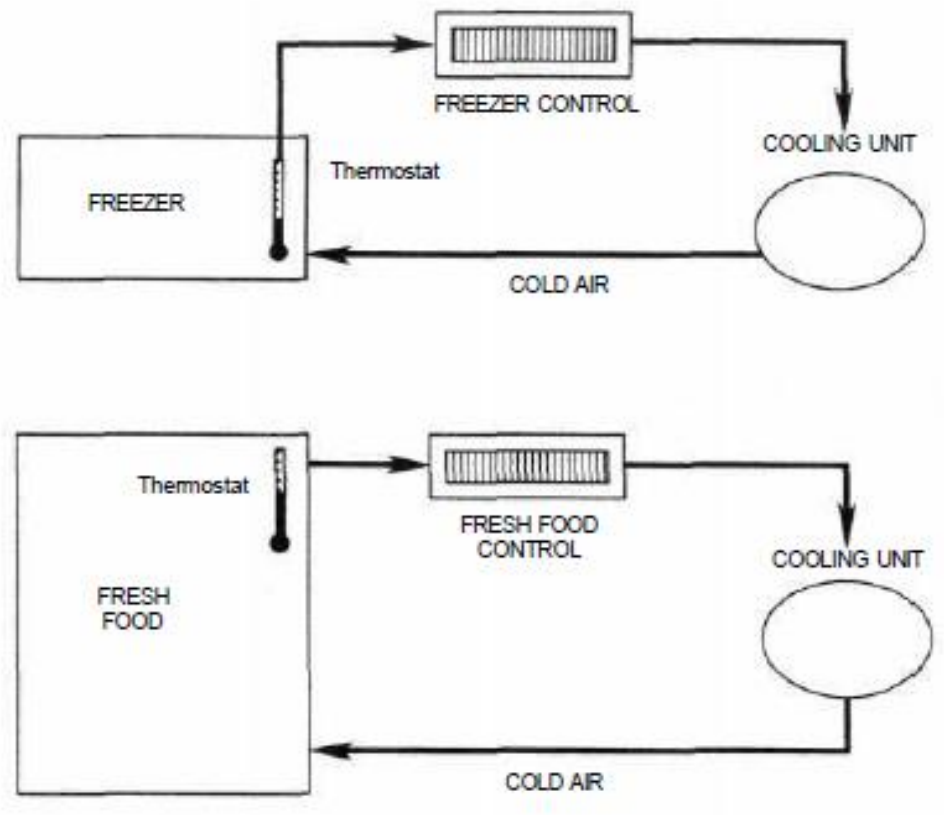


FREEZER



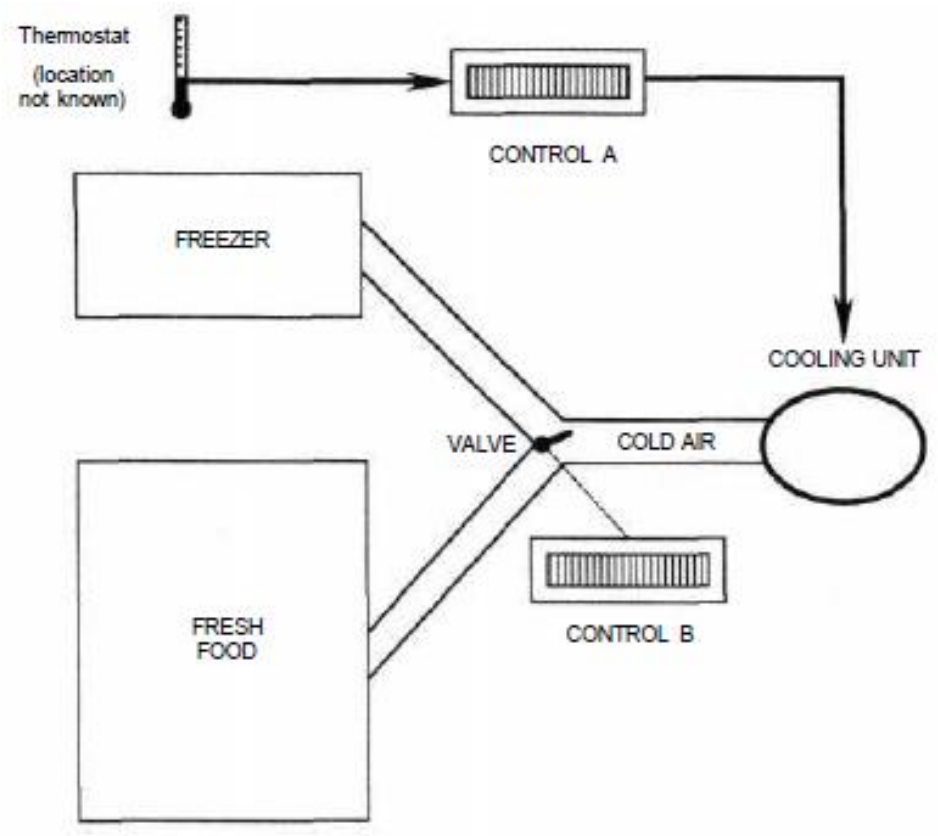
FRESH FOOD

The control panel of the refrigerator denotes a cognitive representation of the control system as below

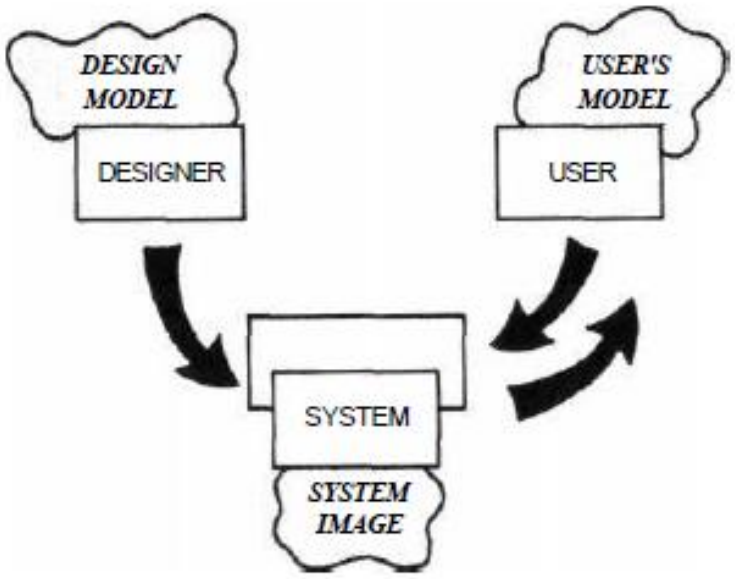


The correct representation of the control system of the refrigerator

(only one thermostat, cooling of one compartment affects the other)



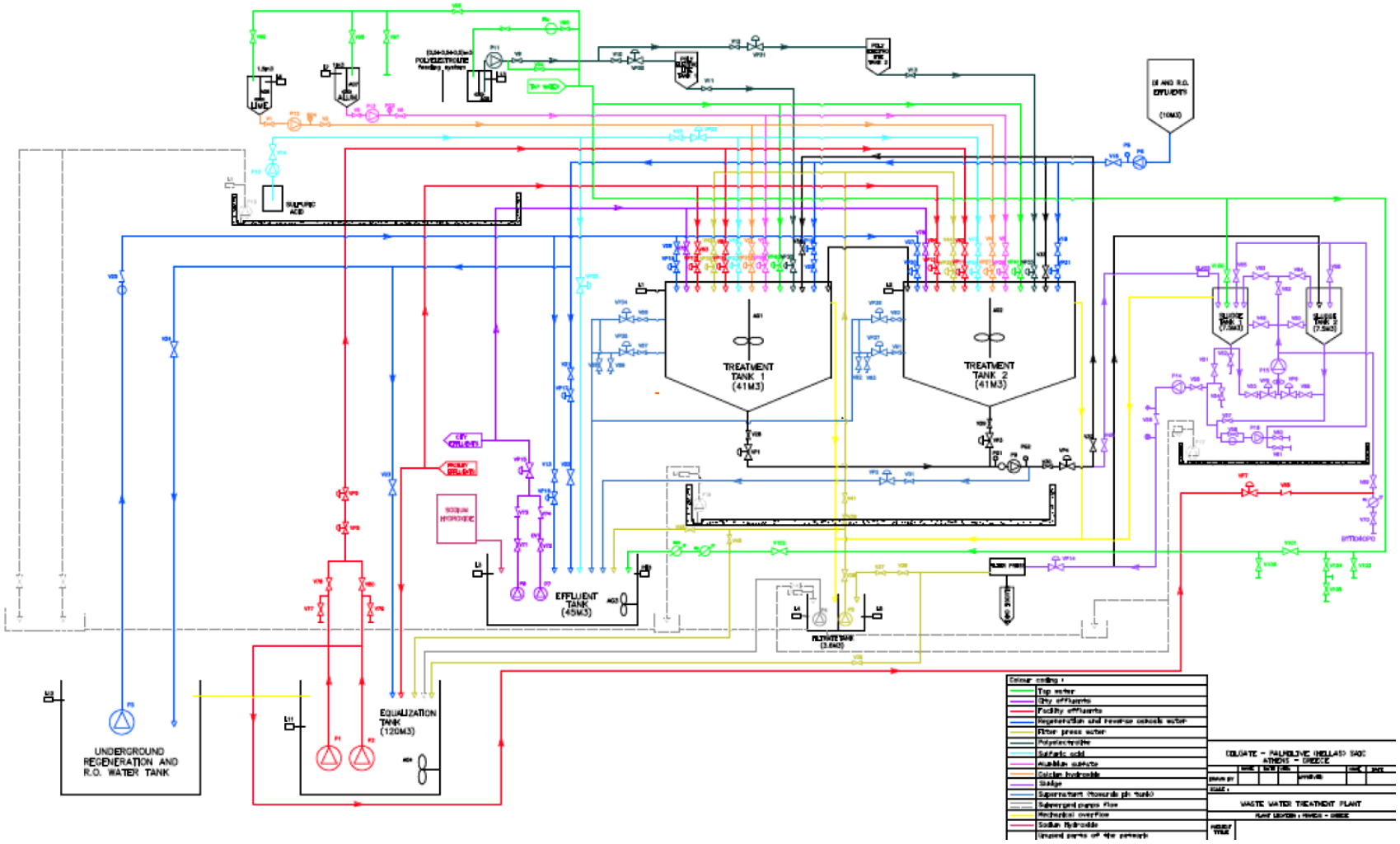
All communication between designer & user passes through the system image.



If the system image does not make the design model clear the user will end-up with a wrong mental model

C.S. Peirce's Semiotic triangle is behind this
(i.e. Referent – Representamen – Interpretant)

Interface design for a Factory Chemical Cleaning Plant



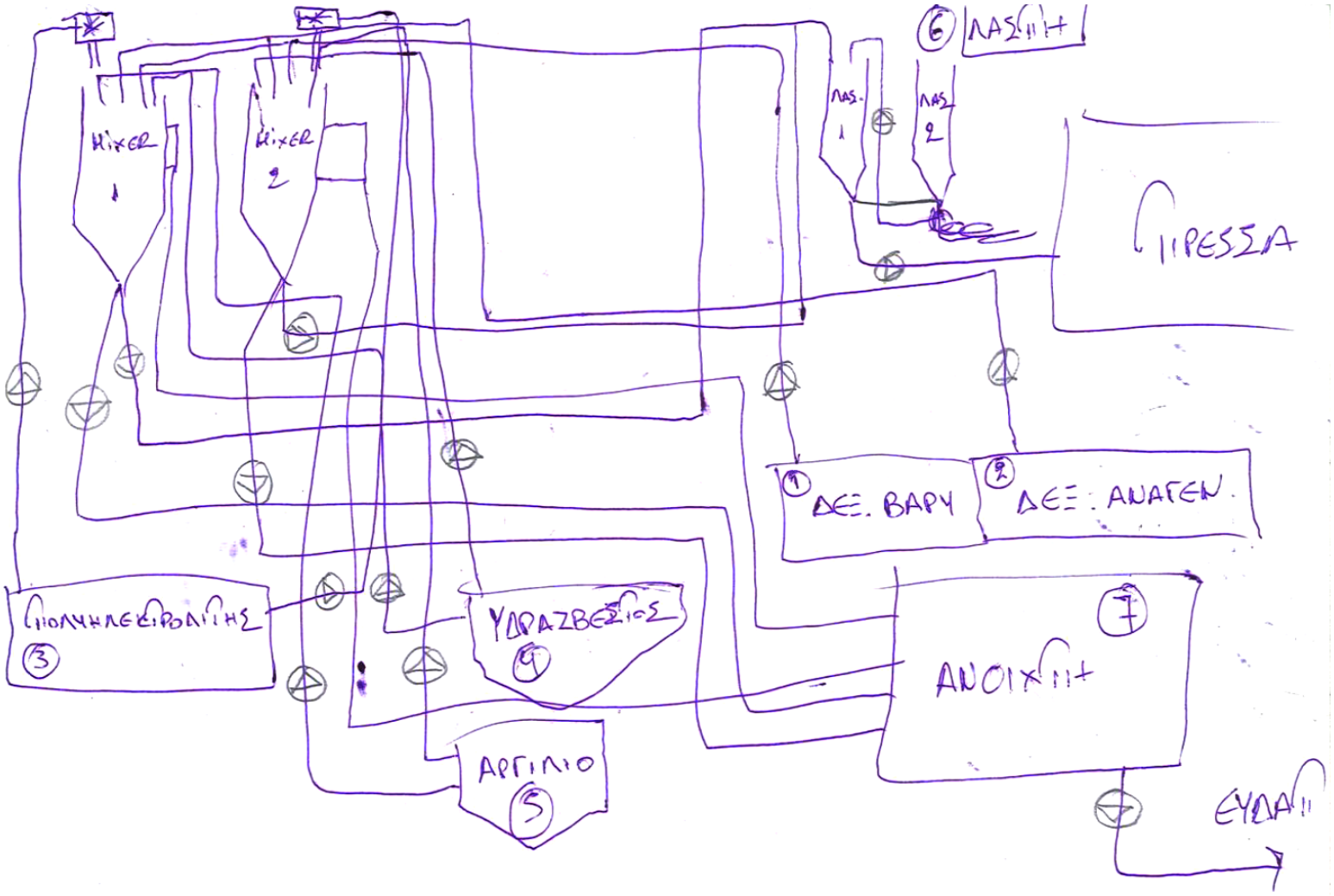
Engineering diagram of the chemical plant

Interface design for a Factory Chemical Cleaning Plant operators were asked to sketch out the process by hand

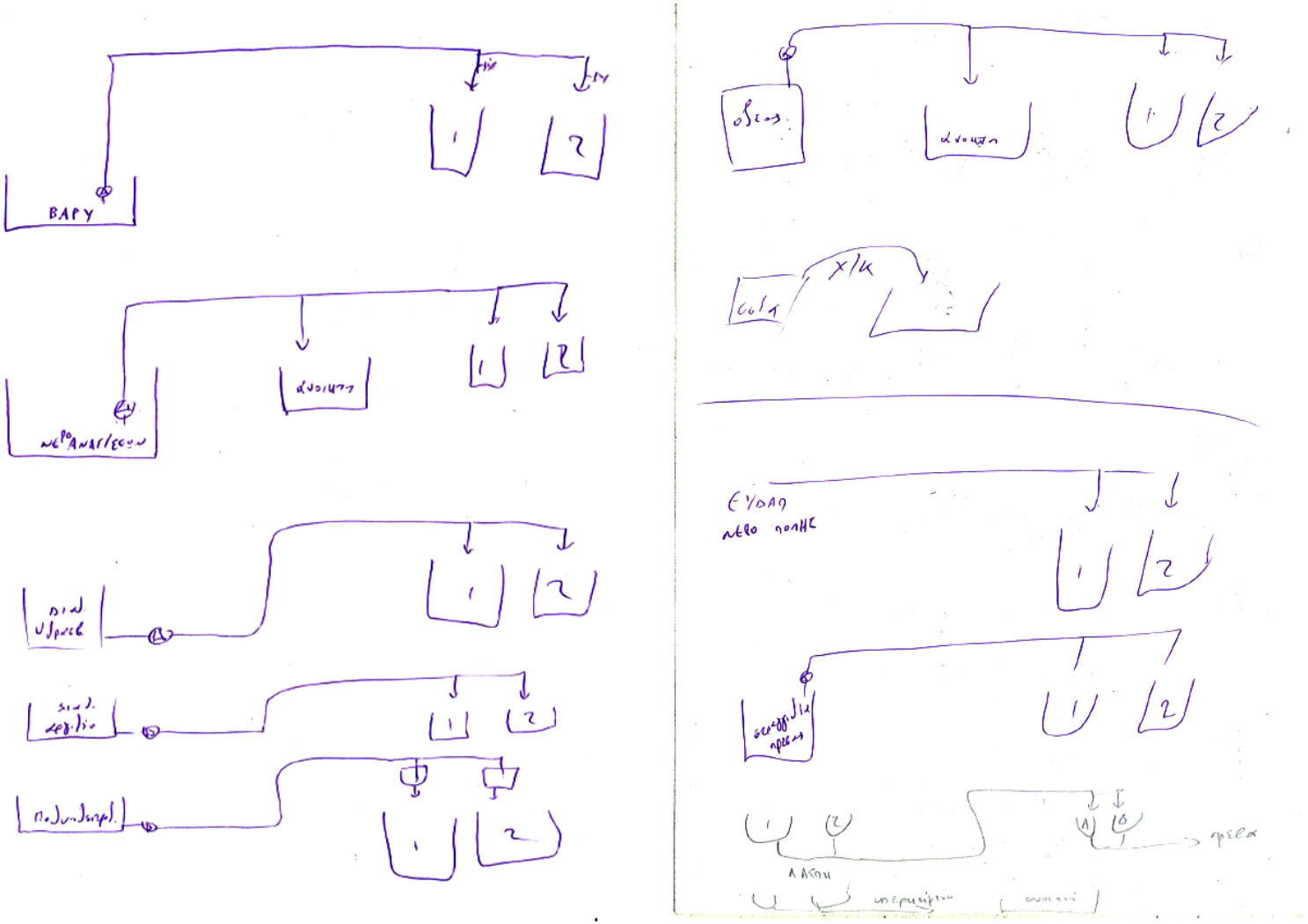
“Please draw, piping, reactors, vanes etc. so as to explain exactly how the plant works. Please try to be meticulous in your representation”

Michailidou Ifigenia - Mechanical Engineering Dissertation 2014

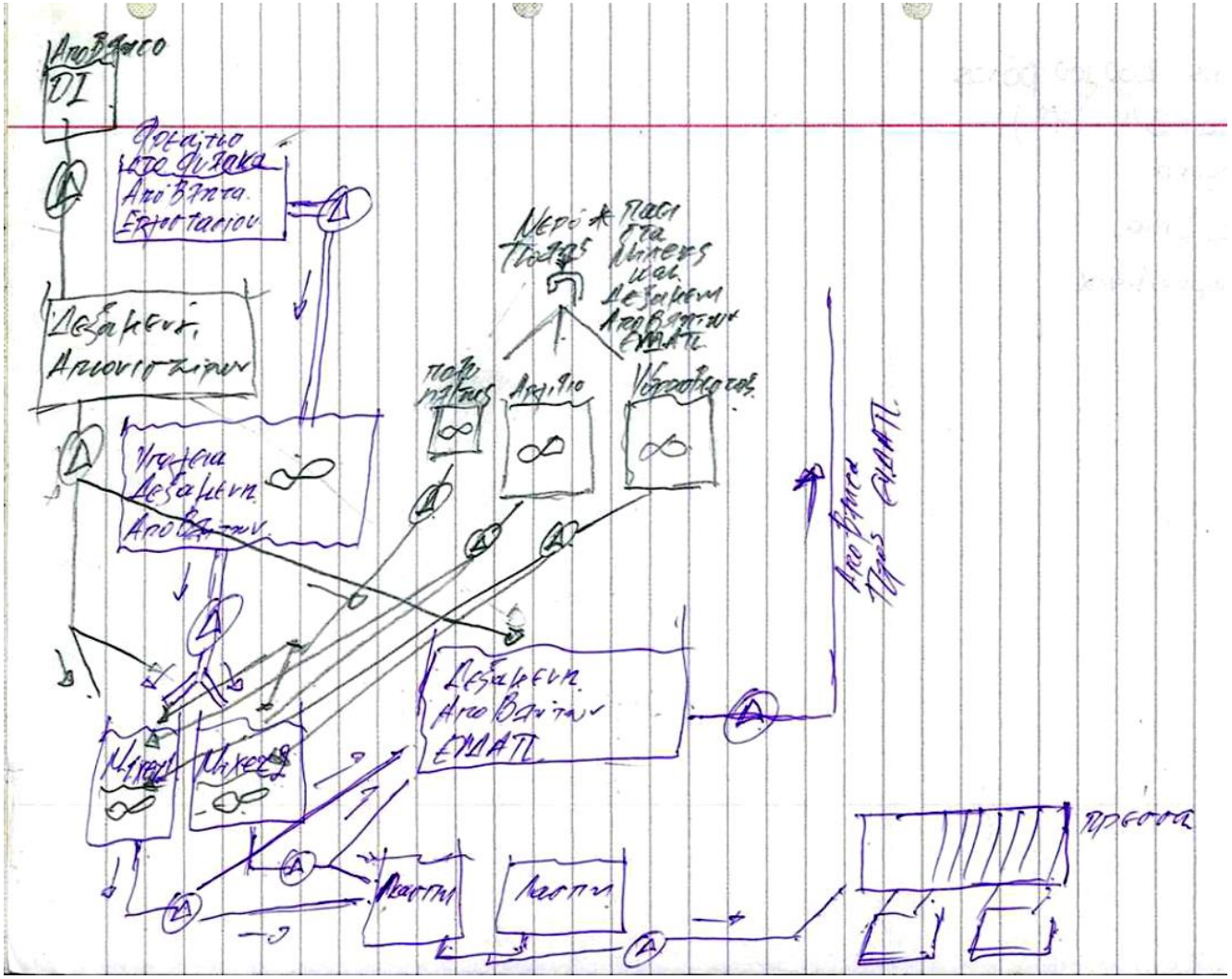
Operator sketches of the whole system (5)



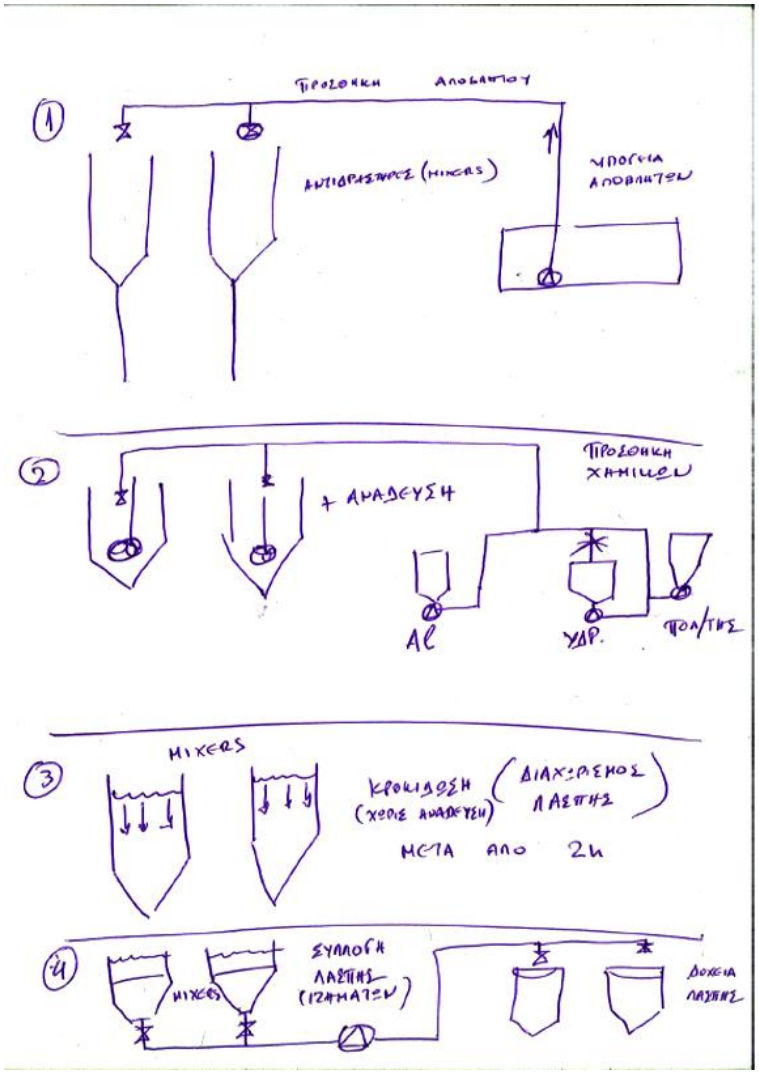
Operator sketches of the whole system (1) team-leader

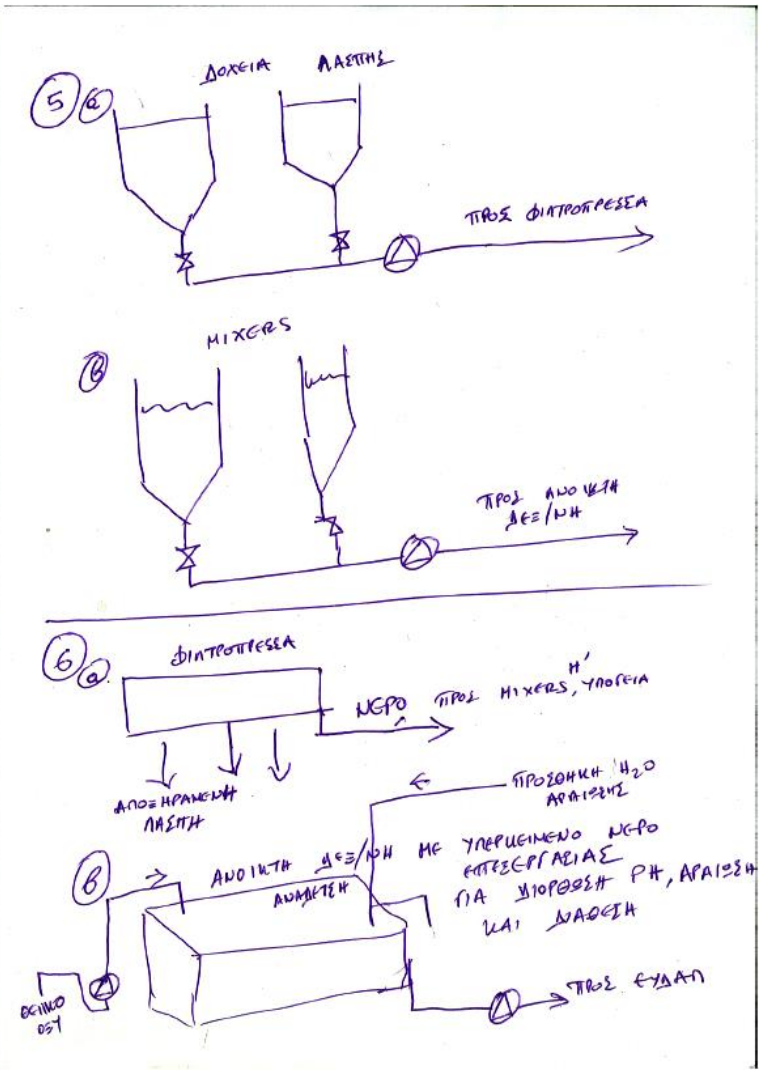


Operator sketches of the whole system (2)

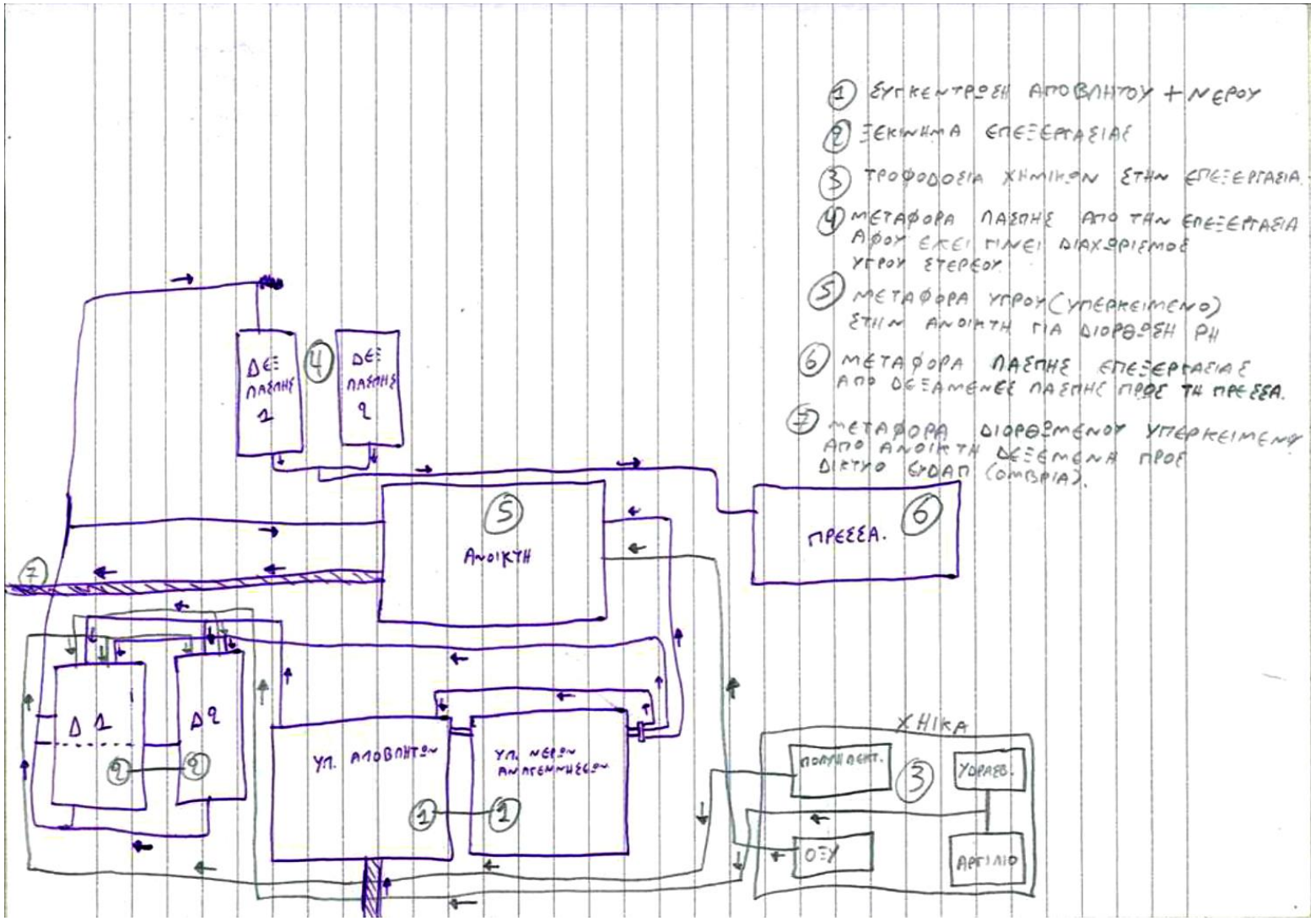


Operator sketches of the whole system (3)

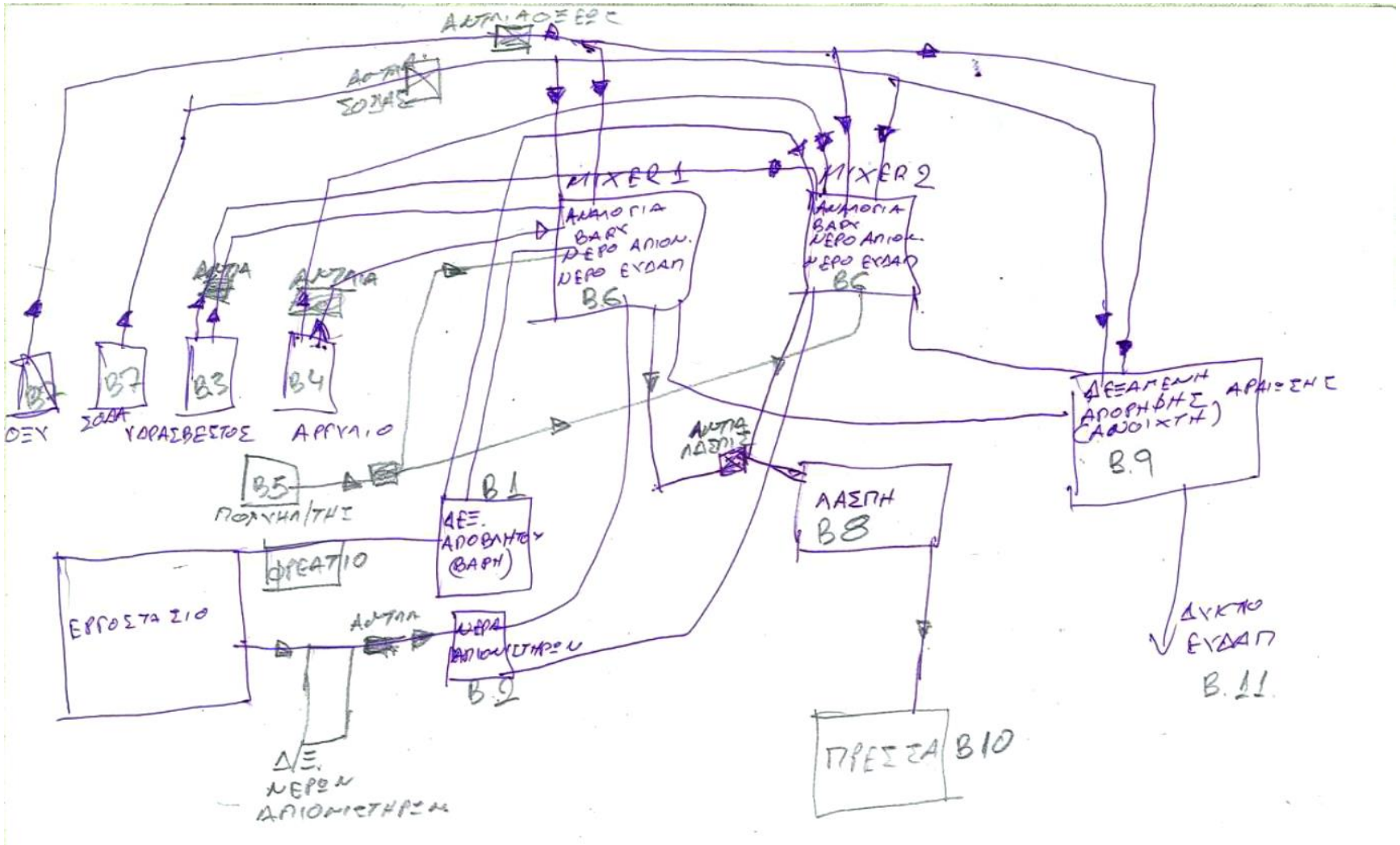




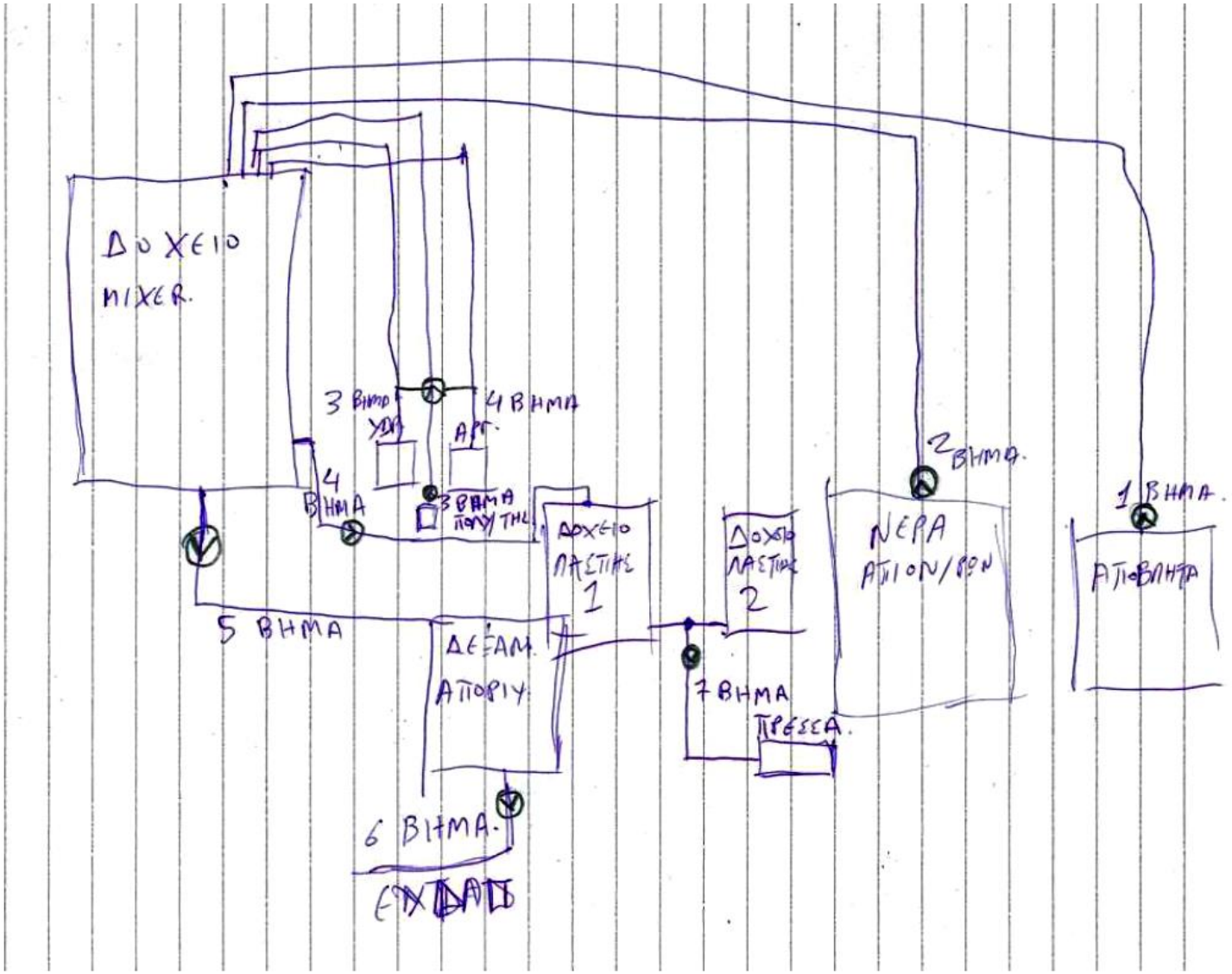
Operator sketches of the whole system (4)



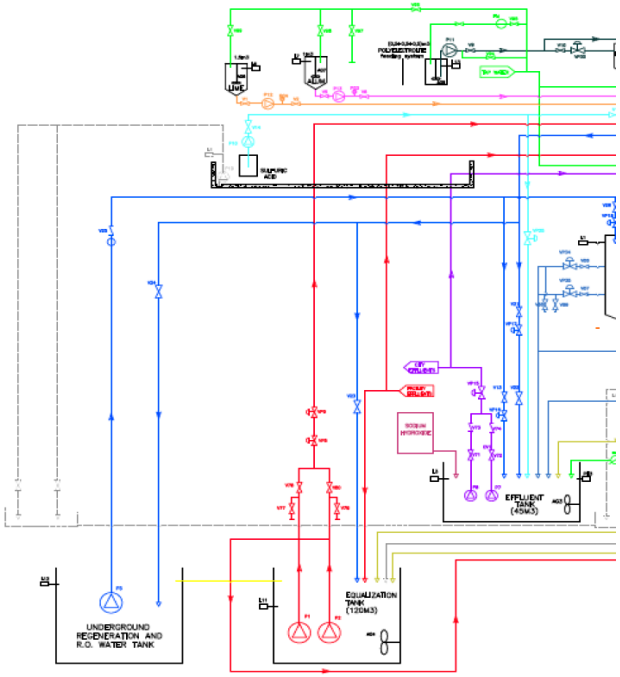
Operator sketches of the whole system (7)

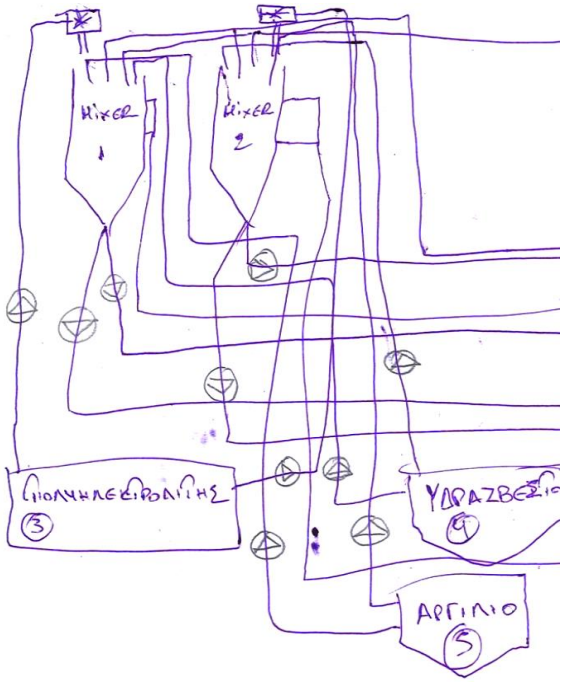


Operator sketches of the whole system (6)



Operator sketches are a good way to identify Users model
this helps
checking across consistency of mappings between users
checking compatibility of user model with design model





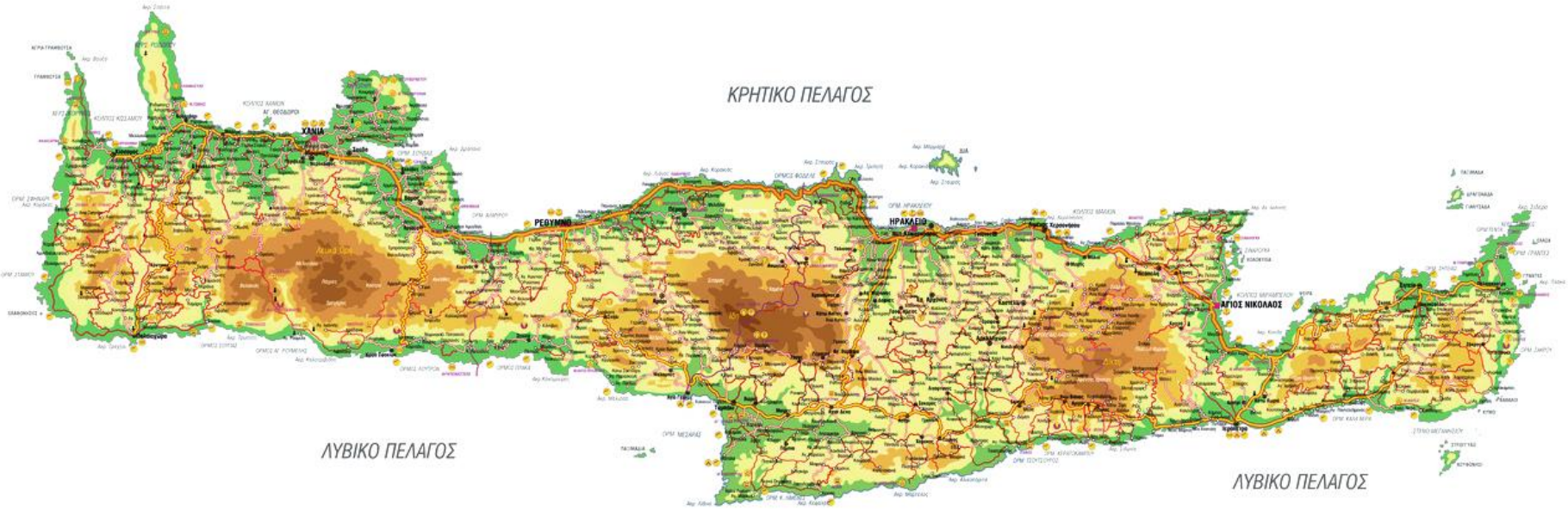
Remembering vs Recognition: try to sketch a Bicycle from memory

Remembering vs Recognition: Bicycle

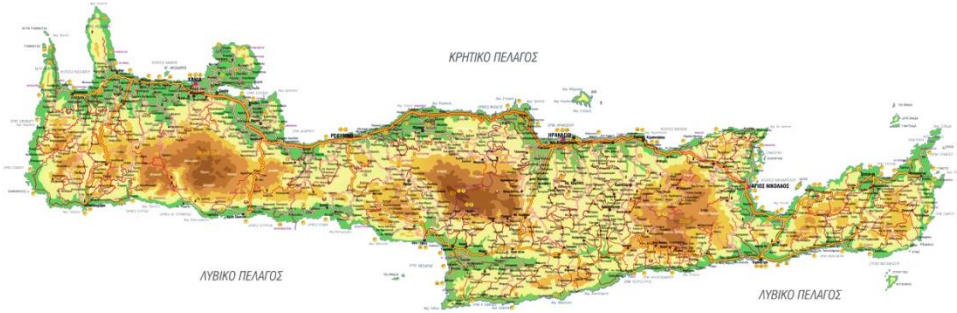
Remembering vs Recognition

https://www.gianlucagimini.it/portfolio-item/velocipedia/?fbclid=IwAR2owp2WQfg52LD0WVrX3h4-CJQbv6VwzVLjnd4uPHf5_rZ7elFlPTyh7bM

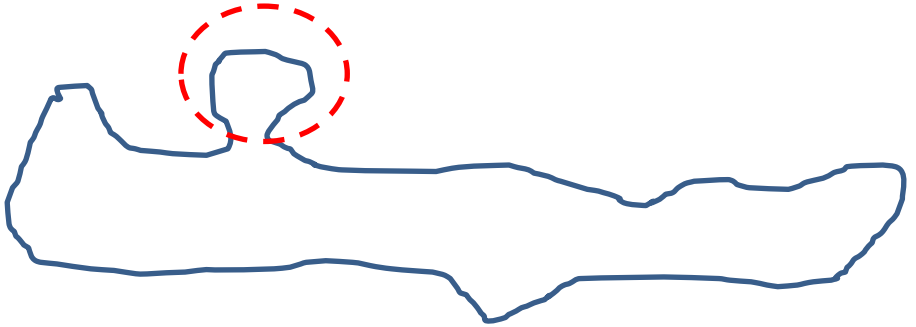
Cognitive representations are biased towards the most salient features:
map of Crete



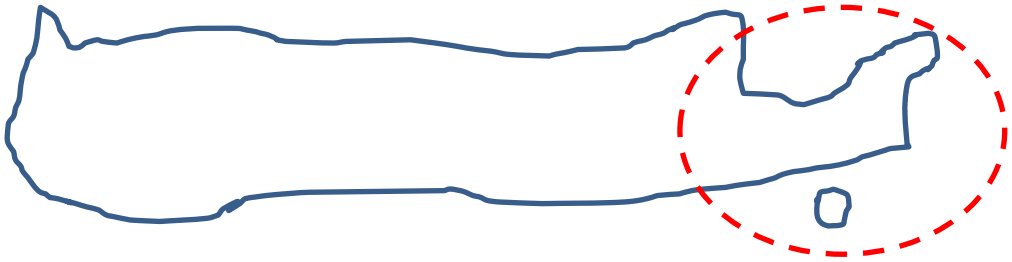
Cognitive representation
Functional deformations



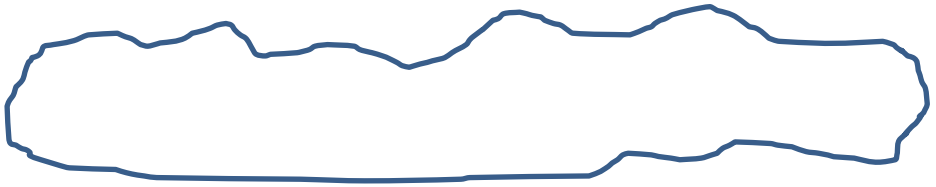
Born in Chania



Visited Lasithi last year
(including koufonisi)



Greek – Never visited Crete



Cognitive representations - *schemas*

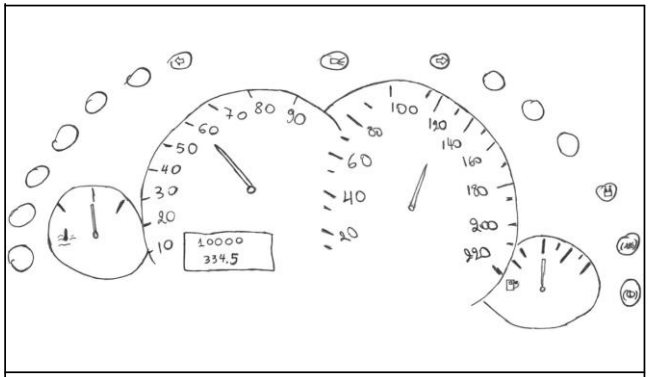
Schema: an active organized setting of past reactions or experience (Bartlett, 1932)
Schemas are always constructed on the spot, based on the current context

Schemas are not stored in memory as static representations, but they are living and developing, and help to determine our daily modes of conduct
Related concepts : "*frames*" (Minsky, 1975) and "*scripts*" (Schank and Abelson, 1977)

Examples of drivers drawings with different level of driving experience, regarding the display panel of their vehicle

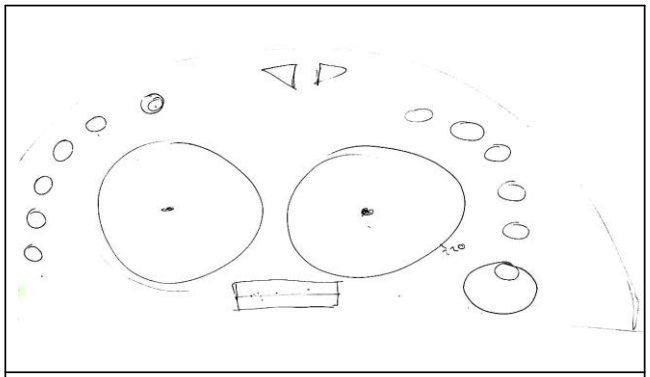
FORD Focus I

(e)



Male, 22 years, License 1 years

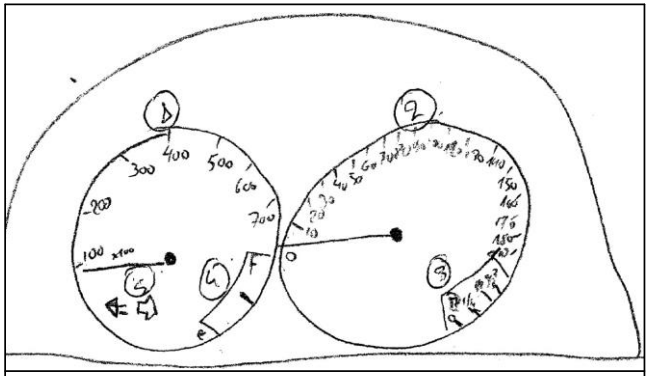
(f)



Female, 50 years, License 33 years

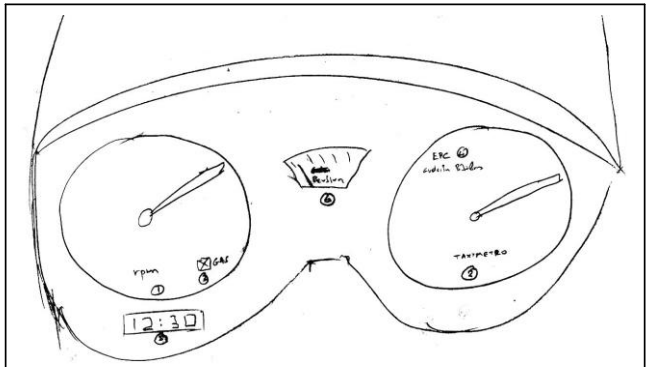
VW Polo Mk3F

(g)



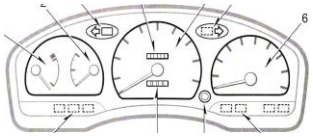
Male, 26 years, License 8 years

(h)



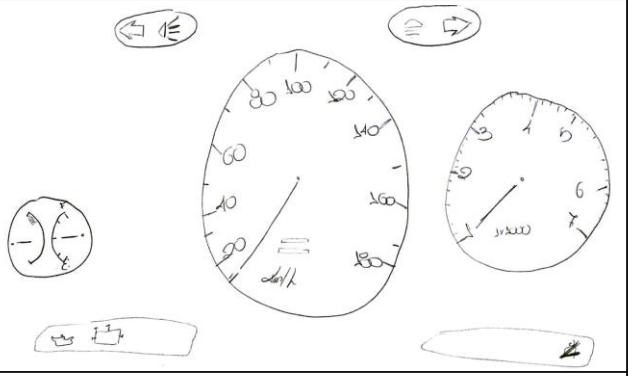
Male, 31 years, License 12 years

Examples of drivers drawings with different level of driving experience, regarding the display panel of their vehicle



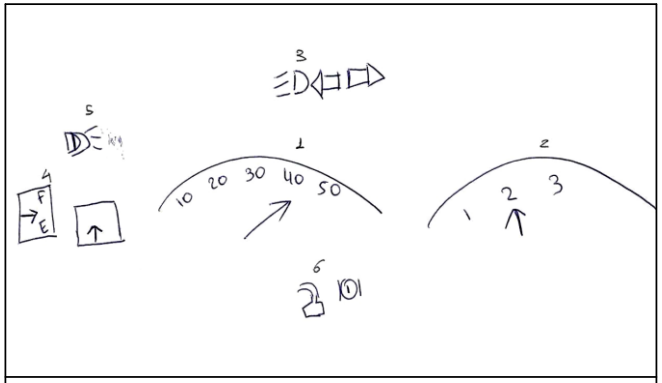
TOYOTA Starlet III

(a)



Male, 21 years, License 3 years

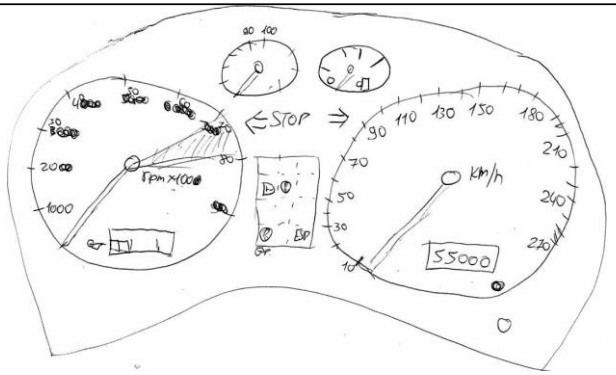
(b)



Female, 34 years, License 14 years

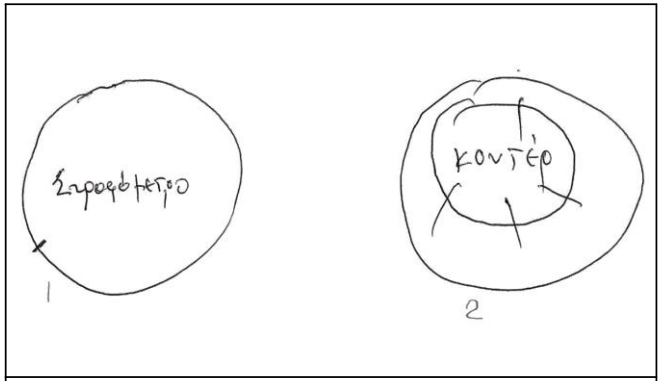
PEUGEOT 307

(c)



Male, 25 years, License 7 years

(d)



Male, 58 years, License 30 years

Declarative and procedural knowledge

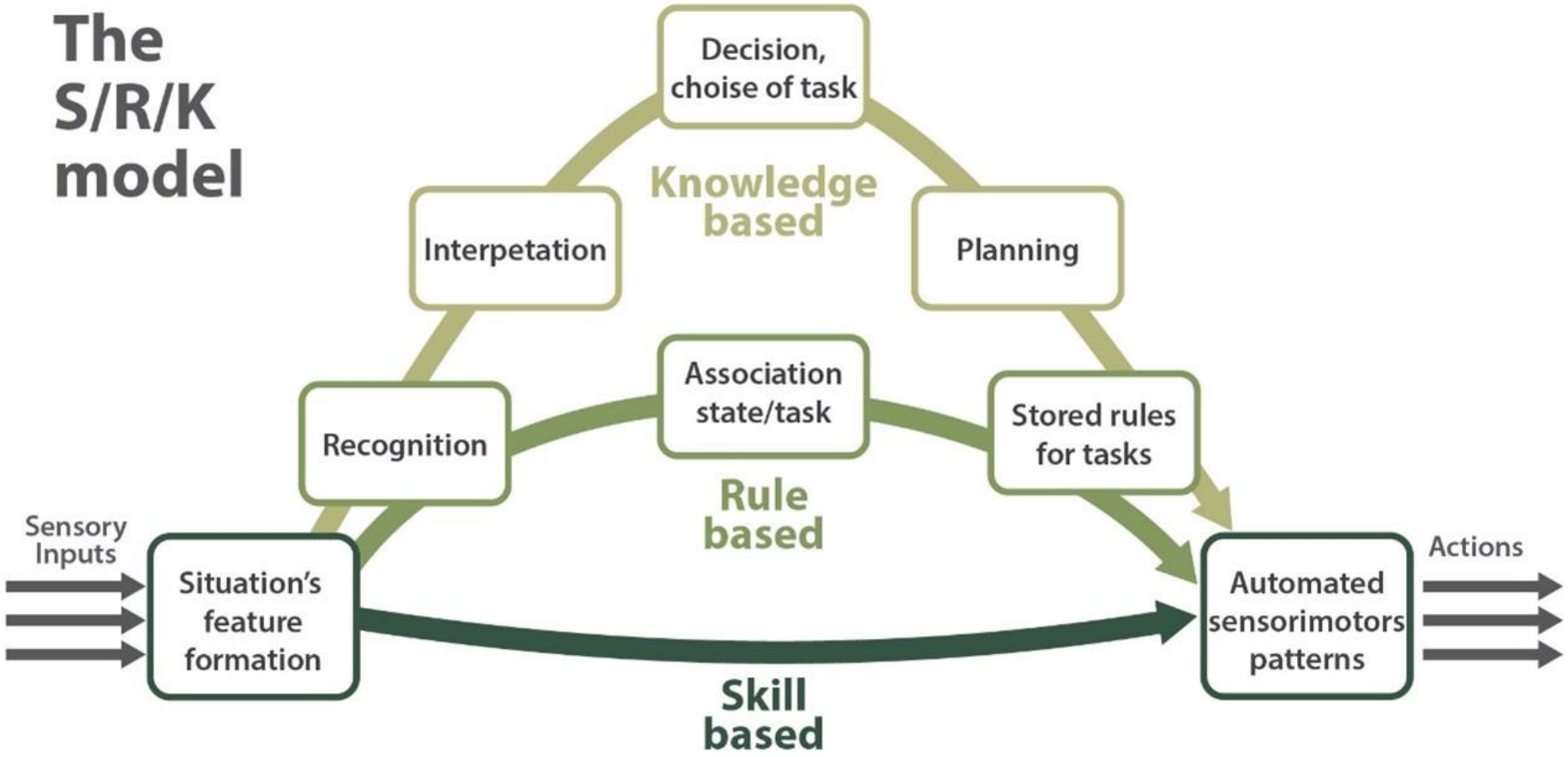
Declarative knowledge: what someone possesses about the structure and operation of objects, artefacts, environments.
They can be described by language, drawings …

(i.e. the date that Greek independence straggle started)

Procedural knowledge: what someone possesses in order to interact with artefacts or the environment aiming to achieve particular goals.
They cannot always be described by language, drawings … (tacit knowledge)

(i.e. taking blood from a patient's arm, changing gear in you car, knitting)

The S/R/K model



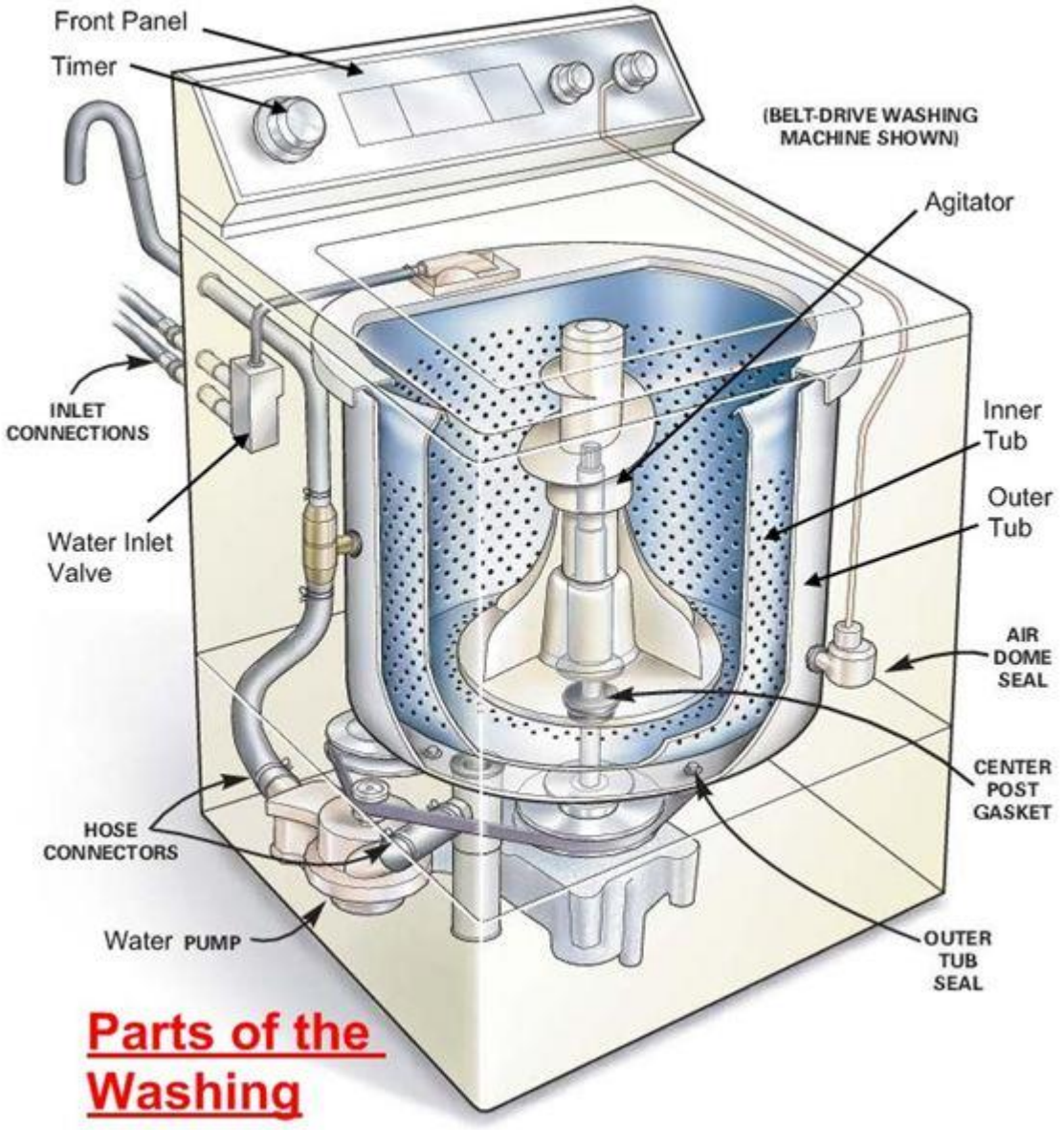
Manual for non-experts

ΟΔΗΓΟΣ ΑΝΤΙΜΕΤΩΠΙΣΗΣ ΠΡΟΒΛΗΜΑΤΩΝ

Το πλυντήριό σας είναι εφοδιασμένο με διάφορες αυτόματες λειτουργίες ασφαλείας. Αυτό του επιτρέπει να ανιχνεύσει τις βλάβες έγκαιρα και το σύστημα ασφαλείας να δράσει ανάλογα. Αυτές οι βλάβες είναι συχνά τόσο μικρές που μπορούν να επιδιορθωθούν μέσα σε λίγα λεπτά.

Πρόβλημα	Αιτίες - Λύσεις - Συμβουλές
Η συσκευή δεν εκκινείται, καμία λυχνία δεν είναι αναμμένη	• Το φις δεν είναι σωστά τοποθετημένο στην πρίζα. • Η πρίζα ή η ασφάλεια δεν λειτουργεί σωστά (χρησιμοποιήστε ένα επιτραπέζιο φωτιστικό ή παρόμοια συσκευή για να τη δοκιμάσετε).
Η συσκευή δεν εκκινείται παρόλο που πιέσατε το κουμπί "'Εναρξη (Παύση)"	• Ενεργοποιήθηκε η λειτουργία "Κλείδωμα για παιδιά" =—○ (εάν υπάρχει σε αυτό το μοντέλο). Για να ξεκλειδώσουν τα πλήκτρα, πιέστε ταυτόχρονα το πλήκτρο θερμοκρασίας και το πλήκτρο ταχύτητας στυψίματος και κρατήστε τα για τουλάχιστον 3 δευτερόλεπτα. Το σύμβολο κλειδιού στην οθόνη εξαφανίζεται και το πρόγραμμα μπορεί να ξεκινήσει.
Η συσκευή σταματά κατά τη διάρκεια του προγράμματος και αναβοσβήνει η λυχνία "'Εναρξη (Παύση)"	• Ενεργοποιήθηκε η επιλογή "Σταμάτημα με νερό στον κάδο" (εάν υπάρχει σε αυτό το μοντέλο) - τερματίστε το "Σταμάτημα με νερό στον κάδο" πιέζοντας "**Εναρξη (Παύση)**" ή επιλέγοντας και ενεργοποιώντας το πρόγραμμα "Αδειασμα". • Το πρόγραμμα άλλαξε - επιλέξτε ξανά το πρόγραμμα που θέλετε και πατήστε το κουμπί "**Εναρξη (Παύση)**". • Το πρόγραμμα διακόπηκε και τελικά ανοίχθηκε η πόρτα - κλείστε την πόρτα και επανεκκινήστε το πρόγραμμα αφού πατήσετε το κουμπί "'**Εναρξη (Παύση)**". • 'Εχει ενεργοποιηθεί το σύστημα ασφαλείας της συσκευής (δείτε "Περιγραφή των ενδείξεων σφάλματος"). • Η βρύση του νερού δεν είναι ανοιχτή ή ο σωλήνας παροχής νερού είναι τσακισμένος (ανάβει η ενδεικτική λυχνία "Βρύση νερού κλειστή").
Η θήκη απορρυπαντικού περιέχει υπολείμματα απρρυπαντικού/προσθετικών στο τέλος της πλύσης	• Η θήκη του απορρυπαντικού δεν είναι σωστά εγκατεστημένη ή είναι μπλοκαρισμένη (δείτε "Καθαρισμός και συντήρηση"). • Το φίλτρο μέσα στο σωλήνα παροχής νερού έχει μπλοκάρει (δείτε "Καθαρισμός και συντήρηση").
Η συσκευή παρουσιάζει πολλούς κραδασμούς κατά το στύψιμο	• Το πλυντήριο δεν είναι ισοσταθμισμένο. Τα πόδια δεν είναι σωστά ρυθμισμένα (δείτε "Εγκατάσταση"). • Το πλαίσιο μεταφοράς den έχει αφαιρεθεί. **Πριν χρησιμοποιήσετε το πλυντήριο, πρέπει να αφαιρέσετε το πλαίσιο μεταφοράς**.
Στο τέλος του προγράμματος τα ρούχα δε στύβονται καλά	• Η ανισορροπία του φορτίου πλύσης κατά το στύψιμο εμπόδισε τη φάση στυψίματος για την προστασία του πλυντηρίου (δείτε "Ανισορροπία κατά το στύψιμο). • Η δημιουργία υπερβολικού αφρού εμπόδισε το στύψιμο. Επιλέξτε και ξεκινήστε το πρόγραμμα "Ξέπλυμα και στύψιμο". Αποφεύγετε την υπερβολική δοσολογία απορρυπαντικού (δείτε "Απορρυπαντικά και προσθετικά").

Cognitive representation of expert users

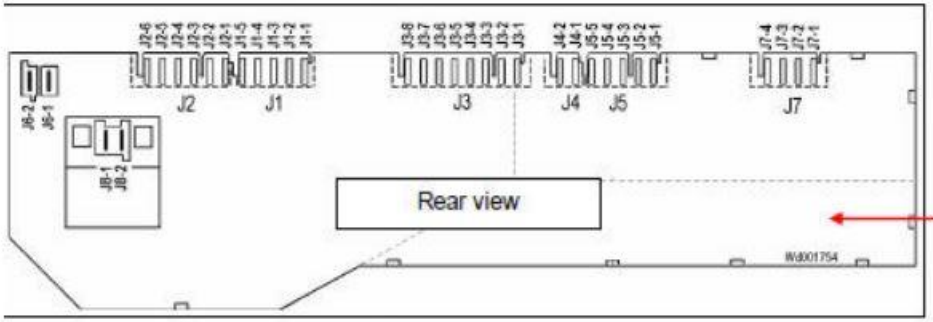


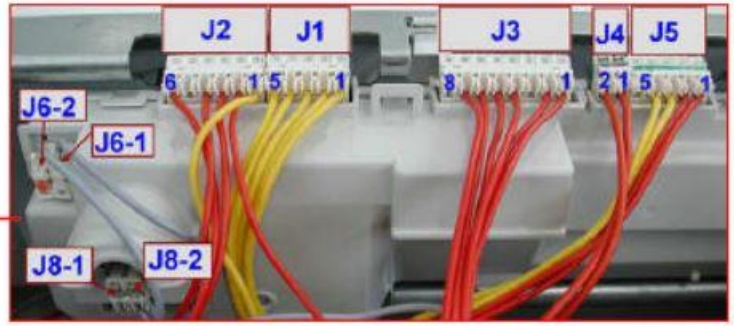
Manual for expert users

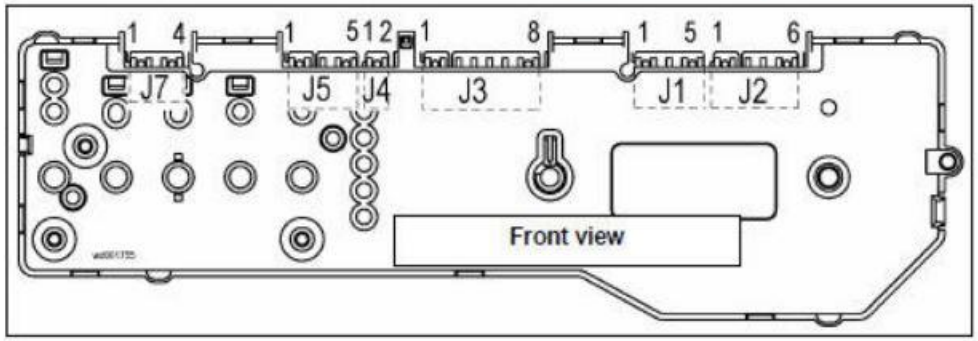
Elektrolux washing machine connectors on control board circuit

1.9 Connectors on circuit board EWM1000

J6	J2	J1	J3	J4	J5	J7
J6-1: Heating element (relay) J6-2: Door safety interlock (line)	J2-1 Door safety interlock (line-sensing) J2-2 1st level(sensing) J2-3 (Anti-overflow pressure switch) J2-4 Door safety interlock (triac) J2-5 (Door safety interlock) J2-6 (Anti-overflow pressure switch)	J1-1 Motor (triac) J1-2 Motor (stator – full range) J1-3 Motor (stator - 1/2 range) J1-4 Motor (rotor) J1-5 Motor (rotor)	J3-1 Drain pump (line) J3-2 Solenoids (line) J3-3 (line) J3-4 Drain pump (triac) J3-5 Pre-wash solenoid (triac) J3-6 Washing solenoid (triac) J3-7 Solenoids (line) J3-8 (Not used)	J4-1 "Door closed" pilot lamp J4-2 "Door closed" pilot lamp	J5-1 NTC temperature sensor J5-2 NTC temperature sensor J5-3 Motor (tachymetric generator) J5-4 Motor (tachymetric generator) J5-5 (DSP drum positioning system)	Serial interface: J7-1 ASY_IN J7-2 ASY_OUT J7-3 5V J7-4 GND
J8						
J8-1 line J8-2 line (neutral)						







Knowledge in the world vs. Knowledge in the head

Knowledge in the head is what one needs to learn (internalize) in order to manipulate a technological artifact. If one possesses such stored knowledge he can manipulate a technological artifact with a very simple interface e.g. through written text.

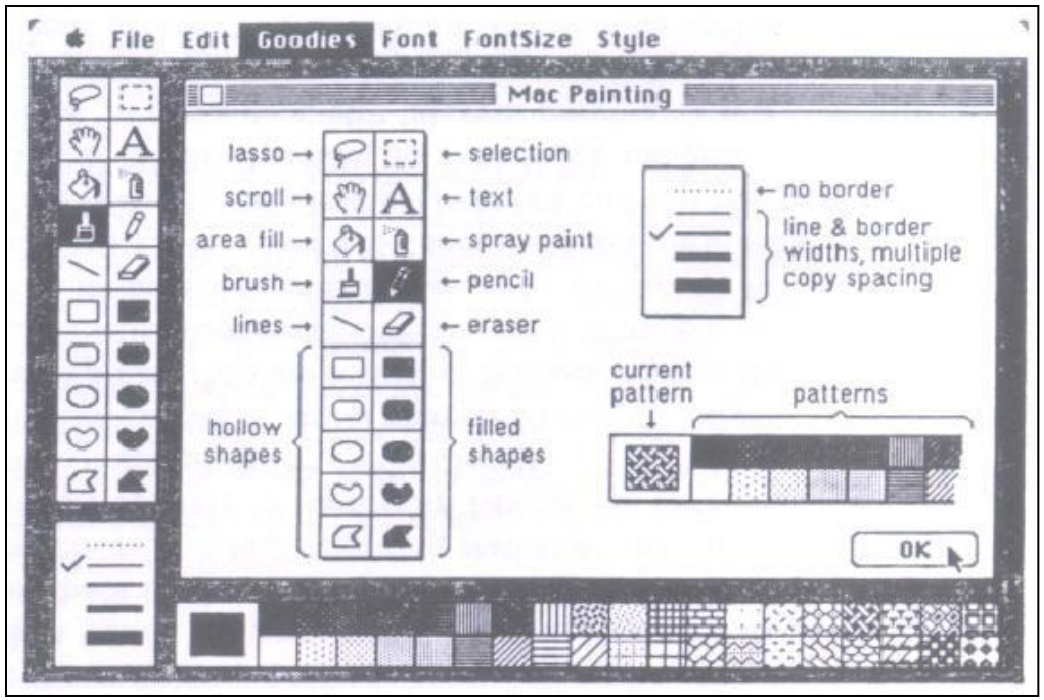
Think of written human languages or computer programming through a first or second generation Programming Language. One acquired it is very versatile but the effort needed is substantial

```
Displays a list of files and subdirectories in a directory.

DIR [drive:][path][filename] [/P] [/W] [/A[[:]attribs]] [/O[[:]sortord]]
    [/S] [/B] [/L] [/C[H]]

  [drive:][path][filename]   Specifies drive, directory, and/or files to list.
  /P      Pauses after each screenful of information.
  /W      Uses wide list format.
  /A      Displays files with specified attributes.
  attribs   D  Directories   R  Read-only files         H  Hidden files
            S  System files  A  Files ready to archive  -  Prefix meaning "not"
  /O      List by files in sorted order.
  sortord   N  By name (alphabetic)       S  By size (smallest first)
            E  By extension (alphabetic)  D  By date & time (earliest first)
            G  Group directories first    -  Prefix to reverse order
            C  By compression ratio (smallest first)
  /S      Displays files in specified directory and all subdirectories.
  /B      Uses bare format (no heading information or summary).
  /L      Uses lowercase.
  /C[H]   Displays file compression ratio; /CH uses host allocation unit size.

Switches may be preset in the DIRCMD environment variable.  Override
preset switches by prefixing any switch with - (hyphen)--for example, /-W.

C:\>_
```

The UNIX interface required an important amount of knowledge in the head

Knowledge in the world

Direct manipulation interfaces– a successful design that persists



One of the earliest commercially available direct manipulation interfaces was MacPaint

Direct manipulation interfaces were introduced in the 1980s and proved particularly successful:

- Visual representation of entities that interest the user,
- Manipulation of visual entities trough a fixed set of relevant alternative actions (most often also presented – rather than remembering commands and conditions)
- Effects and results of user actions are directly visible and most often reversible

What do we mean by knowledge in the world?

Hints, metaphors, cues and other signs that are incorporated in a technological artifact specifically in order to signify to its users how they can use it.

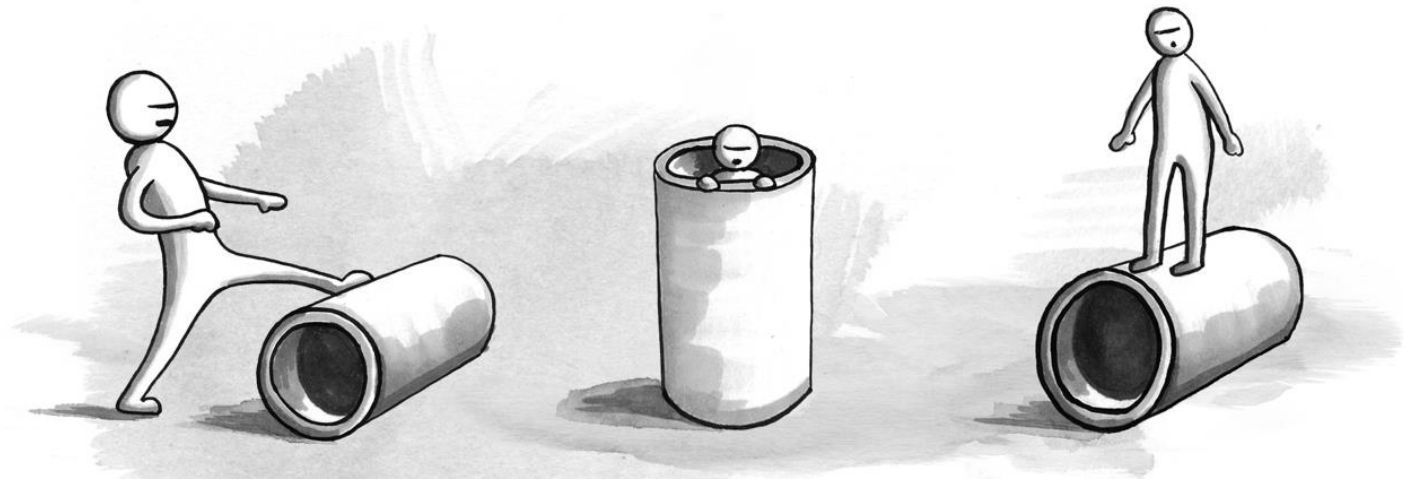
Knowledge in the world can take many forms such as:

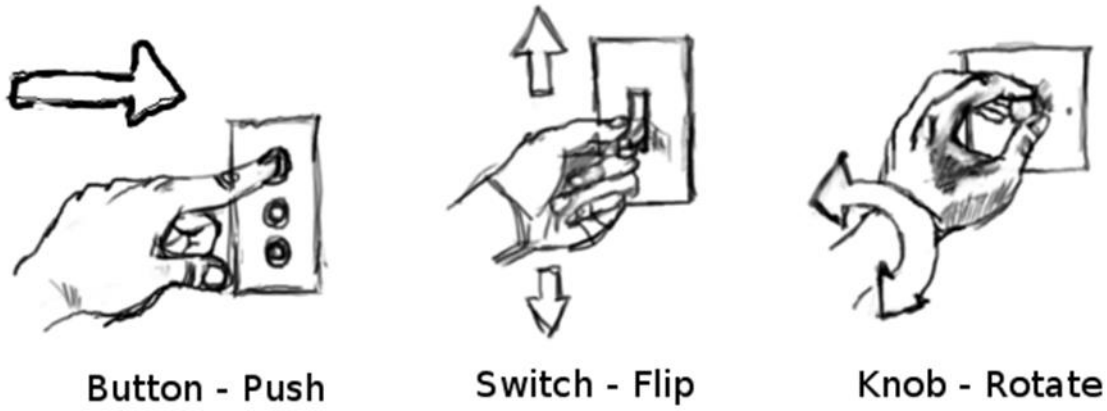
- Written, symbolic, schematic or verbal suggestions,
- Physical constraints *for the users actions, which indirectly point towards the correct way of performing a task*
- Affordances, i.e. design features that suggest the range of possible manipulation ways (or degrees of freedom) of the artifact

Knowledge in The Head vs In the world: comparison

Pros/cons	Knowledge in the World	Knowledge in the Head
Underlying cognitive process	Requires interpretation of signifiers	Requires retrieval form long-term memory
Learning	Minimal. Depends on signal perception and compatibility of signal with knowledge content	Requires learning, often copious. Ease of learning depends on the adequacy of underlying conceptual model.
Speed of use	Speed slowed down by perception / interpretation processes	Very fast
Walk-up & use	Yes	No
Continuous use	No advantage	May have advantage
Aesthetics	May become cluttered due to number of signifiers / instructions etc. Heavily depends on design quality	Allows for freedom in design / appearance,

Affordances



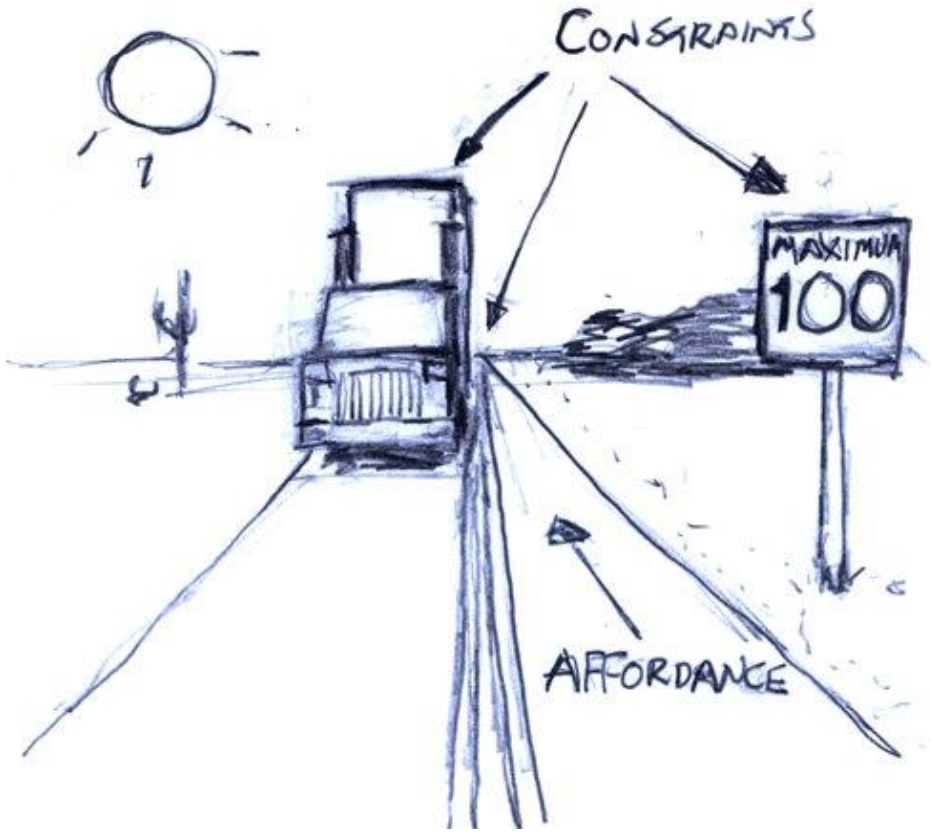


Affordances are an object's (or environmental) properties that show the possible actions users can take with it, i.e. what the object "affords" from the animal to do with it

Affordances & signifiers

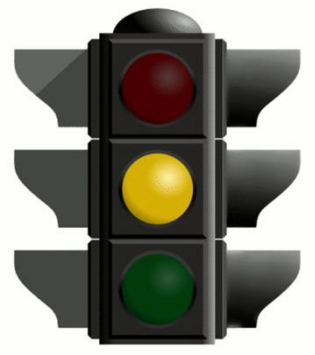
A signifier [*σημαίνον*] is a feature of an object (a cue) that enhances the perception of its affordances for a specific animal (user)

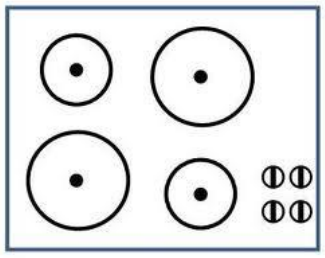
Affordances & Constraints

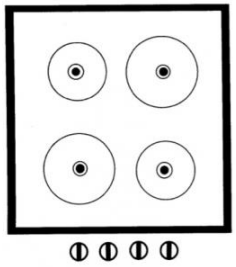


Constraints may be physical (i.e. non-affordances) or semantic (i.e. signifiers)

Constraints: how we classify them



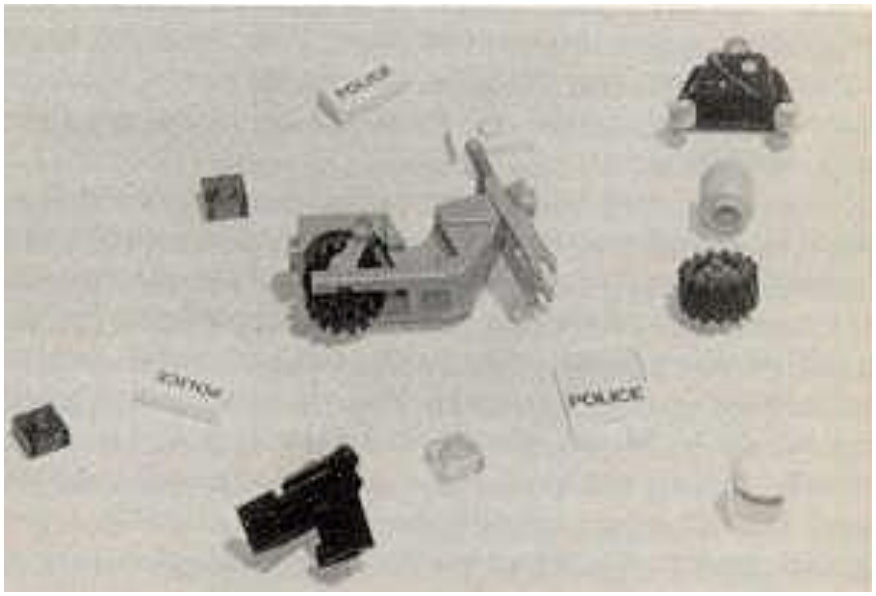




- ***Physical*** (e.g. the shape of an electrical plug not only affords but directly constraints the way it should be connected to the socket)
- ***Semantic*** (e.g. in a car, the button on the right controls the right side window and the one on the left, the left side window)
- ***Cultural*** (e.g. a western *Homo Internetis* would seek to the upper left of a web page to find the owner of the page)
- ***Logical*** (e.g. if you are assembling an IKEA furniture you would expect that no supplied pieces should be left unused).

What about modern USB plugs?

Lego Toys: a combination of all constraint types



What type of constraint is used to:

assemble the motorists head to his trunk?

choose which light to put at front and witch at the rear?

Place the “Police” stickers?

Hard constraints (or forcing functions)

A European 220 AV plug – Re-design it for DV imposing less constraints

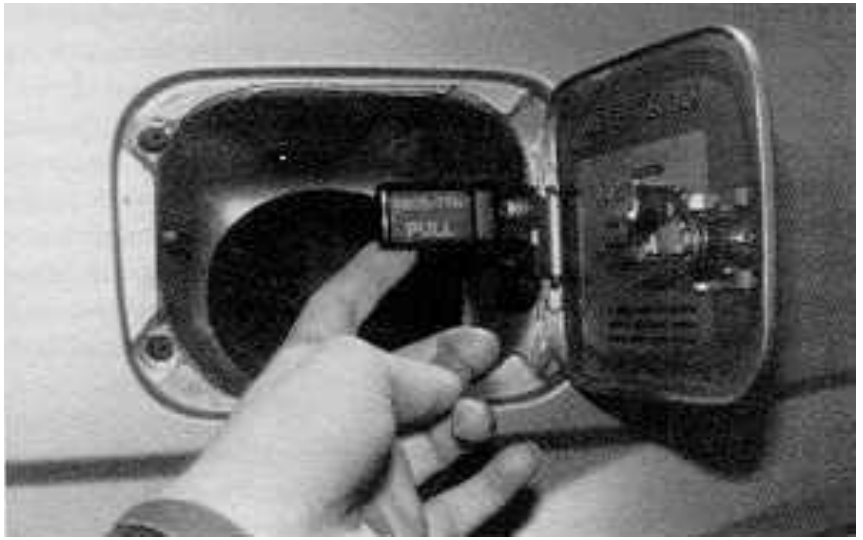
Hard constraints - Interlocks

An industrial press operation forces the user to position both his hands on the commands before pressing begins

interlock: enforces the user to perform necessary actions trough a predefined sequence

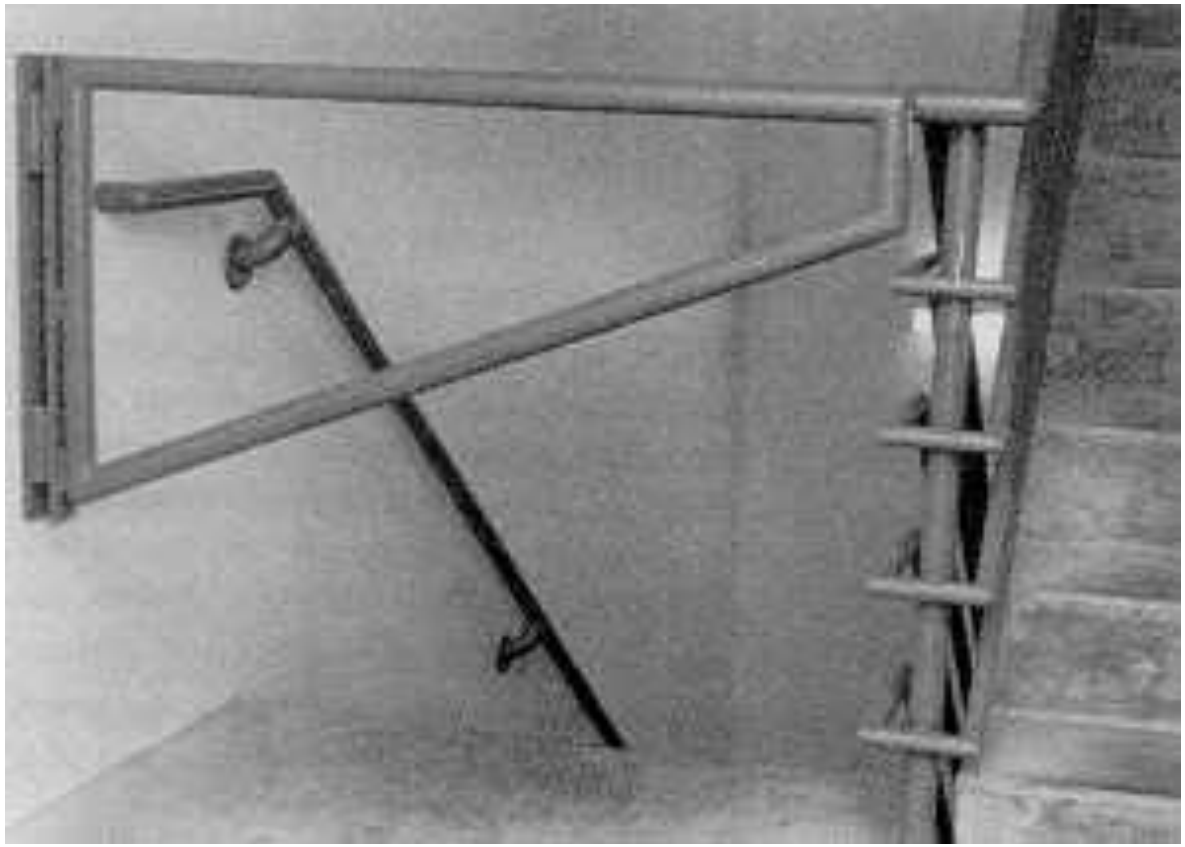
- **Lock-in**: prevents the user from quitting a procedure without performing all necessary steps (e.g. cashiers on a supermarket or in a self-service restaurant)
- **Lock-out**: prevents the user from performing an action before successfully performing a prior one (e.g. shut the door of his car without taking the car keys from the ignition)

Example of an Interlock



The rear sliding door of the particular van model is prevented from opening during gas filling. You cannot actually put the gas hose inside the tank unless you lift-off the small lever on the right

Example of a Lock-in



This particular barrier has been placed at the floor level of a building to prevent residents from accidentally going down the stairs towards the basement in the case of emergency (earthquake etc.)

Example of a Lock-in

The doors in the kindergarten classrooms opposite are designed so as to prevent young children from getting out without the consent of a tall and literate being e.g. a human adult ☺

The same principle is commonly used in medical packaging to prevent children from accidentally administering drugs to themselves

Example of a Lock-in and Lock-out

Try to find a lock-in and a lock-out in this common process

What does each one tries to prevent?

How could one redesign the process

Principles for Design

By Dieter Rams for Braun

Use both knowledge in the world and knowledge in the head

Simplify the structure of tasks

Make things visible: bridge gulfs between Execution and Evaluation

Get the mappings right

Exploit the power of constraints

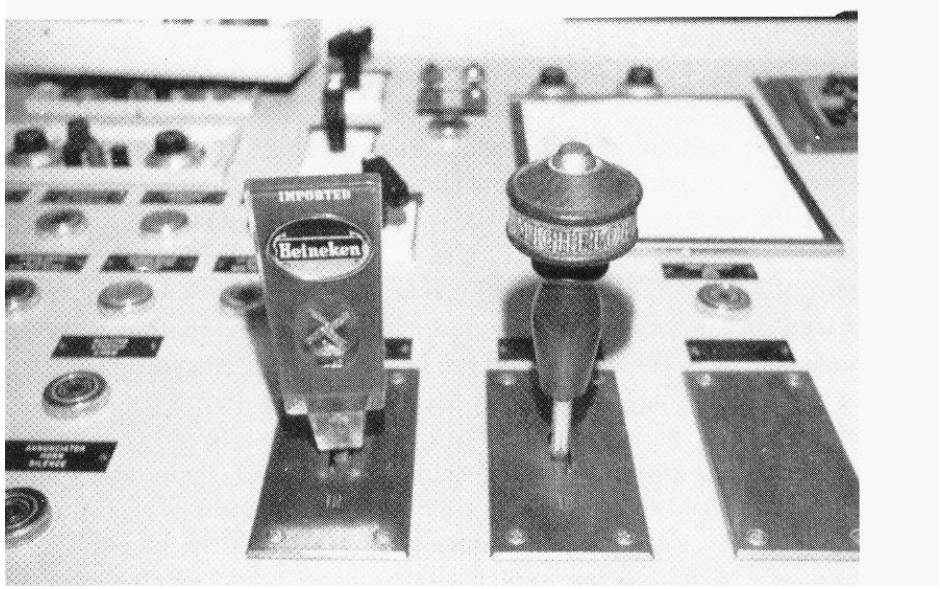
Design for error

When all else fails, standardize

The design of control functions: a real life example

The image opposite has not been taken at a beer bar…

It is from the control room of a Nuclear electricity production plan



- Apart from a joke (which is not!)… what would be the reasons for the control room operators to change the original levers with the ones you see in the image?
- What criteria were they trying to satisfy?
- Which criteria of control design may have deteriorated from this intervention?

Criteria for the design, selection or evaluation of control functions

- ✓ Ease of operation,
- ✓ Feedback on manipulation
- ✓ Ease of detection of the control
- ✓ Ease of discrimination among multiple controls,
- ✓ Prevention from accidental effectuation,
- ✓ Attention to possible erroneous operation
- ✓ Compatibility with:
- ✓ The resulting effectuation to the controlled system,
- ✓ The need for precision in the controlled system,
- ✓ The required speed of control,
- ✓ The required force to be exerted,
- ✓ The required frequency of use,
- ✓ The required use duration.

Design and selection of control functions

- Compatibility of control with effectuation to the controlled system,
- The need for precision in the controlled system,
- The required speed of control,
- The required force to be exerted,
- The required frequency of use,
- The required use duration

- Ease of operation,
- Feedback on manipulation
- Ease of detection of the control
- Ease of discrimination among multiple controls,
- Prevention from accidental effectuation,
- Attention to possible erroneous operation

Think and sketch

- The tuning and volume controls of an analog radio
- The same controls of a digital radio
- The controls for opening doors in a public city bus
- The pointer system of a digital design application
- The car controls (direction, braking, acceleration, speed selection..)
- The trigger of a gun

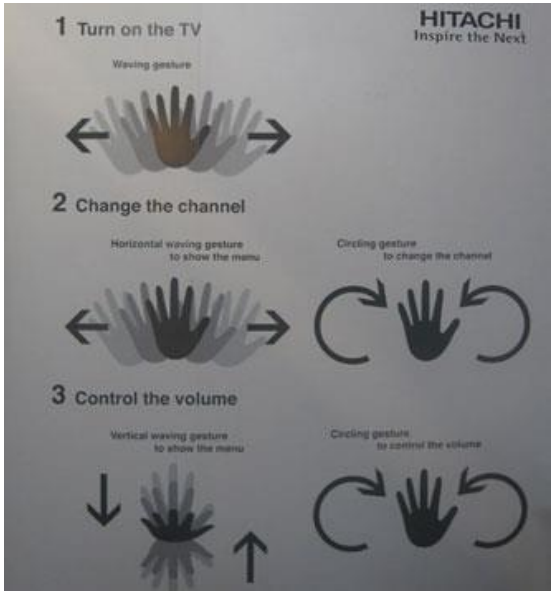
Pads & Touch-Screen controls – are they any different?

Some issues of touch screen pads

- Lack of natural tactile feedback + button hidden by fingers
- Gesture controls independent of topology
- Multi-touch gesture control
- Hand held – hand operated
- Discrete vs. analog parameter controls

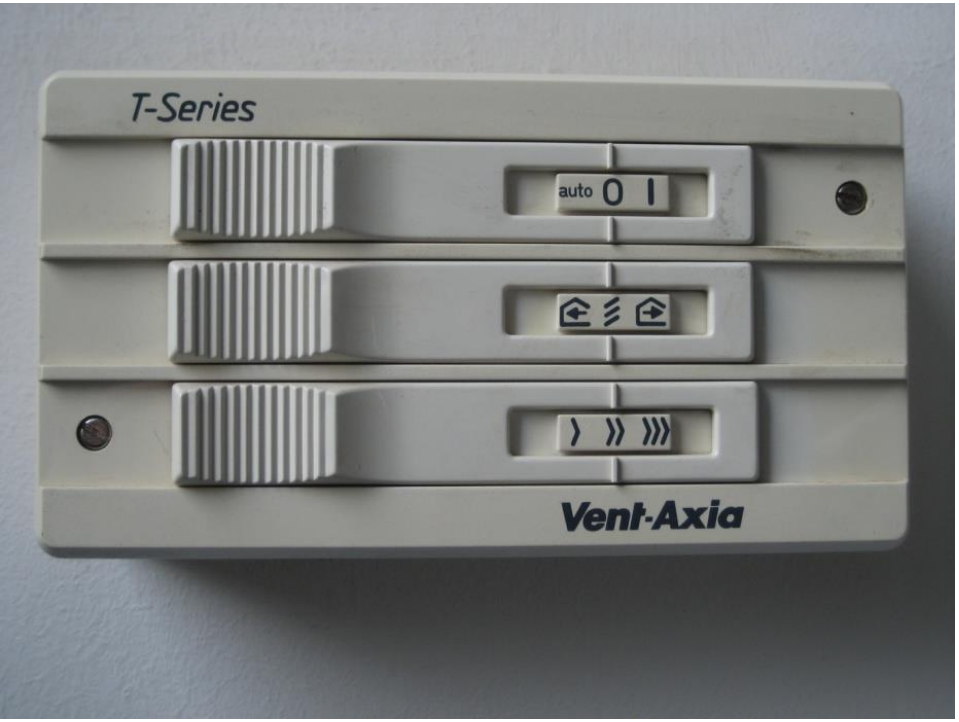
Also….how about:

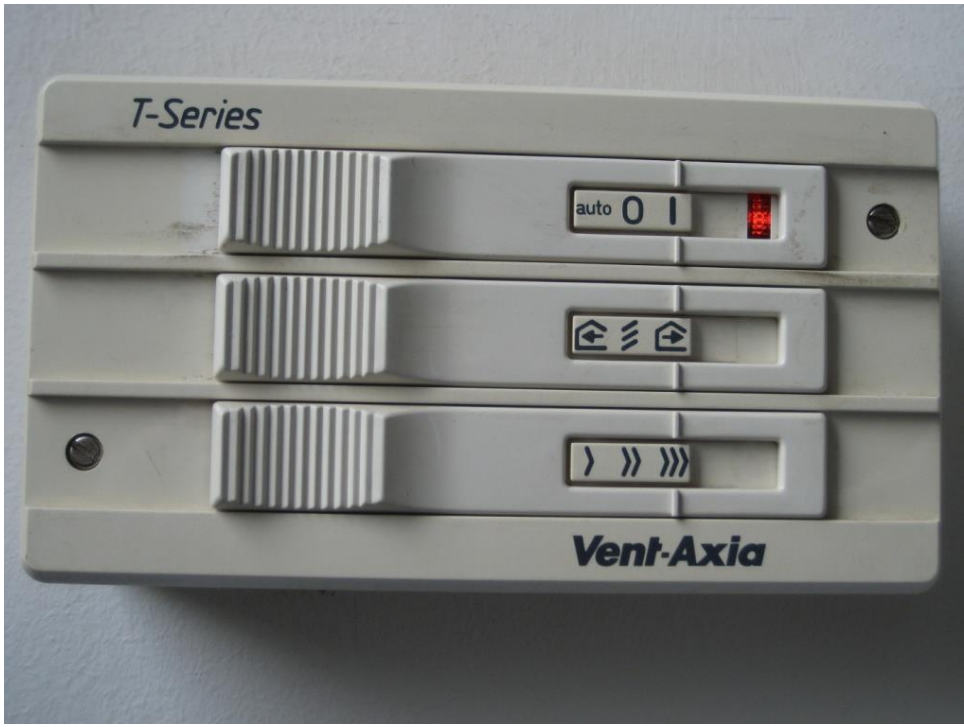
- 3D navigation pads
- 3D gestures?
- Whole body Gestures?
- Voice commands?
- Combined gesture v- voice commands?



An office ventilator

Check the previous questions on the interface below…

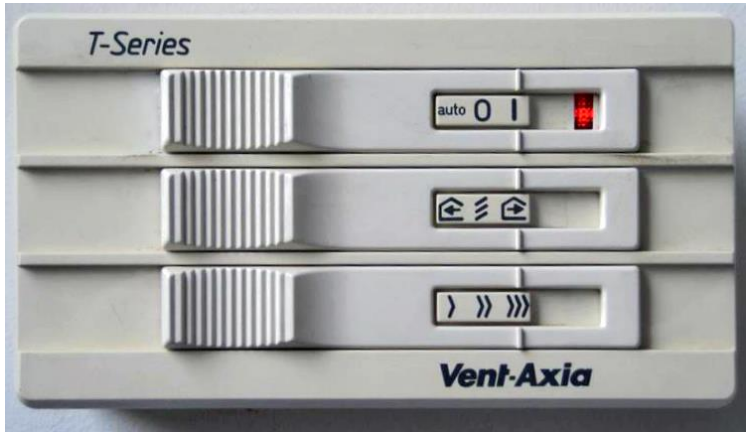




Οι επιθυμητές καταστάσεις του συστήματος είναι οι εξής:

- Τρείς ταχύτητες εισαγωγής με ανοιχτές περσίδες
- Τρείς ταχύτητες απαγωγής με ανοιχτές περσίδες
- Περσίδες ανοιχτές χωρίς λειτουργία ανεμιστήρα
- Περσίδες κλειστές χωρίς λειτουργία ανεμιστήρα

Σύνολο 8 επιθυμητές λειτουργίες



Σύνολο επιτρεπόμενων λειτουργιών

2 x 3 x 3 = 18

Οι επιτρεπόμενες αλλά μη επιθυμητές καταστάσεις χωρίζονται σε τρεις κατηγορίες:

1. Καταστροφικές για το σύστημα (π.χ. κλειστές γρίλιες + λειτουργία ανεμιστήρα)
2. Παράλογες καταστάσεις (π.χ. κλειστό σύστημα + μέγιστη ταχύτητα ανεμιστήρα)
3. Τεχνικά εφικτές αλλά που δεν καλύπτουν κάποιο πραγματικό σενάριο για τον χρήστη (π.χ. λειτουργία ξυπνητηριού με ακρίβεια δευτερολέπτου)

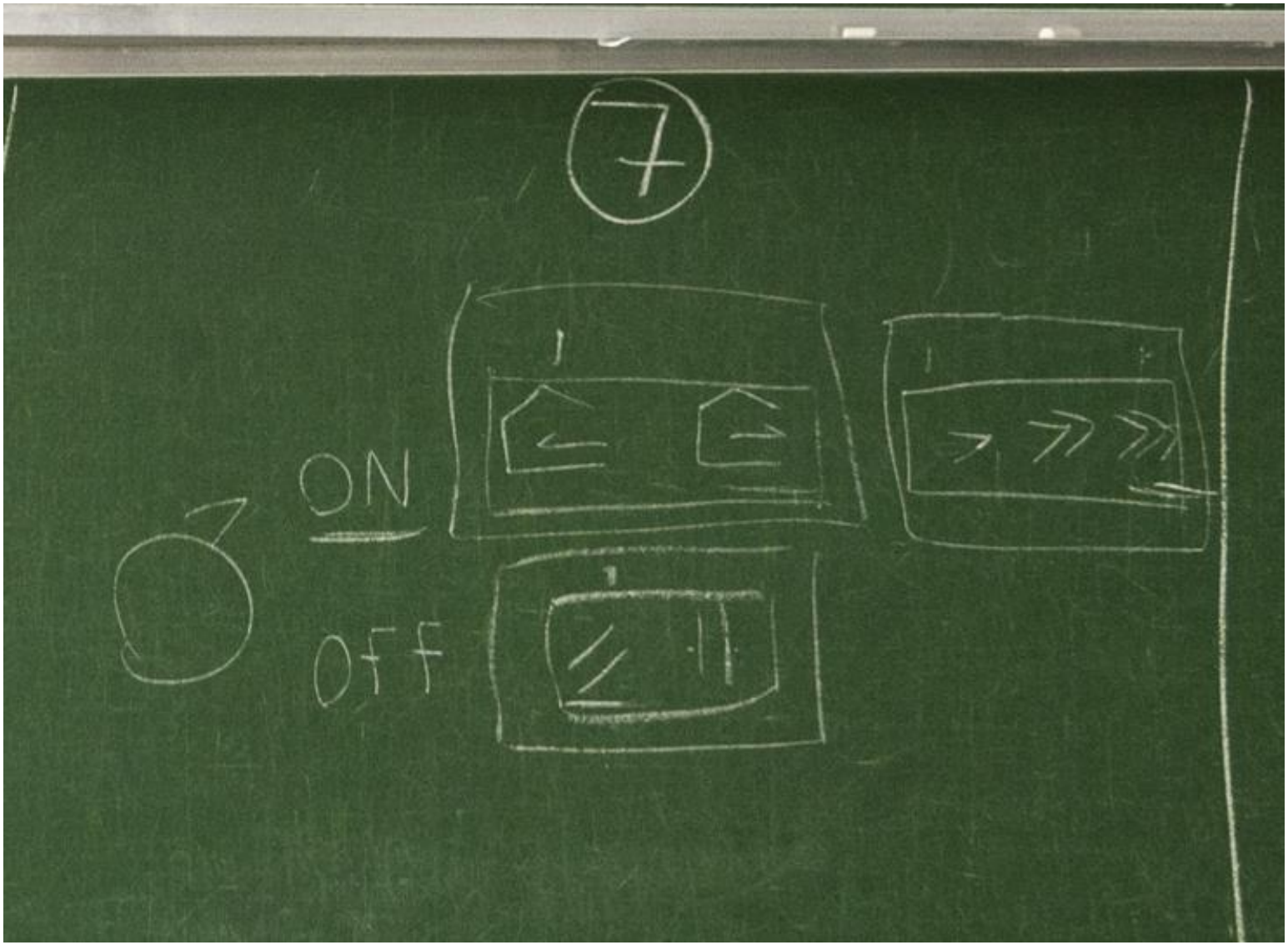
Up to you! An exercise

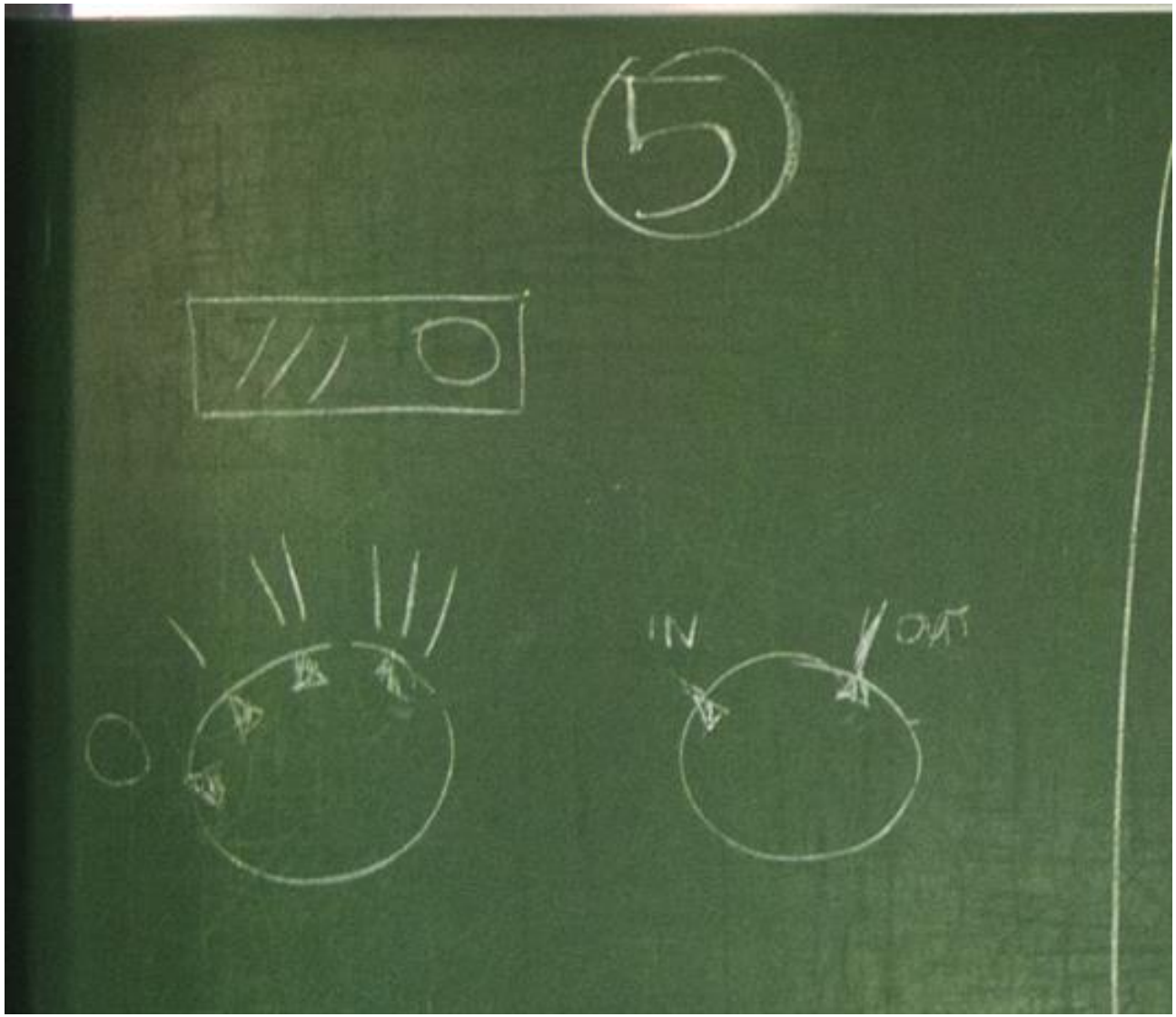
Try to design your own interface for an electric ventilator that is mounted on a wall or window for office or home use.

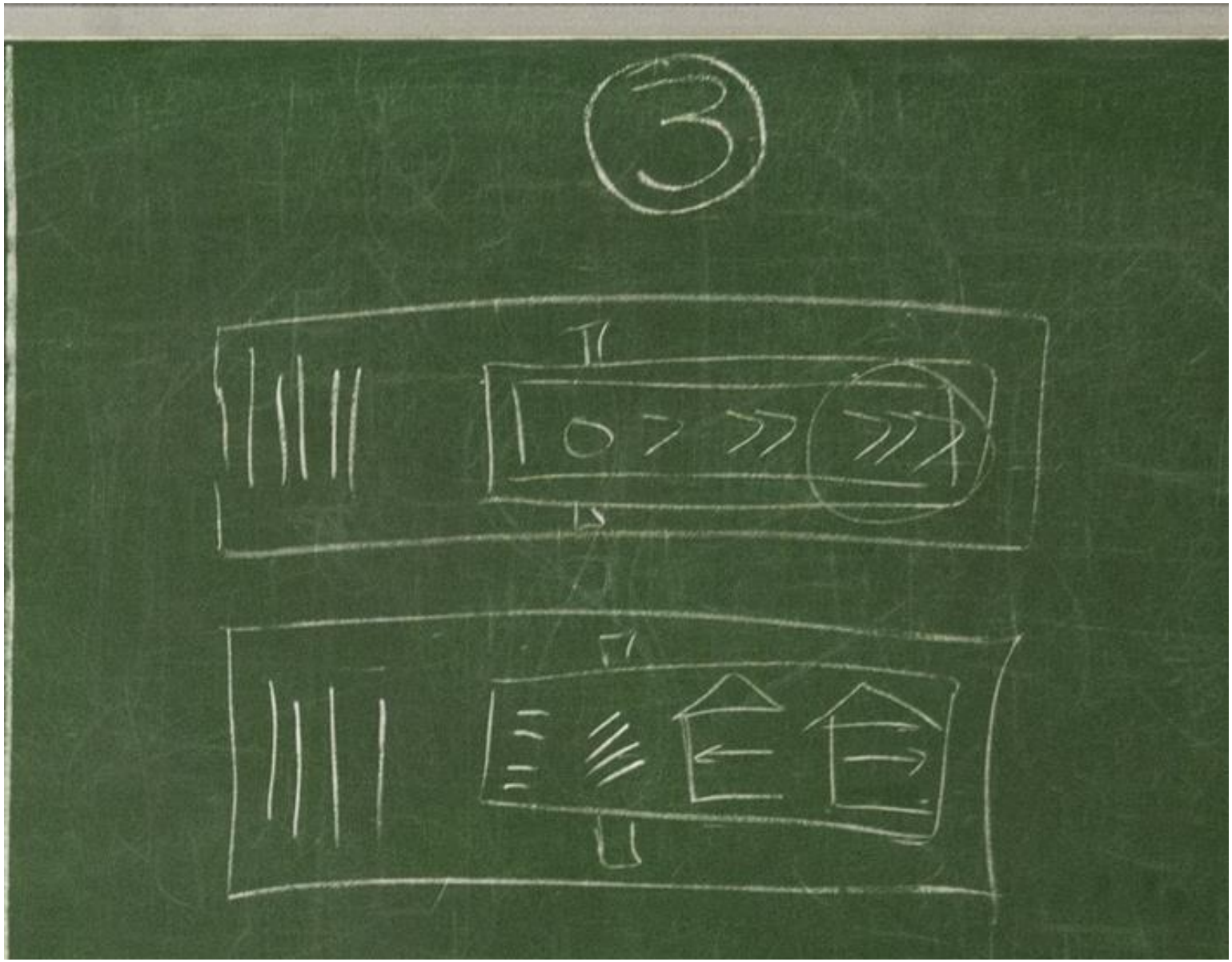
Technical specifications

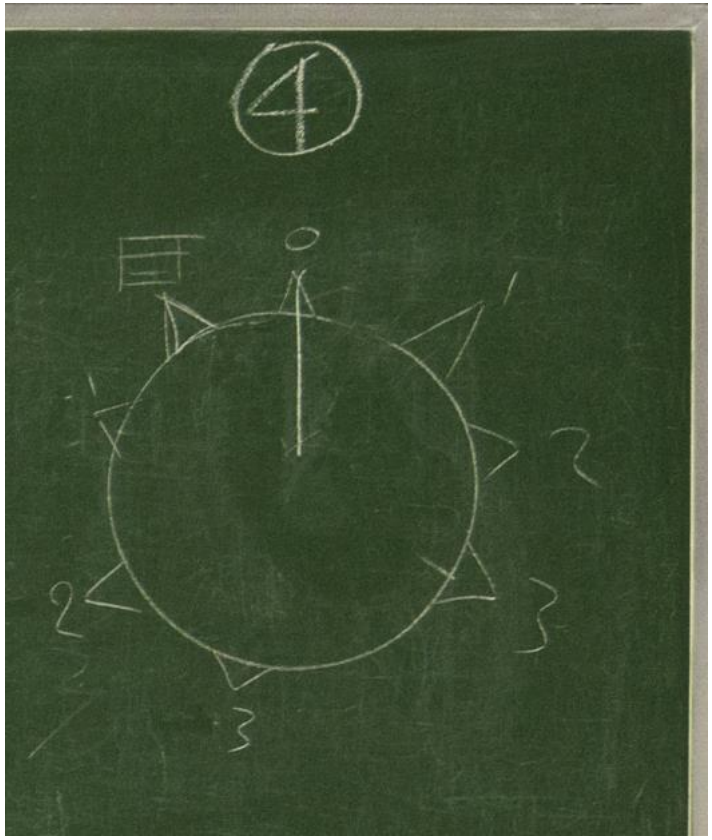
- A fan with three rotating speeds
- possibility to reverse the airflow, either intake or outturn
- a grill / louver that can open and close the ventilator’s opening

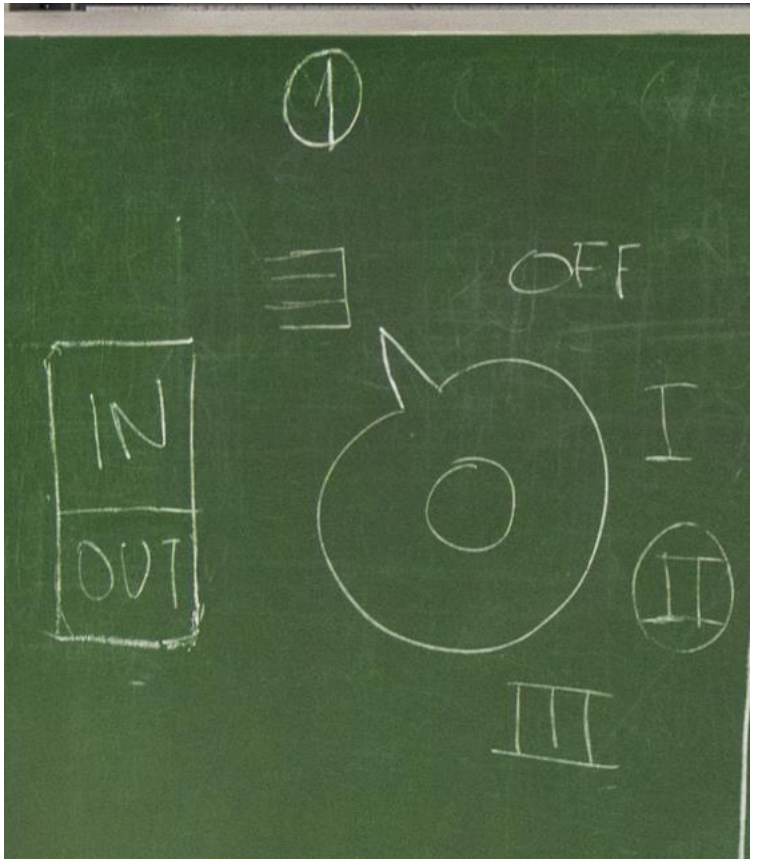
Try to think what are the expected user goals and design for these. Providing action possibilities that are not part of the expected user goals is often source of complexity, misinterpretations and errors


7
ON
off

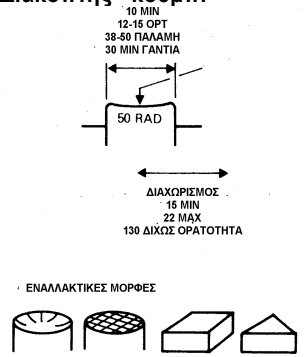
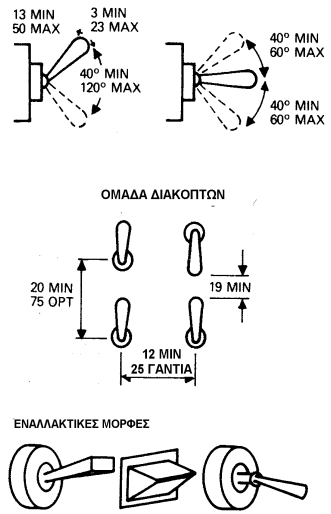
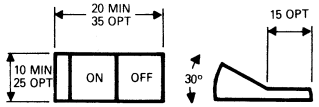

5
IN
OUT

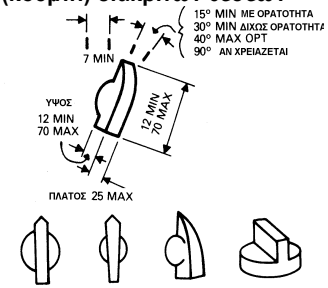
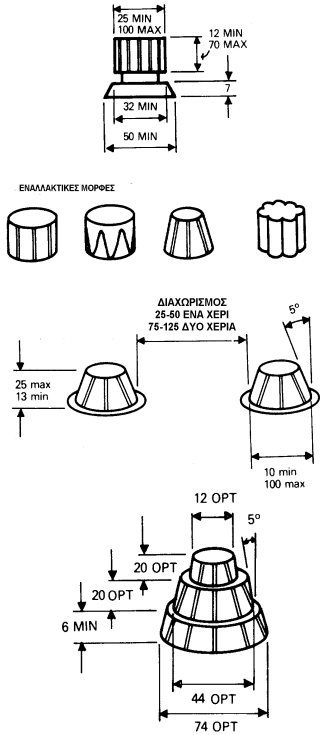

3


④
0
1
2
3
3
2
3

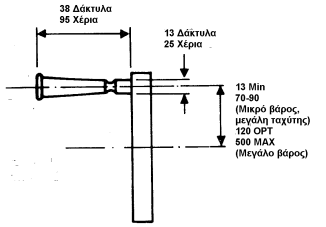
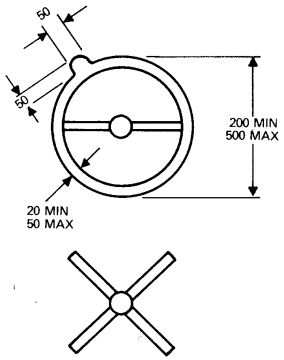
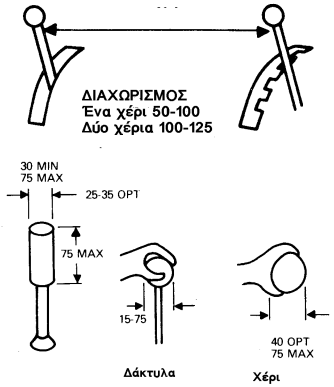
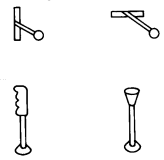

①
OFF
IN
OUT
I
II
III

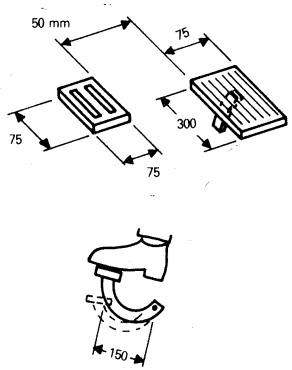
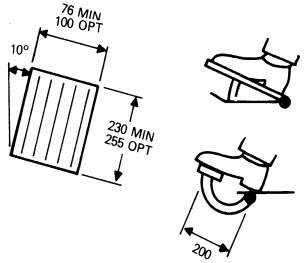
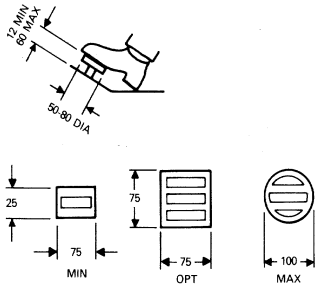
Examples of controls with detail specifications (1)

Τυπικές & εναλλακτικές μορφές- Ενδεικνυόμενες διαστάσεις (mm)	Δύναμη (kg) min	Δύναμη (kg) max	Διαδρομή(mm) min	Διαδρομή(mm) max	Σχόλια
Διακόπτης - κουμπί 	0.25 Η αντίσταση θα πρέπει στην αρχή να είναι μικρή, και να αυξάνεται προς το τέλος της διαδρομής. Πληκτρολόγια: 0.15	1.2 0.3	3 (για χειρισμό με γάντια εργασίας η διαδρομή μπορεί να φθάνει ως και 40)	16	Το μέγεθος, το σχήμα και η απόσταση μεταξύ κοντινών διακοπτών πρέπει να λαμβάνει υπ' όψη τις συνέπειες του λάθος και την εξοικείωση των χρηστών. Οι διακόπτες αυτοί μπορεί να φωτίζονται εσωτερικά. Μπορεί επίσης να υπάρχει χρωματική κωδικοποίηση.
Διακόπτης - μοχλού 	0.25	10	40^0 μεταξύ των διαδοχικών θέσεων		
Ορθογώνιος διακόπτης 					Οι διακόπτες αυτοί μπορούν να χρησιμοποιηθούν αντί των διακοπτών-μοχλού. Επιγραφή πάνω στο διακόπτη είναι δυνατή.

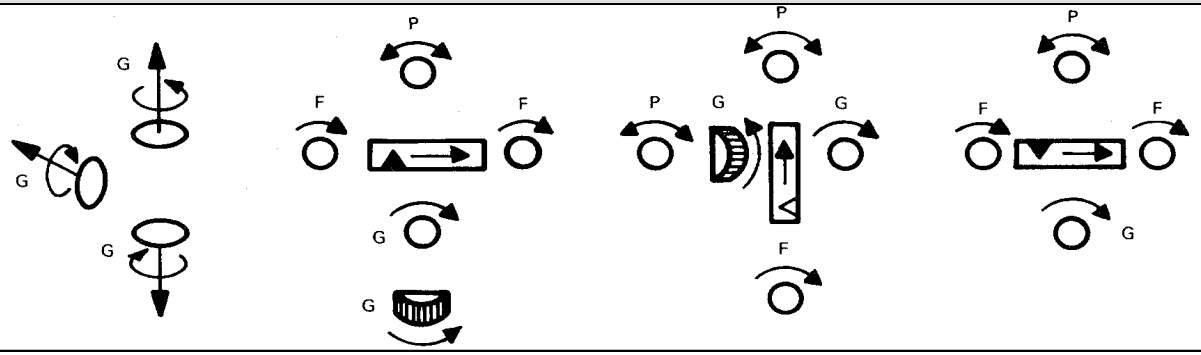
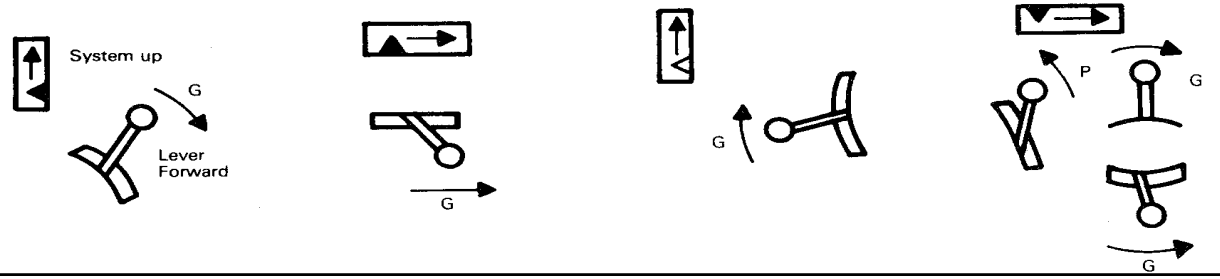
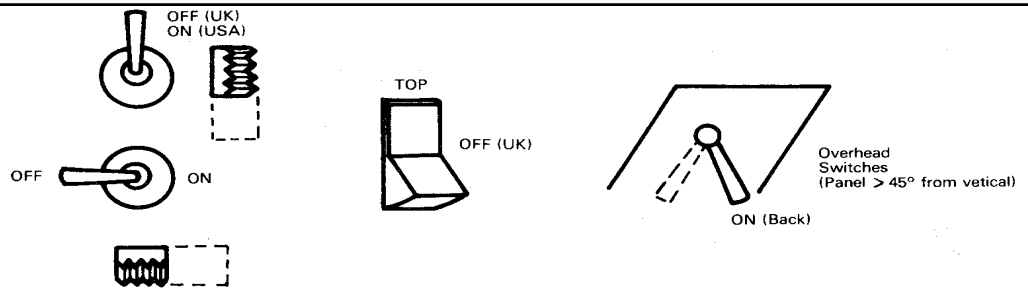
Τυπικές & εναλλακτικές μορφές- Ενδεικνυόμενες διαστάσεις (mm)	Δύναμη (kg) min	Δύναμη (kg) max	Διαδρομή(mm) min	Διαδρομή(mm) max	Σχόλια
Περιστροφικός διακόπτης (κουμπί) διακριτών θέσεων 					
Περιστροφικός επιλογέας μη διακριτών θέσεων 					Ακατάλληλο για γρήγορες ρυθμίσεις.

Examples of controls with detail specifications (2)

Τυπικές & εναλλακτικές μορφές- Ενδεικνυόμενες διαστάσεις (mm)	Δύναμη (kg) min max	Διαδρομή(mm) min max	Σχόλια
Στρόφαλος 	Περιφερειακές δυνάμεις Ταχείες ρυθμίσεις 0.9 2.5 2 4 Ακριβείς ρυθμίσεις 3.5	Μέγεθος(rad) 70-90 500 Ταχύτης(rpm) 120 200	Ταχύτερες ρυθμίσεις επιτυγχάνονται με κάθετο τον στρόφαλο. Μεγαλύτερη ακρίβεια ρύθμισης επιτυγχάνεται με μεγάλη ακτίνα και μικρή διαδρομή.
Τιμόνια			
	Με ένα χέρι 2 13 Με δύο χέρια 25		
Μοχλός (λεβιέ)			
	1 13.6 MAX 1 χέρι 2 χέρια 16 έκταση 25 18 έλξη 39 9 επάνω/κάτω 7 αριστερά 16 9 δεξιά 16	MAX γωνία χειρισμού 96^0 έλξη/έκταση 50 355 δεξιά/αριστερά 965	Εναλλακτικές μορφές 

Τυπικές & εναλλακτικές μορφές- Ενδεικνυόμενες διαστάσεις (mm)	Δύναμη (kg) min max	Διαδρομή(mm) min max	Σχόλια
Ποδομοχλός (πεντάλ)			
με οριζόντιο το πέλμα 	1.5 9		Ενδείκνυται για καθιστή στάση. Ορθια στάση επιτρέπεται όταν ο ποδομοχλός βρίσκεται στο έδαφος ή χρησιμοποιείται λίγο και για μικρά χρονικά διαστήματα. Πρέπει να υπάρχει δυνατότητα στήριξης του ποδιού (π.χ. ελατήριο επαναφοράς)
με το πέλμα υπό γωνία 	1.5 5.4		Μέγιστη δύναμη με το γόνατο στις 160^0 Μέγιστη ακρίβεια για μικρές διαδρομές και με το γόνατο στις 95-135^0.
Διακόπτες ποδιού 	Ελατήριο επαναφοράς 8 kg για χειρισμό σε όρθια στάση.		Ο χειρισμός σε όρθια στάση επιτρέπεται.

Experimental results of compatibility between control action and resulting effect for different physical controls

Actuator type	Desired effect on system or device
Rotary knobs (buttons, wheels etc.) G: Good compatibility F: Fair compatibility P: Poor Compatibility	
Levers	
Swiches	

Compatibility of interface controls to the user goals

Mapping of physical actuators to the user goals (e.g. flow & temperature control)

- Left: indirect (need to manipulate both knobs to control temperature and flow
- Right: Direct (vertical control -> flow, horizontal → Temperature)

Semantic vs. functional relation between control functions

The relative proximity of different control functions depends on:

- Functional dependencies and typical sequences of use
- Semantic / technological groupings
- Etc.

Depending on the domain of application there are a number of principles and standards.

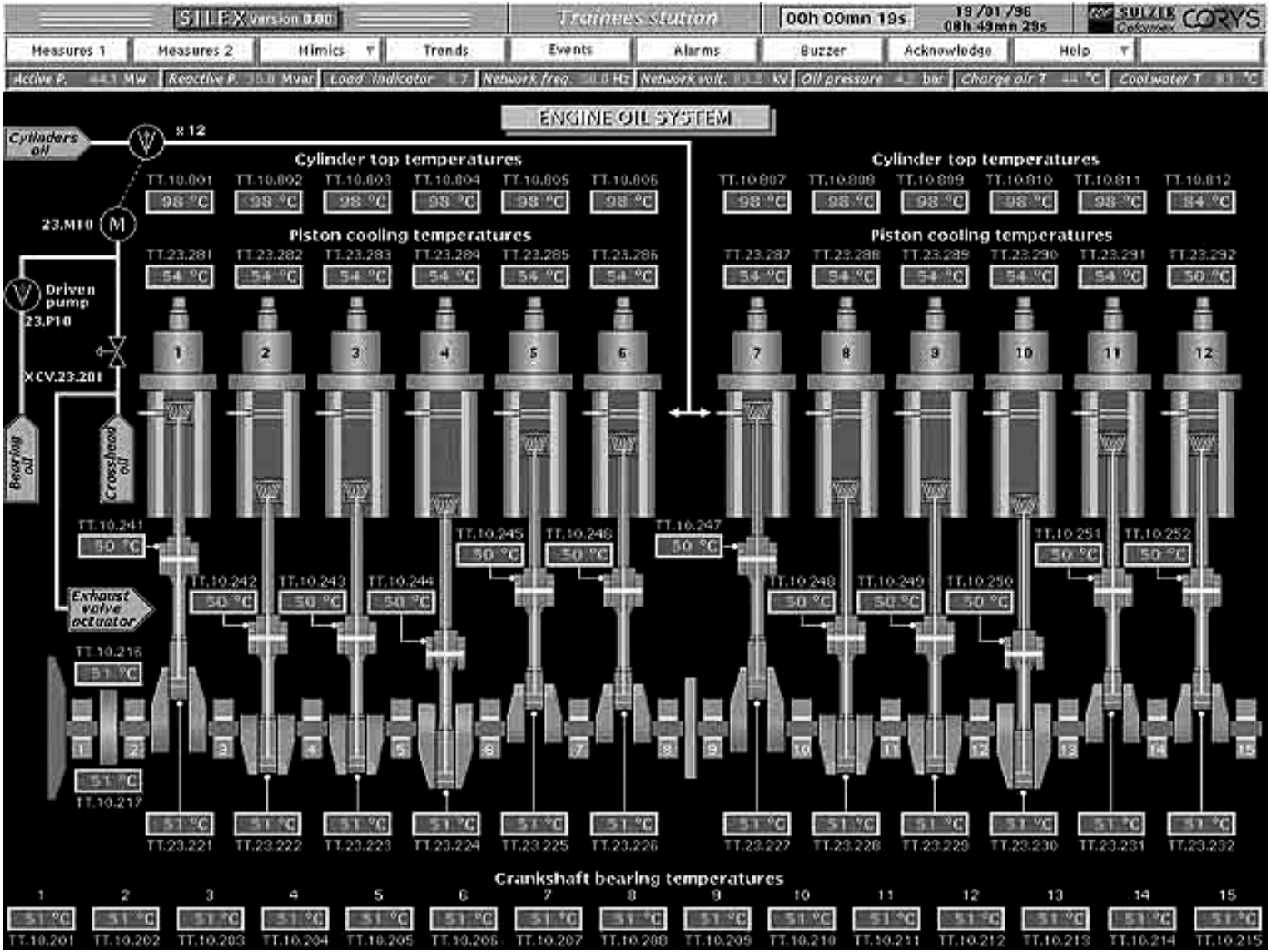
Nevertheless, control display design retains part of the art feeling

General principles for the relative positioning of control functions

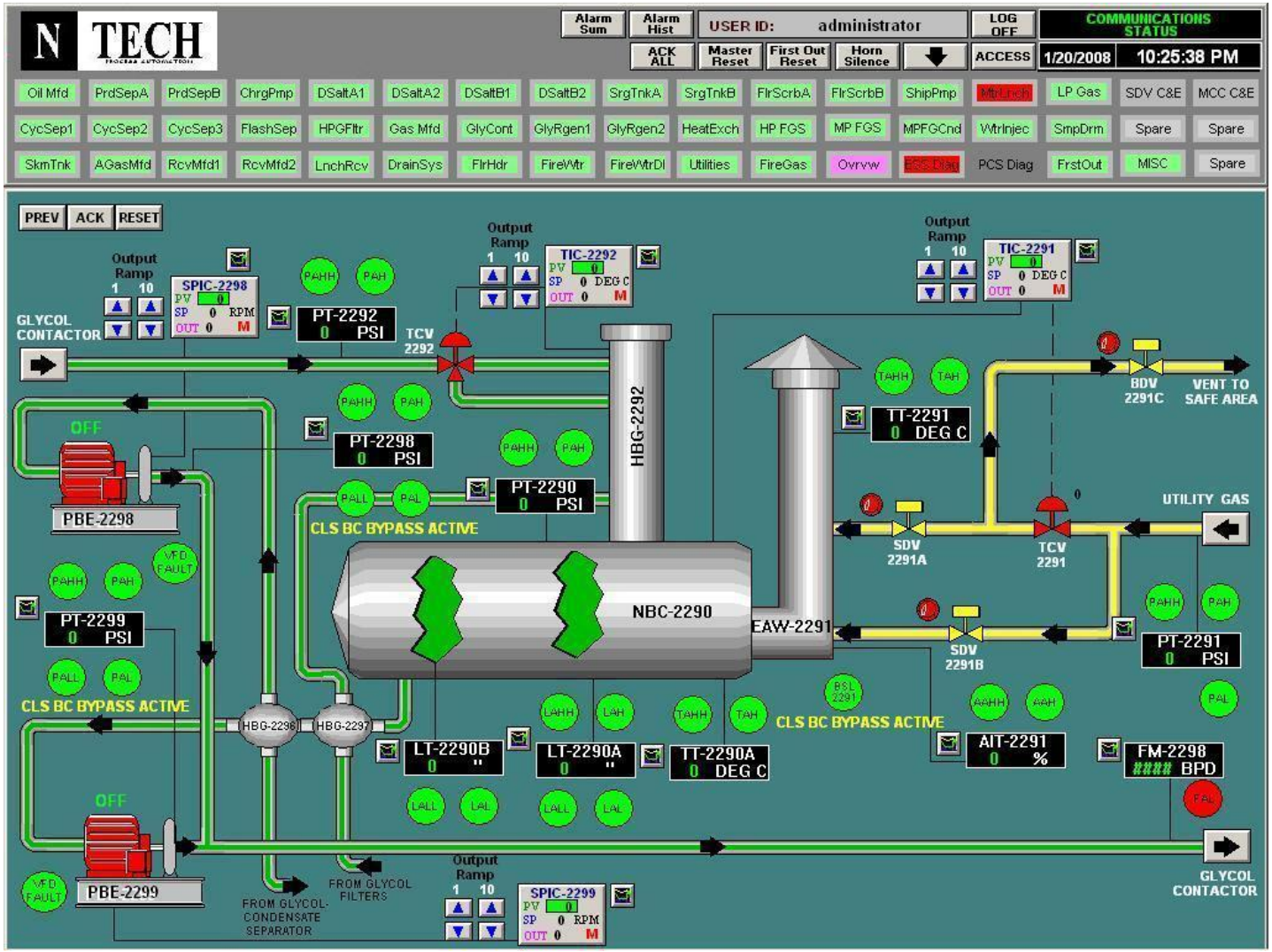
- There should be a topological correspondence between the positioning of a control and the positioning of the controlled function (if applicable).
- Controls performing similar actions should be similar in shape and be positioned in a similar direction.
- Directional displacement of controls performing similar actions should be the same.
- Controls that should not be confused or that should not be actuated simultaneously should be positioned far from each other (far meaning in physical or informational / navigational space)
- When placing a large number of controls on a panel it is advised to limit the size of matrices to 3 x 5 to minimize slip errors
- Sequence of actuation between controls should preferably follow a left to right and top to bottom direction

It may be –and usually is- difficult to satisfy all criteria. In any particular design one should make the appropriate trade-offs

Example of a marine engine topological mimic diagram

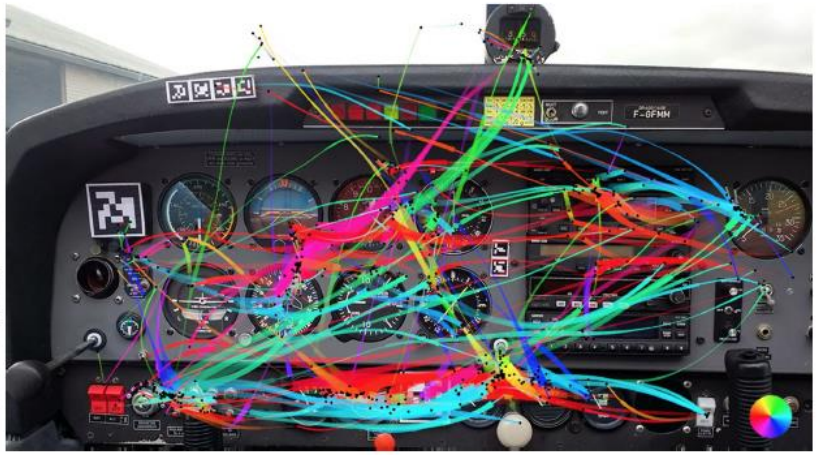


Example of an industrial process functional diagram



Principles for the layout of visual display functions

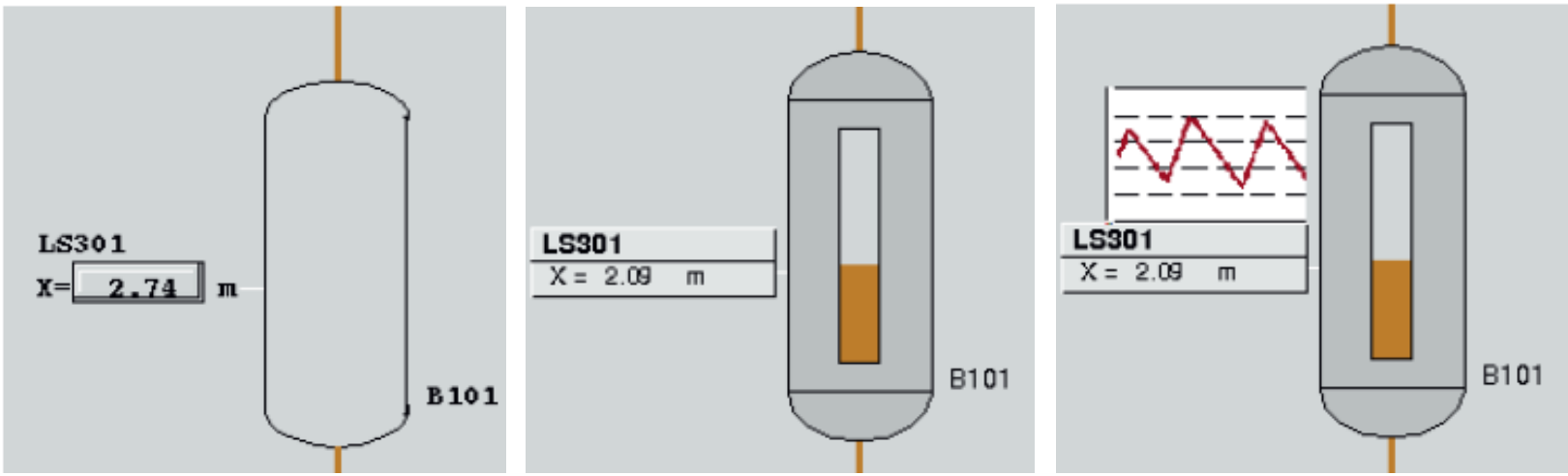
- Mimetic diagrams should be used when the topology of the physical process is relevant for cognitive or manual task execution
- Functional diagrams should be used when the physical topology is not relevant
- In frequent checking sequences, place displays from left to right and top to bottom



Criteria for the design, selection or evaluation of information display functions

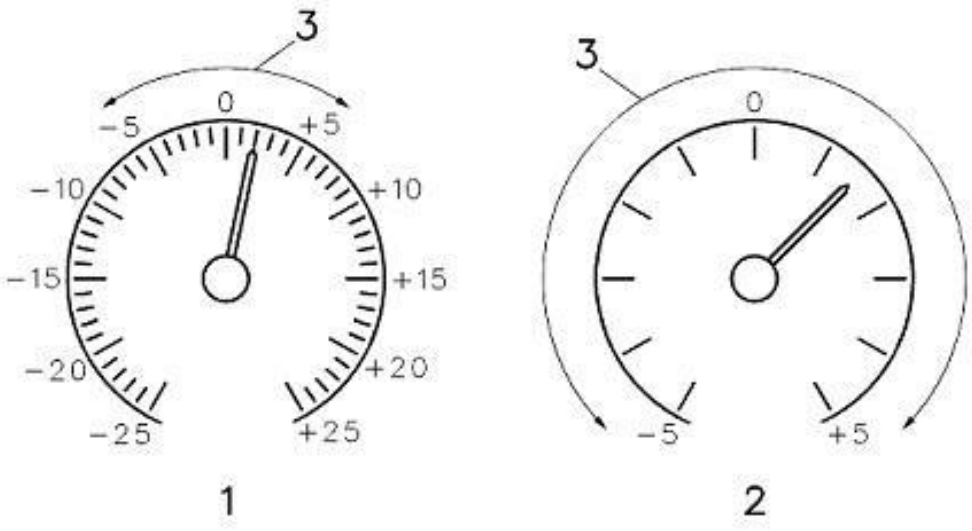
- Information displays should display the required accuracy and no more. Value scales should have no more resolution than required for the task
- Avoid high resolution if not accompanied by the same level of accuracy (see recent marine accidents)
- Information should be easy to read and prevent from erroneous reading
- Information should be in a format that is close to the cognitive process that it supports (e.g. digital, analog, trend)
- Changes in the information status of displays should be easily detectable
- Display malfunctions should be detectable
- Audible information should be used primarily as extra support for critical inf.

Criteria for the design, selection or evaluation of information display functions



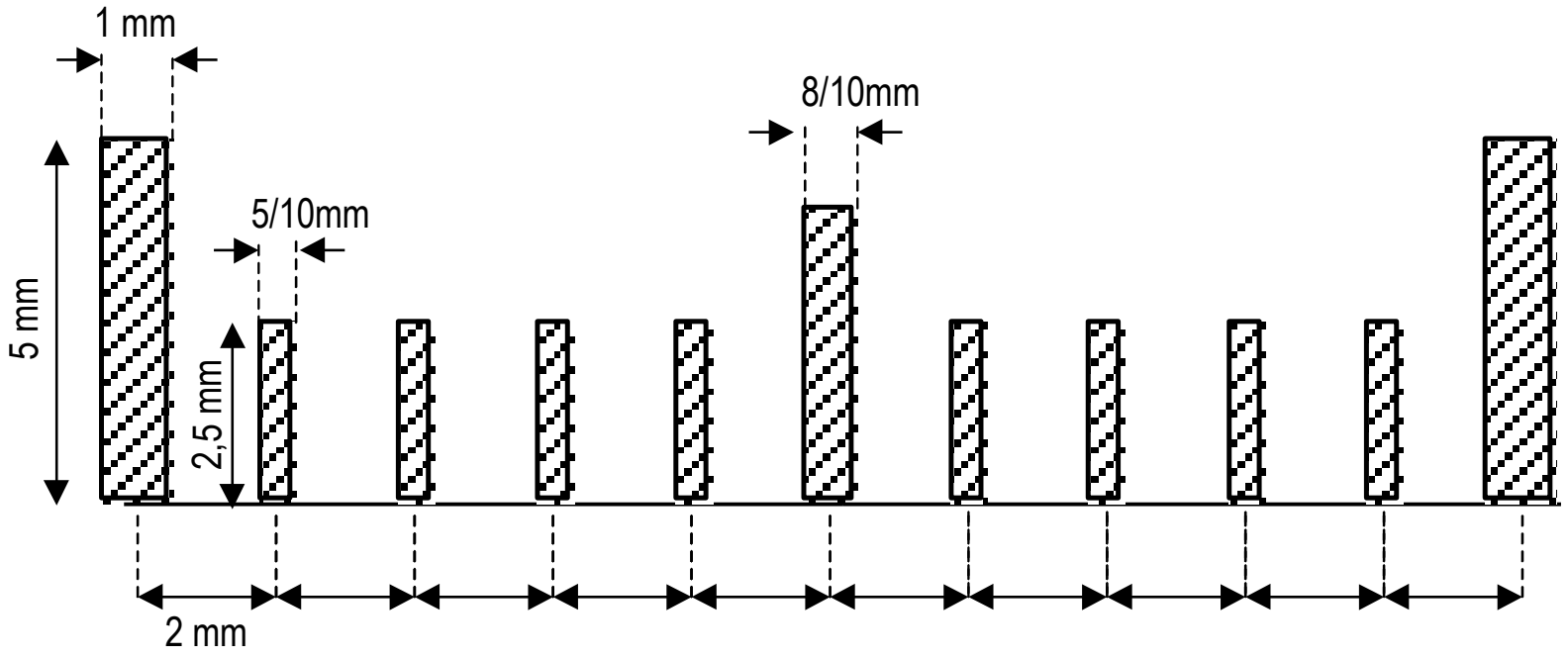
- Display with (a) digital (b) analogue and (c) dynamic (trend-supported) tank level feedback. Source: University of Oldenburg

Examples of standards, design recommendations for analogue displays

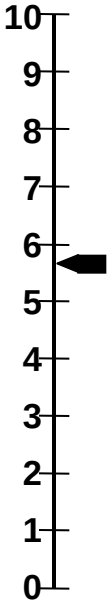


1 inappropriate design - 2 appropriate design - 3 applicable value area

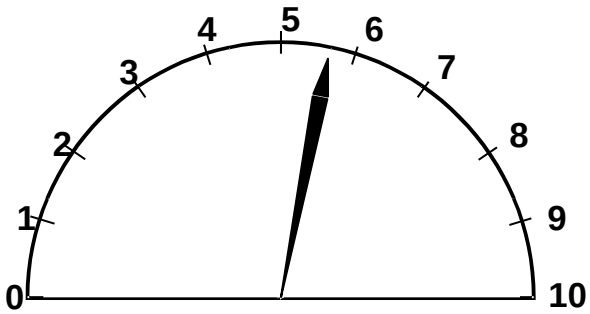
Standard dimensions of scales for analogue visual displays



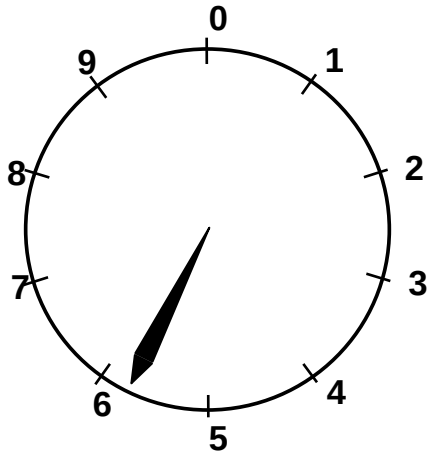
Experimental results of error rate of different types of displays



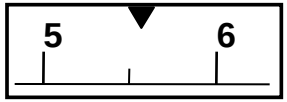
Κάθετης κλίμακας:
35,5% σφάλματα ανάγνωσης



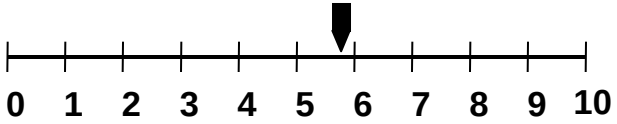
Ημικυκλικής κλίμακας:
10,9% σφάλματα ανάγνωσης



Κυκλικής κλίμακας:
16,6% σφάλματα ανάγνωσης

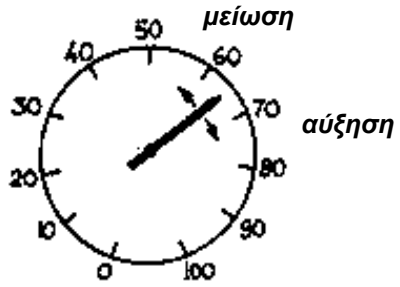


Παραθύρου :
0,05% σφάλματα ανάγνωσης

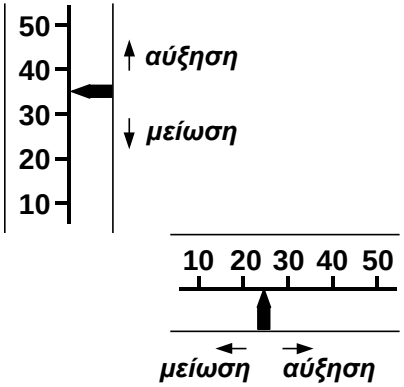


Οριζόντιας κλίμακας:
27,5% σφάλματα ανάγνωσης

Suggested pointer direction from different types of analogue visual displays

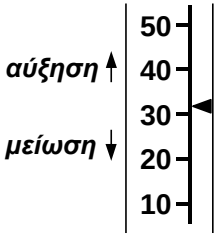


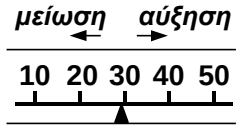
Σταθερή κλίμακα - κινητή βελόνα



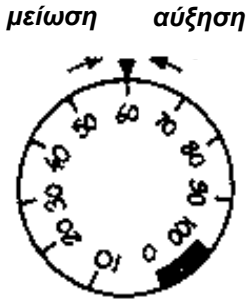
Σταθερή κλίμακα - κινητή βελόνα

Σταθερή κλίμακα - κινητή βελόνα



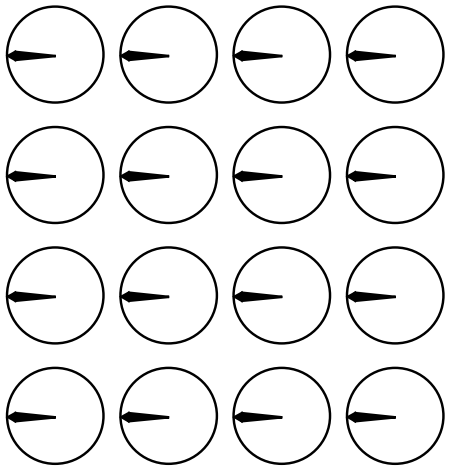


Κινητή κλίμακα - σταθερή βελόνα

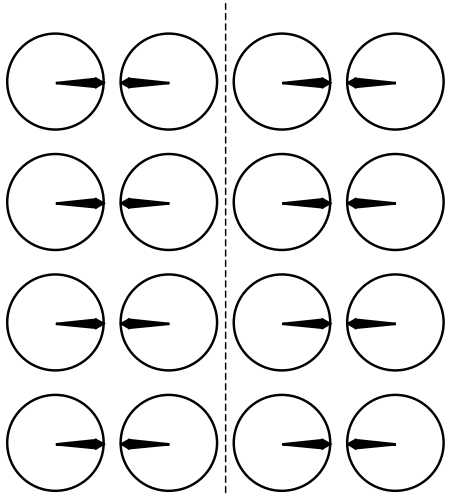


Κινητή κλίμακα - σταθερή βελόνα

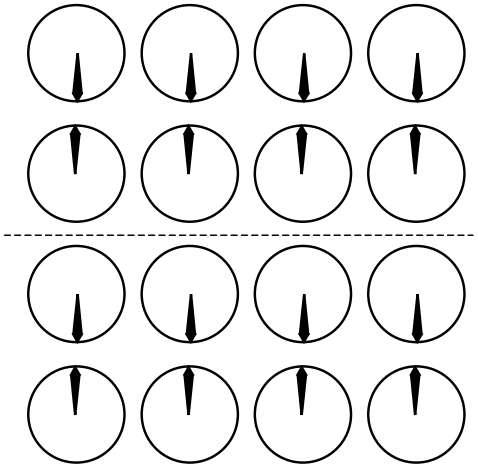
Groupings of analogue displays



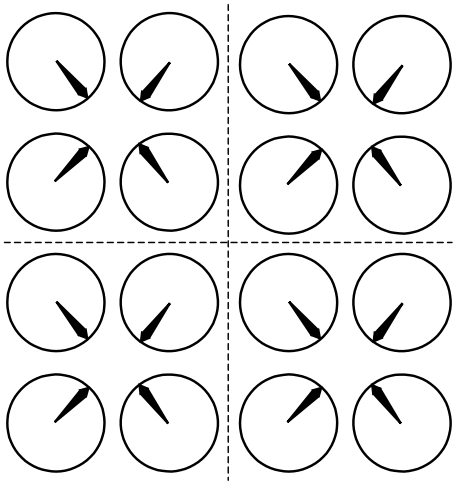
Καλά ευθυγραμμισμένα



Καλή ομαδοποίηση

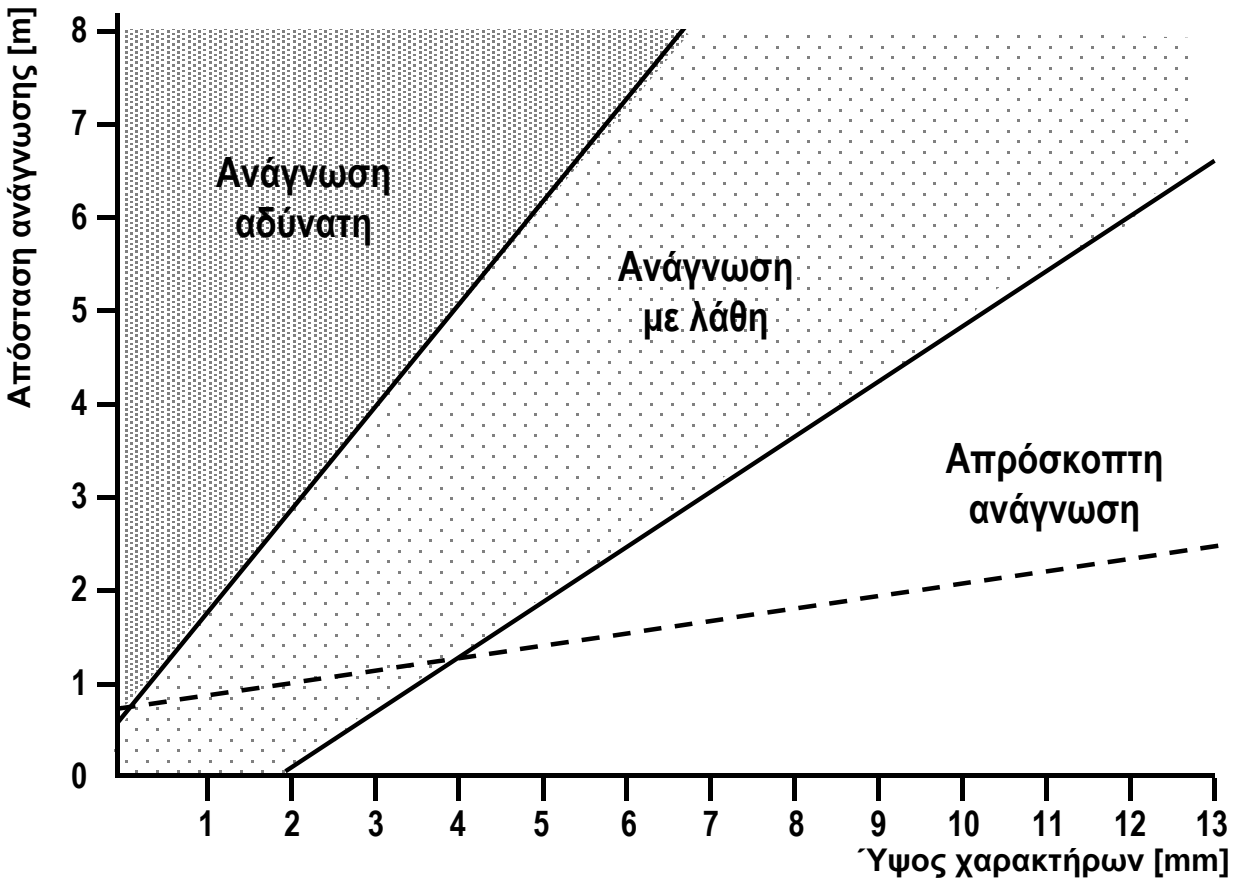


Καλή ομαδοποίηση



Κακή ομαδοποίηση

Alphanumeric character height and readability as a function of reading distance

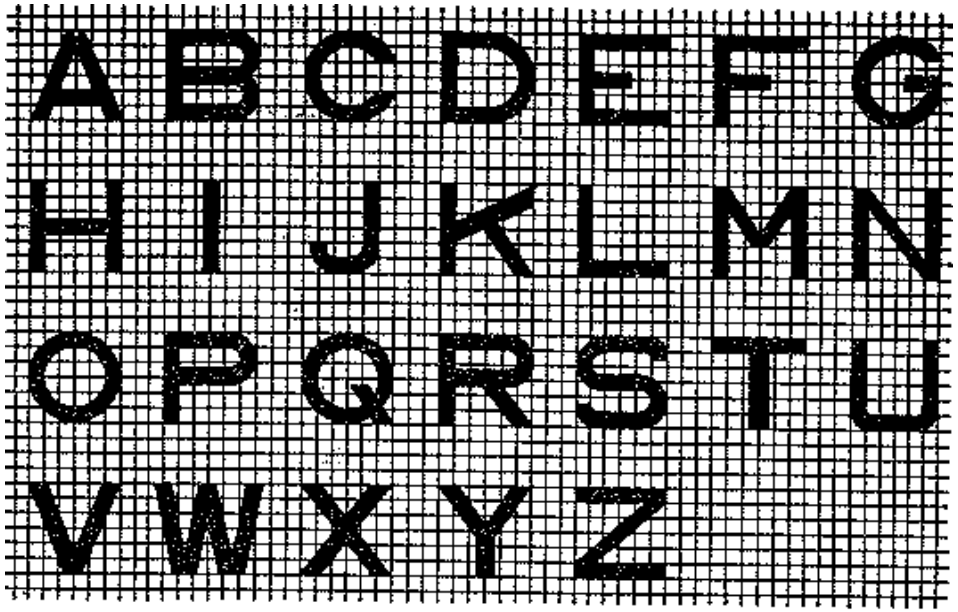


- - - - - - : In practice the following formula is used:

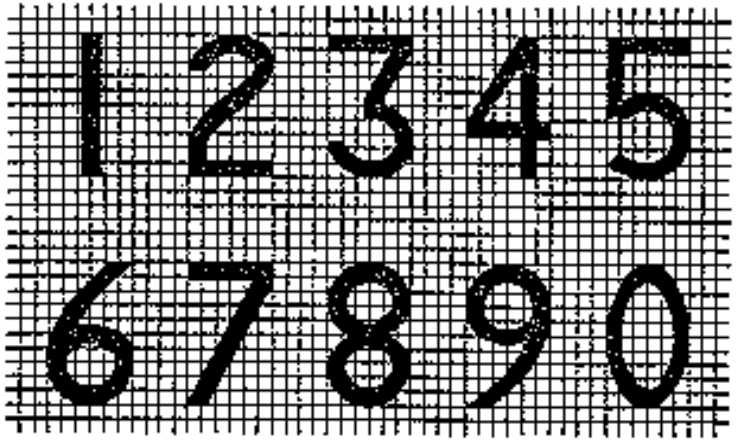
H(m) = d (m) / 200

Where d = Reading distance

Correlation between alphanumeric character Height & width



Optimum correlation height/width: 1/1



Limit correlation height/width: 2/1

These suggestions are generic and do not take into consideration typeface design, kerning (character spacing), color contrast, back or front illumination etc.