



# Engineering in Computer Science HUMAN COMPUTER INTERACTION



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# 1 Overview

WinWork has been developed for a real company that produces plastic bags for many customers across the country. It is a web application designed for mobile devices that aims to solve a real problem of loading and displaying data related to production processes. The goal is to allow an agent to load data inherent to several production processes, and subsequently, view the data entered. Each production process is characterized by several phases, some of these need a periodic check because they must respect a certain standard of reliability.

The application allows agents to manage information about two specific production phases:

**Weight detection of the bags block:** Each machine produces blocks of bags, in parallel, based on the tracks of the machinery. Each agent must measure the weight of each block and save it on the application.



Bags production



Bags withdrawal

**Moving the boxes on the platforms:** Once the agent has weighed the blocks, he puts them in the boxes and then, he puts the boxes on the numbered platforms.



Boxing



Positioning on the platforms

## 2 WinWork user

### 2.1 Applied UserProfile, Persona, Scenario

**Age:** 18-60 years

**Gender:** 80% male

**Job Title:** Diploma

**Location:** Italy, Terni

#### Persona

Daniele is 23 years old, he has a diploma and he really wants to work. He delivered the pizzas for three years, but he wanted a more interesting job. He has been working in the company for a few months and he is very fascinated by his work.

#### Scenario

It's 17.45 on Monday, Daniele is been working for many consecutive hours, moving to the various sections of the company. He is monitoring several production processes but he doesn't remember them. So, he opens WinWork and checks easily the machines that he must monitor, optimizing the time and reducing errors.

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#### Persona

Giovanni is 56 years old, he is a veteran of the company. In a few years, he will retire but he still wants to work. He is a reference point for everyone in the company and he is very friendly to everyone.

#### Scenario

It is 6.00 pm, after many hours of work, Giovanni isn't mentally lucid. He is putting the boxes in the '0129' platform, there are already many boxes on the platform and he has difficulty counting and adding the new boxes. So, he uses the application and he can view the number of boxes already placed and he can easily increase the number with a specific button, minimizing the use of short memory.

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#### Persona

Luca is 35 years old, he has worked for several years in the company and he is no longer impressed by the job, but he has a family and he must work. He would like to change jobs but he is paid well and he stays in the company.

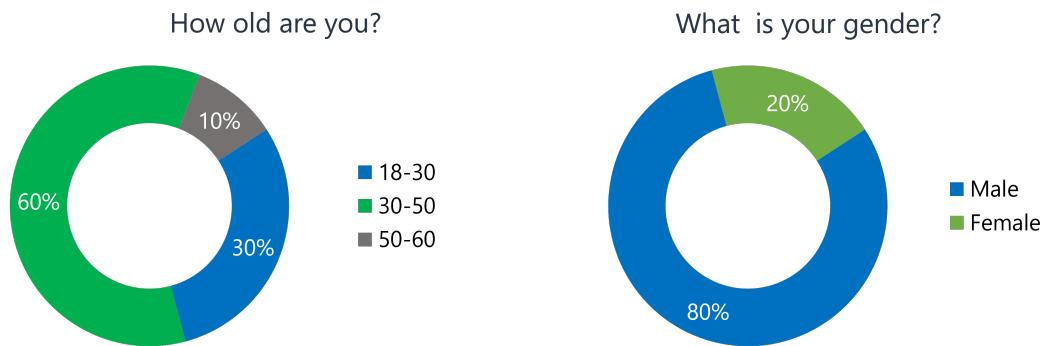
#### Scenario

It is 5.30 pm, Luca is very tired but he has to work. Furthermore, the machine '004' has crashed and he is very stressed because he must monitor the other processes. Thus, he opens WinWork and he sends a message to the manager notifying him of the problem, being able to continue monitoring the other processes, optimizing the times.

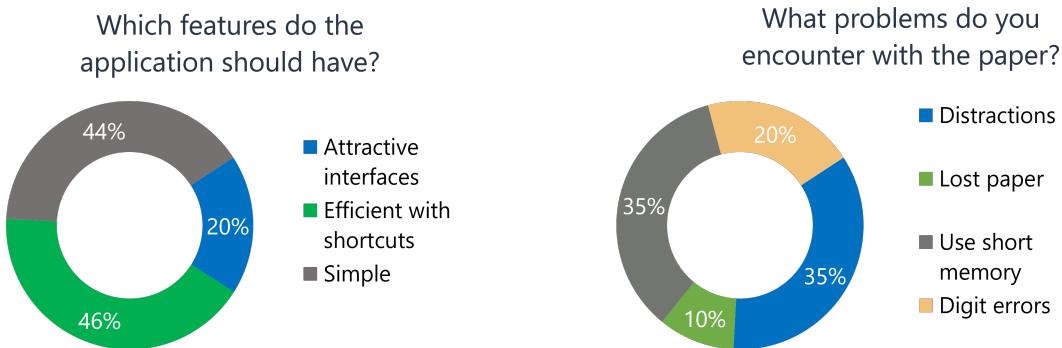
## 2.2 Requirements Analysis

I started the project performing some questionnaires to understand the needs and the type of user that will use the application. The first ones are for statistical purposes (age and gender), the others are focused on the current method used by agents with their considerations. The last ones are for better comprehend the possible user interaction. After that, I integrate it with some interviews to understand the real problem of agents and how they would like to improve their work.

### Questionnaires

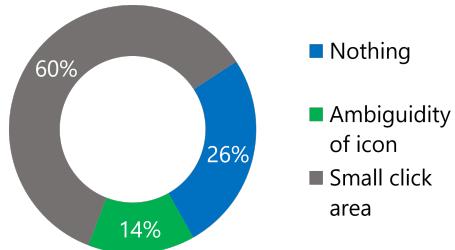


As we can see, most of the agents are aged between 30 and 50 years and there is a huge disparity between the sex of the staff (80/20).

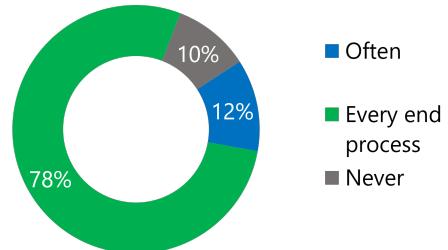


As we can see, most of the agents want an efficient and simple application to perform their tasks. In addition, they have several problems with the actual method, in particular way, they have many distractions and struggle to resume their activities.

What problems do you find in common applications?



When do you review the concluded processes?



As we can see, most of the agents have some problems to interact with their usual application, in particular way, they have difficulty clicking into the sections of interest and they are bored by the inconsistency of the icons/buttons. In addition, we can see that most of the agents see the concluded processes a few times a day.

## Interviews

1)

Name	Age	Years of work
Mario	42	12

**Question:** What problems do you encounter when you change the production process with the paper method?

**Answer:** I have several papers for each production process, so when I have to change them, I can have two problems: 1) If I forgot the papers in each location of the machine, I don't remember the machine in which I worked. 2) If I have all the papers with me in each production process, I have a lot of papers and it's more difficult to manage all of them, increasing errors and time of work.

**Conclusions:** The agent must always know the processes that he is monitoring and he must be able to change them easily.

2)

Name	Age	Years of work
Francesco	32	8

**Question:** What problems do you encounter when you write data with the paper method?

**Answer:** I can have several problems: 1) I forgot the pencil in the last location. 2) When I do a survey, I must write the number of surveys, the hour and finally the weight value, so I spend a lot of time and I can make errors. 4) When I have to update a value, for example, the number of boxes on the platform, I have to remember the last value and perform the sum, so I can make errors. 3) When I wrong, I have to dirty the sheet and I make a problem for the manager that he has to read my sheets.

**Conclusions:** It's necessary to minimize the data that an agent must write, minimizing also the use of short memory.

### 3 Design and Analysis

#### 3.1 Guidelines

The entire design is designed for mobile devices, considering the main guidelines for mobile development and the user requirements previously treated.

**Tiny screen sizes:** Mobile devices don't offer much space to present information or choices, so it is important to minimize interfaces, showing only the bare necessities.

**Variable screen widths:** It's hard to make a design that works well on several different screens.

**Touch screens:** The majority of mobile applications come from devices providing touch screens. It's hard to touch small targets accurately with fingers. A good design makes links and buttons large enough to hit easily.

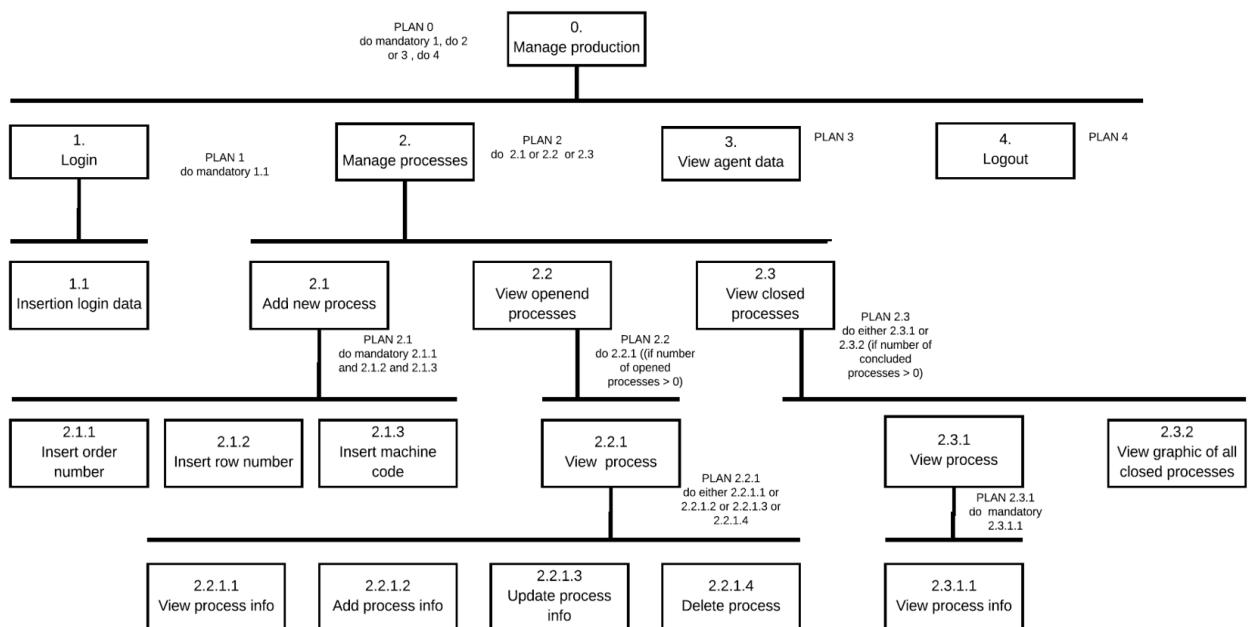
**Difficulty of typing text:** It is uncomfortable to type long text on a touch screen. A good design makes typing unnecessary or very limited.

**Limited user attention:** The mobile user uses the application in different contexts and he is subject to distractions. A good design takes care of distracted users.

**Manage thumb zone:** Better manage the thumb zones in order to maximize the efficiency of the main operations, limiting others.

#### 3.2 Prototype 1

##### 3.2.1 HTA



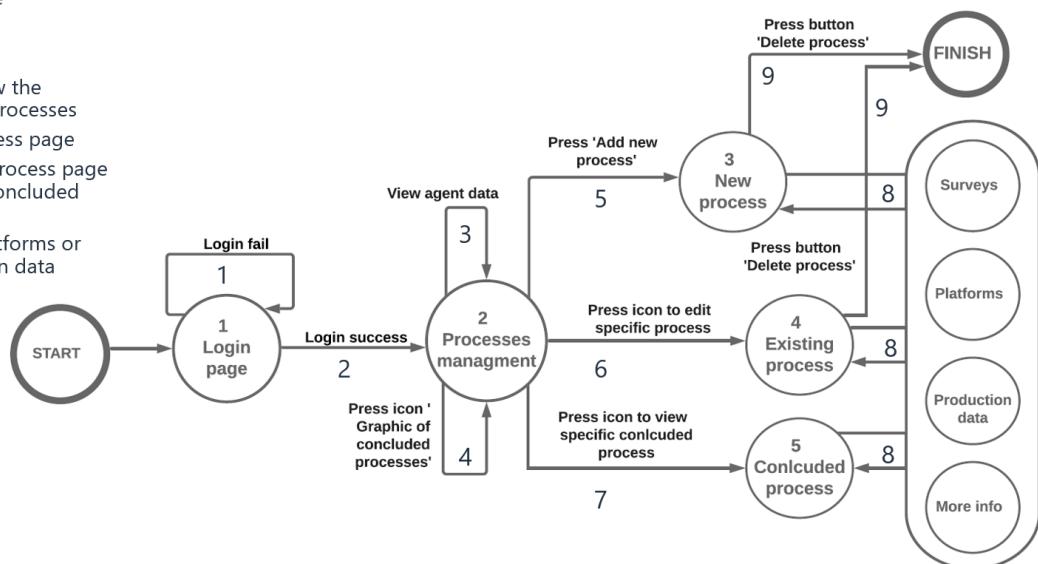
### 3.2.2 STN

#### System feedback

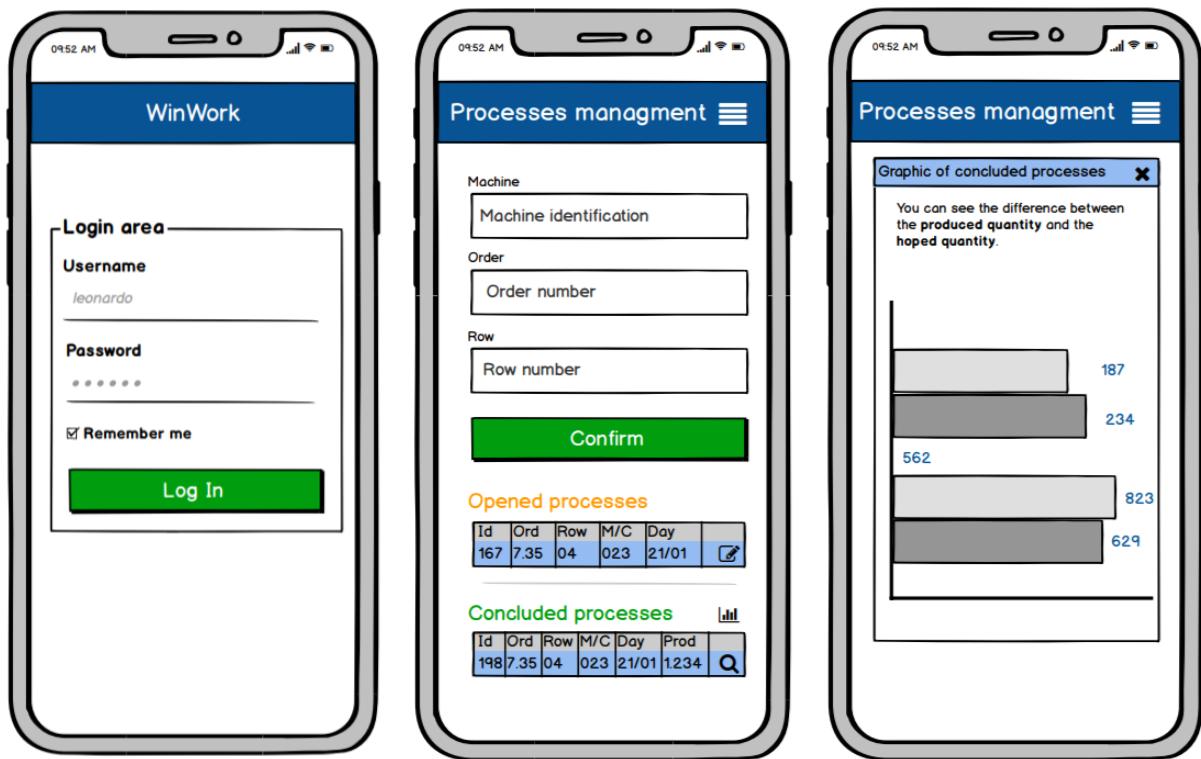
- #1 Show error message
- #2 Go to landing page
- #3 Show agent data
- #4 Open popup to view the graphic of concluded processes
- #5 Go to the new process page
- #6 Go to the existing process page
- #7 Go to the specific concluded process page
- #8 View Surveys or Platforms or More info or Production data
- #9 Delete process

#### Reachability

- 1: 2
- 2: 1, 3, 4, 5
- 3: 1, 2
- 4: 1,2
- 5: 1,2



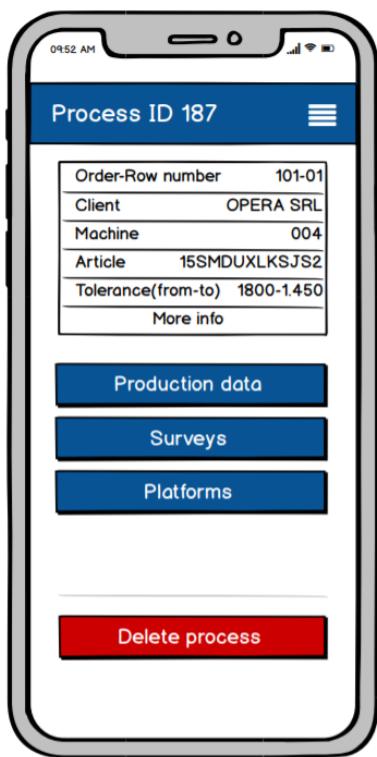
### 3.2.3 Balsamiq Mockup



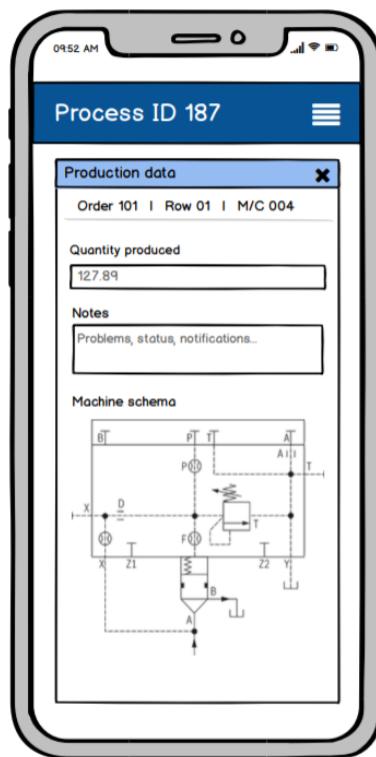
Login

Processes management

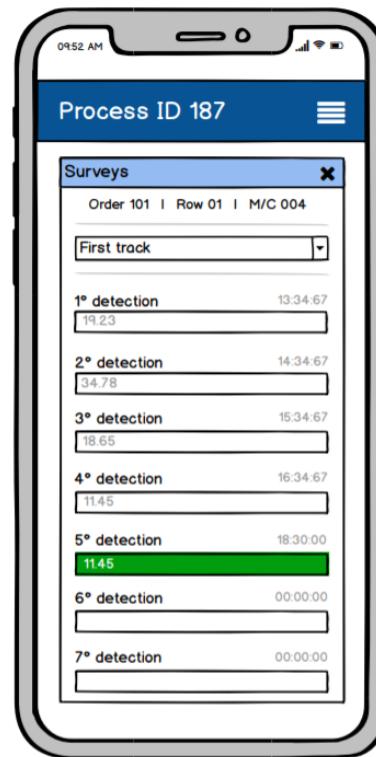
Graphic report



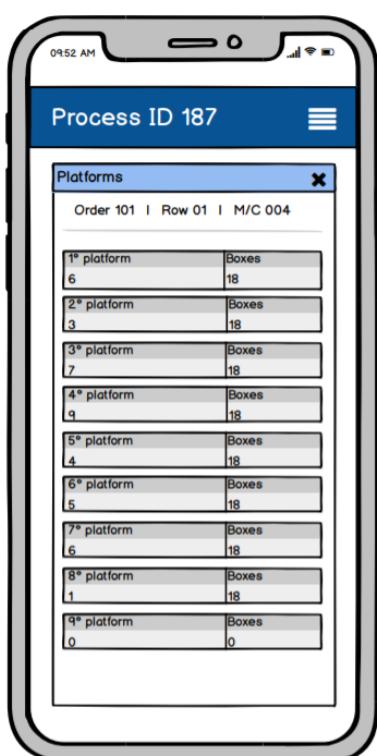
Production process



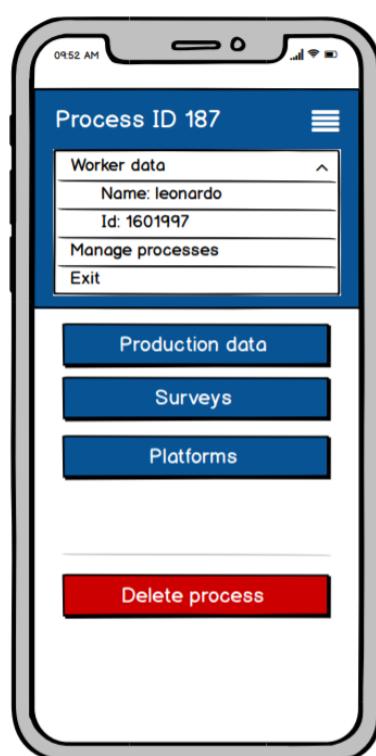
Production data



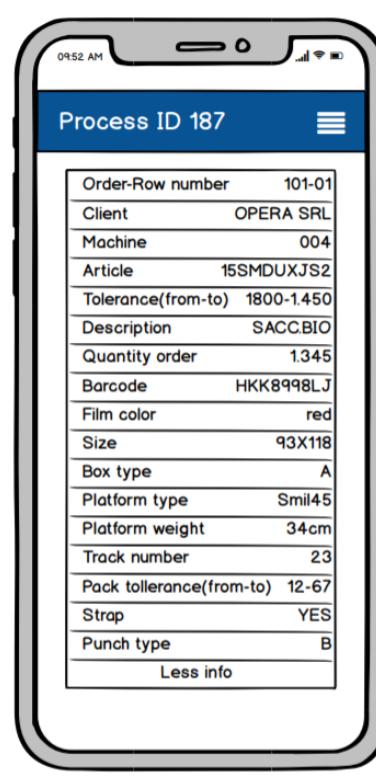
Surveys



Platforms



Menu



More info about the current process

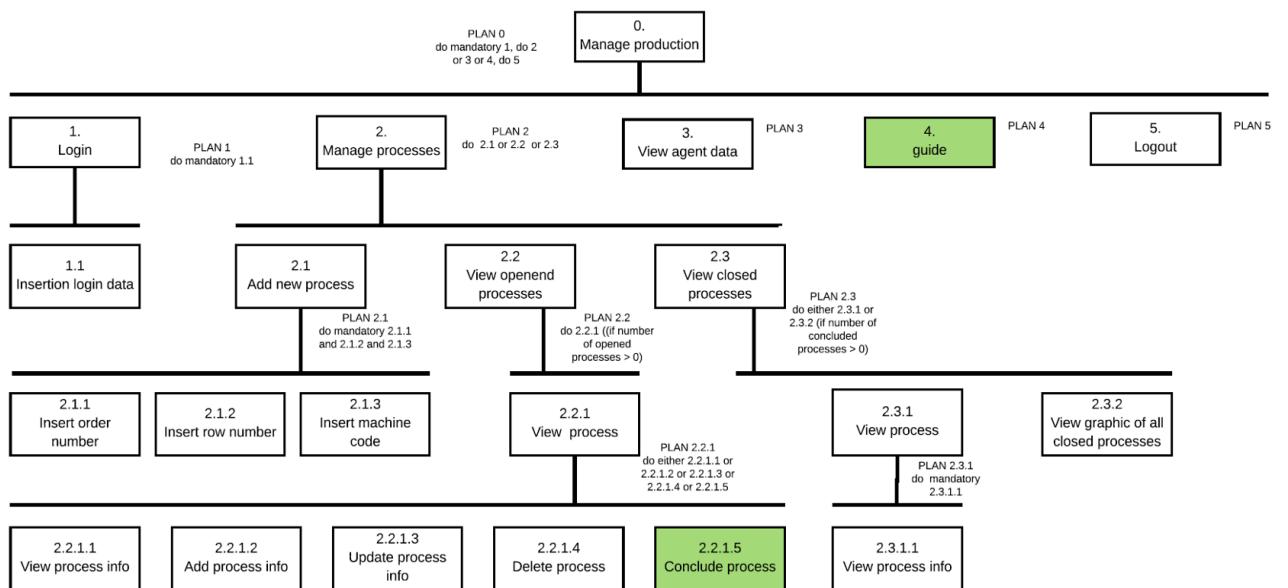
### 3.3 Heuristic Evaluation

Page	Heuristic violated	Severity	Description
Login page	Recognition rather than recall	2	If username is the employee id number think about replace «username» with «employee number»
Login page	Recognition rather than recall	2	Supply a brief indication on how to recovery in case of forgotten password
All	Help and documentation	3	Introduce a brief help in order to illustrate the application. A glossary with the sued terms (machine,order, row...) could be useful
Graphic	Recognition rather than recall	3	It will be useful indicate the information on the axis and the bars
Process	Visibility of system status		«Process id 187» is on several different pages with different data

### 3.4 Prototype 2

After the first prototype, I have done several changes to improve many aspects of the interaction. In addition, to the arrangement of the violated heuristics (emerged from the heuristic evaluation), all heuristics have been reworked for better usability.

#### 3.4.1 HTA



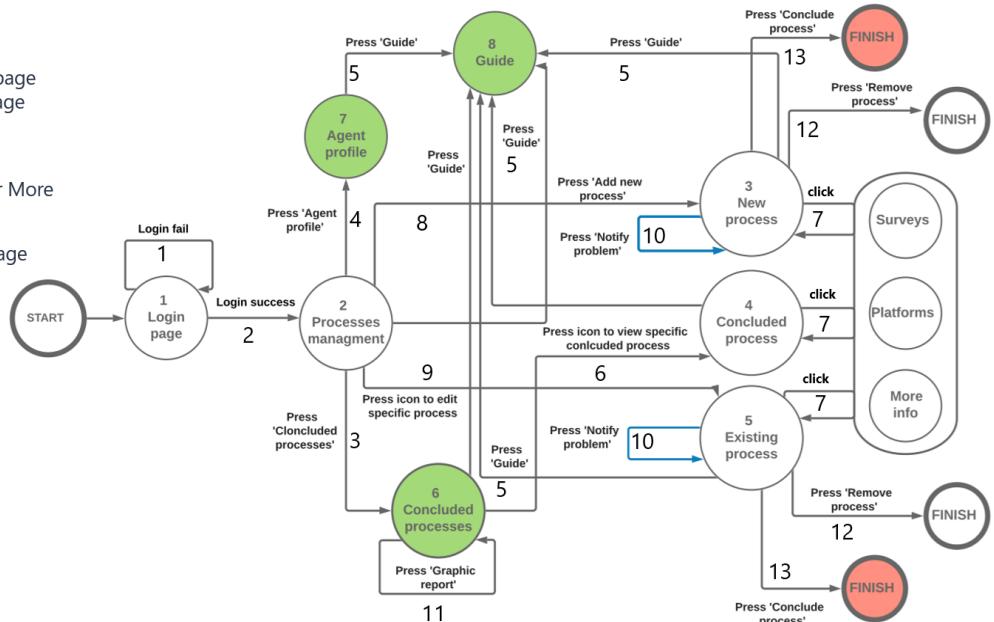
### 3.4.2 STN

#### System feedback

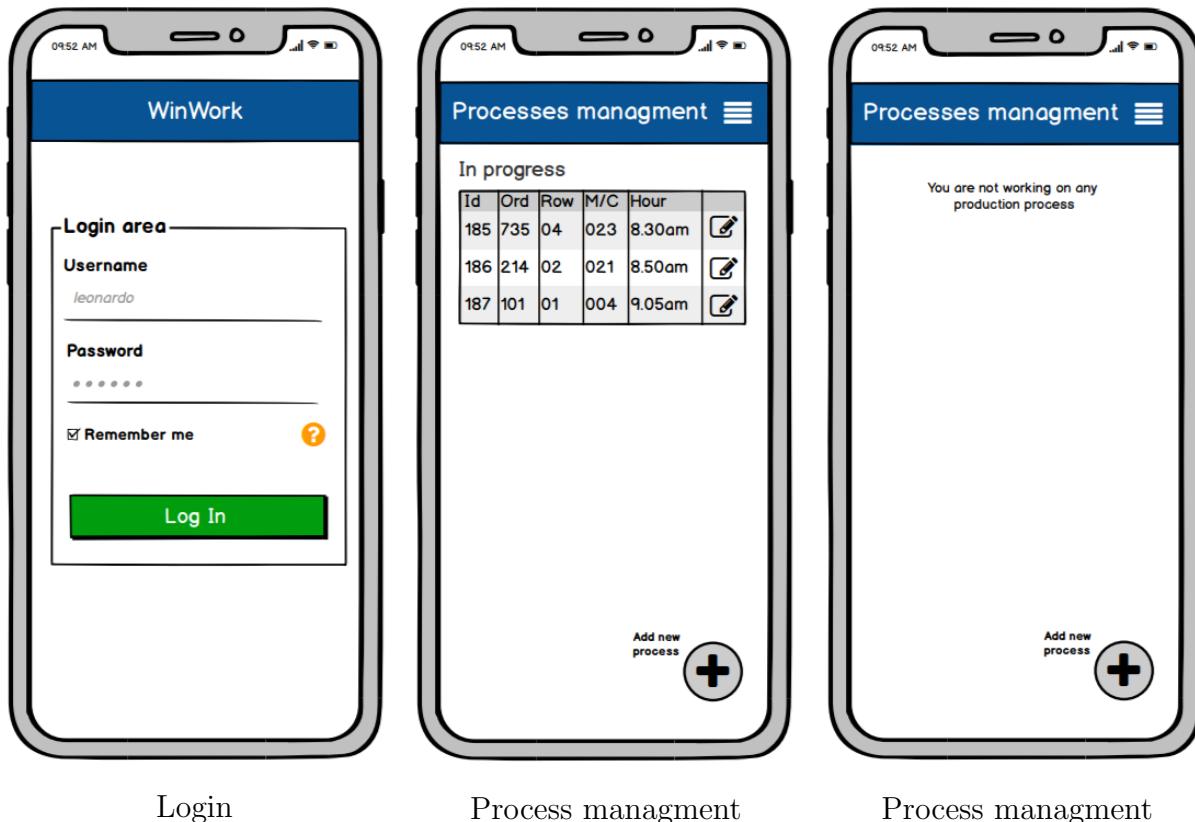
- #1 Show error message
- #2 Go to landing page
- #3 Go to concluded processes page
- #4 Go to the personal profile page
- #5 Go to the guide page
- #6 Go to the specific concluded process page
- #7 View Surveys or Platforms or More info
- #8 Go to the new process page
- #9 Go to the existing process page
- #10 Send message
- #11 View Graphic report of concluded processes
- #12 Delete process
- #13 Conclude process

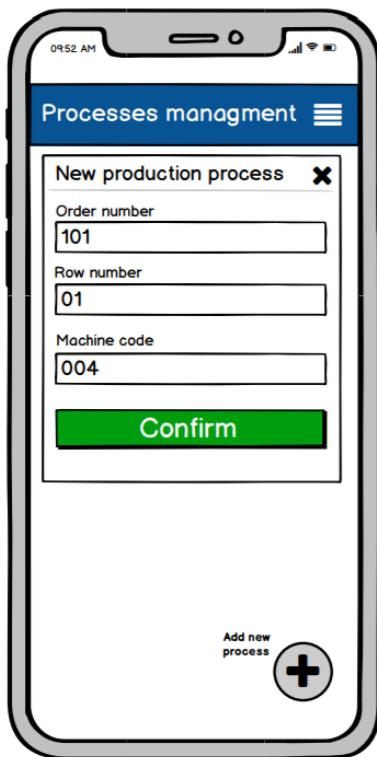
#### Reachability

- 1: 2
- 2: 1, 3, 5, 6, 7, 8
- 3: 1, 2, 6, 7, 8
- 4: 1, 2, 6, 7, 8
- 5: 1, 2, 6, 7, 8
- 6: 1, 2, 5, 7, 8
- 7: 1, 2, 6, 8
- 8: 1, 2, 6, 7

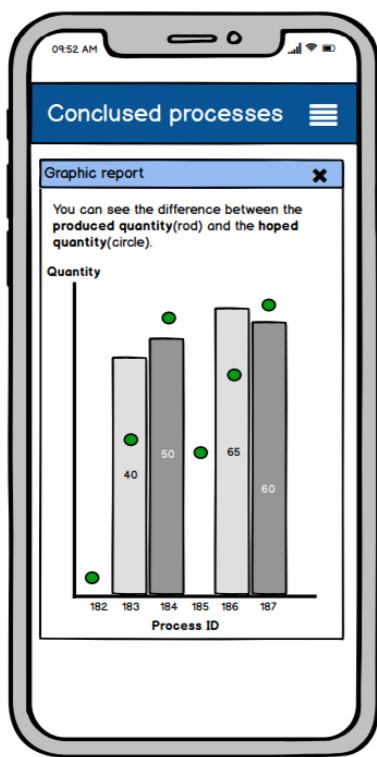


### 3.4.3 Balsamiq Mockup





New process



Graphic report

09:52 AM

Production process

ID 187

Order-Row number	101-01
Client	OPERA SRL
Machine	004
Article	15SMDUXLKSJS2
Tolerance(from-to)	1800-1450
More info	

Surveys

Platforms

Production process

09:52 AM

Production process

Options

Order 101 | Row 01 | M/C 004

Conclude the current process  
**CONCLUDE**

Notify a problem to the manager  
**NOTIFY**

Delete the current process  
**DELETE**

Process options

09:52 AM

Production process

Surveys

Order 101 | Row 01 | M/C 004

First track

4° detection 16:34:67  
123

5° detection 00:00:00

Surveys

09:52 AM

Production process

Surveys

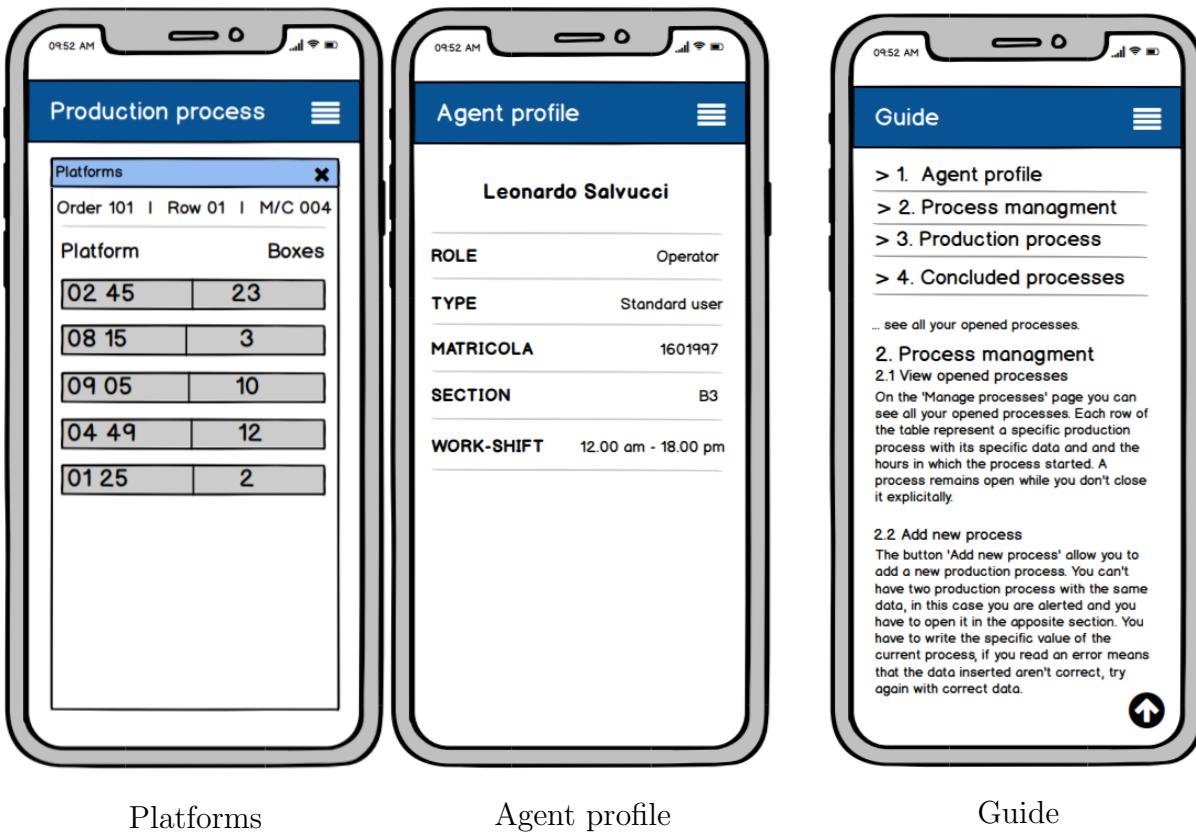
Order 101 | Row 01 | M/C 004

First track

4° detection 16:34:67  
123

CANCEL CONFIRM

Edit survey



Platforms

Agent profile

Guide

#### 3.4.4 How the heuristics have been applied

##### Visibility of system status

In each screen or simple internal activities (pop-up), the user is always able to view the main information, for example, the process phase and the information related to the current process.

##### Match between system and real world

The main goal is to reduce cognitive tension, using an intuitive nomenclature inherent to the technical language known to the agents.

##### User control and freedom

The user always has full control over his actions, receiving a specific message for each action, being able to cancel any operation without difficulty with immediate notification of success.

##### Consistency and standards

Consistency is always respected, being consistent with the nomenclature used.

##### Error prevention

Particular attention has been paid to the prevention of errors, in particular, when the user has to perform an operation on a certain section, the interface is minimalized so as not to confuse the agent. An agent is able to perform his activity even in the presence of distractions, minimizing the short memory used.

### **Recognition rather than recall**

The use of memory has been minimized, the agent works for many hours with the application, so an excessive attention will tire the agent, increasing the possibility of errors.

### **Flexibility and efficiency use**

The system offers shortcuts for more experienced users (surveys layout). It allows the agent to suspend an operation, putting the application in background, the agent doesn't lose the data entered.

### **Aesthetic and minimalist design**

There is a minimalist design, presenting content and features in a simple way, direct way by providing as little distraction from the core content as possible. I removed content or features that don't support the primary goals of the users.

### **Help user recognize, diagnose and recover from errors**

All messages are clearly displayed, without ambiguity. The dangerous actions (remove a process) are forced, while the others are quick and clear. After each operation it is possible to go back easily, managing any distractions.

### **Help and documentation**

The application is very intuitive and the terminologies fall within the skills of the agents, however, there is a documentation to help the novice trainees or those who come from a long period of pause.

## **3.5 User-based evaluation**

### **3.5.1 Think Aloud**

In this kind of evaluation, I want to understand the mental paths that the user makes to perform the established tasks. I have requested to perform different tasks to a group of 7 agents with different ages. I checked the critical points in two interfaces:

#### **1) Surveys**

GOAL	DESCRIPTION OF INCIDENT	HOW THE INCIDENT WAS FOUND	POTENTIAL SOLUTION
<b>View previous surveys</b>	The user doesn't easily understand how he can view the previous surveys: "How can I see the previous surveys?"	In the surveys interface, if the user wants to view the previous surveys, he doesn't find an explicit indication to carry out the operation and he remains blocked for a few seconds	The addition of an explicit indication to view the previous surveys

## 2) Production process

GOAL	DESCRIPTION OF INCIDENT	HOW THE INCIDENT WAS FOUND	POTENTIAL SOLUTION
<b>View process options (Conclude process, notify a problem, delete process)</b>	The user doesn't easily understand how he can view the process option, for example, to conclude the current process: "How can I conclude the current process?"	In the production process interface, if the user wants to view the options, for example, to conclude the current process, he doesn't find an explicit indication to carry out the operation and he remains blocked for a few seconds	The addition of an explicit indication to view the process options

### 3.5.2 First controlled experiment

To evaluate the problems encountered in the previous evaluation (Think Aloud), I decided to perform a Controlled Experiment to compare the previous solution with an alteration able to satisfy even the less intuitive users. I organize two groups of 7 people for each experiment, mixing them by age.



Previous

Proposal

In the previous interface, the user to view the whole list of previous surveys must swipe down in the current section, while in the second, there is also an explicit label to perform the task. Of course, to keep the flexibility and efficiency, the previous function hasn't been removed to allow an expert user to work efficiently.

- **Participants:** sample of 7 agents
- **Independent variables:** interface layouts, Previous and Proposal
- **Dependent variables:** the time required to execute the task (in seconds)
- **Hypothesis:**
  - **My hypothesis:** The proposal interface layout reduce time to perform the task (View the previous surveys)
  - **Null hypothesis:** There isn't difference between the two layout interfaces
- **User task:** View the previous surveys about an opened process
- **Assumptions:**
  - The user is already logged
  - The user is browsing the page related to manage processes

**Applying ANOVA on the collected data in experiment** It helps me to figure out if you need to reject the null hypothesis or accept the alternate hypothesis.

	A	B	C	D	E	F	G	H
1	Previous layout	Proposal layout						
2	38	17						
3	30	21						
4	45	15						
5	42	18						
6	35	23						
7	22	16						
8	40	22						
9								
10								
11								
12	<b>Anova: Single Factor</b>							
13								
14	<b>SUMMARY</b>							
15	Groups	Count	Sum	Average	Variance			
16	Previous layout	7	252	36	61,66666667			
17	Proposal layout	7	132	18,85714286	9,80952381			
18								
19								
20	<b>ANOVA</b>							
21	Source of Variation	SS	df	MS	F	P-value	F crit	
22	Between Groups	1028,571429	1	1028,571429	28,78081279	0,000169491	4,747225347	
23	Within Groups	428,8571429	12	35,73809524				
24								
25	Total	1457,428571	13					
26								

**Analysis of data** The result come out applying ANOVA are the following:  
 Having the P-value less than the threshold value (0.05) the experiment is significant. In addition, having  $F > F_{crit}$  ( $28.7808 > 4.7472$ ), I can reject the null hypothesis.  
 Considering the averages  $A(\text{prev}) > A(\text{prop})$  ( $36 > 18.85$ ), I conclude that the proposed layout reduces the time to perform the task (View the previous surveys).

### 3.5.3 Second controlled experiment



In the previous interface, the user to view the options of the current process (conclude process, notify a problem and delete process) must click on the top section in which there are the 'ID process' and the options icon (three vertical points), while in the proposed solution, there is an explicit bottom on the top of the section that, of course, it facilitates recognition, but weighs up the interface.

- **Participants:** sample of 7 agents
- **Independent variables:** interface layouts, Previous and Proposal
- **Dependent variables:** the time required to execute the task (in seconds)
- **Hypothesis:**
  - **My hypothesis:** The proposal interface layout reduce time to perform the task (Find the options)
  - **Null hypothesis:** There isn't difference between the two layout interfaces

- **User task:** Find the option of the process to conclude/delete the current process or to notify a problem to the manager about an opened process
- **Assumptions:**
  - The user is already logged
  - The user is browsing the page related to processes management

**Applying ANOVA on the collected data in experiment** It help me to figure out if you need to reject the null hypothesis or accept the alternate hypothesis.

	A	B	C	D	E	F	G	H
1	Previous layout	Proposal layout						
2	12	6						
3	18	10						
4	17	8						
5	20	7						
6	9	8						
7	14	12						
8	15	7						
9								
10								
11	Anova: Single Factor							
12								
13	SUMMARY							
14	Groups	Count	Sum	Average	Variance			
15	Previous layout	7	105	15	14			
16	Proposal layout	7	58	8,285714286	4,238095238			
17								
18								
19	ANOVA							
20	Source of Variation	SS	df	MS	F	P-Value	F crit	
21	Between Groups	157,7857143	1	157,7857143	17,30287206	0,001323569	4,747225347	
22	Within Groups	109,4285714	12	9,119047619				
23								
24	Total	267,2142857	13					
25								

**Analysis of data** The result comes out applying ANOVA are the following:

Having the P-value less than the threshold value (0.05) the experiment is significant. In addition, having  $F > F_{crit}$  ( $17.3028 > 4.7472$ ), I can reject the null hypothesis.

Considering the averages  $A(\text{prev}) > A(\text{prop})$  ( $15 > 8.28$ ), I conclude that the proposed layout reduces the time to perform the task (Find the options).

## 4 Final product

**Login**

149.202.38.124/hci/index.php

Leonardo

Log in

**Process management**

In progress

Order	Row	M/C	Hour	
187145	004	002	09:42	
187145	004	001	12:50	

Add new process

**New production process**

Order number  
187145

Row number  
004

Machine code  
001

Confirm

**Process**

Process ID 247

OPTIONS

ORDER - ROW NUMBER	187.145 - 004
CUTTING MACHINE	002
CUSTOMER	GIANT SRL (004034)
ARTICLE	1RSUMBI040SMB120

More info

SURVEYS

PLATFORMS

**Surveys**

Order 187.145 | Row 004 | M/C 002

First track

2° survey 09:42:34  
40

3° survey 00:00:00

See previous

**Edit survey**

Order 187.145 | Row 004 | M/C 002

First track

2° survey 12:51:32  
25

CANCEL CONFIRM

See previous

96% | 11:09

149.202.38.124/hci/index6.p

### Platforms

Order 187.145 | Row 004 | M/C 002

Platform code	Boxes number
02 93	4
08 23	0
03 66	0
08 26	0
09 12	0

< □ ≡

Platforms

12:43 96% | 75% | 11:09

149.202.38.124/hci/index6.p

### Process ID 303

#### OPTIONS

#### Options

Order 187.145 | Row 004 | M/C 002

- Conclude the current process **✓ CONCLUDE**
- Notify a problem to the manager **⚠ NOTIFY**
- Delete the current process **DELETE**

< □ ≡

Options

96% | 11:09

149.202.38.124/hci/manual.p

### Guide

- 1. Processes management
  - 1.1 View opened processes
  - 1.2 Add process
- 2. Production process
- 3. Personal profile
- 4. Concluded process

< □ ≡

**1. PROCESSES MANAGEMENT****1.1 View opened processes**

On the page 'Manage processes' you can see the all your openend processes. Each row of the table represent a specific production process with its specific data and the hours in which thie process strated. A process remains open while

Guide

22:56 10% | 11:42

149.202.38.124/hci/profile.p

### Personal profile

**Leonardo Salvucci**

ROLE	Operator
BIRTHDAY	12/02/1994
TYPE	Standard user
MATRICOLA	1601997
SECTION	A2
WORK-SHIFT	8.00 am - 16.00 pm

< □ ≡

Personal profile

16:37 93% | 68% | 11:42

149.202.38.124/hci/closed\_c

### Concluded processes

#### About today

ID	Order	Row	M/C
218	187.145	004	001
216	187.145	004	001
214	187.145	004	001

**Graphic report**

< □ ≡

Concluded process

16:37 68% | 11:42

149.202.38.124/hci/closed\_c

### Graphic report

Difference between the **produced quantity** (stack) and the **expected quantity** (circle).

Process ID	Quantity produced	Expected quantity
311	162	115
309	189	108

Trial Version  
CanvasJS.com

< □ ≡

Graphic report

## 5 Conclusion and future work

I designed the application by myself, finding a compromise between the guidelines of good design and the demands of the company. I tested the application on the real user being able to customize their interaction. I am very satisfied having immediately received good impressions from the agents since the first days of use. I'm excited to design new changes for the application, especially, I'm going to do several updates:

- Addition of other types of processes;
- Integration of the QR code reader to identify machines, platforms, etc., reducing the user's active interaction, maximizing performance and minimizing errors;
- Addition of automatic filters based on the user's privileges, for example, allowing the edit/delete of processes already concluded;
- Interfaces updates based on subsequent changes and new analyzes.

## Useful links

### **Slides of the presentation on Slideshare**

<https://www.slideshare.net/secret/g38DsZU9kERFU4>