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From Real-world Identities to Privacy-preserving and Attribute-based CREDentials for Device-centric Access Control

WP7 – Large Scale Pilots and End User Experience Assessment

Deliverable D7.1 "HCI concept testing on user groups"

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Executive Summary

ReCRED project aims for designing and implementing an integrated next generation access control (AC) solution aligned with current technological trends and capabilities, offering a unifying access control framework that is suitable for a multitude of use cases that involve online and physical authentication and authorization.

This project will provide a solution to the main problems of traditional password-based AC, liberating users from the burden of having to deal directly with multiple passwords, pins and accounts.

For the purpose of developing usable, secure and user-friendly AC system, the ReCRED solution will be designed considering the needs and the pain points the users meet for accessing different kinds of web services and managing their online identities.

In order to understand actual users’ issues regarding privacy and security and find the best way to solve them, the project includes this Deliverable 7.1 “HCI concept testing on user groups” within the Work Package 7 *Large Scale Pilots and End User Experience Assessment*.

This document presents the results of the preliminary qualitative research we have conducted to explore the user experience (UX) and gain relevant design insights as useful recommendations based on the user-centred approach.

UX research and assessment will be carried out throughout the ReCRED project as extensive in-field investigation of the main HCI issues regarding privacy and security from the point of view of the target users (end-users as well as web services administrators and providers).

Within the cycles of iterative design process, this research will provide contributions to different tasks and deliverables: from the initial definition of uses cases and functional requirements, to the prototype test and pilot sites assessment.

In the first section of this document, the research framework is described in order to highlight the main principles and assumptions which guide the user-centred approach as reference in the ReCRED project. Then, the analysis of UX and its relevant findings are presented in the form of the service design tools which are selected and used in order to provide a comprehensive representation of the users’ characteristics (motivations, needs and preferences).

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1. Introduction

Today, Internet affects more and more aspects of our life and work and therefore online security becomes an important management issues for companies, computer users and society as a whole [1].
The objective of the ReCRED project is to build an integrated next generation access control (AC) solution for web services that solves the main problems of the current password paradigm:

- *password overload*, referring to the inability of users to remember different secure passwords for each one of their accounts;
- *identity fragmentation*, stemming from the fact that independent identity providers (email, social networks, etc.) create disjoint identity realms, making it difficult for end-users to prove joint ownership of accounts, e.g., for reputation transfer or to fend off impersonation attacks;
- *lack of real-world identity binding* to an individual’s legal presence, e.g., id number, passport, etc.;
- *lack of support for attribute-based access control* (ABAC), which facilitates account-less access through verified identity attributes (e.g., age or location).

ReCRED project aims for developing an innovative service that represents a “meeting point” between the needs of the verifiers (online services or physical infrastructure administrators) as well as of provers (end-users), providing a usable and reliable AC system.
Designing innovative service is a costly process. Indeed, there are hundreds of unsuccessful ICT products or services beyond every success [2]. Often, the reason of this design failure is that the users find their ICT tools/services more stressing and frustrating than relaxing and user-friendly [3].
In such a context, the so called “user-centred approach” can play a key role in speeding up effectively the innovation processes to address users’ needs and design successful services [4].
According to these considerations and with the purpose of reaching the best solution, ReCRED project includes the user experience (UX) research and assessment with actual users, both in controlled environment and within the natural contexts.
From the beginning to the end of the project, we will investigate users’ concerns and needs about security and privacy using different techniques (questionnaire, interviews) and we will consider the findings in the development of the ReCRED architecture.
The results from this research will benefit the project, feeding both the technical development and fine-tuning, the validation of the design concept and the usability.
The UX research will be conducted throughout the project, and in each phase of the design process it will take different connotations: in this first part of the project, it is carried out as an exploratory investigation to analyze lacks and problems of current AC, identify target users and develop a deep understanding of their needs, goals and concerns, so to inform the design with relevant recommendations and guide the concept definition; then, once ReCRED concept is defined and the first prototype is created, the research will take the form of concept evaluation in order to validate the project core ideas. While in the last part of the project, when the pilot sites are set up, it will be carried out as usability assessment with actual users in the real contexts.

In this way, we can comply with the user-centred approach and achieve the ReCRED mission of developing an innovative solution that meets the real needs of the users.

1.1. Design framework

Human-Computer Interaction (HCI) has emerged relatively recently as a highly successful area of computer science research and development, and it has evolved rapidly as it has struggled to develop a scientific basis and utility in interactive system development [5].
Considering HCI merely as the study of user interfaces seems an extremely limited view. HCI is a science of design [6]. It seeks to understand and support human beings interacting with and through technology, and it has two main roles as a science for design: it produces general descriptions of users interacting with systems, which could be synthesized as guidelines for developers; and it directly verifies the usability of systems as (or more typically, after) they were developed.
Considering “innovation” as the imagination of what could be based in a knowledge of what is, it is essential to explore users’ activities and develop a deep understanding of their needs and motivations, so to imagine new ways and tools for enhancing their experience [7].
In the early days of HCI, the notion that computer systems should be designed and developed with explicit consideration of the needs, abilities and preferences of their users was not taken seriously [6]. Understanding the user's needs and activities is essential to the system development process, but such consideration is often incorporated into the design process simply as a set of specifications that the delivered system must adhere to [8].
On the contrary, “putting the users first” means that their experience is crucial in discussing the initial capabilities of the system and the required functionalities, and persists in the development and evaluation of prototypes, as well as in final implementation of the solution in the real world.
As the UX design and the user-centred approach spread, the role of psychologist and social scientists in the design of interactive systems becomes reinforced. Within the ReCRED project, UX experts can help to build a bridge between the reality of the users and the developers, bringing users’ voice into the design process. Furthermore, promoting the awareness and knowledge about the components of the UX benefits the design process keeping it focused on actual users with their real needs, goals, expectations and concerns.

1.1.1. Re-thinking the concept of “users”

The human-computer interaction is a bidirectional process that happens when the user is driven to accomplish a specific goal using a tool/service, within particular situation and context, and it is included in a system of activities. It deals with functionality but is embedded in an overall and more complex experience that has important emotional dimensions [3].
In order to design this interaction, we need to analyze every aspect of the phenomenon starting from some principles and assumptions, firstly regarding our representation of the human component of the HCI.

> «I have chosen to mention the terms *human factors* and *human actors* as I believe it

> highlights a difference in the perception of the person, the former connoting a passive, fragmented, de-personalized, un-motivated individual, the latter connoting an active, controlling one. […] The human is often reduced to being another system component, with certain characteristics, such as limited attention span, faulty memory, etc. that need to be factored into the design equation for the overall human - machine system. […] People are more than a sum of parts, be they information-processing subsystems or physiological systems, they have a set of values, goals and beliefs about life and work» [5, p.27].

Using the term "human actors" the emphasis is placed on the person as an autonomous and sense-making agent who has the capacity to regulate and coordinate his or her behavior, rather than simply being a passive element in a human-computer interaction.
This change in terminology may help in adjusting design perspective, emphasizing the holistic nature of the person acting in the real setting, in contrast to the view of the person as a set of information processing mechanisms that can be analyzed in the same manner as the information processing mechanisms of the technology [5]. Considering users as human actors serves to focus on their overall experience within the socio-cultural context, acting to achieve intelligent and meaningful action [9].

1.1.2. Service design approach

We can consider the ReCRED project as a service design process, involving multi-disciplinary expertise to address some of the key challenges arising from current AC systems.
The Service Design approach helps to innovate (create new) or improve existing services to make them more useful, usable, desirable for users and efficient as well as effective for providers [10].
In the last years, the shift from product design to service design (from owning to using, from things to experience) have changed the economy that now is focused on service dominant logic, with different advantages both for organizations and for customers. This does not mean that products are not important any more. Services are integrated as a complement offering to products and tools [11].
Designing a service is more than designing a single product and it requires special considerations. It is a new holistic, multi-disciplinary, integrative field: it considers the whole experience of the people using the service that becomes tangible and usable through its touchpoints, within a sequence of actions [12].
Taking into account the whole experience means that we design the end-user journey - starting from the pre-service period when the user gets in touch with the service, and considering all the steps to go on - as a coherent process [10], integrated with other services as the ReCRED solution represents the metaphor of their doorway.
Furthermore, designing ReCRED as a service requires to bear all the service stakeholders in mind: not just the end-users but also the services providers and administrators, with their privacy and security needs and concerns.

2. User Experience Research

In order to explore current AC for web services usage and understand users’ needs and concerns about privacy and security, we have conducted an exploratory research involving participants from the first pilot site (*Campus Wi-Fi and web services access control*).
The research we have carried out consists of the following steps:

a) identification of the groups of users as target of the ReCRED solution;
b) collection of data through interviews;
c) data analysis using service design tools, to provide a qualitative representation of users;
d) identification of design insights and further aspects to be examined in depth.

This research provides relevant recommendations to better define use cases and ReCRED concept, as well as it gives meaningful descriptions of the target users so to maintain the focus on their needs and characteristics during the overall design process.
We cannot consider this research as an exhaustive and comprehensive study of the UX, but rather as a preliminary investigation of the domain the ReCRED project addresses.
In the next stage, the research will go on using different methods and techniques (i.e. survey) with the purpose of collecting heterogeneous and rich data which cannot be gained using only one technique, as the interview is. The further investigation will start from the preliminary information we have collected until now, so to fill the gaps and enlarge upon every relevant topic.
Indeed, using the interview as technique to understand the user experience, we can gather information only about users’ representation of their experience, in an indirect manner [13]. We can understand their point of view on web services usage and construct with them the meanings, but we need to observe their interaction with AC system within the natural context, and then integrate all the data gained.

2.1. Participants and data collection method

We have conducted the UX research in the context of university as the first pilot site identified to implement the ReCRED project.
We have carried out semi-structured interviews with 21 participants, selected as target users of ReCRED solution: they are students, professors and members of the front office staff from two universities of Rome (Sapienza University and Tor Vergata University).
While students and professors can be considered as end-users of the ReCRED solution, members of the front office staff need a specific category to express their role: they can’t be defined neither as administrators nor as end-users; they work to provide services and they care relations and contacts with end-users.
The interviews were mainly focused on Wi-Fi connection and web services provided by the university (e-mail, web site and portal, e-learning platform, software repository), but we have also explored the use of other kinds of online services (internet banking, file sharing, e-commerce etc.), so to consider users’ concerns about privacy and security in the wide context of their everyday life and daily activities.

The questions asked during the interviews are open-end so to avoid anticipated answers, allowing the respondents to provide any answer they choose without forcing them to select from pre-defined options, leaving them free to talk and ascribe their personal meanings [13]. Furthermore, the framework of the interview was flexible enough to be adapted to the narration of the interviewed.
The topics of the questions used as guidelines are the following:

- web services used during daily activities;
- situations in which the web services are used;
- pain points of access control and identity management;
- delegated use of web services;
- privacy representation and security needs;
- risks envisaged using web services.

According to the informed consent accepted by the participants, the interviews were audio-recorded and then transcribed using fictional names which allow us to maintain the concealed identity of the participants. Once all the interviews were collected and transcribed, the data analysis proceeded with the creation of the service design tools as described in the next paragraphs.

2.1.1 Participants’ background and skills

A brief discussion about the personal background and skills of research participants, which contribute to the determination of their representations and concerns about privacy and security, is essential to understand the kind of data we have gained and the resulting characterization of the users.
Students and professors involved in the research study/work at the Faculty of Psychology or at the Faculty of Engineering, so they have their own professional visions [14].
This means that some of them (the engineers) are interested in the inner mechanisms of current AC and web services, having a deep knowledge of the technical aspects that allows them to judge the level of reliability and decide to trust or not.
While other users (the psychologists), those who are not experts in the field of ICT, care about “what it does” (what kind of activities and goals are supported by the tool/service) more than “how it works”, and their opinion about the reliability of web services is affected by several factors (see paragraph 2.3.3 - *Users’ attitudes toward privacy*).
Based on these considerations, the further research will involve other kind of users with different skills and background so to enlarge the UX analysis with a wider range of possibilities and visions.

2.2. Data analysis

The amount of collected data was elaborated using some tools which have been selected as useful models to comply with the user-centred approach:

- Empathy Map
- Persona
- Mental Model

Each model has its own function serving specific research goals, and all together these models build an integrated representation of the users and help to keep them in mind.
In the design process, these models act as intermediaries that capture and carry the essential understanding about users. They reveal the underlying reasons behind users’ actions, choices and decisions so we can proactively design for their real needs. They also allow to quickly understand the experience and focus the design team on it, in ways that listening to or reading a report cannot [8].

2.2.1 Developing empathy: Empathy Map

Empathy is the key to develop a deep understanding of the experience from the users’ point of view [4]. This process can be encouraged using Empath Map (EM) that was created by Scott Matthews of XPLANE and then the technique was published by Dave Gray, Sunni Brown e James Macanufo [15].
Using this tool, we can create a map of the UX in the domain of AC and web service usage including different dimensions, such as emotions, thoughts and behaviors. Starting from the transcribed interviews, each content has been selected and included in the corresponding category of the map:

- feelings and emotions;
- meanings, opinions and visions of the world;
- quotes and relevant use of the words;
- needs and wishes;
- pain points, struggles and barriers;
- what the users see in their context;
- rumors, suggestions and opinions heard from others.

Until now, we have created one EM for each user role (*Annex 1*): one of the students, one of the professors and another map of the front office staff.

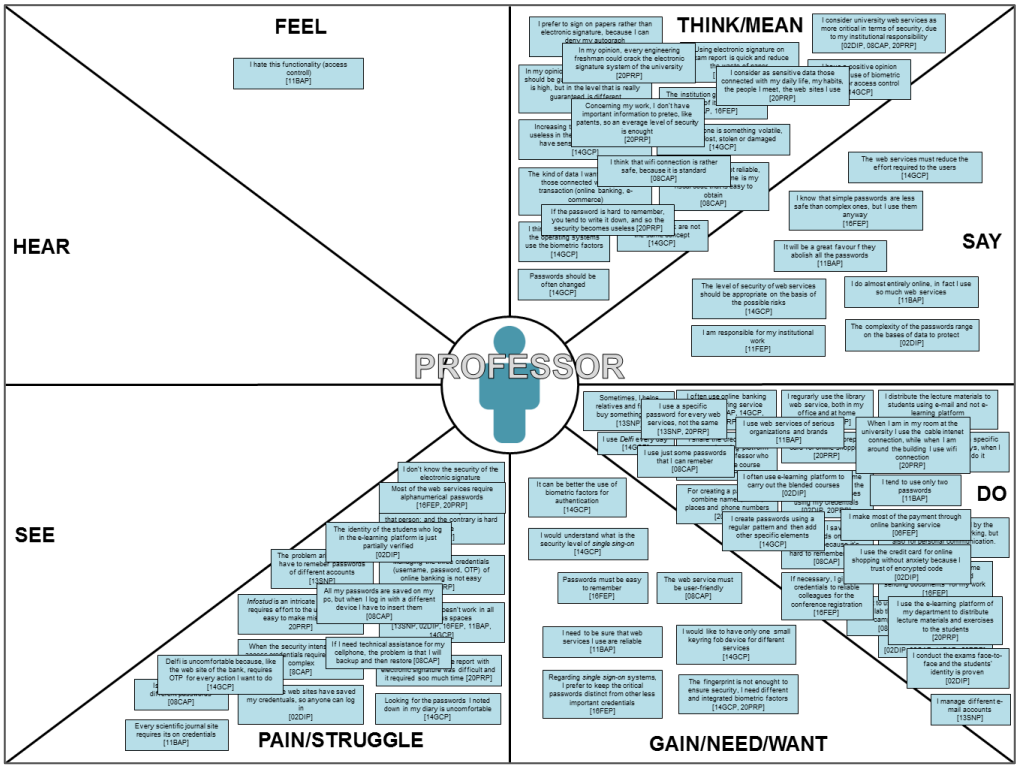

Figure 1 - Empathy map of professor

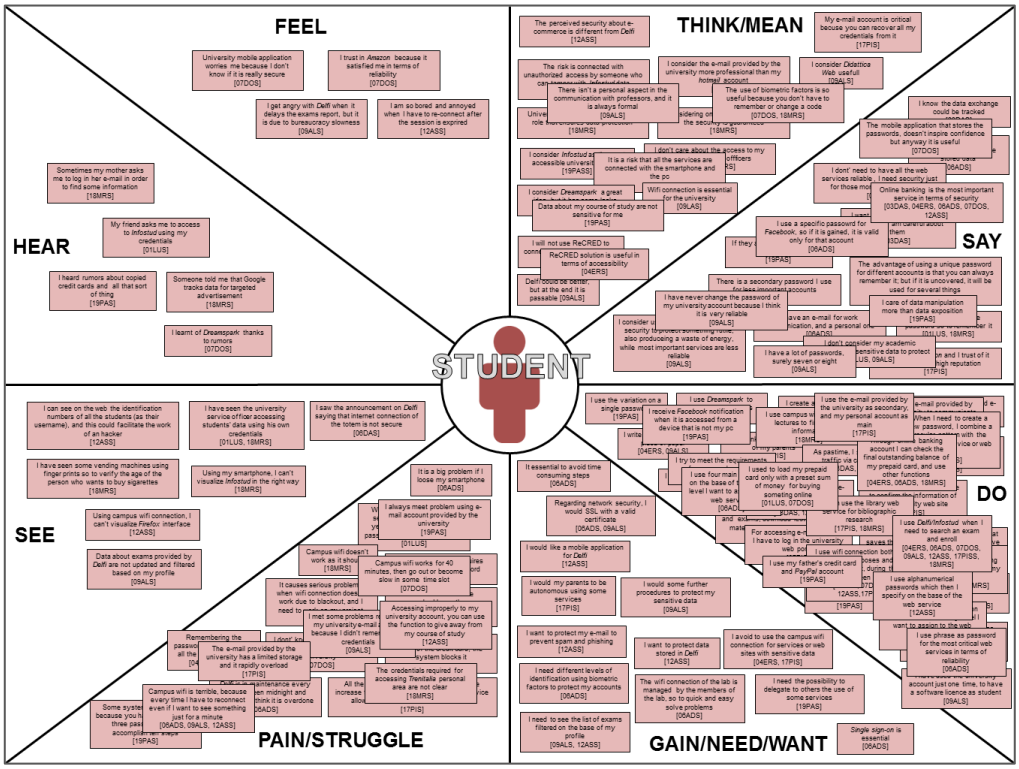

Figure 1 - Empathy Map of student

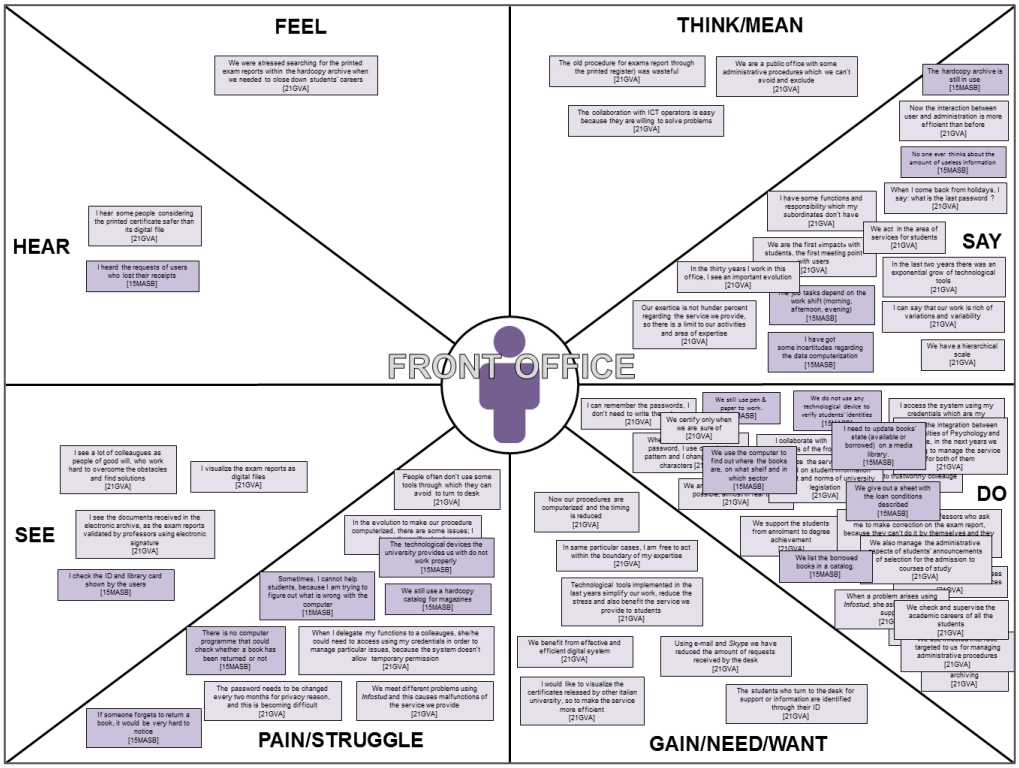

Figure 2 - Empathy Map of front office staff

As you can see, some categories of these maps (“see”, “hear”, “feel”) are quite poor of contents, because the interviews were mainly focused on users’ activities, needs and pain points, so the data gained concern these specific dimensions of the experience.

In the next phase of the research, we will collect further information in order to enrich the EMs and enhance the understanding of the overall experience connected to each user role.

Within the service design process, once we gather together the data about the complex reality of actual users, then we need to reduce it, specify the UX and distinguish groups of users among each role. To this end, we have created Personas.

2.2.2 Defining users as Personas

Personas are archetypes, fictional characters representing different attributes of actual users: from their social and demographic characteristics, to their own needs, desires, motivations, habits and personal representations [8, 16].

Verisimilitude most likely contributes to the strength of Personas: they sound like people you could know, and over the course of the project can take on a reality that encourages empathy and facilitates thinking from the user’s perspective [8].

Portraying archetypal users as fully formed people may have a certain humanistic appeal, but users as people are complex and multifaceted, as is reflected in the elaborations needed to lend realism to Personas.

At this stage of the research, we have identified 7 Personas (*Annex 2*), differing for their roles as users of the university web services (student, professor or front office staff), web services usage patterns and personal attitudes towards privacy.
They will be further defined when new empirical data will be collected.
Thinking that we can design a solution that is valid for all the users, covering all scenarios and all the possible cases, is a dangerous misunderstanding. For this reason, we need to focus on a specific target, prioritizing our Personas to determinate who could be primary or secondary target, based on the features/scenarios included in the ReCRED solution [16]

2.2.3 Analyzing users’ activities: Mental Model

Once we have identified the target users and shaped their profiles, we need to explore their activities within the domain of AC and web service usage.
The ReCRED solution must be designed to enable users to perform activities, and this requires more than just an understanding of the roles they play, but also a thorough understanding of the tasks that users must be able to accomplish in performing those roles [8].
The human activities are driven by certain needs where people wish to achieve certain purposes, and they are mediated by one or more instruments and tools [17]. This “mediation” is essential to understand the nature of artifacts as objects in use, and the way they support human activities [18].
With the aim of analyzing users’ activity system (that includes goals, actions and artifacts) and identifying the best way the ReCRED solution can support them, we have created Mental Models (MM).
Mental Model is an affinity diagram of user’s behaviors represented as a flow of tasks to accomplish goals. It is a useful tool that helps to identify opportunities for designing innovative solutions based on the lack of the existing tools [19].
From the data gathered through the interviews, we have created two MMs (*Annex 3*): one for describing end-users (students and professors) behaviors regarding web service usage, and the other for representing the flow of the work of library assistant as member of the front office staff.

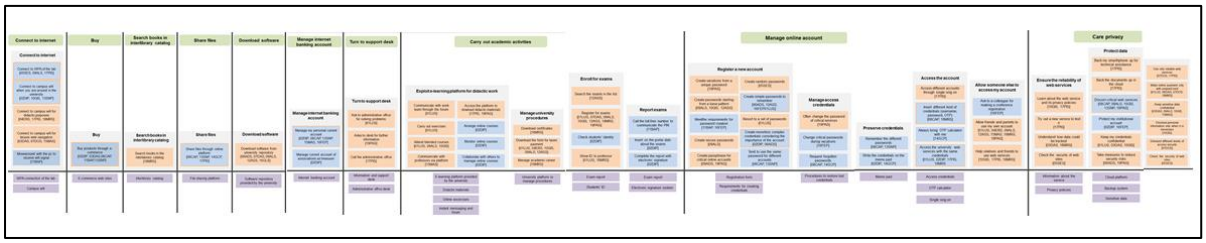

Figure 4 - Mental Model of student and professor

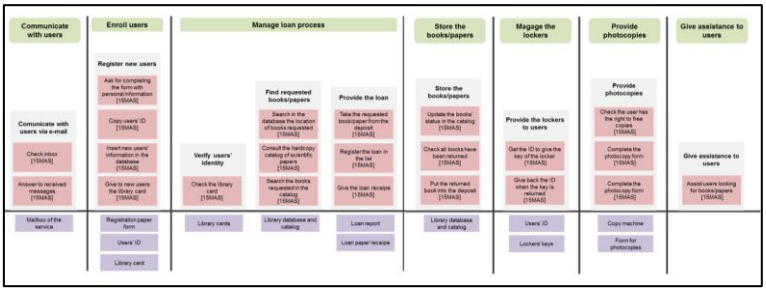

Figure 5 - Mental Model of library assistant

The top part of the model is a visual depiction of the activities representing root motivations, while the bottom part shows ways of supporting matching behaviors. Where support and activity are aligned, there is a solution. Where a behavior is not supported, there is an opportunity to fill the gap. In order to show how this tool helps to analyze users’ activities and identify opportunities for designing innovative solutions, we can discuss a particular detail of the model.

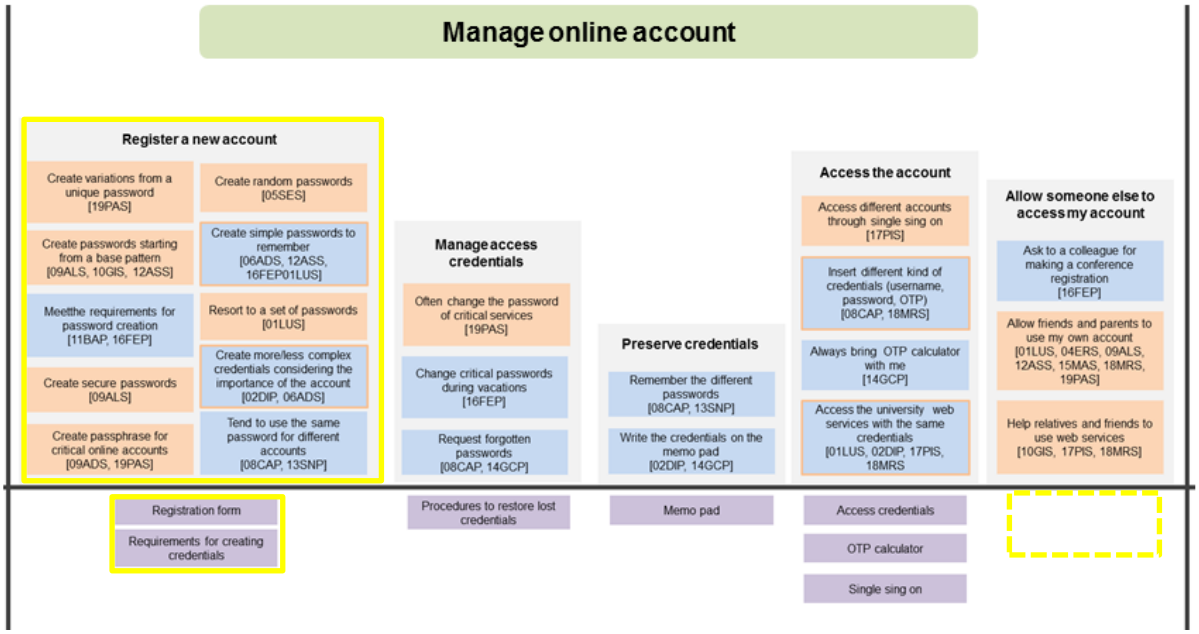

Figure 6 - Detail of the Mental Model of student and professor

As you can see in the above figure, the mental space for managing online account requires effort, the users perform several tasks to accomplish the goals (to create and preserve credentials, to access the account and so on) and it is supported just by few tools/contents/services. Thanks to ReCRED solution, these steps will be skipped or simplified, and consequently the UX will be enhanced.

Indeed, as a final step in the MM creation, we will draw a content map of ReCRED features and align it under the model so to validate and match our ideas with users’ goals, considering how ReCRED solution could affect users’ activity systems.

2.3. Design insights

Starting from the data collected about UX and the available literature, we can highlight some relevant insights which can be used to focus the design process and reach the best design solution.
These gained understandings represent useful information for different purposes:

- ✓ to better define ReCRED business and use cases;
- ✓ to identify alternatives and uncovered scenarios which could be considered to apply ReCRED solution in a wider context of use;
- ✓ to consider how the design choices affect the overall user experience;
- ✓ to make informed and conscious decisions finding the best solution to solve users’ problems and support their needs.

In the following paragraphs, the relevant HCI issues concerning privacy and security are discussed from end-users’ point of view, citing their own quotes through which they express their needs, opinions, attitudes and personal representations.

2.3.1 User authentication and access control

User authentication and identity management addressee the needs of both parties involved in the web service: the end-users want to ensure that only authorized people can access and modify personal information that they share through the service, while service providers/administrators want to ensure that only authorized users have access to the services and content it provides [20].
Furthermore, when services and resources are available through the web, there is often a need to know who the users are and to control what services/resources they are entitled to use. In such context, identity management has two main parts, where the first consists of issuing users with credentials and unique identifiers during the initial registration phase, and the second consists of authenticating users and controlling their access to services and resources based on their identifiers and credentials during the service operation phase.
But the main problem with many identity management systems is that they are designed to be cost effective from the perspective of the service provider, which sometimes creates inconvenience and poor usability from the users’ perspective [21].
Currently the most widespread approach to AC relies on passwords, and even the most sophisticated system based on this traditional paradigm becomes useless if users mismanage their password [1].
Through the interviews, we explored the common practices for managing credentials, identify schemes and patterns based on different motivations, and highlight troubles and challenges that password management poses to users.
Some users consider password management a critical task to ensure privacy and security, and they tend to create complex credentials.

> *I usually create passwords starting from a generic pattern. Those passwords will be subsequently specified in regard of services they are going to protect.*
> [Alex - Student]

> *I use passphrases, because using a long phrase with some special characters should guarantee the security [...] I use phrases I can remember for most critical web services.*
> [Adriano - Student]

But complex credentials are difficult to remember especially when the user manages several online accounts. So, a common tendency is to use the same credential or just few main passwords for several online accounts, save the credentials on the browser or write them on paper, reducing the cognitive effort but increasing vulnerability.

> *I save my credentials on the browser. But in this way, everyone who can access my pc, can easily access all the accounts.*
> [Diana - professor]

> *I write the passwords on my memo pad that is always at my fingertips. But it is uncomfortable. Look! How much pages... If I look for a specific account and need to find the right credentials among 30 pages, I will lose two minutes. If I do it ten times a day, I will lose twenty minutes.*
> [Giacomo - professor]

> *Nowadays everything has username and password, and it is so hard to manage! For example, every scientific journal requires its own specific access credentials, and over the years I tend to lose them. So, what is my strategy? When it is possible, I tend to use the same username and two alternative passwords.*
> [Barbie - professor]

> *I use only three different passwords. Since I do not frequently change these passwords, I don’t need to list them down on a piece of paper.*
> [Davide - student]

Even if users know what constitutes a “good” or “bad” password and which common password management practices are appropriate to ensure security (such as alphanumerical, memorized and not written down, often changed passwords), they tend toward convenience more than security [1].

> *I know that simple passwords are less safe than complex ones, but I use them anyway. Passwords must be easy to remember.*
> [Federico - professor]

Users seem to be motivated to engage in bad password management for two main reasons: to reduce effort using easy-to-remember access credentials, and because they don’t see any immediate negative consequence to themselves. This optimistic view can be summarized with the expression “it won’t happen to me”.
Considering the different issues and challenges related to users' practices of password management, the attempt of ReCRED to go beyond this traditional paradigm represents an innovative change in the UX.

2.3.2 Users’ opinion about multifactor biometric authentication

The multifactor biometric authentication that will be implemented in the ReCRED solution matches with the users' need of secure and usable AC, and it represents an alternative to the long and hard to remember passwords, reducing associated risks. As the single sign-on solution, it can eliminate the need for users to remember multiple passwords for accessing their several accounts.

During the research, we have collected participants’ opinions about the use of biometric attributes for AC through multifactor authentication: despite users consider it as a better solution compared to traditional password paradigm, they have doubts about its reliability.

> *Biometric authentication could be useful because there is no more need to keep in mind different codes and passwords.*
> [Marta - student]

> *Multifactor authentication should be faster than “classical” log in, thus better.*
> [Adriano- student]

> *Biometric factor is personal, so it is secure. Beside I think that impregnable technology doesn't exist, over the years my accounts increase, so the idea of the unique access credential can help*.
> [Piero - student]

The main doubt the interviewed users reported is related to the entity who store the personal attributes as biometric factors, and connected with the level of reliability of this system toward hackers’ attack.

> *Once I obtain the digital file of the biometric factors of one person, I am that person, and the contrary is hard to prove.*
> [Fabrizio - professor]

In conclusion, research participants believe that the biometric factors for AC is a useful solution to solve the problems connected with password management, only if it includes multi-factors authentication within a reliable security framework.

2.3.3 Users’ attitudes towards privacy and security

As the use of web services increases, so do risks associated with security and privacy. Considering users perception, it is not necessarily important how private or safe they are (from policy makers point of view) but whether they perceive themselves to be safe and private [22].
Identifying users’ perceptions of privacy is critical for distinguishing what needs to be protected and how best to protect it. So, the main question is: which information users regard as private, from whom, and in which context?
Every user has a specific perception of which information are sensitive and confidential, and the perception of privacy seems to be shaped by the interrelation of 4 key elements [22]:

- the perceived identity of the information *receiver;*
- the perceived *usage* of the information;
- the subjective *sensitivity* of the disclosed information;
- the *context* in which the information is disclosed.

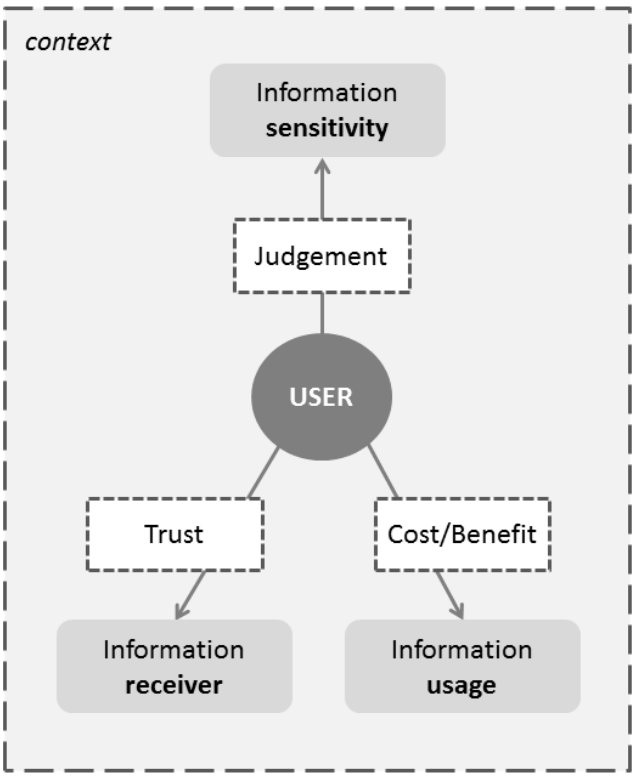

Figure 7 - Diagram of the user's perception privacy model

In line with this model, the following quotes show the differences among users’ representations of privacy needs and security risks, based on the perceived usage and sensitivity of the data and the entity of the information receiver.

> *I suppose that University staff members can access my account. Since I trust in my University and its staff, I do not care whether they access my account.*
> [Davide - student]
>
> *Bank account details and my academic personal information must be kept safe*.
> [Alessandro - student]
>
> *I am only worried about my bank account details. I do not care about anything else*.
> [Erica - student]
>
> *I really want to protect my Facebook account from hackers’ attacks.*
> [Adriano- student]
>
> *I care about data manipulation as a risk more than the exposition of my personal data. […] In fact, I use a secondary password for the accounts I consider less important. I mean, if they are hacked out, it doesn’t cause a damage.*
> [Paola - student]

According to users’ representations and concerns, security refers to the protection of personal information that would invade privacy or could be used for fraudulent purposes (money and identity

theft). But their worry is also connected to the exposition of personal information to unknown parties who might use such information improperly but not illegally.
Thus, users choose strong passwords and care about the protection of their personal information if they are willing to sacrifice convenience for the security of those accounts for which there is an immediate negative consequence when the account is compromised [1].
Another relevant consideration is about the privacy policies of web services. As the costs/benefits analysis regarding information usage by web services plays an important role in the decision-making process, make policies involving privacy and security easy to locate, read and enforce is crucial. Although privacy policies are widespread, some are so difficult to find and incomprehensible to read that they only undermine trust [23].

2.3.4 Trust towards web services

Trust with all its connotations has been studied in numerous disciplinary fields, and it presents important research opportunities and applications especially in the context of web service: if service providers enhance their perceived trustworthiness to potential customers, then the number of people who engage in the services should increase substantially [24].
According to the privacy perception model [22], trust is one of the determinants of the interaction between the user and the service. The “information receiver” is the users’ perception of the person (not necessarily the actual person, but also organizations) who receives and/or manipulates the information exchanged.
As mentioned above, the main risk associated with the security of web service reported by the interviewed users, is connected with unauthorized access to online account and illegal use of personal information.
Especially in the case of services and organizations, trust is related to the brand identity and reputation: previous experiences, reports form other users and expectations act as antecedents and influence the UX of the service [23].

> *I trust in Amazon simply because it is Amazon.*
> [Donato - student]

> *I trust in Last Pass just because everyone uses it regularly.*
> [Sergio - student]

> *I am always worried about the reliability of the web sites for e-commerce. I use only secure web sites, such as Alitalia and Expedia for booking travels, or Amazon or other big organizations like that.*
> [Barbie - professor]

Interviewed participants trust in web services based on their high reputation as international organizations chosen by millions of users. From the users’ point of view, the strong brand identity guarantees the reliability and foster the trust.

2.3.5 Delegated use of web services

A consistent pattern reported by the interviewed users – also highlighted in the literature about privacy and password management – is that in some situations they delegate to trusty people (relatives, friends or colleagues) the use of web services, authorizing the access with personal credentials. This happens as exceptional case but also as a habit [1].

> *I have asked a reliable colleague to sign me up for a conference, giving to him my credentials and the codes of my credit card, but only because he is trustworthy.*
> [Federico - professor]

> *Since I am not at home so often, I get used to ask my parents to buy on Amazon.*
> [Alessandro - student]

> *I usually ask my sister to help me with university online procedures.*
> [Marta - student]

> *I often use web services on behalf of my parents, such as online purchase or internet banking, if they can't do it by themselves or when they need to learn how to use such services. Potentially, I can access all the accounts of my parents because I know their passwords, but I do it only when they ask me to do it.*
> [Piero - student]

Based on this consideration, ReCRED solution should be flexible enough to include form of delegation within a context of security, so to allow this particular practice.

2.3.6 Multi-devices: primary and secondary interfaces

The design of the service touchpoints – meaning any point of contact between the user and the service, where the service becomes tangible and usable – is crucial because it affects usability as well as the overall service experience [10].
The interviewed users reported that they access the web services through different devices (smartphone, tablet and pc) based on the circumstances, the kind of task to accomplish and the service characteristics. Indeed, nowadays most of the web services allow multi-device authentication and interaction, and if it doesn't happen it could cause some troubles to the user: for example, professors have explained that the university portal they use to report exams is suitable only for desktop interface.
Thus, defining the ReCRED concept, we can assume that the smartphone could be the key that allows to access web services also using a different device.
Furthermore, the use of the smartphone as the main device needs to envisage the possibility of loss, that is one of the security risk reported by interviewed users, as expressed in the following quotes.

> *Based on my experience, the critical aspect of the smartphone is connected with the fact that it is "volatile", I mean it can be easily lost, stolen or broken. In those cases, I need to block and then restore all the stuff.*
> [Carlo - professor]

> *Smartphones and portable devices might be easily lost. What will happen next?*

[Adriano- student]

3. Conclusion

This document shows our perspective regarding Human-Computer Interaction and the research method we have applied to comply with the user-centred approach in designing an innovative service, realizing the objectives of the ReCRED project.

The UX research included in the Work Package 7 *Large Scale Pilots and End User Experience Assessment* is still ongoing and it will provide further information to enhance the service design process, by collecting data to enrich the preliminary understanding of the user experience.

Thanks to the exploratory investigation conducted until now, we have gained some relevant insights about the complex experience of the users interacting with AC systems for web services usage. In addition to the analysis of challenges and pain points connected with the use of passwords, that supports and validates the core idea of the ReCRED project, we have also discussed with the users involved in the research some of the main issues and personal representations about privacy and security.

The research was carried out interviewing different participants from universities (as the first pilot site for ReCRED implementation) who are students and professors with the role of end-users, and also members of front office staff who work to provide services to end-users. The results collected were organized and integrated using three tools of the Service Design Thinking (Empathy Map, Persona, Mental Model) which serve to understand and represent the needs, motivations and activities of the target users.

Because ReCRED solution is addressed to end-users as well as administrators and providers of web services, the research will explore these latter roles with their needs and objectives. In this way, we can design the next generation AC as a meeting point between all the stakeholders involved.

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Annex 1: Empathy Maps

<table>
<tr><th colspan="3">Empathy Map of Professor</th></tr>
<tr><th>DO</th><th>SAY</th><th>GAIN</th></tr>
<tr><td>I distribute the lecture materials to students using e-mail and not the e-learning platform
[16FEP]

I change the passwords in specific periods, during the holydays, when I have enough time to do it
[16FEP]

I prefer to use the Wi-Fi connection of my lab that works better than campus connection
[08CAP, 16FEP]

As usual, I save the passwords on my browser, because it's hard to remember them
[08CAP]

I use the e-mail provided by the university not only for working, but also for personal communication
[13SNP]

I spend most part of my time answering to e-mails and sending documents for my work
[16FEP]

I use the e-mail provided by the university every day and regularly, as main account
[02DIP, 08CAP, 11BAP, 20PRP]

When I am in my room at the university I use the cable internet connection, while when I am</td><td>I know that simple passwords are less safe than complex ones, but I use them anyway
[16FEP]

The web services must reduce the effort required to the users
[14GCP]

It will be a great advantage if they abolish all the passwords
[11BAP]

I do almost everything entirely online, in fact I use so much web services
[11BAP]

The level of security of web services should be appropriate based on the possible risks
[14GCP]

The complexity of the passwords ranges based on the data to protect
[02DIP]

I am responsible for my institutional work
[11FEP]

PAIN

If I need technical assistance for my cellphone, the problem is that I will backup and then restore
[08CAP]</td><td>I consider positively the use of biometric factors for authentication
[14GCP]

I would understand what is the security level of single sign-on
[14GCP]

The web service must be user-friendly
[08CAP]

Passwords must be easy to remember
[16FEP]

I need to be sure that the web services I use are reliable
[11BAP]

I would like to have only one small keyring fob device for different services
[14GCP]

The fingerprint is not enough to ensure security, I need different and integrated biometric factors
[14GCP, 20PRP]

Regarding single sign-on systems, I prefer to keep the critical passwords distinct from other less important credentials
[16FEP]

THINK</td></tr>
</table>

around the building I use Wi-Fi connection [20PRP] For creating a password, I combine names, cities, places and phone numbers [20PRP] If necessary, I give my credentials to reliable colleagues for the conference registration [16FEP] I conduct the exams face-to-face and the students' identity is proven [02DIP] I use the credit card for online shopping without anxiety because I trust of encrypted code [02DIP] I use the e-learning platform of my department to distribute lecture materials and exercises to the students [20PRP] I regularly use the library web service, both in my office and at home [02DIP, 20PRP] Sometimes, I help relatives and friend to buy something online [13SNP] I use the university platform every day [14GCP] I often use online banking and file sharing service [02DIP, 08CAP, 14GCP, 20PRP] I use *PayPal* and prepaid card for online shopping [20PRP] I share the credentials to access e-learning platform with another	The university platform is uncomfortable because, like the web site of the bank, requires OTP for every action I want to do [14GCP] All my passwords are saved on my pc, but when I log in with a different device I have to insert them [08CAP] The identity of the students who log in the e-learning platform is just partially verified [02DIP] The problem arises because I have to remember passwords of different accounts [13SNP] Most of the web services require alphanumerical passwords [16FEP, 20PRP] The university platform is an intricate system that requires effort to the user and you can easily make mistakes [20PRP] When the security intensifies, the access credentials required become complex [08CAP] It is hard to manage different passwords [08CAP] Wi-Fi connection doesn't work in all the campus areas [13SNP, 02DIP, 16FEP, 11BAP, 14GCP] E-commerce web sites have saved my credentials, so anyone can log in [02DIP] Every scientific journal site	Security and risk are not the same concept [14GCP] I consider university web services as critical in terms of security, due to my institutional responsibility [02DIP, 08CAP, 20PRP] I prefer to sign on papers rather than using the electronic signature, because I can deny my autograph [08CAP, 20PRP] In my opinion, the level of security that should be guaranteed by the university is high, but the level that is really guaranteed is different [16FEP] Increasing the level of security is useless in the cases in which I don't have sensitive data to protect [14GCP] The kind of data I want to protect are those connected with money transaction (online banking, e-commerce) [08CAP, 13SNP,14GCP] Using electronic signature on exam report is quick and reduce the waste of paper [11BAP, 20PRP] I have a positive opinion about the use of biometric factors for access control [14GCP] I think that today not all the operating systems use the biometric factors [14GCP] Passwords should be often changed [14GCP] The institution guarantees the

professor who holds the same course [08CAP] It happened that some colleagues logged in the campus web services using my credentials [02DIP, 20PRP] I use a specific password for every web service, not the same [13SNP, 20PRP] I use web services of serious organizations and brands [11BAP] I manage different e-mail accounts [13SNP] I use just some passwords that I can remember [08CAP] I create passwords using a regular pattern and then adding other specific elements [14GCP] I often use e-learning platform to carry out the blended courses [02DIP] I make most of the payments through online banking service [06FEP] I tend to use only two passwords [11BAP]	requires its own credentials [11BAP] Once I obtain the digital file of the biometric factors of one person, I am that person; and the contrary is hard to prove [20PRP] I don’t know the security of the electronic signature [02DIP] Managing the three credentials (username, password, OTP) of online banking is not easy [20PRP] Fixing an error on the report with electronic signature was difficult and it required so much time [20PRP] Looking for the passwords I noted down in my diary is uncomfortable [14GCP] I hate this functionality (access control) [11BAP]	security of its services [11BAP, 16FEP] The smartphone is something volatile, it could be lost, stolen or damaged [14GCP] I consider the university platform not reliable, because the username is my fiscal code that is easy to obtain [08CAP] Concerning my work, I don’t have important information to protect, like patents, so a medium level of security is enough [20PRP] In my opinion, every engineering freshman could crack the electronic signature system of the university [20PRP] I think that Wi-Fi connection is rather safe, because it is standard [08CAP] I consider as sensitive data those connected with my daily life, my habits, the people I meet, the web sites I use and so on [20PRP] If the password is hard to remember, you tend to write it down, and so the security becomes useless [20PRP]

Empathy Map of Student		
DO	**SAY**	**GAIN**
I use campus Wi-Fi during the lectures to find further information [18MRS] I use the e-mail provided by the university to communicate with professors and university staff [01LUS, 18MRS] I try to meet the requirements for password creation [03DAS] I often use the library web service for bibliographic research [17PIS, 18MRS] I use Wi-Fi connection both for didactic purposes and entertainment, during the breaks between lectures [04ERS, 07DOS, 12ASS,17PIS] I use Internet for planning and booking travels on behalf of my uncle [17PIS, 18MRS] I use the university web site to gain information about professors and exams, download lecture materials and exercises [04ERS, 17PIS] I receive *Facebook* notification when it is accessed from a device that is not my pc [19PAS] I don’t need the university e-mail, I use my personal account [03DAS, 12ASS] For accessing e-mail account, I have to log in the university web portal [07PIS] I often share my credentials with my best friend	I know the data exchanged could be tracked [03DAS] The level of security I demand is based on the stored data [06ADS] I want to keep private just few things, and I am careful about them [03DAS] I try to use the same password so to remember it [01LUS, 18MRS] The advantage of using a unique password for different accounts is that you can always remember it; but if it is uncovered, it will be used for several things [18MRS] There is a secondary password I use for less important accounts [19PAS] I consider useless to have a high level of security to protect something futile, also producing a waste of energy, while most important services are less reliable [09ALS] I care of data manipulation more than data exposition [19PAS] I use single sign-on and I trust of it because of its high reputation [17PIS] If they add another safe code, I will go crazy [19PAS] I have an e-mail for work communication, and a personal one	Single sign-on is essential [06ADS] I want my parents to be autonomous using some services [17PIS] I want to protect data stored in the university platform [12ASS] I would some further procedures to protect my sensitive data [09ALS] The Wi-Fi connection of the lab is managed by the members of the lab, so to quickly and easily solve problems [06ADS] I would like a mobile application for the university platform [12ASS] I avoid using the campus Wi-Fi connection for services or web sites with sensitive data [04ERS, 17PIS] It is essential to avoid time consuming steps [06ADS] Regarding network security, I want SSL with a valid certificate [06ADS, 09ALS] I want to protect my e-mail against spam and phishing [12ASS] I need the possibility to delegate to others the use of some services [19PAS] I need different levels of identification using biometric factors to protect my accounts [06ADS]

[19PAS]

I use four main passwords based on the security level I want to assign to the web services
[06ADS]

I create similar passwords so to memorize them
[07DOS]

I use the variations of a single password
[19PAS]

I write the password on a piece of paper
[04ERS, 09ALS]

I use the university online repository to download software
[17PIS]

I use banking service on behalf of my parents
[17PIS]

I use single sign-on service
[07DOS]

As pastime, I sniff network traffic via campus Wi-Fi connection
[03DAS, 06ADS]

I have used the university account just one time, to have a software licence as student
[09ALS]

I use file sharing, cloud and e-commerce services
[19PIS, 18MRS]

I use e-learning platform for attending courses and prepare for

[06ADS]

I don’t consider my academic information as sensitive data to protect
[01LUS, 09ALS]

Online banking is the most important service in terms of security
[03DAS, 04ERS, 06ADS, 07DOS, 12ASS]

The mobile application that stores the passwords, doesn’t inspire confidence but anyway it is useful
[07DOS]

I don’t need to have all the web services reliable, I need security just for those more important for me
[09ALS]

I have a lot of passwords, surely seven or eight
[09ALS]

I use a specific password for *Facebook*, so if it is gained, it is valid only for that account
[06ADS]

I have never change the password of my university account because I think it is very reliable
[09ALS]

PAIN

Campus Wi-Fi doesn’t work as it should
[18MRS]

It is a big problem if I lose my

I need to see the list of exams filtered based on of my profile
[09ALS, 12ASS]

SEE

Using my smartphone, I can’t visualize the university platform in the right way
[18MRS]

Using campus Wi-Fi connection, I can’t visualize *Firefox* interface
[12ASS]

Data about exams provided by the university platform are not updated and filtered based on my profile
[09ALS]

I can see on the web the identification numbers of all the students (as their username), and this could facilitate the work of a hacker
[12ASS]

I have seen some vending machines using finger prints so to verify the age of the person who wants to buy cigarettes
[18MRS]

I have seen the university service officer accessing students’ data using his own credentials
[01LUS, 18MRS]

I saw the announcement on university web site saying that internet connection of the totem is not secure
[06DAS]

HEAR

exams
[01LUS]

I call the administrative office to confirm the information of the university web site
[17PIS]

I use the university mobile application that saves the Wi-Fi password, so you don't have to insert it to reconnect
[07DOS]

I gave my credentials to friends when they needed to use the Wi-Fi
[04ERS, 09ALS, 12ASS]

I try to use some patterns when I create a new password
[04ERS, 09ALS, 12ASS]

I often use campus Wi-Fi connection, even if it hasn't a valid certificate
[09ALS]

When I need to create a new password, I combine a regular pattern with the name of the service or web site
[09ALS]

I use the university platform when I need to search an exam and enroll
[04ERS, 06ADS, 07DOS, 09ALS, 12ASS, 17PISS, 18MRS]

I use phrase as password for the most critical web services in terms of reliability
[06ADS]

Through online banking account I can check the final outstanding balance of my prepaid card, and use other functions
[04ERS, 06ADS, 18MRS]

I use my father's credit card and *PayPal* account
[19PAS]

smartphone
[06ADS]

Campus Wi-Fi is terrible, because every time I have to reconnect even if I want to see something just for a minute
[06ADS, 09ALS, 12ASS]

Accessing improperly to my university account, you can use the function to give away from my course of study
[12ASS]

Campus Wi-Fi works for 40 minutes, then goes out or become slow in some time slot
[07DOS]

I met some problems recovering my university e-mail account because I didn't remember the credentials
[09ALS]

Some systems are useless because you have to remember three passwords, and accomplish ten steps
[19PAS]

The university platform is in maintenance every day between midnight and 5a.m. and I think it is overdone
[06ADS]

The credentials required for accessing my personal area on the train service web site are not clear
[18MRS]

The e-mail provided by the university has a limited storage and it rapidly overloaded
[17PIS]

Remembering the passwords and managing all the accounts is hard
[04ERS, 17PIS]

Recently, the university platform

I learnt of the university online repository thanks to rumors
[07DOS]

Someone told me that Google tracks data for targeted advertisement
[18MRS]

Sometimes my mother asks me to log in her e-mail in order to find some information
[18MRS]

My friend asks me to access to university platform using my credentials
[01LUS]

I heard rumors about copied credit cards and all that sort of thing
[19PAS]

FEEL

I trust in *Amazon* because it satisfied me in terms of reliability
[07DOS]

University mobile application worries me because I don't know if it is really secure
[07DOS]

I get angry with the university platform when it delays the exams report, but it is due to bureaucracy slowness
[09ALS]

I am so bored and annoyed when I have to re-connect after the session is expired
[12ASS]

THINK

My e-mail account is critical because you can recover all my credentials from it
[17PIS]

I will not use ReCRED to connect all the services I use

I used to load my prepaid card only with a preset sum of money for buying something online [01LUS, 07DOS] I use alphanumerical passwords which then I specify for each web service [12ASS] I use the e-mail provided by the university as secondary, and my personal account as the main [17PIS]	requires alphanumerical password [19PAS] It causes serious problems when Wi-Fi connection doesn’t work due to blackout, and I need to work on my project [06ADS] I can’t remember the passwords, I lose them over and over again [19PAS] After the third attempt to find the code of the credit card, the system blocks it [19PAS] I don’t know how I can access the e-mail provided by the university [07DOS] Having all the passwords stored in a single service increases the risk, because accessing that service allows to access all the other services [17PIS] I always meet problems using e-mail account provided by the university [19PAS] When I try to access to web services I haven’t used for years, I can’t remember the password so I need to change it [01LUS]	[17PIS] The perceived security about e-commerce is different from the university platform [12ASS] The risk is connected with unauthorized access by someone who can tamper with university platform data [18MRS] University office has an institutional role that ensures data protection [18MRS] Saving the passwords on the browser is not secure, because someone using your pc can easy gain the credentials [07DOS, 04ERS] I consider the university platform as the most accessible university service [19PASS] It is a risk that all the services are connected with the smartphone and the pc [01LUS] I don’t care about the access to my data by university officers [03DAS, 18MRS] I consider the university e-learning platform useful [09ALS] The university platform could be better, but at the end it is passable [09ALS] Considering online banking, it seems that the security is guaranteed [18MRS] I consider the university online repository a great idea, but it has some lacks

		[09ALS] I consider the e-mail provided by the university more professional than my *hotmail* account [09ALS] There isn't a personal aspect in the communication with professors, and it is always formal [09ALS] The use of biometric factors is so useful because you don't have to remember or change a code [07DOS, 18MRS] Wi-Fi connection is essential for the university [09LAS] ReCRED solution is useful in terms of accessibility [04ERS] Data about my course of study are not sensitive for me [19PAS]

Empathy Map of Front office staff		
DO	**SAY**	**GAIN**
I access the system using my credentials which are my identification number as username and the password [21GVA] I can remember the passwords, I don't need to write them down [21GVA] When I need to change the password, I use one single pattern and I change just few characters [21GVA] We answer to e-mails as soon as possible, almost in real time [21GVA] When I don't work (i.e. during	There is a hierarchical scale [21GVA] Our expertise is not hundred percent regarding the service we provide, so there is a limit to our activities and area of expertise [21GVA] We are the first impact with students, the first meeting point with users [21GVA] We work in the area of services for students [21GVA] I can say that our work is rich of variations and variability	In some particular cases, I am free to act within the boundary of my expertise [21GVA] Technological tools implemented in the last years simplify our work, reduce the stress and also enhance the service we provide to students [21GVA] Now our procedures are computerized and the timing is reduced [21GVA] We benefit from effective and efficient digital system [21GVA]

vacations) I delegate my functions to trustworthy colleagues [21GVA] We still use pen and paper to work [15MASB] We do not use any technological device to verify students' identities [15MASB] We check and supervise the academic careers of all the students [21GVA] Due to the integration between the Faculties of Psychology and Medicine, in the next years we are going to manage the service for both of them [21GVA] We certify only when we are sure [21GVA] We use the university platform interface targeted to us for managing administrative procedures [21GVA] When a problem arises using the university platform, I ask for technical support [21GVA] I manage and supervise the proceedings archiving [21GVA] The general manager supervises different areas with their services [21GVA] I collaborate with colleagues of the	[21GVA] Now the interaction between user and administration is more efficient than before [21GVA] During the thirty years I work in this office, I see an important evolution [21GVA] When I come back from holidays, I say: what is the last password? [21GVA] I have some functions and responsibility which my subordinates don’t have [21GVA] In the last two years there was an exponential grow of technological tools [21GVA] The job tasks depend on the work shift (morning, afternoon, evening) [15MASB] I have some doubts regarding the data computerization [15MASB] The hardcopy archive is still in use [15MASB] No one ever thinks about the amount of useless information [15MASB] **PAIN** We meet different problems using the university platform and this causes malfunctions of the service	The students who turn to the desk for support or information are identified through their ID [21GVA] Using e-mail and *Skype* we have reduced the amount of requests received by the desk [21GVA] The exchange of information among universities should be increased [21GVA] I would like to visualize the certificates released by other Italian universities, so to make the service more efficient [21GVA] **SEE** I see a lot of colleagues as people of good will, who work hard to overcome the obstacles and find solutions [21GVA] I see the documents received in the electronic archive, as the exam reports validated by professors using electronic signature [21GVA] I visualize the exam reports as digital files [21GVA] I check the ID and library card shown by the users [15MASB] **HEAR**

front office
[21GVA]

I organize the service we provide based on student information booklet and norms of university legislation
[21GVA]

We support the students from enrolment to degree achievement
[21GVA]

We also manage the administrative aspects of students’ announcements of selection for the admission to courses of study
[21GVA]

We provide information to students who want to enroll, change the course and son on
[21GVA]

I receive the e-mails from professors who ask me to make correction on the exam report, because they can’t do it by themselves and they need my authorization
[21GVA]

We list the borrowed books in a catalog
[15MASB]

I need to update books' state (available or borrowed) on a media library.
[15MASB]

We give out a sheet with the loan conditions described
[15MASB]

We use the computer to find out where the books are, on what shelf and in which sector
[15MASB]

we provide
[21GVA]

In the evolution to make our procedure computerized, there are some issues; I hope they will solved
[21GVA]

People often don’t use some tools through which they can avoid turning to desk
[21GVA]

The password needs to be changed every two months for privacy reason, and this is becoming difficult
[21GVA]

When I delegate my functions to a colleague, she/he could need to access using my credentials in order to manage particular issues, because the system doesn’t allow temporary permission
[21GVA]

The technological devices provided to us by the university do not work properly
[15MASB]

Sometimes, I cannot help students, because I am trying to figure out what is wrong with the computer
[15MASB]

We still use a hardcopy catalog for magazines
[15MASB]

There is no computer program that could check whether a book has been returned or not
[15MASB]

If someone forgets to return a book, it would be very hard to notice
[15MASB]

I hear some people considering the printed certificate safer than its digital file
[21GVA]

I heard the requests of users who lost their receipts
[15MASB]

FEEL

We were stressed searching for the printed exam reports within the hardcopy archive when we needed to finalize students’ careers
[21GVA]

THINK

The old procedure for exams report through the printed register was wasteful
[21GVA]

We are a public office with some administrative procedures which we can’t avoid and exclude
[21GVA]

The collaboration with ICT operators is easy because they are willing to solve problems
[21GVA]

Annex 2: Personas

Persona - professor

Silvia

https://humanrights.ca/sites/default/files/styles/large/public/images/blog/blog113_human-rights-toolkitweb.jpg?itok=0IWUxXIS

“I do everything almost entirely online!”

Profile

She is 45 years old.
She is married and she has two teenager sons.
She is a psychologist and since 2005 she is a professor at the University of Rome. She loves her work and she puts a lot of effort into didactic and research activities.
During the free time, she likes travelling and seeing new places with her family, and she always plan amazing journeys.

Activities and tools

She teaches Developmental Psychology through blended courses, by using the e-learning platform.
Sometimes, she organizes conferences and other kind of events at the university, in order to meet the scientific community for sharing innovations and news in her field of work.
She uses four different devices (smartphone, tablet, the computer provided by the university, and her personal notebook) and thanks to them she can be always connected.
In order to communicate and be in touch with the others (relatives, friends, colleagues) she uses social networks and instant messaging services, and only one e-mail that is provided by the university.
Due to her familiarity with web services, sometimes she helps friends and colleagues, for example when they need to book a flight or make the registration for a conference.
Indeed, she uses a lot of web services both for work and for personal purposes: e-commerce, file sharing, scientific database, forums and web sites about travels, video streaming and so on.
Thus, she manages several online accounts with their access credentials, and she applies a specific strategy to create and remember passwords: starting from some regular patterns, she adds few elements to specify the password for the particular registration.

Goals/needs

- To be updated about (and contribute to) innovations and evolutions in the field of Psychology.
- To manage the blended courses in the best way, taking advantage of the ICT for learning.
- User-friendly web services and mobile applications.
- To get easy access to the most used services whenever she need and wherever she is.
- To use only reliable web services.
- To have more free time for her hobbies and interests.

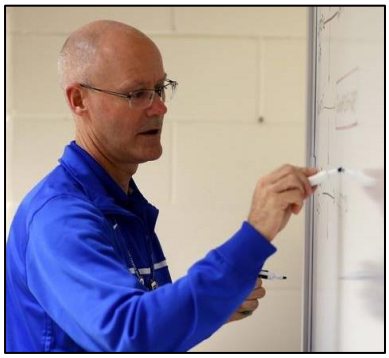
Motivations/opinions

In her opinion, the services considered more reliable and trustworthy are those with high reputation and strong brand identity, also taking feedbacks and opinions of other users into consideration.
She does not consider as «sensitive» her personal and academic data, which are available on the web. The data she wants to protect are those connected with her banking account, thinking about the risks of unauthorized access.
She tends to reduce the effort connected with registration and identity management required by online services. For this reason, she considers the use of biometrics factors for access control as a benefit.

Questions	Barriers/pain point
– How can I make my work more efficient and less time consuming? – Why do some procedures and activities still require papers? – How can I create passwords which are simple to remember and safe? – Are the single sign-on systems reliable and secure? – How much time I will waste to recover all my staff if I lose my smartphone?	○ She has to manage several online accounts with their credentials, and she wastes time to meet requirements in the registration phase. ○ She forgets the access credentials for sites and services less used, and then she has to recover them or make a new registration; and this requires precious time. ○ She has not in-deep knowledge of technical aspects of technologies.

Persona - professor

Carlo



http://www.dailyherald.com/storyimage/DA/20141031/news/141039723/EP/1/1/EP-141039723.jpg&updated=201410310048&MaxW=800&maxH=800&updated=201410310048&noborder

“There is a difference between the security that should be guaranteed and the state of play”

Profile

He is 60 years old. He is a long-time professor of Engineering at the University of Rome, and every academic year he holds different courses joined by several students. He cares of his work, in a professional and accurate manner, and with a strong sense of responsibility towards the institution.
He spends the free time playing chess (his main hobby) and staying with his family and friends.

Activities and tools

He collaborates with researchers and other professional figures to carry out his didactic work, and also to conduct innovative projects in the field of telecommunications.
Due to the several courses to manage, he is often very busy and sometimes he asks for the support of trustworthy PhD students so to carry out lectures and exams.
As support for his activities, he uses different services as collaboration tools (i.e. file sharing).
Because of his several online accounts to manage, he writes the credentials on the memo pad that is always in his bag, so he doesn’t need know all of the passwords and PINs by heart.
Unlike the colleagues, he does not use the e-learning platform provided by the university, because he prefers to send the lecture materials to the students via e-mail.
He uses two e-mail accounts: the institutional account used for work and research activities, and the personal one, keeping these two spheres distinct. Thanks to his smartphone, he can hold all the communications in check.
In order to reduce security risks, when he buys something online he use *PayPal* connected with a prepaid card.

Goals/needs

- Simple and efficient procedures required by university bureaucracy.
- To be sure the services he uses are reliable and secure.
- To protect the sensitive data from disclosure and unauthorized use.
- To manage the amount of e-mails received every day as soon as possible.

Motivations/opinions

He has a specific representation of privacy and «sensitive» data: every single information about him should be protected because it could be used to cause damage and offense. He tends to avoid the exposure and visibility of the information connected with his daily life (i.e. habits, people he meets and places he frequents). Despite he does not consider himself as «person at risk», he tries to pay attention when he uses the web.
He doesn’t use *single sign-on* systems and he prefers the memo pad, so to have the responsibility for his own accounts and avoid committing his credentials to a third part.

Questions	Barriers/pain point
– Are the university web services reliable? – Why hasn’t the campus Wi-Fi connection a valid certificate? – Is one single biometric factor enough to ensure the security of the access control?	○ The use of OTP is time consuming when he needs to carry out more than one task. ○ He can’t remember all the credentials, and he has troubles looking for a specific password among the pages of his memo pad. ○ He has doubts about the security of biometric factors for access control.

Persona - student

Giovanni

http://images.collegexpress.com/article/majors-academics-advice-students-starting-college-study.jpg

“I tend to keep my stuff private"

Profile

He is 27 years old and he studies Telecommunications Engineering at the University of Rome and he carries out an important research for his PhD.
He is hardworking, but during weekends and holidays he likes to spend time listening and playing music with his band.
He is considering whether to create a startup company to develop some interesting ideas together with his friends and colleagues.

Activities and tools

He collaborates with other researchers and he spends a lot of time at the lab, where he has all the tools available provided by the university (computers, internet connection etc.).
He prefers to use the Wi-Fi connection of the lab that is more reliable and efficient than campus connection; and before using any web service he checks its reliability.
In order to ensure the security, he uses complex credentials for his online accounts. In particular, he uses four main passwords as starting point, and then he adds some elements to meet the requirements (length, characters, numbers etc.), considering the level of security he wants for the specific service.
He uses the e-mail account provided by the university and the personal one, that is rarely used.
For online shopping, he uses a debit card so to feel safe.

Questions

- Can web services be more secure?
- Why are the privacy policies so unclear and difficult to understand?

Goals/needs

- To avoid using services that he does not consider secure.
- To take care not to lose his phone.
- To have notification systems to protect online accounts.
- To avoid exposing data.
- To use services and tools which meet his needs of efficiency and high performance.

Motivations/opinions

He knows the risks connected with web use, so he tends to protect all his data and disclose information only when it is strictly needed. He thinks that every kind of information could be used to cause sort of damage.
He doesn’t use *single sign-on* despite it could help him, because he fears that if it is uncovered, it will be used to access a lot of different accounts.
When he finds a new web service or an innovative mobile application, he tries it out and if it doesn’t meet his performance and reliability needs, he gives up.

Barriers/pain point

- Managing all his online accounts is difficult for him.
- Reconnect when the Wi-Fi connection is lost.

Persona - student

Marco

http://images.inmagine.com/400nwm/photoalto/faa049/faa049000039.jpg

“More safety, less effort”

Profile

He is 24 years old graduate engineering student at the University of Rome, and he spends a lot of time studying. He has excellent knowledge of ICT, and he is always updated about new trends and innovations.
He likes to stay with friends, even only for having a coffee during the spare time.

Activities and tools

He uses different web services and mobile applications, and he prefers online procedures instead of those «offline».
During his free time, he likes to put his skills to the test, playing codewars and online role play games, and also sniffing at web traffic via campus Wi-Fi connection, in the break between a lecture and the following.
Due to his familiarity with technologies and web services, sometimes he helps relatives and friends to use them and solve problems.
There is always the smartphone in his pocket, and he has a notebook that he can use sitting on the sofa as well as in the university library.
He uses social networks to keep in touch with friends and share online contents.
Using several web services, he has to manage the different access credentials. In order to make this task easy he uses a set of few passwords which range in terms of security: simple passwords are used for less critical services, while complex passwords are used when he needs to be safer.
He doesn’t need to use the e-mail provided by the university (except for having software licence for students), because his personal e-mail account is enough.

Goals/needs

- To use mobile apps to have access to services.
- Efficient and trustworthy web services and digital devices.
- To check the security before using web services.
- To make the study entertaining.

Motivations/opinions

In his opinion, not all the web services require the same level of reliability, and this depends on the data they gather.
There are less important information (those connected with his course of study and academic degree) and more critical data (in the case of money transaction). In fact, he cares of data manipulation (i.e. for stealing money) more than personal data exposition in the web.
Anyway, when he chooses web services or digital tools to use, he prefers those of major brands and trustworthy reputation.
When someone asks for his help, he wonders why some people are still not autonomous in the use of digital tools and web services.

Questions

- He wonders why some tools and web services are not user-friendly, so his parents need his help to use them.
- Is there a mobile application I can use for this service?

Barriers/pain point

- Some registration processes require too many steps for creating a new account.
- Not always his password patterns meet the requirements of web service registration.

Persona - student

Susanna

http://www.thesoundsnews.com/wp-content/uploads/2013/05/college-girl-stock-300x199.jpg

"If they add other safe codes, I will go crazy"

Profile

She is 25 years old and she studies Psychology at the University of Rome, but her interests range from Art to English literature.
When she has some free time, she likes reading books and visiting museums and exhibitions around the city together with her friends.
She lives with her family and, at this time, she can't have a job because she puts a lot of effort into the study.

Activities and tools

She spends most of her time in the campus to attend lectures and study in the library.
She often uses different web services (fidelity cards, online magazines, scientific database, social networks, cloud storage etc.) and she hasn't a good memory for password. For this reason, she uses *single sign-on* system, and she used to save the credentials on the browser.
She always tries to solve the problems she meets using university web services by herself; if she can't do it, she asks to skilled colleagues or she turns to the administrative desk.
She manages two e-mail accounts: the first is provided by the university and she uses it only for formal communications with professors and university staff; while her *hotmail* account is used as the main.
In addition to the smartphone and the pc, she has a tablet that is useful especially during lectures to surf the web searching for further information about interesting topics.
When she needs to buy something through e-commerce (books as well as shoes) or to make flight reservation, she uses her father's credit card, and she always do it using trustworthy web sites.

Questions

- Is this web service reliable?
- How will they use the data I am disclosing?
- How can I delegate to others the use of web services with biometric authentication?

Goals/needs

- To get easy access to her online accounts.
- To avoid phishing.
- To have mobile applications for the most used web services (i.e. e-mail, *Facebook*, *Google Maps* etc.)

Motivations/opinions

Few years ago, she had the habit of using a unique password for different accounts so to remember it; but over the years, she heard rumors about risks regarding web security, and friends' suggestions about useful strategies to prevent them.
Now, she pays more attention using the web, especially when she uses e-commerce web sites.
She trusts of *single sign-on* because it is used by millions of users and due to its high reputation brand.
She also relies on university web services because the institution guarantees their reliability, and the kind of data they obtain (course of study, exams reports etc.) are not sensitive for her.

Barriers/pain point

- Managing the several online accounts.
- The use of different credentials (username, passwords, PIN and safe codes) for accessing some web services.

Persona - front office staff

Maria

https://pixabay.com/static/uploads/photo/2014/11/24/16/22/secretary-544180_640.jpg

"We are the first meeting point between the students and the university"

Profile

She is 57 years old and she works as office manager in collaboration with her subordinates to provide support service to the students of the Faculty of Psychology at the University of Rome.
Within the hierarchical scale, she has an important role with particular tasks and responsibilities.
But during vacations, she can delegate her functions to trustworthy colleagues and enjoy the free time.

Activities and tools

Together with the office colleagues, she provides informational and administrative support to students who want to enroll, change the course etc.
She also manages the administrative aspects of students' announcements of selection for the admission to courses of study.
She uses the administrative interface and the electronic archives (in which all the reports and certificates are stored). When some problems arise using these tools, she asks for the support of the technical staff.
The access credentials for all the tools she uses to carry out her work are the same: identification number as username and the password. The privacy policies demand that she often changes the password, and in order to simplify this task she uses a single pattern and every time she changes just few characters to create a new code.
She uses the e-mail account provided by the university to communicate with the users and the staff.

Goals/needs

- To support students from enrolment to degree achievement, supervising their careers.
- Often change the password to comply with the privacy policies.
- To solve administrative issues.
- To reduce the effort and the time needed to accomplish tasks.
- To increase the use of ICT.
- To provide high quality service.

Motivations/opinions

She considers the innovations introduced in the bureaucracy as a benefit for both administrative staff, students and professors.
Due to her expertise and responsibility, she pays attention on everything she does during her work. She knows that solving mistakes and slips with critical effects is not always easy.

Questions

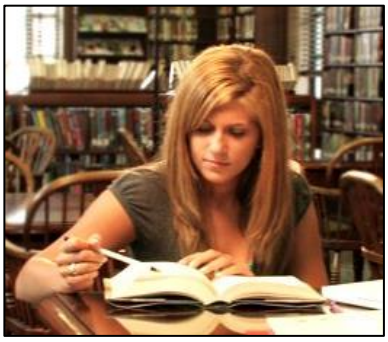
- Why do people hesitate using tools through which they can avoid turning to desk?
- Why doesn't the university platform allow temporary permissions to other user roles?
- How can I quickly and easily verify some certificates and documents released by other institutions?

Barriers/pain point

- Manage the hardcopy archive and search for old printed exam report.
- Still existing lacks and problems of computerized procedures.
- Lack of integration and communication among the services of the different universities
- Due to the recurring change of password, it is hard to remember what the last one is.

Persona - front office staff

Giulia



http://ak.picdn.net/shutterstock/videos/476104/preview/stock-footage-students-study-in-the-library.jpg

“We still use pen and paper to work”

Profile

She is 24 years old and she works as assistant at the university library. She likes this work because during the idle time she can consult all the books and papers she wants.
She got this job in order to earn some money to pay for her studies.

Activities and tools

She spends most time in the library where she works and studies.
The digital tools provided by the library are not enough to accomplish all the tasks included in her job activity, which are: helping the students to find the books required, writing down what books have been borrowed in a catalogue and checking the identities of the students who borrow books, checking the status of a loan, and marking down the books required that are not yet available in the library.
Everything is done on paper, and this is the reason why she encounters many obstacles in carrying out her job tasks efficiently.

Questions

- Can the library provide the digital tools we need to carry out our work efficiently?
- Why do we still have to use a hardcopy catalog instead of a digital one, which would be easier?

Goals/needs

- To use a computer program to verify student identities.
- To have an online catalog of books and magazines.
- To accomplish job activities as soon as possible so to spend the rest of the time studying.

Motivations/opinions

She believes that the computerization of data can enhance the library service that should be quick and efficient.
She is frustrated when some tools do not work properly, especially when she uses the system to keeping track of books borrowed/returned that is very outdated.

Barriers/pain point

- Using the hardcopy catalog is time consuming.
- It is difficult to notice if books are not returned.

Annex 3: Mental Models

Legend:

- Tasks performed by students
- Tasks performed by professors
- Tasks performed both by students and professors
- Tasks performed by library assistant
- Current contents/services/tools available to support tasks

Mental Model of end-users (student and professor)			
Connect to Wi-Fi	**Buy products through e-commerce**	**Search books in the interlibrary catalog**	**Share files through online platform**
Connect to Wi-Fi	**Buy products through e-commerce**	**Search books in the interlibrary catalog**	**Share files through online platform**
Connect to WPA of the lab [05SES, 09ALS, 17PIS]	Buy products through e-commerce [02DIP, 03DAS,08CAP, 11BAP,13SNP]	Search books in the interlibrary catalog [18MRS]	Share files through online platform [08CAP, 13SNP, 14GCP, 17PIS]
Connect to campus Wi-Fi when you are around in the university [02DIP, 10GIS, 13SNP]	E-commerce web sites	Interlibrary catalog	online platform for file sharing
Connect to campus Wi-Fi for didactic purposes [04ERS, 17PIS, 18MRS]			
Connect to campus Wi-Fi for leisure web navigation [03DAS, 07DOS, 15MAS]			
Move around with the pc to receive Wi-Fi signal [11BAP]			
WPA connection of the Lab			
Campus Wi-Fi connection			

Download software	Manage internet banking account	Turn to support desk
Download software	**Manage internet banking account**	**Turn to support desk**
Download software from university repository [06ADS, 07DAS, 09ALS, 12ASS, 16GLS]	Manage my personal current account [02DIP, 08CAP, 13SNP, 15MAS, 16FEP]	Ask to administrative office for solving problems [01LUS]
Software repository provided by the university	Manage current account of associations as treasurer [02DIP]	Ask to desk for further information [19PAS]
	Internet banking account	Call the administrative office [17PIS]
		Support desk

Carry out academic activities			
Exploit e-learning platform for didactic purposes	**Manage university administrative procedures**	**Enroll for exams**	**Report exams**
Communicate with work team through the forum [01LUS]	Download certificates [18MRS]	Search the exams in the list [12ASS]	Call the toll-free number to communicate the PIN [11BAP]
Carry out exercises [01LUS]	Download the form for taxes payment [01LUS, 04ERS, 10GIS, 09ALS, 12ASS]	Register for exams [01LUS, 07DAS, 09ALS, 10GIS, 12ASS, 18MRS, 19PAS]	Insert on the portal data about the exams [02DIP]
Attend blended courses [01LUS, 09ALS, 10GIS]	Manage academic career [18MRS]	Show ID to professor [01LUS, 18MRS]	Complete the report with electronic signature [02DIP]
Communicate with professors via platform [15MAS]	University platform to manage administrative procedures	Check students’ identity [02DIP]	Exam report
			Electronic signature
Access the platform to download didactic materials [17PIS, 19PAS]		Exam report	
Arrange online courses [02DIP]		Students’ ID	
Monitor online courses [02DIP]			
Collaborate with others to manage online courses [02DIP]			
E-learning platform provided by the university			
Didactic materials			
Online exercises			
Instant messaging and forums			

Manage online account			
Register a new account	**Manage access credentials**	**Access the account**	**Allow someone else to access my account**
Create variations from a unique password [19PAS]	Often change the password of critical services [19PAS]	Access different accounts through single sing on [17PIS]	Allow friends and parents to use my own account [01LUS, 04ERS, 09ALS, 12ASS, 15MAS, 18MRS, 19PAS]
Create passwords starting from a base pattern [09ALS, 10GIS, 12ASS]	Change critical passwords during vacations [16FEP]	Insert different kind of credentials (username, password, OTP) [08CAP, 18MRS]	
Create secure passwords [09ALS]	Request forgotten passwords [08CAP, 14GCP]	Access the university web services with the same credentials [01LUS, 02DIP, 17PIS, 18MRS]	Help relatives and friends to use web services [10GIS, 17PIS, 18MRS]
Create passphrase for critical online accounts [09ADS, 19PAS]			
Create random passwords [05SES]	Remember the different passwords [08CAP, 13SNP]	Always bring OTP key with me [14GCP]	Ask to a colleague for making a conference registration [16FEP]
Resort to a set of passwords [01LUS]	Write the credentials on the memo pad [02DIP, 14GCP]	Access credentials	
Create simple passwords to remember [06ADS, 12ASS, 16FEP01LUS]	Procedures to restore lost passwords	OTP key	
Create more/less complex credentials considering the importance of the account [02DIP, 06ADS]	Memo pad	Single sign-on	
Meet the requirements for password creation [11BAP, 16FEP]			
Tend to use the same password for different accounts [08CAP, 13SNP]			
Registration form			
Requirements for password creation			

Care about privacy	
Ensure the reliability of web services	**Protect data**
Learn about the web service and its privacy policies [10GIS, 17PIS]	Back my smartphone up for technical assistance [17PIS]
Try out a new service to test it [17PIS]	Back the documents up in the cloud [17PIS]
Understand how data could be tracked [03DAS, 18MRS]	Keep my credentials confidential [01LUS, 03DAS, 10GIS]
Check the security of web sites [05SES]	Take measures to reduce security risks [06ADS, 19PAS]
Information about the web service	Use only reliable web services [07DOS, 17PIS]
Privacy policies	Check the security of web sites [05SES]
	Demand different levels of access security [07DOS]
	Disclose personal information only when it is necessary [10GIS]
	Make online payment only with prepaid card [01LUS, 06DAS, 07DOS, 18MRS]
	Keep sensitive data confidential [03DAS, 09ALS, 10GIS, 15MAS]
	Discern critical web services [08CAP, 09ALS, 10GIS, 13SNP, 19PAS]
	Protect my institutional account [02DIP, 16FEP]
	Cloud platform
	Backup systems
	Sensitive data

Mental Model of library assistant				
Communicate with users	**Enroll users**	**Manage loan process**		
Communicate with users through e-mail	**Enroll users**	**Verify users’ identity**	**Find requested books/papers**	**Provide the loan**
Check inbox [15MAS]	Ask for completing the form with personal information [15MAS]	Check the library card [15MAS]	Search in the database the location of books requested [15MAS]	Take the requested book/paper from the deposit [15MAS]
Answer to received messages [15MAS]	Copy users’ ID [15MAS]	Library card	Consult the hardcopy catalog of scientific papers [15MAS]	Register the loan in the list [15MAS]
Mailbox of the service	Insert new users’ information in the database [15MAS]		Search the books requested in the catalog [15MAS]	Give the loan receipt [15MAS]
	Give to new users the library card [15MAS]		Library database and catalog	Loan report
	Registration paper form			Loan paper receipt
	Users’ ID			
	Library card			

Store the books/papers	**Manage the lockers**	**Provide photocopies**	**Give assistance to users**
Store the books/papers	**Manage the lockers**	**Provide photocopies**	**Give assistance to users**
Update the books’ status in the catalog [15MAS]	Get the ID to give the key of the locker [15MAS]	Check the user has the right to free copies [15MAS]	Assist users looking for books/papers [15MAS]
Check all books have been returned [15MAS]	Give back the ID when the key is returned [15MAS]	Complete the photocopy form [15MAS]	
Put the returned book into the deposit [15MAS]	Registration paper form	Copy machine	
	Users’ ID	Form for photocopies	
Library database and catalog	Locker keys		