

# Leveraging User Experience and Touchpoints Analysis for Services Design: Case of Crisis Management

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User experiences have been the focal research issue in service design (SD), as it has various benefits. As it will be demonstrated in this paper, developing an efficient, yet usable crisis management service requires a deep understanding of the experience (UX) of all stakeholders involved in the crisis. While many SD studies have proposed different principles, practices and tools, there is a lack of a practical comprehensive design framework that empowers designers to integrate effectively UX in the SD lifecycle. In this paper the authors propose a methodological framework called UXD-IS (User eXperience Design of Interactions and Services) that combines UX characterization and touchpoints analysis. The framework has been validated through a case study related to flooding crisis management. The investigations reveal that the framework is a powerful support tool during the first phases of the development of a new service or the improvement of an existing one.

Interaction Science Key Words: user experience, service design, interactive service, design framework, touchpoints, user journey, crisis management.

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## 1 INTRODUCTION

The rapid evolution of service-based system and organization raises new challenges for service design (SD). In services today, many stakeholders involved, including organizations, as well as configurations of people, technologies and other resources that make the entire service function. Improvement and maintenance are especially difficult, as the authors should take into account new situations and user experiences (the term user refers to any person interact with one or more service interface). Thus, user experiences, including needs, expectations and attitudes, should ultimately guide how the entire service-system is being designed and managed. At a time of major restructuring and reform, a participants-centered approach is what is needed.

This is where SD is extremely relevant. Service design is an approach involving understanding users and their context, understanding service providers and social practices, and translating this understanding into development of evidence and service systems interaction [1]. SD considers the quality of the service from the human perspective as a key pillar [2]. However, the service designers' community, despite the considerable research efforts, often neglects the analysis and evaluation of the user's experiences. Moreover, service design raises several challenges in terms of user experience (UX), overpassing traditional usability aspects [3].

Crisis management services are an example of complex user-service interactions [4]. Indeed, the emergency of an unforeseeable crisis situation can have an impact on the work of intervening actors – precisely on decision-making and coordination between the different participants and implied organizations [5]. The experiences generated before, during and after using crisis management services should constitute a solid information design to improve the existing services as well as to

innovate in the design of new services. [6] have already raised this finding when they described premises set for crisis management systems design (i.e. system training, information focus, crisis memory, exceptions as norms, scope and nature of crisis, role transferability, information validity, exchange of information, and coordination). In particular, the “crisis memory” premise states that “learning and understanding what actually happened before, during, and after the crisis is extremely important for the improvement of the response process. Thus collecting information on the performance of people in given situations should be incorporated into design of crisis management systems.” [6].

In this sense, UX design has emerged as a research field seeking to offer a systematic approach to design and evaluate the user’s holistic experiences with service technology. UX refers to users’ perceptions and responses that arise in the use of a product, system or service [7]. In human-computer interaction (HCI), user-centered design and service design disciplines, the design of desirable human experiences has been one of the major interest areas in service UX design [3]. The user-service interaction being the focus, service design methods may be used for improving the UX of a service interface, the visible part of the service to the users, thus stimulating behaviors and choices.

The key rationale and motivation for adopting a UX design approach for the design of services are broadly highlighted hereafter.

### **1.1 Usability testing to UX analyzing**

A service user interface hard to understand and use causes many problems to users. Usability is a measure of the extent to which users are able to perform their activities in their specific context of use [8]. Testing the service usability means observing and asking a number of users about the use of existing or future products or services in a situation of everyday life [10]. Other hand, the UX extends the more traditional concept of usability, focused primarily on ease-of-use, by emphasizing subjective attributes like esthetics, emotions and social involvement [11]. Indeed, UX is a much richer scope where users’ feelings, motivations, and values are given as much, if not more, attention as efficiency, effectiveness and basic subjective satisfaction (i.e. the three traditional metrics used to assess usability). UX includes also a person’s perceptions of the practical aspects such as utility, ease of use and efficiency of the system. However, these measures are subjective in nature because it is about individual perception and thought with respect to the system. Therefore, the integration of UX into the SD lifecycle may face to some problems. Indeed, without an effective design support (i.e. support allowing better communicate both the users requirements and assessment attributes on the quality of perceived UX) the designers will find it difficult to justify and test their choices compared to the analysis of the existing UX.

### **1.2 Capturing and evaluating UX quality**

For a service-based system and organization, such as crisis management, the multitude of the underlying intervention equipment and technologies as well as the significant number of participants from the various sectors of an organization with their different characteristics (qualification, behavior, culture, etc.) make the design of those services highly challenging [12]. Moreover, from the user side, the end-user must be able to reconfigure. the service interaction in a dynamic manner and designate changes in priorities, filtering the options and delivery the decisions at any moment during his or her interaction with the given service [13]. From the service side, however, it also means the service has to observe these changes dynamically and keep other participants up to date.

All issues previously cited make more critical the precise evaluation of the impact of use of those services on the participants and broadly on the progress of the organization management process. It is important to provide designers a methodological framework to capture and evaluate the quality

of the UX during the journey of the user with a service and therefore deliver services that are more innovative and desirable to end-users. In this paper the authors will focus on subjective evaluation of UX because it is rich and lends itself well to the capture of complex subjective experiences.

### **1.3 Leveraging a touchpoint analysis in SD lifecycle**

The interaction analysis between the different users and service through various contact points, namely touchpoints, is often ignored or even non-existent despite several research works resulting from other application fields. For instance, studies about medical emergency [14], cloud computing [15] and e-learning services [16] have highlighted the relevance of adopting the UX design and the associated touchpoint technique in the service design life cycle. Furthermore, a few practical works have dealt with user-service interaction and the UX perspective [17].

### **1.4 Integrating UX in SD practices**

In their survey conducted with software companies (in Italy and Denmark), [18] reported a set of problems about integration of UX evaluation in software development practices. They state that many developers have their minds set mainly on programming aspects, technical challenges and functionality of the product rather than on its usability, and many of them know even less about UX. Another main obstacle they reported is the lack of suitable methods that could be integrated in development practices without demanding a lot of resources. This shows the interest of encompassing existing UX methods and SD techniques in a methodological framework facilitating its understanding and use by designers.

### **1.5 Research objectives**

The authors investigate the following research questions:

- (a) How to capture and evaluate the attributes characterizing the UX at each user-service contact point?
- (b) How to ensure a certain traceability between the UX descriptions and the created service designs?
- (c) How the users should be involved in SD lifecycle since the users may also become developers of the service, or at least contribute to its content and how it appears to others.

Therefore, we need a methodological framework that use a correlated tools and techniques from both UX design and SD for purpose of narrowing the gap between UX and SD practices. More precisely, our research is tailored towards the definition of a process that identifies from multiple tools (i.e. personas, touchpoints and user-journey) the set of attributes in order to assess the UX quality of current service designs and also to detect pain points during the user-service interaction.

The remainder of this article is as follows. Section 2 reports related work on UX and its application in service design. In section 3, the authors give an overview of the proposed framework (UXD-IS). Section 4 shows the detailed description of UXD-IS phases applied to a real flooding crisis management case study. Finally, in section 5, the authors discuss the main issues and ideas relative to the proposed approach as well as some lessons learned from the research practices, whilst concluding and suggesting some research perspectives.

## 2 BACKGROUND

### 2.1 Service Design

From services marketing perspective, [19] state that “Service design aims at designing services that are useful, usable and desirable from the user perspective, and efficient, effective and different from the provider perspective.” They add “Services are systems that involve many different influential factors, so service design takes a holistic approach in order to get an understanding of the system and the different actors within the system.” Service design is also defining as holistic, co-creative, and user-centered approach to understanding customer behavior for the creation or refining of services [20-21]. All these definitions agree that service design is co-creative, in that the design team works with stakeholders, (e.g., users and staff), to co-create or refine services that meet or adjust to customer (user) expectations, while also working with frontline personnel to deliver a high-quality service. At the center of the process is the user and insights into user behavior [20]. It is through this lens that services are refined and improved—or even created—to meet user needs and expectations.

Service designers use various tools and methods (e.g. user journeys, stakeholder maps, personas, service blueprints, prototyping) borrowed from a number of disciplines (e.g. social science, business and design) to understand the needs of users and (re)design services better to suit these needs. In HCI design, service design leads to a thorough analysis and deeper understanding of user-service interaction. The persona tool has been used to characterize the users targeted by the design [22-23], and blueprinting has been defined as a process control technique for modeling the user-service interactions [24].

In the plethora of service design methods, different artifacts are used for portraying visually the design concepts and ideas [25-26]. Most of them are applied according to the culture and skills of the stakeholders involved in the service processes [27].

The Double Diamond is another example of the service design methods [28]. Double Diamond is a process model inspired by the professional design process that entails emphasis on problem analysis as the basis for creating a solution for an external client. The model is particularly suitable for structuring a course with external collaboration and user involvement in the development of solutions [28]. The model presents four main stages across two adjacent diamonds. The first diamond is to define strategy (i.e. understand why and define how) and the second diamond for executing a solution (i.e. create outcome). The two stages of the first diamond are discover (i.e. identify, research and understand the initial problem) and define (i.e. limit and define a clear problem to be solved). The second diamond contents: develop (i.e. focus on and develop a solution) and deliver (i.e. test and evaluate, ready the concept for production and launch).

The capacity for innovative service design is another challenge that researchers and practitioners are facing today. In fact, the lack of frameworks capable of supporting the innovative service design has already been raised by some authors [25, 29-30]. The framework called the Service Model Innovation Framework (ServiceMIF) for the design of innovative services described by [29] proposes customer value development that comprises five milestones: discovery of supplier-customer context, solicitation, evaluation and capture of the customer value (or profit), and finally translating the new version of the service. However, the deep analysis of the user and the service UX is neglected in ServiceMIF. [30] propose another framework, called Multilevel Design Service (MSD), for the design of complex service systems at three abstraction levels (i.e. value constellation, service experience and service encounter). Despite the detailed level of the proposed models based on the blueprinting approach, the characterization of the service UX remains unclear in terms of evaluating the perception of the user (or customer).

From the user perspective, some studies pointed out that involving users in service co-production may be necessary in some cases [31-32]. As mentioned by [33], the service design also aims to ensure that the overall experience of service is useful, usable and desirable as well as efficient,

effective and technically feasible. This has given the birth to user experience design (UXD), which has recently gained significant popularity within the service design community.

## **2.2 UX Design: Definition and Models**

The scientific literature provides several definitions for the UX concept. The International Standard Organization (ISO) defines UX as a “person's perceptions and responses that result from the use or anticipated use of a product, system or service” [7]. [34] defines UX at two levels. At the lowest level, he describes UX in terms of actions: motor-goals (e.g. pressing the keys of a cellphone) performed in order to accomplish a do-goal (e.g. sending a text message). At the highest level, UX is detailed as be-goals which motivate the actions. For [11], UX includes only the interaction between a person and something that has a user interface. They also argue that UX is subjective and focuses on use, whereas usability is more objective and quantifiable.

Several abstract models characterizing UX have been proposed in the literature. For example, [35] describes a UX process model and introduces four dimensions to experience modelling: perceived usefulness, ease of use, hedonic quality, and visual attractiveness. It is claimed that these four factors could explain approximately 79% of the total variance of the intention to use a website. [36] have described the valence method which intended to capture positive and negative feelings during the exploration of an interactive product (or service) and elicit the product design aspects causing negative or positive UX. [37] have described a holistic model of UX based on co-creation value with an experimental study for Living Lab experiential design.

In the UX evaluation field, [38] proposes an integrated evaluation framework of usability and UX by including influences on other people. The proposed framework tends to make the connection between objective measures (usability) and subjective measures (UX) when evaluating the interaction of the service and the user. UX Curve [39] is another evaluation method, which aims at assisting users in retrospectively reporting how and why their experience with a service has changed over time. Unfortunately, all these methods concern only the overall context of use without analyzing the quality of UX in both each service encounter (called also the touchpoint) and the connection between those encounters that form a user journey.

Diverse tools for capturing and modeling UX have been proposed. UX-Modeler [40] models the UX using the persona and design patterns. The persona is a narrative description of a class of users that may be involved in the service organization and that has an important role in making different decisions, such as in crisis management [13]. Moreover, [17] have demonstrated that a persona could be an effective and efficient tool for capturing the main facets of UX.

## **2.3 Touchpoints as a Technique for Understanding and Documenting UX**

In marketing research, extensive work has been done on the importance of the points of contact of the services (called touchpoints) in creating positive effects on customer experience. [41] describe integrated marketing as a combination of three elements that are closely related to service design: an understanding of consumer behavior, focus on brand and link to customer experience. In the same way, [42] suggest that the coordination of touchpoints is one major part of linking contact experiences to the brand. Other authors have investigated the combination of touchpoint alignment within integrated marketing [43]. Moreover, according to [44], the touchpoint alignment means that customer contact channels, such as email, in-store, online, and smartphone channels, are both integrated and available in real time to anyone in an organization of services. [45] propose a customer experience framework (CEF) that focuses more on the journey of the customer in experiencing the service. A journey or a cycle is a series of critical encounters that take place over time and across channels [33].

The concept of designing touchpoints between the service provider and the customers has recently gained significant credibility in service design. These touchpoints have even become one of the three pillars of service design (i.e. users, content and context) [46]. According to the community of practitioners, service design is “design for experiences that happen over time and across different touchpoints” [47]. This definition confirms the central role played by touchpoints when describing the link between the service provider and the customer through customer experience. However, as mentioned by [32, 48], there is still little or no documented research work on the applicability and the implementation of this concept in actual service design.

### 2.4 The Need for an Integrative UX Design and Touchpoint Analysis Framework

Although much literature covers the importance of touchpoint analysis for service design [44, 49], there is little or no documented research on touchpoints when it comes to planning and implementation in the development of new products and services [48]. Furthermore, despite all research conducted on UX design, there still remains the lack of a rigorous service design methodology employing the UX to assist designers in the development of new design service-based solutions. This raises the pertinent research question of how to assist designers in developing a successful service UX. This is a particularly motivating issue in the current research work.

## 3 UXD-IS: USER EXPERIENCE DESIGN OF INTERACTIONS AND SERVICES FRAMEWORK

### 3.1 Framework Overview

The Fig. 1 portrays the key milestones of the UXD-IS framework. The principle of the framework gradually generates artifacts describing all of the aspects of UX (i.e. service context, user characteristics and service touchpoints). The underlying methodology of UXD-IS distinguishes four phases: (1) service context discovery, (2) UX characterization, (3) touchpoint analysis, and (4) service-UX prototyping. Each phase produces an artifact that can be considered by the designer during the next step in the service design process as proposed in the Double Diamond model [28]. The phases of UXD-IS can also be re-executed for improving the UX of service designed.

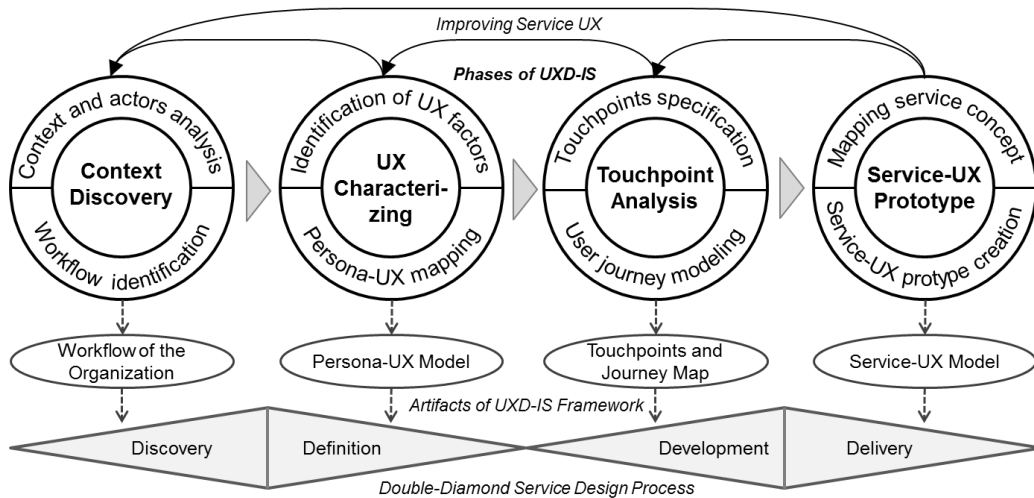


Fig. 1. Overview of UXD-IS Framework

Phase 1 aims to discover the context in which the service is or will be used, including the technological, human and organizational aspects. This allows designers to understand the activities and human processes supported by the service and the role of each user in these processes.

Phase 2 consists of studying the users of the service and their experiences. This allows designers to define a set of design goals that can be used during the service development phase. Thus, the designers can assess the service design against this set of design goals.

In phase 3, the UX analysis will continue with a service touchpoint and user journey map. The aim of this analysis is to assist designers in the specification of identified touchpoints and modeling of user journey with its UX evaluation.

During phase 4, a prototype of the service UX is developed based on the results of the three previous phases of the UXD-IS framework. This prototype encompasses the mapping service concept-UX and the modeling of the users' interactions with the service through the list of touchpoints. The prototype, named the Service-UX model, depicts a holistic view of how UX is supported.

#### 4 DESCRIPTION AND APPLICATION OF UXD-IS IN CRISIS MANAGEMENT CASE STUDY

UXD-IS has been applied in the context of a civil protection department (CPD). The aim was to explore the applicability of UXD-IS in the service design loop of current services. The authors also explored how it helps service designers to create experiences-based services that are more meaningful for emergency responders. A large pool of CPD members and stakeholders has been engaged in the different phases of the proposed framework.

##### 4.1 Description of the Case Study

The case study deals with the center of operations for crisis response and management. The study lasted two months, during which the authors investigated the structure of the center of operations organization and the tools used for crisis management. A scenario was jointly elaborated with officers and managers of the center of operations, describing the key actions carried out by all of the actors of the center who handle floods. The authors focused mainly on interactions between the user and the service, as well as those between the different human actors at the civil protection department in their interactions with the existing web-based services.

A total of 24 civil protection agents participated in the study. The participants were divided into two groups, A and B, based on their roles. Group A had 6 participants with the following roles:

- Supervising and coordinating the various actions carried out by all of the civil protection agents.
- Coordinating the operations.

Group B was composed of 18 participants who were in charge of:

- Executing the evacuation and helping the victims during and after the disaster,
- Collecting information about users (i.e. agents of civil protection) and their service experiences.

Table 1. Composition of the participants in the study

Group	Structure	Specific Role	Common role	Age	Domain experience
A (6)	Fixed headquarters	Command post officers (3) Operations commander (1)	Officer	34-56	4-18 years
B (18)	Post Operations	Logistic & equipment agent (2) Medical rescue agent (1)	Agent	21-52	2-28 years

The participants answered an online questionnaire which provided answers to the research questions: (1) Who are the users of crisis management services? (2) What are their needs and experiences? (3) How well are those needs currently being met?

The questionnaire included 25 questions divided into four sections: demographics (6), scenarios of use related to crisis management services (5), perceptions of crisis management services (7), and experience evaluation (7).

#### 4.2 Phase 1: Service Context Discovery

This phase consists of collecting and analyzing information related to the domain where the service is to be developed (or modified), the environment of the organization as well as the human actors involved. The tasks carried out by the actors and the underlying information exchanged are documented in a workflow model. The service context discovery enables us to identify the potential actors, their collaboration, and their roles in the service organization. This phase consists of two sub-steps.

4.2.1 *Step 1: Context and actors' role analysis.* In this step, the following information is collected:

- (1) The definition and the scope of the problem to be solved
- (2) The main activities carried out within the organization to achieve its goals
- (3) The physical and social environment.

In this phase, apart from questionnaires, the authors also use interviews and focus groups [53]. To document the collaboration between the different actors, the authors proposed a graphical notation that illustrates the relationships between actors with their task oriented goals (i.e. do-goal) and activity oriented goals (i.e. service goal). A service goal corresponds to an objective of the service to meet its users. While a do-goal corresponds to an objective specific to each actor in order to contribute to the achievement of the service goal. Thus, each service goal may contain one or more do-goals. The collaboration between two actors is represented in an elliptic form split into two parts by a horizontal line. Each ellipse is attributed to a service goal and each inner part of the ellipse is associated with a do-goal assumed by a given actor. In this notation, the actors are identified by their roles played within the organization of services. Moreover, an arrow oriented towards the do-goal of each actor represents the actions flow executed by an actor.

Fig. 2 shows an example of collaboration between three actors (crisis cell manager, command post officer, and civil protection agent).

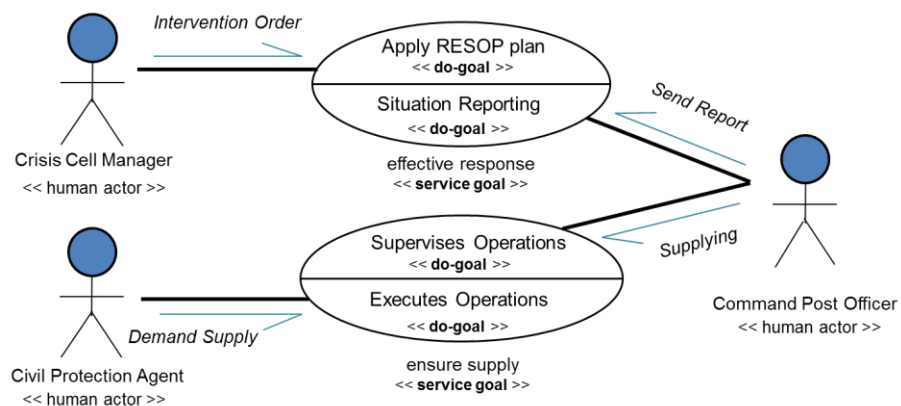


Fig. 2. Example of collaboration in crisis management



The crisis cell manager coordinates response operations with the command post officer in order to apply the Rescue Organization Plan (RESOP). The command post officer supervises the intervention operations while ensuring the human and material resource supply of the civil protection agents.

4.2.2 *Step 2: Workflow identification.* This step consists of identifying the sequence of activities carried out by the various implied actors. The authors use Business Process Management Notation (BPMN) [50] to describe the workflow graphically. The aim is to represent the activities, which can be processes, sub-processes or elementary tasks. All of the workflow activities are organized in boxes representing parts of the process carried out by a participant (actor or particular organizational entity). Fig. 3 illustrates a simplified model workflow describing the sequence of the main activities undertaken by the various actors involved in the CPD organization.

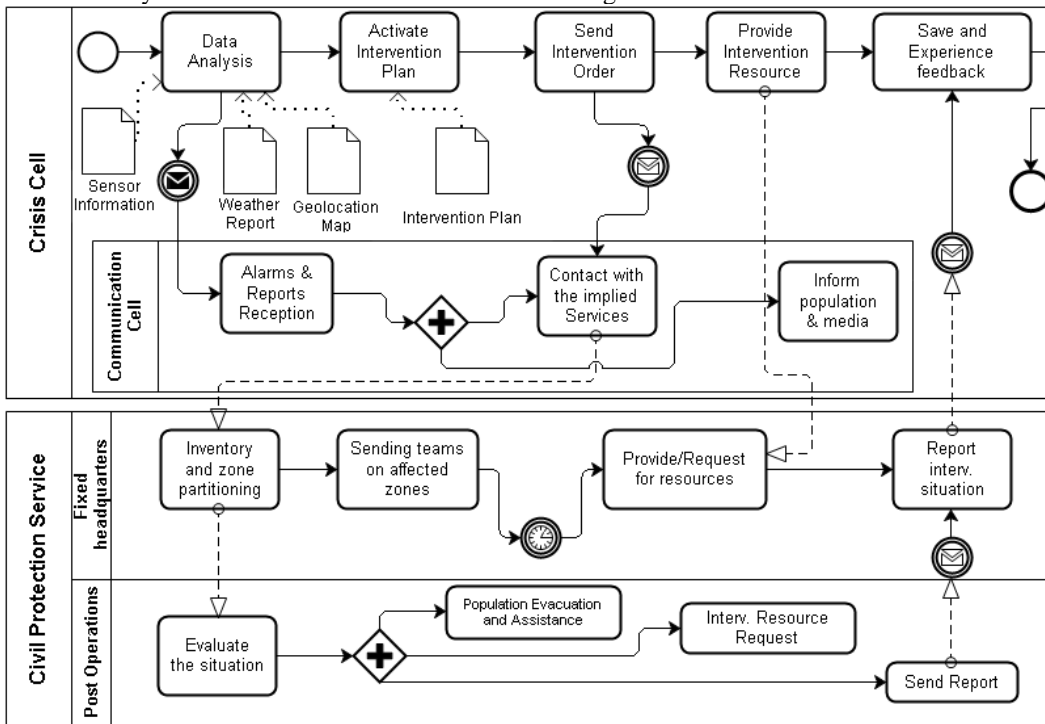


Fig. 3. Workflow of organization of crisis management services

As showed in Fig. 3, the workflow model depicts two main business processes (related to crisis cell and civil protection services) wherein different actors interact with the service functionalities. The execution of the workflow starts with data analysis on the crisis situation which can lead to sending an intervention order. According to the collaboration graph shown in Fig. 2, the Crisis Cell Manager send to civil protection service the RESOP plan (i.e. “Send Intervention Order” activity in the workflow). Next, the Command Post Officer handles the plan to identify the partitioning zone with their priority (i.e. “Inventory and zone partitioning” activity in the workflow) and orders the Civil Protection Agents to intervene in the identified zone. After the intervention, the Command Post Officer sends to Crisis Cell Manager the report about the situation (i.e. “Report interv. situation” activity in the workflow).

The next step concerns the characterization of the actors who will be the future users of the services to be designed.

### 4.3 Phase 2: UX Characterization

The aim of the second phase is to identify the classes of the potential users of the service. These classes must be differentiated using the specificity of the experience of each user class. The persona [22] is thus used in order to characterize the UX for each actor type involved in the services. In addition, the attributes characterizing the UX are defined in this phase and will be allocated to each persona created.

*4.3.1 Persona and UX attributes identification.* In this step, the authors use personas to provide an understanding of the service usage in terms of users' characteristics, needs and goals that can be used to design and implement different service features. In addition, the authors extended the persona technique to support the identification of the relevant UX parameters at earlier phases of the persona creation process. Table 2 summarizes the activities to create personas.

Table 1. Description of the persona-UX technique activities

Activities	Objectives	Techniques/tools
1: State hypotheses	State preliminary hypotheses about the possible personas to be created.	Based on the data gathered from the service's users, the nature of the application domain and the service organizational domain.
2: Identify the UX attributes	Based on a list of persona hypotheses, investigate possible UX attributes that influence user-service interaction.	- The interview of class users represented by each supposed persona; - Observation in-situ of users.
3: Identify behavior patterns	- Based on interview responses and selected UX attributes, identify similarities between users' responses with each rang of UX attributes; - Map the respondents to different ranges of identified UX attributes; - Create with the behavior patterns according to the groups of UX attributes.	- Brainstorming and participatory meeting with respondents (i.e. users); - Analyses and syntheses of transcribed interviews; - Clustering and group percentage table (similarity between interviews and rang of the UX attributes).
4: Scenario development	Write a description of each scene (activities, tasks) of user-service interaction according to persona goals.	Narrative description, survey, and observation.

In this study, the preliminary hypotheses are based on the role played by each actors of crisis management. The authors use thereby the two identified user categories (i.e. command post officers and civil protection agents) to create the personas. To identify the significant UX attributes, the authors have developed an online questionnaire (see Fig. 4). In this questionnaire, the authors proposed items based on the UX attributes cited in several research papers [35, 51]. Then the participant has the choice to evaluate his degree of agreement or to ignore the item. As a result, the authors obtain a list of UX attributes selected by all survey participants with the score obtained for each attribute. In the case where the NA (Non-Applicable) choice is selected, the attribute will be ignored during the touchpoints analysis (i.e. phase 3). The retained list of UX attributes for the study is shown in Table 4.

To identify the behavior patterns, the authors observed during the survey that the behavioral aspects such as orientation towards the sense of organization and coordination, level of stress, and the quality of contact with the others are attributes that characterize the UX of each participants group in the study (i.e. groups A and B). For instance, the authors observed that the level of

engagement, utility and clarity in the crisis response process is characteristic of the command post officers (group A). In addition, the UX attributes related to effectiveness, relatedness and assistance are characteristic of the intervention agents (group B). Therefore, the authors identified two behavioral patterns which are potentially shared by the participants in each group. In fact, these two patterns represent the two primary personas for this study. Afterwards, the authors completed the created personas by developing the scenario of use and fictitious information (e.g. photo, name, age, etc.).

**4.3.2 Step 2: Personas - UX mapping.** In this step, the authors associate each created persona with its UX attributes identified in the previous step. Based on Hassenzahl’s model [51] two categories of parameters should be specified: (1) pragmatic (or instrumental) that refers to usability aspects (e.g. effectiveness, efficiency, safety, learnability, and utility) and (2) hedonic (or non-instrumental) related to the user’s perceptions (e.g. pleasure, autonomy, competences, and sociability).

The proposed persona-UX model consists of two main parts (see Fig. 6.b). The first part uses a traditional template of a persona (i.e. scenario of use, goals and expectations, and disabilities) as presented by [23]. The second part is relative to the UX evaluation aspect of the existing service. Each element of the service (e.g. home page, research engine, etc.) is evaluated against both pragmatic (usability) and hedonic attributes using UX assessment models [52-53] like an online questionnaire with evaluation scales. This allows a service designer to have a richer view on the perceived service UX quality.

Indeed, the quality of the UX has been evaluated according to the three aspects of the service concept: content, interaction and functions [33]. For each aspect, the authors have chosen specific elements of the service (e.g. home page, map viewer) and assessed the quality of the UX perceived by the user at each encounter with those elements. To perform this assessment, the authors use self-reported metrics [52]. This approach aims to give the most important information about the users’ perception of the service and their interaction with the service.

To collect self-reported data, the authors use a rating scale based on the seven-point scale (i.e. disagree-agree). Therefore, an online questionnaire has been provided for each participant to transcribe the degree of the UX perceived during his interaction with service element. Measured by Cronbach’s Alpha, the results of this study showed the scales were sufficiently reliable. The Fig. 4 illustrates the questionnaire with a sample evaluation of UX.

UX Evaluation of Crisis Management Services	
Service :	Resources Management
Element of service :	Home Page
<b>Usability of service interface</b>	1 2 3 4 5 6 7 NA
1. Using this element in my job would enable me to accomplish tasks more quickly	Disagree <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> Agree <input type="radio"/>
2. Using this element would enhance my effectiveness on the job	Disagree <input type="radio"/> <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> Agree <input type="radio"/>
3. My interaction with this service element would be clear and understandable	Disagree <input type="radio"/> <input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> Agree <input type="radio"/>
5. It would be easy for me to become skillful at using this service element	Disagree <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> Agree <input checked="" type="radio"/>
6. I would find this element useful in my job	Disagree <input type="radio"/> <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> Agree <input type="radio"/>
7. I would find this service element easy to use	Disagree <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> Agree <input type="radio"/>
8. I would find the service element to be flexible to interact with	Disagree <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/> Agree <input type="radio"/>

Fig. 4. The questionnaire to identify and evaluate the UX of crisis management services

The authors reported hereafter some results of the UX evaluation. Fig. 5 shows the results of the UX quality evaluation (vertical axis) for sequence activities (horizontal axis) reported in the scenario of the case study related to operations intervention. For clarity, the authors chose only three UX attributes (i.e. effectiveness, trust and satisfaction).

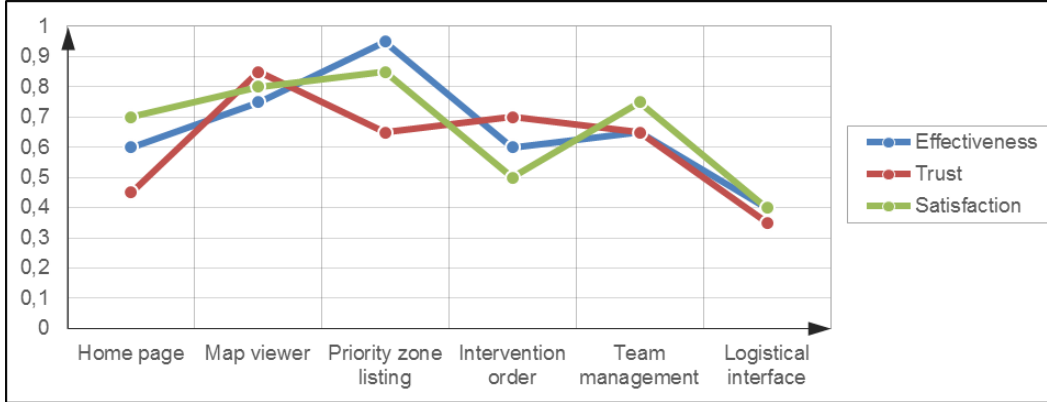


Fig. 5. Results of the UX evaluation related to the scenario of the operations intervention

The Table 3 shows the detailed list of UX attributes related to persona “Command Post Officer” with the average values of UX quality for each factor.

Table 3. UX Attributes evaluation

Service aspect	Service element	UX attributes						
		Instrumental (Usability)			Non-Instrumental (Hedonic)			
		Effect.	Safety	Utility	Trust	Engaging	Satisf.	Confidence
Content	Home page	0.60	0.55	0.75	0.45	0.65	0.75	0.65
	Priority zone listing	0.95	0.80	0.90	0.65	0.70	0.85	0.80
Interaction	Map viewer	0.75	0.65	0.80	0.85	0.90	0.80	0.75
	Logistical interface	0.40	0.35	0.40	0.35	0.50	0.40	0.35
Functions	Teams management	0.65	0.70	0.75	0.65	0.55	0.75	0.60
	Intervention order	0.60	0.55	0.65	0.70	0.45	0.50	0.55

As shown in Fig. 5, the effectiveness factor related to usability quality is more significant than the satisfaction factor when the users interact with the priority zone listing interface. This proves a correlation between some usability attributes (e.g., effectiveness and utility) and hedonic attributes related to the general perception of the UX. However, this is not always valid with the affection attributes (trust and engagement) that depend on the internal state of the user, as mentioned by [51]. Therefore, it is necessary for the designers to keep in mind the overall result of the UX evaluation to revise some design elements, especially when the users interact with a succession of service touchpoints. To this end, a depth analysis of service touchpoints is necessary to improving the UX of the designed service.

To support the design of Persona-UX model, the authors have developed an application called Persona-UX Design Tool. The Fig. 6 shows two screenshots of the tool. The first depicts the clustering component for creating the personas based on behavior patterns. The second screenshot shows the viewer of Persona-UX model.

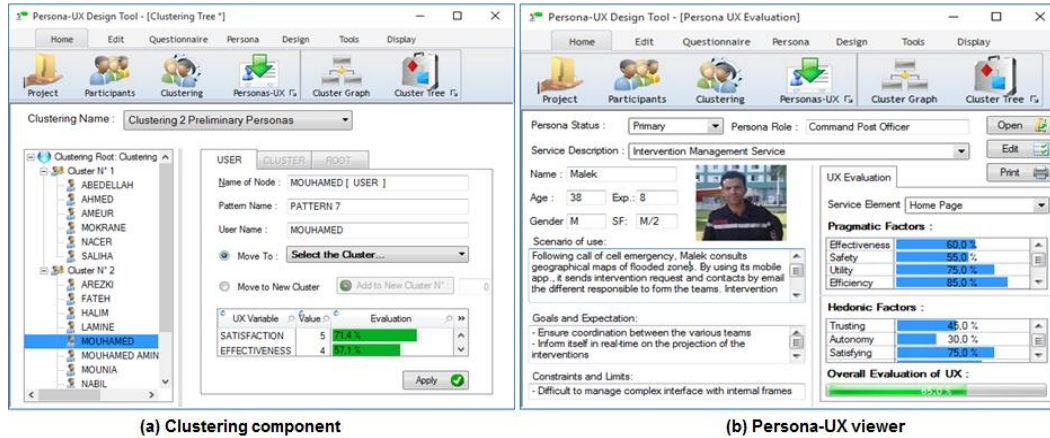


Fig. 6. Persona-UX Design Tool as support tool binding UX evaluation and Persona

#### 4.4 Phase 3: Touchpoints Analysis

Different interaction interfaces between the implied actors and the services are identified in this phase. Each of these touchpoints is specified in terms of interactions that have occurred, the resources and the communication channels used, and the exchanged information contents. Consequently, a diagram representing the contact points of the service is given at the end of this phase. This phase is conducted through two main steps as follows.

4.4.1 Step 1: Touchpoints specification. The authors explore the results obtained in Phase 1, in particular the workflow model and its components, to identify the list of the service touchpoints. However, complementary information is necessary to draw up a complete listing of the service touchpoints. Thus, some interviews must be conducted with the user of the service, and some documents of the organization must be consulted, such as customer relationship files and log files about user activity. Table 4 shows the list of touchpoints with their service resources (i.e. channel and terminal) and UX attributes related to the “Command Post Officer” persona.

Table 4. Touchpoints with UX characterization

Touchpoints	Service resources		UX attributes		
	Channel	Terminal	Usability	Hedonic	Consequence
Web site	Internet	Computer, smartphone, tablet.	Effectiveness, efficiency, safety, utility,	<u>Positive UX:</u> confidence, simplicity, assistance,	Motivation, Satisfaction, Appeal,
Map mobile application	Internet, GPS, WIFI, GPRS.	Telephone, smartphone, tablet.	clarity, learnability, memorability.	engagement, comfort, stimulation.	Competence, Emotional achievement, Attachment,

Intervention Management System	LAN, Internet.	Computer, smartphone, tablet.	<u>Negative UX:</u> annoyance, unpredictability, frustration, complexity, unhelpfulness, dullness.	Acceptance of challenges, Experience, Sociability.
Call center	Phone line	Telephone		
Mail service	Internet, phone line	Computer, smartphone, tablet.		

Next, the authors specify the connections between the identified touchpoints and the potential activities supported by the service. The result of this assembly is a touchpoint matrix. The lines represent the service touchpoints and the columns activities involved in the service experience creation. Thus, if an activity includes the interaction at the touchpoint level, a small circle is positioned at the intersection of the activity line and the touchpoint line. Each circle represents a connection point for the user in the overall service experience. In addition, the designer can associate for each touchpoint the appropriate list of UX attributes (e.g. confidence, engagement and satisfaction) represented by a code (Ui). This list allows us to evaluate the UX quality at a specific interaction moment of the user with a specific touchpoint, and simplify and clarify the obtained matrix.

The touchpoint matrix is used to provide a visual schema that enables a service designer to connect the points of contact in the user experience. Once the touchpoint matrix has been created, the service designer can connect it to a specific persona and draws its journey, detailing the different touchpoints. Thus, the touchpoint matrix brings a deeper comprehension of the user-service interaction and facilitates the further development of the opportunities offered by the service. Finally, the graph of the touchpoint matrix provides a quick visualization of what is possible in terms of interaction with the different touchpoints. Subsequently, the introduction of the personas drives the representation of several specific journeys within the graph and the comprehension of the possible derived user scenarios. Fig. 7 depicts the touchpoint matrix related to the intervention management scenario.

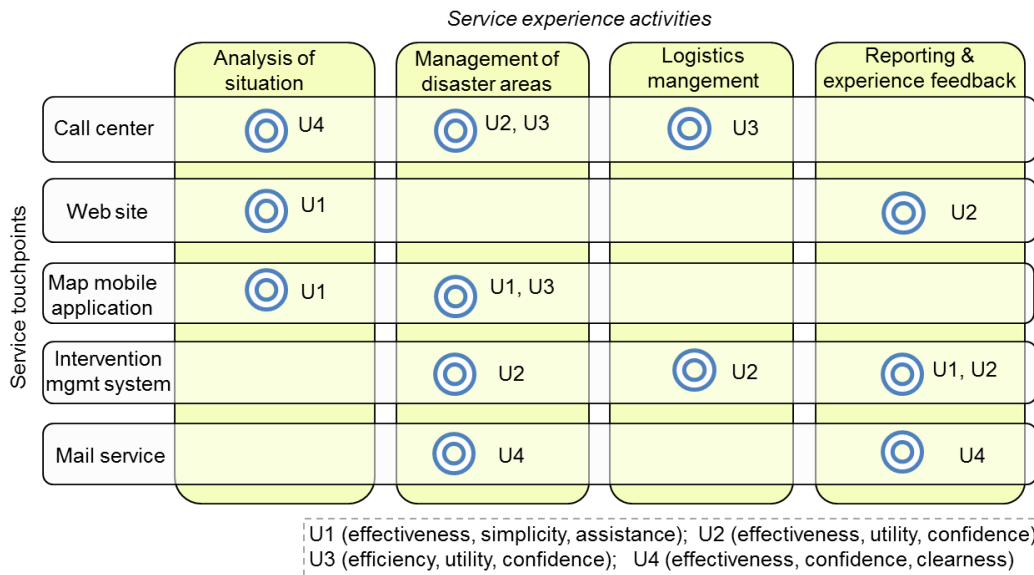


Fig. 7. Touchpoint matrix for a crisis management scenario

As shown in Fig. 7, each point relates to a touchpoint and a specific service experience activity characterized through a common set of UX attributes ( $U_i$ ). For instance, according to the user study (i.e. Phase 2) the actors in the operations' post believe that the current mobile application related to crisis area management should have a simple user interface with suitable assistance features. Moreover, the confidence aspect of the communication with the crisis cell team remains an important issue for the staff of operations' post. The study shows also that the list U4 (i.e., effectiveness, confidence, and clarity) is crucial in the assessment of the quality of UX in both the management of disaster areas and feedback reporting.

*4.4.2 Step 2: User journey modeling.* At this step, the focus is on the description of the entire life cycle related to the interactions between the user and the service touchpoints. It is thus a question of tracing the interaction points shaping the overall service experience. In other words, the authors start from information on the personas, the selected touchpoints, and the scenarios of use. These scenarios scrupulously describe the moments, events and scenes that occurred at the time of the meeting of the user with the service.

This step synthesizes the entire journey of a persona in a unified written form. Indeed, it is a question of superimposing the persona's journey experience on the touchpoints used and the potential activities carried out during the service experience. The result is a diagram called the user-journey map that illustrates the journey of each persona with the service. This type of diagram is represented as a directed graph, where the nodes represent connections between the activities of the persona and the touchpoints of the service, and the arcs illustrate the sequence at the time of the encounter between the persona and the service. This conceptual visual representation is useful for designers in pinpointing the best user-service interaction moments and the "pain points" that need to be improved or eliminated.

Finally, including the user journey map in service design process have the following advantages:

- Identifying the pain points (e.g. confusion, conflicts, misunderstanding, and irritation) that do not perform particularly well from a user viewpoint when interacting with the service. For example, by identifying in a web page the link where interaction with service is interrupted, or an action to which the user reacts negatively;
- Adding new touchpoints to the user journey or modifying and improving some touchpoints of the user journey to improve the UX;
- Mapping an existing situation by identifying the service touchpoints that are relevant in each phase of the user journey;
- By studying the user journey diagram, the designer of the service can anticipate the following phase of the service encounter;
- Proposing to the user the best possible journey to achieve the objectives of the service interaction.

Fig. 8 shows an example of a user journey schema related to the persona created in the case study. This schema traces the whole of encounters between the persona "Command Post Officer" and the various interfaces of the "Intervention Operations Management Service". In addition, based on the results of Phases 1 and 2, the authors can identify exactly the task implied in the persona-touchpoint interaction.

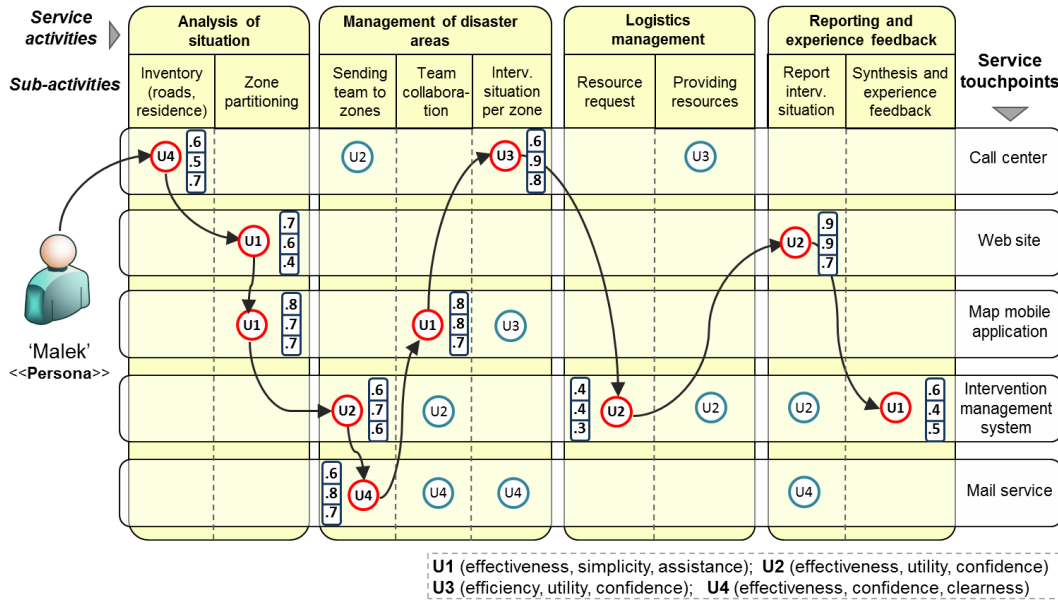


Fig. 8. User-journey schema for the persona “Command Post Officer”

The user journey schema presented in Fig. 8 shows that only some points (with red color) in the touchpoints matrix were involved in the journey. Otherwise, the authors linked only the points related to the user-service encounters described in the scenario of the persona concerned. In this user journey schema, the introduction of the persona ‘Malek’ allows the representation of several specific journeys within the graph.

To assess the UX quality of the journey, each encounter of a persona with a given touchpoint is rated by the participant group using a quality degree. For this, the authors apply a five-point scale, as in Phase 2. Each valuated UX factor group (i.e. Ui) defined in step 1) is represented using a column of values next to the persona-touchpoint interaction point (Fig. 8). As depicted in the user journey schema (Fig. 8), the authors observe a decrease in UX quality during the interaction between the persona ‘Malek’ and ‘Intervention Management System’ touchpoint, particularly when ‘Malek’ edits and sends the ‘Resources Request’. Indeed, the factor values of U2 (i.e. effectiveness: 0.4, utility: 0.4, and confidence: 0.3) show a low usability quality for the ‘Logistic Management’ service interface. This indicates that users did not like the experience proposed by the logistical management service interface.

Therefore, when redesigning the interface concerned, the designers must consider usability attributes such as effectiveness and utility by, for instance, reduce the number of user’ actions when editing and sending the request. In addition, the designers can ask the participants to give more information about their experiences with such a service touchpoint. This may give more details about the problems that current users have faced while interacting with the touchpoint in question.

Finally, with the user journey schema, the designer can deduce the possible user scenarios enabling the enhancement of the UX quality across selected touchpoints. To do this, the designer can determine the user journey that accumulates a higher score for UX quality when connecting the appropriated existing touchpoints, or in some cases add new touchpoints. To this end, it is necessary to analyze in depth the overall service UX components; this is the goal of the next phase.



#### 4.5 Phase 4: Service UX Prototyping

In this phase, a synthesis is carried out on the models obtained from previous phases to highlight and describe all of the elements constituting the service experience and their interrelations. This consists of defining a cartography unifying at the same time the service concepts (described by the workflows and touchpoints) and the UX characteristics (described by the personas and user journey). This may serve as a work support for the service designers, and to facilitate its exploitation, the service blueprinting model [24] and an extended BPMN notation [50] are used. This phase is conducted through two main steps as follows.

**4.5.1 Step 1: Mapping a Service concept and UX.** In this step, each activity must be related to one service touchpoint or more. The progress of these activities through the user journey makes it possible to generate results (or artifacts) which finally determine the service value perceived by the user. In addition, each persona-touchpoint encounter creates a user perception (i.e. consequences, emotions, and judgments) about the service UX quality. These perceptions are gathered in the form of a set of attributes that are used to measure the generated UX quality.

To carry out this type of analysis, the authors define a graphical tree structure, highlighting the relations maintained between the various components of the user journey and divided into six levels (see Fig. 9). At the first level, the main phases of the user journey are linked with the corresponding activities according to the scenario described in the persona. At the following level, a list of touchpoints involved in the execution of the activities is established. At the fourth level, the authors specify UX constraints, checking the UX quality of the encounter between the persona and touchpoint. As a result, the authors obtained the relevant information that enables measuring the value of the service. At the last level, the authors specify the service-UX attributes that allow us to evaluate the perceived UX quality at each touchpoint.

Fig. 9 presents an illustrative example describing the hierarchical analysis of service-UX components relating to the “Intervention Operations Management Service”.

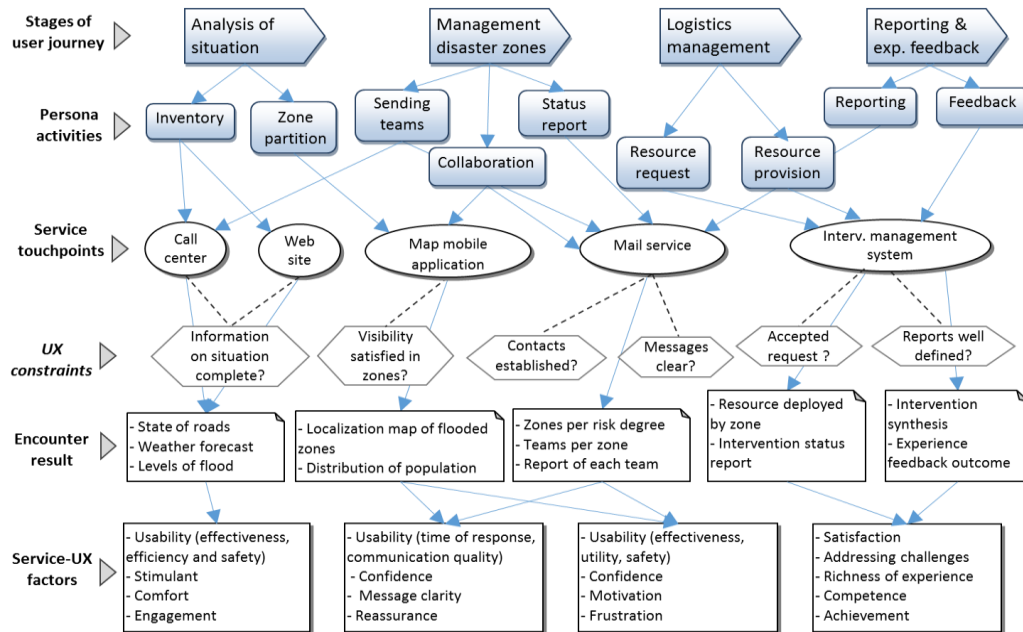


Fig. 9. Hierarchical analysis of service-UX components

As already highlighted in the touchpoint matrix, four stages are identified in a user journey related to the service experience. For instance, the activity “team sending” that is included in the “management disaster zone” requires two service touchpoints (i.e. call center and mail service). For the “mail service” touchpoint, it is important for the officer to verify if the contacts were well established with the agents’ team, and verify the clearness of message received from the agents present in the flooded zone. Once those constraints were satisfied, the officer may obtain the result of the service encounter (e.g. list of teams per zone and intervention report). Finally, each encounter was characterized through UX attributes related to both usability (e.g. utility and safety) and hedonic attributes (e.g. confidence and motivation). Such characterizations of the persona-touchpoint encounter may provide for the designers a rich holistic understanding of the service UX.



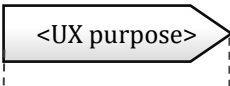
*4.5.2 Step 2: Service-UX Prototype Creation.* This last step consists of building a model for taking into account the UX in a service design process. This model encompasses the artifacts resulting from the previous phases, articulating them in a unified diagram. This model will provide a precise and detailed view of the user-service interaction process to achieve the user’s objectives. Moreover, this model helps better to understand the service UX creation process and the impact the user journey has on the generated service UX quality. The Service-UX Card artifact consolidates and combines different design models which are workflow, the persona model and the user journey map obtained from the previous phases of the framework in order to build a new version prototype of the service-UX.

To build this prototype, an extension to the BPMN notation was necessary. the authors have integrated three new elements into the BPMN notation to better support the integration process of the UX in service design. These new elements help to:

- (1) Visualize explicitly the significant encounters that shape the service UX. Thus, the authors propose to include in the BPMN formalism the vertical representations illustrating the important moments that have occurred at the time of the interaction between the user and the service. Indeed, each representation details a phase in the user journey for the created persona.
- (2) Differentiate between the actors. This distinguishes representing the users of the service (external or internal users of the organization) and representing the service touchpoints. the authors propose to separate the two types of elements (personas and touchpoints) by distinctive horizontal BPMN swim lane symbols. Two distinct symbols are assigned for this purpose.
- (3) Including the interaction lines between personas and service touchpoints. the authors propose to use the interaction lines, according to the blueprinting model [24], to separate the service users from the various supports (systems or physics).

Table 5 on the next page illustrates the added symbols of the tree elements.

Table 5. Elements for an extended BPMN notation

Graphical form	Description
 <Name of Persona>	A symbol indicating a persona. The name of the persona must be indicated. The role of the persona can be also specified. Each persona is associated with a pool structure in a BPMN model.
 <Name of Touchpoint>	A symbol indicating a specific service touchpoint. Each touchpoint must be associated with a pool structure in a BPMN model.
 <UX purpose>	A symbol specifying an important phase in the user journey for the persona. A vertically aligned corridor is associated in a BPMN model for each phase of the journey.

As shown in Fig. 10, the persona named Malek starts his user journey with an analysis of the situation in the flooded region by requesting more information about the geographical position and alert reports received from the crisis cell. Malek then interacts with different features offered by the service organization to achieve the required operations of the intervention management process. For instance, officer Malek can firstly send a supply resource request to the protection civil center or crisis cell by using the call center touchpoint. Next, he saves the request by using the touchpoint of the intervention management system.

Fig. 10 illustrates an example of the prototype of the Service-UX Card related to the intervention management in the operations' post.

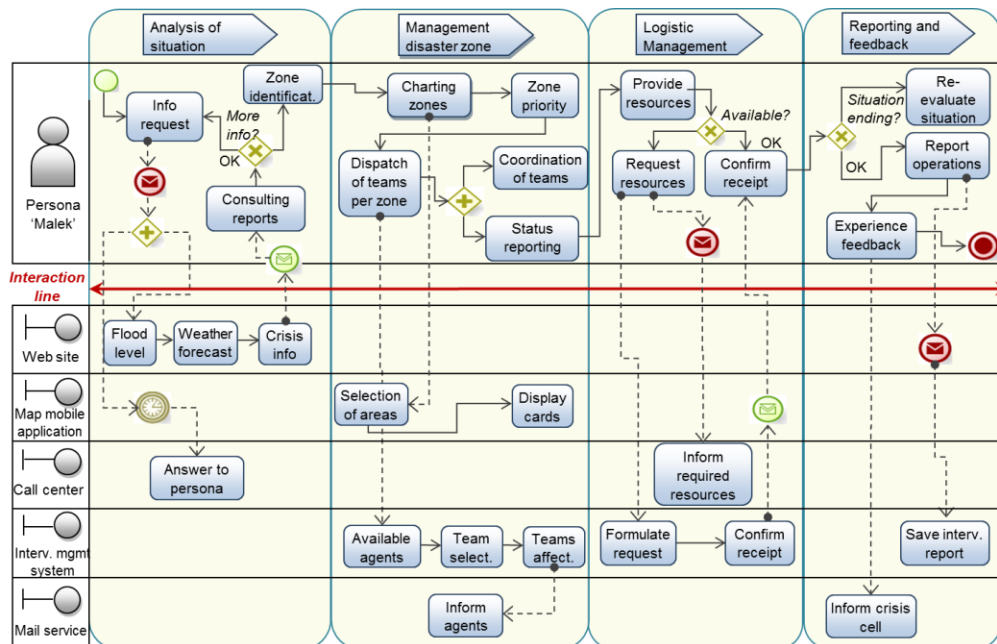


Fig. 10. Service-UX Card

Compared to the workflow model (phase 1 of the framework) Service-UX Card give more details about the interaction user-service through user journey phases. In UXD-IS framework each phase defined in user journey for given persona should related to service activities of the workflow model. This allows giving more traceability between the top-level of service activities (i.e. workflow model) and down-level of user journey phases (i.e. Service-UX Card). For instance, the service activity “Inventory and zone partitioning” (see Fig. 3) is developed in the phase “Analysis of Situation” of user journey (see Fig. 10). Indeed, the persona “Malek” interacts with service touchpoints by analysing the request, consulting the report, and identifying the affected zone.

The prototype of the Service-UX Card presented in Fig. 10 clearly shows the distinction between the activities performed by the persona Malek and the backphase tasks carried out at the level of service touchpoints. This distinction is specified through the drawn interaction line. As a result, the Service-UX Card can help a service provider better to understand how its services are “consumed” by their future users, and, in so doing, be able to refine and optimize each touchpoint along the user journey schema described in Phase 3.

## 5 DISCUSSION

The UXD-IS framework has been developed and applied to the design of crisis management services. The authors also compared the framework with two existing frameworks: ServiceMIF [29] and MSD [30]. In the ServiceMIF framework, the touchpoint analysis uses a reduced model that directly links every service touchpoint with a channel and an activity. In contrast, for a given activity in the UXD-IS Framework, the user may have several choices in the touchpoints and channels to use. This gives more flexibility to designers in selecting the most relevant journeys to improve the UX quality perceived by the end-user.

Moreover, the UX evaluation approach used in ServiceMIF is based solely on the overall UX assessed on a very basic scale (bad, good, excellent) without considering the components and the complexity of the UX concept, particularly distinguishing between instrumental attributes and hedonic attributes of the UX. Therefore, it makes the process of ideation and innovation for designers more vague and rigorous in the selection of service design features. The UXD-IS framework solves this problem by exploiting the UX characterization models that exist in the literature, such as those introduced by [34-35], to analyze in depth the facets of the UX generated during the use of the service and thus enables a more refined and accurate assessment.

For the MSD framework [30], despite the detailed models it generates, the analysis model of the service experience at the touchpoints (i.e. service encounter level) remains static because it can describe the experience of a single type of user (i.e. the customer) with only one possible journey. Therefore, on the one hand, this excludes the integration of different categories of users. On the other hand, the evaluation of the UX quality and comparative analysis between several user journeys becomes impossible. This problem is mainly due to the lack of studies of users’ archetypes and their intrinsic characteristics and behavior.

In response to the issues previously raised in MSD, the UXD-IS framework has proposed integrating the persona model into earlier phases of the service design life cycle. This helps to develop adaptive and configurable services for each user category, represented by the persona, and to anticipate new needs of users that may contribute to improving the quality of the service experience. The objective of UXD-IS framework is to provide service designers a tool to identify for each persona several user-journeys weighted by the UX quality at each touchpoint. This will identify the user-journey(s) with the best possible UX.

To validate the UXD-IS framework, relevant artifacts obtained during the implementation of the framework (workflow, persona-UX, touchpoint, user journey and UX-Service Card) were proposed to a team of four designers specializing in mobile application development. This team uses these artifacts to develop new ideas and possible improvements to the service design.

Initially, the authors trained the designers in service design principles and the UX concept while presenting them the proposed framework and the five design artifact results obtained in the case study. The authors allocated two weeks for the designers to apply the framework. Subsequently, a reflection meeting and discussion with the participating team were organized at the end of the framework implementation. The authors organized the collected comments according to four themes: (1) collected personas in the analysis' needs, (2) the impact of UX attributes on service design, (3) concerns of the involvement of the touchpoints and the user journey in the creation and adjustment of some features of the service, and (4) addressing the use of the UX-Service schema in the design of innovative user-service interactions.

Table 6 summarizes the feedback from four designers (identified by D1, D2, D3 and D4) on the contribution of the framework to their crisis management service design practices.

Table 6. Observations and comments of participants

Theme	ID	Transcribed remarks
Implication of persona	D1	I think that personas are a good way to communicate and exchange new ideas between us developers and even with other participants (stakeholders, users, etc.). However, it is unclear how to use them concretely in the design process.
	D2	The most important part is the service scenario where I can use it to deduce the interactions between the user and the elements of service interface; otherwise, I think the demographic information is not useful.
	D3	I do not use personas in the specification needs and analysis step because I am not sure if they reflect reality or not!
	D4	I find that personas are a good tool to focus on the real users of the service rather than on our own inspirations.
UX factor evaluation	D1	I think that the UX attributes related to the usability aspects are objectively verifiable, such as spending time on a specific task; but it is not the case when the authors address the subjective hedonic attributes, like stimulating and engaging!
	D2	In my opinion, the evaluation of UX quality in the service interface is very useful for determining what the user feels when interacting with some features of the service.
	D3	I think that using the evaluation results of hedonic attributes remains unclear, unlike usability values. Therefore, as a designer, focusing more on UX evaluation can significantly increase the time of service design.
	D4	The linking of service elements with user perceptions in terms of UX quality is very interesting when the authors apply the evaluation test of each service UI mockup.
Touchpoints and user journey	D1	The association of each point of contact (touchpoints) with the UX attributes is in my opinion very useful in the assessment of the existing interface and its improvement.
	D2	The user journey schema seems more practical than the abstract models of UML, which I use to model the flow of users' actions, including sequence and activity diagrams.
	D3	I found that the touchpoints and the connection between them does not provide more compared to traditional UML models like the sequence and activity diagram. Besides, I think it is difficult to transform this model (i.e. user journey) into a more practical service model.
	D4	Evaluation of the UX at every touchpoint is important in my opinion when the authors design a new service interfaces that will be more attractive and easy to use!
Service-UX Card	D1	This synthesis model reminds me of business modeling processes, in particular when designing the service orchestration aiming to achieve a common goal.
	D2	The distinction between the user tasks (persona) and service activities facilitates the development of the journey scheme in the graphical service interface.

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|----|--|
| D3 | I find that this model is interesting; however, its operation requires some background on the BPMN notation and the blueprinting method, which constitutes for me an obstacle!         |
| D4 | I think that this model provided a rich view in terms of the sequence of activities; however, it becomes, in my opinion, more difficult to create it for more complex design problems. |
- 

## 5.2 Service Usage and Management

Our study confirmed the central role of the end-user in the creation and development of innovative services. In fact, the proposed framework aims to ensure the designers' reactivity facing the changes and the new service user requirements. Indeed, by studying the evolution of the UX quality through the analysis of the UX attributes and user journey map the designer can react in real time by asking the user about his experience with a particular touchpoint or about a specific journey. This may help the users of the service to obtain a clear response to their needs in terms of UX. Moreover, by applying the proposed framework, the designer can develop a service that proposes and identifies the best possible journey to improve the UX of the users. In crisis management, it will be interesting to provide the actors involved a list of the best sequences of activities, proposed by the service in order to efficiently respond to the crisis. This may improve the quality of the interventions by selecting the activities sequence (or user journey) having a better quality of UX.

Developing services by applying the proposed framework can help to control the user journey through different service touchpoints. As a result, for example, a crisis management actor may avoid getting lost during his or her interaction with the service. Therefore, this approach allows create service designs delivering some confidence and insurance to users against the service. Another advantage of applying the proposed framework is prioritizing the provided options and the relevant contents to the users at the right moment. In fact, by using the user journey map and the Service-UX Card, the designer can consider and anticipate the best options and provide the relevant contents to the user at each touchpoint along the user journey.

## 5.3 User Study : Persona

Despite the limited time allocated to the designers to apply the framework to develop new design solutions, the designers have broadly and easily adopted the authors' approach. However, the authors noted certain difficulties encountered by the participants, particularly in the use of personas and also in trusting the information transcribed in the personas provided. In fact, that confirms the result of the study undertaken by [55], who noted that the effective use of and empathy generated by the personas are observed much more in the creators of the personas than in other the members who did not take part in the creation of the personas.

However, the credibility problem of personas has already been discussed in [23, 56], who propose rigorous user studies to create personas and linking them to what is called the "foundational document" [23] which includes the user study data backing up the persona. In this study, the authors had linked each element of a persona with the result of interviews and a survey carried out during the case study. Thereafter, the authors observed that participants better accepted the personas created.

## 5.4 UX evaluation

Another issue raised by the participants is that the framework presents very subjective information to be used directly in the analysis of needs. Participants indicated that overall, the touchpoints and user journey provide more realistic and practical views on different aspects of interaction between the user and the service in accordance with the scenario described in the persona. Furthermore, despite the difficulty encountered by some participants in the use of the new models such as the user

journey and UX-Service Card in their design, participants agreed that the artifacts generated or used by the framework help to develop new ideas and especially focus on the real needs of the users.

### **5.5 Limits and suggestions**

The authors recognize that this study presents some limits relating mainly to limited number of participants in the survey. Indeed, the creation of a user model (i.e. Persona-UX) requires the participation of a wide range of users from different sectors in crisis management. In addition, the validation of the approach presents gaps in the limited number of experts and their expertise (i.e. mobile application development). Therefore, the authors suggest extending this study to other experts including software engineering and service design.

Finally, this study shows that integrating UX in the design and development of services remains a major challenge. Unfortunately, the authors found that service design seldom focuses on UX modeling and capture. Furthermore, crisis management remains insufficiently explored by the service designer community, particularly the integration of the UX facets for the possible design evaluation of new or existing services. This research need to focus more on the end-to-end journey of all stakeholders and move away from “polishing” individual touchpoints.

## **6 CONCLUSION**

The proposed UXD-IS framework for the capture and integration of UX into the service design process is a simplified but very helpful way of improving overall service design practices. The analysis of the large existing body of knowledge both on UX and service design techniques paved the road for the UXD-IS framework development and validation. It also justifies why the framework uses diverse techniques to document and model UX. UXD-IS exploits an innovative design process that distinguishes four stages. The framework has been developed, used and validated using a concrete, real-world case study in the field of crisis management services. The authors conducted an empirical study with a small team of designers in order to understand their perceptions and practices when using the proposed framework. The results show that participants were able to master and use the diverse techniques included in the proposed framework.

An important component of this research is understanding designer activities and how stakeholders can participate in these activities while being engaged in each of the four stages of the process the authors proposed. However, it is important to provide more details of each of the four stages. One issue is then the study of how stakeholders become more engaged and can contribute to these design activities beyond just providing information on their experiences. Another beneficial research focus would be what encourages or inhibits the cooperation of service designers and stakeholders. Studies of computer supported collaborative work could guide designers in attracting and retaining their most loyal stakeholders.

Through this paper the authors hope advanced the discussion on service design and design studies in the field of crisis management. This includes the different ways in which crisis managers and operators can participate in the design of services. The framework the authors proposed has been compared to two existing frameworks. Still, it requires more extensive empirical testing, which is the obvious next stage of this work. For example, the persona technique for capturing the various aspects of the UX needs further investigation to convince designers about its utility in crisis management. An extension of the persona-UX model is needed to effectively incorporate in the persona template the relevant empirical data from the user analysis study. In addition, a tool that assists designers in using the proposed framework is required. In the long term, this tool will make it possible for designers to transform the data collected during the analysis phase (scenarios, workflow, attributes, UX, etc.) into a usable service design.

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