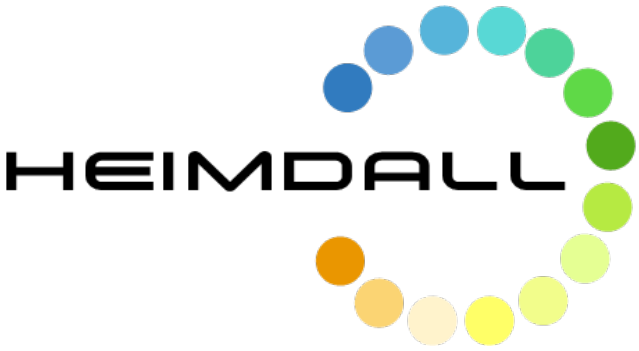

D3.8

Analysis of Human Factor Involvement in the use of Autonomous Systems in DRR and Response and Specifications for User Requirements – Issue 1

Instrument	Collaborative Project
Call / Topic	H2020-SEC-2016-2017/H2020-SEC-2016-2017-1
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1.0.F	14/12/2017	First issue	EKUT

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List of Acronyms

DLR	Deutsches Zentrum für Luft-und Raumfahrt e.V. (German Aerospace Center)
DRK	Deutsches Rotes Kreuz (German Red Cross)
DRR	Disaster Risk Reduction
DSS	Decision Support System / Decision Support Services
EB	Ethics Board
EC	European Commission
EKUT	Eberhard Karls Universität Tübingen
ELSI	Ethical, Legal and Social Issues
EMS	Emergency Management Service
ERCC	European Emergency Response Coordination Centre
EU	European Union
GUI	Graphical User Interface
HCI	Human-Computer-Interaction
NGO	Non-Governmental Organisations
THW	Bundesanstalt Technisches Hilfswerk (German Federal Agency for Technical Relief)
VSD	Value Sensitive Design
WP	Work Package

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Executive Summary

This deliverable provides a definition of Human Factors and the implications of a human factors analysis for the HEIMDALL system. It also delimits its scope and its complementarity with D3.11 on the societal acceptance and ethical acceptability of the system. Furthermore, it covers a list of human factors, which are of importance for the development of a sensitive platform for emergency planning, management and communication in cases of disaster, as it is the aim of HEIMDALL. Therefore, the list is a preliminary collection of different kinds of points to consider concerning the interaction between humans (end-users as well as citizens) and the HEIMDALL system. As this is the first issue of this deliverable, the work done has been primarily based on desk-based research and focused on potential dimensions to be addressed by the platform before the very first prototype (Release A). It is neither complete nor final; rather it is a starting point for further research and most importantly for discussion within the HEIMDALL project. The list might be modified after the empirical work (interviews) is done the following months and the end-users' perspectives are incorporated. Hence, as the work on the system progresses, the work on human factors will also delve further into details, potentially highlighting new and/or different aspects that shall be considered when making HEIMDALL operational. Updates will be reported in the upcoming issues of D3.8, i.e. D3.9 and D3.10.

1 Introduction

WP 3 “focuses on all those activities and actions that involve stakeholder knowledge capitalization, support stakeholder engagement and Human factor and ethical issues for a suitable design of the system platform.” (see Grant Agreement [6], p. 24) In this regard, WP 3 provides insights into the interaction of stakeholders (e.g. end-users), disasters and the HEIMDALL system and is therefore an important source of system’s specifications. These are determined based on three different interactions (see Figure 1-1):

T3.1 and T3.2 focus on the (current) response strategies of end-users, referring to knowledge of stakeholders, currently used procedures and experience, which stakeholders have acquired due to previous disaster events. The resulting requirements thus **address the current situation** and the **needs of stakeholders**.

T3.3 takes a closer look on the interaction between the HEIMDALL system and disaster situations in terms of application scenarios and best practice examples. The resulting recommendations therefore are based on the differing **needs considering different kinds of disasters**.

Finally, T3.4 adds a perspective on the interaction between end-users and other stakeholders and the HEIMDALL system. In this regard, the results refer to **aspects of human-machine-interaction in technical and social terms** in order to increase the acceptance of the HEIMDALL system. This task comprises deliverables D3.8–D3.13, and therefore includes this deliverable (D3.8), which is concerned with human factors and is complemented by the social and ethical aspects of human-machine-interaction that are part of D3.11 on Social Acceptance and Ethical Acceptability. In order to gain a better understanding of the content of this deliverable, a short outline showing the relationship between a more technical and a more social perspective of human-machine-interactions as well as acceptance and acceptability will be presented in the figure below.

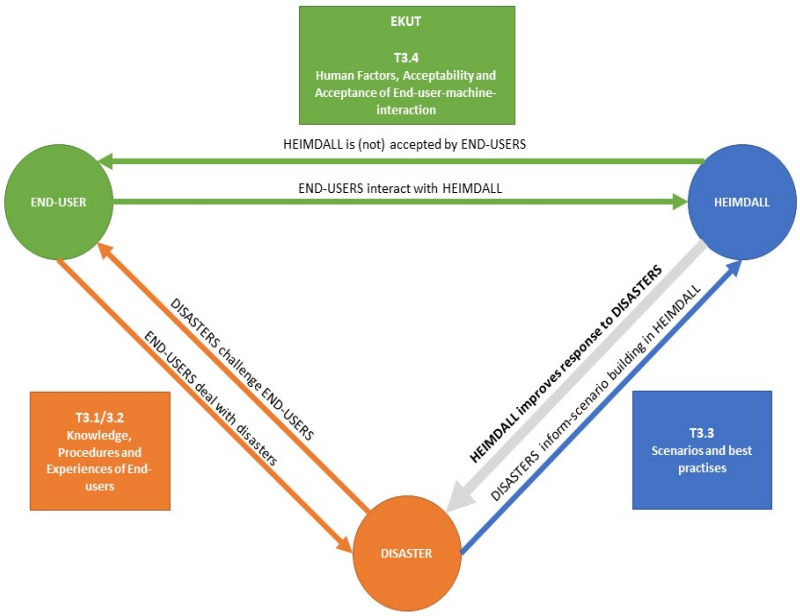

Figure 1-1: The role of WP3 in HEIMDALL (own compilation)

The success of the HEIMDALL system is not only dependent on its technical operability, but it also is a question of its acceptance by users and, more general, by society as a sensible tool for improving disaster response. Data on “social acceptance” is gathered by empirical research, e.g. focus group discussions and will be performed along the development of the system. In this regard, **social acceptance represents a descriptive perspective (‘What**

is?') on the empirical question whether a technology is likely to be used and under what conditions.

In addition, it is important to scrutinise the criteria that make a technology likely to be used. This **normative perspective ('What should be?') is discussed in terms of human-machine-interaction** referring to two sets of factors:

The first set comprises **Human Factors**, aiming at a well-suited working environment for the users of any kind of technology. Human Factors is a field of study devoted to the analysis of psychological, physical, cognitive, organisational and contextual conditions and the corresponding emergent properties of any socio-technical system with the aim of improving the overall working conditions, outputs and impacts of the human-machine-environment interaction. In other words, Human Factors aims at optimising work environments and at reducing mistakes. Examples are the physical design, understandable user interfaces or possibilities for the user to adjust the interface to personal needs and preferences. Furthermore, it includes the prevention of careless errors or an overload for individual capacities. This is the topic analysed in the present deliverable.

In deliverable D3.11 the technological and psychological perspectives of D3.8 are complemented by **social or value-related factors** of human-machine-interaction. The term "ethical acceptability" refers to the question of how technology is related to values a society needs for thriving or to the question *in which society we want to live in*. This rather abstract concept may be illustrated using the example of a machine being able to make us feel happy during the time we are physically connected to it. In this fictional case, we would just sit in a comfortable chair with all our physical needs satisfied and there would be no harm or grief, just a beautiful life. While this machine might be widely accepted due to its design and the pleasure it provides – this is an empirical question -, we might not feel comfortable with it as it may not fit our idea of a life worth living. These two different aspects refer to the difference of acceptance and acceptability. Furthermore, a constitutive condition of acceptability is that it cannot be determined easily. It is rather connected to discourses on one of the fundamental ethical questions: "Which society do we want to live in?" Therefore, the formulation of acceptability criteria is less a definition than an ongoing discourse.

The combination of both technical and ergonomically factors (human factors) and social or value-related factors (ethical acceptability) and the feedback from the empirical work on acceptance (social acceptance) will serve as crucial foundation for the formulation of stakeholder-related points to consider for the HEIMDALL system.

2 What are Human Factors?

Human factor issues arise in every domain in which humans interact with the products of a technological society. As Meshkati [10] explains, ergonomics, or human factors, is focused on improving people's productivity, health, safety, and comfort while they efficiently and effectively interact with the technology in use in the context/environment in which technology and humans work together. In other words, ergonomics aims at optimising working environments and the reduction of mistakes. This includes aspects of physical, cognitive and organisational ergonomics. In addition, according to the Human Factors and Ergonomics Society, there is a slightly important difference between ergonomics and human factors. Following Boatca and Cirjaliu [1], human factors attend more to the psychological aspects of the working conditions ([1], p. 55). Therefore, the term Human Factors (in capital letters) is preferred, encompassing the physical, cognitive, organisational and psychological aspects of the human-machine-environment interaction or the socio-technical system. Furthermore, Boatca and Cirjaliu [1] hold that the idea behind the analysis of all these elements is to intervene actively in the work situation in order to transform it.

A more detailed explanation of Human Factors includes understanding the connection between the individual and her working conditions, the type of tasks performed, the division of functions, tasks and responsibilities, and the interaction with colleagues, machines and the environment. In addition, it is necessary for the understanding of the system to grasp the knowledge, perceptions, attitudes, values and goals of the employees, as well as the decision-making processes and organisational culture that are particular to each working space. Furthermore, studying Human Factors also implies comprehending the way machines and equipment intervene in the division of labour, the assignment of workloads and how this affects the communication between them and humans. Finally, as all these different and intertwined aspects of the human-machine interaction take place in a particular context, the combination permits to elaborate an analysis of the safety, productivity, human satisfaction, efficiency, effectiveness and estimation of human error that corresponds to that specific environment [1]. Against this backdrop, current definitions of Human Factors consider the co-production and co-evolution of environment and individuals as the main component to affect when proposing an intervention. In other terms, the characteristics of the system fit with the needs and particularities of the users, at the same time that its design and the interaction affects the users ([1], p. 58).

Moreover, Human Factors can be approached by distinguishing aspects of the micro and macro level. The micro-level analysis of the human-machine system focuses on aspects such as the design of individual screens and displays, the organisation of workstations, ergonomic seats, human skills and knowledge, the information-processing and decision-making processes. The macro-level, on the other hand, is concerned with the overall people-technology system perspective or "the impact of technological systems on organizational, managerial, and personnel (sub-) systems ([10], p. 138)" and therefore, it adopts a top-down standpoint.

In this sense, there are two main stages for Human Factor interventions, the design process and the operating phase, which, of course, are characterised by their overlapping and interconnected nature. In the first stage, the considerations include the design of the control rooms, workstations and control panels, training and "stress training", workload estimation and clarity of operating procedures and hierarchies. In the operating phase, the Human Factors refer to the performance of the operators immediately before and during the incident and consists of the causes of "active errors" such as mistakes and misjudgements ([10], p. 142). Following Clegg [4], however, a third phase to this development process should be added. Moreover, the distinction between what is part of the design phase and what is part of the operating phase is sharper. In the first moment, the physical, cognitive and psychosocial aspects that characterise the users are defined. According to Carayon [2], in the second phase issues such as participation, training, organisational support and commitment are important, and the third stage occurs once the system has been redesigned and the interest

is on sustaining the change, to make it continuously adapt, accumulate and improve ([2], p. 532).

Therefore, actions that are involved in any continuous process of system adaptation or improvement are the following:

- PARTICIPATION: The active participation of employees/customers/end-users is necessary in the design activities;
- INTERACTION: together with the active participation, their continuous interaction with the organisation developing the system is necessary;
- TO DESIGN and REDESIGN: the aim is to collaboratively define and model the system;
- ADAPTION: the design should be adaptable and improved continuously in order to achieve the system's long-term sustainability;
- TO LEARN: to generate constant activities to promote individual and organisational learning instances of the system;
- TO MAKE SENSE: as a product of the continuous redefinition of the system, it is necessary to understand the changes and their impacts ([2], pp. 533–534).

It is important to highlight that as the discipline evolves, new understandings of the socio-technical systems are generated. As such, Wilson [13] argues that a system can be a facility, a work site, an organisation or even a society ([13], p. 6), which produces further complexity and provides new challenges. In the same line, his own definition of system remarks the interaction as a way of recognising the emergent properties of the process ([13], p. 8; [8]). Wilson holds that the emergence aspect is important for three reasons. Firstly, the system will face real situations not planned by the designers (time or space constraints, management pressures, personal motivations) that will make it work in unexpected ways. Secondly, even if there are poor design conditions or simply real-life situations not anticipated, the users are always capable of making the system work. Thirdly, the users are not only capable of overcoming the system's shortcomings; they are also prone to create new uses for it. Therefore, Human Factors analysis should add to the previous psychological, physical, cognitive and organisational aspects, the possibilities of emerging properties due to its interaction with the ecological, economic, legal and socio-political context ([8], p. 8–9).

To conclude, Human Factors is a field of study devoted to the analysis of psychological, physical, cognitive, organisational and contextual conditions and the corresponding emergent properties of any socio-technical system with the aim of improving the overall working conditions, outputs and impacts of the human-machine-environment interaction. It is in this sense that an early exploration of these aspects (psychological, physical, cognitive and organisational features of the emergency response task forces), contextual conditions (economic, legal and socio-political) and their impacts provides for a better-adapted and much deeply thought development of any technology. This is particularly the case for the HEIMDALL system. Therefore, in the following section, a first attempt will be made in order to define and explore those characteristics that as such can (positively and negatively) affect HEIMDALL's development.

2.1 What Human Factors might look like in relation to the HEIMDALL system?

Following Wilson [13] and Carayon [2], the nature of Human Factors is to understand people and their interactions, as well as the relationships between these interactions, and to improve those interactions in real settings. Interactions occur between people and elements of sociotechnical systems ([2], p. 528). In light of the main characteristics and concerns of the Human Factors discipline that were previously mentioned, this section will focus on those aspects and issues that might arise during the design phase of HEIMDALL and that are part

of the desk-based research to be complemented during the fieldwork. Both inputs, the preliminary list of potential Human Factors that is part of this deliverable as well as the issues mentioned during the interviews with end-users to be carried out in the following months and that will be summarised in the deliverable D3.9, will provide feedback for better adapting and much more participatory developing of the HEIMDALL platform.

Based on the aspects introduced in the previous section, the first point to take into consideration when providing a Human Factors analysis of HEIMDALL is the environment. The main characteristic of the context of application of HEIMDALL is the exceptionality of a disaster or emergency situation in which individuals require information to act quickly under conditions of extreme stress. In such a moment, the information given might either be incomplete, too much or too little, thereby complicating the interaction with groups disseminated in the field (of their own and other forces) plus volunteers. Against this backdrop, the overall objective of the HEIMDALL project is to improve "preparedness of societies to cope with complex crisis situations by means of providing integrated tools to support efficient response planning and the building of realistic multidisciplinary scenarios ([6], p. 3). The aim is to design and develop a system that facilitates organisational coordination among many actors, integrates a wide range of support tools to be used operationally by a large variety of stakeholders (firefighting units, medical emergency services, police departments, civil protection units, command and control centres), enhances the cooperation between autonomous systems (satellite-, sea-, land- and air-based) from different agencies and consolidates the methodology for cross-border scenario-building. Therefore, the challenge of HEIMDALL is to comply with the idea of "the right information at the right time in the right format to the right person". This implies to design a system that functions as a part of the team and supports the emergency forces in their tasks but that does not drive them [3].

Professionals who have a well-developed sense of awareness of the situation or "the ability to maintain the 'big picture' in a dynamically changing environment" ([12], p. 1) can face up to the challenges of the emergency scenario. As such, this aptitude allows for rapidly absorbing information, judging its meaning, relevance and reliability, deciding about options for actions and making a decision, and coping with plans that were prepared without knowledge of the real circumstances ([3], p. 34). Nevertheless, to support this situation awareness, a system complying with Human Factors analysis should be designed taking several considerations in mind.

Firstly, any Human-Computer-Interaction (HCI) intervention, like the proposed here for HEIMDALL's design, should focus on the **usability** of such a system, which consists of diverse and interconnected issues. The emergency responders, in the command and control centre as much as in the field, depend upon the **best possible and timely data** in order to have an accurate perception as possible of the disaster to make the best possible decisions. Carver and Turoff ([3], p. 34) argue that during those challenging hours, the cognitive absorption of first responders increases enormously which allows them to cope with the information overload that characterises those episodes. As much as the situation awareness is a critical ability that permits to manage complex events, this aptitude also demands to feed vast amounts of information to counteract the "threat rigidity syndrome" ([3], p. 34). If responders feel they are losing control of the situation or having a reduced understanding, this feeling generates additional stress, anxiety and fear, reducing their cognitive absorption and effective control of the emergency. Therefore, there are two challenges: One is connected with remote sensors, colleagues and organisations having access to and providing their knowledge; the other one is to generate visualisations and interfaces offering the necessary information requiring little or no cognitive effort so that by a quick glance responders have a clear picture of the situation and, therefore, their **mental fatigue** is decreased ([11], p. 104).

On the other hand, the screens of the system should allocate tasks adaptively, which means, a trade-off between delegating functions that can be automated and the unpredictability of each disaster with the additional workload that it can bring. This degree of **automation** is one

of the many issues that needs feedback from the end-users in terms of cooperating with the system as it can create at the same time greater complexity and lack of **transparency** in the ways it decides about the interactions. Furthermore, it also requires the intervention of the end-users as the **communication style** (**rhetoric and terminology**) of the system can also enhance communication with a non-intrusive and patient attitude or to create over complacency ([11], pp. 108–109). In this sense, the decision support, modelling and simulations modules can either be seen as tools used for anticipating and predicting relevant information or as mechanisms for delegating decision and **responsibility**. Thus, the interviews with end-users will focus on the attitudes and emotions that this struggle for power, reliance, trust and complacency generates. In addition, **universal usability** means that HEIMDALL should be designed for all kind of end-users and citizens, which means considering **language, cultural differences and vulnerable groups**. As such, a much better understanding of this issue can be achieved not only via the interviews, but especially through the focus group discussions that are part of the empirical work of the social acceptance and ethical acceptability deliverables.

Connected to the previous point is the **feedback** that every user receives about the system's state and the effects that produces on it the human-computer interaction. As this dynamic allocation of functions creates **flexibility** and dependency of context, the distribution of tasks is not only a design problem but also an ongoing activity of the system's operation ([11], p. 109). This thorny issue is about **efficiency** as much as is about **productivity**. As any analysis of Human Factors might show, the degree of adaptability is not a given but a case-by-case decision. In HEIMDALL's case, the participation of end-users and continuous re-design might address this issue. In addition, the interviews and focus group discussions will provide information regarding supplementary requirements or potential points to consider. In particular, as the system is supposed to be used under extremely stressful conditions, careless mistakes and errors are more likely to occur, and the question of designing HEIMDALL for addressing this concern can effectively modify the level of efficiency and its overall productivity.

Besides providing timely information for a clear picture of reality, efficiency, productivity and reduction of errors is achieved by communicating this information to all the organisations involved, rightly **addressing hierarchies and structures** and facilitating and fostering the **open exchange of information**, including the one coming from the field (from end-users and citizens alike). These visualisations should support the **mental models** of the emergency responders − the common understanding of goals, tasks, and procedures − and the design should support their operational routines. Nevertheless, it should also be flexible enough to encourage creativity and improvisation, at the team and the personal level ([3], p. 56). Furthermore, it should also be **versatile** enough in order to allow exchanges or integration with other systems. In other words, the correct combination of flexibility, versatility and openness to foster **trust** in the system is difficult to be determined in advance. Therefore, again, the participatory process of design, which includes the interviews with end-users and focus groups helps to achieve a useful combination.

The negative aspect of having a clear perception of the current emergency, on the other hand, is the question of how to balance the need for an ever-increasing amount of data while respecting the right to **privacy** and **confidentiality** of all the stakeholders. As **surveillance** is necessary for HEIMDALL to function its design should address the risks of leaks, breaches, hacks, misuses and dual uses of data. Then, the platform should find an equilibrium so that the **safety** of end-users and citizens is assured while it can also guarantee the necessary data for maintaining situation awareness. Once more, reaching end-users and other stakeholders will be a key for designing the system so that it can cover this dilemma and ensure trust in HEIMDALL.

As it was previously mentioned, in terms of mental models HEIMDALL should support them through a functional interface. Nevertheless, the correct use of the platform goes together with the necessary **training and learning time**. Emergency teams work seldom together during non-emergency normal times and therefore training opportunities are occasions to

create a bond, to acquire those mental models, to incorporate practices for good teamwork, to produce response plans and, in HEIMDALL's case, to test the system under realistic disaster scenarios. Hence, HEIMDALL's participatory design should be accompanied by learning instances in which end-users can learn and test the system as well as suggest chances and produce feedback. This might be even more important for cases in which cross-border cooperation and/or cascade events requires appreciation of inter-cultural and/or language issues.

Finally, if the analysis of the Human Factors involved in HEIMDALL's development should expand also towards the more contextual (legal, economic and socio-political) aspects that are studied in more detail in deliverable D3.11, the questions of its **availability** and **affordability** step to the fore. Therefore, these issues will only be mentioned here in order to highlight the importance of asking for the reasons for developing such a platform and its potential value. As Human Factors is a discipline that aims at optimising working spaces and reducing errors, the need for a platform that can provide for timely and reliable data for disaster planning, response, and mitigation seems to be obvious. Nevertheless, the aforementioned issues (universal usability, efficiency, productivity, safety, flexibility, versatility, transparency, feedback, automation, reliability of data, responsibility) could make such a system extremely expensive, which might challenge its acceptance and adoption.

To conclude, the focus on only one (or several but not all) of these dimensions is likely to neglect the further impact and therefore requirements that other decisions on specific human factors might have. As an example, and summarising the aspects mentioned in the previous section:

- **Psychological**: The crisis generates a demand towards the system to reduce the stress, anxiety and fear that any end-user might feel facing the challenge. Nevertheless, HEIMDALL's design might actually increase it.
- **Physical:** The device on which a connection to the HEIMDALL system is available has an influence on which persons and/or organisations might use it.
- **Cognitive:** The safety of the system against careless mistakes might prohibit necessary creative uses/changes of data to react on unusual disaster situations.
- **Organisational:** Although the HEIMDALL system intends to facilitate inter-organisational and cross-border communication it might be counterproductive as the eye-to-eye communication and the social aspect of cooperation is a highly valued constituent of trust and therefore collaboration.

Therefore, this socio-technical system is a collective and ongoing process of negotiation between designers, end-users and other stakeholders. This will be reflected in the following issues of this deliverable as the interviews and focus group discussions are carried out and used as means to provide the end-users and other stakeholders' perceptions of the platform, to participate in its development, and to make sense of this tool.

2.2 Preliminary list on project requirements against the backdrop of Human Factors

As explained above, the aim of this issue of the Human Factor analysis of HEIMDALL is to highlight potential requirements and associated decisions related to the design of the system. Nevertheless, the following requirements' descriptions refer to the value-dimension, as it is important to contextualise them. This dimension refers to social and ethical issues, which complement these requirements, and are part of deliverable D3.11 on Social Acceptance and Ethical Acceptability. Additionally, EKUT recommends the adoption of a Value Sensitive Design (VSD) [5] and, in principle, addressing the following six values: *privacy*, *physical welfare*, *universal usability*, *informed consent*, *autonomy* and *trust*. Many of them have already been named by EKUT in the work prepared for D8.1 regarding the ethical criteria of HEIMDALL research. In this regard, the Human Factors approach also complements and supports the interest of exploring the Ethical, Legal and Social implications (ELSI) of the

HEIMDALL system. For example, the platform shall implement security measures to prevent hacker attacks, breaches, loopholes, bypassing of access controls, privacy violations and misuse of personal data, as well as to be protected against misuse by intelligence services and/or by military organisations. The adoption of such security measures ensures trust in the platform and protects sensitive data and the privacy of end users and the public. Furthermore, it ensures that the HEIMDALL system abides by the law. Nevertheless, these measures shall not affect the necessary actions of the first responders on the field. Informed consent measures shall be taking into account when developing the platform for this feature.

It must be noted that, as this is the first issue of three consecutive deliverables, the work done has been primarily based on desk-based research and focused on potential dimensions to be addressed by the system before the very first prototype. This needs to be extended by incorporating a sound basis of end-users' (and if agreed upon citizens) perspectives, which is the reason for the empirical work − interviews and focus group discussions − that will be done in the following months. Therefore, as the work on the system progresses, the work on Human Factors will also delve further into detail, potentially highlighting new and/or different aspects that shall be considered when lifting HEIMDALL to an operational level.

The following list of project requirements with regard to Human Factors employs the table template adapted from the *Annex I* of D2.6 Requirements Report (see Table 2-1) as the best way to convey them in a coherent form following the D2.6 structure. Consistent with the methodology of opening up a discourse on ethical, legal and social aspects, the requirements have been presented using the verb "shall" and expressing a demand upon the designer or implementer.

Table 2-1: Human Factors Template

Requirement ID						
Requirement:						
Data sources						
Profile						
Main Risk						
DRM Cycle						
Scenario Phase						
Source						
Summary						
Context						
Benefits						
Negative impacts						
Constraints						

Requirement ID	HF_1				
Requirement: The system shall be designed for different types of end users and the different equipment they use.					
Data sources					
Profile					
Main Risk	ALL				
DRM Cycle	Response	Recovery	Preparedness		
Scenario Phase	Communication	Incident Identification and Classification			
Source	EKUT				
Summary	As not all end users have the same equipment, the system should be developed in such a way that a variety of end users' operational equipment might be used to access vital information without barriers.				
Context					
Benefits	If HEIMDALL is developed in such a way that access to vital information is achieved through a variety of operational equipment, this system will improve disaster preparedness, crisis management and response because it places less barriers to end users and citizens to access helpful information.				
Negative impacts	The restriction to specific kind of equipment and/or the design of interfaces for only specific types of end users are not only a matter of discrimination and a potential legal issue but also can undermine the very objective of the platform by not considering the characteristics of this situation.				
Constraints	This also applies to citizens even if they are only granted access to the platform but not permission for inserting/sharing data.				

Requirement ID	HF_2				
Requirement: The system shall be designed to take into account different kinds of end users in terms of different expertise, different knowledge and different levels in the hierarchy.					
Data sources					
Profile					
Main Risk	ALL				
DRM Cycle	Response	Recovery	Preparedness		
Scenario Phase	Communication	Incident Identification and Classification			
Source	EKUT				
Summary	As end users have differences in equipment, capabilities and responsibilities, to name a few, the platform should be developed in such a way that permissions are granted and interfaces designed to allow end users to access vital information without barriers.				
Context					
Benefits	The aim of the HEIMDALL system is to improve disaster preparedness, crisis management and response and the accessibility of the information by all end users could only contribute towards achieving this goal.				
Negative impacts	The restriction of permissions and/or the design of interfaces for only end users with some capabilities, equipment or responsibilities are not only a matter of discrimination and a potential legal issue but also can undermine the very objective of the platform by not considering all the potential scenarios.				
Constraints	In relation to population awareness and citizens at risk refer to HF_5				

Requirement ID	HF_3				
Requirement: The system shall be designed for different types of end users or citizens having special needs (hearing-, speaking-, visual-, mobility impairments) to be able to insert, access and use the information.					
Data sources					
Profile					
Main Risk	ALL				
DRM Cycle	Response	Recovery	Preparedness		
Scenario Phase	Communication	Incident Identification and Classification			
Source	EKUT				
Summary	As end users or citizens have different capabilities, the platform shall be developed in such a way that permissions are granted and interfaces designed to allow end users and/or citizens to access vital information without barriers.				
Context					
Benefits	If HEIMDALL is developed in such a way that access to vital information is achieved through a variety of operational equipment, this system will improve disaster preparedness, crisis management and response because it places less barriers to end users and citizens to access helpful information.				
Negative impacts	The restriction of permissions and/or the design of interfaces for only end users and citizens with certain capabilities are not only a matter of discrimination and a potential legal issue but also can undermine the very objective of the platform by not considering the characteristics of this situation. Furthermore, there could be people with disabilities among first responder organisations and stakeholders in general.				
Constraints	This requirement should be considered even in the case that citizens are only granted access to the platform but not the option of sharing data.				

Requirement ID	HF_4				
Requirement: The system shall be designed for end users and citizens with different mental capacities.					
Data sources					
Profile					
Main Risk	ALL				
DRM Cycle	Response	Recovery	Preparedness		
Scenario Phase	Communication	Incident Identification and Classification			
Source	EKUT				
Summary	The platform should be developed in such a way that interfaces are designed to allow end users and/or citizens with different mental capacities to access vital information without inappropriate barriers.				
Context					
Benefits	If HEIMDALL is developed in such a way end users and/or citizens with different mental capacities can access vital information, this system will improve disaster preparedness, crisis management and response because it places less barriers to end users and citizens to access helpful information.				
Negative impacts	The design of interfaces for only end-users and/or citizens without mental disabilities is not only a matter of discrimination and a potential legal issue but also can undermine the very objective of the platform by not considering the characteristics of this situation.				
Constraints					

Requirement ID	HF_5				
Requirement: The system shall be designed considering translation, linguistic and cultural issues in regards to end users and citizens alike.					
Data sources					
Profile					
Main Risk	ALL				
DRM Cycle	ALL				
Scenario Phase	Communication	Incident Identification and Classification	Assessment of risk		
Source	EKUT				
Summary	The platform should be developed taking into consideration that different languages and different cultural habits and practices are major obstacles that might affect its adoption and use.				
Context					
Benefits	The aim of this project is to develop a working prototype that can be applied in managing crisis situations, preparing for them and responding in enhanced manners. HEIMDALL's geographical focus is the European Union, which as such is composed of many different countries with their own languages and cultures. Therefore, in order for this platform to be successfully implemented in this region these aspects must be addressed.				
Negative impacts	One of the aims of HEIMDALL is to provide a system to help European Union's end users and citizens alike, who by definition do not share language and culture. By failing to prevent these issues HEIMDALL negatively affects its chances to succeed.				
Constraints	The consortium has to be bear in mind that regardless of training time and documentation available, the more general and translatable terms and procedures are, the more likely slight (cultural) differences might arise. In some cases, this may create big difficulties. In addition, similar terms do not always have the same meaning in different organisational/cultural contexts.				

Requirement ID	HF_6
Requirement: The system shall be developed considering uniformity of interface, commands and terminology.	
Data sources	
Profile	
Main Risk	ALL
DRM Cycle	ALL
Scenario Phase	ALL
Source	EKUT
Summary	The platform should be developed based on common terminology, commands and interface to ensure fast and clear communication among end users and citizens alike.
Context	
Benefits	The consistency in terminology, commands and interface supports clear communication between organisations and citizens alike, ensures smoothness in exchanging information and knowledge, and reduces the stress and anxiety created by the disaster itself.
Negative impacts	The trade-off between standardisation of terminology and critical view of the categories in place is the possibility that vulnerable groups, defined priorities and/or strategies proposed and adopted might negatively affect some individuals, regions and/or infrastructure.
Constraints	It has to be kept in mind that regardless of training time and documentation available, the more general and translatable terms and procedures are, the more likely slight (cultural) differences might arise. In some cases, this may create big difficulties. In addition, similar terms do not always have the same meaning in different organisational/cultural contexts.

Requirement ID	HF_7
Requirement: The system shall be developed taking into account potential mistakes in using it and leading to confusion and/or failure of the system.	
Data sources	
Profile	
Main Risk	ALL
DRM Cycle	ALL
Scenario Phase	ALL
Source	EKUT
Summary	The platform should anticipate that users can make serious (careless) mistakes while using the tool, either by rapidly detecting it and offering a comprehensible and fast mechanism to revers them or by not permitting them. Nevertheless, errors might occur and technical support should be provided in terms of administrators' rights or physically present administrators.
Context	
Benefits	Crisis situations generate higher levels of stress, anxiety and clumsiness (by pressing the wrong buttons, for example) and make people more prone to errors. Good design should prevent or mitigate these errors or present the users with a confirmation option before the action affects the system.
Negative impacts	
Constraints	As disasters do not hold on to plans it might be necessary to find creative ways to solve problems. This is not always possible, as the platform should prevent (careless) mistakes. Both claims are contrary and should therefore be discussed in advance.

Requirement ID	HF_8
Requirement: The system shall provide informative feedback about its status whenever the user is interacting with it.	
Data sources	
Profile	
Main Risk	ALL
DRM Cycle	ALL
Scenario Phase	
Source	EKUT
Summary	The user should receive confirmation of every action they perform in the platform.
Context	
Benefits	The HEIMDALL platform aims at being used by many different end users and citizens, in various situations and under stressful circumstances. By receiving feedback to the actions performed the users are assured of their impact.
Negative impacts	
Constraints	Feedbacks, such as confirmations and acceptance clicks need time and may easily lead to bureaucratic frustration and stress. On the other hand, these security mechanisms are important in terms of accountability and responsibility.

Requirement ID	HF_9
Requirement: The system shall consider the necessary learning time of their users (end users as well as citizens).	
Data sources	
Profile	
Main Risk	ALL
DRM Cycle	Preparedness
Scenario Phase	
Source	EKUT
Summary	The platform should have an intuitive design that provides for rapid learning and easily connects with the users' knowledge and expertise. In addition, documentation should be available for any type of user.
Context	
Benefits	Intuitive design reduces learning time, provides for better understanding of the situation, collaborates in exchanging information and coordinating efforts and relieves from anxiety and stress. Moreover, it becomes a reliable tool. Furthermore, it diminishes the necessary time to recall when using it after some time.
Negative impacts	
Constraints	Intuitive design, unfortunately, does not resolve the necessary learning process and practice time, which should occur during normal situation. In addition, documentation (or online/offline help) should be provided to overcome any unforeseen circumstances, which shall be easy to search, navigate and understand.

Requirement ID	HF_10
Requirement: The interfaces of the system shall be designed considering the reduction of the information load to one person/member of the crisis management task force.	
Data sources	
Profile	
Main Risk	ALL
DRM Cycle	ALL
Scenario Phase	ALL
Source	EKUT
Summary	The amount of information displayed should be balanced to reduce the concentration required, mental fatigue and stress of the risk/crisis situation.
Context	
Benefits	HEIMDALL aims to integrate large amounts of information in an efficient and clear presentation in order to support decision-making and response processes and times. Therefore, the volume of this information shall be balanced in order to achieve these concomitant goals while reducing the mental fatigue (learning/forgetting processes) and concentration associated with the emergency situation. Furthermore, it also reduces dissatisfaction with the system and anxiety.
Negative impacts	The drawback of selecting the type, amount and interface design is the possibility of incomplete, inaccurate or biased information or its representation.
Constraints	The HEIMDALL consortium, especially the end users, have to discuss the extent and form of the information processed and presented within the platform to facilitate work for their end users. This is important as more information is not necessarily better and it is not always clear beforehand which information might be relevant. Therefore, options should be implemented to allow for adjustment of the information base to the need of the user as well as preventing overload.

Requirement ID	HF_11			
Requirement: The system shall support operational routines but also be flexible and versatile.				
Data sources				
Profile				
Main Risk	ALL			
DRM Cycle	ALL			
Scenario Phase				
Source	EKUT			
Summary	The platform should uphold operational protocols and standard procedures but it should also be flexible to deviate from routines when circumstances demand.			
Context				
Benefits	The presentation of and support in executing operational procedures exonerates end users and reduces the chance for (careless) mistakes. By developing a flexible system, the platform is prepared for not fully predictable or uncertain situations in which standardised procedures or mechanisms are incapable to provide the corresponding information, result or plan. In addition, the versatility of the system contributes to accomplish the overall objective of HEIMDALL, which is to improve preparedness of societies to cope with complex crisis situations by permitting the generation of new functionalities.			
Negative impacts				
Constraints				

Requirement ID	HF_12
Requirement: The system shall support clear leadership structures in order to grant permissions and access to data, information, assessment of situations, scenarios and response plans.	
Data sources	
Profile	
Main Risk	ALL
DRM Cycle	ALL
Scenario Phase	ALL
Source	
Summary	The platform shall support and make visible clear responsibility structures in order to grant permissions and access to data, information, assessment of situations, scenarios and response plans. In turn, this shall be reflected on the interface design, the adaptability of it to the context of the user and the actions that the user can take.
Context	
Benefits	The visibility of the structures generates trust in the platform and clearly identifies the level and kind of responsibility of each organisation and of the end users. This is reflected on the permissions granted, and the available data, information, scenarios and plans, as well as on the interface design, the adaptability of it to the context of the user and the actions that the user can take.
Negative impacts	
Constraints	

Requirement ID	HF_13
Requirement: The system shall be transparent on the decision support mechanisms and used criteria.	
Data sources	
Profile	
Main Risk	ALL
DRM Cycle	ALL
Scenario Phase	
Source	EKUT
Summary	The system shall provide advice on possible procedures for preparedness, mitigation, response and recovery phases (assessment of the situation, risk and vulnerabilities; catalogue of scenarios, associated response plans, and corresponding best practices) in the most transparent form in order to not bias the end user's decision.
Context	
Benefits	Transparency on decision support mechanisms and used criteria is associated with trust in the HEIMDALL system, decision implementation, and corresponding levels of structural responsibilities.
Negative impacts	
Constraints	Unfortunately, not only is full transparency not possible, but also decision support is likely to be misunderstood as decision-making. Providing options is different from deciding what option to take. This subtle difference might be neglected when using HEIMDALL, which is a system that provides decision support. Nevertheless, decision support must be prevented from being misunderstood as decision-making, which is the task and responsibility of end users. Unfortunately, it is not always easy to identify to what extent specific decisions are simply suggested or rendered by imperfect or biased information.

Requirement ID	HF_14
Requirement: The system shall be able to assign levels of certainty to the information items provided by the different systems and actors (autonomous systems, end users and citizens).	
Data sources	
Profile	
Main Risk	ALL
DRM Cycle	ALL
Scenario Phase	
Source	EKUT
Summary	The platform should provide real and trustworthy data; this aim is part of the research process itself. It may be honest and simple to assign a high level of certainty to the data provided by the first responders or to create a validation process for the data provided by the autonomous systems but it is more difficult to ensure the trustworthiness of the data inserted by citizens due to conscious or unconscious misinformation.
Context	
Benefits	Crisis situations generate higher levels of stress, anxiety and clumsiness which is why reliable data is of utmost importance.
Negative impacts	
Constraints	The aim of up-to-date information is always a negotiation between time/speed and trustworthiness. As the system shall facilitate work by giving important information right away and therefore exonerate end users it is likely that this folds into an uncritical use of data without further investigation of sources.

Requirement ID	HF_15
Requirement: The system shall be designed to reduce execution time and tasks and provide with monitoring and backup options in case of damage.	
Data sources	
Profile	
Main Risk	ALL
DRM Cycle	ALL
Scenario Phase	ALL
Source	EKUT
Summary	The system shall facilitate the work and data sharing within disaster management structures by shortening the time necessary to get, sort and find data.
Context	
Benefits	Faster data means better up-to-date actions and therefore a better response to the ongoing disaster.
Negative impacts	It is a likely situation of automated or semi-automated tasks (faster and less demanding tasks) to go hand in hand with new and/or more tasks and a loss of control on the previous tasks. This may lead to more confusion if these technological assisting devices fail or they are not monitored in an appropriate way. Previously assigned personnel that get other/more tasks might be confused and overburdened in case the device breaks.
Constraints	

Requirement ID	HF_16
Requirement: The system shall offer an offline protocol when internet connection is off or infrastructure is damaged.	
Data sources	
Profile	
Main Risk	
DRM Cycle	
Scenario Phase	
Source	EKUT
Summary	The platform shall offer an offline protocol and the corresponding satellite-based communication system option in case of damages to the internet connection or other infrastructure.
Context	
Benefits	The integration of an offline protocol and the corresponding satellite-based communication system option into the HEIMDALL platform reduces the anxiety and stress of end users and population, and increases the trust on the platform.
Negative impacts	
Constraints	

3 Empirical research plan

3.1 Objective

As defined in the Grant Agreement, the research on Human Factors requires the use of empirical research methods. In order to develop a catalogue of human factors to be considered when implementing HEIMDALL, 24 qualitative interviews will be conducted with the end-users (n=12) and with other relevant actors and experts (n=12). The aim of these interviews is to find out about the opinions and attitudes of the interviewees towards different factors related to human-machine interaction, such as trust, responsibility, usability and communication style, to name a few. The analysis of the generated data will provide an insight into potential concerns of humans interacting with the specificities of HEIMDALL's system that might differ from or add to the ones identified by the literature review of human factors that is part of this deliverable. Another aim of the interviews is to explore the practical experience and specific knowledge of the end-users and to actively involve their perspectives into both the human factors and technical development, as well as into the research on ethical issues and societal acceptance (see D3.11).

Note: The qualitative empirical research on Human Factors can be completed by the findings of the focus group discussions with potential end-users of the HEIMDALL platform, as described in D3.11 (see description of research plan on societal acceptance and ethical acceptability).

3.2 Research design: qualitative interviews

3.2.1 Sample of interviewees

The qualitative interviews on Human Factors (n=24) will be conducted with potential end-users of HEIMDALL (n=12) and with other relevant actors and experts (n=12).

Possible interviewees among the end-users are, on the one hand, the end-users involved in the HEIMDALL project and, on the other hand, other potential end-users not involved in the HEIMDALL project (e.g. the German Federal Agency for Technical Relief (THW) or the German Red Cross (DRK)) as well as members of relevant organisations operating in European countries not represented in the HEIMDALL consortium, like for example from Croatia, Bulgaria or Sweden. The international character of the sample will allow to identify Human Factors related to a variation of specific national contexts, as well as to include in the catalogue potential intercultural matters.

Possible experts and other relevant actors to be interviewed could be representatives of public institutions involved in disaster relief (e.g. the European Emergency Response Coordination Centre – ERCC); representatives of social organisations concerned with vulnerable groups (e.g. the Christoffel Blindenmission or HelpAge); representatives of NGOs involved in disaster relief actions (e.g. Médecins sans Frontières, German Federal Agency for Technical Relief (THW)); members of international disaster response fellowship programmes; as well as politicians involved in the decision-making process; scientists and researchers in the field of disaster risk reduction and disaster response, and citizens engaged with disaster-related topics (e.g. in social media and blogs).

The selection of the interviewees will start right after finishing this delivery D3.8, beginning with HEIMDALL end-users. The selection of other potential end-users and other relevant actors will be guided by criteria such as the level of involvement, experience and expertise as

well as the snowball technique[1], however taking into account also socio-demographic criteria like gender and age.

Note: The aspired number of interviewees outlined here might be subject to change depending on the recruitment process, the level of saturation or redundancy of the findings, as well as on possible budget and time limitations.

3.2.2 Methodological aspects

The interviews on Human Factors will be conducted as semi-structured expert interviews, following the general rule for guided interviews: “as open as possible, as structured as necessary” ([7], p. 560). Actually, openness can be considered one of the most important principles of qualitative research: in order to fulfil the openness-requirement, the questions or invitations to the interviewees to talk about their experiences and professional attitudes have to be formulated in a way that narrows the range of possible answers as little as possible. For example, attention should be paid to not predefine the concepts and terms in question, allowing the interviewees to formulate their own understanding of them ([7], p. 562). In the same line, interviewers should not take their own understanding as a basis for categorising the points of view of the interviewees, neither should they make judgmental/valuing remarks of any kind. On the contrary, the interviewers should try to get involved with the perspectives of the interviewees and accept them as their present subjective truths ([7], p. 561). Another frequent interviewers’ mistake that should be avoided for the same reason is the hunt for confirmation of own assumptions or hypothesis by the interviewees. Especially, the interviewees should not be asked for information that could be provided by easily available sources like specialised literature, as this might create the impression of laziness as the main reason for doing the interview.

The principle of openness, however, is limited by the existence of a specific research interest that has to be somehow addressed and focused on during the interviews (which means leaving aside other aspects) and by the simple fact that every interview situation is also a communicative situation, and therefore follows general rules of social interaction which automatically limit the possibilities of self-expression ([7], p. 562). The considerations of the interviewees of what is expected of them might have a high impact on their statements, as well as their knowledge about the specific purpose of the interview and about their role within the research process. If the interviewees, for example, are addressed as highly valued experts within a certain field, they will probably share their points of view more openly as if they were addressed as representatives of a position or practice that the researchers openly criticise.

Although it is impossible to totally avoid certain influences on the interviewees’ answers, it is important to be aware of possible factors of influence, such as the communicative situation, the different roles within the interview situation and the resulting power relations between interviewer and interviewee (see [7], pp. 564–565).

3.2.3 Preparing, conducting and recording the interviews

In order to get comparable results, a general questioning route for all the interviews will be developed, covering the main topics of interest (see 3.3), but also providing space for additional upcoming questions as well as for spontaneous interventions by the interviewees. The questions or invitations to talk will be formulated in the questionnaire in a rather open way, so that the interviewers can adopt them to the current interview situation, the language

[1] Snowball sampling is a non-probability sample technique that begins from a core of known study subjects who recruit other subjects to increase the number of members of the original sample. The name of this technique is based on the analogy of the increasing size of a snowball when rolled down a snow-covered slope.

and mode of expression of the interviewees and the amount of information already obtained by previous questions.

The questioning route of qualitative interviews is usually structured in three parts (see [7], p. 566):

I. In the first part, the interviewee will be given the opportunity to express himself/herself about the main topics of interest as freely as possible. The first questions should therefore be formulated in a way that allows the interviewee to bring up as many content-related aspects as possible, without any limitations. These questions should also address the personal experiences of the interviewees in his/her field of expertise.

II. In the second part, the interviewees will be asked about the aspects that could not be answered by the desk-based literature review about Human Factors. In this part, their factual knowledge as experts in their field will be addressed.

III. In the third part, questions might arise from what the interviewees expressed in the first and second part, and/or the interviewees can be asked about their attitudes towards relevant aspects. In this last part, they can also be asked for their personal judgement on different topics, which should be avoided in the more fact-based second part of the interview.

The questioning route itself will be developed in four steps. Firstly, all the possible questions connected to the research interest will be collected, without any restrictions in mind. Secondly, the questions will be critically reviewed, checking their appropriateness in terms of the methodological aspects outlined in 3.2.2. Questions entering in conflict with methodological principles should be erased or listed in a separate document that might be considered at the end of the interview, in case there is time left. Thirdly, the remaining questions will be sorted by content-related and qualitative aspects (e.g. questions on personal experience, factual knowledge or personal judgement). Fourthly, for every group of questions will be set up an introductory impulse question inviting the interviewee to spontaneously come up with the aspects that come to his/her mind. Aspects not mentioned by the interviewee can then be addressed subsequently (see [7], pp. 567–568).

Before starting the interview, the interviewer should introduce himself/herself and the research project to the interviewee, the interviewer should point to the need of recording the interview, as well as to the anonymity of the participants and the confidentiality of the analysis. The interviewer should also give some basic information on the role of the interviewer, the importance of the interviewee's knowledge for the research and the estimated duration of the interview (approx. 1 hour).

To make sure the voluntariness and awareness of the interviewees, all participants will sign the informed consent sheet (see D8.2) before starting the interview. They will additionally receive the project information sheet (see D8.4).

The interviews will be recorded via voice recorder, stored in encrypted file containers and they will later be transcribed by members of EKUT. After the transcription, the audio files will be deleted. The names of the interviewees and other identifying information will be anonymised in the process of transcription. The findings of the interviews will be presented to the HEIMDALL consortium and, if appropriate, to other publics exclusively in a strictly anonymised and aggregated way.

The interviews will be conducted, if possible, as personal interviews (face-to-face communication) by members of the EKUT HEIMDALL team. In order to avoid high costs, it seems suitable to conduct the interviews with the HEIMDALL end-users before or after the HEIMDALL project meetings in the respective cities. This might allow us to reduce travel costs and to use some of the infrastructure of the hosting project members. The interviews with other potential end-users and experts from different European countries, however, will have to be done partly via phone or skype, due to time and budget restrictions.

3.2.4 Evaluation of the generated data

As outlined in 3.2.3, the audio files generated during the interviews will be transcribed and anonymised by a member of EKUT. In order to guarantee a consistent transcription process, common transcription rules will be established for all the qualitative interviews. Important points to consider, or rather open questions to be discussed, are the following:

- Will we transcribe only spoken words, or also breaks, laughter, sighs, etcetera?
- Will we roughly summarise the content of the statements, or will we transcribe everything word by word?
- Formal aspects like line numbering, line spacing, etcetera have to be defined.

The open questions concerning the transcription rules will be discussed among the EKUT team when developing the questioning route for the interviews and then will be set in written form.

The transcripts of the interviews will be evaluated using the descriptive-reductive content analysis method (see [9], p. 183 et seq.). The aim of this method is summing up the main contents and arguments, increasing the density of the information by reducing the data volume. Therefore, in a first step, a system of categories will be developed according to the main interests of the research. In a second step, relevant text passages will be identified and grouped by the corresponding category. By using this cut-and-paste-technique, relevant information (words, sentences or entire passages) can be quickly extracted and distinguished from less relevant information. In a third step, appropriate quotations of the interviewees will be looked up in order to illustrate the main arguments. The extracted information should then, in a last step, be summed up and, if necessary, interpreted in the context of the research field. In reference to the interviews with other end-users and experts, consistent and/or divergent patterns of information can be worked out. At the end, the Human Factors identified in the interviews can be compared with or added to the ones identified in the literature review.

3.3 Sample of topics to be addressed in the interviews

The questioning route to be worked out should (at least) touch the following topics:

- What is the personal perception of the HEIMDALL system for the interviewee? What notion does the interviewee have of the HEIMDALL system?
- What should the HEIMDALL system, in the interviewee's opinion, (not) offer to him/her? Does the system meet his or her needs?
- Which could be (in the experience of the interviewees) the most crucial points in the interaction of humans and the HEIMDALL system?
- What are their feelings regarding the automatic system?
- What are their feelings concerning the Decision Support System?
- Is it useful to them?
- How do they think it might affect their decisions and their responsibility?
- How could the system propose actions or options in the best way?
- How do they feel about the simulation tool? Do they trust it? Do they think simulations are useful for their work?
- What communication options should HEIMDALL provide? What would (not) be useful for them?
- Who should be able to access HEIMDALL? Should the information be restricted to certain end-user groups?

- How should the visual interface of HEIMDALL look like in order to facilitate their work?
- What do they think about the data safety in HEIMDALL?
- How would HEIMDALL, in their opinion, affect the routines and actions in their corresponding countries (e.g. in terms of legal operation, chains of authority, etc.)?
- Are there standard situations in disaster management situations? Do you know of any critical evaluation of standard situations so far?

4 Conclusions and Recommendations

This deliverable provided a definition of Human Factors and the implications of a human factors analysis for the HEIMDALL system. Human Factors is a field of study devoted to the analysis of psychological, physical, cognitive, organisational and contextual conditions and the corresponding emergent properties of any socio-technical system with the aim of improving the overall working conditions, outputs and impacts of the human-machine-environment interaction. This perspective complements the social or value-related factors that are part of D3.11 on the societal acceptance and ethical acceptability of the system. Whereas Human Factors focus on improving peoples' productivity, health, safety, and comfort while efficiently and effectively interacting with the technology in use in the context/environment technology and humans work together, social acceptance represents the empirical question whether a technology is likely to be used and under what conditions. In addition, ethical acceptability refers to the question of how technology is related to values a society needs for thriving or to the question *in which society we want to live in*.

This deliverable also covers a preliminary list of human factors requirements for the development of the HEIMDALL system. As this is the first issue of this deliverable, the work done has been primarily based on desk-based research and focused on potential dimensions to be addressed by the platform before its first prototype. It is neither complete nor final, rather it is a starting point for further research within the HEIMDALL project. The list might be modified after the empirical work (interviews) is done the following months and the end-users' perspectives are incorporated.

In Section 3, the research design and methods for this upcoming empirical work have been laid down. Interviews have been planned with potential end-users involved in the HEIMDALL project, as well as with other potential end-users external to the project plus other relevant actors and experts. The analysis of the data generated will provide an insight into potential concerns of humans interacting with the specificities of HEIMDALL's system that might differ from or add to the ones previously identified.

The updated list plus the results of these interviews will be reported in the upcoming deliverables.

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