

SUPPORTING RESILIENCE MANAGEMENT THROUGH USEFUL GUIDELINES

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Abstract

The paper describes an on-going project, DARWIN, which is developing resilience management guidelines for the context of crisis management. The project started with a vast review of associated literature, standards and operational documentation, as well as interviews of practitioners. Numerous requirements were identified, in particular to capture resilience management capabilities the guidelines should address. The context is that of organisations that already have a number of processes and tools in place to support their management of crises (e.g., preparation activities, contingency plans, procedures, learning activities). As a result, the guidelines are positioned at a meta-level: they provide a perspective on these processes and tools grounded in research and practice on resilience management inspired by the fields of Resilience Engineering and Community Resilience. The paper describes the nature of the guidelines, established development and evaluation process, and components of the guidelines defined through an iterative discovery process. These different aspects aim at ensuring the usefulness, i.e. applicability and usability, of the DARWIN guidelines.

1 INTRODUCTION

The use of the term *resilience* has emerged during the last decades as a complementary concept for industry and society to improve beyond the limits of the prevalent approach to risk and crisis management, although the concept of resilience is however used widely differently in diverse areas of research and in response to different challenges (Woods, 2015). DARWIN, the on-going European project which is the topic of this paper, postulates that resilience has a reflective quality: resilient systems have the ability to manage their own resilience (Woods and Branlat, 2011). DARWIN aims to build resilience management guidelines to support critical infrastructure organizations in developing and enhancing their resilience in the context of crisis management. The project focuses on a proactive approach for dealing with disturbances and assumes that surprises are an inherent characteristic in these situations. Trends that have influenced calls to operationalize resilience include (Boin & McConnell, 2007; Herrera *et al.*, in press):

- the changing nature of societal risks to higher complexity, difficulty in predicting occurrence and impact, and increased interdependencies in occurrence, impact and response;
- the awareness of limitations in prevalent risk-based approaches that emphasize the predictability of risks' occurrence and impacts, but downplay rare events, systemic and emerging risks, and risk controversies;
- the insufficient ability and increasing demands to learn and evolve from experience from these types of crises and limitations of prevention and planning;
- the complexity and risk of propagation of everyday performance variability and cascading across boundaries to other systems (making prevention, mitigation, and preparation very challenging).

In the context of these trends in modern-day crises and accidents, the DARWIN project bases its development of Resilience Management Guidelines on two major strands of research: The Resilience Engineering perspective, and the body of knowledge on Community Resilience. Both traditions are particularly relevant to the context of crisis management due to their respective topics of interest, concepts and methods.

During the first 6 months of the project, a vast review of Resilience Engineering, disaster resilience, community

resilience, and associated literature, standards and operational documentation, as well as interviews of practitioners, was undertaken (DARWIN, 2015). A significant number of requirements were identified, then selected via a modified Delphi process (see Adini *et al.*, 2017 for more details). The process resulted in an overall set of 51 items that were recommended for inclusion in resilience management guidelines in order to guide the subsequent development of the DARWIN guidelines (DARWIN, 2016). Those requirements included especially conceptual requirements that captured resilience management capabilities the guidelines should address, i.e. specific objectives for their content. Other requirements addressed, for instance, the form or quality of the guidelines, or their development and evaluation process. However, the requirements did not specify the nature of the guidelines, i.e. the object of design, in order for them to be useful. The development of such object is a typical “ill-defined” problem, i.e. corresponds to a problem for which there is no clear end goal, nor clear path to a solution. The nature of such problem is further complicated by the typical scope, scale and complexity of the domain of crisis management for which the guidelines are developed. As a consequence, the development process was an iterative discovery process, during which the team made attempts and learned about what the end-product (the guidelines) should be, as well as about the process to reach a satisfying solution.

The objective of this paper is to describe the approach adopted to ensure the guidelines are: (1) relevant to the objectives and effective at operationalizing resilience concepts, methods and tools (see section 2); (3) developed with operational needs in mind (see section 3); provided in a usable form and able to evolve (see section 4).

2 DEVELOPMENT OF RESILIENCE MANAGEMENT GUIDELINES

2.1 Object of design

The guidelines offer a critical overview of an organization’s activities from the standpoint of resilience management, with the aim to effectively assist it in the creation, assessment or improvement of its own processes and documents. In other words, we are not developing guidelines for crisis management per se, but rather guidelines at a meta level: the context is that of organizations that already have a number of processes and tools in place to support their management of crises (e.g., preparation activities, contingency plans, procedures, learning activities). As such, the DARWIN guidelines can be complementary to existing guidelines or procedures in an organization, but they do not replace them. The guidelines are directed towards critical infrastructure managers, crisis and emergency response managers, service providers, first responders and policy makers. They provide these actors of crisis management with a perspective on these processes and with tools grounded in research and practice in resilience management.

To define such guidelines, the DARWIN project is developing Concept Cards (CCs), which propose interventions that can be implemented in order to reach the resilience management capabilities described by the requirements. While requirements define *what* needs to be addressed, the CCs describe *how* it can be done. Specific interventions are proposed for the different phases of the crisis (the pre-emergency period, the crisis itself, and the post-emergency period), as well as across phases when relevant.

The CCs constitute the building blocks of the guidelines, and describe their conceptual framework. The guidelines form a holistic perspective, and capture the relationships between the CCs. Indeed, conceptual requirements don’t stand alone, because the resilience management capabilities they refer to are not independent. For instance, the management of adaptive capacity requires that coordination be properly supported between operational units; these types of resilience management capabilities are different, but interdependent (Woods and Branlat, 2011). Many similar relationships can be found between CCs. A central component of the guidelines is a conceptual map that organizes the CCs; it is used both for knowledge representation and development purposes. In addition, categories are used to qualify and organize the CCs: general themes, functions of crisis management, resilience abilities, and users. Those categories play a central role in the access to the information provided by the guidelines (e.g., navigation with the content).

The last component of the guidelines is a web platform that aims to facilitate the development and future use of the guidelines (see section 4 for details). The platform is an inherent part of the guidelines, because it changes their nature, content and associated capabilities, especially compared to more traditional document formats.

2.2 Guidelines development process

The guidelines development process has evolved significantly from the beginning of the project. We

summarize here the current 4-step iterative process that organizes the two core tasks: the development of CCs and updating of the guidelines conceptual map (see DARWIN D2.1, 2017 for more details).

The *1st step* is the selection of an undeveloped capability described in a requirement. Efforts are initially made to collaboratively agree on the meaning and intent underlying the description. These efforts might lead to the decision to develop a CC, or to drop the requirement, e.g., based on the fact that the corresponding capability is covered by another CC. In the latter case, the guidelines map is updated and another resilience management capability is considered.

The *2nd step*, the development of a draft CC, is a collaborative and iterative process within the development team, which involves different DARWIN consortium members, presenting various perspectives on the resilience management approach. It consists essentially of finding relevant content in the material captured during the initial literature review and interviews, then synthesizing this content in the appropriate fields of a template. This content is complemented when appropriate based on the knowledge and experience of persons involved in the development (e.g., knowledge of a relevant resilience management practice identified in previous work). In addition to the interventions proposed, the CC include a wide range of information, including: purpose and rationale; sources of information used in the development; targeted actors of crisis management; associated functions of the crisis management; expected benefit; associated challenges.

The *3rd step* is the revision of a CC based on its presentation to operational experts once it has reached sufficient maturity. Three main types of events provide such opportunities: efforts to adapt the CC to the domains of healthcare (HC) and air traffic management (ATM), carried by end-user organizations in DARWIN; evaluations carried within the project (see next section); events with the DARWIN Community of Practitioners (DCoP), experts from various academic and operational domains. These are all opportunities to gather early feedback (vs. only for a more finalized product) and lead to new cycles of collaborative revisions of the guidelines' content.

Finally, the *4th step* is the revision of the guidelines map. The development of a CC generates new knowledge and understanding about the overall guidelines. It can for instance lead to the identification of relationships with other content, or of a resilience management capability not previously captured in the map.

2.3 Current guidelines' content

The DARWIN Resilience Management Guidelines, in their current form (DARWIN D2.1, 2017), provide guidance on the following themes and associated resilience management capabilities:

- *Supporting coordination and synchronisation of distributed operations*: Ensure that the actors involved in resilience management have a clear understanding of their responsibilities and the responsibilities of other involved actors; promoting common ground in cross-organizational collaboration in crisis management; and establish networks for promoting inter-organizational collaboration.
- *Managing adaptive capacity*: Adapt to both expected and unexpected events (all-hazard approach), and adapt relative to procedures.
- *Assessing resilience*: Identifying sources and manifestations of brittleness and resilience, for organisations as well as communities.
- *Developing and revising procedures and checklists*: Systematic management of policies involving policy makers and operational personnel for dealing with emergencies and disruptions.
- *Involving the public in Resilience Management*: Communication strategies for crisis management organisations – interacting with the public not yet affected or involved.

3 INVOLVING END-USERS IN THE CREATION AND EVALUATION OF THE GUIDELINES

The guidelines need to be relevant to actual operations in order to be useful. For this purpose, operational experts representative of potential end-users are involved throughout the project. First, three end-user organizations are part of the project consortium: ENAV, the Italian Air Navigation Service Provider; ISS, the Italian National Health Institute; and KMC, a Swedish center for Disaster Medicine and Traumatology. In addition, members of the DCoP or additional experts from the fields of crisis and resilience management are solicited regularly, for instance: in the modified Delphi process that led to the selection of concepts, approaches and practices to be incorporated in the resilience management guidelines and judgment of their relative importance; in planned pilot studies to support the evaluation of the guidelines. The previous sections have described these experts' inputs in the development efforts, this section will describe their evaluation in

greater detail.

The evaluation process is based on three main pillars: (1) an **initial evaluation involving representatives of the end users internal to the DARWIN Consortium**, with experience in HC and ATM domains; (2) the **collection of feedback** from members of the DCoP, including experts of crisis management from a wide variety of domains (not limited to the HC and ATM); (3) the application of the guidelines in a set of **'pilot exercises'** with the active participation of practitioners with experience in the HC and ATM sectors, as well as of experts from different domains which are impacted by the cascading effects of the crisis types identified in the pilot exercises.

(1) The initial evaluation has been performed already. It essentially consisted in two focus group meetings in which a first sample of three Concept Cards was analyzed in collaboration with experts from the three end-user organizations in DARWIN (ENAV and ISS in Italy, KMC in Sweden). The participants of the focus groups reflected on the potential use of the sample concepts cards in their own crisis management activities, providing feedback on their applicability and insights on the opportunities and showstoppers for their implementations in different contexts. Overall, they also helped to better understand the characteristics of the Concept Card format that are more important to develop.

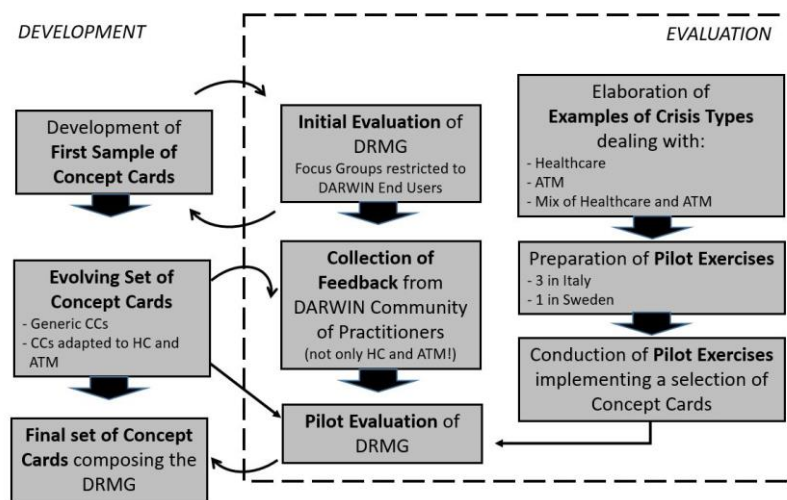


Figure 1. Development and evaluation of the DARWIN guidelines.

(2) The collection of feedback from outside the project mainly occurred during a workshop organized in March 2017, which was attended by 24 people from the DCoP, belonging to 19 organizations, from 9 different countries. This allowed comparing the experiences of crisis management practices from countries different from Italy and Sweden and from sectors different from the HC and ATM (e.g., water and wastewater networks, civil protection organizations, fire and rescue organizations). In this case, the feedback was less analytical compared to the one achieved during the focus group meetings, but still offered many opportunities to understand how to improve the cards. On the other hand, a larger set of concept cards was available and more aspects of resilience management were addressed.

(3) Finally, the core part of the evaluation will occur during the pilot exercises organized in the second part of 2017 in Italy and Sweden. The pilot exercises consist of different evaluation sessions taking as reference a set of crisis type scenarios identified and designed with the collaboration of the DARWIN end-user representatives mentioned before. Each scenario will be used to investigate the impact of applying the guidelines in real crisis scenarios. Particular importance will be given to crises affecting a mix of the two main domains addressed in DARWIN, but the cascading effects on other domains will also be investigated, with adequate participation of experts from these domains (e.g., fire brigade, civil protection and regional emergency agencies). Four main examples of crisis imagined in concrete contexts have been selected, with particular domain focus (indicated between brackets): Aircraft crashing in urban area close to Rome Fiumicino Airport shortly after taking off (ATM, HC); Blackout in Rome Area Control Centre due to cyber attack (ATM); Disease outbreak during flight due to land at Rome Fiumicino (HC, ATM); Collision between Oil Tanker and Passenger Ferry leaving Gotland Islands in severe weather conditions (HC).

The theoretical approach guiding the evaluation of concept cards is mainly informed by the I-CMO framework (Pawson and Tilley, 1997). This framework is appropriate for formative evaluation of social policies and change programs, and emphasizes the investigation of the conditions (Context) and impact (Mechanisms, Outcome) to

understand the fitness for purpose of the Interventions proposed. This evaluation framework is therefore quite relevant to investigate operational issues associated with the implementation of the guidelines developed.

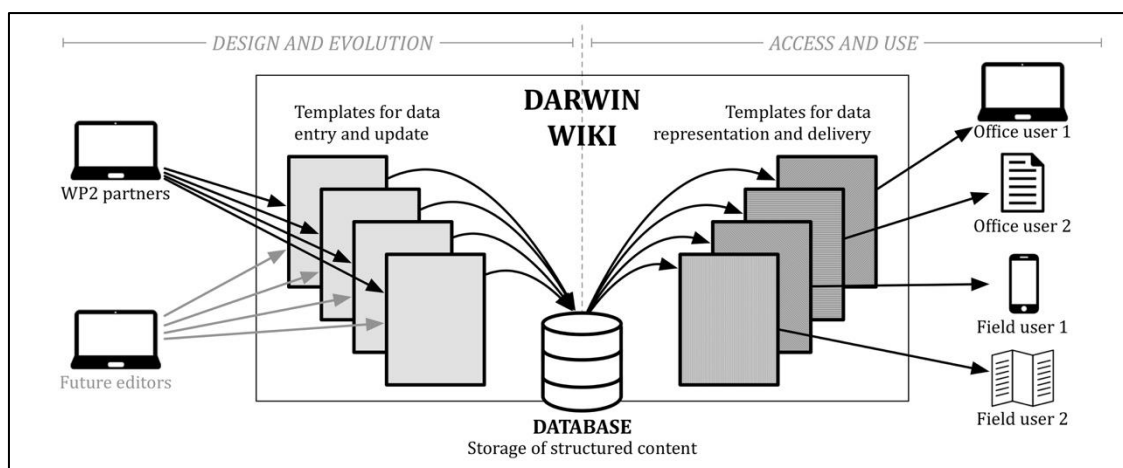
4 USABLE: SUPPORTING INFORMATION MANAGEMENT AND RETRIEVAL

A key objective of the guidelines is to allow for their flexible use, which corresponds to two different needs: (1) supporting the development and management of the evolving nature of the guidelines, requiring regular revisions of the content; (2) Generating a variety of means to access the guidelines, to account for the variety of envisioned users and uses. These needs correspond to Knowledge Management (KM) issues associated with the storage, versioning, variants, representation, and delivery of content. It quickly appeared that creation of content in typical office documents would constitute a strong limitation to effectively and efficiently update the guidelines as their structure evolve and scope increase, as well as to propose a variety of formats and means to access information. To better fulfil the project KM needs, a wiki-type platform, more specifically based on Semantic MediaWiki, was developed. The DARWIN Wiki provides a standardized way to create content collaboratively, facilitates the management of updates and offers flexible means for delivery of information. The core idea is to separate development of and access to guidelines through structuring the content of the guidelines, content that can then be used in various ways, for instance: reusing content in different formats for different purposes; sorting or aggregating information automatically; creating links between elements.

The main envisioned end-users, e.g., policy makers in a critical infrastructure administration, can consult the guidelines online. Content is organized in four main sections: “Implementation”, “Understanding the context”, “Relevant Material” and “Navigate in the DRMG”. Content related to internal management and review, used for development, is not displayed to end-users. The main information of interest is the “Implementation” section, i.e., the description of the set of interventions proposed for a particular capability. This content, organized by phases of crisis management (across phases, before, during, after), is potentially complemented with “triggering questions”, which aim at pointing users to the relevant issues via a set of questions users can reflect on and try to answer (the use of these questions was inspired by Lay and Branlat, 2014).

For users who would like to better understand the context of the interventions proposed, or refer to original documents describing a method recommended in the CC (sections “Understanding the context” and “Relevant material” respectively), content is available on demand: clicking on the corresponding section title reveals or hide the text. This content access principle is used in other parts of the wiki in order to make the core content

Figure 2. DARWIN Wiki application: support for development and use of the guidelines.



more compact and readable (clickable sections or elements are represented by the use of italic text format).

Finally, the “Navigate in the DRMG” section groups in a table the various links that the user can follow to access related DRMG content, e.g., other CCs associated with the same resilience ability, or parent theme.

Following the example of existing guidelines (e.g., WHO, 2008), a “DRMG Field Guide” was created to propose a minimal format to access guidelines outside of the office, i.e. in the field. The Field Guide is not thought of as a complete view of the guidelines, but rather as a quick reference material to remind of and guide people in the field to the right issues, as is the case with a checklist. The assumption for the envisioned use is that access to the guide is possible, whether in real-time online or as a saved document (depending on the constraints).

The Field Guide proposed is simply an aggregation of the title, purpose and “triggering questions” for all the existing concept cards, organized by themes.

5 CONCLUSION

The paper described various issues involved in the development of resilience management guidelines in project DARWIN. Designing useful guidelines (i.e. that will not constitute yet another document sitting on a shelf) requires the consideration of these aspects of development and evaluation, as well as format. During a workshop held in March 2017, participants from different sectors appreciated the general approach and idea of concept cards to address resilience management capabilities. Sessions targeting the implementation of specific guidelines were insightful in various ways, providing input to enrich the current guidelines:

- They provided operational perspectives on the applicability of the interventions proposed, including from organizations and domains outside of the DARWIN end-users;
- They confirmed the needs identified and targeted by the CCs;
- They provided examples of approaches and practices;
- They revealed differences between domains and between countries / cultures.

Relative to the presentation and format of the guidelines, experts insisted on the need to develop focused and easy to understand guidelines. Such feedback will lead to the revision of current guidelines to simplify and clarify the implementations proposed, both through clearer and more focused text, and through identifying opportunities for other forms of content (e.g., generalizing the use of diagrams). However, the project will have to find a reasonable balance between the need for immediate clarity and the potential importance of introducing new concepts or approaches to support resilience management.

Finally, the reception from outside experts was positive on the use of a wiki-type application for resilience management guidelines. It confirmed the general direction taken in the project for providing access to the guidelines and created opportunities to discuss relevant end-user needs that could be investigated before the end of the project (e.g., supporting data collection for resilience assessment). The prototype wiki application¹ offers opportunities to reconsider common views on the nature of guidelines, their necessary evolution, and their multi-faceted, multi-purpose content.

Acknowledgements

The research leading to these results has received funding from Horizon 2020, the European Union's Framework Programme for Research and Innovation (H2020/2014-2020) under grant agreement n° 653289.

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