D7.6 Final Report about the Online Community Management and Quality Assurance

Research Report

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EXECUTIVE SUMMARY

About the project

LINKS "Strengthening links between technologies and society for European disaster resilience" is a comprehensive study on disaster governance in Europe. In recent years, social media and crowdsourcing (SMCS) have been integrated into crisis management for improved information gathering and collaboration across European communities. The effectiveness of SMCS on European disaster resilience, however, remains unclear, due to the use of SMCS in disasters in different ways and under diverse conditions. In this context, the overall objective of LINKS is to strengthen links between technologies and society for improved European disaster resilience, by producing sustainable advanced learning on the use of SMCS in disasters. This is done across three complementary knowledge domains:

- Disaster Risk Perception and Vulnerability (DRPV)
- Disaster Management Processes (DMP)
- Disaster Community Technologies (DCT)

The project will develop a framework through an iterative process and bring together 15 partners and two associated partners across Europe (Belgium, Denmark, Germany, Italy, Luxembourg, the Netherlands) and beyond (Bosnia & Herzegovina, Japan) to understand, measure and govern SMCS for disasters. The LINKS Framework consolidates knowledge and experiences on the uses of SMCS into useful products for relevant stakeholders. It will be developed and evaluated through five practitioner-driven European cases representing different disaster scenarios (earthquakes, flooding, industrial hazards, terrorism, drought), cutting across disaster management phases and diverse socioeconomic and cultural settings in four countries (Denmark, Germany, Italy, the Netherlands). Furthermore, LINKS sets out to create the LINKS Community, which brings together a wide variety of stakeholders, including first-responders, public authorities, civil society organisations, business communities, citizens, and researchers across Europe, dedicated to improving European disaster resilience through the use of SMCS.

About this deliverable

The LINKS Community Center (LCC) is a web-based platform for the LINKS Community, enabling the community to exchange information and experiences and to access, discuss and assess products developed by the project and contained within the LINKS Framework. The LCC can be accessed online at links.communitycenter.eu

In order to assess and ensure high quality of the LCC and to manage its community, an integrated methodology was developed to achieve both objectives with a unified holistic approach. It includes workshops and meetings to test and assess the LCC, tool-based evaluations, an internal task force, a motivational concept for the LINKS Community as well as a process for ensuring high quality of

user-generated content. This methodology was first introduced and documented in D7.5 (Kiel, Habig, & Marterer, 2022).

This deliverable is a follow-up to D7.5 and represents a report on improvements performed in the LCC as a direct result of the application of the methodology as well as adjustments to the methodology itself. Furthermore, it offers a retrospective on the successes and challenges of applying the methodology since its introduction and offers a brief outline of the future prospects of the LCC after the conclusion of the LINKS project.

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LIST OF ACRONYMS

Abbreviation / Acronym	Description
D	Deliverable
DCT	Disaster Community Technology
DMP	Disaster Management Process
DRPV	Disaster Risk Perception and Vulnerability
LAC	LINKS Advisory Committee
LCC	LINKS Community Center
LCW	LINKS Community Workshop
SEO	Search Engine Optimization
SMCS	Social Media and Crowdsourcing
WP	Work Package

DEFINITION OF KEY TERMS[1]

Term	Definition
Case-based assessments	The case-based assessments (or case assessments) are joint efforts between WP2-4 and investigate the specific knowledge domains across different contexts while exploring interacting themes. The cross-based assessments are thus both an attempt to explore domain-specific questions through a comparative lens and an attempt to explore the interdependent questions cutting across knowledge domains.
Crowdsourcing	Describes a distributed problem-solving model where the task of solving a challenge or developing an idea get "outsourced" to a cloud. It implies tapping into "the wisdom of the crowd" (LINKS Glossary, builds on Howe, 2006).
LINKS Community	Community of multidisciplinary stakeholders working collaboratively hand in hand with the LINKS Consortium, learning and benefiting from the project development and results, and in turn providing their knowledge and expertise for the improvement of LINKS research and the validation of project's results.
LINKS Community Center	The LCC brings together different stakeholders (LINKS Community) in one user-friendly and flexible web-based platform and enables them to exchange knowledge and experiences and to access, discuss and assess learning materials on the usage of SMCS in disasters.
LINKS Framework	The LINKS Framework consolidates knowledge and experiences on the uses of social media and crowdsourcing in disasters, into products for relevant stakeholders. The Framework is accessible online through the LCC, and can be used by stakeholders to openly explore knowledge, or as a strategic planning tool for guiding disaster management organizations in their planning for using social media and crowdsourcing in disasters.
LINKS Knowledge Bases	The outputs and knowledge obtained from the assessments of the three knowledge domains. The knowledge is used to develop the LINKS Framework.
Social Media	A group of Internet-based applications that build on the ideological and technological foundations of the Web 2.0 and that allow the creation and exchange of user-generated content. Forms of media that allow people to communicate and share information using the internet or mobile phones. Web 2.0 is the Internet we are familiar with today in which people are not just

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[1] Definitions are retrieved from the LINKS Glossary at http://links-project.eu/glossary/.

	consumers of information but producers of knowledge through social networking sites and services like Facebook, Twitter, and Instagram (LINKS Glossary, builds on Kaplan & Haenlein, 2010).

1. INTRODUCTION

A key objective of the LINKS project is to build a sustainable, multidisciplinary stakeholder community consisting of different actors from various countries, professions, and schools of thought. It is intended that the members of this LINKS Community learn and benefit from the project development and outcomes while providing their knowledge and expertise to improve LINKS research. An important tool for this purpose is the LINKS Community Center (LCC) as it is the gathering place for the online community.

> The LCC brings together different stakeholders (LINKS Community) in one user-friendly and flexible web-based platform and enables them to exchange knowledge and experiences and to access, discuss and assess learning materials on the usage of social media and crowdsourcing (SMCS) in disasters. (LINKS Glossary)

Through the LCC, stakeholders are able to access products included in the LINKS Framework (Fonio & Larruina, 2023), such as libraries on SMCS technologies and guidelines. The evaluation and practical application of the LINKS Framework have been carried out through case assessments (WP6). The LCC, therefore, plays a vital role in creating and fostering a lively community around the LINKS project and its results. Furthermore, the LCC will be a valuable tool for establishing and sustaining the LINKS Community beyond the duration of the LINKS project.

The LCC directly contributes to the LINKS project objectives by:

- **Sustainable advanced learning on SMCS in disasters (O1):** Integrating the LINKS Framework in an online environment in a dynamic way which enables stakeholders to access, learn and refine the LINKS Framework.
- **Achieve a consolidated understanding of SMCS in disasters (O2):** Supporting the LINKS case assessments of the Framework.
- **Govern the diversity of SMCS in disasters (O3):** Providing visibility for and access to the Framework and project results and supporting the validation and evolution of the Framework by the LINKS Community.
- **Bring multidisciplinary SMCS stakeholders together (O4):** Providing an online interface for diverse stakeholders to learn through discussions, collaborations, and the exchange of knowledge.

In summary, the LCC significantly contributes to all four LINKS project objectives by integrating the LINKS Framework into an accessible online platform. This dynamic environment supports the assessment and improves the visibility of the Framework by providing access to it for the LINKS Community. Being an open online platform, the LCC also brings stakeholders together and allows them to learn from each other.

The needs and potentials of the LCC were described in Deliverable 7.1 (Kiehl, et al., 2021), and an architecture based on them was elaborated in Deliverable 7.2 (Kiehl, Tappe, Werner, Habig, & Marterer, 2021). A first version of the demonstrator was presented in Deliverable 7.3 (Kiehl, Habig, & Marterer, 2021) and a second version in Deliverable 7.4 (Kiehl, Habig, & Marterer, 2022). The first report on community management and quality assurance in the LCC was published in Deliverable 7.5 (Kiel, Habig, & Marterer, 2022).

1.1 About this deliverable

Based on the previous work, this document provides a progress report on the application of the integrated quality assurance and community management methodology from D7.5 and describes the changes that were implemented as a result of this application.

To this end, first the methodology itself is described in an abridged form in Section 2, briefly explaining its three main components: content, user experience and community. Following this introduction, each following section describes changes and progress implemented within each of these three aspects. Section 3 describes changes in the "content" aspect, Section 4 – in the "user experience" and Section 5 – the community. Finally, Section 6 provides a summary and future plans.
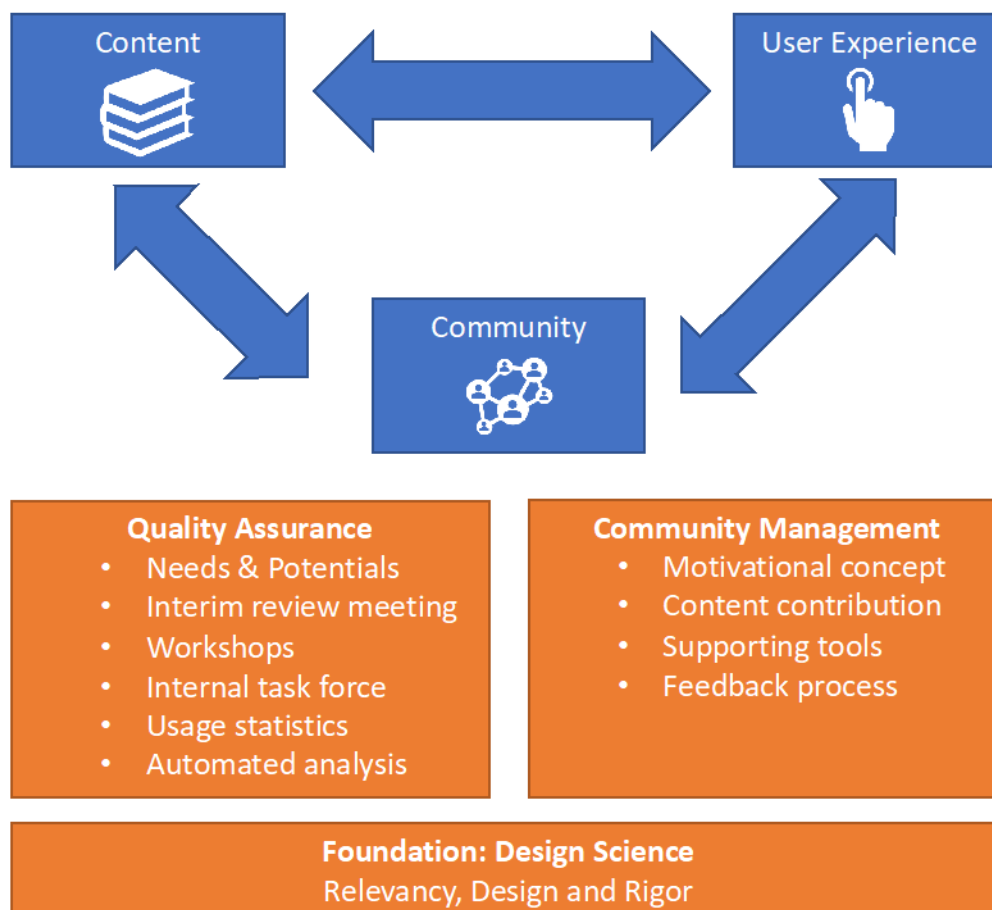
2. METHODOLOGY

The integrated quality assurance and community management methodology (depicted in Figure 1) was described in D7.5 (Kiel, Habig, & Marterer, 2022). In this document, we provide a short summary of its basic principles for the sake of convenience and clarity of document structure.

2.1 Overview

This methodology combines both the community management and the quality assurance of the LINKS Community Center (LCC), as both are inseparably linked with each other. Workshops (e.g., LINKS Community Workshops and LINKS Advisory Committee meetings) conducted for the quality assurance simultaneously stimulate the community as they are realized together with community members. Conversely, all community members also contribute to the quality assurance, e.g., by reporting or correcting incorrect or outdated information or by reporting usability issues.

Figure 1: The integrated quality assurance and community management methodology

During the development and testing of the LCC it has become apparent that there are three distinct but interrelated areas which need to be examined using the integrated methodology. These areas,

described as content, user experience and community, all influence one another and are related to each other. These three aspects of the methodology are described in the following subsections.

2.2 Content

As described in Section 5.4 of D7.2 (Kiehl, Tappe, Werner, Habig, & Marterer, 2021), the LCC facilitates access to the content produced by the LINKS Knowledge Bases and the LINKS Framework. In this capacity, the LCC supports the product owners in performing quality assurance for the products that are developed fully within the LCC, which includes all SMCS Libraries. For this purpose, it provides tools to report incorrect, outdated or missing content and to forward such reports to the responsible persons. Furthermore, since the LCC provides easy access to the developed products it can therefore be used to evaluate and explore the products, both during the LINKS project, e.g. in workshops, and by end users and stakeholders, even outside of LINKS activities. The content aspect of the integrated methodology will be explored further in Section 3.

2.3 User Experience

Next to the content, an enjoyable and pleasant user experience is key to the LCC's success. Users who experience frustration while using the LCC, e.g. due to technical issues or poor usability, are less likely to keep using the LCC. Conversely, achieving high levels of user satisfaction through improved user experience can help bring more users to the platform. Additionally, parts of the user experience, such as loading times, can influence the LCC's ranking on search engines and are therefore important for the platform's visibility and user acquisition. The gathering and evaluation of data on the user experience and its subsequent improvement is therefore a key part of the quality assurance methodology. Section 4 of this document will focus on the user experience aspect further.

2.4 Community

Establishing the LINKS Community is a key aim of the project (governed by WP8) and the LCC is an important instrument in the formation and expansion of this community. Conversely, the community is a crucial instrument for the LCC, as its members can help produce content, identify issues and report problems by simply using and engaging with the platform. Therefore, community is tightly intertwined with the content aspect of the methodology and contributes significantly to ensuring high quality in the LCC. Furthermore, a lively community can attract even more users over time, further strengthening its positive effect on the platform. This bidirectional importance between the community and the LCC therefore calls for a holistic quality assurance methodology that also covers the community management and engagement by design. The community aspect will be covered in Section 5.

3. CONTENT

This chapter describes changes in the LCC that fall into the "Content" aspect of the methodology. These involve additions of new content in the LCC as well as improvements in closely related areas, such as content management and contribution mechanisms. Some of these changes were prompted by the community's feedback and workshops while others were conceived by internal task forces as a direct application of the methodology.

3.1 Sustainable Quality Assurance Concept

3.1.1 Idea and Motivation

As described in Section 2 of this document, the integrated methodology encompasses quality assurance in its overall conceptual framework. Now that the LINKS project has reached its conclusion, several of the instruments of the quality assurance are no longer available. In particular, this concerns workshops, internal task forces and other activities previously organized through the project. This means that the "community" and, in part, the "content" aspects of the integrated methodology are affected negatively. Therefore, the extent of how much quality assurance can be applied as initially envisioned by the integrated methodology is reduced. For this reason, it is crucial to set up a sustainable quality assurance concept that will help to mitigate these gaps. This chapter will present such a concept and possible ways to implement and build upon it.

The core idea of the concept is to involve community members more directly using LCC's internal mechanisms. In contrast to community activities organized by the project where participants are guided by, e.g., workshop organizers, the new concept seeks to provide community members with the means to directly influence content quality without supervision or external assistance. In this way, the proposed concept can be more self-sufficient and therefore more sustainable long-term.

The cornerstone of this sustainable quality assurance is the notion of "approvers". Approvers are a special type of user with additional user rights. Conceptually, approvers possess the ability to review changes to the content within the LCC and determine whether the changes measure up to the quality standards. However, unlike reviewers that one would normally find in, e.g., a journal or a book editing process, approvers are not expected to immediately suggest how to improve upon the proposed changes. Instead, they possess the ability to approve or reject the proposed changes. This has been decided in order to streamline the quality control process and not overburden the approvers.

Naturally, approved changes are incorporated into the LCC while rejected changes are discarded. The crucial part in this process is that changes that have not yet been processed by an approver are marked as unapproved, thus signaling that they need verification.

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3.1.2 The Concept in Detail

The entire process can be seen in Figure 2. It consists of 10 steps, most of which are performed by the system automatically. This should decrease the workload on both the user and, most importantly, on the approver in order to make the process more efficient even when there are many edits to approve.

Figure 2: Sustainable quality assurance concept
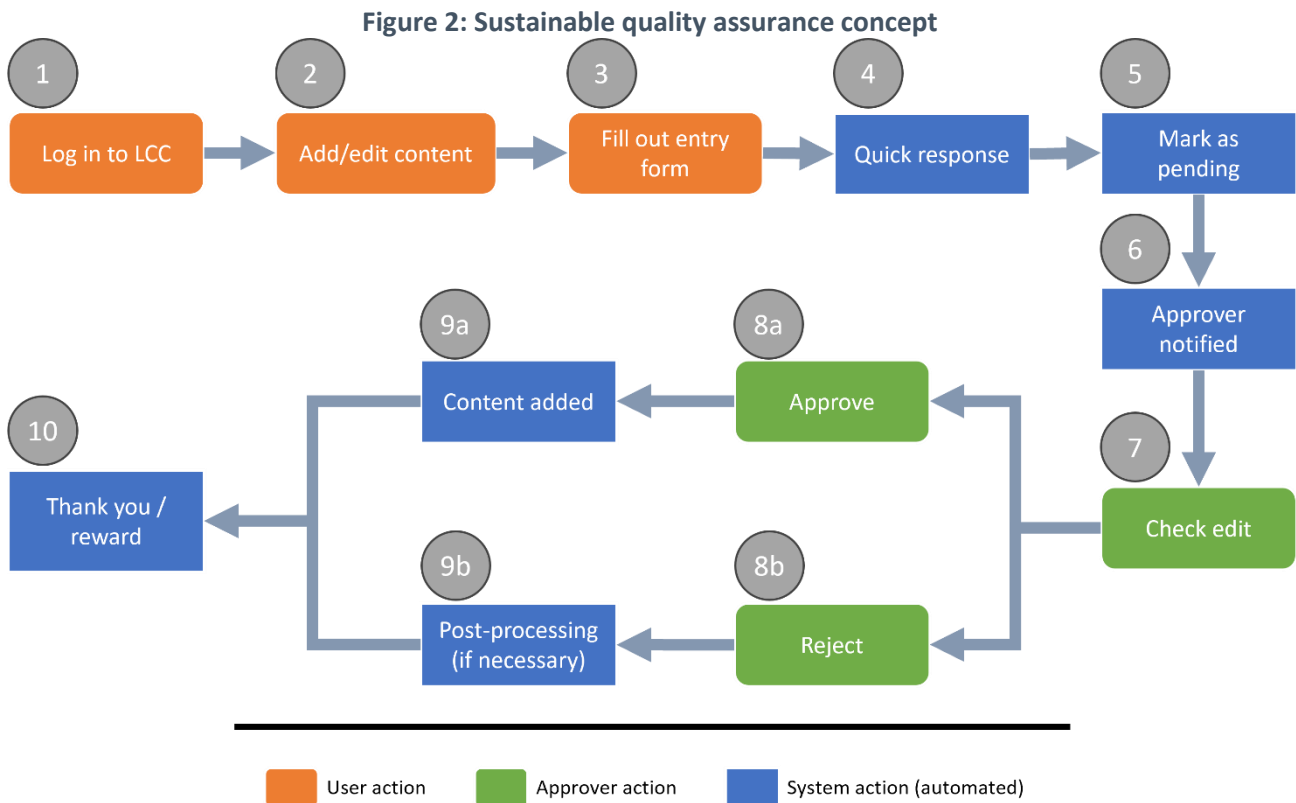
The steps are as follows:

1. The user needs to be registered and logged in order to make changes to the LCC.

2. The user adds new content or makes changes to the existing content.

3. This step only applies to the four SMCS Libraries as they can only be modified through the new contribution forms (see Section 3.4), which applies to both adding new and editing existing entries. The forms offer an additional benefit in terms of quality control in that they can contain mandatory fields. With this, it can be guaranteed that the user supplies at least the bare minimum in terms of data, such as the "core data" of a DCT. For all other content in the LCC, the user will be utilizing internal editing facilities provided by the MediaWiki[2] software. In either case, the process works regardless of the input method.

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[2] www.mediawiki.org

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4. The system replies to the user action with a confirmation. This is an important step because the user's edit will not be applied before approval which can lead to confusion. At this point, the response message should inform the user about the approval process and that it might take some time. This can take the form of, e.g., a popup displayed directly on the screen, a personal notification, an email message, etc.

5. The system saves the user's edits if they passed a contribution form's validation. The change remains in the system's data but is marked as unverified to alert the approvers.

6. The system notifies approvers or otherwise makes it known that a new edit is pending approval. This can be a direct in-system message or an email to all approvers. Depending on how many edits can be expected to be produced simultaneously, several strategies are possible here: notifications can be sent in batches in timed intervals rather than per-edit; notifications can be sent to only select approvers that subscribed to particular edit types instead of en masse; finally, notifications can be collected in a single special page on the LCC that the approvers can visit at their leisure.

7. The approver checks the edit to verify that it complies with the quality assurance requirements. There is a multitude of characteristics or dimensions of data quality that can be used for this purpose, such as completeness, accuracy, relevance, timeliness, etc. Each of these characteristics can entail its own validation process. For example, checking the accuracy of data would require the approver to re-check the source if provided or even necessitate finding a source themselves. On the other hand, checking the completeness of new edits should only require checking the data against the corresponding schema and identifying missing information. Selecting the appropriate quality assurance requirements for content in the LCC is therefore a balancing act between data quality and effort.

8. Based on the previous step, the approver decides to approve (8a) or reject (8b) the edit.

9. Based on the decision made in the 8th step, the system performs one of the following:

    a. The change is applied to the system and is marked as approved.

    b. The change is rejected and any necessary post-processing is performed. This can include a variety of actions: simply remove the change from the system; apply the change, but leave some type of a warning that the change was not approved or should be regarded with caution; save the change as a separate entity, possibly pointing back to the original (for example, an automatic redirection); attempt to correct invalid data automatically; and many more.

10. Finally, the system notifies the contributor about the outcome of the approval process. The mechanism of this notification can be one of those described in step 4. This step carries a similar importance in terms of user experience as step 4. Firstly, silent approval or rejection

can lead to confusion on the user's part. Secondly, this step offers an opportunity to increase community engagement by providing a reward for a successful contribution. This can take the form of a simple "Thank you" message or an in-system reward, such as awarding a community badge.

Overall, this concept is designed to be easy to use by both contributors and approvers, as most steps are performed by the system. This means that the initial set up efforts can potentially be quite high, as every automatic action requires initialisation and configuration.

3.1.3 Improving the Concept

In addition to the considerations for each separate step described above, there are also user-related aspects that can be leveraged to improve the concept further.

Firstly, approvers should generally be trusted and respected within the community. Therefore, well-established, active and motivated members of the community are particularly suited for the role. This can become an additional facet of the motivational aspect – just as active users are rewarded with badges and achievements as outlined in D7.5 (Kiel, Habig, & Marterer, 2022), they can be rewarded with a more privileged role of an approver on the platform to increase engagement.

Secondly, approvers with high levels of expertise can bring additional benefits. Depending on the selected data quality criteria, the approver might need to possess a certain amount of expert knowledge in the domain of disaster management and social media. For example, while simple protection from vandalism would require relatively little specialist knowledge – which would generally fall under the "relevance" aspect – verifying the accuracy of data might require an expert's oversight. For this reason, it might overall be a good strategy to involve experts and specialists in the field to fulfil the approver role.
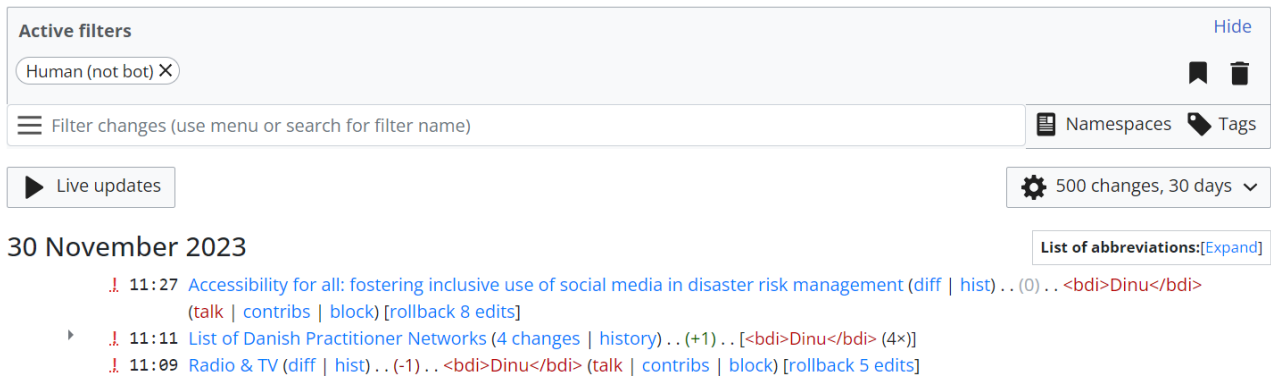
Finally, the concept can be implemented on an even stronger scale. Instead of simply marking the edits as unapproved, they can be hidden from other users entirely until an approver verifies them. This version of the concept is more disruptive as the changes made by regular users will not be applied immediately, but it offers better protection against vandalism.

3.1.4 Application of the Concept in the LCC

This quality assurance concept has been gradually introduced to the LCC in the last year since the publication of D7.5, first beginning with conceptualisation then moving to initial implementation stages. Due to the necessity to first evaluate whether the technical infrastructure of the LCC can support the required processes as well as the need to not disrupt regular community activities like workshops, a decision was made to introduce the concept in small steps – starting with a realisation on a reduced scale and gradually moving towards full implementation.

In accordance with the notification strategy options described in the 6th step, all unapproved edits are collected in one special page on the LCC where approvers can view them alongside a short summary of the changes. This can be seen in Figure 3 where pending edits are marked with a red exclamation point.

Figure 3: List of unapproved changes (excerpt)

Following the improvement strategies outlined in Section 3.1.3, test application of the concept has been performed with a selected team consisting of experts in the LINKS project, namely members of SIC, FEU, DHPol and VU. The differences in the areas of expertise allowed the approvers to split responsibilities for validating different dimensions of data quality. The following dimensions have been considered:

- Accuracy – approvers were asked to verify that the entered data accurately reflects true values and states it describes. This often required double-checking the source of the information or performing a brief research. Expert knowledge has proven particularly useful here.

- Consistency – even though the contribution forms of the SMCS Libraries help ensure consistency of data, sometimes users mistakenly enter correct data in the wrong field or use incorrect formatting. Approvers were tasked to ensure that supplied information aligns with the schemata.

- Relevance – approvers screened the data for information irrelevant to LINKS and the LCC, such as entries in the SMCS Libraries that did not align with the LINKS understanding of DCTs, Guidelines or Use Cases.

- Completeness – this concerned entries inside the four SMCS Libraries. The data was checked against the corresponding semantic schema to identify missing components. Missing information has been supplied where possible.

In addition to the list above, the LCC also provides automated support for ensuring the following data quality dimensions:

- Validity – the data must adhere to the constraints of the data model. This is ensured by making the SMCS Libraries editable only through the contribution forms, which directly reflect the schemata.

- Accessibility – The technical foundation of the LCC is the MediaWiki software which is open by design and the Libraries present all their data in a user-friendly and publicly accessible way.

Overall, the usage of the concept proved a success. Throughout the course of testing, the concept proved to function adequately with the current software infrastructure of the LCC and has led to a lot of improvements in the LCC's content landscape – from small corrections to full article rewrites. Many smaller inconsistencies in the entries of the SMCS Libraries have been caught and fixed as well.

3.2 Crisis Communication Library

The Crisis Communication Library (CCL) is a brand new SMCS library that has been added to the LCC. It was conceived and elaborated by the LINKS Consortium partners at FEU.

The CCL collects information on apps, websites and texts that pertain to crisis communication with the general population, such as warning apps, emergency notification apps, official recommendations on how to act in or prepare for various emergencies or disasters and other instructions on crisis situations from trusted sources. The aim of this library is to create a structured and navigable overview of both the content and the instruments of public crisis communication.

The initial idea for the library was proposed during round table discussions at the LINKS Annual Meeting in July 2023 which involved both LINKS Consortium members as well as invited practitioners. After the meeting, FEU proceeded with conceptual development and collection of data for the library in preparation for its technical implementation in the LCC.

Fundamentally, the CCL is aligned with the other SMCS libraries in its aim to enhance, facilitate and simplify the work with SMCS for disaster management organisations. In particular, it has been identified that DMOs, especially at the local or regional level, are often unfamiliar with or unaware of existing developments in crisis communication, such as particular warning/emergency apps or websites. This issue is further exacerbated by the fact that such crisis communication methods are often specific to particular countries or regions (e.g., the German NINA app) and are therefore less known or promoted in the rest of the world. The CCL is intended to help practitioners fill these knowledge gaps.

In addition to apps and websites, the CCL also collects crisis communication texts which typically include instructions and recommended actions before, during and after a disaster situation. By including them in the library, the CCL helps the practitioners find appropriate instructions for the general public in addition to the technological means of spreading them.

Like other SMCS libraries, the CCL also possesses a semantic schema which outfits each entry with a set of properties that can be used for search, filtering and semantic interlinking purposes. Complementing useful metadata such as a source URL and the name of the publishing organisation, the following properties can be used for filtering:

- Type: indicates whether the entry is a text, website or an app.

- Language: the language of the main content or user interface.

- Disaster Management Phase: indicates which phases (before, during and after) the content is applicable to.

- Scenario: indicates which scenario the content pertains to. This is typically a disaster scenario such as an earthquake, tornado, terrorist attack, etc.

Similarly to other libraries in the LCC, a user interface has been developed for the CCL, which includes a filterable overview table and a "profile" page for the entries. The interface was designed to have the same look and feel as the other libraries in order to maintain the overall design philosophy of the LCC. The abovementioned properties can be used as a dynamic filter in order to find results quickly. To complete a typical LCC library setup, a contribution form has been created for easy and intuitive data entry.

Overall, the CCL is a valuable addition to the LCC as it aims to help practitioners effectively communicate with the public regarding risk awareness, preparedness and appropriate crisis behaviour. With ca. 60 entries at the time of writing, the CCL represents the largest addition to the LCC's content landscape since the publication of D7.5.

3.3 Bridging Pages

As the LCC serves as the main platform to make the LINKS products accessible, it is important to ensure that the presentation of the products in the LCC aligns with their purpose, represents them well and offers a good entry point for the end users unfamiliar with them. This has already been covered for the SMCS libraries since they are published on the LCC in their entirety and have been designed with usability and user-friendliness in mind. However, three further products – Feel Safe, Including Citizens Handbook and the Resilience Wheel – required integration in the LCC as they are not implemented within the Library model (cf. D2.7 (Lüke, et al., 2022)). Since two of them are full-scale web platforms themselves, these products have been integrated on a reduced scale in the form of "bridging pages" in collaboration with the respective WPs.

As the name suggests, the purpose of these pages is to create a logical bridge between the LCC and the product's respective platform. Through this bridge, the user can be informed about the products, their aims and their structure directly on the LCC and then navigate to their respective platform.

These pages existed in the previous version of the LCC, but did not act as a bridge conceptually. In order to improve the user experience with these pages and foster a closer integration of the products, the bridging pages have been updated in close cooperation with the WPs responsible for each product. In the updated version, the pages have been expanded considerably, now providing more detailed descriptions of the products and explaining their structure as well. Furthermore, the structure of the products has been made navigable, thus providing a kind of a "table of contents" for each product and allowing the user to navigate to specific sections of the product that are relevant to them (an example of this can be seen in Figure 4). This navigability of the bridging pages also plays a key role in the updated User Guidance, as it makes it possible for the Guidance to match specific question paths to specific product sections and guide the user to them. Section 4.1 offers more information on this topic.

Figure 4: Bridging page for the Including Citizens Handbook, showcasing navigable sections (excerpt)

Out of the bridging pages, the page for the Resilience Wheel represents a special case since it is not an external platform, but rather a set of methodological tools. In order to adequately represent the Wheel and make it accessible to the user, all the required materials have been made available on its page in collaboration with WP3, including downloadable templates and a full description of the methodology and its procedures. Thus, the user is granted full access to the Resilience Wheel directly from the LCC making it part of the LCC's content landscape.

3.4 Contribution Forms

Since content is one of the major pillars of the integrated methodology and one of the main attractions of the LCC for end users, it is highly beneficial for the content base to be allowed to grow and expand. Combined with the LCC's overall aim to form and maintain a community, this means that

allowing users to contribute new content aligns well with LCC's main goals as well as with the integrated methodology itself, falling under its "content" and "community" aspects.

The success of this approach has been already demonstrated in D4.4 (Lüke & Habig, Case Assessment regarding Disaster Community Technologies, 2023) through the example of the Use Cases Library which has been experimentally outfitted with a special online form that allowed users to contribute new use cases to the library. This approach has since been extended to all four SMCS Libraries.

Firstly, a contribution form has been developed for each library (an example for the SCMS Technologies Library can be seen in Figure 5). The forms reflect each library's semantic schema, which is a set of properties describing the model of a library's entry, (cf. D2.7 (Lüke, et al., 2022) and D4.4 (Lüke & Habig, 2023)), so each field in the form corresponds to a particular semantic property. This allows for an uncomplicated and intuitive method to enter all the data in a structured way, strictly adhering to the library schemata, even if the user is not intimately familiar with all of its aspects. To make the process even more self-explanatory, the fields have been outfitted with short explanations and placeholder examples wherever we anticipated the user might encounter difficulties in understanding the purpose of the property.

Secondly, all the forms have been made publicly accessible via LCC's user interface to all registered users by clicking on the "Add new…" link above the overview list.

Figure 5: SMCS Technology contribution form (partial)

Technology: New Technology

Basic Data	Search & Monitor	Post & Schedule	Analysis	Metrics	Report	Collaboration	Interoperability	Meta

Is archived: ⓘ ☐

Description:

Website:

Provider: ⓘ

Source country:

Tool created in year:

Formerly known as:

Used by Practitioners: ⓘ ☐

Use Cases available: ☐

Disaster Management Phase:
☐ After
☐ Before
☐ During

Crisis Communication Matrix:
☐ Citizens to Citizens
☐ Authorities to Citizens
☐ Citizens to Authorities
☐ Authorities to Authorities

Overall, this change should contribute to increasing community engagement as it allows motivated community members to actively participate more easily, while non-contributing members can benefit from the new shared knowledge. Additionally, this change is also expected to contribute to the increase in the amount of content available on the LCC, thus serving the purpose of further application of the integrated methodology.

4. USER EXPERIENCE

This chapter describes the progress pertaining to the "user experience" aspect of the methodology. Similarly to the "content" area, these changes were prompted by direct feedback from the community and conceived by internal task forces with the view to further improve user experience.

4.1 User Guidance Update

The "User Guidance" is a dedicated page on the LCC that contains a wizard-like interface that matches various LINKS products to simplified questions. By answering these questions one by one, the user is guided to the products that best correspond to their interests. The User Guidance therefore helps to onboard new users and introduce them to the products, many of which are implemented directly in the LCC.

The User Guidance has been evaluated and updated several times throughout the project as a result of multiple rounds of case assessments and the subsequent analysis and further development of the LINKS Framework and the products. The final result has been achieved between April and November 2023 which has also led to an update to the User Guidance as a manifestation of the updated Framework (see D6.6 (Larruina, et al., 2023) for full report).

The most important change was in the content of the Guidance, i.e., the questions and answers it contains. In collaboration with the relevant WPs, multiple questions have been rephrased for improved clarity and several answers have been made more precise in the destination they lead the user to. For instance, where some of the previous answers would lead the user to the Feel Safe or Including Citizens Handbook bridging pages, they now point to specific subsections of these products that are most relevant to the question. This has been made possible with the update to the bridging pages that has outfitted them with navigable structures (see Section 3.3). Furthermore, some of the User Guidance answers that have previously led to the overview pages of the Guidelines or the Use Case Libraries now pre-activate appropriate filters in them for a more precise answer set (this was already done for some of the answers pertaining to the Technologies Library).

Another important change was the handling of the Resilience Wheel. In the previous version of the User Guidance, the Wheel was treated the same as other products and thus the question paths that led to the Wheel were on the same level as all other products. However, evaluations have shown that, conceptually, the Wheel fits on a higher level within the question hierarchy as it can cover multiple subthemes at once. For this reason, the answer cards leading to the Resilience Wheel have been taken out of the User Guidance and replaced with a highlighted infobox, once per major theme. This helps to better position the Wheel within the Guidance and thus helps improve the user experience by providing more precise navigation.

The updated User Guidance has then been evaluated as part of the final application of the LINKS Framework in a broader context (D6.6 (Larruina, et al., 2023)). Overall, the changes were well-received, confirming that regular evaluations with the community lead to increased quality of content as envisioned by the integrated methodology. For more information on the User Guidance evaluation, see Section 5.3.

4.2 Snippets

The content base of the LCC has been steadily growing throughout the project and in its current state the LCC offers a large amount of information to its users. In order to further enhance the user experience in regards to interacting with this content, a new feature has been introduced – the snippets.

Snippets are small interactive cards or tiles with mostly textual content, however pictorial content such as icons and images is also possible. These user interface elements are an established web design practice and can be found on many websites, e.g., Amazon. Functionally they act as quck navigation aids that lead to other sections of the LCC. The text inside a snippet normally contains at least a short description of what the snippet links to in the form of a suitable "tagline". Optionally, the snippet can also contain a headline/title that precedes the tagline so that they can form a question-and-answer pair, e.g., "Want to advance your organization's use of social media?" – "Try the Resilience Wheel".

Figure 6: Snippets in the LCC, showing the headline/question side

In their current implementation, the snippets in the LCC show the headline/question by default and flip over to reveal the content/answer when the user moves the mouse over them (see Figure 6). Currently there are six snippets visible on the home page, arranged as a grid, leading to six different products, but the implementation allows any number of snippets to be recorded while the snippet grid selects six at random. Therefore, as more snippets are added, the snippet grid will show a different selection of snippets on each page visit or page load.

Conceptually, the snippets represent highlights within the LCC's content landscape – particularly well-written and informative articles, interesting entries in the libraries etc. By placing the snippets in a prominent location on the LCC's home page, the user can be made aware of such content more directly instead of relying on it to be found naturally. On one hand, this improves the user experience of the content consumer because they are directed to highlighted content. On the other hand, this improves the user experience of the content producer since their contribution can be highlighted and promoted through snippets.

However, the conceptual scope and potential of the snippets is actually broader than just highlighting content. Snippets can be used as focused and targeted entry points to any kind of "content category" and content quality is only one of many possible ways to define such a category. To further leverage interlinking and data structuring mechanisms already present in the LCC, one could define content categories via, for instance, filter types in the libraries. An example of such interlinking could be the "Audience Experience Level" filter in the Guidelines Library which determines the level of expertise required for a particular guideline. Using this filter essentially creates an "on-the-fly content category" defined by the expertise level. Leveraging this mechanism, one could, for example, create a snippet that would lead a user to beginner-level guidelines on a particular topic, thus acting as a dynamic introduction to it.

From the user experience standpoint, snippets have a very focused target range, bringing the user directly to a point of interest in the LCC. This presupposes a certain amount of existing knowledge on the user's part: in order to know what snippet targets would be interesting, the user needs to possess at least a basic understanding of the LINKS-adjacent concepts, such as SMCS, the meaning of "technology" in this context, etc.

4.3 Tool-based Analysis

In addition to regular evaluations with end users, it is also important to ensure that the technical foundations of the LCC perform optimally and up to modern standards. While evaluations with the community are important for maintaining high user-friendliness, the basic criteria of a sound technical implementation can be evaluated automatically. At the same time, technical issues or suboptimal performance can negatively affect user experience with the LCC and therefore have to be identified and remedied. For these reasons, an automated tool-based analysis of the LCC's technical implementation is performed regularly.

The Google Lighthouse[3] analysis tool is used to evaluate the LCC across four metrics: performance, accessibility, best practices and search enginge optimization (SEO). While performance and accessibility are important for the user experience (i.e., low scores on these metrics affect it negatively), the latter two are important for such aspects as stability, security and how well the LCC can be discovered through search engines. Each metric receives a score from 0 (worst) to 100 (best). An example of such a report can be seen in Figure 7.

Figure 7: Current Lighthouse report for the Home page (excerpt)
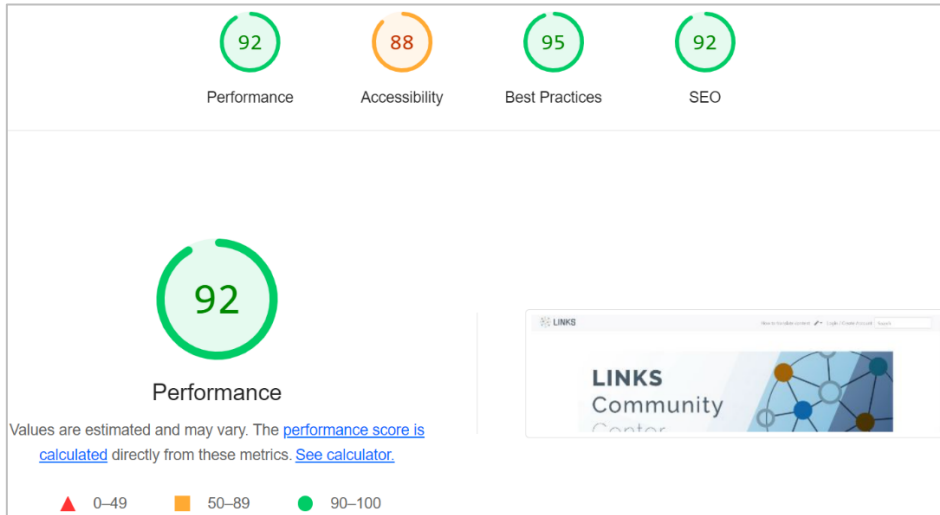
In order to demonstrate how the LCC has been improved with the help of the tool-based analysis, we compare the current evaluation results with the numbers published in D7.5 (Kiel, Habig, & Marterer, 2022). Since Lighthouse performs its analysis on a per-page basis and the LCC contains hundreds of pages, three key pages have been selected for the sake of illustrating how well the LCC performs in general. These pages are the home page, the Technologies Library and the Technology profile page. These pages are not only key for the user experience, but are also the most computationally intensive, as most other content in the LCC is text-based.

The following table shows a comparison of the measurements between the numbers reported in D7.5 and their current values. The "best practices" metric was not reported in the D7.5 therefore it is not represented in the table, although the current values will be reported later in this section.

Table 1: Comparison of current Lighthouse scores with D7.5

	SCORE IN D7.5	CURRENT SCORE
Performance		
Home page	65	92
Technologies Library	37	98
Technology profile	72	97

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[3] developer.chrome.com/docs/lighthouse/overview

Accessibility		
Home page	96	88
Technologies Library	83	81
Technology profile	92	79
SEO		
Home page	85	92
Technologies Library	85	92
Technology profile	85	92

As can be seen from the values, the performance of the sample pages has been improved drastically. Previous scores, especially the Technologies Library, were significantly below the optimal range which directly correlates with longer loading/rendering times. This is detrimental to user experience, as many users will feel frustrated if the page takes too long to be displayed and sometimes even outright leave before it loads fully. Following up on the mitigation strategies outlined in D7.5, loading times and overall performance have been brought up to the near-maximum score.

This has produced a moderately negative side effect in the accessibility score experiencing a slight decrease for all three pages. The main reason for this are the updates to the underlying software – the MediaWiki engine and most of the extensions. The newer versions of the software do not fulfil some of the more recent accessibility recommendations, such as restrictive list element hierarchies, which has lowered the overall score. However, the decrease is negligible and should be fixed automatically with future software updates.

The SEO scores have also been improved based on suggestions from the Lighthouse reports. This should lead to the LCC being more discoverable through search engines and crawlers, which should improve the platform's visibility on the internet.

Finally, the current best practices scores are 95 for the home page and the Technologies Library and 100 for the Technology profile. This indicates that the LCC follows good practices and recommendations of software development which should ensure stability and security of the platform.

Overall, continuous tool-based analysis of the LCC was able to identify weak spots in the areas of user experience, visibility and stability which has led to significant improvements in these areas in the current reporting period, ensuring high quality and user satisfaction with the LCC.

5. COMMUNITY

This chapter describes activities and measures corresponding to the "community" aspect of the methodology. These activities heavily involve the LINKS Community as its primary instrument and correlate with aims and activities of WP8, placing the emphasis on the LCC and its interconnection with the LINKS Community. As this deliverable is a follow-up to D7.5 (Kiel, Habig, & Marterer, 2022), only the activities that occurred since its submission are described here. Thus, the reporting period is from December 2022 to November 2023.

5.1 LAC Meetings

The LINKS Advisory Committee (LAC) is an extremely important instrument for the development and continuous improvement of the LCC. The committee is composed of invited professionals and experts who represent a wide range of stakeholder organizations aligned with the main target groups of the LINKS project. As such it holds the main role within the overarching LINKS Community structure and is therefore of high importance for the community aspect of the integrated methodology.

The aim of the LAC activities is to achieve validated and practical results in the project by providing guidance, insights, and validation for the project's developments and outcomes. To this end, the LAC conducts extensive discussions on the project's outputs with a diverse group of stakeholders, including representatives from associations within the project consortium. Several of these LAC activities in the current reporting period involved discussions and feedback on the LCC, either as a whole or as the platform hosting the discussed products, and only those activities will be mentioned in this section. For a more detailed description of the LAC meetings and their results, please refer to D8.6.

In particular, the **3rd LAC meeting** that occurred online in February 2023 dealt with the assessment of the LINKS Framework and its integration into the LCC and incorporation of the SMCS Libraries. As all these elements are tightly integrated with the LCC, the discussions also involved feedback on its design and usability.

The **4th LAC meeting** in Rotterdam in June 2023 which also involved members of the ENGAGE project dealt with the LCC and the SMCS Libraries which were presented to the audience. The following workshop and round table discussion have produced some valuable feedback on how to improve the LCC even further.

Finally, the **LINKS Final Event** in Rome in October 2023 involved presentation of the libraries and especially Crisis Communication Library which also led to discussions around the topic of the LCC. Many of the members of the committee were present for the discussions and their feedback could be collected.

Altogether, the LAC activities have proven to be invaluable for continuous improvement of the LCC as many of the changes presented in this document came as a direct result of these activities. This represents strong evidence that the community leg of the integrated methodology has been correctly identified as one of the crucial aspects of quality assurance.

5.2 Snippet Workshop

As described in Section 4.2, the snippets were a new concept developed to enhance user experience in the LCC. In order to inform the community about this development and make the snippets as relevant and engaging as possible, a workshop dedicated to snippets was held at the Annual LINKS Meeting in Osnabrück, Germany in July 2023.

The participants were split into groups corresponding to the LINKS products, with the product owners leading the respective group. Each group was given paper templates to fill out which consisted of three parts corresponding to the content of a snippet: an optional headline, which would normally contain the "question"; the tagline/content which would contain the "answer" or a call to action; and finally the action that is supposed to happen upon a mouse click.

During the description of the workshop task, it was emphasized that the snippets should motivate the user to visit the respective product and therefore the contents of a filled out template should be written akin to an exciting advertisement and include an engaging call to action. This had a dual purpose. Firstly, the texts produced in this way would be more likely to motivate an LCC user to view content highlighted through snippets. Secondly, these texts, due to their engaging nature, could be further reused to promote the LCC on social media, e.g., by posting single snippets on Twitter.

An example of a filled out template made by the Including Citizens Handbook group can be seen in Figure 8.

Figure 8: A snippet workshop template filled out for Including Citizens Handbook

Overall, the participants found the workshop enjoyable and reported satisfaction with this possibility to further promote their products. In fact, in the final round table discussion it was decided to continue this activity even past the Annual Meeting. For this purpose, participants were given the template in digital form and were encouraged to continue the activity in their respective task forces, submitting the results per email. Altogether, both the workshop and the subsequent individual work by the product owners has produced 33 snippet suggestions, which can be considered a successful outcome. Overall, the workshop demonstrated that the concept is well-received in the community and confirmed the interconnected approach of the integrated methodology.

5.3 User Guidance Evaluation

The User Guidance is an important part of the LCC aimed at enhancing user onboarding and providing navigational aid. It influences the user's overall experience with the platform. Conversely, it is not possible to evaluate the Guidance from the user's perspective without the user interacting with the LCC. The evaluation of the User Guidance that was performed for D6.6 (Larruina, et al., 2023) is

of interest for WP7 and activities carried out in the context of this evaluation fall under the "community" aspect of the integrated methodology.

The User Guidance was evaluated through a short assessment in a Google form. The assessment consisted of questions to assess the user guidance navigability and user-friendliness. An online evaluation was used to carry the validation because that allowed the respondents to answer in a situation as close to the real world as possible. In other words, the respondents would be sitting in front of their computers, at home or work, and navigating independently, looking for useful information and tools without assistance.

This was done by formulating questions about the different elements that the user would find on the journey through the themes, subthemes, questions, sub-questions and when arriving at the product(s) that would help to address their questions. The survey was formulated and evaluated between WP5 and WP7, whereas the WP7 perspective was covered by the addition of several questions that pertained to the LCC's overall usability and user satisfaction. Once the questions were finalised and formulated in the Google form, the form was tested to identify any issues the respondent could find when answering the questions.

The respondents were enrolled among practitioners and experts in the LINKS partners' extended network. The main criteria was that they needed to be individuals who, due to their work and interests, could use the User Guidance to navigate the LCC. The respondents were contacted by email and provided a link to the form and a link to the LCC. The survey was answered by 15 individuals within the two weeks provided. They represented four countries in the LINKS consortium – Italy, Germany, the Netherlands and Denmark – plus Spain and Norway. The respondents worked at operational and strategic levels within disaster management organisations or organisations that can eventually support disaster risk management activities at different levels. They were in the target group of the LCC; therefore, their experience with the User Guidance was paramount for the evaluation.

All the answers were very positive. All the respondents found the User Guidance user-friendly, clear, informative and visually engaging. They found the overall design appealing and easy to navigate in all its steps. Some minor feedback was provided regarding the amount of text used in the landing pages and the info cards. There were also minor suggestions about drop-down menus and reducing the number of questions in the Guidance. Nevertheless, while this feedback is valuable, its immediate application does not affect the overall navigability and use of the User Guidance, which all the respondents praised. All participants acknowledged that the Guidance was helpful when needing assistance to focus on recognising their needs as practitioners and while navigating the LCC to address the use of SMCS in disaster management.

In terms of the experience with the LCC as a whole, the form contained several questions regarding the overall usability, user friendliness and design of the LCC with an additional question requesting suggestions for improvement. Nearly all respondents stated that the LCC was very user friendly and

easy to navigate and described the visual design as pleasant. They also praised the minimalist approach to the user interface and deliberate use of color-coding and helper visuals like small icons as it makes it easy for new users to get used to the interface. All suggestions for improvement were minor and concerned only small inconveniences in the overall design, such as the placement of the search bar or the large size of the title on the home page. In summary, the User Guidance evaluation has demonstrated high user satisfaction rates with the LCC overall and the Guidance in particular. This confirms that the LCC has achieved high levels of quality as a project platform through its continuous involvement of end-users and the community in the evaluation and implementation process, as described in the integrated methodology.

5.4 Social Media Campaign

A social media campaign was designed to promote, enhance awareness, disseminate information, and foster community engagement regarding the LINKS products, the LCC and the integrated User Guidance. For each product, including the LCC, individual posts were created by the consortium tailored to the interests and needs of different target groups.

As the LCC is either the host of the LINKS products or integrates them via a bridging page, the social media campaign was of major importance for the purposes of visibility and acquiring new users. It played a crucial role in not only generating visitor traffic to the LCC, but also in expanding the LINKS Community. A larger community implies more members contributing new content, engaging with the LINKS products, participating in discussions, and providing feedback for quality assurance. An example post can be seen in the following figure, promoting the different products in the LCC.

Figure 9: Example Post from the Social Media Campaign
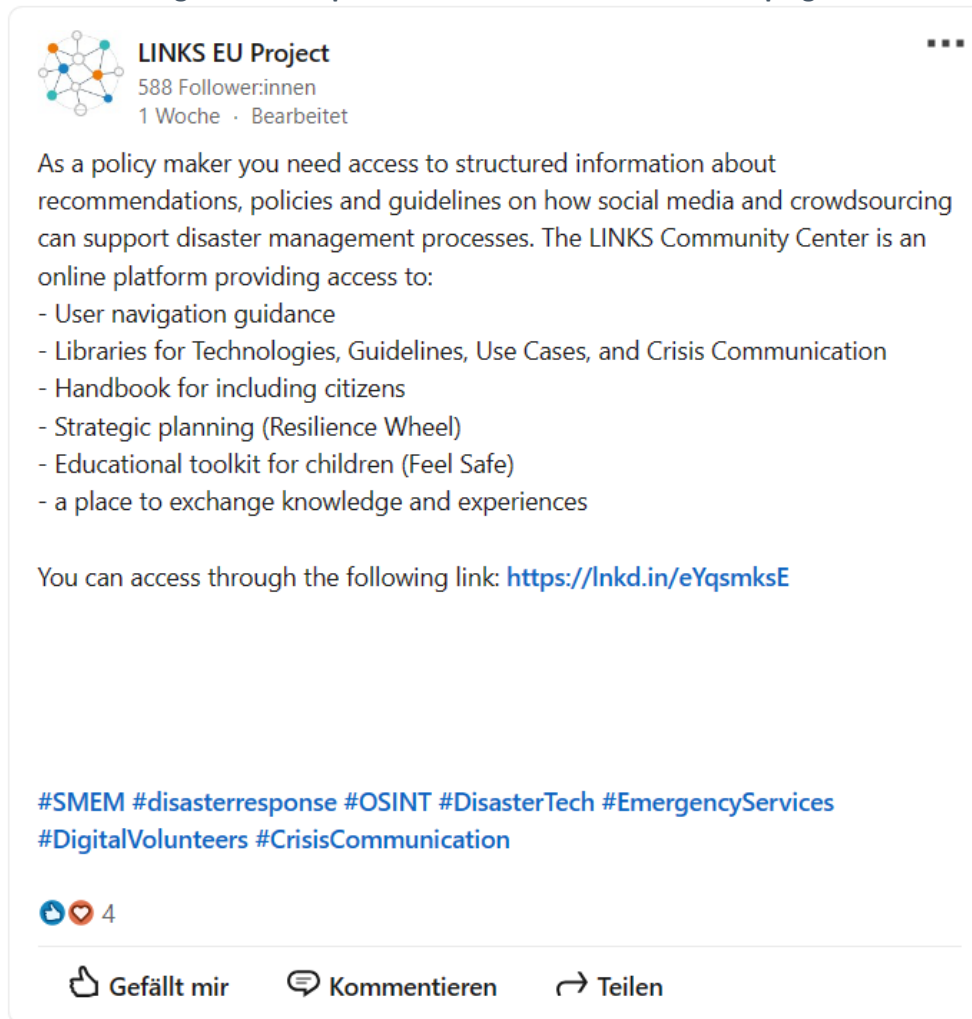
Taking into account the sustainability of the LCC beyond the project runtime, the growth in community size increases the potential to acquire new approvers, bringing in new expertise and background knowledge. This approach ensures a dynamic and interactive platform where community engagement leads to continuous improvement and expansion of the reach and impact beyond LINKS.

5.5 Usage Statistics

Collecting statistics about the usage of a website, such as the number of visitors, is an important tool in ensuring the website's quality as statistical data can reflect how successful the platform is or reveal weaknesses. The LCC utilizes Matomo Analytics[4] to record its usage statistics. Matomo is a web analytics platform that puts emphasis on privacy and data protection and has been configured
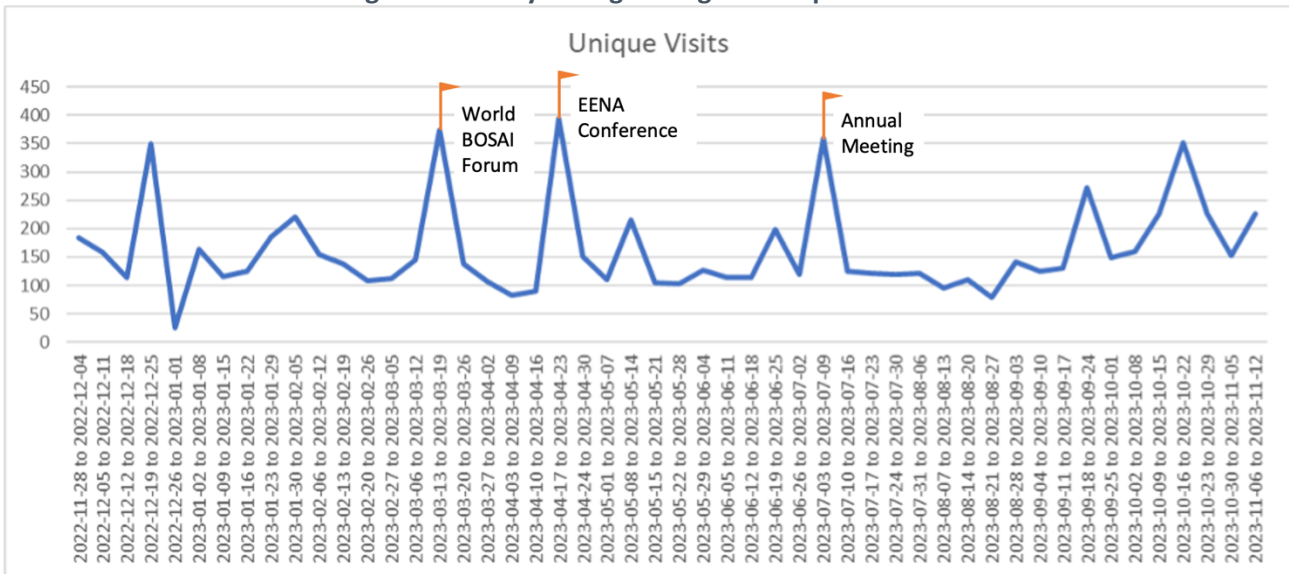
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[4] matomo.org

to be compliant with GDPR. This ethical approach to web analytics means that the recorded statistics provide an estimate below the actual numbers, since users can explicitly opt out of tracking or do so implicitly by disabling third-party cookies or engaging anti-tracking features in their browser.

As stated earlier, this document reports on progress since its predecessor, D7.5, which also means that the usage statistics provided here report for the time period since December 2022 until mid-November 2023. Furthermore, since D7.5 already contained a preliminary analysis of usage data, we will use its reporting period for comparison. This reference period encompasses data collected between May 2022 when the final demonstrator of the LCC first went online until the end of November 2022 when D7.5 was published. As is evident, this reference period is shorter than the reporting period used in the current document which can lead to slightly inflated comparison data. However, we believe this to not be an issue for the purposes of identifying trends, which is more relevant than raw numbers.

The most crucial user statistic for any public website is the number of visits. During the current reporting period, this number went up by 226,8% (from 2448 to 8001, cumulative total) compared to the reference period. Even adjusted for the differences in period lengths, this shows a very strong positive trend. This means that more and more people are visiting the LCC and from this we can infer that the community building methodology introduced shortly before the start of the current reporting period has produced good results. This is further supported by the number of unique page views also going up by 47,6%.

To provide an overview of average user activitiy and for the purpose of direct comparison with the reference period, a 7-day rolling average of unique visits is displayed in Figure 10. As can be seen, the average number of visits per week remains relatively stable around the baseline of 100 visits, excluding the holiday seasons, which can be observed around mid-to-late December 2022. Meanwhile, the spikes in activity roughly correspond to various community and dissemination events, such as the Annual Meeting in early July 2023, presentation of LINKS at the EENA Conference in mid-April or at the World BOSAI Forum 2023 in February.

LINKS
Strengthening links between technologies and society
for European disaster resilience

This project has received funding from the European Union's Horizon 2020
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Figure 10: 7-day rolling average of unique visitors

Overall, analytics data shows that the LCC has built a stable user base which has only grown in size during the current reporting period. This growth also indirectly confirms that the integrated quality assurance and community management methodology, which was introduced around the beginning of this period, has contributed to growing the LINKS community in accordance with its purpose.

6. CONCLUSION AND FUTURE PLANS

6.1 Conclusion

The integrated quality assurance and community management methodology introduced in D7.5 (Kiel, Habig, & Marterer, 2022) has been continuously applied in the final year of the LINKS project. As is evidenced by the multitude of positive changes and new features implemented in the LCC as a direct result of its application as well as increased usage statistics, the methodology has proven itself to be a valuable output of WP7 and a crucial tool for ensuring high quality and user satisfaction within the LCC.

Moving forward, the integrated methodology and its new quality assurance concept will help sustain and advance both the established LINKS Community and the high-quality content, as the LCC is maintained and developed further within the framework of the Horizon Europe project SYNERGIES. This project will build upon and extend the results of several Horizon 2020 projects, including LINKS, and the LCC will remain one of the crucial inputs.

6.2 Future Plans

As the culmination of LINKS draws near, the sustainability of the LCC and the embedded products stands as a testament to the commitment to fostering community engagement and advancing sustainability initiatives. SIC pledging to keep the LCC alive for another year, although our vision extends beyond this temporal horizon, focusing on securing sustainable funding for its continuous operation and growth.

At present, the LCC serves as an open, web-based semantically connected knowledge platform, nurturing connections with esteemed initiatives such as CMINE[5], PreventionWeb[6,7], and DRMKC by JRC (participated in the 3rd LINKS Webinar[8]). Additionally, the UCP Knowledge Network[9] is envisioned as potential collaboration partner in the future.

While the hosting of LCC is ensured for the upcoming year, the need for additional funding to sustain, for example, community managers is evident. These managers will play a pivotal role, curating content, ensuring accuracy, and safeguarding against any potential misuse of the platform. To secure the necessary funding for these community managers beyond the initial year, SIC has already embarked on identifying potential avenues. Furthermore, while Artificial Intelligence (AI) brings new

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[5] www.cmine.eu/topics/21875/feed
[6] www.preventionweb.net/quick/73885
[7] www.preventionweb.net/quick/17204
[8] www.cmine.eu/events/122304
[9] civil-protection-knowledge-network.europa.eu

capabilities, human moderators remain essential to ensure high-quality content. In order to cover costs, introducing a Freemium model for LCC with self-financing is another strategic approach.

As mentioned in Section 6.1, the Horizon Europe project SYNERGIES will continue evolving the outcomes of LINKS, including the further development of the LCC, the LINKS Products and the LINKS Community. Through SYNERGIES, a roadmap is created for the continuous evolution and application of the research outcomes of LINKS. Furthermore, collaborations with the European Commission or potential engagement with national governments offer promising avenues for financial support. These strategies align with the vision, allowing to steer LCC towards a future marked by longevity, relevance, and impactful sustainability.

In tandem with these efforts, SIC remain committed to a broader vision of collaboration and partnership. Our aim is to continually seek alliances that align with our ethos, fostering the dissemination of our outputs and vision of community and sustainability. The overarching goal is to maintain LCC's operational status for an extended duration, ideally far beyond the minimum one-year target, ensuring accessibility and relevance. Our commitment to the sustained operation of LCC extends beyond mere continuation. It encompasses a vision of growth, collaboration, and steadfast dedication to empowering communities through accessible and comprehensive knowledge sharing.

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