EUROPEAN NETWORK OF CYBERSECURITY CENTRES AND COMPETENCE HUB FOR INNOVATION AND OPERATIONS

D9.13 SOCIETAL IMPACT TOOLKIT

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SOCIETAL IMPACT, ASSESSMENT, CYBER SECURITY

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Executive summary

ECHO project Task 9.5 has delivered a Societal Impact Assessment (SIA) Toolkit questionnaire to measure the effectiveness and impacts of cybersecurity within organizations. This deliverable provides an overview of how approaches on inter-organizational knowledge transfer as learning outcomes of networked co-creation can impact societal impact assessment.

Several academic papers have been and are published under T9.5 'Societal Impact Assessment', and five of these provide an overview of some theoretical background that has guided the development of the Societal Impact Toolkit questionnaire.

The Internet has changed society in many ways. Businesses, organizational communication and learning have become transformed. Modern society has become very technology driven, where people in workplaces interact on social networking platforms and cloud-based solutions. Information and Communication Technology (ICT) is an integral part of people's lives. Besides the many benefits, ICT technologies also bring threats, like cyber-attacks exploiting vulnerabilities in ICT applications and systems.

The Societal Impact Assessment Toolkit questionnaire has been developed in steps during 2021. The initial set of questions and answers were first developed, then rigorously evaluated, and third, a pilot study was conducted and analysed by quantitative methodology to finalize the questionnaire for it to have relevance in measuring the societal impacts of cybersecurity. The questionnaire is available in the Typeform service.

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1. Introduction

1.1 Purpose and scope of the document

A major purpose of the ECHO project task 9.5 'Societal Impact Assessment' is to deliver a Societal Impact Assessment (SIA) Toolkit. The aim has been to understand the effectiveness and impacts of networked co-creation for innovation and measure the related societal impacts of cybersecurity. This deliverable D9.13 provides an overview of the theoretical approaches on inter-organizational knowledge transfer as learning outcomes of networked co-creation, discusses the effect of these approaches in performing societal impact assessment, and describes the path of creating the toolkit questionnaire based on the selection of relevant learning outcomes to the use of selected means of impact assessment.

The European Union (EU) expects positive impacts on society by promoting innovation through research and innovation funding programs. These opportunities create knowledge, products, services, and other benefits, engage diverse organizations of academics, businesses and public organizations to form project consortia. Innovation projects have a strong focus on sharing insights and experiences. Yet participants may simultaneously have conflicting interests for participation which must be guided toward common goals.

The ECHO project has, as part of its networked approach through effective and efficient multi-sector collaboration to strengthen proactive cyber security in the European Union, developed this Societal Impact Assessment Toolkit questionnaire. This deliverable explains the work done in regards to the assessment of societal impacts and describes the methodology to assess them and some body of knowledge that has been used as the theoretical basis of this toolkit.

1.2 Structure of the document

This document is structured in four sections. Section one details general issues in relation to this ECHO project deliverable and the scope of this document. Section two provides a theoretical and practical background that has guided the work of T9.5. Section three describes an overview of the steps taken and work done to develop the Societal Impact Assessment Toolkit questionnaire, and section four provides links and practical details to access this questionnaire.

1.3 Relation to other work in the project

The development of the Societal Impact Toolkit has been carried out in relation to the work done in WP2 (e.g. Multi-sector needs analysis and Cyberskills Framework), WP4 (Transversal technical cybersecurity challenges) and WP8 (Demonstration Cases). A Societal Impact Assessment of the ECHO Assets (WP5, 6 and 7) was conducted as part of the development of the questionnaire, and its results are relevant to all parts and tasks of the ECHO project (including WP1).

1.4 Applicable and reference documents

The following ECHO documents contain requirements applicable to the generation of this document:

Reference	Document Title	Document Reference	Version	Date
[GA]	Grant Agreement 830943 – ECHO	-	1.0	02/04/2019
[PH]	D1.1 Project Handbook	ECHO_D1.1_v1.42	1.42	20/10/2019
[PQP]	D1.3 Project Quality Plan	ECHO_D1.3_v1.4	1.4	23/04/2021

Table 1: Applicable ECHO documents

The following academic documents have been consulted for the generation of this document:

Reference	Authors	Document Title	Publication	Version	Date
[1]	Aaltola, K. & Ruoslahti, H.	Showing evidence of safeguarding networks in Cyber-Physical Domains by Societal Impact Assessment	Springer, in press		2021
[2]	Aaltola, K. & Ruoslahti, H.	Societal Impact Assessment of a Cyber Security Network Project	Information & Security: An International Journal	46, no. 1, 53-64	2020
[3]	Hytönen E., Trent. A. & Ruoslahti, H.	Societal Impacts of Cyber Security in Academic Literature – a Systematic Literature Review	21st European Conference on Cyber Warfare and Security - ECCWS 2022, accepted	Chester, UK	16-17 June 2022
[4]	Ruoslahti, Harri, and Amir Trent.	Organizational Learning in the Academic Literature – Systematic Literature Review	Information & Security: An International Journal	46, no. 1: 65-78	2020
[5]	Ruoslahti, H. & Davis, B.	Societal Impacts of Cyber Security Assets of Project ECHO	APSAC 2021 Proceedings, in press		2021

Table 2: Reference documents (relevant academic papers)

1.5 Intellectual Property Rights

Based on the legal framework provided in the ECHO Grant Agreement and the Consortium Agreement, ECHO specific Intellectual Property Rights (IPR) procedures have been established to protect the innovations and knowledge developed within this deliverable. The IPR Registry has been updated to reflect the innovation and knowledge generation developed by this deliverable.

1.6 Glossary of acronyms

Acronym	Description
CR	Cyber-Range
ECHO	European network of Cybersecurity centres and competence Hub for innovation and Operations
EU	European Union
GA	Grant Agreement
GDPR	General Data Protection Regulation
ICT	Information and Communication Technology
IPR	Intellectual Property Rights
OL	Organizational Learning
QR-code	Quick Response code
SIA	Societal Impact Assessment
WP	Work Package

Table 3: Glossary of acronyms, initialisms, and abbreviations

2. Background

Academic papers have been published and are submitted under T9.5 'Societal Impact Assessment' to provide a theoretical background for the development of the Societal Impact Toolkit questionnaire. The following text are some excerpts and overview of the five most relevant academic papers (listed in Table 2) that have served as background and part of development activities in developing the Societal Impact Toolkit questionnaire.

The 2020 Allianz Risk Barometer ranked cyber incidents as the number one risk that threatens business continuity. Organizations may face any number of challenges, such as data breaches, ransomware incidents, and post-event litigation.

The Internet has changed society in many ways. Businesses, organizational communication and learning have become transformed. Modern society has become very technology driven, where people in workplaces interact on social networking platforms and cloud based solutions. ICT is an integral part of people's lives. Besides the many benefits, ICT technologies also bring threats, like cyber-attacks exploiting vulnerabilities in ICT applications and systems.

Ruoslahti & Davis (2021) [5] note that networked research and innovation projects, such as ECHO, may face challenges in assessing the impact and effectiveness of its knowledge and value creation. Funding instruments set requirements and expectations for projects to devise impact assessment processes that address the impact and effects of learning and sharing knowledge in relation to the criteria of the community. Aaltola & Ruoslahti (2020) [2] find that societal impact can be demonstrated as learning outcomes and identify measurable project outcomes as products or services, knowledge use, and benefits to society.

2.1 Organizational Learning

The systematic literature review by Ruoslahti & Trent (2020) [4] looks at organizational learning in the academic literature to provide a theoretical basis for the work done in T9.5.

Ruoslahti & Trent (2020) [4] find that "organizational learning remains as a continuous process that requires a dedication to innovation and collaborative activities from the entire organization in order to take advantage of organizational learning benefits. The analysis shows that organization learning can be successfully deployed, but the transition is primarily dependent on the atmosphere of the organizational culture in terms of establishing support of the process. This essentially involves that executives advocate the need for Organisational Learning (OL) and that personnel be receptive to change in the restructuring of the company, and that they foster a positive atmosphere of OL allowing the distribution of knowledge and collaboration that helps expand innovation and specialization in skills to further enhance competitiveness. The results suggest that these four main elements, discussed in this literature review, become exhibited throughout the activities of the company. Thus, OL with ICT technology can have significant impacts in building innovative culture helping establish competitive advantages."

Ruoslahti & Trent (2020) [4] "… conclude organisational learning should not only be prioritized in order to build competitive advantage but primarily to instil essential skills, such as e-skills, which has become a requirement for modern organizations to thrive. Companies could further strengthen organisational learning by integrating a systematic learning package on ICT critical for business processes to address any discrepancy of e-skills competence among staff."

Ruoslahti & Trent (2020) [4] examine organizational learning "as four themes: ICT alignment, organizational culture, innovation culture, and ICT readiness. This would imply that successful organizational learning in today's digitalized world would have to consider these themes. These may also be considered by project ECHO in designing its Societal Impact Assessment Toolkit and E-skills and Training Toolkit to assess the impacts of ICT and technology-enhanced learning from a perspective of organizational learning."

2.2 Societal Impact

The systematic literature review by Hytönen, Trent & Ruoslahti (2022) [3] on societal impacts of cyber security in academic literature provides an understanding of how societal impact is viewed in academic papers.

Hytönen, Trent & Ruoslahti (2022) [3] identify six categories of investigation of societal impacts of cyber security: 1) Impacts on Social and Societal Levels, 2) Detection of cyber-crime and incidents, 3) Critical infrastructures and services, 4) Impacts of incidents and individual technology, 5) Cybersecurity awareness, and 6) Cybersecurity and collaboration.

Ruoslahti and Davis (2021) [5] note that the "Societal Impact Assessment aspect of the ECHO project aims to introduce a quick analysis for SIA and e-skills as well as an Assessment Methodology for SIA and e-skills, while referring to traditional effort-intensive SIA qualitative methodology applied in preceding work and projects. This study serves as one of many that introduce a practical but rigorous Societal Impact Assessment pathway which will be implemented in the ECHO project."

The workshop results by Ruoslahti and Davis (2021) [5] show that ECHO expects to have positive impacts on society, which include improved network collaboration and information sharing. Increased information sharing has the potential to expand overall cyber-security. Self-assessment can be complemented with external assessment measures, which highlights the need for such SIA methodology that encompasses rigour and relevance to provide practical and objective results to understand societal impacts in the context of ECHO assets and the entire project.

2.3 Assessment Methods

Aaltola and Ruoslahti (2020) [2] find that social learning can be examined as impact assessment, which is facilitated through an organizational learning approach and linked with stakeholder engagement and best practices. Societal impact assessment processes within complex innovation networks require that people are committed to organisational and individual levels of learning to adopt knowledge, skills and competences needed in network co-creation by their communities.

The matrix by Aaltola and Ruoslahti (2020) [2] below (Table 4) provides a practical framework to assess societal impacts as both learning outcomes and SIA-outcomes that provide a basis to evaluate the impacts of any innovation project.

Learning outcome	**Learning outcome 1:**	**Learning outcome 2:**	**Learning outcome 3:**	**Learning outcome 4:**	**Learning outcome 5:**
Description	Development of Behaviors and Attitudes	Acquisition of skills and knowledge	Community norms and values	Dissemination Quality	Systematic documentation
Communication	Input	Input	Throughput	Output	Output

Learning outcome	Learning outcome 1:	Learning outcome 2:	Learning outcome 3:	Learning outcome 4:	Learning outcome 5:
SIA-outcome	Action with commitment	Knowledge transfer loop	Collaboration objectives	Clarity	Dissemination progress
SIA-outcome	Stakeholder engagement	Social and informal learning	Collaboration arenas	Environment linkages	Targeted media sectors
SIA-outcome	Experiential learning	Cognitive development	Collaborators	Consistency	Two-way information transfer
SIA-outcome	Meaningful messages	Joint problem solving	Collaboration tools	Responsiveness	Committed project partners
SIA-outcome	Social change	Interactions in joint environments	Collaboration processes, contracts	Efficiency	Project processes

Table 4: Learning and SIA-outcomes Matrix (Aaltola & Ruoslahti, 2020 [2]; Aaltola & Ruoslahti, 2021[1])

3. ECHO Method

In aiming to provide a measurement of societal impacts of cybersecurity, ECHO T9.5 has developed the Societal Impact Assessment Toolkit questionnaire. The questionnaire is based on a prior ECHO survey on Cyber Ranges and background research made public in academic papers published in relation to ECHO research activities. The Societal Impact Assessment Toolkit questionnaire has been developed in steps during 2021, involving developing an initial set of questions and answers, rigorous evaluation of these initial questions, and pilot study that was analysed by appropriate quantitative methodology to finalize the questionnaire for it to have relevance in measuring the societal impacts of cybersecurity.

3.1 Rigour and relevance

The ECHO Societal Impact Assessment Toolkit questionnaire is based on a questionnaire that is has been validated with relevant quantitative methods. The survey questions were influenced by the theoretical classification of six categories Impacts on Social and Societal Levels, Detection of cyber-crime and incidents, Critical infrastructures and services, Impacts of incidents and individual technology, Cybersecurity awareness, and Cybersecurity and collaboration, and a previous cyber-range (CR) study, and related grouped data and analysis. The questions of this CR-survey were evaluated by cyber security experts, and responses were gathered from the organizational representatives who either use the cyber ranges or provide cyber range services.

The first draft of the questionnaire was elaborated to a total of 73 questions generalized aiming to provide a standardized method to measure the societal impacts of cybersecurity. The first draft of questions was sent to all T9.5 partners for comments and evaluation Invitations were sent by email to a total of 62 partners asking for their comments. The questionnaire was amended based on the comments that the experts provided with a questionnaire sheet in Word and asked to comment on the appropriateness of each question, its answer alternatives, and language.

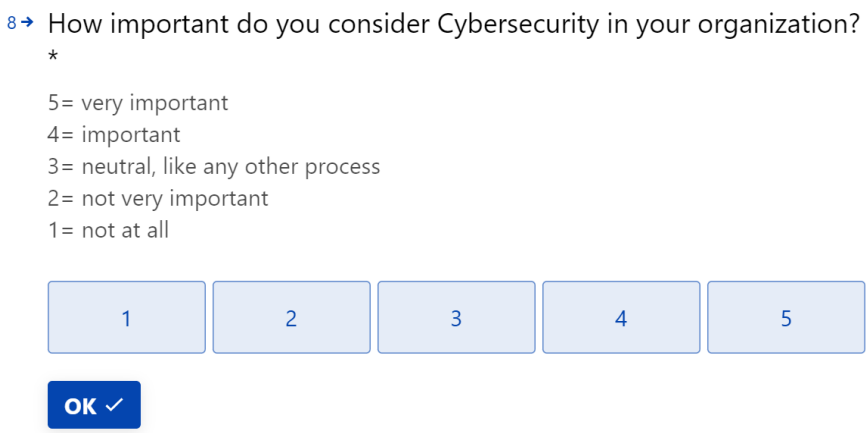

Figure 1: Example question from the Societal Impact Analysis Toolkit

Amendments were made accordingly, and the questionnaire was made operational in the Typeform service (see Figure 1 above). T9.5 partners were asked to provide 10 respondents each to complete a pilot study of a minimum of 100 respondents. Unfortunately, T9.5 partners did not participate with the expected activity

and only 81 responses were achieved. This was just enough to run appropriate quantitative methods to validate and amend the final set of questions for this Societal Impact Assessment Toolkit questionnaire.

The multiple-choice questions were tailored according to expected responses, allowing respondents to specify their answer with the use of open-ended options. Factor analysis was used to find possible unobserved and known variables from the data. Correspondence analysis, utilizing the Euclidean distance in two dimensional figures, helped measure similarities between attributes and their relationships with each other. Same-time correspondence figures help those not familiar with statistical methods, but through pictures, they may easily see connections. Correspondence analysis is an exploratory multivariate technique that converts a data matrix into a particular type of graphical display in which the rows and columns are depicted as points. Discriminant analysis and cluster analysis provided further findings.

4. Societal Impact Analysis Toolkit

This final questionnaire is based on 72 questions probing their approach to cybersecurity. Respondents are asked to provide their answers using the five step Likert scale to provide a standardized toolkit to assess the societal impacts of cybersecurity.

The Societal Impact Assessment Toolkit questionnaire has a Typeform link that can be openly disseminated within organisations that wish to assess the societal impact of their products, services, knowledge use, and benefits to society. Carefully answering the SIA-questionnaire takes 30 to 45 minutes. Responses are collected for analysis in the Typeform service.

4.1 Questionnaire links

Internet link to the ECHO Societal Impact Assessment Toolkit questionnaire:

https://zflut9l8ruw.typeform.com/to/SGZ1oyZ5

There is also the opportunity to use the QR-code (Figure 2) to open the questionnaire on one's mobile device.

Figure 2: QR-code to Societal Impact Assessment Toolkit questionnaire

The Societal Impact Assessment Toolkit questionnaire on Typeform is accessible by Internet link or QR-code for use by mobile device.

5. Conclusions

The Societal Impact Assessment Toolkit questionnaire link can be openly used within organizations that wish to assess the societal impact of their products and services. Answers will be collected for analysis in the Typeform service.

One major aim T9.5 was to deliver a Societal Impact Assessment Toolkit. The aim has led to the creation of the toolkit questionnaire for the assessment of societal impacts of an innovation project, such as ECHO, an organization, or its relevant products, services, knowledge use or benefits.

The questionnaire is now structured, evaluated and tested by appropriate qualitative methods. When used in more quantity, a path towards a standardized method to assess the societal impacts of cybersecurity can be taken as a contribution to science and theory. The contribution to practice will be the availability for usage of this Societal Impact Assessment Toolkit questionnaire in future research and innovation projects.

This questionnaire addresses the societal impacts of cybersecurity. The same approach could be adopted to develop structured and standardized methods to assess other issues, e.g., sustainability or ethics, thus answering the recognized need to develop easy to use methods of analysis in place of the now used labour and time intensive qualitative approaches.

Please, open and answer the questionnaire!

Please, contact ECHO representatives Harri Ruoslahti (harri.ruoslahti@laurea.fi) or Ilkka Tikanmäki (Ilkka.tikanmäki@laurea.fi) to arrange the questionnaire to be conducted to a limited sample, e.g. an organization.