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# Societal Impact Assessment of a Cyber Security Network Project

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## ABSTRACT:

The European Union promotes innovation through its funding programmes for research and innovation. To support the innovation process, one of these projects, ECHO, aims to deliver a Societal Impact Assessment (SIA) toolkit to assess the impact of establishing a European network of cybersecurity competence centres. This article provides an overview of the theoretical foundations on network co-creation and inter-organizational knowledge transfer as learning outcomes, and discusses these approaches in performing impact assessment at the societal level. Literature review on evaluation and assessment, co-creative innovation, and learning approaches are examined, summarized and combined into a learning and SIA-outcomes Matrix. Measurement of impacts through a digital Societal Impact Assessment toolkit can improve the quality of the value creation. Towards that purpose, we offer an approach that combines traditional evaluation and assessment, co-creative innovation, learning and SIA-outcomes in a practical Matrix to provide an applicable element towards a more comprehensive SIA-toolkit for the ECHO network.

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## Introduction

The European Union (EU) promotes innovation through its funding programmes for research and innovation. These offer opportunities for the creation of knowledge by engaging diverse organizations of academics, businesses and public organizations to form project consortia. Innovation projects have a strong focus in sharing insights and experiences, though participants may simultaneously have conflicting interests for participation. Project ECHO aims at organizing a net-worked approach through effective and efficient multi-sector collaboration that aims at strengthening proactive cyber security in the European Union. Project ECHO (European Network of Cybersecurity Centres and Competence Hub for Innovation and Operations) started in 2019. This position paper in part explains the nature of the body of knowledge that the project will cumulate in regards to assessment of societal impacts.

Research and innovation network projects, increasingly face the challenge of mobilizing knowledge towards value creation in a manner that takes into account assessing its impact and effectiveness.<sup>27</sup> Societal expectations increasingly demand projects to review the criteria of the community and a comprehensive impact assessment processes that is capable of delivering outcomes, which address learning and sharing of knowledge.<sup>36</sup>

One part of the purpose of the ECHO project is to deliver a Societal Impact Assessment (SIA) toolkit. The aim is to measure the effectiveness and impacts of network co-creation. The purpose of this article is to provide an overview of approaches on network co-creation and interorganizational knowledge transfer as learning outcomes, and to discuss the nature of these approaches in performing Societal Impact Assessment. The aim is to elaborate the path from the selection of relevant learning outcomes to means of impact assessment, which becomes demonstrated in forms of learning outcomes. This paper builds on the dissemination evaluation framework for European research projects presented in Henriksson et al., "Opportunities for Strategic Public Relations – Evaluation of International Research and Innovation Project Dissemination."<sup>13</sup>

## Literature

### *Evaluation and Assessment*

Knowledge management has become complex in requiring, for example, comprehensive approaches to assessment. Some limitations of evaluation approaches that have can been recognized are their limited foci on degrees of influence, subjective satisfaction of results, or empowerment. Daniel Fiorino<sup>10</sup> and Frank Laird<sup>19</sup> used political theories in the development of normative evaluation criteria, and they evaluated a wide variety of participation models. The concept of *public participation* played a role in the impact assessment of public participation programs, and provided some added strength to earlier, more narrow, evaluation approaches. The model helped describe proper and improper conduct in public decision-making activities in democratic government.

Good practices of traditional research dissemination and exploitation are needed.<sup>13</sup> A traditional documentation in evaluating research impacts with quality dimensions (clarity, environment orientations, consistency, responsiveness and effectiveness) and systematic documentation activities (quarterly dissemination and progress evaluation, relevant exposures across targeted media sectors, successful two-way information transfer, committed project partners, and adoption of project processes).<sup>13, 28</sup>

Social learning can be treated purposefully as an outcome of impact assessment, which is facilitated through the organizational learning approach and linked with best practices of stakeholder engagement. Sánchez and Mitchell grouped learning outcomes into three different categories: “acquisition of knowledge and skills, developing new behaviours and developing sustainability-oriented norms and values”. In order to achieve such outcomes, the means include education and/or training, experiential learning, learning through participation and social learning as well as a ‘learning organization approach’.”<sup>36</sup>

Vos et al.<sup>39</sup> see measurement processes may need “*strong commitment and an open culture of learning*” (p. 66). In sensitive matters outcomes may be difficult to compare, and it “*would be recommended to supplement self-assessment with other measures such as external assessment*” (p. 66). Interactions can be understood through cycles of input, throughput, and output communication, and in the context of innovation projects, communication activities follow the elements of complexity in cyclical ways. This can provide a framework to evaluate the workings and impacts of innovation projects.

Beyond relevant evaluation and assessment processes, complex network reality requires people who are committed on both organizational and individual levels to learn and adopt the knowledge, skills and competences required by the network co-creation and communities that there are involved in. Development of professional expertise comply with networks, complexity and technological innovations at the same time. Complexity of research and innovation projects, raise the need of positioning variety of relevant approaches to impact assessment and evaluations. Network co-creation and learning approaches provide new systematic ways to analyse the impacts on a societal level of network projects funded by the public funding.

### **Network co-creation**

Innovation is based on new knowledge and it drives growth and success.<sup>6, 7</sup> Creating knowledge for innovation requires collaboration between research and business partners; co-creation is seen as a collaborative activity, and it involves objectives, arenas, collaborators, tools, processes, and contracts,<sup>5</sup> on different layers, such as co-creating futures or policies, and involving agents.<sup>1</sup> Partners, who work in collaboration in research and network projects, generate new knowledge and skills resulting to innovations.<sup>13</sup>

Ruoslahti finds that co-creation in projects call for: collaboration and a common problem, and innovation networks have three main challenges to manage to ensure open communication toward co-creation of knowledge: stakeholders

need to be actively engaged throughout the project, which takes time and effort.<sup>34</sup> Co-creation of knowledge can occur in physical spaces, digital environments or combining both.<sup>5</sup>

Vos, Schoemaker and Luoma-aho suggest that communication takes place in Issue Arenas, where actors meet in physical or digital spaces to address and discuss issues that are relevant to them.<sup>41</sup> Arenas can thus, be seen as competitive spaces, where actors may, besides having common agendas, have interests their own, use with problem solving and influencing strategies,<sup>35,39</sup> and yet, deep engagement of the actors involved benefit all stages of an innovation process.<sup>8</sup> Ruoslahti<sup>33</sup> demonstrates that a process flow of elements of complexity<sup>25</sup> can be recognized in the context of innovation projects, and in relation to the input-throughput-output communication.<sup>40</sup>

### *Learning approaches*

When people are involved in working towards mutual common objectives, or a purpose that affects their communities, they become more responsible. This in turn reaffirms democracy. On a societal level, this phenomenon can be described as social learning.<sup>44</sup> In addition, Webler, Kastenholz and Renn<sup>44</sup> provided a solid basis for evaluating public participation processes through fairness, competence and social learning. Theory of cognitive development,<sup>30</sup> theory of experience<sup>9</sup> and social constructivism<sup>24,42</sup> were some of the key constructivist viewpoints, which have led to the experiential learning tradition, commonly used in adult education and training.

Studies have shown that individual learning processes are dependent of social interaction and external sources.<sup>4,22</sup> It has been argued that Piaget strongly built the basis for the constructive way of thinking.<sup>32</sup> Constructivist learning theories believe in the role of social environmental contexts and interactions with others in moulding individual development<sup>9</sup> and assert that learning becomes socially situated.<sup>20</sup> Dewey addressed that humans are active learners and the nature of learning is based on problem solving.<sup>9</sup> Network research and innovation projects are envisioned in line with the conceptual understanding of public participation where “a community of people with diverse personal interests, but also common interests, who must come together to reach agreement on collective action to solve a mutual problem.”<sup>44</sup>

Beyond the pedagogical or psychological tradition, social learning has been studied in the organizational and management studies with the use of concept organizational learning.<sup>2,3</sup> The German sociological critical theory by Habermas described social change as a process of social learning with cognitive and normative dimensions.<sup>11</sup> Polanyi's assumption was that some knowledge is difficult to articulate with language and may exist in a form of experiences.<sup>31</sup> His understanding of tacit knowledge is in a relation with society and to our personal interests and commitments. According to Nonaka & Takeuchi<sup>26</sup> (pp. 57-58) knowledge is defined in relation to action and with commitment and beliefs on messages. Wenger's contribution as knowledge management theory focused on communities of practice in the central of learning, meaning and identity.<sup>45</sup>

They described information as a flow of meaningful messages. Stenmark argued that fact knowledge includes both forms of knowledge, tacit and explicit,<sup>37</sup> while Weick argues that paying attention to forgotten and avoided facts through stories and examples is a way to “discipline imaginations around the topic of organisational learning.”<sup>46</sup>

Knowledge creation and learning theories strongly argue the relevance of understanding knowledge as a socially constructed process. In addition, experiential learning approaches and skill development highlight the role of experience, when the aim is to improve knowledge, skills and competences. The range of instructional and methodological design opportunities is quite broad, and the effective learning techniques support adaption of new competences in different contexts in a form of informal learning.<sup>23</sup>

### Summary of the Literature Review

The summary of literature review discusses in the above-mentioned academic literature, Table 1 (below) presents three main theoretical dimensions relevant in the toolkit of societal impact assessment of network project: foundations of evaluation and assessment, co-creative innovation, and learning approaches. These three dimensions are shown in relation to some key concepts and themes as relevant authors have presented them.

The above literature review findings of key theoretical foundations (Table 1) indicate that Societal Impact Assessment (SIA) can be based on the relevant evaluation and assessment theories, co-creative innovation and learning approaches. The findings show that the measurement indicators to assess societal impacts can be combined from the evaluation and assessment practices, innovation targets and learning outcomes. This approach is discussed and modelled to practical needs of societal impact assessment below in the Conclusions section.

**Table 1. Summary of the literature review.**

Evaluation and Assessment		
Approach	Author(s)	Key concepts and themes
Evaluation and Assessment	Fiorino <sup>10</sup> Laird <sup>19</sup>	- normative evaluation criteria of participation models
Research project dissemination evaluation framework	Palttala & Vos <sup>28</sup> Henriksson et al. <sup>13</sup>	- quality dimensions in evaluation - systematic documentation of dissemination
Organizational learning approach and stakeholder engagement in impact assessment	Sánchez and Mitchell <sup>36</sup>	- social learning as an outcome of impact assessment

<b>Co-creative innovation</b>		
<b>Approach</b>	<b>Author</b>	<b>Key concepts and themes</b>
Plan and manage project to co-create value	Bhalla <sup>5</sup>	- collaborative activity with: objectives, arenas, collaborators, tools, processes, contracts
Input, throughput, output	Vos & Schoemaker <sup>40</sup>	- communication management contributes to three phases - mutual agreements about communication
Co-creation in EU-funded innovation projects	Ruoslahti <sup>33</sup>	- collaboration - common problem - stakeholder engagement, time and effort
<b>Learning approaches and knowledge creation</b>		
<b>Approach</b>	<b>Author</b>	<b>Key concepts and themes</b>
Cognitive development and cognitive constructivism	Piaget <sup>30</sup> Piaget <sup>29</sup>	- learning is a process of accommodation, assimilation and equilibrium
Social constructivism	Dewey <sup>9</sup> Vygotsky <sup>42</sup>	- humans are active learners - learning is based on problem solving - culture and context are highly important
Learning in social change	Habermas <sup>11</sup> Webler, Kastenholz & Renn <sup>44</sup>	- social learning has cognitive and normative dimensions
Socially situated learning	Lave & Wenger <sup>20</sup>	- social environmental contexts and interactions with others in molding individual development
Organisational learning	Argyris & Schön <sup>2</sup> Argyris <sup>3</sup> )	- a single and double loop learning processes - organizational learning is highly context-dependent
Knowledge creation and transfer loop	Nonaka & Takeuchi <sup>26</sup>	- knowledge defined in relation to action and with commitment and beliefs on messages
Tacit knowledge	Polanyi <sup>31</sup> Stenmark <sup>37</sup>	- some knowledge is difficult to articulate with language and may exist in a form of experiences
Informal learning	Marsick & Watkins <sup>23</sup>	- learner-centre focus - focus on self-directed nature, networking, coaching, mentoring, and performance planning

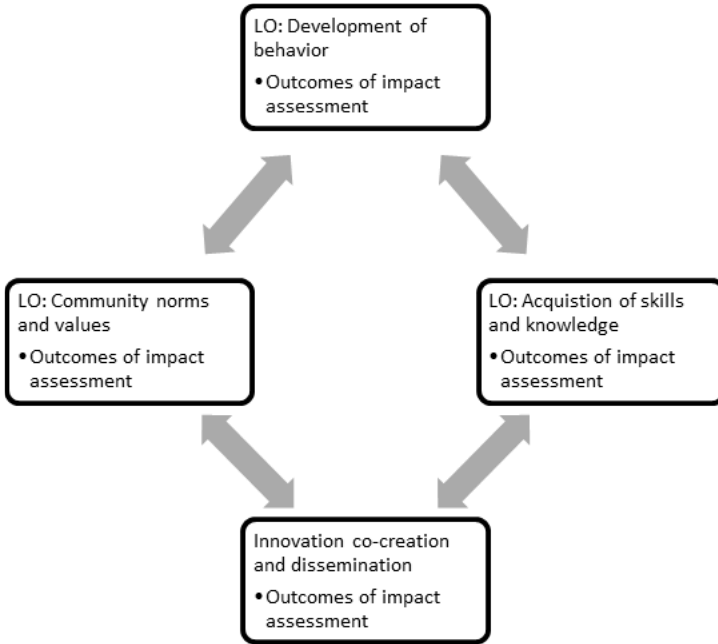


Figure 1: A flow of co-creation learning outcomes for SIA-toolkit.

### Summary of the Findings

Positioning evaluation and assessment traditions, learning approaches and network co-creation can provide improvement for the design of Societal Impact Assessment. Combining these perspectives promote understanding of how structures foster knowledge sharing and interpretation, enhance organizational memory, provide sustainable innovation and finally improve the impact at the societal level. Learning outcomes have to go beyond instrumental learning to reach new behaviours, norms and values<sup>36</sup> to enable an increasingly practical approach to Societal Impact Assessment.

When Societal Impact Assessment becomes measured as both learning outcomes and as evaluation outcomes, a matrix of quality dimensions as noted by Palttala and Vos<sup>28</sup> and Henriksson et al.<sup>13</sup> can be developed (Table 2, below) to provide a way of evaluating societal impacts of network and innovation projects. The innovation co-creation and understanding of communication as issue arenas contribute to

The blue areas in Table 2 represent the linkages of learning approaches to SIA. The yellow areas represent linkages of co-creation for innovation activities to SIA. The grey areas represent linkages of project communication, dissemination and exploitation evaluation activities in SIA. Measurement of SIA-outcomes through a toolkit can improve the quality of the value creation at the societal level.



Table 2. SIA outcomes Matrix.

Level	Societal	Individual	Community	Dissemination	Communication
Learning outcome	<b>Outcome</b>	<b>Outcome</b>	<b>Outcome</b>	<b>Outcome</b>	<b>Outcome</b>
Description	Development of Behaviours and Attitudes	Acquisition of skills and knowledge	Community norms and values	Dissemination Quality	Systematic documentation
Communication	<i>Input</i>	<i>Input</i>	<i>Throughput</i>	<i>Output</i>	<i>Output</i>
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

Research and innovation projects have already been studied from the dissemination and exploitation evaluation point of view (e.g. <sup>13</sup>) but this approach goes beyond and positions relevant learning and co-creative innovation foundations as practical outcome indicators to analytical societal impact assessment in complex network innovation projects, such as ECHO -project. The practical Matrix (Table 2) can provide one applicable element towards a more comprehensive SIA-toolkit for the project ECHO network. A flow of co-creation learning outcomes for the SIA-toolkit are presented below in Figure 1.

Societal impact and its assessment have been lately discussed in both academic literature and in recent EU-funded research and innovation projects. This positioning aims to contribute to this research and practitioners' discussions to better understand the state-of-art, bring in the relevance of the theoretical foundations and to identify potential indicators to develop and provide more practical and accurate methodology for Societal Impact Assessment. Such a methodology contributes to digital creation of AI-assisted toolkit for data creation and could be utilized for any innovation and network project or organization that wishes to understand how its actions and solutions influence at the societal level.

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