Monitoring the Potential of Lithuania's Civic Technologies Platforms to Co-create Collective Intelligence

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ABSTRACT

This paper presents the findings of a systematic survey that evaluated the potential of online communities (or civic tech) in Lithuania to co-create collective intelligence. Civic intelligence is a form of collective intelligence exercised by a group's capacity to perceive societal problems and its ability to address them effectively. The research subject is "bottom-up" digital-enabled online platforms initiated by Lithuanian public organisations, civic movements, or business entities. Traditional approaches to public engagement remain relevant. Notwithstanding, our enquiry is more interested in the potential of digital-enabled citizens to increase efficient collective performance. This scientific project advances our understanding of the essential pre-conditions in online communities through which collective intelligence is being systematically co-created. By monitoring the performance of civic tech platforms, the scientific question was examined: What are the socio-technological conditions that led the communities to become more intelligent? *The results of the web-based assessment were obtained by applying the collective intelligence monitoring technique.*

Keywords: *Collective intelligence, Civic Technologies, Index, Co-Creation*

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INTRODUCTION

The field of ICT (Information and Communication Technologies) enabled civic technologies (or civic tech) is an umbrella term to define ICT-enabled citizen initiatives. According to the Knight Foundation, it is growing annually by 23% (Knight Foundation, 2021). Around the world, civic organisations, individual citizens and even businesses experiment with ICT tools and available open resources to connect, collaborate, and find innovative solutions to address societal problems (Mačiulienė & Mačiulis, 2016). In addition, the international scientific community publishes research results about the creative power of networked systems and their potential to grow under certain conditions, i.e. "collective intelligence" (Malone et al., 2010). Engel et al. (2014) indicated that a collective intelligence factor characterises group performance for face-to-face and online groups.

Despite the enthusiasm and optimism regarding the efficiency of the activities of online communities and their influence on the public good, the process is supported only by fragmented research results (Prieto-Martin et al., 2012). Most scientific activities are biased in favour of government initiatives and the integration of e-participation, e-democracy, and open data tools. Because of the diversity in technological tools and information channels, the users of urban platforms face practical problems with coordination, collective decision-making and opinion structuring, security and privacy, information credibility, content quality, etc. As online communities continue to proliferate, "further research is needed to understand better how these communities use technology-mediated communication platforms for hedonic and utilitarian purposes, including enhanced decision-making" (Meservy et al., 2021).

Our project extends existing knowledge and understanding by evaluating the essential co-creation pre-conditions in civic tech through which collective intelligence emerges systemically. The particular research subject is "bottom-up" digital enabled networked platforms initiated by public organisations, civic movements, or business entities. The sample size for web-based monitoring consists of 70 online communities in Lithuania identified and classified during the pilot research.

DEFINING COLLECTIVE INTELLIGENCE

The scientific society argues that in general, the human group demonstrates higher capabilities of information-processing and problem solving than an individual (Heylighen, 2002; Luo et al., 2009). Intelligence in groups emerges when

each group member evaluates the overall situation and acts accordingly to achieve the overall goal (Leimester, 2010). The research-based literature defines collective intelligence (CI) in various ways—"the distributed knowledge and expertise of individuals located inside and outside the formal boundaries of the enterprise, group, community" (Lesser et al., 2012); "the capacity for information processing, efficiency with which group can solve problems, quality and timing of group decision-making" (Goyal, Akhilesh, 2007); "a matter of building scenarios around a problem-solving situation" (Boder, 2006), "the general ability of the group acting collectively to perform a wide variety of tasks" (Malone et al., 2010). This kind of collective intelligence is the group's property, not just the individual's.

With the growth and expansion of the Internet, "how CI is utilised and leveraged has been fundamentally altered" (Wise et al., 2012). In the context of the application of information ICT, CI can be conceptualised "as a knowledge network created by web-mediated interaction amongst individuals with personal knowledge" (Luo et al., 2009). The new technology-supported form of collective intelligence is closely related to many other existing conceptualisations, i.e. open innovation (Chesbrough, 2003); crowdsourcing (Howe, 2008); the wisdom of crowds (Surowiecki, 2004); wikinomics and mass collaboration (Tapscott & Williams, 2006); and service-dominant logic (Vargo et al., 2008). Exploiting online media's potential to leverage connectivity, responsiveness, creativity and innovation, and value co-creation with stakeholders is typical for these paradigms (Wise, 2014). Any situation "where large enough groups of people gather, act individually but also share some common community goals could potentially be—through the proper use of technology—transformed into a collective intelligence system" (Lykourentzou et al., 2011). At the micro-level, collective intelligence is a combination of psychological, cognitive and behavioural elements. They provide the "rules" according to which individuals act (trust, motivation), according to Salminen (2014). Micro-level sets humans apart from other CI systems (robots, algorithms). At the macro-level, collective intelligence becomes a statistical phenomenon, at least in the case of the "wisdom of crowds" effect (Lorenz et al. 2011). The level of emergence resides between the micro-level and the macro-level and deals with the question of how system behaviour emerges from interactions at the macro and micro-level.

Lykourentzou et al. (2011) classify CI systems into passive and active. Members of passive systems act as if the system was absent. However, such systems may have features of crowd behaviour. In the case of active systems, crowd behaviour is generated and coordinated to achieve the system's specific goal. Related to this, Levine and Prietula (2014) argue that "a group's cooperative outcomes can be remarkably well predicted if one knows its type composition." Active systems may also be subdivided into collaborative, competitive and hybrid. Wikipedia, frequently drawn in the present monograph as an example, is an active collaborative CI system as its actors collaborate to achieve a common goal. Hybrid platforms incorporate both competitive and collaborative elements. Although some communities count large numbers of participants, a small number of people frequently undertake the actual work. Majchrzak and Malhotra (2013) emphasise that the stress between collaboration and competition causes a critical challenge in collaborative systems.

According to Boder (2006), CI emergence comprises three building blocks: competencies development, goal development, and mechanics development. The first one is the development of the competencies that derive from the domain-specific knowledge of the community. The purpose of this dimension is to acquire complementary competencies. The second dimension helps coordinate and integrate various approaches and establish a common goal. The third component is the coordination of and mechanisms of interrelations between individual dimensions. Interrelations stem from both formal and informal communication norms and community culture. Thus, aspects of trust and respect should be taken into consideration.

CO-CREATING COLLECTIVE INTELLIGENCE IN CIVIC TECH

Both concepts (co-creation (CC) and collective intelligence (CI)) were influenced by social media technologies and were developed in parallel. The efforts to leverage CI more effectively improve the effectiveness with which "public value" is co-created (Wise et al., 2012). The ICT enabled systems leverage "the emerging network effect" by combining open online social media, distributed knowledge creation and data from natural environments ("Internet of Things") in order to create possible solutions requesting collective efforts" (Arniani et al., 2014). According to the collective intelligence paradigm, the human group demonstrates higher information-processing and problem-solving capabilities

under certain conditions than an individual (Malone et al., 2010). The "intelligence" in the system can be described as "collective," not only in the sense that it arises from the interactions between participants, but that it does so according to specific principles for extracting "wisdom from crowds:" diversity, decentralisation, independence, and an appropriate mechanism for information aggregation (Surowiecki, 2004). The scientific community discusses different indicators and critical factors to achieve Collective Intelligence systemically. The theoretical and empirical study of Dabbish et al. (2014) suggests that "providing transparency of actions on shared artefacts supports cooperative work" and proposes various ways that transparency can support innovation, knowledge sharing, and community building. Close related to transparency is a problem of independence. Violations of the independence condition might decrease the accuracy of the crowd (the promotion of the idea to friends or relatives, also downvoting, where some users create multiple accounts to give high scores to their own designs and low scores to everyone else) (Salminen, 2014). Previous studies (Mavrodiev et al., 2012; Lorenz et al., 2011) have reported impaired independence of thought by social influences on crowdsourcing platforms. Face-to-face group processes in organisations often lead to polarisation when faced with social influences (Zhou & Fink, 2003). External pressures include managerial influence and intolerance to mistakes (Michailova & Husted, 2003). According to Norvaišas et al. (2011), to eliminate harmful social, psychological and other subjective impacts (subjectivity), we must guarantee the anonymity of participants in online communities. These principles affect the emergence of CI and can positively influence the co-creation processes inside and outside the community, enhancing the collaboration between stakeholders. According to McNutt et al. (2016), development in civic tech is influenced by innovations in the three fields: growing connectivity through ICT, open data movement, and diversity in digital collaboration forms. Open data increases the visibility and speedy identification of societal problems. At the same time, new collaboration and knowledge aggregation methods enable self-organisation and collective decision-making. Mass participation in online interactions means greater diversity, richer data, and the continuous inflow of new ideas and knowledge. Emulating the fundamental design of the Internet, the networks adopted a decentralised structure and distributed leadership. The self-organisation and self-governance capabilities of the community challenge the hierarchical mechanism of traditional organisations. Since

structural units (nodes) are unable to interact with the centre of the network (because it does not exist), they must interact with the network as a whole in a self-regulatory regime and, in so doing, develop one of the most effective forms of collaboration (Brunalas, 2015).

Several researchers (Brown & Osborne, 2012; Krimmer et al., 2016) propose that the roles, perceptions and capacities of actors involved play a central role as drivers or barriers in the co-creative processes. A top-down co-creation approach refers to government-initiated platforms that deliver public services. Engaged as they are in government established platforms, citizens contribute to data and content distribution. They are involved in designing, evaluating, or improving public services based on user-centric approaches (e.g. design thinking, service co-production). A *bottom-up co-creation approach* defines the platforms emerging from outside the governmental sector and without governmental control. According to Badger (2012) and Suri (2013), bottom-up civic technologies are not necessarily designed to be corporate and disruptive to government (a case in point being the so-called Arab Spring of 2011). Instead, they are designed "by, and for, average citizens, using existing open data in innovative ways that can complement the existing channels of information and communication previously controlled by the institutions alone" (Badger, 2012). Moreover, some initiatives by citizens narrowly focus on the formation of society's voice yet fail to emphasise Feedback from the government and the importance of co-creative synergy between all stakeholders (Sandfort & Quick, 2015).

This research paper examines the "bottom-up" co-creation of collective intelligence civic tech, which defines platforms' users' internal and external motivation to act for the public good. This paper defines civic tech platforms as active collaborative CI systems. "New knowledge, ideas, problem-solving methods and solutions, shaped up or structured opinions, innovations, prototypes, are considered to be the collective intelligence a platform co-creates and "public value" for society" (Skaržauskienė et al., 2015). Here, it is essential to note that critical reflection on the co-creation practices is relevant to our understanding of how the digital-enabled managerial and organisational solutions influence the quality of co-creation results. Further, this applies to what works when co-creation methods are implemented, what does not work, and why. A deeper understanding of the dynamics of co-creation is needed to support communities to deliver intended intellectual outcomes.

Many researchers have presented significant results in identifying the potential of collective intelligence to solve various societal problems or in modelling CI from a conceptual point of view (Luo et al., 2009; Malone et al., 2009; Barahona et al., 2012; Salminen, 2012; Kittur et al., 2013; Prpić, 2014), but according to Lykourentzou et al. (2011) they do not focus on a fundamental problem—"CI system design and optimisation processes, through which collective intelligence will be able to emerge systemically."

MONITORING COLLECTIVE INTELLIGENCE: PILOT STUDY IN LITHUANIA

European and National Context

Several EU strategic policy documents (e.g. Europe 2020 Strategy; EU Digital Agenda) have stressed the importance of the ICT-enabled society and open access to information as critical factors in fostering democracy. National governments in the EU have invested heavily in e-government and e-democracy projects to anticipate greater citizen participation and the resulting co-creation. The reality of open government practice is, however, different. It has taken a turn towards the market-based principles of performance measurement and competition, thereby reinforcing a framework which focuses on the customers who demand to be served rather than on the citizens working with their representatives to co-create public value (Meservy et al., 2021; Sandfort & Quick, 2015). A Pew Research Centre survey (2020) shows that many Europeans believe that EU institutions are deaf to their concerns and opinions. Indeed, measured by the quarterly Eurobarometer, confidence in national parliaments and governments is low and slowly declining (2020).

Lithuania's democracy is facing similar challenges. Lithuania is a small country in the Baltic region of northern-eastern Europe, with 2.8 million inhabitants in 65.300 square kilometres. Lithuania gained its independence from the Soviet Union in 1990, which created crucial changes in all areas of Lithuania and its citizens. In recent years, the web's reach and capability have helped facilitate the explosive growth of online communities. Nevertheless, their full potential is unrealised due to the lack of citizen engagement. Lithuania has all of the pre-conditions to become a networked society: a relatively high level of the infrastructure of information technologies and a high level of user accessibility. Despite enjoying seemingly perfect pre-conditions, collective intelligence has

developed slowly, simply because people do not collaborate. They may express their opinions but not structure them and reject the obligation to implement decisions. According to Lithuanian Smart Specialization Strategy documents (2014), the potential of non-governmental organisations promoting social innovation and business is largely untapped, with Lithuania ranked 13th in DESI 2017. The country's performance is above the EU average in all dimensions, except for human capital, where progress has been limited by the country's inability to use digital technologies to address social challenges. The majority of the public government initiatives are centralised and do not reach citizens` empowerment, according to Guogis and Urvikis (2011). For example, there are few proposals in the government-initiated portal for public consultations via e-pilietis (e-citizen) compared to the active citizen-initiated discussions in social media and portals.

Scientific viewpoint and analysis of the influence of social technologies on the formation of collective intelligence raise many questions. Society faces a practical problem with a wide variety of social technologies and the functioning of many diverse societal platforms. It is essential to understand that open data, open science, open source freeware, and open community needs to be supported by a resilient social system. Otherwise, their value-making potential remains limited. If the value dimensions of users acting in a collaborative network are misaligned, and if the technological decisions are implemented in an immature environment, these solutions can accelerate the negative aspects of digital collaboration. These risks manifest themselves as "closing up within one's communities, constraints of individual freedom, the privileged access to community resources and limitations on the engagement of outside persons" (Arniani et al., 2015).

On the other hand, the technological design and structure of the network give impetus to purposeful collaboration toward the common good. According to Nam (2012), in proposing a framework that can be used for investigating citizen-sourcing platform set of three basic categories have to be used: a) design evaluation; b) process evaluation; and c) outcome evaluation. The applied Collective Intelligence Potential Index (CIPI) monitoring technique (Skaržauskienė, Gudelyte, 2015) facilitates a framework to evaluate the design, analyse the processes, and compare the online community projects and their potential to generate intellectual outcomes for the common good.

Methodology: Application of Collective Intelligence Potential Index

The pilot study was conducted in Lithuania from 2019 to 2020. Its main task was to evaluate the co-creation practices by examining the dynamics that reflect the impact of technology, context, and changes in various internal and external parameters. The research subject was the "*bottom-up*" co-creation process in Lithuania's civic tech, initiated by public organisations, civic movements or business entities. The monitoring of the online communities was implemented by applying the Collective Intelligence Monitoring Technique (Skaržauskienė et al., 2015). The proposed Collective Intelligence Potential Index (CIPI) monitoring technique facilitates a framework to evaluate, analyse and compare the online community projects and their potential to generate intellectual outcomes for the common good. The dimensions of this composition are deducted from pre-existing knowledge and are developed during comprehensive empirical research. The CIPI calculation methodology results from the two years EU Global Grant research project "Social Technologies for Development of Collective Intelligence in Networked Society."

The methodology was validated by implementing quantitative and qualitative research, developing a system-dynamic model to test causal relationships and by the experimental application of the method in praxis (Skaržauskienė & Gudelyte, 2015; Skarzauskienė et al., 2015). The research methodology is presented schematically in Figure 1.

Having assessed and integrated various approaches to CI theoretically, criteria for a CI emergence were identified, and hypotheses on the impact of individual factors upon the CI potential were formulated. These hypotheses were tested in quantitative research and analysed during the qualitative research. In order to achieve a statistical sample and the credibility of data collection procedures, the services of a public opinion and market research company were used to deliver surveys of at least 1000 respondents. The qualitative research was conducted to broaden knowledge about processes during the initiation and implementation of online community projects and collect empirical data on features, singularities, stimulating factors and obstacles for collective intelligence to emerge. Results of the qualitative research have complemented insights of the quantitative research and grounded the model of the CI Potential Index. Next, the critical dimensions components and indicators of the Index were identified, and the indicator

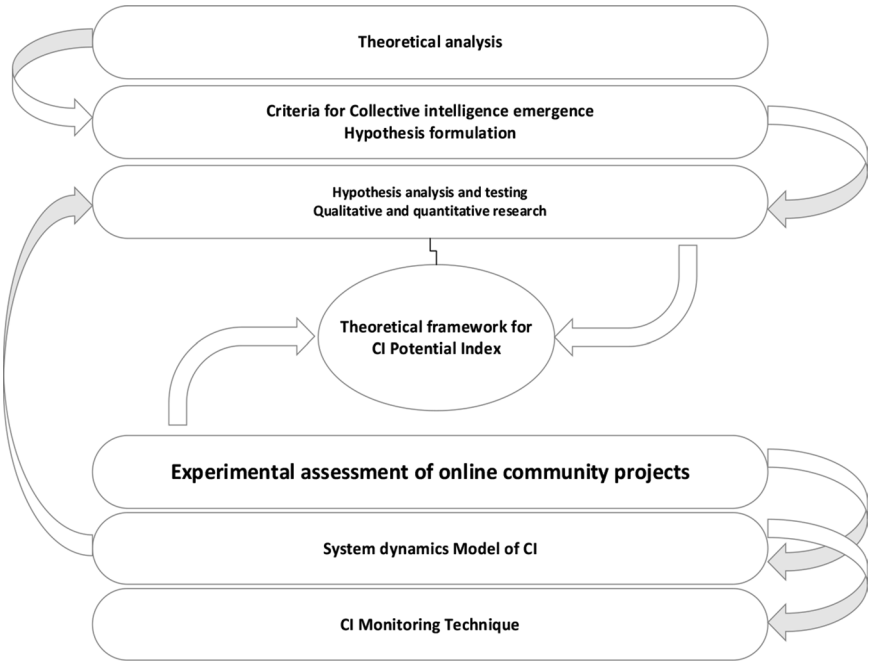

Figure 1. Methodology for Collective Intelligence Monitoring Technique. (Skarzauskiene, 2015)

measurement scales were designed. The model was validated during a scientific experiment, and the correlations between the variables were tested by developing a system dynamics model. The CI system dynamics model has identified the critical factors of the natural CI system and designed the relationships in the feedback diagrams. The identified variables and parameters were combined into a model system that reflects the process of CI emergence and development.

The Collective Intelligence Potential Index (CIPI) evaluates the essential characteristics, functionality, and technological design of online platforms using a set of integral socio-technological indicators (Collective Intelligence Capacity (CAI), Collective Intelligence Emergence (EI), Social Networked Responsibility (SRI) and Social Technologies Index (STI). The calculation of the four (4) sub-indices integrates quantitative data with content analysis results by monitoring the communities' activities in virtual space. The CI Capacity Index is a relational conception that defines the capacity of the community for creativity, aggregating and creating knowledge, decision-making and problem-solving. The CI Capacity Index has three sub-indices: capacity for creativity, capacity

for aggregating and creating knowledge, and capacity for decision making and problem-solving. The different components cover the specific aspects of each sub-index. For example, the *capacity for creativity* includes two components: (a) degree of diversity in the source of ideas and (b) degree of diversity in the engagement forms. Each component related to the sub-index reflects by grouping the different indicators. For example, the component degree of diversity in the source of ideas is measured by the percentage of females in the community, the percentage of different nationalities and age groups, and superadditivity (diversity in opinion, predictions). The CI Emergence Index evaluates the ability of online community for self-organisation, potential for emergence of intellectual outcomes and adaptivity. The sub-indices for CI Emergence Index are potential for self-organisation, intensity of emergence of intellectual outcomes, and potential for adaptivity. The Social Responsiveness Index assesses the maturity of social impact on society, maturity of social motivation and maturity of social orientation. The Social Technologies Index explores the system's structure, design and technological solutions enabling human-machine interaction (six indicators, see Table 1). While CAI, SRI and STI indices are related to pre-conditions for co-creating collective intelligence, CI Emergence Index evaluates the outcomes of the process and CI results. The different criteria are of different importance and can unpredictably influence each other. Therefore, the importance and correlations of the various criteria were calculated using mathematical methods (Skaržauskienė & Gudelyte, 2015).

The data necessary for the identification of the indicator parameters as well as initial values of stocks were collected by implementing the longitudinal web-based monitoring of CI in online communities. The research was conducted in two stages; the first stage was exploratory. The researchers used specific criteria to compile a list of civic tech targeted for the research project. The research sample of 70 communities was established according to the following criteria: Lithuanian origin of urban (related to town or city) communities; communities with specific goals and social innovation orientation; and communities able to involve a critical mass of users and operate more than one year. Most of the analysed platforms were initiated by non-profit organisations. The initial list of civic tech included 120 platforms. However, some projects were removed from the list for different reasons, such as adequacy to project objectives, viability, level of diversity, comparability, and lack of numeric data. The second stage integrated

monitoring of activities in selected communities and collecting data from Google analytics scripts. Apart from monitoring the communities, the stage incorporated negotiations with platform developers and administrators to access specific web analytics data. The monitoring instrument encompassed different criteria based on numeric, binary, and qualitative data. The chosen subjects were observed following the designed survey scheme (representative parameters), and the collected data underwent qualitative analysis and summarised to make corresponding conclusions. Each platform was evaluated independently by two researchers seeking inter-judge reliability.

For the data processing, a virtual research environment with the required software for calculating CIPI was applied available online (in Lithuanian language only). The structure of CIPI, questionnaires and experimental evaluation results are available on the projects` website www.collective-intelligence.lt in the Publications section (in two languages: English and Lithuanian). The values of indicators underwent a qualitative evaluation, and numeric values were ascribed that correspond to their quantitative weight: 0; 0.5 or 1. To improve the users` perception, the obtained values of the composite indices were transformed into a more attractive scale by multiplying the obtained values by 100 (0 is the lowest and 100 is the highest performance level). The values of answers to questions were transformed into a numeric scale under the following procedure: Yes-1, No-0, High-1, Medium-0.5, Low-0. Based on theoretical insights and empirical research results by developing the CIPI instrument (Skaržauskienė & Gudelyte, 2015), the indicators inside of indices are not equally significant; for example, DS, DF PS indicators of CI Capacity Index have more weight (60%) than indicators of CM, DD, DI (40%) (See Table 1).

Monitoring Results

The CIPI monitoring results are presented in Table 1.

As mentioned previously, the CIPI is designed around four (4) indices: CI Capacity Index (CAI), CI Emergence Index (EI), Social Responsiveness (SRI), and Social Technology Index (STI). At the current research stage, the assumption is that four (4) indices are equally significant. The final mean of CIPI of the 70 civic tech communities is **52.00** (48.68+51.66+46.99+60.69/4) (Table 1).

Table 1. CIPI monitoring results.

Dimension	Values		Indicators	Values
CI Capacity Index	**48.68**		$CAI = 0.6\frac{DS + DF + PS}{3} + 0.4\frac{CM + DD + DI}{3}$,	
Capacity for creativity		DS DF	Degree of diversity in the source of ideas Degree of diversity in engagement forms	48.64 43.33
Capacity for aggregating and creating knowledge		DI CM	Degree of interdependence Degree of an adequate supply of "Critical mass" ("swarm effect")	51.58 49.09
Capacity for decision making and problem-solving		DD PS	Degree of decentralisation and independence Degree of efficiency of problem-solving	43.64 54.73
CI Emergence Index	**41.99**		$EI = 0.6\frac{DQ + FG}{2} + 0.4\frac{DC + AT + DM + AL}{4}$	
Potential for self-organisation		AT DC DM	Degree of adequacy in the form of self-organisation to the community task Degree of development of transparent structure and culture Degree of development of distributed memory system	56.97 67.95 46.06
The intensity of the emergence of intellectual outcomes ("public value")		DQ FG	Degree of emergence in new ideas, structured opinions, competencies, and activities . The intensity of feedback from government and other stakeholders	46.36 20.00
Potential for adaptivity		AL	Degree of adequacy to socio-cultural context (local, national, global)	50.00
Social Responsiveness Index	**46.99**		$SRI = 0.6\frac{DT + SR + MC}{3} + 0.4\frac{MM + SS + RS + IE}{4}$	
Maturity of social impact on society		DT SR MC	Degree of sustainability Speed of reaction to social issues Maturity of generated content	38.00 68.00 46.00

(Continued)

Table 1. Continued.

Maturity of social motivation		MM SS	Maturity of social motivation of community Level of social sensitivity of community members	47.00 52.00
Maturity of social orientation		RS IE	Degree of diversity in cooperating partners and financing Strength of internal and external connections with stakeholders	32.00 35.00
Social Technologies Index	**60.69**		$STI = 0.4MD + 0.6\frac{EIT + PS + DM + DA + SC}{5}$	
		MD	Media/ design quality	60.00
		EIT	External/internal networking technologies.	69.00
		PS	Privacy/ security assurance technologies.	43.03
		DM	Decision-making technologies	60.00
		DA	Data aggregation and data access technologies	69.70
		SC	Sharing/creating knowledge technologies	63.82
Collective Intelligence Potential Index	**52.00**		$CIPI = \frac{CICI + CIEI + SRI + STI}{4}$ 48.68+51.66+46.99+60.69/4 = 52.00	

The CI Capacity Index of the evaluated communities has the highest mean compared with the other sub-indices. When measuring the *degree of diversity in the source of ideas* (value of 48.64) and *engagement forms* (43.33), demographic, gender and geographic diversity was evaluated as high in most monitored projects. However, national diversity was defined as being relatively low. Almost all civic projects lack the advanced competition elements, game-based approach, and the adoption for the different age groups. *The degree of decentralisation and problem-solving* efficiency was identified as relatively low. In the majority of the platforms, only the registered users can propose an idea on already posted issues, and there are only a few projects allowing anonymous participation. The diversity in expressing opinions (such as voting, ranking, structuring, and mass deliberation) is low in the majority of the observed communities as they lack technological solutions. The results support the presumption that the maturity in

problem-solving, diversity, and quality of created knowledge/products are better maintained by providing advanced technological tools for users to express their opinion and vote, evaluate, and make collective decisions. On the other hand, in many cases, the possibilities for the users to initiate a new topic, aggregate or create knowledge are limited due to the clear leadership of initiators or managers of platforms.

The value of the CI Emergence Index is influenced by the level of self-organisation (56.97) and the development of a transparent structure (67.95). The observed platforms demonstrate high performance in these dimensions. Moreover, the lower values were identified in the intensity of emergence of new ideas, activities, and development of distributed memory systems, especially in the feedback from government and other stakeholders. The level of diversity in the addressed problems, insights and proposed ideas varies from low to medium. With the rare exceptions, the exchanges of information in civic projects are dominant.

The Social Responsiveness Index has a higher value than the CI Emergence Index. Lithuania's online communities demonstrate a high speed of reaction to social issues (68) and a high level of social sensitivity (52). However, the platforms lack sustainability, visibility and support from cooperating partners and stakeholders. Few platforms publish data on the implemented actions and initiatives. The majority of the results are named as publications or implemented ideas that improve the platform's performance. It is interesting to note that the virtual projects with broad objectives to tackle societal problems demonstrate a wider variety of offered ideas, more mature discussions, and higher quality solutions than those with a narrower focus on specific issues.

Social technologies perform as a supporting mechanism for effective and efficient activities of online platforms. However, technological solutions for collective brainstorming, collective assessment or decision-making are underdeveloped in most projects. Technological solutions, such as support of interaction, interactivity, protection of data and the security of processes, grouping and analysis of discussions, and multilayer environment of discussions, are vital for forming collective intelligence. The level of knowledge aggregation and sharing among the monitored communities was identified as above the average. The most developed technologies foster the formation of interest groups and sharing of information. Greater attention should be paid to privacy and personal data

protection technologies because only half of the platforms have these IT tools installed to protect their users.

Limitations

In the absence of the index calculation results that were equally tested in another socio-cultural context, the comparative value of the outcomes of this research cannot be established. However, the numeric values of the final CIPI and the values of sub-indices can be compared with the average of the already evaluated platforms aiming to get insights into the potential of the networked systems for generating the intended intellectual outcomes. Another limitation is related to qualitative assessment. The increase of collected empirical data would condition the increase in research data reliability and validity of the applied instrument.

In the direction to further work, the relationships between different indices could be evaluated statistically to understand the causality between different variables.

CONCLUSIONS

From sharing knowledge to producing the technology, and from cooperation to competition, further research is needed into how ICT supported co-creation works. Notably, this is an area of continuous exploration for practitioners and research scholars. With the increasing complexity of networked systems and more excellent connectivity between humans and machines, those systems' characteristics are crucial in determining the performance and successful development of collaborations. The ability to influence performance is dependent on the accurate assessment of the systems and their dynamics. The challenge confronting the proposed Collective Intelligence Monitoring Technique was to correlate different factors and find realisable pre-conditions for the collective intelligence to emerge systemically. Such clear criteria can measure not all aspects of the platform's performance. However, collecting empirical numeric data is vitally important. Storing such data over a period could help predict the performance of the online community as a whole or help diagnose and prevent the reduction of community members' motivation or diminished activities.

The monitoring results provided information about the limits of the civic tech platforms and changes that need to be implemented to overcome

the limitations. The evaluation conclusions provided a "helicopter view" of digital co-creation practices in Lithuania, distilled the best practices, identified game-changing communities, and expanded the opportunities for designing targeted engagement strategies. It can be concluded that Lithuanian civic tech possesses a high level of technological pre-conditions (Social Technologies Index). However, the lower values in CI outcomes (CI Emergence Index) can be explained through low and medium scores in CI Capacity Index and Social Responsiveness Index. The explored communities lack the capacity for creativity, diversity, decision-making, and problem-solving. They also usually have lower degree in sustainability, maturity, and internal and external connections. The monitored online communities are considerably different, but they are united by social orientation towards society's problems, and they wish to create a better environment around them. However, most of them do not extensively use the potential of Collective Intelligence. They are frequently limited by narrow group interests or become an instrument of individual self-realisation or marketing.

Evaluation of common standards, procedures, and values should be more significant in developing online communities. In contrast, mature ones should be assessed according to leadership, balance, technological, and procedural openness factors. It can be concluded that CI formation in Lithuania's civic tech is at its initial stage. Thus to discuss particular results is too early. Nevertheless, the development of civic engagement can also be seen as a collective consciousness and a form of collective intelligence, respectively. In pursuance of their vision and mission implementation, communities solve problems and perform activities, adaptively reacting to the fundamental problems. Most of them actively learn and exchange information by carrying out activities, thus creating pre-conditions for developing collective intelligence in Lithuania. In addition, the civic tech progress in Lithuania and perfect technological pre-conditions in the country can be used as a testbed to explore the potential of computer-supported collaborative work in the future.

DISCUSSION

Our paper is based on the presumption that the networked society is likely to be a key player in future society because it has a decentralised structure and operates on a user-to-user mode, developing productive computer-supported collaboration. The concept of co-creation fundamentally differs from the traditional public engagement approach. It focuses on collective intelligence, awareness and

responsibility of all stakeholders by creating the public good. The analysis of scientific sources (Khan & Krishnan, 2017) indicates that though online platforms are considered promising media for promoting e-participation, the benefits of online collaboration are not realised yet, owing to the extant challenges. Accordingly, the authors of that study proposed the following critical areas for future research: theoretically valuable and practically relevant to researchers and policymakers: theoretical background, stakeholders, context, and research methods. Hence, the scientific community needs to develop evidence-based social models to formulate objectives for IT developers who can then create and apply the better targeted and value-creating technological solutions.

Exploring the potential of web-enabled collective intelligence could have enormous practical implications by influencing the more proper and sophisticated application of social technologies in practice. The modern concept of civic engagement is related not only to national identity but also to the capacity of communities to make collective decisions and proactively "intelligent" solve social problems. The first research findings (Skaržauskienė et al., 2015) indicate the promising active behaviour of young people in online platforms of cooperation and their increasing civil power. Torney-Putra et al. (2004) demonstrated that all civic behaviours are correlated with the level of trust vested by young people in the local community (e.g. school principals, chefs in local restaurants), friends, acquaintances and family. In recent years, the active-passive dimension (Lewicka, 2005) of citizenship has attracted the interest of researchers from various scientific disciplines. The representatives of medical scientists emphasise that an active lifestyle delivers numerous health benefits; psychologists and sociologists claim that social, occupational and political activity contributes to welfare, whereas economists argue that enterprise drives prosperity. According to the findings of Ahangama and Krishnan (2021), the quality of life outcomes of a nation is directly affected by the e-participation initiatives of its citizen.

The ability to recognise CI in virtual communities can help communities multiply their abilities to organise themselves and become more productive and efficient. Understanding co-creation processes in online platforms could solve the different social problems of the networked society through virtual means. While online platforms will probably be the first to experiment with these new IT tools, they could be easily taken offline to create and build new organisations that operate in the physical world by multiplying the successful cooperation models

on the national or international scale. The applied CI Monitoring Technique is expected to facilitate policymakers, business designers and community managers or moderators to recognise whether a community has the potential of becoming a CI system, to maximise the benefit that the community and individual users will receive from the system and decide on the adequate technological design and solutions. By evaluating the existing collaboration platforms, the opportunity for IT developers will be created to integrate or develop new tools that a community of stakeholders can exploit to create and enrich human-machine networks.

In conclusion, technological readiness's current knowledge level is essential for the co-creation process. The IT tools and solutions have to create additional social value to the platforms` activities and contribute to the community's identity. IT solutions have to be chosen in such a way that the operation of the main elements of the model of collective intelligence would be insured, e.g. technological solutions are mainly responsible for the formation of creativity, diversity and trust (lower barriers to communication for reaching a particular member of the community, conditions for comments and expression of one's positions and limit in time as well as technical possibilities). If an online community impedes communication, limits its speed, frequency, the contents of discussions, the number of messages, it hinders the spontaneity of the interaction of the members of the community; this in itself reduces trust in the system and alienates members from one another, i.e. average distances between members become longer. The design of a networked platform has to be created with and for the community.

Currently, scientific questions regarding civic tech management cannot be satisfactorily answered because researchers are only beginning to understand similar systems' complexity and possibilities and threats. Our view is that co-creation is more than just sharing, reacting, voting or making decisions. The phenomenon is more about being proactive in finding problems and contributing to solving various social problems. Digital co-created collective intelligence has the potential to become global in terms of its geographic reach and content, although it still has to be parametrised and credibly measured. Perhaps the focus of the researchers should be on developing holistic, interdisciplinary conceptions to understand the complexity of self-organising and "emergent" networked systems and forecasting their development scenarios.

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