
The potential of collective intelligence for fostering innovation: social technologies perspective

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Abstract:

The subject of our research are networked projects (collective intelligence systems) which include collective decision-making tools and innovation mechanisms allowing and encouraging individual and team creativity, entrepreneurship, online collaboration, new forms of self-regulation and self-governance, self-configuration of communities by considering these projects as being sensors for development of collective intelligence (CI). Our first task is to define the phenomena of CI and identify the areas for applying CI systems in innovation management by distilling the best practices from existing and new initiatives and by targeting the integration of various scientific approaches. In our research paper, we try to answer the question how collective intelligence could contribute to the development of innovation in networked society. The answer to this theoretical question could have huge practical implications. Innovative technology enterprises use social technologies for creating competitive advantage but without scientific reasoning, they often choose inadequate tools or methods and do not create expected value and sustainability. By evaluating the existing networked platforms the opportunity for developers will be created to integrate or to develop new tools or IT based applications fostering innovations.

Keywords: innovation; collective intelligence; social technologies; social media; virtual communities; creativity; entrepreneurship; online collaboration.

1 Introduction

Collective intelligence (CI) is one of the greatest challenges nowadays in various fields of our lives. The idea of the research topic is based on “wisdom of crowd” concept (Surowiecki, 2005) explaining that individuals and groups can more effectively and

sustainably react to societal changes by acting on the basis of a collective intelligence (CI) and collective awareness of problems. It is based on the notion “that large groups of cooperating individuals can produce higher-order intelligence, solutions and innovation and come to function as a single entity” (Lykourantzou et al, 2011). In contemporary organizational science, the researchers shifted their attention from observing the individual to monitoring a network of relationships within organizations, because “knowledge becomes an asset to the organization only when it is accessible and its value increases with the level of accessibility the relationships among organization members” (Davenport and Prusak, 2000). At a group or collective level cognitive ability, called intelligence, is a factor underlying creativity and innovation (Goyal and Akhilesh, 2007). The networked society, in most basic terms, is a social framework, which inhibits networks based on use of communication technologies. A network is a formal structure, where intelligent activities emerge (Monge, Contractor, 2004). Following the Internet boom, societies, organizations and movements have evolved from bureaucratic/centralized to both decentralized and distributed networks (Malone, 2010). This evolving change towards de-centralization and democratization of decision-making has started to impact business, governments and society at large (Malone, 2010). “Since the future is basically unpredictable and uncertain, society must rely on creative initiatives from the citizens to be able to create the desired future” (Johannessen, 2001). Volumes of literature published exhibit the growing interest in the field of CI, but despite some efforts (e.g. Luo et al. 2009, Gan et al. 2007, Malone et al. 2010), generally accepted framework for studying collective intelligence in human behaviour either does not exist or research is fragmented and lack of complex structure. Furthermore, due to the lack of a common framework, it is not possible to assess what is already known and to tie the efforts of different disciplines together (Salminen, 2012). In our research paper, we try to answer the question how collective intelligence could contribute to the development of innovation in networked society. The answers to the theoretical question could have huge practical implications. By evaluating the existing collaboration platforms the opportunity for developers will be created to integrate or to develop new tools or IT based applications fostering creativity, self-organisation, collective decision making, collective learning etc.

2 Defining Collective intelligence

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 CI system” (Lykourantzou et al, 2011). Collective intelligence differs from individual intelligence “because it encompasses a social dimension, groups and organizations developing collective mental models” (Senge, 1990). In recent years, there has been a surge of research activity into collective intelligence. Some of the notable outputs of collective intelligence include Google, Wikipedia, and InnoCentive. “Study of collective intelligence in humans is a relatively new field, for which huge expectations are set, for example through speculations on the emergence of the Global Brain (Heylighen, 1999). Salminen (2012) provides the detailed overview on collective intelligence definitions. A number of studies perform research on CI conceptual description (Szuba, 2002; Bosse et al. 2006; Luo et al. 2009). Other researchers explore specific cases, simulations or experiments (Gruber 2007; Woolley et al. 2010; Vanderhaeghen and Fettke, 2010). Lykourantzou et al (2011) define a collective intelligence system, as a “system which hosts an adequately large group of people, who act for their individual goals, but whose group actions aim and may result – through technology facilitation – in a higher-level intelligence and benefit of the community.” According Woolley et al (2010) it is the general ability of a group to perform a wide

variety of tasks. We define collective intelligence using Malone (2010) definition – as groups of individuals acting collectively in ways that seem intelligent in this paper. At the moment, there is no theory capable of explaining how collective intelligence actually works (Schut, 2010). It is challenging for researchers from different disciplines “to be aware of advancements in other fields, possibly under differently named concepts” (Salminen, 2012). The field is also multidisciplinary according Salminen (2012) as it is related to psychology (Woodley and Bell 2011), complexity sciences (Schut, 2010), cognitive studies (Trianni et al. 2011), biology (Bonabeau and Meyer 2001), computer sciences and semantics (Levy 2010) and social media (Shimazu and Koike, 2007). Many researchers have presented significant results in identifying potential of collective intelligence to solve various problems, or in modelling CI from a more conceptual point of view, but according Lykourantzou et al (2011) they do not focus on an essential problem – “CI system design and optimization processes, through which collective intelligence will be able to emerge in a systemic manner.”

Collective intelligence is not a new concept and CI exist generally without the use of technology, but new forms of collective intelligence emerge because of the Internet. “Web 2.0 is an amorphous term used to define a computing paradigm that uses the Web as the application platform and facilitates collaboration and information sharing between users” (Lykourantzou et al, 2011). CI is becoming new tool of collaboration for solving specific problems by sharing ideas. “The explosion of user-generated content referred to as Web 2.0, including blogs, wikis, video blogs, podcasts, social networking sites, streaming, and other forms of interactive, computer to computer communication sets up a new system of global, horizontal communication networks” (Barahona et al, 2012). The concept of collective intelligence is now being explored by businesses interested in innovation and by researchers interested in addressing systemic society problems. Surveys conducted by analyst companies such as Forrester Research (2012) demonstrate that social technologies continue to grow in popularity inside the society and these developments will have an influence on policies and drive economic and societal changes. Therefore it’s very important to stimulate and support the emergence of collective intelligence based systems for developing and fostering innovations.

3 Fields of Collective Intelligence application in Innovation Management

Investigation of literature related to business and social innovation lead to conclusion that there exists multiple of approaches, definitions and frameworks explaining emergence of innovative activities. Although the concept of innovation is usually linked to the scientific and technological dimensions, there is a large consensus that innovation is a complex process that cannot be reduced to the technological side (Pereira et al, 2010). In general, the literature suggests the following variables to underlie successful innovation (Goyal and Akhilesh, 2007): integration of talents; interdependence of roles; task complexity; interdepartmental collaboration; communication structures; diversity of knowledge, talents etc. The long term task of CI systems is “to fuse the knowledge, experience and expertise of individuals, in order to elevate, through machine facilitation, the optimal information and decisions that will lead to the benefit of the whole community” (Kapetanios, 2008). In the workplace, the managers cannot push their employees to communicate and create relations but “can create the conditions where those interactions are more likely to emerge.” Through our research, theoretical analysis and conversations with academics and practitioners, we could define these areas for exploring collective intelligence in innovation management: research development

projects; project management; market research; knowledge management; e-participation; crowdsourcing etc.

In the *R&D and innovation projects*, quality of solutions and consistency of the output should be ensured. Access to talent, diversity of participants and participant engagement, recruiting new members from surrounding learning communities over time preconditions project's quality and consistency of the output (Bonabeau, 2009). Approach of CI systems could be adopted as a mean for solving long-standing scientific problems (Savage, 2012). The findings of several critical and extensive empirical studies suggest considerable benefits of collective decision making using social networking technologies to R&D project teams, and project teams (Cohen and Prusak, 2001; Cross and Parker, 2004). Research indicated a positive relation between team members' participation in collective decision-making processes and their organizational commitment (Hulpia and Devos, 2010). In general employing CI developing tools in *project management* could improve the quality of project output results (Gloor et al., 2008; Goyal and Akhilesh, 2007):

- Communications failures among project members can be reduced, as it converts on-way communication into two-ways communication;
- Virtual communication and collaboration discovers core contributors unlocking the creative potential of team members;
- Knowledge visualizations assist in finding good ideas in the project and the whole organization context;
- Distributing work in new and innovative ways, in targeting and motivating the right participants etc.

In *mergers and acquisitions projects* getting knowledge from different companies involved in the process to form new high-performing teams can be challenging (Gloor et al., 2008). Employing collective and collaborative approach of communication between new members of the group not only helps to improve companies re-design process but also ads / increase value for enterprise. Creating new solutions as collaborative teams, consisting from members with different background and contributing with knowledge, help to aggregate and incorporate in to new knowledge system. New ideas for creating innovations could be created using the experiences and insights of numbers of people around the world. Applying social technology tools in the *market research and customer service* enable to reach wide population and to receive lots of different information: customers stories, complains, recommendations, preferences, experiences, etc. In the market research case, it is important “to maintain ability to discover or elicit true responses, which can be obtained by sample size control (whether it is representative of market) and participants“ engagement (Bonabeau, 2009). Customer service improvement can be developed in users' community environment. The percentage of problems solved, early discovery of problems can detect effectiveness of activity. Key indicators of communication quality can be responsiveness to unsolved problems and participants' engagement (Bonabeau, 2009). As Boder (2006) states CI systems are a keystone in *organizational knowledge* generation. Main actions involved in CI creation in order to maintain high performing organization knowledge system are: make individuals' competence explicit, clear articulation of objectives, smooth mechanics of interaction, complementing various competencies, ensure reciprocal expectations and, trust and respect enhancing interactions and organization norms should be developed.

Crowdsourcing is another field where organisations try to solve their problems through emergence of collective intelligence or wisdom of crowd. Jeff Howe (2006) defined crowdsourcing as “the act of tacking a job traditionally performed by an employee and outsourcing it to an undefined, generally large group of people in the form of an open call”. In other words, “the process is trying to solve a organisations problem by an open call in the network who often possess unique knowledge, offering them conditions to

express that knowledge” (Silva and Ramos, 2011). Crowd creation, voting, crowd funding and other forms of crowdsourcing could be outsourced by organisations for creating open innovations: aggregating knowledge, insights, making better, more informed decisions about the future etc.

More fields where CI approach is useful to employ could be revealed by more extensive literature review and practical case analysis. Fields like *system testing or crises response, law enforcement, recommendation system, requirements engineering*” (Lykourantzou et al, 2011) or other more specific areas can use innovative in CI systems emerged ideas in order to increase process efficiency. For example, CI approach application in system testing could aim to assess number, quality and scope of unexpected issues that are uncovered during the testing. Or application of CI in crisis response activity could aim to access to difficult-to-obtain information, and minimize of damage inflicted by crisis. However, as the scope of the article is limited and the aim is to reveal general opportunities for application of CI systems we follow with the analysis of virtual communities tackling societal problems in Lithuania.

4 The overview of Collective intelligence systems in Lithuania

CI may obtain various shapes and patterns e.g. citizens that work together towards achieving a common social goal beneficial for community or political parties to run campaigns and to select candidates, as well as business enterprises collaborating or competing towards finding the innovative solution to a problem (Lykourantzou et al, 2011).

Klein et al (2007) discusses different solutions applicable nowadays enabling the emergence of CI. Most common technologies are synchronous and asynchronous chat tools (e.g. email) as well as open forums (e.g. blogs). Although, these tools provide interaction on a global scale, they may have limitations in terms of creating CI (Klein et al, 2007). Other technological solutions allow for more advanced forms of CI to emerge. Expert markets (e.g. Quora.com) enable stakeholders to collect ideas from around the world (Denning and Hayes-Roth, 2006). However, the ideas itself are not necessarily created in collective manner. Prediction markets enable sizable human groups to reach sometime surprisingly accurate estimates of given hypothesis or problem (Wolfers and Zitzewitz, 2004). In this case, the collective action is also missing because the guess is executed individually. Group Decision Support Systems could be applicable for collective brainstorming but only in small groups (Gopal and Prasad, 2000). E-voting can be effective when reaching for consensus among numerous and dispersed groups but is most useful when small number of possible choices is available (Klein et al, 2007). The most complex discussed technological solution – mass argumentation. These tools should eliminate limitations of previously mentioned social technologies (Kirschner et al. 2005; Moor and Aakhus, 2006). Mass argumentation allows to focus participants' interactions into a network consisting of three elements: problems, options and arguments (Klein et al, 2007). These measures if properly designed and implemented helps to structure even the most difficult discussions and achieve results. Mass argumentation solutions provide the best conditions for emergence of CI and innovations.

Literature analysis revealed variety of typologies for categorizing virtual communities as active, collaborative CI systems. Often, communities are classified according to interests of their members, for example educational, medical, religious, or political community (Preece et al., 2003, 2004). Lykourantzou et al (2011) divide categories of collaborative and competitive CI systems. Different scientific disciplines tend to distinguish the types of virtual communities only suitable for their research area. For example, researchers of information systems (Preece, 2000; Stanoevska-Slabeva, 2002) classify communities

according to the types of assistive technologies used (chat rooms, bulletin board, etc.). Business management researchers classify virtual communities based on different objectives of communities such as revenue generation (Plant, 2004), customers (Armstrong and Hagel, 1995). Porter (2006) offers an interdisciplinary classification system, which allows scientists from different fields to adapt it to their work. This model will be used for the review of existing Lithuanian virtual communities in the context of social challenges. The classification system is shown in Figure No. 1 “Types of virtual communities in Lithuania”. Key variable of this system is establishment type of the community. The first group of virtual communities are *initiated* and managed by *their members*. The relationship within these communities can be oriented towards *professional* or *social interaction*.

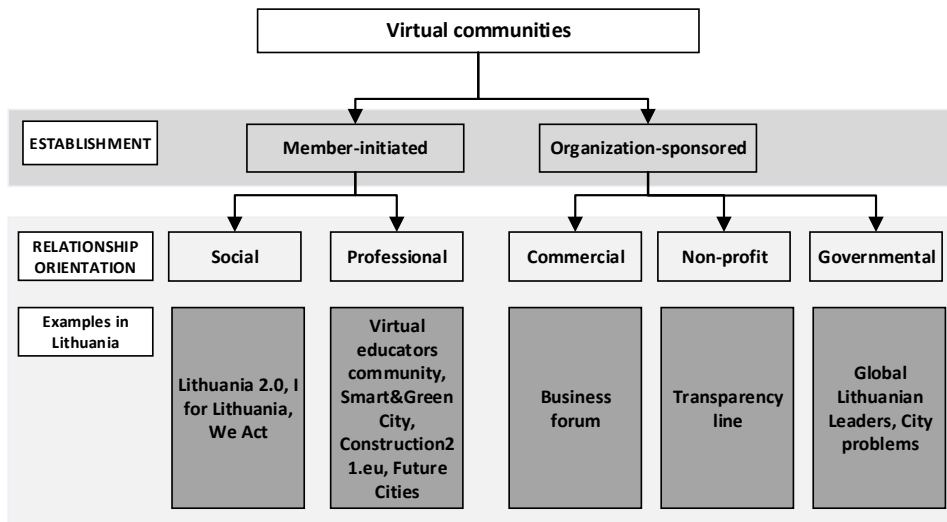


Figure 1 Classification of virtual communities in Lithuania

Source: adapted from Porter (2006)

Communities with *social orientation* are based on member interaction on common interests. This type of community could be held a primary one because they were started to be created together with development of the Internet. There are number of virtual communities of such type in Lithuania for members to discuss their ideas and problems. Advanced platforms of such type are *Lithuania 2.0* and *I for Lithuania* have been developed for ideation and discussion of social issues. Social technologies used in these platforms allow individuals, families, communities and organization to work together to promote common goal – fostering social innovation, ecological thinking, citizenship and social activity.

Virtual communities with *professional orientation* are designed for professionals who can share information and find solutions for problems together with colleagues from other organizations. The best example is the case of Lithuania is a virtual community of educators. Another example of such type of community is *Smart&Green City* focusing on joining people and organizations for discussing on optimal and innovative use of natural energy resources. Emergence of member-initiated online community projects in Lithuania indicates the increasing citizens' desire to promote public debate on the problems and their innovative solutions and thus to contribute to the emergence of

collective intelligence. Unfortunately, in many cases advantages of online space (anonymous access at any time of the day, lack of meeting space limitations) are not exploited.

According to Porter (2006) communities could be established using the support of different organizations. The communication and orientation of these communities are directly related to the organization's mission and goals. As the virtual community projects and platforms are explored in the context of social challenges – it is hard to find examples of *commercial virtual communities*. Closest to this category is *Business forum* initiated by Association of Youth Business Club. Forum is used as a platform to share opinions, good and bad practices and to develop constructive dialogue with all interest groups supporting entrepreneurship. Elements of *non-profit virtual communities* are best reflected in the platform *Transparency line* curated by Transparency International Lithuanian Chapter. Site visitors become members of the community by reporting observed or possible acts of corruption. *Governmental virtual communities* are created public organizations to achieve their goals. *Global Lithuanian Leaders* platform aims for searching of economic opportunities for Lithuanian products. Vilnius City Municipality initiated project *Do business* happening annually is another great example of non-governmental virtual community. Through the use of social network Facebook it brings opportunity for entrepreneurial people to interact and solve problems. This community helps to meet like-minded, get answers to business problems from experienced entrepreneurs and experts from other areas (marketing, law, etc.). Another example – website service offered by Vilnius Municipality named *City Problems* allow people to register issues observed in the city of Vilnius. Organization sponsored communities actively exploit the advantages of the virtual space, and tools enabling users to share views and ideas on how to improve the life of society.

5 The potential of CI systems to foster innovations

In order to assess the potential of virtual community projects to foster innovations, we conducted a qualitative analysis of such projects. Our research sample was setup according these criteria:

- Lithuanian origin of a communities;
- Communities have specific goals;
- Communities have capabilities to involve masses (large number) of members;
- The sample must include both member-initiated and organization-sponsored projects;
- The sample must include communities of various orientations (e.g. social, professional, commercial, non-profit, governmental).

These criteria lead us to selection 11 virtual community projects and deeper qualitative content analysis. Sample consisted of 3 member-initiated social communities (*I for Lithuania*¹ and *Lithuania 2.0*², *We act*³); 4 member-initiated professional communities (*Construction21.eu Lithuania*⁴, *Virtual educators community*⁵, *Future*

¹ <http://www.aslietuvai.org/lt/i-top/ivadas>

² <https://www.lietuva2.lt/lt>

³ <http://www.mesdarom.lt/kas-yra-darom/>

⁴ <http://www.construction21.eu/lietuva/>

⁵ [http://ejournal.emokykla.lt/virtuali_bendruomene/index.php?output=FrontPage\(\)](http://ejournal.emokykla.lt/virtuali_bendruomene/index.php?output=FrontPage())

*cities*¹, *Smart&green city*²); 1 organization-sponsored commercial community (*Business forum*³), 1 organization-sponsored non-profit organization (*Transparency line*⁴), and 2 organization-sponsored national and local governmental virtual community projects (*Global Lithuanian leaders*⁵ and *City problems*⁶). Data were analyzed and organized using three groups of components: Areas of CI employment: project management and knowledge management; Market research and customer service; E-participation. These elements express functions performed by CI in creation and design of innovations. The more components certain virtual community project encompass – the greater the potential it has in fostering innovations. Table 1 provides overview of the selected projects and elements their activity match.

Results of the analysis show that virtual community projects are most active in the areas of project management and knowledge management. Appearance of e-participation components is lower. Market research and customer service components were available only in few instances. Hence, the most favorable conditions for emergence of CI and innovation appear when online communities are employed for creation and/or implementation of social or commercial projects. It must be noted that, deeper analysis of separate areas regarding CI components, only few of the virtual community projects had technological conditions for emergence of CI and innovations.

Knowledge collection and transfer is the most implemented component and can be observed in all selected virtual projects. Nevertheless, the sole existence of this element (without interaction with other elements) is not sufficient for emergence of CI and innovative solutions. Element of collective creation of new knowledge, which is more important in terms of innovation creation, can be noticed only in 3 out of 11 virtual community projects. *Search for consensual knowledge* (i.e. when community members are seeking for a common decision when solving problems, generating ideas or alternatives) can be spotted only in 2 platforms. Only 1 out of 11 communities integrate component of *collective solving of scientific problems* into their activities. Most of the platforms express element of *participant's engagement* well. However, some platforms emphasize attraction of experts rather than mass participation and engagement.

Platforms, which include business actors, aspire to ensure exchange of information and expert knowledge. Nevertheless, some business-oriented virtual communities allow generation of ideas and problem solving activities.

Socially-oriented virtual communities when achieving their designed goals also perform important public function i.e. promotes citizen involvement into public affairs. Hence, the elements of e-participation are closely related to the elements of project management and knowledge management. It must be noted, that Lithuania has a serious problem with citizens' social activity – low political self-awareness and civic engagement. Therefore, the most active members of Lithuanian society try to fix this situation using various means of social technologies. CI components of e-participation play a very important

¹ <http://www.ateitiesmiestai.lt/apie-mus/>

² <http://www.smartandgreencity.com/>

³ <http://www.verslobrolis.lt/index.php>

⁴ <http://skaidrumolinija.lt/apie/>

⁵ <http://www.lithuanianleaders.org/about-gll/>

⁶ [http://old.vilnius.lt/newvilniusweb/index.php/159/?](http://old.vilnius.lt/newvilniusweb/index.php/159/)

role. Interactive public engagement in public problem solving draws these main advantages for participative policy making (Driessen et al., 2001; Pragere et al., 2008, Edelenbos and Klijn, 2005): serves to bring information about the needs and values of the public that add to existing knowledge; provides information about the present situation from different angles and outlines an actual and desirable state; helps to create new knowledge about possible alternatives and plausible solutions; contributes as consensual knowledge when adjusting different attitudes of policy actors; secures policy implementation via possessing new knowledge as its own pragmatic justification; serves to acquire knowledge stimulating policy actors' learning process for future actions and interest representation.

Table 1 Components of CI within Lithuanian virtual community projects.

| Area for CI employment | Component of CI | On-line communities with emerging CI | Number (percent) |
|--|---|---|-------------------------|
| <i>Project management and knowledge management</i> | participants' engagement | <i>Lithuania 2.0; I for Lithuania; Smart&green city; Transparency line; Virtual educators community; We act</i> | 6 (55) |
| | targeting and motivating the right participants | <i>Smart&green city; Global Lithuanian leaders; Construction21.eu Lithuania; Virtual educators community; Future cities</i> | 5 (45) |
| | solving of scientific problems | <i>Construction21.eu Lithuania</i> | 1 (9) |
| | collective and collaborative communication | <i>Lithuania 2.0; I for Lithuania; Business forum; Construction21.eu Lithuania; Transparency line; Virtual educators community; Future cities; Global Lithuanian leaders</i> | 8 (73) |
| | knowledge collection and transfer | <i>Lithuania 2.0; I for Lithuania; Business forum; Global Lithuanian leaders; Construction21.eu Lithuania; Transparency line; Virtual educators community; City problems; Smart&green city; Global Lithuanian leaders; We act</i> | 11 (100) |
| | collective creation of new knowledge | <i>Lithuania 2.0; I for Lithuania; Construction21.eu Lithuania</i> | 3 (27) |
| | collective idea development | <i>Lithuania 2.0; I for Lithuania; Construction21.eu Lithuania</i> | 3 (27) |
| | search for consensual knowledge | <i>Lithuania 2.0; I for Lithuania</i> | 2 (18) |
| <i>Market research and customer service</i> | reaching of wide population | <i>Business forum; Future cities</i> | 2 (18) |
| | idea creation | <i>Construction21.eu Lithuania; Future cities</i> | 2 (18) |

| | | | |
|------------------------|-----------------------------------|--|--------|
| | knowledge collection | <i>Business forum; Construction21.eu Lithuania</i> | 2 (18) |
| | expertise sharing | <i>Business forum; Global Lithuanian leaders; Construction21.eu Lithuania; Future cities</i> | 4 (36) |
| | reaction to unsolved problems | <i>Business forum; Construction21.eu Lithuania; Future cities; Global Lithuanian leaders</i> | 4 (36) |
| <i>E-participation</i> | public engagement | <i>Lithuania 2.0; I for Lithuania; Smart&green city; Transparency line; City problems; Future cities; We act</i> | 7 (64) |
| | problem identification | <i>Lithuania 2.0; I for Lithuania; Transparency line; City problems</i> | 4 (36) |
| | idea creation and development | <i>Lithuania 2.0; I for Lithuania; Future cities</i> | 3 (27) |
| | knowledge collection and transfer | <i>Lithuania 2.0; I for Lithuania; Transparency line</i> | 3 (27) |
| | interest representation | <i>Lithuania 2.0; I for Lithuania; Smart&green city; Transparency line; City problems; Future cities</i> | 6 (55) |

The analysis revealed that most of the CI components are encompassed in virtual community projects *Lithuania 2.0* and *I for Lithuania*. Although the goal of these platforms is to address social problems and concerns, they have the largest potential to foster innovations. *I for Lithuania* community declare their mission to foster wisdom of crowds in order to solve Lithuania social issues. This virtual community seeks to influence state politics while collecting, analyzing and implementing new ideas. Both mentioned platforms apply solutions of social technologies that lead to collective intelligence. *Lithuania 2.0* and *I for Lithuania* created conditions suitable for generation of ideas for value creation using insights and experience of various users. These two projects connect socially motivated and geographically dispersed participants who can compete by submitting ideas and focus on finding alternative solutions for social problems. The platforms break down the problems and innovatively distribute tasks. Using non-hierarchical principle participants use small informal groups to work on specific problems. Group members have several roles - project management and task leaders. Active participation leads to receiving more rights and responsibilities. For CI and innovations to occur, it is important that platforms allow collecting and storing knowledge, insights and expert evaluations of the groups that are vital for future decisions. As can be seen in Table 1, only half of selected platforms have abilities to collect suggested ideas, evaluate and implement them. *I for Lithuania* divide ideas into several value levels: global, national, organizational/community, individual. *Lithuania 2.0* has a different approach – collected, discussed and implemented ideas are used to influence political decisions. Important condition for CI and innovation creation is the availability of various actors in the debates. Both virtual community projects allow participant discussion, interaction, voting and commentary. The effectiveness of these activities in terms of CI and innovation emergence depends on the number of active participants. However, great number of participants may introduce operational and managerial challenges – each participant wants to address different problems so it becomes difficult to handle information flows. Complexity of virtual community projects

burden information search, ability to process large amounts of data, identify supreme problems needed to be solved. Because of that, such projects need to find a way to avoid unnecessary or duplicated information, structure the debate and reach consensus in large groups.

Another analysed member-initiated virtual project with social orientation is *We Act*. However, compared to previously discussed platforms possibilities for CI and innovation emergence here is rather limited as it encompasses only several component of CI. The platform strives to engage wider public in societal problem solving, collection and transfer of knowledge on on going and forthcoming social actions.

Construction21.eu Lithuania, *Virtual educators' community*, *Future Cities*, *Smart & Green city* have professional orientation. They are designed for professionals to share information and find problem solutions while participating in discussions with colleagues from other organizations. In spite of that, they do not ignore wider public and seek to attract as many participators as possible. The most accurate example of virtual community with professional orientation is *Virtual educators' community* where educators from different schools and regions can learn from each other, exchange ideas, methods of teaching, and share teaching material and visual aids. *Smart & Green City*, *Future Cities* and *Construction21.eu* focus on gathering public organizations, government authorities, business sector representatives in one place and stimulate thinking, discussions and calculations on optimal use of natural and energy resources. These platforms are distinct from others because instead on focusing on social problem only they take into account market conditions and business interest. Participants of *Construction21.eu Lithuania* and *Future cities* platforms can contribute to ideation process. Meanwhile, *Smart & Green city* still exist as a website only informing community members about its activity but provides limited opportunities to discuss and express views. This platform compared to other professional platforms has fewer CI components and has limited amount of conditions for CI and innovation to emerge.

Business forum aims to create community of entrepreneurial young people in order to represent their interests and to help build commercially successful new business. Forum is used as a platform to share opinions, good and bad experiences and to seek constructive communication with all interest groups supporting idea of entrepreneurship. This forum includes several CI components. It strives to reach of wide population, collect knowledge and share expert opinions, has search tools for problem solving, but does not include technological solutions for idea creation and development.

Transparency line addresses its goal of fighting corruption by means of participants' attraction, accumulation and transfer of corruption and bureaucracy related knowledge, exchange of experience and consultation. In addition, the platform contributes to the development of e-participation, as participants collectively search for ways how public interest could be represented and/or defended. Such feature of collective intelligence plays very important role in societies with low level of civic engagement.

Global Lithuania Leaders – community initiated and curated by Ministry of Economy of the Republic of Lithuania – allow emergence of CI and innovation by targeting and motivating the right participants, collecting and transferring knowledge on possibilities of Lithuanian products in global markets. This platform contributes to entrepreneurship education of society. Using the platforms, community members can share experiences, create social networks, and announce and solve business problems in online forum via CI component of collective and collaborative communication.

Vilnius city municipality website offers service named *City problems*. So far, it only encompass CI elements of public engagement and problem identification because it allows residents of Vilnius to register observed problems. Although, the site lacks additional functionality (comments, suggestions, monitoring) to be considered a virtual

community platform, but this type of project can be considered as a first step towards a functional platform for dealing with Vilnius problems.

It is necessary to note that Lithuanian virtual community platforms tackle variety of societal problems but often lack technological solutions that could enable emergence of collective intelligence and innovation. Introduction of additional technological capabilities would allow to include larger groups of people into decision-making and foster citizen participation.

4 Conclusions and discussion

Under the collective intelligence paradigm “the focus is on harnessing the intelligence of groups of people to enable greater productivity and better decisions than are possible by individuals working in isolation” (Lykourantzou et al, 2011). Due to its potential positive outcomes, CI is examined not only by businesses focusing on innovation but also by researchers seeking to find answers to existing societal challenges. Through our research, theoretical analysis and conversations with academics and practitioners, we could define these areas for exploring collective intelligence in innovation management: research development projects; project management; market research; knowledge management; e-participation; crowdsourcing etc.

The Web’s growth in reach and capability, and as a medium for interaction, set the stage for the explosive expansion of social technologies in Lithuania. Owing to RAIN I and RAIN II projects carried out by absorbing EU structural support funds, the fast and high-quality internet became accessible not only in cities but also to rural areas public sector, business organizations and residents. It is planned that by the end of 2013 broadband internet will reach 98.7 percent of rural areas. There is no doubt that the widespread and availability of the internet in Lithuania is one of the prerequisites and conditions for the formation of CI systems. Initiators of virtual community projects set up wider or narrower conditions for CI to emerge and as a result of that – increase the possibilities for innovation to occur. Phenomenon of CI in Lithuanian case could be best illustrated by platforms of *I for Lithuania* and *Lithuania 2.0*. These projects integrate all of CI elements needed to address social challenges: can attract large number of geographically dispersed people, have technological solutions enabling identification, discussion of societal problems and allowing search for alternative solutions, evaluation and decision-making. These attributes allow offering innovative solutions. However, the study did not reveal whether "products" created in these virtual environments could be applicable in practice and have a real impact on public decisions. This requires broader and in-depth studies. Creation of virtual social project including maximum number of CI components requires not only innovative technological solutions but also is a managerial challenge. Higher number of components ensures better conditions for CI emergence and consequently more possibilities for creation of innovations. However, the use of crowd and complex functionality leads to following challenges: dramatically increased volumes of inputs, suggestions, information; group structure and composition changes; complicated technological solutions ensuring smooth operation of indirect communication and so on.

By evaluating the existing collaboration platforms the opportunity for developers will be created to integrate or to create new tools or IT based applications fostering self-organisation, collective decision making, collective learning etc. Exploring the potential of collective intelligence could help organisations become more innovative and help societies solve their problems more effectively. By creating new global products innovative technology enterprises use social technologies for achieving competitive

advantage, but without scientific reasoning they often choose not adequate tools or methods and don't create expected value and sustainability.

Scientific observation and analysis of the social impact of technology on development of collective intelligence raises a lot of problems. Following scientific questions could be formulated: how different social projects could become a possibility to effect positive changes in communities and organisations, how to increase engagement of passive society into decision making process, what technologies would help to structure the information, purify the positions, reconcile different opinions and formulate the real society voice. CI development field requires deeper research from academic and practical angle. It would be important to identify the assumptions affecting developing of CI, to define risks areas, to predict possible development scenarios. Society meets a practical problem – a huge number of social technologies and different platforms do not discourage collective intelligence because people do not collaborate, they share opinion but do not structure it, they make no commitment to implementation of decisions etc.

References

- Armstrong A., Hagel J. III (1995) Real profits from virtual communities, *The McKinsey Quarterly*, No.3, pp.127-41.
- Barahona, M., García, C., Gloor, P., & Parraguez, P. (2012) Tracking the 2011 student-led movement in Chile through social media use, *Universidad Catolica de Chile, MIT, Collective Intelligence 2011* [online], <http://arxiv.org/ftp/arxiv/papers/1204/1204.3939.pdf>.
- Boder A. 2006. Collective intelligence: a keystone in knowledge management. *Journal of Knowledge Management*, Vol.10, No.1.
- Bonabeau, E. and Meyer, C. (2001) Swarm Intelligence: A Whole New Way to Think About Business, *Harvard Business Review*, 79, 5, pp.106-114.
- Bosse, T., Jonker, C. M., Schut, M. C., Treur, J. (2006) Collective Representational Content for Shared Extended Mind, *Cognitive Systems Research*, 7, pp.151-174.
- Cohen, D., Prusak, N. (2001) *In Good Company: How Social Capital Makes Organizations Work*. Harvard Business School Press, Boston, MA.
- Cross, R., Parker, A., (2004) *The Hidden Power of Social Networks*. Harvard Business School Press, Boston, MA.
- Davenport, T.H., Prusak, L. (2000) *Working Knowledge: How Organizations Manage What They Know*. Harvard Business School Press, Boston.
- Denning, P.J. and R. Hayes-Roth. 2006. Decision making in very large networks. *Communications of the ACM*, 49 (11), pp.19–23.
- Driessen, P.P.J.; Glasbergen, P. and Verdaas, C. (2001) Interactive Policy-making a Model of Management for Public Works, *European Journal of Operational Research*, Vol. 128, pp. 322-337.
- Edelenbos, J., and Klijn, E.H. (2005) Managing Stakeholder Involvement in Decision Making: A Comparative Analysis of Six Interactive Processes in the Netherlands, *Journal of Public Administration Research and Theory*, Vol. 16, pp. 417–446.
- Forrester Research. (2009). *Global IT Market Outlook: 2009*. Cambridge: Forrester Research, Inc.
- Gan, Y. and Zhu, Z. (2007) A Learning Framework for Knowledge Building and Collective Wisdom Advancement in Virtual Learning Communities, *Educational Technology & Society*, 10, pp.206-226
- Gloor, P. A., M. Paasivaara, D. Schoder, P. Willems (2008) Finding collaborative innovation networks through correlating performance with social network structure. *International Journal of Production Research*, Vol. 46, No. 5, pp. 1357-1371

- Gopal, A. and P. Prasad. 2000. Understanding GDSS in Symbolic Context: Shifting the Focus from Technology to Interaction. *MIS Quarterly*, 24(3), pp. 509-546.
- Goyal, A., Akhilesh, K.B (2007) Interplay among innovativeness, cognitive intelligence, emotional intelligence and social capital of work teams, *Team Performance Management*, Vol. 13 Issues 7/8, pp. 206 – 226.
- Gruber, T. (2008) Collective Knowledge Systems: Where the Social Web Meets the Semantic Web, *Journal of Web Semantics*, 6, pp. 4-13
- Heylighen, F. (1999) Collective Intelligence and its Implementation on the Web: Algorithms to Develop a Collective Mental Map, *Computational & Mathematical Organization Theory*, 5, pp. 253-280.
- Howe J. (2008) *Crowdsourcing: why the power of the crowd is driving the future of business*. New York: Crown Business.
- Hulpia, H., Devos, G. (2010) How distributed leadership can make a difference in teachers' organizational commitment? *Teaching and Teacher Education*, Volume 26, Issue 3, pp. 565-575.
- Johannessen, J. A., Olsen, B., Olaisen, J. (2001) Mismanagement of tacit knowledge: the importance of tacit knowledge, the danger of information technology, and what to do about it, *International Journal of Information Management*, Vol. 21, Issue. 1, pp. 3-20.
- Monge, P. R., Contractor, N. S. (2003). *Theories of communication networks*. New York: Oxford University Press.
- Kapetanios, E. (2008) Quo Vadis computer science: From Turing to personal computer, personal content and collective intelligence, *Data & Knowledge Engineering*, Vol. 67, pp. 286-292.
- Kirschner, P.A., Shum, S.J.B., Eds, C.S.C. (2005) Visualizing Argumentation: Software tools for collaborative and educational sense-making. *Information Visualization*, 4, pp. 59-60.
- Klein, M., Cioffi, M, Malone, T. (2007) Achieving Collective Intelligence via Large Scale On-line Argumentation. *Working paper, MIT Center for Collective Intelligence*, Cambridge (MA).
- Levy, P. (2010) From Social Computing to Reflexive Collective Intelligence: The IEMML Research Program, *Information Sciences*, 180, pp. 71-94.
- Luo, S., Xia, H., Yoshida, T. and Wang, Z. (2009) Toward Collective Intelligence of Online Communities: A Primitive Conceptual Model, *Journal of Systems Science and Systems Engineering*, 18, 2, pp. 203-221.
- Lykourantzou, I, Vergados, D.J., Kapetanios, E., Loumos, V. (2011) Collective Intelligence Systems: Classification and Modelling, *Journal of Emerging Technologies in Web Intelligence*, Vol 3, No 3, pp. 217-226.
- Malone, T. W., Laubacher, R. and Dellarocas, C. (2010) “The Collective Intelligence Genome,” *MIT Sloan Management Review*, 51, 3: 21-31.
- Moor, A.D., Aakhus M. (2006) Argumentation Support: From Technologies to Tools. *Communications of the ACM*, 49, 3, pp. 93.
- Pereira, Ch., Romero, F. (2012) Non-Technological Innovation: Current Issues and Perspectives, *Proceedings of the 7th European Conference of Innovation and Entrepreneurship*, pp. 418-428.
- Plant R, (2004) Online communities, *Technology in Society*, 26, pp.51-65.
- Porter, C.E. (2006) A Typology of Virtual Communities: A Multi-Disciplinary Foundation for Future Research. *Journal of Computer-Mediated Communication*, 10,1.
- Preece, J. (2000). *Online communities: Designing usability, supporting sociability*. Chichester, UK: John Wiley & Sons, Ltd.
- Pragere, K., and Nagel, U. J. (2008) Participatory Decision Making on Agri-environmental Programmes: A Case Study from Sachsen-Anhalt (Germany), *Land Use Policy*, No. 25, pp. 106–15.

- Preece, J., Maloney-Krichmar, D. and Abras, C. (2003) History of Online Communities In Karen Christensen & David Levinson (Eds.), *Encyclopaedia of Community: From Village to Virtual World*. Thousand Oaks: Sage Publications, pp. 1023-1027.
- Preece, J., Nonnecke, B., Andrews, D. (2004) The Top Five Reasons for Lurking: Improving Community Experiences for Everyone. *Computers in Human Behavior*. 20, 2, pp.201-223.
- Salminen, J. (2012). Collective Intelligence in Humans: A Literature Review [online], MIT, *Collective Intelligence 2012*, <http://arxiv.org/abs/1204.3401>
- Savage, N. (2012) Gaining Wisdom from Crowds. *Communication of the ACM*, Vol. 55, No. 4, p. 13-15.
- Schut, M. C. (2010) On Model Design for Simulation of Collective Intelligence,” *Information Sciences*, 180, pp. 132-155.
- Shimazu, H. and Koike, S. (2007) KM 2.0: Business Knowledge Sharing in the Web 2.0 age, *NEC Technical Journal*, 2, 2, pp. 50-54.
- Senge, P.(1990) *The Fifth Discipline*, Currency Doubleday, New York.
- Silva,C., Ramos,I. (2011) Crowdsourcing Innovation: A Strategy to Leverage Enterprise Innovation , Proceedings of 7th ECIE, pp.624-631.
- Stanoevska-Slabeva, K. (2002) Toward a community-oriented design of Internet platforms. *International Journal of Electronic Commerce*, 6, 3, pp. 71-95.
- Surowiecki, J. (2005) *Wisdom of Crowds*, Anchor Books, 306 pages.
- Szuba, T. (2002) Universal Formal Model of Collective Intelligence and Its IQ Measure, *Lecture Notes in Artificial Intelligence*, 2296, pp. 303-312.
- Trianni, V., Tuci, E., Passino, K. M. and Marshall, J. A. R. (2011) Swarm Cognition: an Interdisciplinary Approach to the Study of Self-organizing Biological Collectives, *Swarm Intelligence*, 5, pp. 3-18.
- Wolfers, J. and E. Zitzewitz (2004) Prediction Markets. *Journal of Economic Perspectives*, 18(2), pp. 107-126.
- Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N. and Malone, T. (2010) Evidence for a Collective Intelligence Factor in the Performance of Human Groups, *Science*, 330, pp. 686-688.
- Woodley M. A., and Bell, E. (2011) Is Collective Intelligence (mostly) the General Factor of Personality? A Comment on Woolley, Chabris, Pentland, Hashmi and Malone (2010), *Intelligence*, 39, pp. 79-81.
- Vanderhaeghen, D. and Fettke, P. (2010) Organizational and Technological Options for Business Process Management from the Perspective of Web 2.0: Results of a Design Oriented Research Approach with Particular Consideration of Self-Organization and Collective Intelligence, *Business & Information Systems Engineering*, 2, pp. 15-28.

Acknowledgments

The research is funded by European Social Fund under the measure „Support to Research Activities of Scientists and Other Researcher (Global Grant)“ administrated by Lithuanian Research Council (grant No. VP1-3.1-ŠMM-07-K-03-030, Social technologies for Developing Collective Intelligence in Networked Society).