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VERN' University of Applied Sciences
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Edited by

Visnja Grozdanić

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Linking Knowledge Management With Network Management: Designing the Framework for Monitoring of Virtual Communities

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Abstract: With emergence of Internet, considerate part of human interaction moved to virtual medium. Along with this process, ever-improving social technologies foster emergence and expansion of virtual communities aimed at leisure communication, professional networking or even focused on tackling relevant social issues. However, in order to achieve expected outputs of virtual activities some challenges are being met. These challenges can be illustrated as triangle-shaped system consisting of three equally important apexes: knowledge management, network management, and social technologies (as means ensuring reciprocal interaction of the latters). Harmonization and balance of these apexes could contribute to improved process and outcomes of leadership and management of online projects. Our research strives to develop a framework that could be used as an instrument to monitor virtual communities. Such tool could benefit initiators/managers of both closed and open virtual communities in measuring current activities within network, monitoring the progress and consequently making decisions on further development of online projects. Analysis of scientific literature on operation and management of networks, knowledge management, collective intelligence, co-creation of value lead us to identification of conceptual framework layers and elements. The primary testing of the framework was applied by observing a number of virtual community projects. We limited our empirical study to 18 Lithuanian virtual community projects oriented towards tackling local, national or even global social issues, as content of such projects usually is available publically. The proposed framework joints a number of elements that matches domains of knowledge management, management in network and social technologies. However, it requires further development, which should result in explicit guidelines for framework application.

Keywords: knowledge management, network management, leadership, virtual community, collective intelligence

1. Introduction

New form of intellectual capital – collectively created knowledge – began to shape as a result of synthesis between social technologies and input of many individuals. This fusion is often recognized as the key element of such contemporary notions like crowdsourcing (Howe 2008), wisdom of crowds (Surowiecki 2004), wikinomics (Tapscott & Williams 2006), service-dominant logic (Vargo & Lusch 2004), co-creation of value (Gronroos 2004; Prahalad & Ramaswamy 2004) and open innovation (Chesbrough 2006). These paradigms and research related to them draw attention to shifts in society – we are connected through growing numbers of touch-points and this allows potential creation of added value for the individuals, organizations and society in general. Great illustration of such touch-points are virtual communities and projects taking place in online environments due to ever developing information technologies and social networks. Low operation costs, openness, ability to mobilize people with divergent knowledge in order to communicate on the basis of self-organization, made it possible for large groups of users to achieve incredible results in creation and sharing of collective knowledge (Gloor 2006; Tapscott & Williams 2006; von Hippel 2001). However, such technological solutions are less effective when enabling mass deliberation and ensuring provision of alternative solutions of complex public problems (Klein 2007; Rosenhead & Mingers 2001). Hence, researchers are challenged to define what web-based platform is required in order to create adequate conditions for emergence of collective knowledge while tackling complex and relevant public issues. Our research aims at developing a framework that could be used as an instrument to monitor virtual communities. Such tool could benefit initiators/managers of both closed and open virtual communities in measuring current activities within network, monitoring the progress and consequently making decisions on further development of online projects.

2. Current research: Fusion of knowledge and management in virtual medium

Knowledge management research on organizational level can be traced back to 1990's when changed role of knowledge in business settings was noticed. According to Mikic et al. (2009, p.1), "knowledge has evolved from being an abstract concept that resides within the human mind to a manageable resource that is capable of contributing to organizational competitive advantage". However, traditional understanding of knowledge management poses several drawbacks. First, pioneers of knowledge management focused only on internal

organizational sources of knowledge (e.g. employee know-how, specialized processes) as core of successful strategy. In current settings organizations are recognized as social institutions and have to meet various needs of managers, employees, customers, suppliers and other stakeholders (Prahalad & Hamel 2006). Thus, internal knowledge and information resources are not sufficient. Second, conventional knowledge management focused on centralized repository frameworks and development of information systems in handling large volumes of data (Lee & Lan 2007). However, change in paradigm is apparent due to influence of communication technologies – more conversational approach to knowledge management is apparent. This new approach focuses on communities in terms of knowledge networks and emphasizes importance of collaboration and sharing. Scientific literature from various disciplines stresses inter-personal and inter-organizational collaboration and define these efforts in different terms i.e. community of practice (Lave & Wenger 1991), community of interest (Fischer 2006), knowledge network (Büchel & Raub 2002), knowledge community (Barrett et al. 2004), communities of knowing (Boland & Tenkasi 1995).

A considerable amount of literature has been published on the influence of web 2.0 technologies when creating, sharing and managing knowledge (Shang et al. 2011; Sultan 2013; Levy 2009; Paroutis & Al Saleh 2009). These studies indicate that new technologies are able to not only capture intelligent inputs but also facilitate the emergence of collective intelligence (CI) via collaboration. According to Luo et al. (2009, p.3) communities with virtual features may display "higher intelligent features than a traditional community does since ICT firstly provides an effective communication channel for massive exchange of data, information and knowledge and secondly the computation capabilities of the modern ICT may be of great help for the information processing tasks within the entire community". Higher number of virtual activities ensures better conditions for creativity, knowledge creation, share and fusion and consequently more possibilities for emergence of social problem solving solutions. However, scientific literature has focused mainly on business settings when analyzing management of intelligence. Online communities and open networks are usually left out of the scope even though effective management of such entities could result in benefits for society. Lesser et al. (2012) identifies several areas of collective wisdom that can be significant for society overall:

- Generation of new ideas for value creation using inputs (insights and experience) from people across the world;
- Innovative division and allocation of tasks;
- More versatile and better decisions determining the future;
- Collection of knowledge and expert evaluations from different groups and stakeholders;
- Inclusion and motivation of relevant participants in deliberations.

In order to achieve expected outputs of virtual activities some challenges are being met. These challenges can be illustrated as triangle-shaped system consisting of three equally important apexes: knowledge management, network management, and social technologies (as means ensuring reciprocal interaction of the latters). Harmonization and balance of these apexes could contribute to improved process and outcomes of leadership and management of online projects.

3. Shaping a framework for monitoring of virtual networks

The conceptual framework was designed based on literature analysis following some preconditions:

- It is linked with the concept of CI and could be adapted for evaluation of CI emergence and development within virtual networks;
- The framework encompasses various criteria i.e. quantitative and qualitative, objective and subjective, simple and integrated;
- It allows observation of technologies' influence on activities within networks;
- It could be employed by researchers for a general observation of online communities;
- The framework is applicable for specific monitoring of network performance by managers of virtual networks;
- The monitoring provides data for decision-making.

Corresponding to aforementioned preconditions, the multilayer, multilevel and multi-criteria framework was developed. Elements for the framework were selected from a review of scientific literature on collective

intelligence, social technologies, knowledge management, and social networks with the most significant contributions by Salminen (2012), Griggs & Wild (2013), Luo et al. (2009), and Malone et al. (2010). The proposed framework (see Fig.1) consists of three CI layers: conceptual, organizational and behavioral, and technological. Conceptual layer constructs attitudes towards knowledge creation and sharing, organizational and behavioural processes within online community into three levels: capacity, social maturity and emergence. Organizational and behavioral layer defines features of these processes. Technological layer defines measures ensuring realization of planned activities by network members.

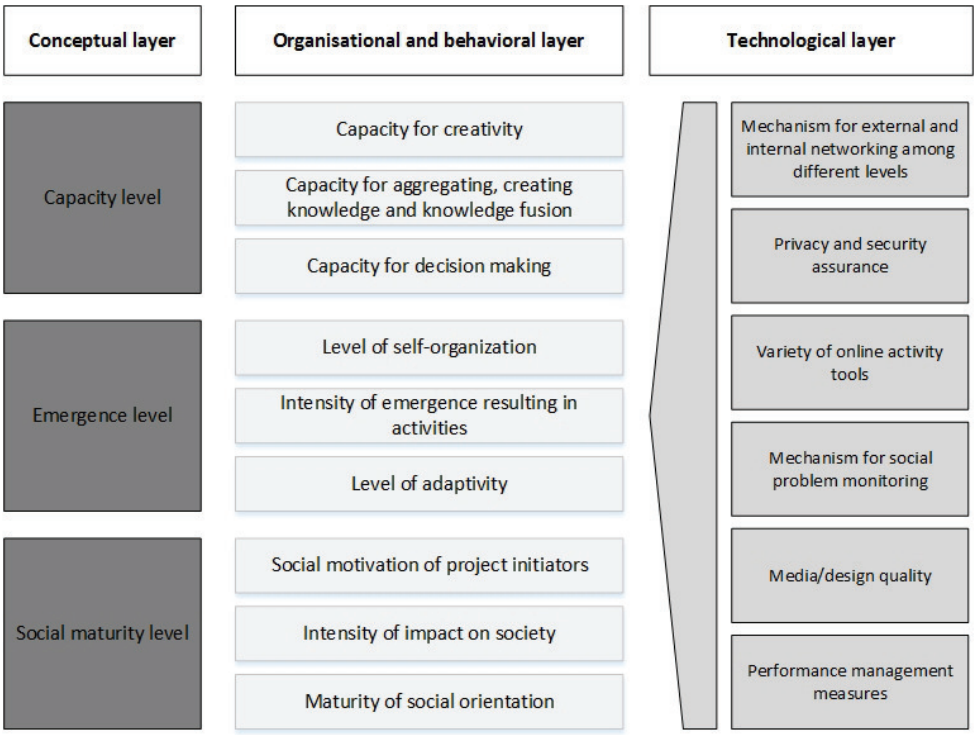

Figure 1: Conceptual framework for monitoring virtual networks

We elaborated on various dimensions, which cover different aspects of each level and created a different group of indicators to measure each dimension. The *capacity level* encompasses features of human beings that enable their networking for creation, transmission and fusion of knowledge. From organizational and behavioral perspective, this level includes network members' capacity for creativity, capacity for aggregating, creating knowledge and knowledge fusion, capacity for decision making. Aforementioned capacities are considered as integrated indicators combining such criteria as degree of participants (agents, members); diversity (demography, gender, nationalities); size of the group; degree of motivation, involvement of group members; degree of freedom and security to offer idea (anonymity versus identification); degree of accessibility; design of structure (hierarchy, team work, leadership); maturity of task formulation etc.

The *social maturity level* defines project initiators' social motivation, intensity of impact on society, maturity of social orientation. Worth mentioning that this level vary depending on mission of online projects. Therefore, this level reflects outputs of investigated online communities. Since we strive for monitoring of socially oriented projects, our framework includes attributes of social maturity such as: mission and vision; network members' values and rules; socio-cultural contents; diversity in cooperating partners for the development of social projects (external, industrial partners, governmental organisations, non-profit organisations); maturity of social task formulation; focus on social innovation and entrepreneurship etc.

The *emergence level* resides in between capacity level and social maturity level. Therefore, this level bridges them explaining how system behaviour (social maturity level) emerges from interactions of individuals (capacity level). At organizational and behavioral context, indicators include level of self-organization, intensity of emergence resulting in activities, level of adaptivity. Criteria for monitoring of emergence features include

but are not limited to number of implemented initiatives; diversity and quality of created knowledge; structure design (hierarchy, teamwork, leadership); self-organization; dynamics and flexibility.

Technological layer overlaps aforementioned units of the framework by providing technological solutions enabling or limiting activities of online network members. (Self)inclusion of crowd into online public consideration of relevant issues creates certain technological challenges – results of public debate could be improper due to lack of adequate conditions and indefeasible technological barriers. Such technological elements as privacy and security assurance are integrated into organizational and behavioral layer, while the others equip online community's activities (i.e. tools for voting, ranking of ideas). In addition, such features of technological layer as speed of interconnection, quality of media, information retention are conditioning expansion of online community and depth of activities within.

4. Testing the framework on Lithuanian socially oriented virtual communities

The framework was tested by observing number of virtual community projects. We limited our empirical study to Lithuanian projects oriented towards tackling of local, national or even global social issues, as content of such projects is usually available publically. Lithuanian population possesses technological facilities for online networking as 66 per cent of Lithuanian households in 2013 had personal computers, and 65 per cent – internet access at home (Official Statistics Portal Lithuania 2013). Representative parameters of the framework were observed in 18 socially-oriented virtual communities. Testing included several stages. First stage aimed at operationalizing of the framework by elaborating monitoring criteria for each integrated indicator. Monitoring instrument encompass different types of criteria based on numeric, binary and qualitative data. The majority of numeric criteria were e from Resources and Tools for Evaluation of Online Communities of Practice (U.S. Department of Education Office of Educational Technology 2011); while qualitative and binary criteria are either retrieved from literature sources analysed in Chapters 2 & 3 or developed by authors. Table 1 presents monitoring techniques including criteria for monitoring and type and availability of data.

Table 1: Instrument for monitoring of virtual community projects

Level	Integrated indicator	Monitoring criteria	Type and availability of data
Capacity	Capacity for creativity	Total visits (number of times the web-site has been accessed or visited); Unique visitors (number of different visitors the community has had); Repeat visitors (number or proportion of visitors who have visited the web-site more than once (ever, or over some period of time); Total number of messages posted (all forms of messaging including forums, blog comments, video comments, etc.); Average page views per visit	Numeric data. Web-site administrators could retrieve precise data. Availability of data for external users is limited
		Degree of participants (agents, members) diversity (demography, gender, nationalities); Degree of motivation, involvement of group members; Degree of freedom and security to offer idea (anonymity versus identification)	Qualitative data. Could be retrieved from surveys or applied subjective evaluation
	Capacity for aggregating, creating knowledge and knowledge fusion	Number of registered participants/members; Average time per visit or session; Top and total referrers; Total number of topics created	Numeric data. Exact data is available for web-site administrators and generalized – for public.
		Degree of accessibility; Longevity; Recognition	Qualitative data. Could be retrieved from surveys or applied subjective evaluation
	Capacity for decision making	Total participation in site polls and surveys (number of respondents/voters); Number of ideas for voting	Numeric data. Exact data is available for web-site administrators and generalized – for public.
		Maturity of task formulation; Diversity of created knowledge/ products; Quality of created knowledge/ products	Qualitative data. Could be retrieved from surveys or applied subjective evaluation

Emergence	Level of self-organizatio n	Design of structure (hierarchy, team work, leadership); Group work activity; Quality of discussions/level of criticism	
	Intensity of emergence resulting in activities	Depth of problem analysis; Variety of problem solving alternatives; Reality of problem solving alternatives	
	Level of adaptivity	Number of 'sharing' activities ("share on Facebook" or other) of community content by community members; Conversion rate (the percentage of unique visitors who become registered members over a period of time)	Numeric data. Exact data is available for web-site administrators and generalized – for public.
Social maturity	Social motivation of project initiators	Mission and vision; Group members values and rules; Focus on social innovation and entrepreneurship.	Qualitative data. Could be retrieved from surveys or applied subjective evaluation
	Intensity of impact on society	Socio-cultural context (local, national, global)	
		Doing global searches on phrases contained in its most popular pieces of content to see how many other sites have "picked them up."	Numeric data. Available for both public and web-site administrators
		Diversity in cooperating partners for the development of social projects (external, industrial partners, governmental organisations, non-profit organisations)	Numeric or qualitative. Exact data is available for web-site administrators and generalized – for public.
		Degree of influence on public opinion	Qualitative data. Could be retrieved from surveys or applied subjective evaluation
	Maturity of social orientation	Degree of influence on governance; Speed of reaction to social issues	
		Number of implemented ideas/projects	Numeric data. Exact data is available for web-site administrators and generalized – for public.
Technologies	Mechanism for external and internal networking among different levels	In-bound links (tracking using standard site analytic tools like Google Analytics)	Numeric data. Available for both public and web-site administrators
		Existence of mechanism for anonymous offering of ideas	Binary data (Yes/No). Available for both public and web-site administrators
	Privacy and security assurance	Existence of mechanism for providing secure and legal activities, protection of personal data; Existence of mechanism of message control	
	Variety of online activity tools	Existence of mechanism for collective brainstorming; Existence of mechanism to generate feedback; Existence of mechanism to vote/rank idea/solution; Existence of mechanism to make decision or conclusions	
	Mechanism for social problem monitoring	Existence of mechanism for idea classification; Existence of mechanism for mass argumentation	
	Media/ design quality	Bounce and exit rates—Bounce rates tell leaders how many participants come to their site and exit after viewing only a single page. Exit rates tell how many leave the site after visiting a particular page	Numeric data. Available for web-site administrators
		Degree of user friendliness, speed and convenience	Qualitative data. Could be retrieved from surveys or applied subjective evaluation
	Performanc e manageme	Existence of mechanism to collect data for evaluation of performance; Existence of mechanism to analyse data for evaluation of performance	Binary data (Yes/No). Available for web-site administrators

	nt measures	Level of development possibilities	Qualitative data. Could be retrieved from surveys or applied subjective evaluation

The next stage of testing included pre-testing procedure aimed at selection of virtual community projects for further research. As mentioned above, we selected 18 units from Lithuanian virtual medium that corresponded the requirement to be oriented on solving of social issues: Lietuva 2.0 (Lithuania 2.0) https://www.lietuva2.lt/lt, Kelk bures (Hoist sail) http://www.kelkbures.lt/ , Kas vyksta Kaune (What happens in Kaunas) http://kaunas.kasvyksta.lt/, Kam to reikia (why it is needed) http://www.kamtoreikia.lt/, Ututi www.ututi.com, Smart & Green city http://www.smartandgreencity.com/, Žalias miestas (Green city) www.sodinkim.lt , Skaidrumo linija (Transparency line) http://www.skaidrumolinija.lt/, Santalka http://santalka.lt.tst.bernardinai.lt/, Miesto problemos (City problems) http://www.vilnius.lt/lit/Miesto_problemos, Minčių sodas (Garden of thoughts) http://www.ms.lt/sodas/, Hub Vilnius www.HubVilnius.lt, Laisvasis universitetas (Free university) www.luni.lt, Viešai (In public) www.viesai.lt, Pincetas (Pincette) http://www.pincetas.lt/, Antakalnio bendruomenė (Antakalnis community) http://www.antakalnietis.lt, Socialinis verslas (Social enterprise) http://www.socialinisverslas.lt/, Mes darom (We act) http://www.mesdarom.lt/. However, after preliminary analysis six of the aforementioned virtual projects were removed from consideration, because in three of them (Smart & Green city, Santalka and Garden of thoughts) no activity was observed in past several years, two (City problems and We act) provide information but does not allow any type of collaboration and HubVilnius gathers users on commercial purposes. Consequently, twelve socially oriented virtual projects passed to the next stage of validation process.

During the third stage – testing – we observed 12 projects using developed instrument. The main limitation of testing procedure – we could not retrieve accurate numeric data available only for web-site administrators. Therefore we gathered qualitative and binary information and in some cases – possibly imprecise numeric data. However, at this stage of research such organization of testing is satisfactory as further validation of framework will be continued and results be used for revision of the instrument. The following is a brief report on testing results.

Capacity. When observing capacity for creativity, capacity for aggregating, creating knowledge and knowledge fusion, and capacity for decision making accurate numeric data (e.g. number of visits, average time per visit or session) is not available for researchers. Only approximate data can be retrieved from announcements posted by web-sites administrators. When measuring degree of participants' diversity, in the majority of monitored virtual projects demographic, gender and geographic diversity could be evaluated as high. However, only Lithuanian speakers are engaged in monitored virtual communities. Therefore, national diversity is relatively low. The measurement of motivation degree and involvement of group members is rather subjective. However, when observing user's activity and contents it is obvious that community members in some of the projects are more motivated than in others. In this regard, community of Lithuania 2.0 differs from the rest with the variety, depth, and creativity of activities demonstrating higher level of motivation and involvement of group members. Degree of freedom and security to offer idea is related to issue of anonymity versus identification. Half of observed virtual communities propose both – anonymous and registered participation in activities, where everybody can surf the web-site while only registered users are able to propose ideas, vote and/or discuss on posted ideas. Some of the communities allow participation only for registered users probably limiting capacity for creativity and diminishing knowledge aggregation and fusion. In addition, there are few virtual communities ensuring total anonymity taking a risk that group members do not take responsibility for their activities consequently reducing plausibility of created contents. Maturity of task formulation, diversity and quality of created knowledge/products depends on ambitions of virtual communities and are maintained by users' voting and evaluation mechanisms. Therefore, virtual projects with broad goals to tackle societal problems demonstrate wider variety of ideas, more mature discussions and higher quality solutions than those with narrower focus.

Emergence. Analysing the level of self-organizations, the performance of the majority of observed communities depends on balance between leadership and teamwork. During discussion on specific topic, people having an interest in this issue join into groups and elect a leader. The more active user is, the more rights in the network he/she gains. In this way, communities maintain high level of self-organization in networks. Quality of discussions and level of criticism as well as depth of problem analysis, variety and reality

of problem solving alternatives are of higher in projects that have wider outlook towards social problems. Among the most standout projects, attributing aforementioned criteria is Lithuania 2.0, which worked or still works on 260 initiatives. An important indicator demonstrating strength of community members' inclusion into network activities is the percentage of unique visitors who become registered members over a period of time. However, this data is available for web-site administrators only.

Social maturity. The basic indicator demonstrating social motivation of virtual project is mission and vision. All observed online communities strive to contribute to the development of e-democracy to various extent. The most ambitious mission is formulated for Lithuania 2.0 members. It challenges the community on creating Lithuania the way participants want state to be. Consequently, the contents and organization of network activities is the most sophisticated among the other reviewed projects. Values and rules are usually set in diverse forms (manifests, users' requirements, privacy guidelines). During the enrolment to the network, individuals accept to follow rules of activities in the community. On such agreement, the trust among network members is built in the majority of communities. Diversity in cooperating partners for the development of social projects demonstrates potential impact on society. Some of observed communities do not strive to attract other members. While there are some projects oriented towards linking industrial partners, governmental, non-profit organisations and informal groups. All virtual communities demonstrate high speed of reaction to social issues as topics covered deal with topical issues on local, national or even global level. Researchers could not identify influence of virtual community on governance or assess the number of implemented ideas/projects. Only several virtual communities publish the data on implemented actions and initiatives. However, the majority of the results are named as publications or implemented ideas improving performance of virtual community. No successful projects, which influenced real changes in public policy were reported yet.

Technologies. Technologies are supporting mechanism for effective and efficient activities of virtual communities. The essential technological means determining existence and development of virtual community are availability of techniques for providing secure and legal activities, protection of personal data, message control. Observed websites match diverse mechanisms for privacy and security assurance including self (user) control, administrative control, user agreement and privacy policy, publication of national data protection inspectorate issued permit. Number and variety of online activity tools differs depending on objectives of the community. Consequently, if some community limited its activity to selection and aggregation of knowledge and withdrew from mass deliberation and/or decision-making, the website would not include mechanisms for collective brainstorming, for mass argumentation, voting/ranking etc.

5. Headings for further research

The first stage of framework testing revealed the complexity of monitoring of virtual community activities. Obviously, not all aspects of performance can be measured by quantitative criteria, but some numeric data is extremely important. Measuring such data over a period could help diagnose and prevent reduction of community members' motivation or diminished activities. Testing demonstrated that some of criteria could be attributed to more than one element of the framework. However, the unique criteria could have different level of influence on different elements. In addition, different criteria for monitoring of the unique element could be of different importance. Therefore, it would be expedient to rank each criteria by its relevance. However, researchers could not access reliable data at this stage of research. Therefore, the importance and correlations of diverse criteria were not analyzed yet and are planned for upcoming research stages. Moreover, the framework could be more sophisticated by demonstrating cause-effect links between criteria where applicable. However, for identification and validation of such relationships other research techniques are required ensuring collection and analysis of actual data and testing of hypotheses. For that purposes a longitudinal observation of the most successful virtual projects could be executed.

6. Conclusions

Conventional understanding of knowledge management has been fragmented by spread of social technologies. Growing need for knowledge sharing resulted in growth of interpersonal and inter-organizational collaboration based on information technologies usually in a form of a community. However, current research focus on communities based in business and public organizations settings. Online communities and open networks are usually left out of the scope even though effective management of such entities could result in benefits for society. Internet enabled society fosters virtual networking, which could serve as a support tool for

performance management and trigger mechanism for innovation processes. Even though, knowledge generated by virtual communities creates value for involved individuals, organizations and society in general, initiators or managers of such networks face multiple challenges while leading, organizing and managing in virtual environment. Periodical monitoring of virtual community performance, including technological parameters supporting the activities, is required.

This paper set out to determine an instrument to monitor and foster online communities allowing to measure and understand the outcomes. Monitoring process using suggested framework could help networked entities, which include collective decision-making tools and innovation mechanisms, to ensure and encourage individual and community creativity, participation, entrepreneurship, and self-governance.The proposed framework incorporates a number of elements matching domains of knowledge management, management in network and social technologies. Analysis of scientific literature lead us to identification of conceptual framework layers (conceptual, organizational & behavioural, technological), levels (capacity, emergence, social maturity) and elements constituting them.

Main limitations of the framework and testing procedure are the limited access to quantitative data about activity and users of online platforms and rather subjective take on quantitative data. Therefore, it requires further development, which should result in explicit guidelines for framework application detailing areas and goals of the monitoring process. Monitoring could be executed at different extent and the performance of a virtual community could be monitored applying full range of framework criteria. However, depending on the narrower specific objectives of the platform different sets of criteria could be selected for monitoring. The guidelines could propose and explain such options suggesting and itemizing each criterion, data selection and collection techniques, and data analysis and interpretation rules.

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