ISSN 2029-7564 (online)
SOCIALINĖS TECHNOLOGIJOS
SOCIAL TECHNOLOGIES
2013, 3(2), p. 415–431.

HOW USEFUL AND POSSIBLE COLLECTIVE INTELLIGENCE TECHNOLOGIES ARE IN PROGRAMMING OF PUBLIC SECTOR'S DECISIONS?

Rūta Tamošiūnaitė

Mykolas Romeris University, Lithuania, tamosiunaite.ruta@gmail.com

Alvydas Baležentis

Mykolas Romeris University, Lithuania, a.balezentis@gmail.com

doi:10.13165/ST-13-3-2-12

Abstract

Purpose *– to explore the essence of concepts of collective intelligence and collective intelligence technologies and to analyze their adaption possibilities in programming public sector's decisions.*

Design/methodology/approach *– review of previous researches and systemic analysis of their findings in the field of intelligence generated by many and collective intelligence technologies is executed. Also, review of collective intelligence technologies and empirical research (qualitative analysis of expert statements) are employed. Finally, synthesis of study results into system of possibilities for adaption of existing collective intelligence technologies in programming public sector's decisions is done.*

Findings *– collective intelligence concept is explored in depth. Collective intelligence technologies are overviewed and a course line for adaption in programming public sector's decisions is presented. Differences between ministries and municipalities in comprehending decisions' structure are presented. Decision characteristics for programming are given in relation to case appropriate social technologies.*

ISSN 2029-7564 (online)
https://www.mruni.eu/lt/mokslo_darbai/st/apie_leidini/
https://www.mruni.eu/en/mokslo_darbai/st/apie_leidini/index.php

Research limitations/implications *– references used for the analysis on intelligence generated by many and collective intelligences technologies are not an exhaustive list within the field. Accomplished empirical research leans only upon analyses of Lithuanian experts. No technical insights into the technologies of collective intelligence are made.*

Practical implications *– findings of the paper provide suggestions for improving strategy of decision making process in public sector, due to which efficient model for participation of citizens (and residents) is possible.*

Originality/value *– the systemic analysis of concepts of collective intelligence and collective intelligence technologies and their adaption possibilities in public sector's decisions is presented. A new viewpoint is given to means of citizens (and residents) participation in public matters. Programming of Lithuania's public sector's decisions is analyzed.*

Keywords**:** *collective intelligence, collective intelligence technologies, social technologies, programming of decisions, public sector.*

Research type**:** *research paper.*

1. Introduction

As long ago as 1968, computer visionaries foresaw the ability of computers to be applied to cooperation in creative endeavors by allowing people capable of solving specific problems to share their ideas (Weiss, 2006). Today, one of the concepts to describe this case is *social technology* – technology used by groups of people (Hearst, 2009). There are eight categories of social technology: recruiting outside expertise, crowd sourcing, shared data, shared world/platform, collaborative creation, social networks, idea markets, implicit contributions (ibid). This article presents the analysis of developing one of the categories (crowd sourcing, or in a more popular term, collective intelligence[1]) in public sector.

Collective intelligence (hereinafter – CI) is a fundamentally different way of viewing how applications can support human interaction and decision making (Gregg, 2010). The CI is trying to suggest another way of thinking about effectiveness, profitability or teamwork in the knowledge societies (Scarlat and Măries, 2009).

The CI can improve competitiveness within organizations in the context of a global market and collective performance has become a critical factor in the organization's development (Scarlat and Măries, 2009). As a collective is more intelligent than one single member (Nguyen, 2008) and group intelligence is not strongly tied to either the average intelligence of the members or the team's smartest member (Johnson, 2010), it is worthy to research CI's possibilities in the public sector, where decisions, affecting a mass of people, are being made every day.

1 Analysis of usable terms for the case is presented in the next chapter.

The goal of this paper is to explore the essence of concepts of collective intelligence by analyzing concepts for intelligence generated by many and collective intelligence technologies by classifying diverse technologies used with the same purpose and setting distinctions between them, and to analyze collective intelligence's and collective intelligence technologies' possibilities in decision making process by revealing connections between vectors of decision making process in public sector and collective intelligence technologies. In order to achieve this, a review of previous researches and systemic analysis of their findings in the field of intelligence generated by many and collective intelligence technologies is executed. A review of collective intelligence technologies is also done. Empirical research (qualitative analysis of expert statements) is executed, too. Finally, synthesis of study results into the system of possibilities for adaption of existing collective intelligence technologies in programming public sector's decisions is done.

References used for the analysis on intelligence generated by many and collective intelligences technologies are not an exhaustive list within the field. The accomplished study leans only upon analysis of publicly revealed information, on existing collective intelligence technologies in the public sector. No technical insights into the technologies of collective intelligence are made. Though, the findings of the paper provide suggestions for improving strategy of decision making process in the public sector.

Presentation of the research is organized as follows: the first chapter presents the analysis on the concepts for intelligence generated by many; the second chapter proceeds on technologies used for generating the intelligence of many, whereas the third and fourth chapters connect collective intelligence technologies and vectors of essential for decision making process in the public sector.

2. The Concept of Collective Intelligence

Before trying to define development possibilities for any object, first, it is important to define what is exactly analyzed. Collective intelligence technologies (hereinafter – CIT) consist of human intelligence generated by a group of humans via technology. Human intelligence is rather clearly defined in Encyclopedia Britannica (2012) as a mental quality that consists of the abilities to learn from experience, adapt to new situations, understand and handle abstract concepts, and use knowledge to manipulate one's environment. When it comes to the concept of CI, any dictionary does not give a definition to it, nor do scientists have a unanimous opinion on the concept to be used describing intelligence generated by a group of humans. Scientists use definitions, such as collective intelligence, collective knowledge, collaborative intelligence, etc. The summary for the concepts is given in Table 1.

Table 1. Concepts for intelligence generated by many

		Authors
Used Concept	**Collective Intelligence** (CI)	Newell (1990); Lévy (1997, 1999); Szuba (2002); O'Reilly (2005); Gouarderes *et al*. (2005); Gibson (2006); Malone and Klein (2007); Kapetanios (2008); Sheremetov and Rocha-Mier (2008); Scarlat and Măries (2009); Nguyen (2009); Wood and Friedel (2009); Gregg (2010); Luft (2010); Flett (2010); Poore (2011); Komninos (2011); Svobodová and Koudelková (2011);
	Collaborative Intelligence (CoI)	Jones *et al*. (1998); Billman *et al*. (2006); Lee and Lan (2007); Cook and Smallman (2007); Martusewicz (2008); Hakman (2011);
	Wisdom of the Crowd (WotC)	Surowiecki (2004); Bechter *et al*. (2011); Simmons *et al*. (2011); Schijven and Hitt (2012); Güneş (2012); Yum *et al*. (2012);
	Collective Knowledge (CK)	Scarlat and Măries (2009); Nguyen (2008);
	CI and CK as synonyms	Scarlat and Măries (2009);
	Aggregated intelligence (AI)	Chiticariu (2008); Norvaišas (2010);
	Crowd Sourcing (CS)	Hearst (2009); Malone (2011).

For this research, the concept of CI is used as it is most common in scientific literature and encompasses the content of other terms mentioned (if content diverse from CI). According to Luft (2010), the CI concept assumes that individuals constantly adapt to their environment. They collaborate to survive, so in this case, CI is a collaboration process created through intelligence (knowledge) based interaction of individuals (O'Reilly, 2005; Gregg, 2010; Gibson, 2006; Scarlat and Măries, 2009; Flett, 2010). Nguyen (2008) ads competition to this understanding, as during competition excessive amount of information and knowledge is shared in order to be over the competitor. Flett (2010) suggests that it is not only a collaborative process of people, but, as the author emphasizes, that those people are reasonably minded, from diverse backgrounds, working systematically together, with one methodology, and may independently come to the same conclusion. CI together with innovation, problem solving and the use of smart devices and networks offer advanced functionality and improved operations (Komninos, 2011). Nguyen (2009) is working in the same sense of CI, as he states that the CI helps to solve the following problems:

- Real-time (or ad-hoc) collaboration – to build innovative knowledge on the basis of decentralized "partial" knowledge;

- Social collaboration – to search a criterion for a group of users, whose intelligence can be integrated.

The previously mentioned authors use the CI term without exact definitions, which are given by Malone and Klein (2007), Kapetanios (2008), Svobodová and Koudelková (2011):

– CI is the synergists and cumulative channeling of the vast human and technical resources now available over the Internet (Malone and Klein, 2007);
– CI is basically the tool for connecting people and computers that create an intelligent system to bring the added value (Svobodová and Koudelková, 2011);
– CI is a human-computer system, in which machines enable the collection and harvesting of amounts of human-generated knowledge (Kapetanios, 2008).

Though, there are three definitions, which content is on the basis of the same elements: human knowledge, knowledge harvesting and technologies based on the computer programming.

In other cases, the authors stress other aspects of CI. Svobodová and Koudelková (2011) talked about enterprises' CI and stated that it is seen as a multi system of programs that communicate with each other, it is able to combine the views of employees between departments, divisions and further expand the knowledge and experience of employees and customers. Kominos (2011) also worked with the organizational aspect, where the authors suggested that the collective intelligence of their community is formed when machine intelligence is added to the human intelligence of citizens. Haylighen (1999) characterized collective intelligence as a group ability to solve more problems than its individuals. Levy (1999) described collective intelligence as a form of universally distributed intelligence, constantly enhanced, coordinated in real time and resulting in the effective mobilization of skills. Finally, CI was described as a computational process by Szuba (2002): "*CI can be formalized as a specific computational process through the use of a molecular model of computations and mathematical logic, in terms of interacting information molecules, which are chaotically or quasi-chaotically displacing and running natural-based inference processes in their own environment*."CI usage in activities creates new perspectives for innovations and extra added value (Svobodová and Koudelková, 2011; Komninos, 2011). As it is seen from the analysis, CI does not form itself: a certain technology is necessary to form the CI. In the next chapter, the analysis of CI technologies is given.

3. Collective Intelligence Technologies

As it can be seen, one concept covers many meanings, which seem to make it difficult to generalize, but the CI concept and the CIT analysis (presented in Table 2) show that those CI variations may be explained by the used CIT, which means that the CI concepts can be classified by its technology.

Table 2. Technologies for Collective intelligence

Author	Technology	Content	Examples
Giarratano and Riley (1987); Szuba (2002); Svobodová and Koudelková (2011)	Computer software	Multi system of programs that communicate with each other	-
Malone and Klein (2007); Kapetanios (2008); De Lido *et al*. (2011)		Human-computer interaction where software is a tool to harvest intelligence from human	*Decision formulation applications (Pfiltzer's local Idea Center, AT & T local software, Synnet)*
O'Reilly (2005); Gibson (2006); Gregg (2010); Komninos (2011); Norvaišas (2010); Gouarderes *et al*. (2005); CIO (2010)	Web (2.0) based collaboration platforms	Collaboration and information sharing between users	*Wikis, blogs, social network services (G+, Facebook, Twitter), social bookmarking, education applications (Moodle, Svs.lt)*
Poore (2011); Levy (1999)	New technologies	Distributed intelligence which enhances through effective coordination of individual skills	*Video conferencing tools*
Scarlat and Măries (2009); Haylighen (1999); Luft (2010)	New informational and communication technologies	Shared (group) intelligence that emerges from the collaboration of individuals	*Google, Wikipedia*
Newell (1990); Lévy (1997); Wood and Friedel (2009); Nguyen (2009); Norvaišas (2010)	Collaborative technologies		*Peer review's online (Peer review of Online Learning and Teaching System), OJS (Open Journal System), IBM Lotus Domino*

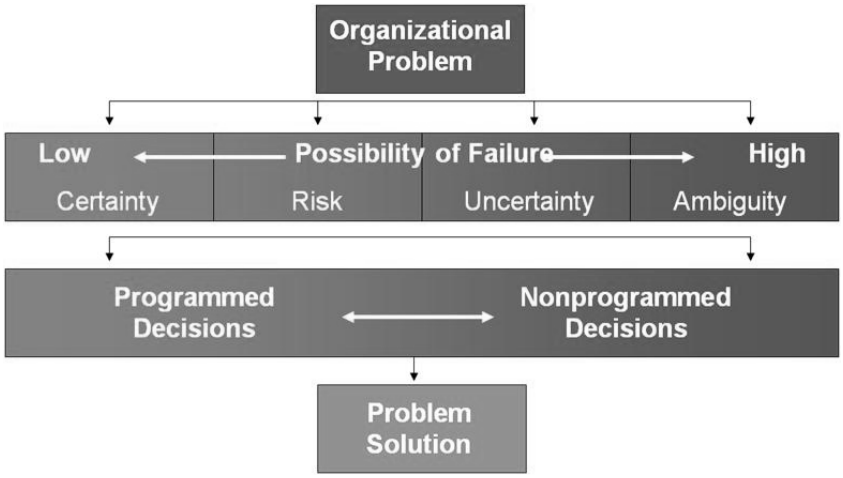
CIT among researchers is not diversified uniquely: differently named technologies cover the same content or the other way around (see Table 2). Some terms for CI technologies still have problematic understanding, such as "*new informational and communication technologies*" and "*new technologies*". The word "*new*" used in those terms is polysemous. This characteristic is not appropriate for academic terms, as it is not specific. In Table 2, there is one visible problem of the problems rising from the usage of polysemous word: Poore (2011) and Levy (1999) talked about "*new technology*", though the content of the technology is describing the same elements as "*collaborative technologies*".

In the next chapter, particularity of decisions in the public sector found in literature is presented and research field is set for empirical research to finalize the particularity of

public sector decisions in order to synthesize collective intelligence adaptability model for decisions in the public sector.

4. Programming of Decisions in the Public Sector: Research Field

Organizational decisions are on one level divided to programmed and un-(non-) programmed decisions (Soelberg, 1966; Etzioni, 1988; Daft, 2007; Sekhar and Babu, 2012; Cheng *et al*., 2012). Programming is based on the possibility of failure (see Figure 1). Management of information flow and usage is one of the most important factors in the process of effective programmed decision.



Source: Daft (2007)

Figure 1. Conditions that affect the possibility of decision failure

Programming of decisions in the public sector may encompass a schema for citizen inclusion. There are many schemas for citizen participation in public sector decisions. Buškevičiūtė and Raipa (2011) suggested the following ways: elections, right to create associations and political parties, participate in assemblies and meetings or various movements, citizens' inquiries, etc. A very important component in managing decisions in the public sector is communication development in public governance environment, which recently in Europe has gained tendencies of integration that emerge in various forms of cooperation with civil society institutes in order to perfect tradition of clientela in strategic decision policy (ibid). Impact of globalization on the emerging civil society in the new culture puts more emphasis on communication reliability (inter-institutional and interpersonal trust), and not rationalistic confidence (Job, 2005). Therefore, confidence in the government is now very determined government and citizens' communication, i.e. civil society and government interaction (Domarkas, 2008). Citizens' right to participate in public policy formation is mostly regulated by laws and legal acts. That is why special

schemas for citizen participation are necessary to be included in programmed public decisions. Citizens' participation is much more difficult with un-(non-)programmed decisions. Further research is carried out to set the programming schema for decisions in the public sector. The research field (see Figure 2) is set on the basis of Daft (2007) schema. In this schema, Daft (2007) relates programming of decisions to success certainty (the possibility of failure).

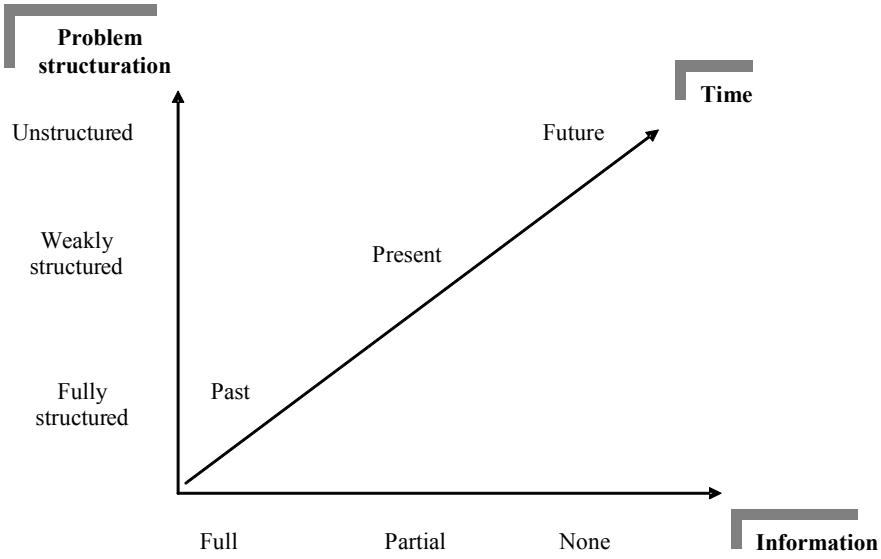


Figure 2. Conditional field of decisions

In the present research, field programming is defined by problem stucturation, time and information available. The further in the axes, the less programming decision possible. For empirical research, a qualitative analysis was chosen as for setting programming schema an insight into administrator's discretion is necessary. In the following chapter, a methodology of the research is presented in detail.

5. Research Methodology

Empirical research (with qualitative analysis) is based on experts' statements given to open questions. Later, questionnaires were compiled in order to synthesize a general matrix of public decision programming. Public administrators with a high level of decision making discretion were chosen as experts. This type of administrators is found in the positions as heads of departments at Lithuanian ministries (state level) and municipalities (local governance level). In Table 3, validation of experts' competence to participate in the research is presented.

Table 3. Experts' validation

State governance level		Local governance level	
Position	Experience in years	Position	Experience in years
Director	5	Director	5
Director	10	Director	10
Director	6	Director	14
Director	15	Director	5
Director	15	Director	10

Decisions in the public sector encompass two important vectors for decision making: problem structuration vector and information vector. Problems may be structured in three levels: fully structured, weakly structured, unstructured. Fully structured problems are defined as follows: all components of the problem are clear, all acting factors and causalities and their relations (which may be measured by quantitative indicators) are known. Weakly structured problems encompass all components as fully structured, except that all parts of structuring, which are possible only partially; this level is transitional between fully structured and unstructured levels. Unstructured problems are complicated situations, where the structure of components is unknown, components themselves are unknown, acting factors and causalities and their relations are unknown. Accordingly, the information may be split into full, partial and none existing. Information is understood as full, when full, exhaustive qualitative and quantitative information is available, which is needed to make decision; all factors and results are expressed in measurable units. Information is understood as partial, when sectional qualitative and quantitative information is available, which is needed to make the decision; all factors and results are expressed in measurable units. None existing information is considered to be the one, when the problem is being solved for the first time and there is no previously gathered information necessary to make the decision.

The system of those vectors (see Table 4) defines 5 hierarchical types of decisions in the public sector: routine decisions (the easiest to come to, marked No. 1), operational decisions (marked No. 2), tactical decisions (marked No. 3), strategic decisions (marked No. 4) and unique decisions (the most difficult to come to, marked No. 5).

Table 4. Conditional field structure for public decisions (Research matrix)

Problem structuration vector	Unstructured	**3**	**4**	**5**
	Weakly structured	**2**	**3**	**4**
	Fully structured	**1**	**2**	**3**
		Full information	Partial information	None existing information
		Information vector		

Empirical research was executed during June-August in 2013. For interaction with experts, face-to-face and distant communication methods were used. The experts presented their respective opinions regarding governance decisions' content and structure by dividing the time spent on each type of decisions during governance cycle (one year).

6. Results and Observations

In order to represent the situation on central government level, representatives of ministries with decision making discretion were inquired; for local governance, level situation representatives of municipalities with decision making discretion were inquired. In this section, a detailed governance decisions' structure in the level of ministries (see Figure 2), a detailed governance decisions' structure in the level of municipalities (see Figure 3), a general governance decisions' structure comparison between ministries and municipalities (see Table 5), collective intelligence technologies adaptability in the conditional field structure for public matter decisions (see Table 6) are presented and then characteristics of public governance decisions (see Table 7) are described.

The detailed governance decision structure in the level of ministries how decision making discretion owners at ministries comprehend the content of decisions in their work regarding structuration and information vectors is presented in Figure 3.

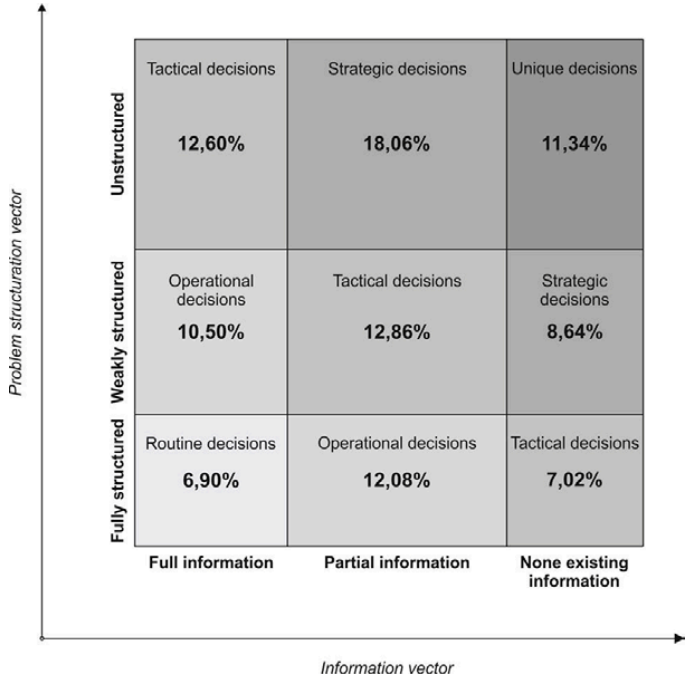


Figure 3. Detailed governance decisions' structure in the level of ministries

In ministries' level, five types of decision lay out as follows: routine decisions (7,1 pct.), operational decisions (22,58 pct.), tactical decisions (32,46 pct.), strategic decisions (26,7 pct.) and unique decisions (11,34 pct.). According to Juran and Godfrey (1998) research, Paret principle is valid in any managerial situation. In governance, the higher level of decision making, the bigger influence is made, accordingly, cumulative percentages counting of governance decision structure show that to the 20 pct. (which influences 80 pct. of outcomes) falls most of strategic and all unique decisions in ministries (38,04 pct. of decisions).

The detailed governance decisions' structure in the level of municipalities how decision making discretion owners at ministries comprehend the content of decisions in their work regarding structuration and information vectors is presented in Figure 4.

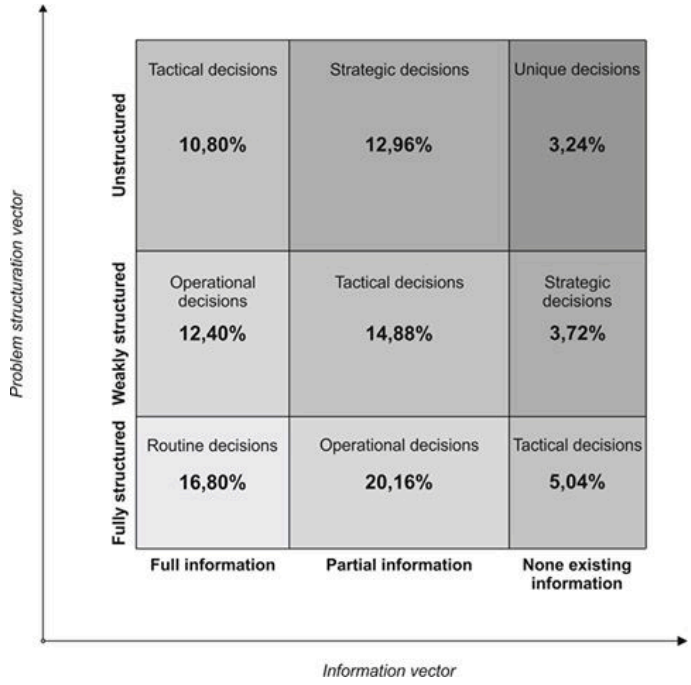


Figure 4. Detailed governance decisions' structure in the level of municipalities

In municipalities' level, five types of decision lay out as follows: routine decisions (26,8 pct.), operational decisions (22,56 pct.), tactical decisions (30,72 pct.), strategic decisions (16,68 pct.) and unique decisions (3,24 pct.). According to the Juran and Godfrey (1998) research, the Paret principle is valid in any managerial situation. In governance, the higher level of decision making, the bigger influence is made, accordingly, cumulative percentages counting of governance decision structure show that to the 20 pct. (which influences 80 pct. of outcomes) falls most of strategic and all unique decisions in municipalities (19,92 pct. of decisions).

The detailed governance decisions' structure analysis in the ministries and municipalities shows that in the central governance level there are as twice as much decisions of the highest level of importance as in municipalities.

The experts were asked to define the decisions they make according to the five categories, and this data was used as control values. Detailed values are cumulated according to the research matrix. Comparative analysis of the data is given in Table 5. Taking into account 5 pct. variance as acceptable, further evaluations were made.

Table 5. General governance decisions' structure comparison between ministries and municipalities (values in pct.)

	Ministries			Municipalities		
	Detailed values	Control values	Variance	Detailed values	Control values	Variance
Routine decisions	6,9	16	9,1	16,8	20	3,2
Operational decisions	22,58	22	-0,58	32,56	28	-4,56
Tactical decisions	32,48	28	-4,48	30,72	20	-10,72
Strategic decisions	26,7	22	-4,7	16,68	22	5,32
Unique decisions	11,34	12	0,66	3,24	10	6,76
Total:	100	100	0,02	100	100	0

In the ministry level, a significant variance is observed for routine decisions. In the municipality level, the significant variance is observed in tactical decisions, strategic decisions and unique decisions categories. This might be explained by the specific nature of activities in each level. As ministries work more with decisions of a high level of importance, as their decisions affect the whole country, in categories of more complex decisions the experts were more precise. Accordingly, in municipalities, were decisions more related to executive activities, the experts from municipalities were more precise in categories of decisions with a lower level of complexity.

Empirical and theoretical research synthesis allowed to develop a characteristics' matrix for public governance decisions (see Table 6).

Table 6. Characteristics of public governance decisions

Decision type	Possible level of innovativeness	Time	Risk level	Repeatability	Adaptable social technology
Routine	Traditional	Past	Very low	Very often	Automated systems
Operational	Novelties	At the moment	Low	Often	Automated systems or Social software
Tactical	Changes	Present	Medium	Rare	Social software
Strategic	Reforms	Near future	High	Very rare	Social software
Unique	Development	Far future	Very high	First time	Social engineering

The matrix encompasses sections as follows: possible level of innovativeness, time factor, risk level, repeatability and adaptable social technology, which are assigned to each group of decisions. Social technology adaptability is related based on collective intelligence technologies adaptability in conditional field structure for public decisions analysis (see Table 7) developed during theoretical analysis.

Table 7. Collective intelligence technologies adaptability in conditional field structure for public matter decisions

Problem structuralization vector	Unstructurized	Web (2.0) based	New information and communication technologies	Collaborative technologies
	Weakly structurized	Computer software	Web (2.0) based	New information and communication technologies
	Fully structurized	Computer software (automated programs)	Computer software	Web (2.0) based
		Full information	Partial information	None existing information
		Information vector		

A qualitative analysis of decision structures allows using social technologies more efficient in optimizing public matter decisions. In Table 7, problem structuration vector and information vector elements are assigned according to the collective intelligence technologies analyzed earlier in the paper.

7. Conclusions

Collective intelligence is an artificial form of intelligence, which exists only organized purposely. For collective intelligence creation, five types of technologies are used: Web (2.0) based collaboration platforms, new informational and communication technologies, collaborative technologies, new technologies and computer software.

Decisions are programmed after defining them in three vectors: problem structuration, information and time. Contemporary public sector decisions encompass a great deal of citizen participation.

Governance decisions' structure in state and local governance levels have its specialties and may be clearly separated as types of decision process. State level decision making process is twice as often related to the highest level of importance as in local governance.

Decision types are defined by five factors: possible level of innovativeness, time, risk level, repeatability, adaptable social technology. Social technology adaption may

encourage citizen involvement in public matter decisions. The main tool of social technologies analyzed in this research is collective intelligence technologies. To each decision type, different collective technology may be assigned: routine decisions – computer software (automated programs), operational – computer software, tactical – Web (2.0) based, strategic – new information and communication technologies, unique – collaborative technologies.

References

Bechter, C.; Jentzsch, S.; Frey, M. 2011. From Wisdom of the Crowd to Crowdfunding. *Journal of Communication & Computer*. (8, 10): 951–957.Billman, D.; Convertino, G.; Shrager, J.; Massar, J.P.; Pirolli, P. 2006. *Collaborative Intelligence Analysis with CACHE and Its Effects on Information Gathering and Cognitive Bias*. Paper presented at the Human Computer Interaction Consortium Workshop, Snow Mountain, CO.

Buškevičiūtė, J.; Raipa, A. 2011. Sprendimai šiuolaikinio viešojo valdymo evoliucijoje. *Viešoji politika ir administravimas*. 1(10): 17–26.

Cheng, M.; Cheng, L.; Tu, W.J.; Fang, L. 2012. A Survey on Similarities and Differences between Systematic Analysis and Decision Analysis. *Advanced Materials Research*. (628): 396–402.

Chiticariu, L.; Kolaitis, P.G.; Popa, L. 2008. *Interactive Generation of Integrated Schemas*. Proceedings of the 2008 ACM SIGMOD International Conference on Management of Data, p. 833–846.

Cook, M.B.; Smallman, H.S. 2007. Visual Evidence Landscapes: Reducing Bias in Collaborative Intelligence Analysis. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*. 4(51): 303–307.

De Lido, A.; Sandor, A.; Buckinhgam Shum, S. 2011. Contested Collective Intelligence: Rationale, Technologies, and a Human-Machine Annotation Study. *Computer Supported Cooperative Work (CSCW)*. (21, 4–5): 417–448.

Domarkas, V. 2008. Nukreipiantis Jungtinių Tautų Organizacijos vaidmuo viešojo administravimo raidos procesuose. *Viešoji politika ir administravimas*. 23.

Encyclopædia Britannica. 2012 [interactive]. [accessed on 06-01-2012]. <http://www.britannica.com/EBchecked/topic/289766/human-intelligence>.

Etzioni, A. 1988. Normative-affective Factors: Toward a New Decision-making Model. *Journal of Economic Psychology*. (9, 2): 125–150.

Flett, F. 2010. Collective Intelligence and the Possibility of Dissent: Anonymous Individual Opinions in VTO Jurisprudence. *Journal of International Economic Law*. 13(2).

Giarratano, J.; Riley, G. 1994. *Expert Systems*. PWS Pub.

Gibson, S. 2006. *Wikis Are Alive and Kicking in the Enterprise* [interactive]. [accessed on 29-09-2011]. <http://www.eweek.com/article2/0,1895,2061135,00.asp>. Gouarderes, G.; Saber, M.; Nkambou, R.; Yatchou, R. 2005. The Grid-E-Card: Architecture to Share Collective Intelligence on the Grid. *Applied Artificial Intelligence*. (19): 1043–1073.

Gregg, D. G. 2010. Designing for Collective Intelligence. *Communications of the ACM*. (53, 4).

Güneş, S. 2012. Wisdom of Firms versus Wisdom of Crowds. *International Journal*

of Business, Humanities & Technology. (2, 3): 55–60.

Hakman, J.R. 2011. *Collaborative Intelligence – Using Teams to Solve Hard Problems*. Berrett-Koehler Publishing, Inc.

Hearst, M. A 2009. *Social Technology* [interactive]. [accessed on 06-01-2012]. <http://www.slideshare.net/marti_hearst/social-technology>.

Heylighen, F. 1999. *Collective Intelligence and Its Implementation on the Web: Algorithms to Develop a Collective Mental Map*. Springer Netherlands.

Job, J. 2005. How Is Trust in Government Created? It Begins at Home, but Ends in the Parliament. *Australian Review of Public Affairs*. 1(6): 1–23.

Johnson, C.Y. 2010. *Group IQ* [interactive]. [accessed on 06-02-2012]. <http://www.boston.com/bostonglobe/ideas/articles/2010/12/19/group_iq/>.

Jones, P.M.; Hayes, C.C.; Wilkins, C.; Bargar, R.; Sniezek, J.; Asaro, P.; Mengshoel, O.; Kessler, D.; Lucenti, M.; Choi, I.; Tu, N.; Schlabach, M.J. 1998. CoRAVEN: Modeling and Design of a Multimedia Intelligent Infrastructure for Collaborative Intelligence Analysis. *IEEE International Conference on Systems, Man, and Cybernetics*. 11-14 Oct. (1): 914–919.

Juran, J. M.; Godfrey, A. B. 1998. *Juran's Quality Handbook*. McGraw-Hill Professional.

Kapetanios, E. 2008. Quo vadis Computer Science: From Turing to Personal Computer, Personal Content and Collective Intelligence. *Data & Knowledge Engineering*. (67).

Kolektivní inteligence a crowdsourcing. 2010. CIO: Business World, p. 32–33.

Komninos, N. 2011. Intelligent Cities: Variable Geometries of Spatial Intelligence. *Intelligent Buildings International*. (3, 3).

Lee, M., R.; Lan, Y. 2007. From Web 2.0 to Conversational Knowledge Management: Towards Collaborative Intelligence. *Journal of Entrepreneurship Research*. 2(2): 47–62.

Lévy, P. 1997. *Collective Intelligence: Mankind's Emerging World in Cyberspace*. New York, NY, USA: Basic Books.

Lévy, P. 1999. *Collective Intelligence. Mankind's Emerging World in Cyberspace.* R. Bononno, Trans. Cambridge Massachusetts: Perseus Books. (Original work published in 1994).

Luft, H. S. 2010. Data and Methods to Facilitate Delivery System Reform: Harnessing Collective Intelligence to Learn from Positive Deviance. *Health Services Research*. (45, 5).

Malone, T. W. 2011. *Solving Climate Change with Crowdsourcing* [interactive]. [accessed on 06-02-2012]. <http://mitsloanexperts.com/2011/02/06/solving-climate-change-with-crowdsourcing/>.Malone, T.W.; Klein, M. 2007. Harnessing Collective Intelligence to Address Global Climate Change. *Innovations: Technology, Governance, Globalization*.

Martusewicz. 2008. Educating for "Collaborative Intelligence": Revitalizing the Cultural and Ecological Commons in Detroit. In: M. McKenzie, H. Bai, P. Hart and B. Jickling (eds.). *Fields of Green: Re-Storying Education*. Hampton Press.

Newell, A. 1990. *Unified Theories of Cognition*. Cambridge, MA: Harward University Press.

Nguyen, N. T. 2008. Inconsistency of Knowledge and Collective Intelligence. *Cybernetics and Systems: An International Journal*. (39).

Norvaišas, S. 2010. Towards the Networked Society. *Socialinės technologijos'10: iššūkiai, galimybės, sprendimai: konferencijos medžiaga*. November 25-26, 2010, Vilnius-Net.

O'Reilly, T. 2005. *What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software.* O'Reilly Media, Inc. [interactive]. [accessed on 29-09-2011]. <http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html>.Poore, M. 2011. Digital Literacy: Human Flourishing and Collective Intelligence in a Knowledge Society. *Literacy Learning: The Middle Years*. (19, 2).

Scarlat, E.; Măries, J. 2009. Increasing Collective Intelligence within Organizations Based on Trust and Reputation Models. *Economic Computation & Economic Cybernetics Studies & Research*. (43, 2).

Schijven, M.; Hitt, M. A. 2012. The Vicarious Wisdom of Crowds: Toward a Behavioral Perspective on Investor Reactions to Acquisition Announcements. *Strategic Management Journal*. (33, 11): 1247–1268.

Sekhar, B.M.R.; Babu, K.V.S.N.J. 2012. MIS. Vs. DSS In Decision Making. *Global Journal of Management and Business Research*. 16(12): 1–8.

Sheremetov, L.; Rocha-Mier, L. 2008. Supply Chain Network Optimization Based on Collective Intelligence and Agent Technologies. *Human Systems Management*. (27, 1).

Simmons, J.P.; Nelson, L. D.; Galak, J.; Frederick, Sh. 2011. Intuitive Biases in Choice versus Estimation: Implications for the Wisdom of Crowds. *Journal of Consumer Research*. (38, 1): 1–15.

Soelberg, P. 1966. Unprogrammed Decision Making. *Academy of Management Proceedings*. (1): 3–16.

Surowiecki, J. 2004. *The Wisdom of Crowds*. Random House, USA.

Svobodová, A.; Koudelková, P. 2011. Collective Intelligence and Knowledge Management as a Tool for Innovations. *Economics and Management*. (16).

Szuba, T. 2002. Was There Collective Intelligence before Life on Earth? Considerations on the Formal Foundations of Intelligence, Life, and Evolution. *World Futures*. (58): 61–80.

Weiss, A. 2005. The Power of Collective Intelligence. *Net-Worker*. (9, 3).

Wood, D.; Friedel, M. 2009. Peer Review of Online Learning and Teaching: Harnessing Collective Intelligence to Address Emerging Challenges. *Australasian Journal of Educational Technology*. (25, 1).

Yum, H.; Lee, B.; Chae, M. 2012. From the Wisdom of Crowds to My Own Judgment in Microfinance through Online Peer-to-peer Lending Platforms. *Electronic Commerce Research & Applications*. (11, 5): 469–483.

KIEK GALIMOS IR NAUDINGOS KOLEKTYVINIO INTELEKTO TECHNOLOGIJOS PROGRAMUOJANT VIEŠOJO SEKTORIAUS SPRENDIMUS?

Rūta Tamošiūnaitė

Mykolo Romerio universitetas, Lietuva, tamosiunaite.ruta@gmail.com

Alvydas Baležentis

Mykolo Romerio universitetas, Lietuva, a.balezentis@gmail.com

Santrauka. *Kolektyvinis intelektas ir jo formavimo technologijos pastaruoju metu dažnas tyrimų objektas. Viena priežasčių – suaktyvėjęs požiūris į gyventojų įtraukimo vertę ir tam būtinų technologijų paieška. Šiame straipsnyje pristatomo tyrimo tikslas – ištirti kolektyvinio intelekto ir jo formavimo technologijų esmę ir apžvelgti jų taikymo galimybes sprendimų programavimui viešajame sektoriuje. Atlikta literatūros analizė ir empirinis tyrimas (kokybinė*

analizė – ekspertų apklausa). Atlikus ekspertų apklausą buvo apibrėžtos sprendimų viešajame sektoriuje charakteristikos ir sprendimų struktūra valstybinio valdymo ir savivaldos lygmenimis. Empirinis tyrimas atliktas su Lietuvos ekspertais.

***Raktiniai žodžiai*:** *kolektyvinis intelektas, kolektyvinio intelekto technologijos, socialinės technologijos, sprendimų programavimas, viešasis sektorius.*