MULTILEVEL INTERACTION IN SMART CITY PROJECTS

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Abstract: *Interaction in the Smart City projects is considered in the paper. The essence of the concept of Smart Cities is revealed. Difficulties which are associated with the implementation of the Smart City projects are showed. The importance of interaction of all stakeholders is underlined. Background of the conception of smart cities is analyzed. The features of smart devices, smart home, and smart urban quarter are briefly discussed. Basic conditions that need to implement the conception of performance are determined. The key stakeholders of the Smart City projects are identified. The basic level of interaction in smart city projects is singled out. It refers to the planning level, the level of the project realization, the level of project teams, and the level of the executors. The specific features of interaction at every level are analyzed. Forming project teams as one of the most important tasks of interaction is defined. The non-forceful interaction theory for solve this problem is used. From the position of the theory, the importance of planning of information flow in the project team is grounded. Using the principle of Minimax for distribution of information flows is suggested. Some other features of distributed project teams are presented. Difficulties of separating project management from operating activities in the Smart City projects are displayed. Mechanisms of interaction in the Smart City projects, using decision support systems, are outlined. Some ways for refining the Smart City projects management are proposed.*

Keywords: *project management, non-forceful interaction, smart city, triple helix*

ACM Classification Keywords: *K.6.1 – Project and People Management, I.2.11 – Distributed Artificial Intelligence*

Introduction

The essence of the Smart City conception is effectiveness of city sources management to increase quality of citizenry life, which is based on using modern information and communication technologies. Moreover, this path of cities transformation corresponds to one of the aims of sustainable development approved by United Nation Organization. But now the conception with all its affinity does not include enough details to complete implementation of its principles.

Obviously, practical realization of Smart City projects involves severe difficulties and both state structures and private corporations can do it by own strength. In this condition, all stakeholders need to

interact. Hence, search, analysis and ensuring of the most effective forms of interaction are very actual tasks.

The aim of this article is identification of stakeholders of Smart City projects, the levels of interaction separation and its mechanisms justification.

Smart City projects and mechanisms of interaction

The Smart City conception includes several different directions. Among them we can pick out systems like public water supply, sewerage, heating, electric public utility, street lighting. Other important activities are management of financial flows, integrated security system, transport management. Sometimes monitoring of environment, medical care and social service, municipal free net with access points in public place, automatic sorting of domestic waste, charging station for electric vehicle, and solar batteries mounting, are added to this list.

Evidently, the Smart City conception appeared to be a good reason. The first step was the smart devices creation. Their functions are sufficiently multi-various. For example, we can remember the automatic regulator of heat supply depending on the temperature in the room, lighting switch which has reaction to somebody appearance, washing-machine with built-in-function of powder supply according to fouling factor.

Later such devices had an expanse; many of them had joined to networks. Mobile phones to be used for control of these networks were realized. That cause advancing of the idea of the Smart Home. Owner-occupied dwelling or flat in tenement-house may be described as particular cases. The engineering solutions for both cases have not essential distinctions. But the inhabitants in the multi storey block of flats ought to co-ordinate housekeeping with each other.

The smart urban quarter and urban area became the next steps of this conception. People can unite for solution of public problems. The land improvement may be one of the tasks. In particular, rigging of playground by picture monitors and other smart devices will help parents to control the children and provide safety. Another field of action is connected with discovering of joint interests of people, organization of their meetings, information interchange, rendering of mutual aid in domestic jobs. Often, the particularized Web portal serves for more handy intercourse.

Finally, all smart technologies are included in the Smart City conception [Hatzelhoffer, 2012]. But it's developing needs to satisfy many additional conditions. Above all, we ought to take into account high cost of the projects. This is one of the reasons that, in most cases, the existing decisions are characterized as fragmentary or insular. This way, producing the intelligent control, corporations test and advertise their equipment and technologies. Accordingly, the leadership in the projects belongs to

these corporations. For participation in more scaled projects they need precise estimation of recoupment of investment.

Another condition applies to all potential users of intelligent technologies. Untrained person cannot use smart devices and intelligent systems. As a result many advanced functions will be not called for. This circumstance demands of special education programs for all categories of citizens.

The next important issue is the protection of intelligent city networks from illegal access [Greenfield, 2013]. Presence of ample quantity of the smart sensors and devices with access to Internet is the aggravating factor of this problem because often such devices are open to injury from attacks and have no mechanisms of signalizing.

As a whole, for success of the Smart City conception in the specific place the appropriate complex strategy ought to be worked out. More or less extent in the strategy will be presented to all foregoing structure levels. But the basic items are priority aims and accessible resources. Definition of the priorities is very actual task. Investigation of stakeholder's opinions is necessary step for search of optimal decision. Moreover, local authorities ought to stimulate people to share they views on the most significant problems, including through Internet. Monitoring information systems are also important source of data. Analysis and summarizing of gathering information allow defining directions of perspective projects. Obviously, simultaneous realization of all Smart City technologies is impossible. According to reveal preferences scarce resources allocation ought to occur.

But summarizing of citizens opinions is not enough to provide successful projects. The broad participation is very important too. Attraction to team-work is the special question; it calls for effective procedures of interaction. Thereupon we purpose to consider the levels of interaction in detail.

Levels of interaction

- ***Planning***.

The Smart City conception is possible to be considered as one of the forms of innovation development. Among effort in field of innovation the *Triple Helix theory* hold much favor. The essence of this theory is interaction of three main driving forces of innovations: Universities, Industry and Government [Etzkowitz, 2008]. So, planning of the Smart City projects needs in coordination of all contacting parties. Practically all citizens are users of products of the Smart City projects. On the other hand, managers, employees, officials, scientists, etc., are citizens too. Also, the capability for projects generation may be determined as one of the criteria of maturity of information-oriented society [Осауленко, 2014]. Hence, the structures of the civil society will be included inside the Triple Helix. On basis of all available information

the plan or program for sustainable city's development in general will be result of interaction on the level of the main institutes.

- ***Projects realization***

At this level, several problems ought to be solved. First of all, potential project participants need to be informed about conception of the project. Stakeholders in the circumstances will analyze the conformity of the project aims to their own interests and evaluate probable profit and risks. Depending on results each takes a decision.

But sometimes, one of the actors is very significant for other partners and the project as a whole. Accordingly, they will make an attempt to persuade not agreeing partner to take part in the project. In general, for definition of participants inclination to consensus, non-forceful (non-power) interaction theory is used [Teslia, 2014]. This theory is based on the use of statistical criteria known as information distance. The information distance is determined by the frequency of reaching an agreement in the history of previous relationships of two partners. This parameter can range from 0 (unity with no questions) to 1 (complete antagonism). Obviously, smaller distance between the actors mean more likely to reach a consensus on further joint activities. During formation the project team, we must avoid both extreme situations. Otherwise we get lack of critical approach or permanent confrontation. As a result, for each project, the organizations that take part in it have to be identified.

Taking into account the information distance, it is relevant not only during the forming of the project team. Planning of information flows in the project team depends on this parameter, too. It is expediently to organize the circulation of information and information influences in compliance with minimax principle. Such approach means minimal interaction of participants' pairs with maximal information distance. This mechanism of interaction allows optimizing team-work at the project.

- ***Distributed project team***

Actually structural units of involved in the project organizations interact at this level. It has some features. On the previous two levels mainly direct contacts take place. At this level interaction is through networking. But specificity of the Smart City, projects stipulate for quick change of work stations, for example, during mounting of equipment and lines of communication. At the same time interaction with inhabitants in the form of feedback occurs.

- **Executors**

Besides this, distributed project teams have some others features. Sometimes, process of production needs of replacement the personnel. In this case, new executors must to grow into a role. This process calls for several time and additional mechanism of interaction which provides for corresponding training

and quickly allows taking up the duties. Reasoning from that we also can separate the level of executors.

Interaction in the Smart City project

The Smart City projects are characterized by large quantity of modern engineering solutions. At the same time, application of new principles of city management ought to accompany the existing ones. These conditions make it difficult to interact. The importance of integrated planning and coordination increases. Moreover, as a rule, the project does not end with the start of operation of the relevant smart systems. Additionally, it is required to provide training for users at all levels and to ensure optimal modes of intelligent systems. Thus, it is difficult to determine exactly where the project ends and operating activities start. The experience which is gained in these conditions is very valuable for future project management.

The above considerations provide additional grounds for the use of decision support systems in the Smart City projects management. Using this technology for search of optimal decision can ensure several advantages. Among them, the possibility to estimate more variants and efficiency are often remembered [Ghasemzadeh, 2000]. But realization of the preferences needs in appropriate structure.

The ***interaction in the Smart City project with DSS*** is illustrated by the scheme on Figure 1. We can separate several contours of management and corresponding mechanisms of interaction. The first and simplest case is interaction of members of distributed project team through servers of own organization and messages' control system. This method is appropriate for routine coordination. If the task is more significant, interaction will occur through project server, where all information concerned to the project is checked by the project leader and stored in the project database. For solving optimization problems and searching similar decisions, users can call to the project management models and knowledge base. Sometimes during accomplishment of the project, the necessities of partial team replacement or adding participant proceeding appear. In such cases, the project leader can call to the database of partners. If the project needs in additional resources, the proper message to the City Project Office will be addressed.

Also, the Project Office is connected with the Center of City management and City smart systems. This data exchange allows receiving relevant information about exploitation of the smart systems, discovering imperfection and users requests. It is possible; several users to be in readiness to participate in current projects. Such information is recorded in the projects databases.

The priority aims of the City development are in the scope of the Project Office attention, too. It allows to define the most important projects and to make changes in current projects.

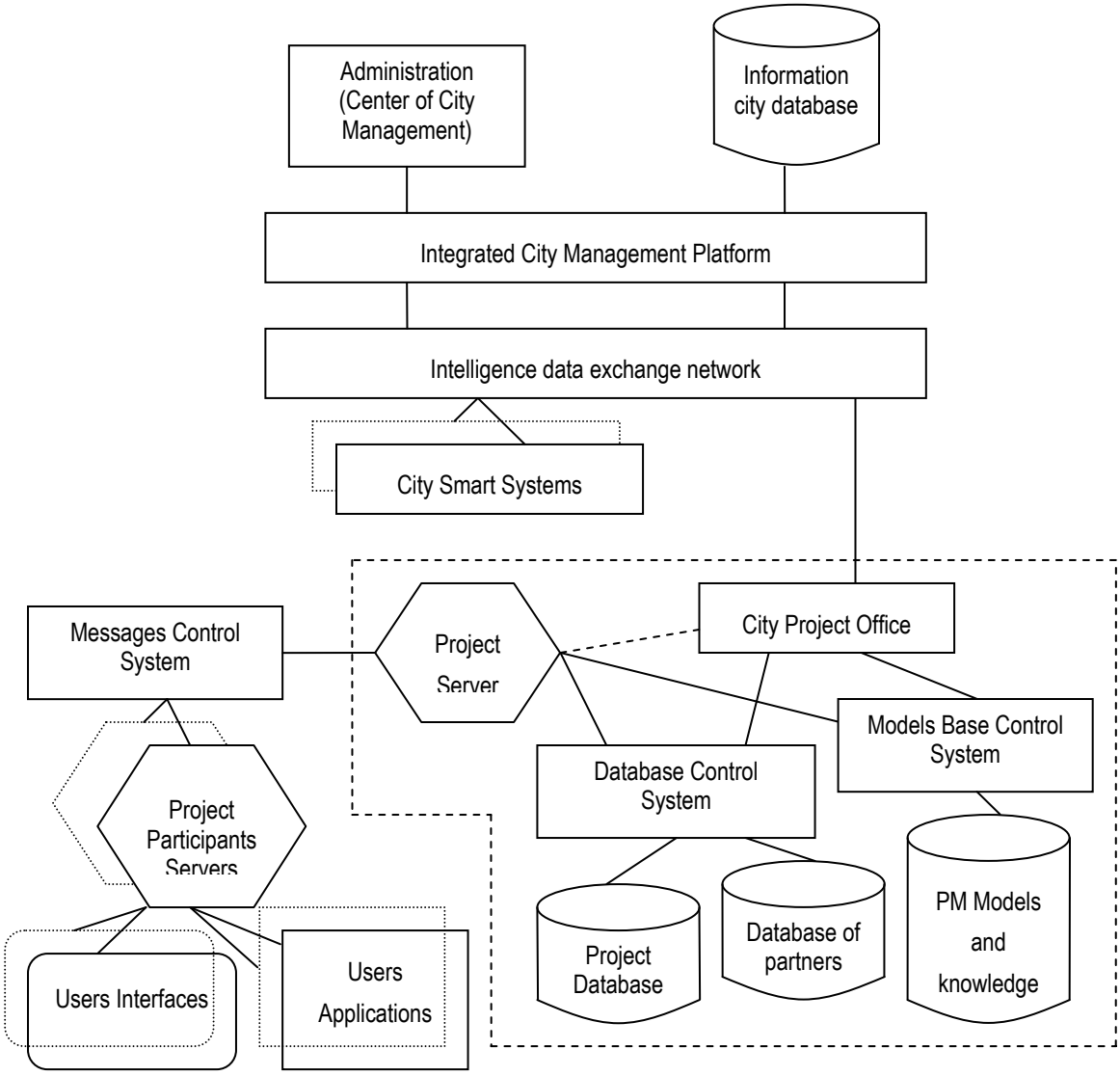

Figure 1. Scheme of interaction in Smart City project using a Decision Support System

Conclusion

Consideration of interaction in the Smart City projects permits to display the problem which during accomplishment of the projects appears. One of the main difficulties is connected to deficiency of detailed elaboration of the Smart City conception. Thereupon City Administration and all other stakeholders together ought to define the foreground tasks for solving.

All citizens are consumers of products of the Smart City projects. In the circumstances, involving of all stakeholders in the Smart City projects planning is very important. It can be obtained by effective mechanism of interaction. All levels of interaction and all stages of the projects are connected to this problem.

As one of the tools of the problem solving, the using of non-forceful interaction theory is proposed. Application of this theory enables the opportunity of efficient selection of the projects participants. It is

important to use planning connected with information flows. The Minimax principle in interaction allows obtaining functioning of project team with minimal risk of conflict.

One more significant task of the Smart City projects is developing the professional skills of users. Any smart technology cannot be effective without training the consumers. So, the suitable arrangements are need to stipulate each Smart City project. The protection of the smart systems from illegal access is important task of the projects, too.

Using intelligent technologies in the Smart City project management is very important. Thereupon we have recalled the decision support systems. Possible applications of these systems are rather multifarious. They past experience is accumulated and allow availing project managers of this information. Built-in model is assigned for solving optimization problem.

Advanced approach allows extending traditional functions. One of new application is the module for partners searching and statistics collections. Other possibilities for project management improvement concern the feedback with consumers and more close connection with City Administration. These circumstances can help for success of the Smart City projects.

Bibliography

[Etzkowitz, 2008] H. Etzkowitz. The Triple Helix: University – Industry – Government Innovation in Action. Routledge, 2008.

[Ghasemzadeh, 2000] F. Ghasemzadeh, N. P. Archer. Project portfolio selection through decision support. Decision support systems, Num. 29, pp. 73-88, Amsterdam, 2000.

[Greenfield, 2013] A. Greenfield. Against the smart city (The city is here for you to use). Kindle Edition, 2013.

[Hatzelhoffer, 2012] L. Hatzelhoffer, K. Humboldt, M. Lobecr, C.-C. Wiegandt. Smart City in Practice: Convertive Innovative Ideas into Reality. Jovis, 2012.

[Teslia, 2014] I. N. Teslia.Non-forceful Nature. Monograph. Cherkasy, 2014.

[Осауленко, 2014] И. А. Осауленко. Проектный подход и зрелость информационного общества. International Journal Information Technologies & Knowledge. Vol. 8, Num. 4, pp. 389-391, Sofia, 2014.

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Major Fields of Scientific Research*: Project Management, Information Technologies in Economics, System Analysis*