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A Look at Evolution of Teams, Society, Smart Cities, and Information Systems based on Patterns of Primary, Adaptable, Information, and Creative Society

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***Abstract*—Development of information and communication technologies (ICTs) and society are interdependent. Smart City (SC) is one conception emerging as a result of such interdependence. This paper considers evolution of teams, society, SCs, and Information Systems based on Patterns of Primary, Adaptable, Information, and Creative Society. The evolution is described in 16 levels according to the Simple Learning Motivations Hierarchy Model (SLMHM). Success factors of ICT projects and strategy for SC development are discussed from point of view of patterns considered.**

I. Introduction

THERE is a gap between development levels of society and technologies. Such phenomena are observed during globalization processes where developed countries try to adopt technologies in undeveloped ones. Artificial Intelligence (AI) threat to humanity is an example of a gap between levels of society development and ICTs. Another gap relates to 5G cellular networks, where some researchers cannot say if this technology is dangerous, or not [1, 2].

Structure of society patterns, including Initial Formation (IFP), Primary (PSP), Adaptable (ASP), Information (ISP), and Creative (CSP) (the five patterns in further text)[3], is considered. The five patterns are based on idea of four organization cultures, i.e. Impulsive, Dependent, Independent, Interdependent [3, 4]. Development of society and ICT solutions are considered according to 16 levels of the SLMHM model (see [5] and Fig 1 for details). The discussion includes conception of SC [6-12] and several maturity models [8, 10, 12-20]. Understanding of demand in information technologies and information systems (IT/IS) according to the five patterns and SLMHM levels is a success factor of ICT projects.

II. Methodology, Theoretical Background, and Research Questions

This research is theoretical and based on observations and literature analyses. The methodology is based on the 1) literature analyses; 2) juxtaposition of the five patterns, SLMHM levels, and IT/IS (see Fig. 1); 3) discussion of findings and their possible practical application.

Ecological, economic, socio-cultural, and political components were proposed to be considered as ones of the Sustainable Information Society (SIS) [21]. Technological, economic, occupational, spatial, and cultural elements of the Information Society were selected [22]. 17 UN sustainable development goals [23] can be achieved by the harmonization of society and the environment. ICTs provide valuable tools for such harmonization allowing intensive information processing and control [3,5]. Rabie describes human society development ages as the following: hunting and gathering, agricultural, industrial, knowledge (post-industrial, the information, the globalization) [24].

Cities worldwide play a prime role in social and economic aspects and have a huge impact on the environment [6]. Although the meaning of SC is not settled yet, there is an agreement on the significant role of ICTs in smart urban development [7]. ICTs are an important tool for the transformation of industrial society into information and knowledge society. It is a networked society, emerging a new social morphology, and gaining economic, social, political, and cultural primacy. Society is constantly changing, either because the economic, social, political, and cultural contexts are increasingly massified, internationalized, and globalized, or because the relations of life, study, work, and capital are changing rapidly and constantly [25].

There are also several mature models allowing to assess how "smart" the city is. The low level of maturity of the SC, the lack of sufficient and real-time data, and the lack of standardization in previous years hampered the development of such models. Citizens are considered "prosumers" of geotagged data and content affecting cities' everyday norms and interactions [8]. The study shows that SC can be considered a socio-technical system [9].

SC Development Maturity Model, defined in [10] consists of five levels: initial, repeated, defined, managed, and optimized, and is built based on six factors for which the maturity is determined on these five levels which are strategic alignment, culture, people, governance, method, and IT/IS.

Software Capability Maturity Model (SW CMM) was developed by the Software Engineering Institute (SEI) at Carnegie Mellon University in 80s-90s as a response to a re-

quest to provide the government with a method for assessing the capability of their software contractors [13]. It should be mentioned, that SW CMM was developed for organizations, but not for country-level projects [14, 15]. Since the introduction of the Capability Maturity Model, many maturity models were developed including Knowledge Management Maturity Model (KMMM) [16].

There are ISO 37xxx standards relating to establishment of SC operating models for sustainable communities [26-28]. There are ranking SC models and experience of ranking cities [11, 29]. The SC Maturity and Benchmark Model have been designed to capture the key aspects of a city's transformation journey to a smarter city. The model allows a city to quickly assess its strengths and weaknesses in five key dimension areas related to city smartness and set clear goals as to how it wishes to transform over the next two-five years [12]. Three maturity models, which approached a city in a holistic way were discussed in [17, 18]. Main maturity model design patterns were identified. Typically, three application-specific purposes of the model used, i.e. descriptive, prescriptive, and comparative are distinguished [19]. Different Maturity Models for Information Systems were studied. The number of levels in the considered models varies from 4 to 6 [20].

Sarkar describes quadri-dimension economy as a part of Progressive Utilization Theory (PROUT) [30]. These 4 parts of economy intuitively match 4 McWinney's realities [31, 32]. Several economic conceptions were taken from Life Cycle Management [33-35] and from the experience economy [36]. Types of dystopia that are described in [37] intuitively match to the considered patterns.

The following research questions are:

RQ1. What are the stages of society development from ICTs point of view?

RQ2. How do stages and trends of society development relate to ICTs and how this relation can be used for ICT projects?

III. The Model

Fig. 1 outlines the five patterns, SLMHM levels, and related IT/IS. The five patterns are similar to the development stages. Main features of the model include:

- society develops consequentially from Initial Formation to Primary, then to Adaptable, then to Information, and finally to Creativity stages;
- SLMHM allows modeling the team/society development by more detailed steps (levels);
- transition to specific level requires satisfaction of requirements of all previous levels;
- there are no clear boundaries between development stages;
- the structure of society contains IFP, PSP, ASP, ISP, and CSP in different proportions;
- the prevailing pattern shows which technologies are demanded;
- applicability to groups of any size, from small teams up to large organizations and society;
- can be integrated with other models vertically (by relevant layers) and horizontally (by breaking up the area of interest into parallel developing parts).

IV. Discussion of the Findings

There is intuitive match between the five patterns and different economical (four Whitmore's cultures [4], dimensions of sustainability [33], etc.) and philosophical (PROUT [30], McWinney's realities [31, 32], etc.) conceptions. The match is discussed in detail in [3]. According to [28], the model, presented in Fig. 1 corresponds to all three levels of SC standards: Strategic, Process, and Technical Specifications. There is no direct accordance between the CMM [10] and SLMHM levels. Menwhile, one can say that some match between CMM and SLMHM levels exists.

Part of the IFP in society can be assessed through a percentage of the informal economy and unemployment rate. So, the contribution of the informal sector, excluding agriculture, to GDP in developing countries is about 16.3% (Venezuela, 2006) up to 61.8% (Benin, 2000) [38]. The study presented in [39] shows higher figures for informal non-agricultural employment – from 46.2% (Hanoi) up to 83.1% (Lomé). One can say that exclusion of the agricultural sector from considering informal employment reflects the fact that the agricultural sector relates to the agricultural age according to Rabie [24], i.e. to the PSP. Entertainment ICT solutions seems the only ICT solutions demanded in this pattern.

PSP represents the structure (skeleton) of the society. Its part can be estimated by level of bureaucracy and traditions. Here database solutions seems the most demanded ones. ASP is based on logic and facts. Industry and production are the main components of the ASP, while analytics and optimization are the main components of ICTs. ISP is characterized by connectivity and networks. The main values of this pattern relate to the human feelings. That's why social media and networks have become so popular nowadays. CSP is the next pattern, characterized by the creativity, ideas, and expansion. The key technologies here are Artificial Neural Networks (ANNs), AI, and blockchain. Although mankind is in the information age (ISP), the entry into the post-information age (age of creativity / CSP) is characterized by the development of these technologies. This is possible because there are no clear boundaries between development stages.

IFP, PSP, and ASP relate to reactive approaches to the changes. IFP is not considered in many cases because it does not relate to a team or complete society. The main aim of ASP is to achieve adaptation to changes and sustainability. ISP and CSP relate to proactive approaches [41] to the changes and sustainable development.

There is a need for a maturity model for maturity modeling [42]. SLMHM can be used to design other development and maturity models.

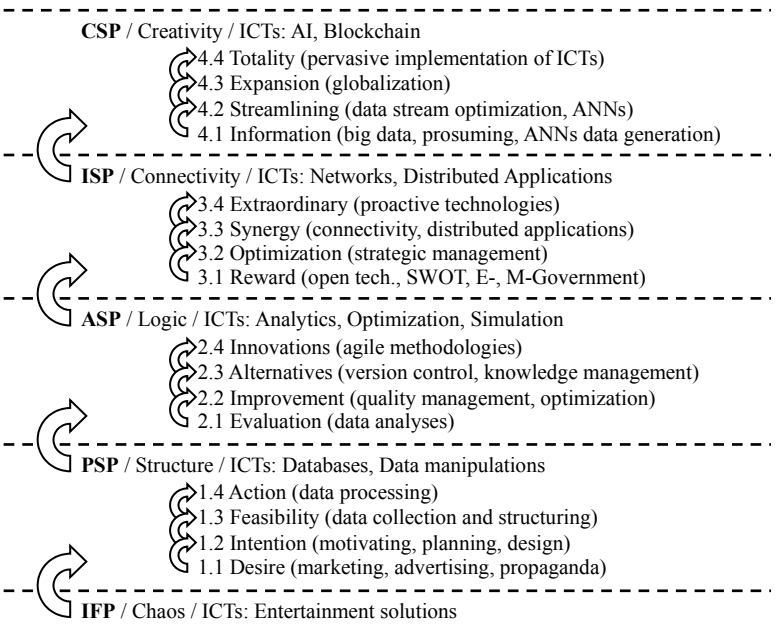

Fig 1. The Five Patterns, SLMHM Levels, and IT/IS

Examples of problems that can be explained by the considered model are presented in Fig. 1. They include:

- AI threat problem. AI relates to CSP. CSP requires developed ISP. ISP is currently developing (information age). It means that developed connectivity is a key to solve such problems;
- teams that have not adopted quality management cannot gain full benefits from technologies relating to SLMHM level 2.3 and higher;
- sustainability can be achieved only if SLMHM level 2.4 is achieved. Sustainable development can be achieved only if SLMHM level 3.4 is achieved;
- stage of society development can be assessed in two ways. 1) by studying the culture; 2) by studying of effectiveness of implemented ICT solutions;
- implementation of higher level technologies in societies with lower level is risky. Assurance that society level is the same or higher than that of implemented IT/IS is a recipe for success;
- implementation of technologies of higher level before appropriate implementation of technologies of lover levels is risky;
- moral decision making by algorithms [43] is not a trivial problem because modern algorithms relate to ASP. At the same time, moral relates to human feelings, in other words, to ISP. The development of ISP is the key to solving the problem.

There are strong reasons to assert that the implementation of ICT solutions in societies with lower level will contribute to raising the society's level, because society and penetrated ICT solutions form one system.

V. Conclusion

The five patterns corresponding to the development stages, 16 SLMHM levels, and corresponding ICTs were considered (see Fig. 1). Match of society development level and relevant ICTs is considered as a success factor of ICT projects implementation. The ICT projects are essential in realization of SC conception.

Disadvantages of this research include small scope of this paper, considering ICTs briefly, and theoretical nature of the research. Practical implementation of considered theory requires methodology for assessing levels of society development and high volume of computations [5].

Future research should include detailing of Fig. 1 by adding ICTs and development of society assessment methodology. Practical implementation of the theory has the special interest.

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