ORGANIZATION TECHNOLOGY OF PROFESSIONAL INTERACTIONS IN THE ENGINEERING ENVIRONMENTS

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ABSTRACT

The article deals with the specifics of matrix management of interactions in the engineering environment, which is associated with the presence of a certain norm of intellectual and business communication, as well as with the normalization of the professional action technology in development, evaluation, implementation of given targets in the techniques and procedures. The research methodology is based on a systematic approach that emphasizes the implicit factors of interaction and functional relationships between subjects in the engineering environment. The analysis of technology tools for organization of professional interactions in engineering activity is conducted within the framework of the information paradigm. The authors sum up the evolution of interaction norms through the history of professionalism from ancient times to the present day, and emphasize the fact that the development of systems based on intellectual and information technologies changes the interpretation standards of engineering and technology, objects of engineering and objects of technology. The need for accounting the innovative, environmental, social risks for technical projects requires new forms of professional action, in addition to mathematical, technological, economic calculations. The peculiarity of communication in the professional community is that professional relations are mediated by the semantic network of disciplinary and interdisciplinary knowledge. The need to cope with interdisciplinary projects distinguishes modern trans-professional from the traditional free professionals and general trade specialist. Information interactions in modern professional environments are mediated by abstract systems, and are always normalized by an invisible but understood semantic structure in messages production, transmission and perception. The study of implicit environmental factors of professional interactions organization throughout the evolution of engineering activity shows that the code nature of information communication in professional interactions design has deep roots in the history of culture. Professional functions normalization acts as the main tool that allows modeling situations that motivate certain cognitive and behavioral acts in a professional environment. In this regard, one should note the control function of abstract systems represented by information websites and the expert community. The

principle of common values and action norms formation acts as the dominant principle of professional interactions organization in network information environments.

1. INTRODUCTION

Engineering activity is associated with various professional fields in the process of technical products design and development. In the history of culture, from the moment of division of labor between architect (designer, computing engineer, draftsman) and actual manufacturer (builder, mechanical) onwards, it is possible to talk about the evolution of subject interactions in the professional environment. There are different professionals who perform the design stage of the product (constructive ideas, drawings, calculations) and its material development (production according to technical documentation) [1]. The priority task of engineering activity is to develop or modernize any artificial material object (for example, a sports complex). But in the modern world, information networks, inter-subjective connections and relations can also be an object of design. Solutions that only account technical efficiency to the detriment of norms and values appear to be destructive for subtle matter of social relations [2, 3]. The latter fact introduces significant corrections into the process of technical projects justification, involves new principles into the system of engineering activity organization. Design of man-machine, socio-technical systems is associated with non-physical constraints. Calculation of such a system state parameters turns out to be a difficult task, coupled with identification of effective principles for interdisciplinary interactions organization in the professional environment [4, P. 89, 90].

Authors' position is defined by social and anthropological paradigm which emphasizes the human factor prevalence in any technical system design. In this article we investigate implicit environmental factors of interaction management in socio-technical system of relations, which develops along with the engineering activity evolution. In this regard the attention of authors is focused on the analysis of available tools for matrix organization of professional interactions in the history and the present.

1.1. Literature Review

Describing the history of the professional elite in Western Europe, G. Perkin identifies three professional revolutions, which are accompanied by the transformation of ways of thinking and professional activity, as well as changes in the forms of its social organization [5]. The technical infrastructure of the Internet allows us to implement the third professional revolution, creating conditions for the formation of new super-elite professionals who live and work as a virtual team in networks. The design of subject interactions is determined in this case by the formation of trans-professional teams to solve complex problems. A virtual team does not exist in the physical space, but is created by combining agents in the information field by electronic means and operates in cyberspace on the basis of Internet services and knowledge of management tools. It is a kind of meta-organization that combines

the goals, resources, traditions and experience of a number of such communities, as well as coordinating their development [6, 7].

The key principle of the third professional revolution is *customization*. This principle assumes calculation of the expected result, designed together with the customer and taking into account his conditions.

The functions of an engineer as a trans-professional are expand. He must be an Entrepreneur and Manager, as well as a multilateral technical specialist capable of carrying out a trans-disciplinary synthesis of knowledge [5]. This form of relations is the most constructive for the interactive dialogue of the subjects of interaction in the conditions of the modern technological structure. Designing subject interactions in this context is a process of creating a prototype of relationships, which results into theoretically reasonable definition of options for the development of new processes. It is in this way that the subject interactions design is presented in the market matrix of the capitalization model of the future [8].

The analysis of matrix organization of interactions in e-culture would not be complete without accounting the media space impact on the professional environment, as well as the specifics of mass communication, which refers to the obvious and hidden patterns of behavior stereotypes [9, 10]. Every subject perceives communicative environment as a continuous space of relations and interactions, continuously transforming but staying within the limits of public sphere set by the subject. At the same time, socio-psychological factors act as environmental pressure factors, influencing the individual's perception of situations and the communication process. In terms of topological approach, mass communication is a field phenomenon, since the communication means and the audience on their own form a communicative environment, which in turn affects the media and society [11, 12].

In terms of N. Luhmann's structural-functional theory, the media space, being a part of the social space, projects social structures formed in the process of media agents' interactions onto the physical space, as well as onto other fields of human life world. The ratio of physical and social space is considered as a product of dual social construction because of its dependence on the objective conditions of life, social status, as well as on subjective preferences, value orientations, and cultural traditions [13, 14].

2. MATERIALS AND METHODS

The methodology of our study is based on a systematic approach that emphasizes implicit factors of interactions organization, and functional relations between subjects in professional engineering environment. The analysis of management tools for professional interactions in the history of engineering and in modern socio-technical conditions is carried out within the framework of the information paradigm.

We assume that any interaction takes place in space and time, while the conditions for subjects' activity and interactions change constantly as the technological mode evolves. In modern information environments and large technical complexes, the subject is included into the system as its functional element. At the same time, subject's action may configure system conditions to the point where it will be necessary to change its programs and action algorithms. In this study, we analyze the evolution of professional interactions in the socio-historical retrospective in terms of the topological principle of information and functional relations organization in engineering activity. Such a vision allows analyzing the socio-technical conditions of engineering activity as a whole, and opens up a perspective for specifying informational determinism via the study of tools for matrix organization of professional interactions.

3. RESULTS AND DISCUSSION

A professional is a person who has devoted himself to any occupation as his line of work. Any professional activity involves interactions that are formed on the basis of division of labor and exchange (informational and material). Initially, subjective interactions organization in a community is implemented at the semantic level, has an implicit character and is manifested via actions motivation. Following the ritual or tradition organizes interactions in community through common line of thought, so it is perceived by everyone as the natural course of life.

3.1. The Organization of Professional Interactions in Traditional Society

The first professions began to emerge when human had settled down, had started to practice agriculture, had mastered pottery and smith craft. Information, skills, and also certain rights and duties of shamans, chiefs, priests, healers are of sacred nature; knowledge and skills are imparted only to those who are considered as the most worthy. It is important that information is not available to common, uninitiated people. Human of that era understood that in many respects the success of his activity depended on the relations between him (a plowman, a hunter, a healer, for example) and totem patrons or various higher forces. Human life and the life of nature are covered with mystery, which contributes greatly to sacral of certain skills developed by a person, and development of a craft on their basis.

Knowledge and information about the world were formed under the influence of mythological ideas, which encapsulated the idea of gods' protection, contributing to success in this or that activity. For example, in ancient Greek mythology winegrowers and winemakers fell under the auspices of Dionysus, hunters - under the auspices of Artemis, navigators - under the auspices of Poseidon, all the arts - under the auspices of Apollo, science and poetry - under the auspices of the Muses, daughters of Zeus and Mnemosyne.

The crafts and occupations of the ancient Greeks were defined by the pantheon of the Greek Gods. At this time, any professional knows: no God protection, no success. Therefore, appeal to the patron, sacrifice and oath to him - these are what the craftsman made before proceeding to his craft. A potter, for example, appealed to Athena Ergana (patroness of the craft), a smith - to Hephaestus (patron of smith craft), a poet - to Euterpa (the muse of poetry and lyrics). Thus, the process of interactions design is under the jurisdiction of higher forces and constitutes a general semantic (sacral) background for all activity reproducing the vital world.

In the middle Ages, the sacral level of subject interactions design acquires a different context. The demand for asceticism is a general requirement of Christian culture for professions related to the temple. It largely determines the nature of activity of monks, artists, architects, builders, who must keep the fast, live in modest and focused way. As a rule, they do not put a signature on their works, rejecting their authorship, since everything is God's will and is done with His help. Carrying out his work up to the authoritative instructions of elders and strict canons, the author presents himself as only being involved into creation process. The talent and skill of the craftsman is the plan of God. Mastery in the middle Ages is related to the spiritual, moral maturity of a person, in accordance with the maxim: "A bad person cannot do a good thing." The master in medieval culture is not only the one who creates the thing, but he also acts as a guarantor of the product quality, he is responsible for the technology preservation and impart to the next generation.

In the Renaissance, equation of talent and morality forms the basis for the establishment of the unquestioned authority of the Master in the craft community (guild). The master (painter, sculptor, and architect) strives for harmony, perfection, and in his work he is similar to the

Creator. The guild organization of handicraft labor in Europe culminates in the late 15th - early 16th centuries. In each craft guild, knowledge is kept and imparted from the master to a student, most often in the form of the recipe. The craft technology is kept secret; the craft history is often tied to the biblical story, which contains the reference to the Holy Patron. For example, in Venice there was the technology of glass production kept secret for a long time; in Lucca and Bologna the silk manufacturing techniques were kept; in Nuremberg - the secrets of the sandglass and technologies for various metal products; and weapons and knives were kept secret in Solingen. The sacredness of the recipe, the serious attitude to its preservation and immutability contributed to the formation of the traditional culture as the basic principle of interactions design in terms of craft technologies.

3.2. The Features of Professional Interactions in the Age of Enlightenment and Modernity

The modern age in Western Europe is characterized by the development of experimental science and empirical theory of knowledge. The originality of the author as opposed to tradition becomes the benchmark of professionalism. Galileo in his "Starry Messenger" (Galilei, Sidereus nuncius, 1610) specifically emphasizes the "absolute novelty" of his discoveries. Hobbes argues that all political philosophy is "no older than my book De cive" (Hobbes, The English works, ed. Molesworth, 1839, I, p. IX). Descartes wrote to his translator that he knew not a single philosopher before himself who did a philosophy business more or less successfully (preface to the "Principles of Philosophy"). "Fruitful experience" (in the philosophy of F. Bacon - the experience of experimental work) creates a culture of the industrial revolution, innovative by nature.

The search for new forms of experience dominates the science of modern times. Professional vocation is determined by the person's free choice. The ideal plan of professional activity is to realize one's affiliation with a certain horizon of culture, an ongoing process of progressive production of goods, but not connection with the transcendent element, the Supreme Absolute or collective community. In the system of social activity, the scientist acts as an amateur, going in for something according to his addiction, love, vocation. It is known that Einstein was developing a special theory of relativity at the time when he worked in the patent office in Bern, so then he turns out to be, in fact, an amateur physicist [15]. In English-speaking countries, a person who has got the means and time to develop his interests, to go in for any knowledge, but who does not use this knowledge or skills to earn his living, is referred to as a "gentleman" (Gentleman driver, Gentleman scientist, Gentleman farmer, Gentleman architect, and even Gentleman pirate).

The first professional revolution, according to H. Perkin, begins with the opportunity to freely sell one's labor and to own absolutely a developed product [5]. At this time not estates, but professional communities become the way to organize professional interactions. Free professionals are people who consciously develop their own potential. These people have laid the groundwork for the modernization process in Western Europe. The ideology of community organization as a free association of people of free professions is characteristic also of the Enlightenment. The second professional revolution is connected with the formation of specialized professions. The second professional revolution was initiated by an industrial revolution and the serial production development and leads to the emergence of bureaucratic organizations that allow subject interactions design within the boundaries of narrow activity fields' reproduction.

A form of social organization of first-wave professionals is a community of free professionals, represented in Europe by the republic of scientists. The second wave is

characterized by the emergence of trade unions. Employees of one corporation unite in vertical trade unions. At the same time, interactions are determined by corporate principles that restrict the freedom of professionals by goals, purposes, and regulations of the corporation. On the basis of free association principle, horizontal trade unions unite people who are engaged in the same activity.

Subject interactions in the professional sphere can be expressed in a symbolic way as the pyramid, facing the base down: general trades are at the base, free professionals - at the top. Representatives of the first wave (free professionals) are included in mega machine structures as specialists, managers, inventors, designers. Reproduction of professionals, specialists of general trades is carried out by means of the education system.

The third professional revolution begins in the 70s of XX century, when there emerges a stratum of new specialists — trans-professionals, who, thanks to the development of their thinking and activity organization, are ready to work in different professional environments, to freely enter and leave different structures, creating adequate forms of organization to solve any complex tasks. The ability to synthesize not only methods and means, but also ways of thinking and activity for a specific task, which has no ready-made solutions, is the basis of competency of this kind of specialist. In their activities, trans-professionals should take into account the interests of various people, social groups, generations, and also bear moral responsibility for the solutions they propose.

The need to successfully work in interdisciplinary projects distinguishes modern trans-professionals from representatives of traditional free professionals and general trade specialists. Representatives of general trades are tied to a specific place and a certain function, while representatives of free professions are tied conceptually to the subject field of their specialty and have a rather strict specialization and limited responsibility. Neither the first nor the second class of professionals would fail in the new interdisciplinary professional environment. They need to adapt. It is this problem that HR managers solve, forming various teams (from virtual to cross-disciplinary and multifunctional), utilizing forms of internal and external training and retraining.

3.3. The Specifics of the Professional Interactions Organization in a Modern Network Environment

The Internet structure in modern informational conditions makes it possible to successfully regulate trans-disciplinary interactions through the formation of virtual professional environments in the form of epistemic communities uniting specialists on a specific issue or type of knowledge. At the level of national policy, as a rule, significant decisions are made on the recommendations of specialists - experts. Such expert communities seek to transform their beliefs into a dominant social discourse and are often created artificially to be used as a pressure tool in case of imposing desired decisions through international bodies [16]. The activity of epistemic communities as a network form of professional interactions is also underlined by the fact that the engineering activity info-sphere is integrated into the socio-cultural environments that accumulate and activate explicit and implicit resources for innovative development [17]. Physical space is only a condition for interaction, since material objects are perceived in their social function, giving meaning to things. The whole space of human life is formed by culture; it is social and cannot be separated from the contemplating subject who acts in certain horizon of consciousness.

The processes of globalization in modern society, guided by technological factors, are accompanied by the promotion of new values, preferences, symbols and sign systems that are presented as generally significant within the framework of integrated information and

communication field of technological civilization. The information factor is one of the significant environmental factors of globalization, which actualizes the issue on various sign systems creation and use by human. In particular, the media space serves as an active tool for matrix management of interactions, by giving social meaning to physical objects and symbolic interactions.

The main impact on the audience in the media space is realized through the formation of "agenda", which provides a semantic (cognitive) orientation in events interpretation. The unconscious formatting of individual and public consciousness in this case is based on confidence in judgments of the media [18]. With the total coverage of the target audience, the media space influence, however, is characterized by selective impact, which can be either cognitive, or behavioral, or emotional, and also various in times - short-term, long-term, and intermittent. It is impossible to specify in advance the impact type and effect [19].

Subject interactions are regulated implicitly by the relationship of normatively and freedom. Information interactions in professional environments are mediated by abstract systems, and are always normalized by an invisible but understood semantic structure in messages production, transmission and perception. The code nature of information communication in engineering environment has deep roots in the history of culture. The code acts as an order parameter in information transfer, but the content of messages is not directly related to the code and is determined by language or intellectual norm. Explicit or implicit (hidden) knowledge of the norm allows person to navigate in sign symbolism, understand the transmitted signals and expect other subjects to understand them.

An important aspect of subject interactions design in modern information technology environments is confidence in abstract systems, such as information websites, cognitive structures, and the expert community. Abstract systems, acting as an intermediary communicator in the information network, ensure high security of everyday life, notes A. Giddens. For example, for plain traffic and travel a modern person needs a certain set of knowledge and organizational actions that is obtained with the help of information services. Confidence in abstract systems is a prerequisite for wide security zones provided by modern institutes of professionalization. Every day practices integrated into abstract systems are a factor of ontological security. Traditionally, human confidence in stable living conditions relies on his personal experience in relationships with other people. Confidence in abstract systems provides for maintaining daily confidence in the information technology environment reliability regardless of interpersonal trust relationships, Giddens notes [20]. In case of abstract systems, confidence implies belief in impersonal principles and hierarchical control, ensuring the safety of action [21].

4. CONCLUSIONS

The study of implicit environmental factors in professional interactions organization throughout engineering activity evolution shows that functions normalization acts as the main tool that allows modeling situations of meanings perception and translation to motivate certain cognitive and behavioral acts, as well as blocking the semantic field via activation of implicit barriers of understanding in professional environment.

In the info-sphere of e-culture, normatively is essentially connected with the technological format of knowledge extraction, representation, storage, processing, transfer, and knowledge management in general. The topological approach to interactions design outlines the features of the media environment, which is associated with a new area of activities, new social roles and professional statuses.

Analysis of the interaction principles evolution in professional environment shows that in the modern world it is necessary to combine the socio-technical, civilization and spiritual aspects of professional activity. The basic instrumental principle regulating interactions in the digital world at the cognitive and behavioral level is the principle of normatively. Interactions organization in this case is associated with codes and matrices that carry certain meanings that motivate emotional and intellectual activity.

- The dominant principles underlying the process of professional interactions organization in network information environments are:
- The principle of subjects' common values and common interaction norms (norms of dialogue) formation;
- The principle of responsibility (ability of subjects to announce initiatives and take responsibility for their implementation).

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