STEPS IN THE DEVELOPMENT OF THE INFORMATION NETWORKS' USER MODEL AS BADLY FORMALIZED OBJECT

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***Abstract**: Steps of an information networks' creating through the formalization of one of their most important input parameters are proposed in the article. Stages of collecting information about users, the formalization of the data and analytical methods are described. The information networks' user model is used to improve the efficiency and reliability of information networks' modeling. In the proposed model a criterion for the formation is its applicability for the analysis and synthesis of information networks.*

***Keywords**: information networks, information networks' user, poorly formalized objects, Global Information Infrastructure*

***ACM Classification Keywords**: I.6 SIMULATION AND MODELING – I.6.5 Model Development, C.2 COMPUTER-COMMUNICATION NETWORKS – C.2.1 Network Architecture and Design, K. COMPUTING MILIEUX – K.6 Management of computing and information system*

Introduction

At a time when society is changing from an industrial to an information way of progress, issue of creating a network in which each person has the ability to produce information and knowledge, to find and distribute them, to have access to them, share them so that every individual has the opportunity to get and realize their full potential, is particularly acute in the spirit of the Universal Declaration of Human Rights. Indeed, the development of individuality is based on education, knowledge and information, that is why free access to them will lead to the well-being of society.

Existing info-communication and telecommunications networks were created, modified and optimized by means of analytical estimates and statistical calculations. However, their transformation into information networks (IN) can not be analyzed by such methods, but requires the modeling and the formalization of each of these steps [1-4]. Therefore, on the purpose of analysis, synthesis and optimization of IN it is necessary to solve the problem of conditional split of IN into its component parts, and to formalize each of them for the subsequent simulation of their relations and conditions within a complex system.

The concept of the Global Information Infrastructure (GII) has a dual nature. On the one hand, the global information infrastructure is the creation of the global communications network that combines national, regional and departmental communications networks. On the other hand, it assumes a fact of personalization of communication for each individual user [5-7]. In the concept of GII users are information sources, customers of IN services and creators of message flows with different forms and functions.

That is, users make requirements on the network for the delivery and processing of information in compliance with certain quantitative and qualitative indicators. Information network provides users with a set of different types of communications and services, such as information processing and other related relief of usage and getting different information. Given the above, it can be assumed that the central object of the IN is user.

Existing models used to formalize the IN are often tiered and based on the seven-layer Open Systems Interconnection (OSI) Model [4, 8]. But there is the four-level model used as well as the Stratified Reference Model (SRM), described in [2].However, the precise definition – who is the user of information network, is still

there, so urgent task is to improve the efficiency and reliability of IN modeling through the formalization of one of the most important input parameters – the user model of IN.

Problem statement

In the first stage of IN formalizing the level model be used to determine occurring at the network processes on each of it's levels in the network, and methods of mathematical, simulation and heuristic modeling can be used for the description of each of them. Then, processes in model should be described (if possible) in the whole IN. A formalized model of IN in general should be created on the basis of formalized process' models, which using the similar to used in the first stages methods and assumptions proves its value to reality. That is, all developed mathematical models of each of the levels are formalized and "introduced" in the super-system – in this case IN.

Currently, there are works about the concept of user access. The concept of services is formulated, services and platforms that represent the analysis of options for access lines are presented in [1, 3, 8], standardized interfaces, protocols of user access are developed (Recommendation ITU Series Y); the methods of distribution of information flows in the IN, how to develop the structure of IN depending on various factors [3], the methods for the classification of services, regulations and technical requirements to the underlying networks are developed. Regarding IN user his descriptions are observed from the perspective of the IN and its organization, the calculation of the flow of data and load on the network that he creates.

But the problem is the lack of a formalized description of the main figure of IN – the user – is still open.

Users are the sources of information and consumers who use the services of IN and create messages of different types and with appointments. That is, users make requirements on the network for the delivery and processing of information in compliance with certain quantitative and qualitative indicators.

The complexity of the object that represents the IN user, defines its versatility, the implicit relationship and the relationship of its characteristics, as well as the difficulty in the formalization of these parameters. However, the precise methods of analysis for the study of badly formalized objects domain has been proposed.

This paper deals with the development of formal models of the IN user, which will generate further research aimed at studying and modeling the problem of IN in general.

As already was stated in [9], a user of IN viewed as a badly formalized object for a lot reasons. After all badly formalized objects own not known a priori properties, which changes in the process of functioning [10]. IN user as badly formalized object, has to be turned under the system analysis, which in this case comes as a developing tool of badly formalized object facilities. However, it should take particular attention to fact, that the large number of develops in the field of system analysis of badly formalized objects' science can't say that an ideal tool for holding of system analysis already exists. Methods of various scientists and analysts (Stanford Optner, Spartak Nikanorov, Yuri Chernyak, Anatoly Katrenko, etc) differ, and one of the reasons of this is various subject areas in which the system analysis is used. To tell the truth, such method for information technologies is not created yet [11].

Researchers offer to present badly formalized object, in one hand as a set of parameters, claims and the criteria (which user sets), and in other hand – as patterns, dependence and relationship mechanisms of this parameters with previously condition of the facility (for example, a financial possibility of users and cost of IN services). Classification of facilities is a regulation and development of parameters scheme ratio of the facility, data about it and its behavior in result of various conditions.

Development stages of a Information networks' user model

Considering the object of organizational, management point of view should be understood that the object will exist in the active area (supersystem), and will interact with it, so attempts to characterize it independently from it are

unreasonable, because, ultimately, it is super-system affects the stable operation and ensure normal functioning of the object [11]. From the above it follows the necessity of studying the behavior of both the user and the requirements that it imposes on IN.

The asymptotic analysis – approximation of complex objects – can be used tor consideration of a complex system which is the badly formalized object. Therefore, the user will be presented as a discrete set of parameters and characteristics.

How to formulate the requirements for the formalization of IN users so that they relate only to "essential" that have a direct impact on user behavior aspects, discarding irrelevant and interchangeable? Keeping in mind the dual structure of badly formalized object, it is necessary to consider two complementary fields – internal and external environments for the object. In the specific case – the characteristics of IN users, their needs and requirements for information services (IS) and their characteristics.

The characteristics of IN users and their needs as the internal environment badly formalized object are discussed in the article. They are defined with the help of social research (survey), a sufficient sample of users of IN, market analysis IS users, as well as analysis of the sociological and marketological researches.

Everyone in the community chooses its behavior. Even being the IN user is also the result of choice. Every user action has its infarctions; each choice is a result of many personal factors for each person. Therefore, to understand how larger amount of people will operate, at first it is necessary to understand how an individual person makes decisions. Human behavior is the result of the choice of many alternatives. What, then, can be guided by the principles of the people in choosing their behavior? First, each person has a certain system of preferences, which determines what he likes more and less. Secondly, a person is considering all the alternatives of choice, which he has, and accurately assess the benefits and drawbacks of each. Thirdly, a person tends to the most favorable option for themselves.

In sociological and marketologcal practice there is developed structure of the classification parameters by the network and communication services [12-14]. But this structure is in terms of user information, communications services and user segmentation, and it is provided on the characteristics that describe a variety of user attitudes to the service as a commodity. There are a large number of papers on the classification of users of the services market, based on psychographic, geographic, cultural, behavioral, demographic, etc. sets the characteristics of users. But they all consider a user point of view of the market – as an object for which IS producers and providers want to implement some services (communication, additional, etc.).

In this paper we propose a number of user characteristics that describe its behavior in the IN. It should be noted that the aim of the studies conducted in the work is to create a model for the optimization of IN, but not for the introduction of services. There are a group of symptoms based on studies of user behavior and methods for separation of these features into groups and using them to classify users which are proposed by the author. These characteristics from the author's opinion are necessary for the formalization of the user model of IN from the point of view of the need to enter it into a model of IN to improve the efficiency of synthesis and control, which is consistent with the objectives of the study. Before developing of formalized user model of IN, it’s necessary to collect and analyze information about the users, based on the proposed model.

The need to reduce the dimension of the data source is a major milestone in systems analysis, therefore, proposed by considering a number of features and characteristics of myocardial infarction by modern entrepreneurs, it was suggested on the fuzzy, but logically sound relationship between some characteristics. Note also that all these assumptions are the products of the heuristic and have a probabilistic nature. The obtained characteristics are minimized and presented in fig. 1.

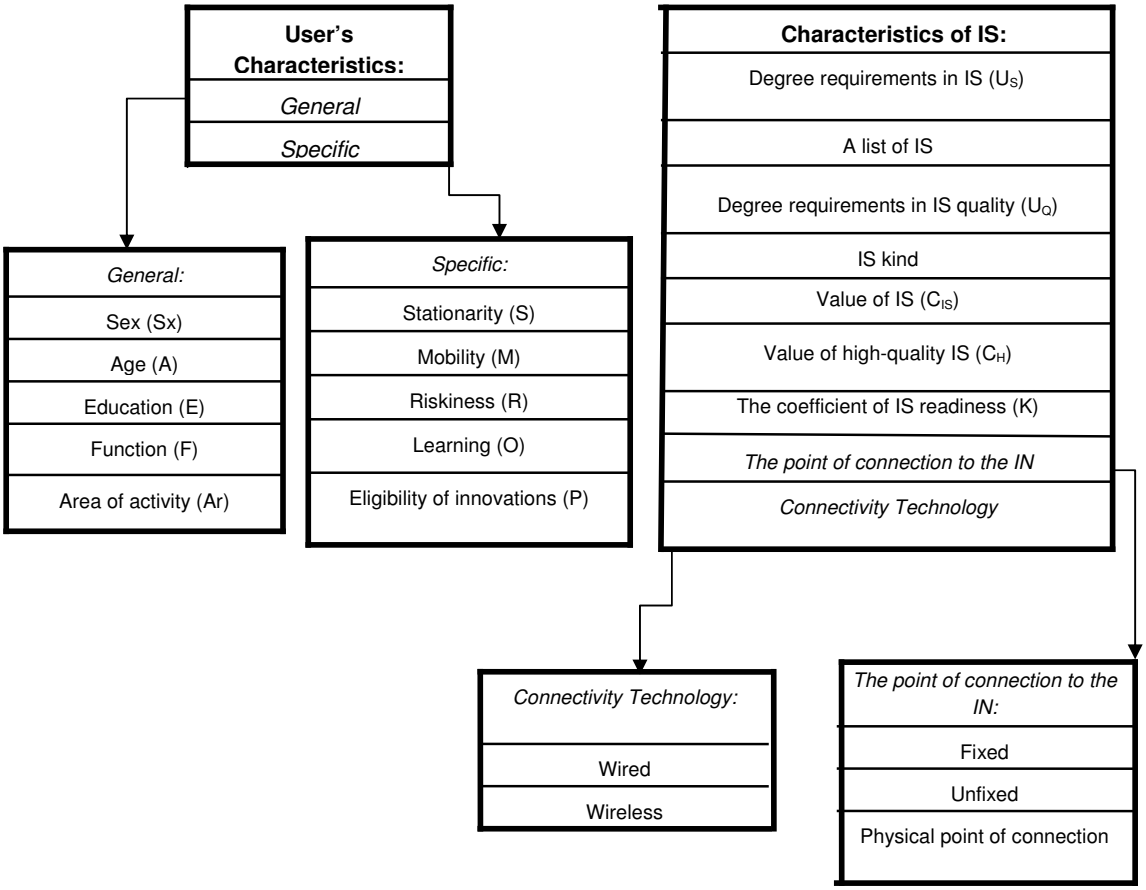

Figure 1 – Proposed set of characteristics.

Consider the following ones.

Stationarity and mobility of the user is directly connected with, first, the communication terminal and, secondly, the method of network connection. Therefore, the connection method (dynamic, fixed) proposes to be combined into a single characteristic with mobility and stationarity, respectively, excluding them from the list of characteristics of IN user. In turn, among the types of terminals for connection to the IS there are also conditionally selected group which includes all mobile devices, personal digital assistants, netbooks, tablets. That is to say that owner of one or more of described mobile devices, typical is inclined to mobility and dynamic method for connecting to IS, and, logically, to IN.

Referring to the mentality of people living in Ukraine, it should be noted that characteristics such as the acceptability of the innovations and risky, as well as the ability to learn will directly depend on the value of innovations and training courses.

Users who work in services, and representatives of the middle age groups (20…25 and 31...40) show a greater level of risk and learning than professionals in other areas.

General characteristics. Gender manual describes the parameter Sx, taking the value 1 when the user – man, and 0 – woman.

Age is determined by the parameter A, and describes the ranges 16 ... 19, 20 ... 25, 26 ... 30, 31 ... 40, 41 ... 50, 51 ... 60, 60 or more years.

Education describes parameter E, and takes the value "General", "Average", "Specialized Secondary", "High", "Science Degree", "No".

Occupation describes the parameter F and takes the value "disciple (student)", "civil servant", "employee of the firm (company)", "entrepreneur", "temporarily unemployed", "Retired", "unemployed".

Scope describes the parameter Ar, and takes the value "Production activities ", "Services activities ", "Science activities", "Education sphere ", "Social sphere", "Engineering activities", "Organizational activities".

Specific characteristics. In this article the concept of stationarity (S) of the user is regarded as his need to connect to the IN in a fixed point in space. Thus S can take two values:

– S = 0 ... 0.5, if the user does not need a fixed point to connect to IN;

– S = 0.51 ... 1, if the user requires a fixed point for connecting to IN.

The parameter S is determined that the user terminal services (mainly fixed, but none that is able to provide information services and operates under the relevant protocol), his need for a stationary point of connection to IN and small need to use different terminals to connect to IN and use of information services.

The following description of the user at first glance is the inverse for stationarity. However, it is not. So the position of the person who can claim a need in fixed point in space and a need to connect to the unstable points in space is described by mobility (M) characteristic.

– M = 0, if mobility is absent;

– M = 0.01…0.20, if user moves in 100 km radius from central town.

– M = 0.21…0.40, if user moves in 200 km radius from central town;

– M = 0.41…0.60, if user moves in 200 km radius from central town;

– M = 0.61…0.8, if user travels in homecountry;

– M = 0.81…1, if user travels throw the world.

Riskiness (R) of the user in this article called his ability to change technology, the operator or terminal, through which it gains access to IS, and the changes will not involve any financial cost. For riskiness users are divided into 3 groups:

– «Conservatives»: R = 0 ... 0.4, the group assigned to users not risking to change technology they used, or operator, or terminal, through which it gains access to services before a critical situation (thus changing technology provider , the abolition of the operator terminal breakage, etc.);

– «Some risky»: R = 0,41 ... 0,75, this group included people who risk change of operator or technology, if the change does not require financial expenses;

– «Innovators»: R = 0,76 ... 1, the group included people who can change the technology or technology provider, even if it requires additional costs.

Eligibility of innovations (P) for the user in this work is the ability to replace outdated manual service at present or additions.

Other characteristics of IN users are formalized by analogy.

Later were suggested to hold a survey of users in order to obtain the training set of input data, using that in future you could get a concrete idea of IN user groups and their characteristics, as well as the subsequent feature extraction or groups of attributes specific to each class by applying the methods of classification.

By classifying the characteristics of IN users using the methods of cluster analysis, using different methods of association (the methods of single linkage, complete linkage, unweighted pair-group average, weighted pair-wise average, median, Ward) and the various measures the distance metric (Euclidean metric, squared Euclidean metric, the metric Chebyshev Manhattan metric), the author concluded that a formalized IN users' model can be refined description of the characteristics of relationships that are not clearly correlated.

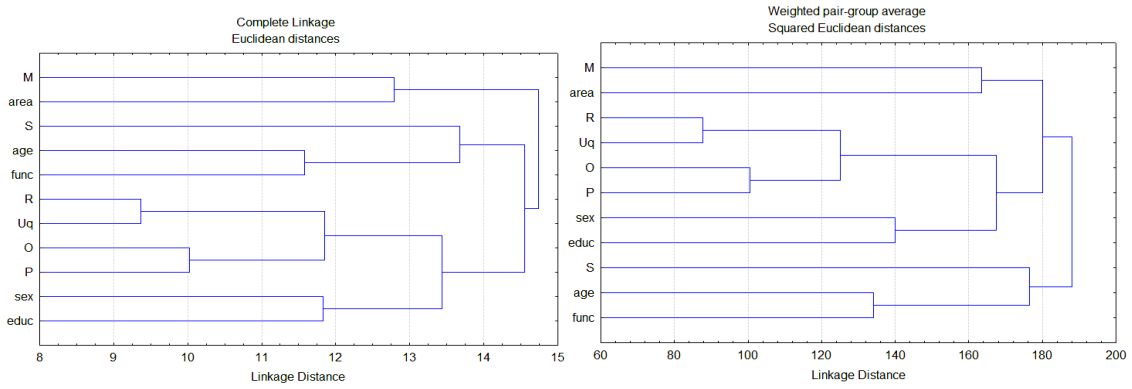

Figure 2 – Examples of provided cluster analysis result.

This will bring a formal model of user information network to the expression 1.

$$U = \overbrace{\{(M,Ar),(A,F),(Uq,R),(O,P),(Sx,E),S,Us,.....\}}^{K \geq 0.99997, C_{IS} < C_H} \quad (1)$$

Conclusion

The stages of development the information networks' user model are suggested in the article. The proposed steps are part of the way of forming a model of the central object of information networks in order to optimize the process of formalization of information networks in general. This model is flexible and dynamic to supplement with information, and compact to implement it in a model of an information network as a whole, reflecting both internal and external processes of interaction of these models, which will help in optimization, synthesis and management of information networks.

Acknowledgements

The paper is published with financial support by the project ITHEA XXI of the Institute of Information Theories and Applications FOI ITHEA Bulgaria www.ithea.org, and the Association of Developers and Users of Intelligent Systems ADUIS Ukraine www.aduis.com.ua.

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