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INFORMATION 4.0 FOR AUGMENTED AND VIRTUAL REALITIES – BALANCE OF IGNORANCE AND INTELLIGENCE

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Abstract

The social-economic knowledge of the human choices and behavioural models demonstrates the deep evolution related to the transition from the economy of scarcity towards the situation of the abundance in many spheres – abundance of resources as well as abundance of information and choice. The efficient human reasoning is based of the logics and analysis of the options to choose, the excess of data or options blocks the humans possibilities to make decisions and to act. The new environment of the surplus of information produced the need for the new concept of data, information, knowledge and competence – the Information 4.0 represents the necessity to produce a new kind of knowledge set from the raw material of data. This analyzed, classified and structured information range helps to increase efficiency, but limits the freedom of choice. The users prefer to ignore the technologies that fulfil the significant functions for a user, they have not anxiety about the dependence on the smart environment and devices, they appreciate the increase of efficiency and they are ready to refuse a part of potentially more attractive, even optimal, options, for the comfort of ignorance. The survey made among universities students demonstrated the very nebulous ideas about the technologies simultaneously with the wide-spread use of the functions they apply with their smart-phones or smart devices. This situation provokes concerns about the tuning of the Information 4.0 to assure the correct optimisation for each concrete user' needs and preferences, that are presented in the paper.

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1. Introduction

The economic model of the XXth century demonstrated the transition from scarce capital and information resources towards the overload of data and the lack of talented and creative human resources. The enterprises perceive the human capital as the essential tool to cope with the abundance of data and to use new producing possibilities with facilitated access to consumers' behaviour analysis. The intelligence systems, neuron-networks and machine learning, cloud and fog computing, digital twins' data intellectual analysis, mathematical tools of fuzzy logics are able to collect and examine the detailed and valid big data, but they are not capable to build a reality, to invent a new sense, new vision or new perception for customer. The human beings have less capacity than machines to analyze information, but the ignorance of details helps them to perceive and understand the essential meanings, to produce new symbols and to create new values and ontologies. The concept of information 4.0 reflects this evolution of the humans role in creating new meaningful realities on the base of intelligence or ignorance.

1.1.Scarcity and abundance of information

Data, information and meanings are different stages of the analysis of the perceived world, of representations and measured indicators. The half-century ago, the most important costs were related to collecting data, a quarter of century ago the treatment, classification and structuring was the essential task for the big data technologies. Today the IT-tools are able to analyse the standardised data collected through cyber-physical systems (CPS) (Alexankov, d'Ascenzo, & Pokrovskaja, 2017) and to conclude in the terms of fuzzy logics (e.g., warm or cold). But the most significant need refers to the understanding and search for the sense and meaning of the information and of the results of data treatment. These semantic elements can be useful to construct new realities and to supplement the existing physical reality with the helpful and pertinent information required by the concrete customer.

The superfluous information impedes the correct humans' reasoning, the new requirement towards the information is the relevance, i.e., the context or targeted advertising is pertinent until the customer has already bought the promoted good or service. The information collected due to the smart-phone that has been used as search tool and payment instrument, and due to the smart streets observing the customer movements can help to avoid unnecessary excess information, especially, with augmented reality devices.

1.2.Information 4.0 as the new tool of context sensing

The concept of the information 4.0 refers to the Industry 4.0 as the 4th industrial revolution based on the ubiquitous smart connection of everything in a networking system (Internet of things, IoT) (Shipunova, Timermanis, & Evseeva, 2014). The Information 4.0 appeared as the resulting concept from the following essential reasons:

- the search for efficiency – the intelligent systems are more efficient than humans to treat and analyze the information. The re-distribution of roles in the division of labour between humans and machines allows humans to create and to produce new realities or to perform the actions that humans prefer to control (Shu, Zheng & Hui, 2017), so the humans' involvement and responsibilities are required for the specific functions;

- the confidence formed – today the customers (even the operators of equipment as customers for industrial products) are much more trustful towards IT and artificial intelligence (Kalmykova, Pustyl'nik, & Razinkina, 2017), than several decades ago. Today people are able to trust an auto-piloted car and to live in a smart house, to have confidence to a smart-phone sending the customer's private data to cloud or centralised corporate terminals;
- the expansion of the IoT system and its penetration into many spheres helps to connect the devices with the information system, so that the autonomous machines are able not only to collect data, but to make decisions about technical maintenance (Khokhlovskiy, Potekhin, & Razinkina, 2018), e.g., an engine or oil or gas pipeline are able to detect metal fatigue and can call on its own for servicing (Gallon & McDonald, 2016);
- the gamification of the working processes as serious games (Routledge, 2015) and the popularity of the games and applications with the augmented reality elements (such as Pokemon go, or furnishing apps similar to Ikea place to put potential pieces into existing rooms) led to the new openness, the notion of the *life at work* appeared to reflect the blended work and game's worlds (Mitsuhara, Iguchi, & Shishibori, 2017). This helped simultaneously to make the work more creative and to marry the people's professional activity and leisure. The augmented reality technologies, in fact, appeared firstly in producing process, when the Boeing researchers T. Caudell and D. Mizell have invented a head-mounted device with an adjusted eye-lens that replaced complex schematics diagram sheets for workers assembling the wiring for aircrafts with the system displaying the wires schemes to the plane boards.

The Information 4.0, as a new approach to collect, classify, structure data and make pertinent conclusions on the basis of the treated data, relies upon these factors and accomplishes the functions that match the new social-economic circumstances (table 01):

Table 01. Information 4.0 functions and objectives, bases and causes of the concept's spread

Background	Objective	Information 4.0 functions
Progress of intelligence and robotics, cyber-physical systems	Increased efficiency	The tasks are divided between machines and humans in the most efficient way, the big data are treated by intelligent systems, the responsibilities are taken and decisions are made, the meanings are conceived by people
Confidence towards IT	Decreased anxiety	The statistics accumulated during the years of experience of the implementing machines and IT persuade people to trust to the advantages of the machines for the fulfilment of a range of tasks
Penetration of smart devices and networking	Controlled environment and safety	The information 4.0 would be useless without access to Internet or sustainable coverage of smart devices and spaces (smart facilities, houses, streets and cities, connected factories, etc.)
Growth of the openness of mind and innovative mentality	Games and creativity	Augmented reality helps to analyze the environment and gives the correct instructions that are suitable to the context

The necessary background was created with the technological and scientific progress, social regulative mechanisms that helped to overcome the suspiciousness and distrust, to construct the wide-spread smart environment (Bylieva, Lobatyuk, & Rubtsova, 2017) and psychological and cultural openness of the people mindset (Shipunova et al., 2017). The facilitating of the work and life processes due to the introduced elements of the Information 4.0 helps to achieve the essential purposes of enhancing

the creativity and efficiency, to overcome the anxiety and to decrease concerns of non-significant details and to build a new space for the better self-actualisation and satisfaction of people with their professional and everyday life activities.

1.3. Information 4.0 as a new reality

The new environments that are created with augmented or virtual realities are based on the assumption that the context plays the determining role for a correct choice of information treatment for making adequate decisions. The information 4.0 as an efficiency-driven approach intends to analyze the context on the basis of the whole set of sources – indicators and parameters that are measured by the smart devices directly connected to the person (customer), structured data received from digital twins (Ponomarev, Kudryashov, Popelnukha, & Potekhin, 2017) and smart spaces (streets, cities, connected factories) about the place and time that refers to the decision to be made.

The choice of the correct instructions for the person is, at the same time, helping and limiting – the choice is automatically made by the neuron-network and intelligent system (Ababkova, Pokrovskaya, & Trostinskaya, 2018), it is not controlled by the person, so, once the only one option is presented to the person, other options are rejected, but they eventually could be useful and even optimal.

That means that the person starts to live in a new reality, where only several potential ways are available and only a limited kit of interests are prioritized. The machine learning bases its improvement on the analysis of the past (on the previous choices made) that determines the future. This new reality can block the evolution, the personal growth or the business innovation process. This concern, nevertheless, can be mastered with the initial settings and tuning of the necessary new options to be proposed. But in fact, this new reality will also be limiting for the freedom of choice, firstly, because the proposals of the new options will be limited by the analysis made by the intelligent system which is built on the basis of the past adjustments, and secondly, because these new options will impose the necessity to make new choices. This remark reflects both the limitations imposed by augmented or virtual realities (Freiknecht & Effelsberg, 2017) and the reason of the human interest towards the Information 4.0 related to the abundance of choice and to the wish to limit the potential options until a reasonable number.

In this sense, the virtual reality creates a new determined ontology with several fixed options, the limitation of the choices' range helps to avoid the uncertainty of the real world (Rodionova, Shvetsova, & Epstein, 2018) that increases the feeling of safety and security. The augmented reality (AR) requires more courage and presents larger choice among realities, than virtual one: if the virtual reality technologies “completely immerse a user inside a synthetic environment”, the augmented reality “allows the user to see the real world, with virtual objects superimposed upon or composited with the real world, ... AR supplements reality, rather than completely replacing it” (Azuma, 1997, p. 356).

The augmented reality permits “to overlay computer-generated images onto the physical environment” (Leu & Peng, 2005, p. 74) through a device, such as helmet, glass (e.g. Google glass) or smart-phone. It allows a user to find information about the real-world objects and to pose queries about the interesting items (Güven & Feiner, 2003). The mixed reality can be built with the possibility to immerse the virtual objects into the representation of the physical reality, such as pokemons which interact with the real-world surfaces and spaces and can hide behind objects. The notion of mixed reality

can be added to describe the completely interacting real and virtual objects, and all the mentioned cases of the combinations of the real and virtual environments are called extended reality (Irvine, 2017).

2. Problem Statement

The augmented reality is not only augmented but is also limited. In the examples of mapping the space, the augmented reality is able to put only the information that already appeared in any other way. The Information 4.0 is able to create a new information about the same item due to the collecting the data from various sources. The pertinence of the new information created by the intelligent systems and not by humans related to the following aspects:

- The extension of the control that people prefer to hold on the range of the fields concerned by the artificial intelligence and machines producing knowledge;
- The danger of non-human decisions made by machines, such as ethical dilemma that can not be solved within the machine' logics;
- The width of the choices presented to the concrete person can depend on her/his own readiness to cope with uncertainty or on the common rules of the smart devices and spaces;
- If the limitation of series of options increases efficiency of humans' functioning, how the social, economic or technological innovations can appear.

These problems reflect the search for equilibrium between the hunger for uncertainty and evasion from it. The human motivation for the Information 4.0 relates not only to the rational causality, but also to the procrastination and to the fear that makes people to prefer a limited choice and a determined way instead of the complete chaos of existence that paralyze any action. This compromise can be helped with the Information 4.0 that is intended to work with the balance between the aspirations and optimisation of efficiency.

3. Research Questions

The research reflects the three facets of the use of the information 4.0 as a helpful and realistic concept describing the new conditions of the humans' activities:

- The study aims to verify the hypothesis that people ignore in a large scale the real penetration of the IT tools in their life and activities;
- The people prefer this ignorance because they don't need a detailed and complete data and information for making decisions;
- The information 4.0 plays a role of the psychological support (people are quiet, when they are sure that their decisions are made on the basis of a rational intelligent tool than originate from their unconscious intuition) as well as of the socio-economic competitiveness tool (facilitating and accelerating choices).

These questions determine the purpose of the research.

4. Purpose of the Study

The study is aimed to reveal the balance between the ignorance that increase efficiency and the hunger for genuine knowledge and authentic existence. This essential purpose relates to the search of a humans' conform level of the managing uncertainty in the conditions of the data abundance.

4.1. Abundance of choice and dependence on smart things

The impossibility to treat the immense volumes of information makes people to rely on the machines' big data instruments. This "forced" confidence towards machines lasts since several centuries, producing different treatments for the perception of the humans' dependence of the machines. The study aims to discover if the young people with intense use of IT-tools are aware of the role of the smart devices or spaces in their making decisions process and if they feel the uncomfortable dependence or they prefer the ignorance.

4.2. Psychological, social and economic reasons for the Information 4.0 scope

The economic efficiency of the ignorance and psychological comfort due to the limited options for choice (or avoiding a necessity to make a choice, when number of options is equal to 1) help to acquire better social position due to the following factors:

- More efficient people get better social, hierarchical position with access to larger resources and with wider power and authority,
- People that act in the similar manner than the others inside their group are affiliated to the communities and enjoy the advantages of group behaviour and resources,
- The low level of anxiety related to the uncertainty helps people to have on opened mind for new solutions and for the possibilities to improve their situation.

These factors are interconnected and determine the interest to the spread of the Information 4.0 concept and practice as instrumental tools.

5. Research Methods

The sample is composed from students of economic fields due to the reasons of their involvement into economic and managerial reasoning (i), their intense use of smart phones and smart devices (Razinkina, et al., 2018) (ii), their availability for study (iii) and their wish to participate in active way in the research on the innovative high-tech projects and the advanced high-edge concepts (iv).

The concepts of the extended realities, such as augmented and virtual ones, and Information 4.0 seem to be of interest for students, that determined their motivation to take part into the research.

The research is based on the survey of students of economic universities and faculties: 4 Saint-Petersburg universities (State University of Economics – 144 students, a private high school University of management technologies and economics – 78 students, department of Advertising and Public Relations of the Peter the Great Saint-Petersburg Polytechnic University – 69 people, department of Advertising and Public Relations of the Herzen State Pedagogical University of Russia – 39 students), a Chinese University (North-West Agriculture & Forestry University, Shaanxi, China – 38 students from international programs), La Sapienza University of Rome in Italy (8 students of the international Master

program of Economic Faculty) and Angers University in France (6 master students during their international mobility in Saint-Petersburg, Russia) (table 02).

Table 02. Sample of the survey: Universities and number of students questioned

University	Bachelor	Master	Total
Saint Petersburg State university of Economics	87	57	144
Saint Petersburg University of management technologies & economics	44	34	78
Peter the Great Saint Petersburg Polytechnic University	58	11	69
Herzen State Pedagogical University of Russia	32	7	39
North-West Agriculture & Forestry University, Shaanxi, China	23	15	38
La Sapienza University, Rome, Italy	-	8	8
Angers University, France	-	6	6
Total	244	138	382

The students of higher educational institutions does not represent the general set of consumers of the tools of extended realities or of the people potentially concerned with the Information 4.0, but their answers help to get several judgements and to conclude on the anticipations about the behaviour of future generations in the new conditions of the Information 4.0.

6. Findings

The survey permitted to obtain the evaluations of the perceptions, attitudes, opinions, behavioural models and feelings of the educated young people, studying at leading Universities, towards the situation when a considerable part of their life is accomplished by the systems they ignore: the smart devices and intellectual software, the IT advanced performances are often presented to the people only in the form of the user' functions and possibilities without any explanation about how they work.

6.1.Awareness of terms and of their content

The survey among students of economic universities and faculties demonstrates that the young generation has heard about extended realities such as virtual and augmenter ones. At the same time, the students have a vague idea about the implementation of these technologies in their real life. Thus the 100% of students (N=382) responded that they are aware of the term “virtual reality”, only 62.8% are able to describe it, answering an open question (“What is virtual reality?”), and 9.9% of respondents recognized that they “don’t know exactly” what does virtual reality mean. The same distribution of answers was revealed for the notion of augmented reality – 97.9% told that they know the term “augmenter reality”, 0.5% don’t know it and 1.6% don’t know exactly.

When they were asked to describe it, the distribution of answers significantly changes (fig. 01):

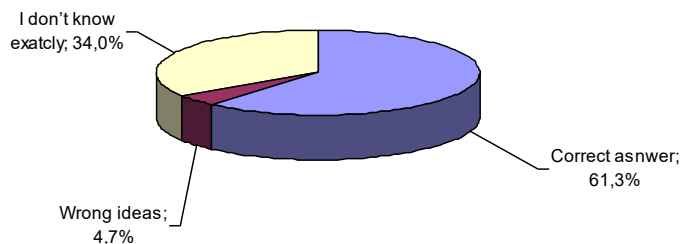


Figure 01. The attempts of respondents to describe the content of the concept “augmented reality”

More than a half of respondents (61.3%) were able to give a correct answer, the closest answers were similar to “a mix of real world with overlaid information”, but 34.0% of respondents told that they don’t know exactly.

6.2. The ignorance of the use of the augmented reality

Many of students think that the augmented reality is something very distant from them.

There were three questions asked about the use of the smart-phones:

- Do you use the augmented reality technology and tools?
- Do you use Google Translate on your smart-phone?
- Do you use the Google Translate tool to make a picture of foreign phrase, to recognise and to translate the picture?

The difference of answers is significant:

Table 03. Sample of the survey: Universities and number of students questioned

Column Heading	Share of positive answers, %
Yes, I use the augmented reality technology	7.6
Yes, I use Google translate on your smart-phone	99.7
Yes, I use the Google Translate option to translate pictures	85.3

That means that among 326 persons who are using a tool of augmented reality (85.3% who answered that they use the instrument to translate pictures made from the real signs around them) only 29 persons (7.6%) know that it is the augmented reality technology. And they are comfortable with this level of knowledge, as the answers at the following question.

6.3. Opinions and feelings of dependence on the machines and intellectual systems

Answering a question about their feelings of the dependence, they were very optimistic for the use of the smart devices as the tools that are helping them:

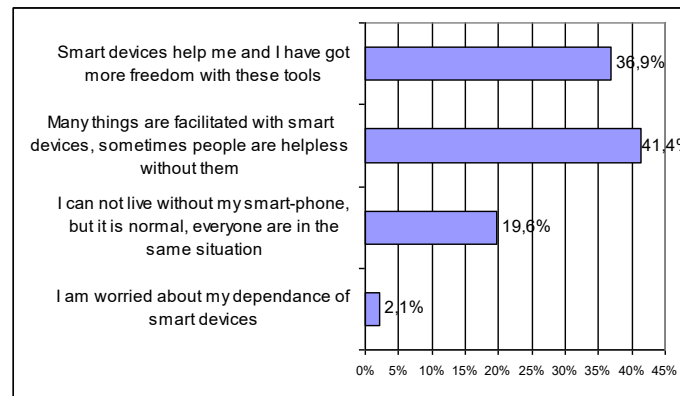


Figure 02. Awareness and evaluation of the dependence on smart devices

Only 8 students told that they are worried about their dependence on smart phones and other smart devices, and 19.6% of young respondents think that it is normal to live “with the smart phone in the hand”. 78.3% of students have the positive opinion about the usefulness of the smart devices and their unavoidability in the actual situation: 41.4% of students think that even if sometimes people can feel the helplessness, the smart devices are penetrated in everyday life and are really necessary to make many things and actions, and 36.9% of the respondents are sure that the smart devices give them more freedom.

7. Conclusion

The results obtained demonstrate the deep penetration and high level of trust of the young people with university background towards the smart environments as a new reality they live. According the respondents opinions, they know quite well the extended realities concepts, but they have difficulties to explain what is the content of the terms “virtual reality” and “augmented reality”. At the same time, only a few of them are aware about the use of the augmented reality tools used inside their smart-phones to accomplish a routine task (translating pictures) for the users.

7.1. The ignorance is comfortable

The innovative economic growth and fast social dynamics created a necessity to limit the options' number because the cost to make a choice of unlimited variants is too high. The efficiency-driven process of analysis and making decision leads to decrease the volume of information. The anxiety of losing control is not considerable comparing with the advantages of the higher efficiency.

7.2. The perspectives for the Information 4.0 and the need for balance between ignorance and intelligence

The new reality is already formed due to the smart devices and spaces: smart-phones and fridges, connected factories, smart houses and streets. The Information 4.0 represents an approach that develops the data treatment and analysis to assure the more comfortable informational environment for people. The expansion of this concept and the penetration of these practices in everyday life and professional activity needs to precise the detailed elements of the machines' right to limit the humans' choice.

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