Metrological support integration in conditions of digital transformation

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Abstract. The article formulates the problems of the development of measurement control regulators in digital platforms. Attention is paid to the role of the digital revolution and metrology on the economy of enterprises and the transformation of the service sector model as a whole. Attention is paid to the impact of the digital revolution and metrology on the economy. The article presents and substantiates the policy of introduction of metrological support for innovative development in the context of the digital cybernetic revolution. The proposed policy pays attention to the consideration of the fundamental model of cyber-physical systems, as a technological basis for the implementation of a new industrial evolution in metrological context. The importance of organizing of measurement principles in network infrastructure and communication protocols in the context of economic transformation is emphasized. A model of the use and implementation of chaos engineering and information technologies in metrological apparatus is considered.

1. Rationale
The implementation of mechanisms of the qualitative and quantitative transformation of economic entities by current analysis of their work has always been associated with a number of emerging problems that implement the role of socio-cultural resistance, technical and manufacturing opposition (in the periodicals of countries with a traditional or outdated economic paradigm), epistemological
opposition. As it was before, subjective influences correlate with the current evolutionary path of economic development of control and measuring instruments. Situational problems arise regarding the functioning of digital duplicates, environments and means of influence, and issues of synchronization, authentication and authorization of measurement practices. Most often they are resolved quickly enough on the user’s side. As it was before, measurements determine a decisive role in making certain decisions of econometric analysis and technical control of such systems.

But more global aspects, for example, those related to the transactional and logistic nature, are already decided by mediators and regulators between the interaction between the buyer and the seller. In addition, the role of the usual means of standardizing industry is complicated [1,2].

Moreover, in the conditions of digitalization of the metrology environment, the usual principles of ensuring the uniformity and proportionality of measurements do not play such an important role in a number of enterprises. Native digitalization requires a declarative approach in any form of relationship, which, due to the growing population of the Earth, requires a larger number of operators and dispatchers to support this kind of relationship. Complicated logistics and heterogeneity of behaviour of objects of metrological support of enterprise econometrics is also expressed through the emergence of law enforcement practice of using information tools. and algorithms: digital signature, encryption and hashing. Certainly, all of them express a new side of maintaining the unity of the integrity of relations and countering threats united by the concept of information security. A policy is needed to minimize threats to the uniformity of measurements, and based logic in decision-making, based on all the same methods of metrological content.

2. Review of the issues of metrological control and standardization during digital transformation of the industry

Digital transformation also affected the occurrence of qualitatively new and hybrid properties and parameters (see figure 1), determined not only by the complexity of economic analysis, but also by a rather weak universality. The fact is that the laws of the virtual world (mediated by the concept of virtualization) most often do not work in the real world, as well as vice versa. Therefore, the real market needs indirect standardization and classification of direct and indirect measurement tools, both on the side of real-life systems and at the interface level (interaction protocols with an explicit server interaction architecture - SmartManufacturingNetwork).

![Digital transformation in enterprise metrology in SmartIndustry 4.0.](image)

**Figure 1.** Digital transformation in enterprise metrology in SmartIndustry 4.0.
Thus, new transformations in the economy that have been mentioned above are associated with the form of presentation of new competencies and skills, encapsulated in the form of tools and mechanisms on the background of the general ignorance of those who shall maintain or use them in professional life. However, such issues are resolved by a practice-oriented approach and methodology of lifelong education, i.e. by issues of a purely temporary nature and of organizational nature. In addition, there are more significant problems associated with a principle approach to the final formation of control systems that integrate the role and compositional features of our time.

The rigid principles of the previous modifiers of control of economic systems: the state system, parliamentarism, financial regulators, compensation costs, declarations of supranational organizations do not reveal sensitive, sensory, forms of perception of reality, influence on created ecosystems, blockchain mechanisms, etc.

The dictated economic voluntarism as the only adequate solution to the problem of the coexistence of existing traditional regulators in the context of digitalization of the economic essence, does not determine the most important parameter of any automated system - stability [3,4,5].

Resilience is a context-oriented metrological parameter needed to determine usefulness and accuracy in decision making, data processing and the response of measurement systems.

3. Policy of information technologies integration into metrological support in conditions of digital transformation of the industry

Consequently, it is necessary to build a policy for the introduction of information technologies (in terms of metrology) already at the stage of the digitalization process of the economy as a whole, based on the existing problems.

In its turn, the value orientation of the policy of introduction of digital metrological assurance of a new generation shall take into account the phased, evolutionary nature of manifestations taking into account several reasons based on the experience of already implemented and functioning technologies. The ideas about the criteria shall be based relying on the experience of critical analysis to the built diversity of the final digitalization of our world that is determined not only by the Internet, Social Media (hence the Web 2.0 device model), but also by Platforms. In fact, the latter manifestation is the foundation for creation of something new through the digital measurement metrology platform[6,7].

The presented criteria shall be reduced to several groups of independent and autochthonous events and shall determine the complex nature of the developed economic systems (networks) of controlled context. First, it shall be reflected:

- in the multi-criteria approach against the background of the obvious heterogeneity of the course of various manifestations: from business processes to technological, requires consideration of the principle of determination and delineation of the structure of application of the principles;
- in the hierarchy of document control of a quality management system by a digital enterprise.

The internal nature (in the conditions of the current transformation of the market economy) shall be expressed by the internal layer, which shall be stable (according to the definition of A.M. Lyapunov). In other words, it is implied to perceive the system from the principles of mechanics, physics. Movement is an indispensable feature (attribute) of the system. The internal (primordial) component is called the "core". This definition is traditional in the description of the specifications of digital and automated systems, system software.

The "core" is a fundamental conjunct in the theory of stability of mechanical systems and in the theory of automated control. Its character shall have an adaptive basis, consisting of three (or more) atomic components that have equal rights and ranks. First of all (when it is about the fourth industrial revolution) cyber-physical systems shall be emphasised [8,9].

Standardization shall directly determine the behaviour of measuring devices, processes and methods of processing analogue discrete values, multiplexing of functional streams from measuring instruments, a system for balanced calculation of inventory control through regulators of algorithmic content (ant
algorithms, artificial intelligence). Such systems express a superposition of unmeasurable contexts of non-scalar content that reflect fundamental, functional, economic, legal and practical meaning in the current realities, when use cases contain real value, and industry and people are ready to exploit on an ongoing basis. This includes all devices of the Internet of Things, machine-to-machine communication: sensors, actuators, mots, hubs.

The architecture of cyber-physical systems implies the definition of data types, memory structures and, in fact, it requires and poses organizational and technical issues.

The "core" must also include the equivalent of the "control device" from technical science [10].

In other words a regulator (a manipulator-comparator) that takes the role of an aggregator of certain relations and deals with issues of concluding contracts, supporting business and production within the framework of the regulatory field and objective reality, expressed not only by the physics of processes, but also by the will of society in the name of obtaining certain benefits and opportunities [11].

Cyber-physical systems in the proposed model of metrological support of digital environments act as a technological basis, predetermining not only the nature of the architecture, but the limits of functional capabilities.

An objective feature of the “possible” category from the field of systems analysis in the manifestations of the “core” of the considered principles is important for adequate functioning in resource-oriented and virtual systems, defining the true side of the emergence of previously inherent relationships or properties [12].

The second (highlighted) layer in the model shall not denote technospheric or information security, but shall be able to delegate it within the framework of the principle of self-regulation. That's what BigData, neural networks and artificial intelligence, machine learning and deep learning exist for. The main criterion for an effective top layer of data is the actual process of organizing of system of control and accounting of measurement types, direct, indirect (implicit). The principle of the stack is absolutely pertinent here, since it defines not only the software and hardware organization, but also has a number of properties useful from the point of view of algorithmization and the search for "optimal" properties [13].

In addition, the stack organization of solving of applied problems does not require a large amount of organizational costs: actually it reflects the "first in first-out" rule. Prioritization and implementation of synchronization modeling in processing and transmission of information in neural networks, which, as it is known, are used in the design of qualitatively new decision-making apparatus (expert systems, real time intelligent systems) can be solved by reducing to the basis of fast-slow systems with subsequent approximated modeling in real life in the form of all the same cyber-physical systems.

Augmented and virtual reality tools will be able to take the function of the visualization of mediators, helping people to adapt to the new realities of life: digital jurisprudence, office work, and development.

However, the focus on the exclusive right of the digital space, the assignment of primary priorities towards the development of digital technologies does not solve the most complex aspect of the behavior of mechanisms of metrological apparatus. On the one hand, it is “stability” that allows to predict the behavior and accuracy of the coincidence of the interests of a person and the production system, but it is precisely this “stability” that can play a critical role in the relational essence of the processes of the physical world, algorithmized by human.

Nevertheless, if the system has predictability, this does not mean that it behaves adequately enough. It affects not only some final process, or a group (flow), affiliated with specific people, groups of companies, but also does not allow conducting the coordinated planning of strategic, business-motivated initiatives based on modern machine learning tools.

In addition, many parameters from the side of real business processes are not determined by scalar values or any objective results. And they cannot be ranked or excluded from the flow of perception of management issues (this includes both data management and general leadership and even working with big data in structured/ unstructured data). As a result, it is difficult to determine the value of integration of big data resources with business performance monitoring. Metrological apparatus solves this issue directly.
We always set goals in order to achieve results. And this is a big problem. Such tasks can be solved through a clear definition of what is definitely "do not needed" to be obtained as the work result. Therefore, it is proposed to use the “anti-goals” model. In fact, there are any serious failures in the operation of our systems (both analogue and digital) [14,15].

It is true that failures occur quite often. With the right feedback, these failures shall not impact the end users. Emergence of the principle of measuring of the likelihood of an "anti-target" (the opposite state of the system) determines the stability of the measurement system. And the chaos engineering principle will help to do it.

Chaos engineering is an approach that involves experimenting with a production system and its' direct measurement to ensure that it can withstand various kinds of disruptions during operation. The main purpose of chaos engineering is to detect problems in the measurement and operation of calibration control systems that are not properly corrected. In other words the construction of a program dogma (policy) of a determined reaction in the conditions of unpredictable behaviour of a technical system (of software in the most cases). Stability engineering is about identification ond subsequent enhancing of the positive capabilities of people and organizations that enable them to adapt effectively and safely in different circumstances.

Chaos engineering is just one of the ways to improve the adaptive capabilities of digital measurement control systems in the context of unstable manifestations of economic transformation, in particular, in queuing systems based on virtualization of the service delivery environment, for example, in online stores and online services [16].

4. Findings

Thus, the combination of principles from the field of architecture of computer technology, cybernetics, methods from software engineering made it possible to form an evolutionary form of a "digital platform of metrological control" which encapsulates the considered multicriteria approach to the fundamental and structural type of organization of metrological regulators operating within the framework of systems with fuzzy logic, requiring compliance with the "sustainability" of the functioning of both designed and functioning economic systems based on digital technologies. The issue of “sustainability” is emphasized [17]. One of the options for solving this issue through a formal method in modern technical engineering, codification and the development of new rules for the coordination of a priori contexts within the framework of SmartIndustry 4.0 standardization is presented.

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