

them a number of obvious, but, unfortunately, often overlooked general requirements necessary for high-quality participation in complex collective socially significant projects. Such general requirements include:

- a high level of **motivation** to participate in the permanent evolution of an integral technological complex that provides the development of effective *interoperable intelligent computer systems*. A comprehensive and high-quality technology for the development and maintenance of *interoperable intelligent computer systems* should be considered as a key product of collective activity in the field of *Artificial Intelligence*. This motivation implies appropriate purposefulness, lack of selfishness, arrogance, individualism, isolationism, parasitism;
- high level of **creative activity**, passionarity, courage;
- a high level of **reflection** — is the ability to analyze one's own goals and actions and correct one's own mistakes, as well as analyze the goals, actions and mistakes made by the team of which the specialist is a member. It is one thing to sincerely recognize the logic and expediency of observing certain rules (principles, requirements), and it is quite another thing to be able to see and correct your own violations of these rules. Without such reflection, the progress of collective creativity is impossible. Knowing how to do it and actually following — it is not the same thing.
- high level of **own interoperability**:
  - the ability to *understand each other* and ensure *semantic compatibility*, which requires permanent monitoring of the current state and evolution of the technological complex;
  - *contractual capacity* — the ability to quickly coordinate their goals and plans, denotational semantics of concepts and terms, as well as decentralize the distribution of sub-problems of a collectively solved problem;
  - *ability to coordinate* and synchronize their actions with colleagues in conditions of possible occurrence of unpredictable circumstances.

Without a high level of developer interoperability, it is impossible to ensure:

- **convergence**, unification, standardization of *interoperable intelligent computer systems*;
- formation of a powerful **Library of standard components of next-generation intelligent computer systems**;
- a significant reduction in labor intensity and an increase in the level of automation of the development and maintenance of *next-generation intelligent computer systems*;

- building a general theory of the **Ecosystem of the next-generation intelligent computer systems** and, accordingly, a general theory of *human* activity.

As a result, in order to create *interoperable intelligent computer systems*, it is necessary that their creators themselves have a high level of *interoperability*. The problem of ensuring this is the main challenge that is addressed to specialists in the field of *Artificial intelligence* at the current stage of development of this field.

The main reason that prevents the formation of the necessary level of *interoperability* among specialists in the field of *Artificial intelligence* is the competitive style of relationships between specialists. This style of relationship is a widespread way to stimulate employee activity. But this is not the only way to stimulate creative activity in solving strategically important problems, which, in particular, is the problem of effective complex automation of all types and areas of *human activity* with the help of *interoperable intelligent computer systems*. Moreover, competition provokes selfishness and ignoring the interests of other subjects (including the interests of the collective of which the subject is a member). Thus, competition clearly contradicts the principles of *interoperability* and, accordingly, the principles of the organization of *intellectual communities*, intellectual creative teams and organizations.

It is necessary to move from a competitive style of relationships to mutually beneficial interaction between subjects of all levels of the hierarchy. This is the main essence of *interoperability* and the transition to *intellectual collectives* and an intellectual society.

It should be noted that the listed general requirements for specialists in the field of Artificial intelligence at the present stage of the development of *Artificial intelligence technologies* should be imposed not only on them, but also on all people who are ready to contribute to technological progress. It's just that at this stage, the main responsibility for this lies precisely with specialists in the field of *Artificial intelligence*.

#### D. *Requirements for the fundamental training of specialists in the field of Artificial intelligence*

The need to significantly increase the level of practical significance and efficiency of work in the field of *Artificial intelligence*, which requires a transition to the next-generation *intelligent computer systems* and to a fundamentally new technological complex, imposes on specialists in the field of *Artificial intelligence* not only general requirements necessary for effective participation in complex collective socially significant projects, but also high requirements for their fundamental professional training:

- a high level of system culture that allows you to "see" the hierarchy of complex systems, the connections between different levels and hierarchies, the difference between tactical and strategic tasks;

- a high level of mathematical culture, culture of formalization;
- a high level of technological culture and technological discipline;
- a high level of self-learning in a rapidly changing technological infrastructure

E. *Problems of the current stage of development of the theory and technology of next-generation intelligent computer systems*

Let's list the main methodological problems of the current stage of work in the field of Artificial Intelligence, which hinder the solution of the fundamental tasks discussed above:

- An insufficiently high level of awareness by specialists in the field of *Artificial intelligence* of their social responsibility.
- The lack of a coordinated awareness of the global goal of work in the field of *Artificial intelligence*, which is to gradually increase the **level of intelligence** of human society by complex automation of all aspects of its activities using a network of interacting *intelligent computer systems*.
- The insufficiently high level of *interoperability* of specialists in the field of *Artificial intelligence* and the predominance of a competitive style of relationships. The consequence of this is an insufficient number of motivated specialists in the field of *Artificial Intelligence*, capable of effective creative interaction. In order for them to appear in sufficient numbers, a good system of their professional training is not enough. It should also be noted that good human relations, psychological atmosphere and Team Building in the development team, which many companies take seriously, is a necessary, but far from sufficient condition for the effectiveness of collective development of complex computer systems (especially for *next-generation intelligent computer systems*).
- Insufficiently high level of comprehensive fundamental training of specialists in the field of *Artificial intelligence*.
- The pronounced interdisciplinary nature of *Artificial Intelligence* as a field of human activity, requiring specialists to be able to work at the junctions of sciences.
- Lack of awareness of the need for deep convergence between various areas of *Artificial Intelligence* and the formalization of the entire complex of knowledge in the field of *Artificial intelligence* for their use in the knowledge bases of intelligent computer systems (first of all, instrumental *intelligent computer systems* that are part of the technological complex for the development and maintenance of *intelligent computer systems* for various purposes).
- The high level of complexity of the complex formal-

ization of all knowledge accumulated by mankind (primarily in the field of mathematics and general systems theory) and their convergence with the complex of knowledge accumulated and formalized in the field of *Artificial intelligence*. This is necessary for the direct use of the knowledge accumulated by mankind in *intelligent computer systems* for various purposes.

- Lack of awareness of the need for deep *convergence* and consistency between
  - research activities in the field of *Artificial intelligence*;
  - activities aimed at the development of private *artificial intelligence* technologies, as well as integrated technology for designing and supporting the life cycle of *intelligent computer systems*;
  - engineering activities aimed at the development of specific *intelligent computer systems* for various purposes;
  - educational activities aimed at training specialists in the field of *Artificial intelligence*.
- The problem of ensuring **semantic compatibility** of *next-generation intelligent computer systems* not only at the stage of their design, but also throughout their life cycle in the conditions of permanent evolution of *intelligent computer systems* themselves during their operation, as well as the permanent evolution of complex technology of their development [6], [7].

The main part of these problems is the need to move to a fundamentally new style and organization of interaction between specialists in the field of *Artificial Intelligence*, without which it is impossible to move from private theories of *Artificial Intelligence* to a **General theory of intelligent computer systems** that ensures compatibility of all private theories of *Artificial Intelligence*, as well as the transition from private *Artificial intelligence* technologies to **Complex Artificial Intelligence technology**, ensuring compatibility of all private *artificial intelligence technologies*. The transition to a new style of interaction of specialists in the field of *Artificial intelligence* is based on the transition from competition to synergetic mutually beneficial interaction aimed at convergence and deep integration of private (local) results, which will lead to the transformation of the modern community of specialists in the field of *Artificial intelligence* into an **intellectual community**. (see [8]).

#### IV. PREREQUISITES FOR THE TRANSITION TO INTELLIGENT COMPUTER SYSTEMS OF THE NEW GENERATION

- An actively expanding variety of information resources and services, the efficiency of which has a low level due to the lack of their systematization and compatibility [9], [10]

- The emergence of formal ontologies as a means of ensuring semantic compatibility of information resources accumulated by mankind, Semantic Web
- Active development of the theory of multi-agent systems, their self-organization, emergence, synergy, theory of intellectual communities and organizations
- Development of the theory of decentralized situational management ("the orchestra plays without a conductor")
- Smart home, smart hospital, smart city
- Industry 4.0, University 4.0
- The appearance of works aimed at clarifying the cybernetic principles underlying Society 5.0

## V. BACKGROUND AND HISTORY OF OSTIS TECHNOLOGY DEVELOPMENT

- 1981 – Japanese and American fifth-generation computer projects
- 1984 – V.V. Golenkov defended his PhD thesis "Structural organization and processing of information in electronic mathematical machines controlled by the flow of complex structured data"
- D.A. Pospelov's advice: Before designing computer systems, it is necessary:
  - to develop basic mathematical and software for such computers;
  - to develop the basics of technology for designing intelligent computer systems implemented on the basis of these computers;
  - to develop a software model (emulator) of a new generation computer being created on modern computers;
  - implement several specific *intelligent computer systems* based on the above technology and the specified software model of the future computer.

If all this is not done, then the developed computer of the new generation will be a brilliantly made "hardware", which is unclear how to use and which, therefore, will quickly become obsolete. That is why all fifth-generation computer projects were doomed.

- 1992 – Prototype of a semantic computer on transputers
- 1995 – Opening of an educational specialty in BSUIR 'Artificial intelligence' and the creation of an appropriate graduate department
- 1996 – V.V. Golenkov defended his doctoral dissertation "Graphodynamic models and methods of parallel asynchronous processing of information in intelligent systems"
- 2010 – Creation of an open OSTIS Project aimed at creating an open integrated technology for designing

*intelligent computer systems*, the implementation of which focuses on the use of *next-generation computers*

- 2011 – The beginning of the annual OSTIS conferences aimed at the development of the open OSTIS *Project*
- 2019 – On the basis of the educational institution 'Belarusian State University of Informatics and Radioelectronics', an educational and scientific association in the direction of 'Artificial Intelligence';
- 2021 – Publication of a prototype of the OSTIS *Technology Standard*, presented in the form of a formalized text, which is the source text of the knowledge base of the Meta-system for Supporting the Design of Intelligent computer systems developed using OSTIS *Technology* [11];
- 2023 – Publication of a collective monograph on OSTIS *Technology*, which is considered as the basis for further development and official recognition of the formalized *Standard of OSTIS Technology* and a significant expansion of the corresponding collective of authors

Summarizing our experience in the field of Artificial Intelligence, we can say the following:

- The requirements for *intelligent computer systems* of the next generation (a high level of *self-learning*, *interoperability*, *independence*, *universality*), involves the creation of a *fundamentally new integrated* technology that integrates, ensures compatibility of the entire variety of existing *private Artificial intelligence technologies* and which supports all stages of the life cycle of *intelligent computer systems* being developed;
- The complexity of the implementation of next *generation intelligent computer systems* (due to the discrepancy between the basic principles of information processing in such systems and the principles of the von Neumann machine underlying modern computers) requires the creation of computers specifically focused on the implementation of *next-generation intelligent computer systems*. But it is necessary to create these new-generation computers on the basis of (or, more precisely, within) the above-mentioned integrated technology for designing and supporting the subsequent stages of the life cycle of *next generation intelligent computer systems*.
- The epicenter of the creation and subsequent evolution of this complex technology for *next-generation intelligent computer systems* is:
  - training of a new generation of specialists in the field of *Artificial Intelligence*, who are initially