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ОСНОВНЫЕ ТЕНДЕНЦИИ ИНТЕНСИФИКАЦИИ ЭЛЕКТРОЭНЕРГЕТИКИ РОССИЙСКОЙ ФЕДЕРАЦИИ С ПОМОЩЬЮ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ

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В условиях конкуренции на российском рынке электроэнергетические компании вынуждены постоянно искать новые рынки сбыта и, чтобы преуспеть в поиске, расширять круг абонентов и клиентскую базу, внедряя инновационные технологии и механизмы интенсификации производства. Предполагается, что они потенциально будут способствовать дальнейшим изменениям в этой области, обеспечивая обновление мощностей и, как следствие, повышая стабильность и безопасность энергоснабжения.

Ключевые слова: Информационные технологии; ИТ; электроэнергетика; IoT; Большие данные; роботизация; автоматизированное управление; цифровые двойники.

THE MAIN TRENDS IN THE INTENSIFICATION OF THE ELECTRIC POWER SECTOR OF THE RUSSIAN FEDERATION WITH THE HELP OF INFORMATION TECHNOLOGIES

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In the conditions of competition in the Russian market, electric power companies are forced to constantly look for new sales markets and, to succeed in the search, expand the circle of subscribers and customer base, introducing the most innovative technologies and mechanisms for intensification of production. It is assumed that they will potentially contribute to further changes in this area, ensuring the renewal of capacities and increasing the stability and security of energy supply, as a result.
In this regard, the article defines and discusses the main trends in the intensification of electric power production in the Russian Federation through the introduction of IT based on real examples of enterprises.

Keywords: Information Technology; IT; electric power sector; IoT; Big Data; robotization; automated control; digital twins.

Introduction

Despite the extensive range of methods for optimizing electricity production: the choice of equipment, rational use of resources, the involvement of highly qualified personnel, etc. — the introduction of IT-sphere developments stands out especially, despite the fact that at the moment information technologies hardly enter this industry as one of the most capital-intensive. Nevertheless, the undiscovered potential of IT has yet to fully show the result of its application in the energy sector.

However, certain trends have already developed in this sector, allowing to make an optimistic forecast in favor of the high technologies implementation.

Predominantly, the introduction of IT into the electric power sector of the Russian Federation should be considered from the point of view of saving an enterprise's budget by automating technical and optimizing processes related to operational activities. Nevertheless, one should not forget about such advantages of IT integration as employee safety, acceleration of information exchange, etc.

Let us look at some real examples of IT implementation, as well as their consequences.

IoT

Let us start with the technology of the "Internet of Things" or the IoT technology, which allows both to reduce power consumption and establish clear control over the technical condition of equipment and the network, in particular. The main way to use IoT is to build a smart network infrastructure based on the Smart Grid principle, in which sensors and controllers connected to a single — online or cloud — server allow for telemetry and remote control, optimizing power generation indicators [1–4].

Thus, in 2017, *Inter RAO — Electric Power Plants* JSC, by implementing IoT technology, reduced fuel consumption and repair costs by the amount of 130 billion rubles in the first year of operation thanks to the data collection and transmission system. At the same time, the payback period of the system, according to the study [5], ranged from 5 to 7 years.

Automated control

Another important aspect of the energy companies development is the use of IT for the control of working personnel and equipment. Mobile phones and tablets with installed control programs are aimed at controlling the equipment and collecting information about its technical condition in places where, for example, the installation of remote or automated equipment control systems is impossible.

Guided by this information, at the end of 2010, *Rosenergoatom Concern* JSC applied eSOMS, an Electronic Shift Operations Management System, at the Smolensk power plant, which, according to the company's representative office, allowed:

- To increase the security of the workspace by introducing partial electronic document management;
- Get more extensive information about the equipment condition quickly;
- Reduce the repair time of equipment by diagnosing deviations from correct operation at early stages [6–8].

Robotization

Coming to practical application in the electric power industry, the IT sphere brings not only phenomena related to online technologies, but also phenomena that can directly — physically — affect the work and productivity of companies. Among these are robotics and the use of UAVs (Unmanned Aerial Vehicles), in particular.

Robotization in the Russian market conditions implies rather than replacing human labor with automated labor, but assistance from technology in human labor. For example, using drones controlled by an operator, it is possible to get to difficult-to-access or dangerous-for-human-work places with extreme conditions.

That was successfully used by *MRSK* PJSC by purchasing 26 unmanned drones in 2018 and optimizing the time for analyzing the state of power lines, as well as monitoring the construction work of the energy infrastructure for the Moscow-Saint Petersburg motorway [9–11].

Now this area of applied robotics is actively developing, opening up new prospects for businesses in the electric power industry — especially in combination with other auxiliary technologies [12–14].

"Digital Twins" modeling

At the same time, in addition to working with real data obtained during the system's operation, technologies are also used in information modeling, allowing the creation of far-reaching calculations that are as close to reality as possible and take into account various, especially programmable aspects.

The so-called "Digital Twins", which are virtual copies, including 3D models of power grid facilities, demonstrate hypotheses and innovations concerning the enterprise, taking into account third-party factors: the level of network load, the detail and accuracy of the model used, etc. — in real-time. Moreover, the digital model not only displays the programmable network operation mode but also highlights the shortcomings and errors that occur during testing [15; 16].

Due to the above advantages, *Rosenergoatom Concern* JSC has put the "Virtual-digital Nuclear Power Plant with a PWR reactor" complex, developed jointly with Nuclear Safety Institute (IBRAE) RAS into operation. According to experimental reports, studies, and statements by system developers, the complex provides an opportunity to test the entire power reactor system depending on the conditions: normal, impaired, and even severe accidents — as well as analyzing models of equipment modernization and ensuring the safety of the network and its personnel [17–19].

Thus, using digital design and the creation of "Twins", in particular, it is possible to predict the problems of the existing network, preventing more fatal failures and malfunctions for the enterprise [20; 21].

Big Data in marketing and economic planning

Also, technologies aimed at processing large layers of information, Big Data, are gaining popularity in the electric power sector. Such developments applied at large enterprises can deepen analytics, automating both the collection and processing of information, which plays one of the key roles in the formation of economic and marketing strategies [22; 23].

In addition to the auxiliary function in controlling the enterprise through IoT and robotics described above, Big Data contributes to marketing and economic planning. Thus, smart systems can segment customers, dividing them by consumption level; visualize information about marketing campaigns and the course of actions, as well as predict sales by building consumption models of the customer base and calculating its metric: average consumption, the price of attracting new electricity consumers, etc. [24–28].

A good example in this area is *SO UPS* JSC, which integrated Big Data into its forecasting system, after which the company had the opportunity to make its periodic forecast of capacity consumption, firstly, ensuring the safety and continuity of connection, and secondly, calculating the composition of equipment and reserves [29]. In particular, by using Big Data and making weekly and monthly forecasts, the marketing and economic departments of the company can calculate the most

profitable savings plans, as well as regulate electricity generation and its territorial distribution based on the values obtained.

Conclusion

As noted above, the large-scale specificity of energy enterprises prevents the unobstructed use of IT in the field of electric power, and it is not possible to automate and transfer all processes to the field of information technology. Nevertheless, IT and its implementation not just will allow delegating some of the tasks to technologies, but make it possible right now, saving both time and money for enterprises and fulfilling the security aspect.

At the same time, by expanding the use of technologies in the electric power sector and paying attention to the main trends in the informatization and computerization field, electric power companies will be able to reveal the advantages of IT and their optimizing properties, which is partially observed already now.

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