Automation of industrial processes and everyday life

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Abstract. One of the main features of our information era is “digitization”. In the oil industry, there is almost no easily produced oil left, so we have to constantly create the latest technologies for unconventional reserves and conduct production in hard-to-reach regions. The "digitization" of all the production components is not a tribute to fashion, but a means of maintaining efficiency and success. The principle of "toothbrush". Toothbrush monitoring is used in the extraction, refining and marketing of petroleum products by monitoring the serviceability of industrial equipment. The principle of mobility and utility. In the field of exploration and production, this means that all information about the field development is processed and, using special applications, is displayed on mobile devices of the relevant people in real time. Portable mobile devices for checking the quality of welds at the junction of pipelines directly at the place of their operation, without stopping the operation process and without damaging the inspected object, can be necessary as well. The developed device for the arc welding of magnetized products — the IST-201 welding current inverter — allows pipes to be welded without their preliminary demagnetization. The device allows one to weld pipes in a matter of hours, and instead of a whole group of personnel, only welders are involved. This development can scan not only finished seams or products, but also details during the manufacturing process, which allows avoiding the risk of defective products already at the production stage.

1. Introduction

According to modern studies, one of the main features of our information era is digitization of data to ensure fast development. Yesterday’s emerging technologies are becoming commonplace today and tomorrow they will be replaced with new, more efficient and productive approaches and ideas [1]. This process of quick global information transfer involves vast numbers of professionals who may improve existing or create a new more advanced technology, thus, the advancement is ever speeding up, forcing companies that are unable to keep pace to the market periphery. The situation is even more acute in the oil industry, as it involves more than competition; there is practically no easily extractable oil left, thus it is necessary to constantly create, then improve, and develop technologies oriented towards extraction of non-conventional reserves as well as to operate in hard-to-get regions. Digitization of all the components of production process in this industry is not jumping a bandwagon, but a means to preserve efficiency and success.

The main trend in IT development during the last decade have been a movement from quantity to quality. Indeed, today 16 Gb of RAM or a HDD of several terabytes are no longer considered wonderful feats of technology. The volumes of obtainable information grow geometrically, but for a person or a company a huge part of these data are useless, thus, it is necessary to learn how to both gather and
process necessary information. This is a problem that when solved may bring up significant dividends to all the people.

2. Toothbrush Principle

Today, information gathering is no longer a problem, as anything may be provided with sensors, from every-day things and industrial equipment to a human body. For example, according to market researchers, the last year’s sensation was fitness gadgets allowing round-the-clock monitoring of their owner’s health. The smart wristband can count your pulse and kilometers walked, while also forming an opinion on your way of life in general and providing you with relevant advice. Experts think that regular toothbrush is going to undergo even a more drastic change. They say that in a couple of years toothbrushes will start collecting data on our teeth and transfer them directly to your dentist’s office. Then, you shall only wait for an appointment. Here we may see the main trend in automation of things: it is no longer of merely indicative nature, but gets new functions thanks to a new possibility to gather, process and transmit data without concerns for distance. Little by little, it leads to automation of daily life processes.

In the oil industry, this trend presents in all its sectors, from production to sales. A modern oilfield is inconceivable without a constant data gathering concerning the state of wells, underground equipment, pipelines, surface infrastructure, digitization of these data and their further processing. The data obtained this way allow for real-time monitoring of production indicators and timely reaction to changes, preventing failure events, saving energy and other resources.

Toothbrush-like monitoring is used in processing and sales to monitor equipment operability. As for future development in sensors, while improvement of their technical characteristics and efficiency is important, nevertheless the main problem lies in a more intellectual area. All the big data arrays shall be useful and bring profit to the company. This is the only case where automation costs are fully justifiable. Ideally, there shall be a completely automated system where data from all sensors and systems are collected, classified, analyzed and form backbone of models allowing making important decisions in a timely manner [2]. That is, the value of data shall be multiplied by application of IT, while the data themselves shall be transformed into a commercial resource.

3. Principle of Mobility and Usefulness

Another trend that has already become popular globally and in the industry is a total shift to mobile devices. What do you personally use for email, social networks and news? When answering this question, most people name their phone or tablet, rather than a PC. Independence of fixed communications is not just convenient; it brings real profits and savings to the company. Usefulness of mobile technologies is evident for regular office workers, fast food workers and the like, and it is already hard to imagine a manager without a cellphone as a minimum. Within the mobile office framework, many companies start using teleworking, saving on rent and other services.

Multiple mobile apps are being created, and each of them may find application in any field. It makes apps universal and thus in demand for working with industrial assets. Shell, ExxonMobil and other giants of the industry already use the digital control technology in project management with mobile devices [3]. In prospecting and production, it means that all the information on field development is processed and output by special mobile apps onto devices of interested parties in real-time. Project operator may use their tablet to watch drilling or production processes, while a top manager may browse through business analytics. In this case, mobility provides round-the-clock control and swift decision-making.

Portable mobile devices may be just as useful in the field, to be used in pipeline weld quality control directly at the operation location, without breaks to the process and without inflicting any damage to the tested object.

Among such outstripping developments are induction accelerators (betatrons) developed by researchers from Tomsk Polytechnic University (TPU).

Magnetic testing leaves welded elements magnetized thus making arc welding impossible.
Oil and gas industry employs special expensive equipment to de-magnetize pipes. It requires a long preparation process and shutting off the pipeline for a day or two. When the magnetic flux passes through the part in defective locations, magnetic force lines become concentrated, which allows finding a damaged area of the pipe. The damaged part is cut away and replaced with a new one. After that, the pipes shall be welded to each other [4, 5].

TPU-based researchers proposed an innovative solution of the problem. They developed an arc welding instrument (Arc current invertor IST-201) which allows welding pipes without prior de-magnetization. The instrument allows completing pipe welding in several hours and its operation involves only welders, rather than a diverse group of personnel usually required currently. Additionally, the enterprise is able to save significantly on purchase and maintenance of special pipe de-magnetizing equipment. Experimental prototypes of IST-201 have been employed at facilities of Surgutneftegaz, Tomskneft, KAO Azot and other companies. Besides, it was tested at operating facilities of Transneft-Central Siberia and Gazprom Transgaz Tomsk, confirming increased efficiency.

For example, a person responsible for welding or casting quality control at a certain facility may easier detect and eliminate defects. This R&D product may scan not only completed welds or products, but parts being manufactured as well, thus allowing eliminating risk of faulty production at the manufacturing stage. Advantages of the device are grounded in its characteristics: Power source of SEA-7 has a mass of about 30 kg, while its predecessor PBX is about 70 kg; emission power of the SEA induction accelerator is 7 MeV, while that of the previous version is two times lower at 5 roentgen per meter; these new characteristics allows examining steel with the thickness of up to 40 cm. Such a mobile device will be very helpful for a person and creates no new issues in operation.

![Induction accelerator for arc welding of magnetized articles – Arc current invertor IST-201](image)

Additionally, if we consider sales of production, mobility here results in direct income by means of optimized logistics and reduced losses.

4. Conclusion
Mobile technologies provide possibilities of new communications and change the appearance of any average employee, whether industrial or social worker [6, 7]. The coming changes will affect everyone. Integration of information and industrial technologies leads to a situation where human participation is limited to remote monitoring and control of operation and timely reaction in case of arising issues [8, 9]. Additionally, development of mobile apps allows us to predict upcoming changes in the very foundation of decision-making, where the main role is going to be not with an opinion of one subject matter expert, but that of a competent expert community.

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