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Industry 4.0: Kazakhstani Industrialization Needs a Global Perspective

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Abstract

This paper presents an analysis of Industry 4.0 implementation in Kazakhstan and shows that it is more advantageous to adopt a global perspective and to target to the global community rather than narrow focus of economic growth and consideration of only short-term inner interests. The current state and importance of Fourth Industrialization for the country as well as opportunities and challenges of its realization in Kazakhstan have been discussed in more detail. It has been shown that a number of large enterprises of the country implements Industry 4.0 by applying global standards, which in turn increased their productivity and competitiveness not only in Kazakhstan but also in the world.

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1. Introduction

In history, there have been three industrial revolutions that shaped the working principles and business approaches of the factories, where achievements in science were applied at the proper time and with the proper strategy. During the First Industrial Revolution (1784 - 1870), when leading countries of the time were implementing mechanization of production [6], in Kazakhstan, an economic form of activity was nomadism. During the Second Industrial Revolution (1870 - 1969), when there have been developing mass production at industries [6], the country in the territory of Kazakhstan was a part of the Russian Empire and, then, a part of USSR. During the Third Industrial Revolution (1969 - Present), when IT systems were automating production lines [6], Kazakhstan just has got its independence and started to attempt of building a new country. As a result, now this country has a poor economy and lags behind for

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many years in development from many others. Nevertheless, it has been claimed that the current new Fourth Industrial Revolution can give an opportunity to raise the financial state of Kazakhstan due to its particular features [2]. The key issue in this is a scope of perspective and an appropriate strategy of implementation of industrialization; and it has been proposed that in the era of Industry 4.0 for Kazakhstan it is more advantageous to need to adopt a global perspective which will help not only in the growth of the local economy, but will also put itself in the global map as solution a provider for Industry 4.0. In this paper we show that Kazakhstani industrialization needs a global perspective by discussing the current state and importance of Fourth Industrial Revolution for Kazakhstan, global market targeted industries, worldwide standards, opportunities and challenges of realization of Industry 4.0 in Kazakhstan.

1.1. Background

In recent years, it can be observed an explosion of knowledge and technology growth all over the world. In the same time, there are still countries benefiting and lagging behind. It has been stated that the reason for this is the scope of a point of view on the economic development of a particular country. This means that narrow perspectives lead to the creation of the problems, while broader perspectives contribute to the solutions of them. In the case of developing country, the meaning of the claim is a necessity of a global perspective to the country's programs in order to solve local problems. This is specifically crucial in regard with Fourth Industrial Revolution in Kazakhstan because there is not enough successful experience in industrialization. A global perspective is important to recognize the illusions and to broaden the scope of the view in order to see actual problems and to solve them. The narrow focus on economic growth and consideration of only a short term frame are seemed to be correct with respect to the country's own scope, while adopting of a global perspective may demonstrate the incorrectness and propose the effective development path.

1.2. Current state of Industry 4.0 in Kazakhstan

The first thing that needs to be defined is Fourth Industrial Revolution. The term, shortly called Industry 4.0, refers to mass implementation of cyber-physical systems in life and labor, as well as the increasing automation of absolutely all processes in production [1]. The main technologies that are being implemented within the framework of Industry 4.0 are big data, Internet of things, virtual and augmented reality, 3D printing, quantum computing, blockchain and robotization [1]. In terms of Kazakhstan, in order to propose industrialization strategies for the future, it is necessary to evaluate the current state of digitization. Currently, there is no precise data on the use of digital technologies. The Ministry of Investment and Development of the Republic of Kazakhstan in response to a request on Informburo.kz published that so far a large number of industry is not up to the fourth revolution. More specifically, results of a survey have shown that out of almost 600 companies, it became clear that more than 80% of manufacturing enterprises and 60% of mining industries are at Industry 2.0 level - this is a semi-automated production or a stage of transition to automated production [3].

The Ministry of Investment and Development analyzed the current situation and immediately revealed several factors hindering the development of digitalization in the country. "These include insufficient business understanding of the economic benefits of digitalization, poor development of domestic developments and competencies in automation and digitalization, lack of qualified personnel, limited financial resources, and infrastructure constraints," - said Minister for Investment and Development Zhenis Kasymbek [3].

In order to eliminate existing barriers, the department proposes: to improve the regulatory framework to develop digital infrastructure, as well as its own technologies and competencies, human capital, financial and other incentive measures [3]. As it can be seen, one of the major problems is the lack of understanding of the benefits of industrialization and the important solution proposed by them is to improve regulatory standards. The standards can be improved by developing new own regulations or by adopting existing global norms.

1.3. Importance of Industry 4.0 for Kazakhstan

There are a number of objective factors that shows the importance of the Fourth Industrialization for Kazakhstan. Those are a small volume of the domestic market, large distances between settlements, lack of access to the sea and many others. It is claimed that Industry 4.0 makes it possible to level these factors by increasing competitiveness, by generating new sources of income and by accessing new market niches. In addition, due to the digitalization of

the industry, new branches will be created around the industry, new high-tech IT companies will compete in the international market. In 2017, Ministry of Innovations and Development of Republic of Kazakhstan announced about the work on a action plan of industrial modernization. At ministry, It has been claimed that Industry 4.0 will allow Kazakhstan to reduce the influence of factors of a small domestic market, large distances in the absence of access to the sea and a shortage of skilled labor on the development of the economy [3].

2. Global Perspective

2.1. Global market targeted industrialization

The integration of digital technology in Kazakhstan is, firstly, considered by large enterprises, since they have great potential and know that in order to compete in the international market they need to constantly improve their practices and introduce new technologies. Those are companies as the Eurasian group ERG, Kazakhmys, Kaz Minerals, Altyn-Almaz, Ust-Kamenogorsk Titanium and Magnesium Plant, etc. Currently, 14 industrialization projects with a total cost of 140 billion tenge are being implemented at existing productions of large companies [3].

For instance, Kaz Minerals has two fields, Bozshakol and Aktogay. In these fields, an automated control system for the beneficiation plant, an automated pit monitoring system, automated transport management, and high-resolution imaging using pilot-free aircraft were developed and integrated. Such projects at Kaz Minerals have already achieved high levels of labor productivity, which are an indicator of competitiveness. On average, Kaz Minerals labor productivity indicators are 10 times higher than similar copper-mining enterprises in Kazakhstan, which is a very good indicator and in 2016, the labor productivity of the Kazakhmys Kaz Minerals group became one of the lowest-cost copper mining organizations in the world. In addition to these projects, a new production of 100 billion tenge by Kazzinc - Polymetals of Zhairam - is being created, within which the widespread use of digital technologies, such as remote monitoring, simulation modeling and others, is envisaged [3].

In the field of aviation, there is an attempt to introduce information systems for paperless workflow in the field of E-freight air transportation, as well as to collect and process data on air passengers, which will allow replacing 20 documents presented today in paper form with their electronic counterparts [3]. Also in the field of railway transport, the project "Automation of the forecast train schedule" is being implemented. It is the implementation of the train schedule with an increase in accuracy and depth of planning from 45 days to 3 hours. In the plans, in the period from 2018 to 2020, there are two more projects: "Digital diagnostics of the track using mobile diagnostic tools" and "Management of multimodal transportation" [3].

2.2. Worldwide standards towards Industry 4.0

As discussed in [5], despite the fact that the social dimension in Industry 4.0 seems to be ubiquitous, the main benefit of Industry 4.0 is opportunities and conditions that society or human could benefit. One of the factors appears to be the provision of sustainability and better working conditions. For example, the real-time temperature, warehouse humidity controller technologies based on the system could make the working environment better, automatic detectors of incidents and corresponding automatic response, enhanced communication systems, a focus on ergonomics, the clean city all of these contribute to human aspects and possibilities that could be obtained through Industry 4.0. Such and more possibilities provided by Industry 4.0 makes us establish and sustain the static standards towards the movement to this era. In the advent of the fourth industrial revolution, and considering its huge potential to change conventional approaches to many industry sections, European countries set their own Industry 4.0 strategy, main aspects of which are research agendas and enhancement of technology roadmaps [5]. In this section, we will consider these strategies and their potential applicability in Kazakhstan, along with what impacts they are expected to bring on the whole economic system of the country. European standards for Industry 4.0 takes into account its impact on the main five sectors so-called Infrastructure, Industry, Well-Being, Transport and Energy. Generally, the strategies set the goal to change the paradigm in European Manufacturing namely: 1) Factory and local communities, in other words, integration of two schemes so that customers can take a part in manufacturing processes and design; 2) Factory and Nature: provide sustainability of resources and their efficiency; 3) Factory and Value chains: manufacturing the product in consciousness of collaborated community, product mass customization; 4) Factory and Humans: human and

object-oriented interface, improving working environment conditions. In addition, this strategy considers facilitation of communication systems between customer, human factor and product providing real-time access to the production information, thereby Europe countries plan to increase their manufacturing sector by 5% till 2030 [5]. Taking into account that core impact on Kazakhstan economy comes from mineral resources and their production, such standards worth considering to implement in the county's manufacturing system. However, there might come to be a question if the technology sector allows us to interpret and introduce these standards into manufacturing service? The European Technology Platforms (ETPs) creates the innovation agendas and technology roadmaps, where the main focus on key technologies and research innovation priorities between the years of 2014-2020 [5]. As raised question regarding technology capabilities in Kazakhstan has been raised in Europe too in early decades, their approach appears to be a potential task to investigate and adopt. Technology poses the fundamental importance that could address the problems and challenges towards boosting Europe's economy and foster job places creation. That includes but not limited with Internet of Things, Agent-based systems, robotic and sensing technologies, cyber-physical systems that were the main research areas in the roadmaps since 2011. Overall, construction supply chain of digitalization can bring significant increase in current sales (in Europe countries 300% improvement), fast and secure response to unforeseen events, operation planning, time to market (70% improvement) thereby having a positive impact on the economy of Kazakhstan as it did in Europe countries

3. Industrialization in Kazakhstan: Opportunities and Challenges of Realization

3.1. Opportunities

Since the announcement of Sebnem Akkaya, World Bank Country Manager where stated that "The path to becoming an innovation-driven economy is not limited to one particular model a country should develop its own model through experience and discovery", Kazakhstan has been deeply involved in the improvement of scientific infrastructure thereby making significant investment into it. Start with Technology Commercialization Project, this prospective project focused on the innovations in the area of nanotechnology and biotechnology. Therefore, since 2015, on the base of this project, there has been created high-tech science park, now is called TechnoPark to support research activities in Kazakhstan and with future prospects to be a driver of research centres of giant companies as Microsoft, Hewlett-Packard, Samsung established in Kazakhstan. Furthermore, Technology Commercialization Center was introduced with a purpose to support technology marketing and launching start-up companies, as well as commercialization of licensing deals. One example towards this can be Sokolov-Sarbay field where several elements of Industry 4.0 have been integrated into the process under the name of Smart Quarry project. Briefly, it is an automated system for controlling the mining process in real time through planning centres and satellite positioning. This project introduces the first step to the Smart Factory which shows the fully integrated cycle of ore extraction, production of concentrate. It is expected to be finished in 2020 and as President of SSGPO JSC, B. Mukhametkaliyev reported this project will increase productivity by 10% and simultaneously provide better working environment conditions along with safety. In addition, SSGPO JSC company takes the action to prepare qualified personnel for the new economy training 6-7 thousand people industrial security courses and technology engineering courses [4]. The company plans to improve their sectors of the economy such production of building materials, woodworking chemicals, textile, machine building and metalworking not underlining their previous focus on food products, engineering, regions traditional activities. Under the Kazakhstan digitalization strategy where processing is taking place in manufacturing services, every region in country introducing Road Maps which include 77 measures in spheres like for Smart City technologies, healthcare, security digitalization, a project in environmental safety, digitalization of agriculture.

3.2. Challenges

From the perspective view of development, transition of Kazakhstan towards Industry 4.0 affords the scope for large-scale usage of advanced technologies, specifically analysis of Big Data, industrial Internet, and self-controlled robotics systems, which are in turn appear to serve as driver for productivity growth including creation of new business, competitiveness of domestic export-oriented industries and economy as a whole. In fact, international experts state that Industry 4.0 implementation would lead to annual GDP increase by 1.5 % [4]. However, for Kazakhstan, even

though the transition to Industry 4.0 poses such advantages, there still exist challenges. These challenges explicitly represent the consequences of the current established infrastructure and national consciousness. In this section, we will consider the main constraints for Kazakhstan in the way towards Industry 4.0, such as mentality, low level of education level, and access to the Internet.

For Kazakh people, family and their community always stand at the first point. From early nomadic life, everyone should rely on their relatives and needs to support the society where they grow up and this attitude still present in Kazakhstan. On the one hand, such a frame of mind seems to be correctly established, but indeed, in Kazakhstan, this is the main source of corruption and unemployment of high-skilled professionals. In other words, most working places which are supposed to be occupied by educated people, are given to relatives of or highly ranked person. As an aftermath, development of infrastructure will be focused on making the profit, not for creation or investigation of new aspects of technology development. Another factor could be the lifestyle of Kazakh people, as according to [4], a quarter of the population still works in the agricultural sector thereby their life mainly depends on land rather than industrialization.

We need to admit, that in some of the cities, the education system is mainly based on Soviet school. This concept is already established as a classical foundation and still continuing to be a root of fundamental knowledge. However, the participation of Kazakhstan students in PISA-2012 and TIMSS-2011, international education quality studies, showed that Kazakhstan students are incapable to apply their theoretical knowledge in practice, lack of critical analysis and approaches to the new problems [5]. The education system barely contributes to the evolution of higher-order thinking skills. The Kazakhstan education system should aim to move towards the introduction of technology, multilingual education, development of cooperation and critical thinking.

Thirdly, in today's world, the main source of education is Internet resources. Nevertheless, according to Tengrinews, recently 14 websites is blocked in Kazakhstan, which include some educational websites and besides this most of online educational platforms have a restriction for the Kazakhstan Internet services. This may include career.cup, promp.com etc. While online education is becoming the main source of information, such limited access could pose problems for the education system of the country.

4. Proposed Steps for the Industry and the Governments of Kazakhstan

Taking into account all the points discussed in this paper, we propose the following steps for Kazakhstani industry towards Industry 4.0 based on experience of local and world companies:

- As it has been mentioned in the section about global market targeted industrialization, there are number of local companies that increased their productivity and competitiveness not only in Kazakhstan, but also in the world by implementing Industry 4.0 elements. The most important suggestion would be that the governments should support with funding or attract investments for small and medium sized local industries. Due to the fact that abovementioned successful companies of Kazakhstan were large enterprises with huge amount of financial state that may allow themselves such kind of realization; while other industries may not have enough financial support or, in the case if they have, there will be high risks of failure.
- Another suggestion for local industries would be to start targeting to a global market from the beginning of their businesses, because the size of Kazakhstani market is very small (almost 18 million people), while the Internet allows to target (to offer your services and goods) to the whole world from any location. The targeting from the beginning is important because the company may spend many years for reaching local customers and then start working out of country borders. The advantage of this strategy would be a bigger marketplace, while disadvantage - high competitiveness.
- Thirdly, as we considered in International Standards of European countries, the governments of Kazakhstan should, also, have structured technological roadmaps which is based on implementation of IoT and CPS in manufacturing industry with the purpose to bring automatic detectors, enhance communication systems, improve the customer role in manufacturing processes and design and working conditions that will help local industries.

- Research agendas should be designed where main resource power and research strategy will be focused on innovation properties in nanotechnology, artificial intelligence, integration of M2M in factories and production services.
- Finally, as we have discussed in the Challenges section, one of the main constraints for the Industry 4.0 in Kazakhstan is an educational system. It can be stated that the country should adopt the European system of education where attention is mainly based on critical thinking, practical experience, and usage of new technology and their implementation. Also, there should be seminars and activities among the population in order to show the potential advantages of Industry 4.0 for the people so that every person could benefit and contribute towards its development.

5. Conclusion

To sum up, the paper sets up to show that in the era of Industry 4.0 Kazakhstan needs a global perspective. It has been discussed, firstly, the current state and importance of Industry 4.0; secondly, the successful examples and plans of global market targeted industrialization; and, thirdly, worldwide standards towards this industrial revolution. Abovementioned discussion about Kazakhstan perspectives and opportunities could be the proof that country has enough resources to create own model of development in technology perspective to fill the gap between Kazakhstan and developed countries. Even though there still exist restrictions in the education system and morality of community, there are still ways to overcome them by introducing new models of teaching and learning, and a new system of government policy.

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