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ENHANCING AGRICULTURAL INDUSTRY THROUGH INDUSTRY 4.0

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Abstract: *Agricultural industry is essential for humanity. It provides it with food, fibers, fuel and raw materials that are necessary for a normal living. As the technology advance, it is vital to see how the same technology can be implemented in other industries. With the development of Industry 4.0, many industries are trying to implement new technologies. Industry 4.0 represents the current peak of industry development. Today there are demands in various industries for shorter delivery and production time, more efficient, cost efficient and automated processes. The technology of Industry 4.0 can be applied to agricultural industry as well. Improvements of agricultural machineries in terms of electronic, sensors to enhance their current performances. Using electronics, sensors and drones, supports the data collection of agriculture key aspects, such as crops behaviour, weather, animals etc. The main task is how to implement the right methods in order to enhance agricultural industry with the help of Industry 4.0.*

Keywords: *Industry 4.0, agricultural industry, industry, technology.*

1. INTRODUCTION

Industry 4.0 is a revolution in manufacturing, and it brings a whole new perspective to the industry on how manufacturing can collaborate with new technologies to get maximum output with minimum resource utilization [1]. Over the years, worldwide the manufacturing context has been characterized by disrupting breakthroughs leading to radical changes in production and related processes [2]. Industries were and still developing due to so-called industrial revolutions.
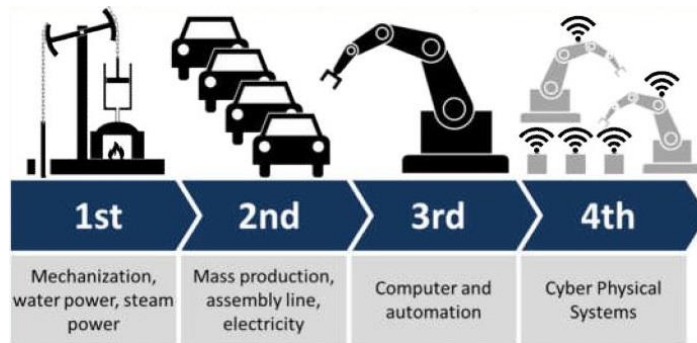
Fig. 1 Industrial revolutions [3]

The first industrial revolution began at the end of the 18th century and was characterized by mechanical production plants based on water and steam power [4]. Industry 2.0, from the end of the 19th century to the 1980s, was the period when industrial products burgeoned both in volume and variety [5]. The third industrial revolution since the 1980s described the use of electronics and information technology (IT) in production automation and generated a widespread digitalization wave. In turn, this digitization wave created a suitable environment for Industry 4.0. [6].

Industry 4.0 involves the use of advanced Information and Communications Technology (ICT) to increase the degree of automation and digitalization of production, manufacturing and industrial processes. Its purpose is to manage the entire value chain process, improving efficiency in the production process and generating quality products and services [7].

Fig. 2 Industry 4.0 [8]

2. MATERIALS AND METHODS

In order to enhance agricultural industry through Industry 4.0, it is vital to define what overall goals are.

Individual operation have to be organized and executed at the right time. It is important to have a good planning, which can be based for example on crop quality, yield, economy and environmental impact. As part of the concept of 4.0 all operations have to be planned as part of full production system [9].

Fig. 3 Industry 4.0 and Agriculture [10]

Agricultural industry is developing in correspondence with Industry 4.0 (Fig. 3). It stands for the combined internal and external interacting of farming operations, offering digital information at all farm sectors and processes. Even in agriculture, as the industrial sector, the 4.0 revolution represents a great opportunity to consider the variability and uncertainties that involve the agri-food production chain. Factories become smarter, more efficient, safer and more environmentally sustainable, due to the combination and integration of production technologies and devices, information and communication systems, data and services in network infrastructures. A farmer with his farm or agricultural companies must be able to adapt and to make changes in order to remain competitive on the market. One of the primary needs to be met is a constant communication between market and production, and within the business itself [11].

Technology has certainly developed in the 21st century. Nowadays we have easy access to it. There are several technologies, which can help farmers or companies and which can be implemented together with Industry 4.0:

- Big Data analytics
- Cloud based ICT systems
- Cheap and improved sensors and actuators

Agricultural machinery (tractors, combine harvesters, etc.) today come with enhanced performance and equipment, which is now standard:

- Many sensors for the operation of the machine and the agronomic process

- Smart control devices (on/board computers)

- Advanced automation capabilities (guidance, seed placement, spraying, etc.) [12]

Agricultural machinery and equipment are now widely used during the entire production process, including land preparation, crop planting, fertilization, harvesting, animal feeding and food processing. Agricultural mechanization significantly reduces manual work and improves productivity, so that fewer farmers can provide more food to meet the global demand for food. The innovation ICT and its integration with agricultural production helps farmers and companies to make a digitalization of farming [13] (Fig. 4).

Fig. 4 Digitalization of farming

Digital farming and in general digital agriculture offers the ability to utilize technology to convert precise data into actionable knowledge to drive and support complex decision-making on-farm and along the value chain. The promise is that, whilst past sources of knowledge were based on general knowledge often derived from research experiments, smart technologies will be able to offer on-farm, local-specific information to farmers. As such, digital agriculture reflects a shift from generalized management of farm resources toward highly optimized, individualized, real-time, hyper-connected and data driven management.

Sensors provide raw data (e.g., weather data), and smart devices (robotic vehicles, drone mounted cameras) will allow sophisticated farm management advice while smart systems have the capability to execute autonomous actions [14]. Large-scale farmland monitoring, crop identification, and yield forecasting are available through remote sensing [15] with GPS technology [16] and UAV [17].

3. RESULTS AND DISCUSSION

In order to implement elements of Industry 4.0 in the agricultural industry, certain tasks must be fulfilled:

- **Farm size**: Usually farmers that have large farms tend to accept new technologies instead of farmer who posseses small size farm due to costs of investment.

- **A need for standards to ensure compatibility of equipment**: The major challenge in Industry 4.0 requires technological standards to ensure the compatibility of equipment and also applicability of equipment in rural areas.

- **Communication infrastructure development in rural location**: An important challenge that faces in rural areas in the IoT adoption for agriculture is communication infrastructures development. Mostly communication network is deployed in urban area specially to capture markets but success of Industry 4.0 in agriculture depends on the ability to exchange and analyses data. Thus, communication networks will have to be established in rural areas.

- **The ability of farmers to modernize from a financial aspect**: The essential challenge of adapting Industry 4.0 in agriculture is farmer's ability to invest and to revolutionize their production practices. The economic tight situation of farmer leads to limited investment ability in new production tools, agricultural machinery and limited access to credits.

When certain tasks are accomplished, implementing Industry 4.0 in agriculture has its own benefits in terms of improving agriculture:

- **Enhanced product quality and volumes**: Controlling all the agriculture processes and maintaining high standard of, for example, grain quality, which results in increase of productivity.

- **Data collected by smart agriculture sensors**: Data collected by sensors are analyzed and states, for example, crop's growth, cattle health, weather conditions, soil quality. This data can be used to track the plants and equipment efficiency.

- **Better control over the internal processes and, as a result, lower production risks**: This new technique helps in planning for better product distribution and depends on output prediction by data processing.

- **Increased business efficiency through process automation**: With the utilization of smart automated device in maximum activity in production cycle like irrigation, fertilizing, etc.

4. CONCLUSION

Industry 4.0 is indeed a new revolution in industry. With the implementation of Industry 4.0 in agriculture, it is possible to have shorter production time, better product quality, automated processes, intelligent machinery, etc. The technology is in constant

development. It is important that with these above stated reasons farmers and companies can achieve better results in terms of production and quality of the goods. Often are people skeptical to new technology and don't see any benefit from it, especially small farmers. It is desirable that they are provided with knowledge what are the benefits of implementing the Industry 4.0 into their farms. Nowadays there are financial funds that can help farmers and companies to buy or upgrade their agricultural equipments and machines.

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