

Impact of Industry 4.0 on agricultural industry

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Abstract: Industry 4.0 represents the newest generation of industry development. Every day the various demands in industry are getting more and more demanding. The demand for shorter production and delivery time, more efficient and automated processes has led us to the Industry 4.0. It is necessary to include and integrate the latest developments based on digital technologies as well as the interoperability process across them. The goal is to enable companies to transmit information in real time in terms of performance and behaviour. Industry 4.0 can be applied to any branch of industry. Agricultural industry is no exception. As far as agricultural machinery is concerned, it is a very important part of agricultural industry. Agricultural machinery incorporates electronic controls and it is a part of digital age, enhancing their current performance. In addition to the electronics, using sensors and drones, supports the data collection of several agriculture key aspects, such as weather, animals and crops behaviour, geographical spatialization, etc. The main tasks are how to apply the right methods and methodologies in order to support a better supply chain decision-making process, how to automate the process and how can Industry 4.0 help a person, who is in agricultural industry, in order to make effective decisions based on objective data.

Keywords: INDUSTRY 4.0, AGRICULTURAL INDUSTRY, AGRICULTURAL MACHINERY, PERFORMANCE, 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.

The fourth industrial revolution is present to this day. Industrial revolutions have significantly changed the world. The general concept of Industry 4.0 was firstly introduced by the German government program to introduce a paradigm shift toward a digital future in industrial production and to increase the competitiveness of the manufacturing industry [3]. Industry 4.0 mainly focus on streamlining industrial and production process, reducing development time, reducing costs and meeting consumer demands effectively [4].

One of the main elements in the concept of and Industry 4.0 is to look at the system as a whole (Fig. 1), not only empirically but also by ensuring that all data and measurements are stored and are visible for analysis in one coherent system. This creates the foundation for a robust, database-lead process of prioritization and decision-making [5].



Fig. 1 Industry 4.0

The goal of the paper is to see how does the Industry 4.0 affects agricultural industry in terms of new technology, new machines, better supply chain, automated processes, etc., and how to improve it all.

2. Materials and Methods

When looking at agricultural production from a 4.0 perspective, it is necessary 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 [5].

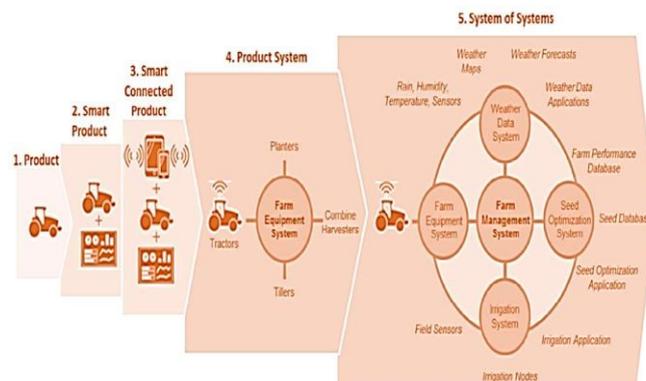


Fig. 2 Industry 4.0 and Agriculture

Agricultural industry is developing in correspondence with Industry 4.0 (Fig. 2). 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 [6].

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

- Cheap and improved sensors and actuators
- High bandwidth cellular communication
- Cloud based ICT systems
- Big Data analytics

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

- Smart control devices (on-board computers)
- Many sensors for the operation of the machine and the agronomic process
- Advanced automation capabilities (guidance, seed placement, spraying, etc.)
- Communication technology embedded in the vehicle [7]

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 [8] (Fig. 3).



Fig. 3 Digitalization of farming

Sensors are used to measure the status of soil and plant leaves for precise microclimate control [9]. Low-power wide area networks and wireless mesh networks are deployed to report the data generated during agricultural production [10]. Without high-speed, high-quality Internet access, many smart farming capabilities could not be implemented [11]. Large-scale farmland monitoring, crop identification, and yield forecasting are available through remote sensing [12] with GPS technology [13] and UAV [14].

Besides new technology and constant upgrading of agricultural machinery, a very good supply chain management is more than desirable (Fig. 4).



Fig. 4 Supply chain management

To achieve robust, resilient and sustainable supply chains in agriculture is very complex because they face more sources of

uncertainty and risks in comparison with other supply chains that give rise to serious questions and concerns about their economic, environmental and social performance. Most important ones are: Product (shelf-life, deterioration rate, lack of homogeneity, food quality and food safety), Process (harvesting yield, supply lead time, resource needs, production), Market (demand, market prices) and Environment (weather, pests & diseases and regulations) [15]. Poor management of these sources of uncertainty can have a very negative impact on safety, quality, quantity and waste of products as well as human, technological and natural resources. Agricultural sector is one of the economic and political areas worldwide, with the key implications in sustainability to cover not only the food needs of the population, contribute to their employability and economic growth, but also in the impact on the natural environment [16].

Agriculture supply chains are strongly pressured to manage these sources of uncertainty and risks whose precise evolution over time is unknown but may jeopardize the future sustainability of these type of supply chains. It is necessary to move away from "business as usual" developing new solutions and implement innovative technologies [17] like digitalized supply chain.

Digitalized supply chain (Fig. 5) allows companies to monitor material flows in real time making potential risks visible and develop future plans to face them.



Fig. 5 Digitalized supply chain

In terms of digitalized supply chain, data is very crucial. Data is the core of any business and the agricultural business is no exception. The new technologies have a great impact on the reduction of uncertainty since they allow obtaining precise data in real time, whose treatment, together with the capacities of autonomous and intelligent decision making will help to increase the efficiency, sustainability, flexibility, agility, and resilience along the whole supply chain from the farmers to final customers [15].

3. Results and Discussion

In order to implement elements of Industry 4.0 in agriculture, certain tasks must be accomplished:

- **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.

- **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. The farmers in rural area needed additional investment in training with new technologies of Industry 4.0 that arises gap between traditional and smart farming. Adoption of new techniques shows positive correlation with the impact of income, gross income and farm profitability.

- **The development of communication infrastructure 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.

- **Farm size:**

Usually farmer with large size of farm are interested in deploying new technologies instead of farmer who possesses small size farm due to costs of investment.

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

- **Data collected by smart agriculture sensors:**

Data collected by sensors are analyzed and states, for example, weather conditions, soil quality, cattle health, crop's growth. 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.

- **Cost management and waste reduction thanks to the increased control over production:**

With continuous monitoring, Industry 4.0 helps to reduce waste and cost management for a particular farm. This increases the yield of crop.

- **Increased business efficiency through process automation:**

With the utilization of smart automated device in maximum activity in production cycle like irrigation, fertilizing, etc.

- **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.

4. Conclusion

Industry 4.0 indeed represents a new industrial revolution. It can be applied to every branch of industry, including of course, agricultural 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, better supply chain management, etc. It is important that with these above stated reasons farmers with small size or large size farm and agricultural companies can achieve better results in terms of production and quality of the goods. It is desirable that the state helps local farmers with implementation of Industry 4.0 in rural areas, which are often, unfortunately, not developed enough. That would include providing necessary knowledge why the concept of

Industry 4.0 is very good for them and to provide farmers with favorable loans, which can help them buy or upgrade their agricultural machineries. Thus rural areas would be more developed.

5. References

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