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THE IMPACT OF USING EQUIPMENT WITH DIGITAL CONTROL ON MODERN AGRICULTURE 4.0 - REVIEW

DUMITRU D.[1)]*, ANGHELACHE D.[1)], PETRE A.[1)],TĂBĂRAȘU A.[1)], MIHALACHE B.[1)], STANCIU M.[1)]

[1)]INMA Bucharest / Romania
E-mail: dumitrudragos.nicolae@gmail.com

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ABSTRACT

Lately, the widespread use and continuous improvement of machine tools has had a significant impact on productivity in the manufacturing industry since the Industrial Revolution. At the beginning of the new era of industrialization, the need to advance machine tools to a new level, which corresponds to the Industry 4.0 concept, must be recognized and addressed. Like the various stages of industrialization, machine tools have also gone through various stages of technological advances, namely Machine Tool 1.0, Machine Tool 2.0 and Machine Tool 3.0. Industry 4.0 advocates for a new generation of machines - Machine Tool 4.0. This paper describes some of the key and desired features of the implementation of intelligent machines such as numerically controlled lathes and milling machine tool centers integrated vertically and horizontally in order to achieve a modern, intelligent, autonomous and safer agriculture.

INTRODUCTION

In 2015, the UN 2030 sustainable development agenda and international community commited itself to ending hunger, roughly 800 milion people worldwide suffer from hunger, 8 precent of the world population will be undernourished by 2030.

Although demand is continuously growing, by 2050 we will need to produce 70 precent more food.

Meanwhile, agriculture share of global GDP has shrunk to just 3 procent, one-third its contribution just decades ago. Four main developments are placing pressure on the legacy agriculture model in meeting the demands of the future: demographics, scarcity of natural resources, climate change and food waste are all intensifying the hunger and food scarcity problem.

To meet these challenges will require a concerted effort by governments, investors and innovative agricultural technologies.

Agriculture 4.0 (Figure 1) will no longer depend on applying water, fertlilizers, and pesticides uniformly across entire fields. Instead, farmers will use the minimum quantities required and target very specific areas. It will be possible to grow crops in arid areas, making use of abundant and clean resources such as the sun and seawater. Other innovations like 3D printing of foods, cultured meat, genetic modification, and seawater agriculture are still in the early stages but could all be game changers in the next decade.

Farms and agricultural operations will have to be run very differently, primarily due to the advancements in technology such as sensors, devices, CNC machines and information technology. Future agriculture will use sophisticated technologies such as robots, temperature and moisture sensors, aerial images and GPS technology. These advanced devices and

precision agriculture and inteligent systems will allow farms to be more profitable, efficient, safe and environmentally friendly. **[1]**

The traditional approach of the food industry is undergoing a fundamental transformation. The first technology revolution in agriculture made impressive strides: between 1961 and 2004, cereal yields in East Asia rose by 2.8 percent a year, or over 300 percent over the period, enabled by modern farming practices, including irrigation, use of fertilizers and pesticides, and devlelopment of new and more productive crop varieties. But efficiency grains are dropping: The rate of yield increases has slowed. And the challenges are greater: The world has to produce 70 percent more food by 2050, using less energy, fertilizier, and pesticide while lowering level of GHGs and coping with climate change. Old technologies must be maximized, and new ones generated.

Agriculture 4.0, the coming agricultural revolution, must be a green one, with science and technology at his heart. Agriculture 4.0 will need to look at both the demand side and the value/ supply side of the food-scarcity ecuation, using technology not simply for the sake of innovation but to improve and adress the real needs of consumers and reengineer the value chain.

Fig. 1 Agriculture 4.0

MATERIAL AND METHOD

Modern farms and agricultural operations will work differently, primarly because of advancements in technology, including sensors, devices, machines and information technology. Future agriculture will use sophisticated technologies such as robots, temperature and moisture sensors, aerial images and GPS techonolgies, to list a few. These advances will let businesses be more profitable, safer and environmentally friendly. Agriculture 4.0 will no longer have to depend on applying water, fertilizers and pesticides across entire fields. Instead, farmers will use the minimum quantities, or even completely remove them from the supply chain. They will be able to grow crops in arid areas and use abundant and clean resources such as the sun and seawater to grow food. **[2]**

In this paper I will present some of the new technologies and solution in the Agriculture 4.0 that can give hope to the food scarcity problem.

Efficiency and productivity will increase in the coming years as precision agriculture becomes bigger and farms become more connected. It is estimated that by 2020, over 75 milion agricultural IoT devices will be in use: The average farm will generate 4.1 million data points daily in 2050, up from 190.000 in 2014.

But while the growing number of connected devices represents a big opportunity for food producers, it also adds complexity. The solution lies in making use of cognitive technologies that help understand, learn, reason, interact and increase efficiency. Some technologies are further along than others.**[3]** Some of the key game changers are:

Internet of Things (IoT): Digital transformation is disrupting the agricultural world. IoT technologies allow correlations of structured and unstructured data to provide insights into food production. IoT platforms such as IBM Watson are applying machine learning to sensor or drone data, transforming management systems into real AI systems. **[4]**

Automation of skills and workforce: By the year 2050, the UN projects that two-thirds of the world population will live in urban areas, reducing the rural workforce. New technologies will be needed to ease the workload on farmers: Operations will be done remotely, process will be automated, risks will be identified, and issues solved. In the future, a farmer skill will increasingly be a mix of technology and biology skills rather than pure agricultural.

Data-driven farming: By analyzing and correlating information about weather, types of seeds, soil quality, probability of diseases, historical data, marketplace trends and prices, farmers will make more informed decisions.

Chatbots: Currently, AI-powered chatbots (virtual assistants) are used in retail, travel, media and insurance sectors. But agriculture could also leverage this technology by assisting farmers with answers and recommendations on specific problems.

These are known as **Industry 4.0 (Figure 2)**

Drones (Figure 3) aren't a new technology, but thanks to investments and a relaxed regulatory environment, their time may have arrived:

Soil and field analysis: By producing precise 3D maps for early soil analysis, drones can pay a role in planning seed planting and gathering data for managing irrigation and nitrogen levels. **[5]**

Planting: Startups have created drone-planting system that decrease panting costs by 85 percent. These systems shoot pods with seeds and nutrients into the soil, providing all the nutrients necessary for growing crops.

Crop spraying: Drones can scan the ground, spraying in real time for even coverage. The result: aerial spraying is five time faster with drones than traditional machinery.

Crop monitoring: Inefficient crop monitoring is a huge obstacle. With drones, time series animations can show the development of a crop and reveal production inefficiencies, enabling better management.

Irrigation: Sensor drones can identify which parts of a field are dry or need improvement.

Health assessment: By scanning a crop using both visible and near-infrared light, drone-carried devices can help track changes in plants and indicate their health-and alert farmers to disease. **[6]**

3D printing (Figure 4), wich is becoming important in manufacturing industries, is now being applied food production. 3D printing (also known as additive manufacturing) is a process whereby layers of material are formed to create objects, in this case, familiar dishes. Experts believe printers using hydrocolloids (substances that form gels with water) could be used to replace the base ingredients of foods with renewables like algae, duckweed, grass. Netherlands Organization for Applied Scientific Research has developed a printing method for microalgae, a natural source of protein, carbohydrates, pigments and antioxidants, and is turning those ingredients into edible food like carrots. The technology essentially turns mush into meals. In one study, researchers added milled mealworm to a shortbread cookie recipe.

Grocery stores of the future may stock food cartridges that last years on end rather than perishable whole ingredients, freeing up shelf space and reducing transportation.

UAVs may one day consist of autonomus swarms of drones, collecting data and performing tasks. The biggest obstacle to that becoming a reality is sensors capable of collecting high-quality data and number-crunching software that can make that high-tech dream a reality. **[7]**

Fig. 2 Industry 4.0

Fig. 3 Drones technology

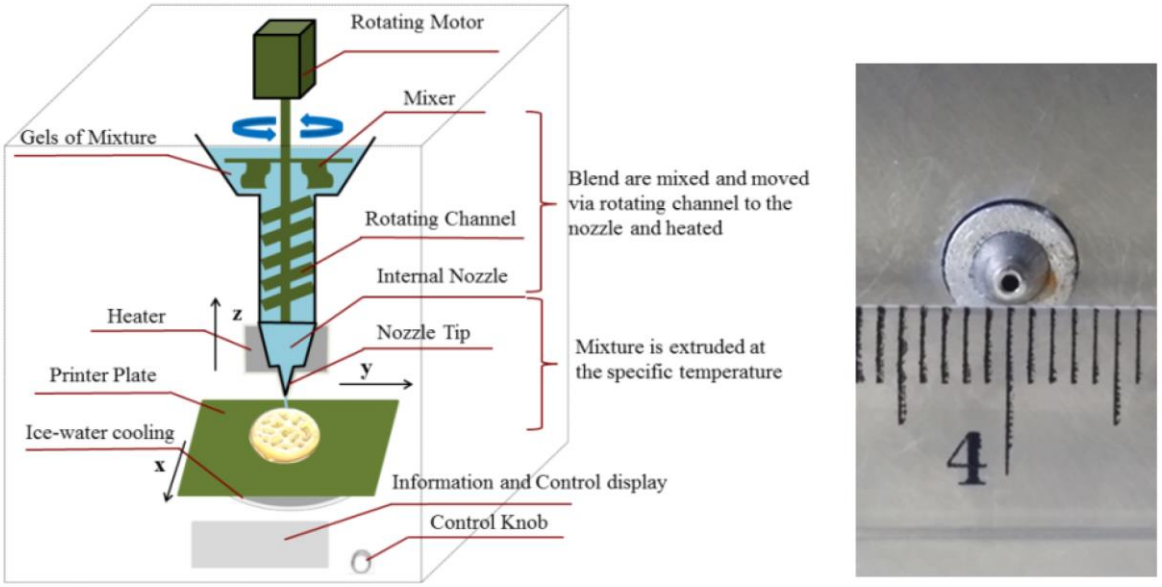

Fig. 4 3D Printing

RESULTS AND DISCUSSIONS

A new method and solution for the optimization of the Agriculture 4.0 are the CNC equipments (Figure 5).

The use of a production activities management solution adapted to the needs of the resarcher, allows to be connected to the rest of the concept, making it possible:

Automatic data retrieval from machines, CNCs, robots (interface with production machines)

Management of maintenance activities

Monitoring the operations in the production units

Implementation of automation techniques

Checking and ensuring the quality of products. **[8]**

Fig. 5 CNC

CONCLUSIONS

Although the prospects of eventually integrating the Industry 4.0 technologies, practices and mindset in the agricultural domain are good, adoption will take time. The sector faces significant challenges, from the standardisation of technologies to the ability to invest to modernise the equipment and supporting infrastructures. The new challenge of Agriculture 4.0 is the need to have data exchange and communication standards that link the different systems together in a unified system covering all aspects of the agricultural exploitation. **[9]**

Another essential challenge in the adoption of Agriculture 4.0 is the ability of farmers to invest and to modernise their practices of production. Finally, another important challenge in the adoption of the IoT in agriculture is the development of communication infrastructures in rural areas. Current wireless communication networks have been deployed with a B2C focus, having a strong emphasis on urban areas.

As we have seen, the ability to exchange and analyse data (often at the platform level) is key to the success of Agriculture 4.0. Thus, communication networks will have to be developed in rural areas. Wireless coverage availability in rural areas in Europe is around 40% but with still important regional diversities17 despite the use of the European Regional Development Fund (ERDF) and the European Agricultural Fund for Rural Development. **[10]**

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