Value of Innovation Platforms in Agriculture

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Abstract – Innovation through modern digital technologies ensures the survival of businesses in today’s ever-changing working environment. Therefore, it should be seen as a comprehensive process of development and application of new competitive digital business models, which will elaborate the impact of the proposed innovation to business success and progress. New ideas and innovations have to be managed, in order for them to achieve their main role as a valuable trigger or contribution to the business development. An Innovation Management Systems (IMS) can be designed as a platform within which all relevant stakeholders of the innovation process can operate in real-time and at the same operational level. In this paper the management of digital innovations in agriculture is presented, with an accent on problems, currently used technologies as well as innovation platforms as potential technology solutions for better management within this sector. Moreover, the value of innovation management systems for some identified stakeholders is analysed and described, giving a comprehensive view of benefits it brings to them.

Key words - innovation; innovation platform; innovation management system; agriculture; digital technologies

I. INTRODUCTION

A general literature overview, seen in [1] on global developing trends showed that the traditional approach to structuring the global GDP is a basis for determining four current and potential future growth poles of the modern global economy:

- Agriculture, which future perspectives are connected to digital modernization of agricultural production
- Industry, which future perspectives are connected to formation of Industry 4.0
- Innovations (R&I), which future perspectives are connected to high tech production
- Service sphere, which future perspectives are connected to development of e-commerce

At the same time the level of digital technologies application and the adoption is not advancing at the same speed in all industries [2]. Moreover, some industries of the most important economic importance, such as agriculture, which is the industry this paper has in focus, are slowly adopting new concepts of work, and environmental, climatic, market and organizational challenges in this area are increasing. Due to its important role in the food chain, the transformation of agriculture is expected [3] and growth in the application of digital technologies is welcomed [4]. Researchers agree that digital innovation [4] and knowledge sharing can have a profound impact on the transformation of the agricultural sector, although this transformation is lagging behind, especially in local communities and on smaller agriculture businesses.

In Europe, continuous policy efforts are aimed at strengthening the digital market, in particular the digitization of the agricultural sector through the Cork 2.0 declaration “A better life in rural areas”; EU Commission proposal for Common Agricultural Policy beyond 2020; EU Communication “Digitizing Europe Industry”; or Digital Single Market (DSM) initiative [3].

The fundamental role of digital technologies is especially important in the innovation process, where the goal of agricultural businesses, driven by the wave of the Industry 4.0 paradigm, is to integrate digital technologies into business processes in agricultural production [3]. The European Commission, in the presented common agricultural policy after 2020 [5] defines policy goals such as increased competitiveness, balance of the food chain, landscape and biodiversity conservation, generational renewal, health and food protection, successful resistance to climate change and financial stability, which should be achieved. Due to the limitation of other resources, this is strongly dependable on the transformation of agricultural processes through the application of technologies and innovation.

Value creation in the agricultural sector is rather linked to other business segments and sectors than to individual farms [4], and the increasing complexity of farm business and interaction with other stakeholders requires digital adaptation and application of communication, selling and distribution platforms.

Analog to Industry 4.0., the agriculture is also undergoing a transformational cycle by redesigning internal and external collaboration and interaction across the whole value chain and processes [6].

II. DIGITAL INNOVATION IN AGRICULTURE

A. Technological innovation in the agriculture

The agricultural sector has rightly been identified as one of the most important industries as it ensures the survival of mankind. Food needs are growing, and it is certainly worth mentioning that in some parts of the world food needs are not being met. Global health disruptions also affect the understanding of the significance of
agriculture locally and regionally raising the pressure on producers to become more efficient and agile.

The problems and challenges in the agricultural sector are diverse in nature and complexity by themselves. One of the most significant challenges is that of an ecological and climatic nature, which relates to global warming and unpredictable weather conditions [2]. The problem of the occurrence of unknown animal and plant diseases and the occurrence of emergencies can disrupt any cycle of agricultural production or completely interrupt it. Another set of challenges is related to markets and demand volatility. Inadequate policies and strategies for agricultural management, changing quantities and prices in the agricultural production sector, inventory management of goods and other performance related issues cause financial and other risks and responses in this sector.

Difficulties in applying innovative technologies in agriculture arise because farms face complex decision-making problems, related to the challenges mentioned above. To optimize agricultural processes and operations, farmers must consider various input parameters that can result in sudden oscillations of the entire agricultural system [7].

In addition to the capacity and readiness of the agricultural enterprise, institutional infrastructure is one of the important factors in understanding innovation activity. In particular, an agricultural policy that affects farmers’ income could affect the innovation process. A strong link between public support for innovation research and programs that support farm incomes has been identified. This could explain the investment in innovation in the agricultural sector [7].

Innovation through technologies should be one of the main factors changing the agricultural sector, and within the agricultural scenario, the classification of innovation can be divided into the following three categories: a) policy issues and strategies behind the creation and adoption of innovations; b) process innovation and product innovation; and c) the impact of innovation on economic operators and the market [7].

B. Use of digital technologies for innovations in the agriculture

The agricultural sector is characterized by poor adaptation and adoption of digital technologies and innovative tools, which leads to a gap between innovative tools on the market and their exploitation and application in agriculture [2]. The challenge of introducing new innovative ways of doing business parallel to daily workloads for SME’s in agriculture minimises the opportunities of promising implementations. There are many factors which influence the readiness of agricultural SME’s to go digital, but this seems to be a complex research area with a huge potential.

Organizational problems or challenges in the agricultural sector can be related internally to the capacity of farmers or agricultural enterprises and related to the knowledge and skills for adoption and application of digital technologies [7].

Digital technologies can be the basis for the development of the agricultural sector and increase its competitiveness in the market. Digital technologies should lead to solving challenges [8] related to environmental, climate, food and preservation sovereignty. Intelligent digital solutions help address such challenges [8] and transform the agricultural sector in terms of economic, social and environmental sustainability [3].

Innovation and use of digital technologies can increase agricultural production, reduce the consumption of resources, time and money, improve working conditions for farmers, preserve and improve the characteristics of agricultural conditions (soil), significantly reduce risks (erosion, disease) or increase resource availability (water) [9].

Robotics, sensors and Big Data analytics are reported as the three pillars of platform digital agriculture [3], and cyber-physical systems represent the basis for the development of innovative solutions for monitoring and managing processes in agricultural enterprises [10]. In addition, Internet of Things (IoT), artificial intelligence (AI) and Blockchain are also reported as being leading promising digital technologies in the entire value chain, from suppliers of input products to consumers [11]. Robotics and robotic systems have made a significant contribution to mastering routine and manual operations in agriculture, and the contribution is visible in the replacement of people in a number of non-professional occupations [8].

Large amounts of data are constantly generated in agriculture, and this technology can be widely used through the digital platforms of the agricultural complex [8], because otherwise, if they cannot be turned into useful tools to support farmers, they have little value [3]. The importance and role of these technologies is studied and explained in crop management systems, livestock, and water management [10].

Internet of Things (IoT) enables communication and transmission of information via the Internet directly between instruments like equipment, devices and goods [8]. Most common case known is monitoring of soil parameters and weather conditions to enable smart irrigation solutions, protection against pests and pesticide use [10]. Examples of pesticide use include unmanned aerial vehicles and ground vehicles with the goal of reducing risks thanks to real-time detection systems and agricultural tools for real-time precision handling, while drones and smart glasses enable reality tracking and tracking and sampling of processed soils to identify problems and enable management of possible outcomes [10].

All mentioned technological innovations are important for companies to strengthen their production processes and organizational structures by using automation and other similar technologies in business processes of the agricultural sector [3], while platforms and applications enable data collection, business monitoring, exchange of knowledge and experience and development of specific agricultural innovations, branches or activities.
III. INNOVATION PLATFORMS IN AGRICULTURE

Digital applications and platforms can potentially drastically change the way knowledge is processed, communicated, accessed and used [3], especially in the agricultural sector where the full transformation of business can be enabled through the application of digital technologies. Digital platforms for farmers provide decision-making opportunities that were not previously possible and simplify the conduct of business processes, leading to radical changes in farm management [3]. The importance of web platforms in agriculture is emphasized by different authors [2] who have developed a method for predicting future shortcomings in agriculture (machine failures), and predictive maintenance is provided through a web platform.

IMS in the agricultural sector are important for several reasons. The first reason is that the adoption of innovations, especially the ones related to digital technologies in agriculture is slow, except for the general application of new technologies in the automation of operations. Another reason is that the challenges in this sector are growing and decision-making is becoming more complex. The third reason is that the development of agricultural production has a perspective, which is confirmed by the fact that the needs for food are increasing, and the supply chain is becoming increasingly unstable. The digital transformation of the agricultural sector, with an emphasis on the application of digital technologies and the development of new ideas and innovations in agricultural processes and products, can contribute to the creation of a promising industrial branch, as a guide to the economy.

Innovation platforms in agriculture sector can be implemented to encourage the adoption of agricultural innovations and stakeholder interactions within a value chain [12] and help in their management. The European Commission has developed a comprehensive system of agricultural knowledge and innovation, abbreviated AKIS, which is designed as multiple process of generating, exchanging, and using knowledge in the field of agriculture that interacts between the heterogeneous stakeholders involved. The AKIS platform includes various stakeholders, the most important being farmers, advisors and researchers. The needs and interactions of stakeholders and access to digital agriculture differ significantly, which is influenced by various factors such as the type of activity, identified problems and others [3].

The use of platforms and multiple stakeholder engagements can result in improved interactions between platform members and their local environment, proactive participation in platform meetings, and a significant increase in farmers’ knowledge about the challenges. The use of platforms can also contribute to enrichment of agricultural production and smart business. Also, innovation platforms can facilitate the collective understanding and use of ready-made options (climate-smart agriculture options) that provide an answer to potential problems [13].

Innovation platforms can be considered as means to develop and scale innovation, as a result of the idea creation of different stakeholders, and they can facilitate conflict resolution, negotiation, social learning and collective decision-making for coordinated action [12].

The key stakeholders we have identified in the innovation process are presented in table 1.

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Role description</th>
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<tbody>
<tr>
<td>Idea creator</td>
<td>An idea creator is any participant in an innovation process who creates an idea or innovation related to a process, product, or performance of an activity. In an agricultural enterprise, it can be any employee of the enterprise who creates an idea or proposes an innovation.</td>
</tr>
<tr>
<td>Expert</td>
<td>Expert represents external knowledge, i.e. research groups, institutions or universities that through their scientific contribution, research and projects contribute to the development of the field and help solve problems or develop ideas. In an agricultural enterprise, these can be external partners with whom the enterprise cooperates and carries out research projects in the field of agriculture. One of the examples of such cooperation is the implementation of experiments in farming where the results of varieties of different seed houses are tested, and everything takes place within the cooperation of the Ministry of Agriculture, i.e. the Sector for Professional Participation in Agriculture, seed distribution companies and agriculture.</td>
</tr>
<tr>
<td>Owner</td>
<td>Owner is the party that identifies the problem and emphasizes other actors on the platform to present their ideas. It can be the owner of an agricultural enterprise or the manager of a certain segment of agricultural production or process. Given the complexity of the agricultural sector, problems can be identified in different business segments.</td>
</tr>
<tr>
<td>Member of experiment</td>
<td>A member of an experiment is a member of a team who works on a particular idea or innovation and participates in its development, which should ultimately result in the development of a prototype process model, product prototype, or a new business concept. These can be experts in the same field or teams that combine knowledge from different fields.</td>
</tr>
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The value IMS can bring to each of the identified stakeholder is shown in the next chapter and can help in defining their benefits.

IV. VALUE OF IMS FOR STAKEHOLDERS

The value of IMS for identified stakeholders is presented through the Value proposition canvas (VPC) [14] in figures 1, 2, 3 and 4. VPC consists of 2 parts, The Customer and the Value part. The Customer side deals with customers’ jobs - what they want to do; pains - what are the problems they are facing when doing their jobs; and gains - what they expect to get as a benefit. The Value side describes the product or service which is offered - in case of this paper the IMS; pain relievers - how they help in neutralizing pains; and gain creators - how they create wanted benefits.

IMS platform and innovation process enable the idea creator (Figure 1) to create and develop ideas. Idea creator
can be any participant who creates an idea for a specific problem of the agriculture business. In addition to creating the idea, the basic job of the idea creator is to participate in the development of innovations, work on patents and participate in the experiment of using the idea. IMS platform enables idea creators to identify existing ideas, exchange ideas with other stakeholders, and play with ideas, ie create ideas related to agricultural products. This is possible through integration with other stakeholders, involvement in the development of agricultural businesses through the platform and the application of innovative methods in the development of the idea. The problems that an idea creator may encounter on the platform are the dissemination of own ideas and non-recognition of other good ideas, and in order to reduce the problems, the categorization of ideas and ready-made forms for creating ideas will help.

Experts (Figure 2) are external participants on the IMS platform and they are in charge of adding and creating knowledge units on the platform to make relevant knowledge units available to the farm, participating in creating solutions to specific farm problems and commenting and giving feedback on ideas created. The value that external experts achieve through engagement on the platform is contact and cooperation with private farms, which is the basis for further research in the agricultural sector, but also the contribution of science to the agricultural sector.
Owner (Figure 3) can be a business owner or a farm manager, who identifies the problems facing, initiates problem-solving activities in terms of generating ideas. The platform can allow the owner to launch initiatives to solve farm problems and manage ideas created by other stakeholders.

![Figure 3: VPC for Owner](image)

A member of experiment (Figure 4) participates in the elaboration of the selected idea/innovation, by commenting on the idea and adding relevant content for the development of the idea. Through the platform, acquisition of new knowledge in collaboration with external experts, upgrade of ideas and contribution to the development of selected ideas for further elaboration is enabled.

![Figure 4: VPC for Member of Experiment](image)

The application of digital technologies can offer many opportunities in agriculture and result in optimized agricultural processes, precise and smart agriculture, and an IMS platform can provide support to the innovation and development process. Collaboration and communication of stakeholders through IMS is one of the mechanisms for the exchange of knowledge and ideas leading to learning and innovation. IMS stakeholders are
provided with learning based on experience and examples of good practice and better results, such as faster decision-making, effective problem solving [11] and increased development potential. Also, the platform enables the creation of collaborative knowledge and the formalization and transfer of knowledge [3]. This form of cooperation encourages mass cooperation, socialization of knowledge and extensive use of information and knowledge, which facilitates and improves knowledge management in the agricultural enterprise. Establishing stakeholder cooperation through IMS is an important factor in understanding innovation activity and as such supports farmers’ income and influences the innovation process. It also represents a strong link between support for innovation research and support programs for income of agriculture business [7].

V. CONCLUSION

The digital age brings great potentials of digital technologies usage and opens many opportunities for progress in diverse industries. In the agriculture, it brings new and raising expectations for improvements, but also, challenges are growing as well.

In this paper a short overview on how innovations related to digital technologies have penetrated in the agricultural sector has been shown.

Due to its characteristics of being mainly a traditional industry, highly dependent on environmental conditions, with relatively experienced human resources who dispose with a lot of domain knowledge and skills but lack the ones related to use of digital technologies, agriculture is relatively slow on adopting innovation ideas and implementing them. An innovation management system can help in identifying digital technologies that can bring benefits to the main actors and users and lead the implementation towards success. Digital platforms, as one of Industry 4.0 technologies have been shown as a possible technological solution, due to their ability to bring all stakeholders together and enable their collaboration and easy communication. This can lead to the development of new business models and new opportunities to increase economic value streams.

The value that a platform based IMS can contribute to all identified stakeholders is easily identifiable but is relatively hard to test. Our further research will therefore be directed into collecting more research data and evaluation of the presented value proposal on different case studies. That will for sure enrich and broaden our insights into the research field.

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