

Agricultural digitalisation and digital transformation: the future of agricultural competitive excellence in the 4.0 Environment**Digitalização agrícola e transformação digital: o futuro para a excelência competitiva no cenário 4.0**

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Renata de Souza França

Doutoranda em Sistemas de Informação e Gestão do Conhecimento. pela Universidade Fumec.

Instituição: Universidade Fumec.

Endereço: R. Cobre, 200 - Cruzeiro, Belo Horizonte - MG, 30310-190

E-mail: profrenatafranca@gmail.com

Fabício Ziviani

Doutor em Ciência da Informação pela Universidade Federal de Minas Gerais.

Instituição: Universidade Fumec; Universidade do Estado de Minas Gerais e Fundação Dom Cabral.

Endereço: R. Cobre, 200 - Cruzeiro, Belo Horizonte - MG, 30310-190

E-mail: contato@fabricioziviani.com.br

Cristiana Fernandes de Muijder

Doutora em Economia Aplicada pela Universidade Federal de Viçosa.

Instituição: Universidade Fumec.

Endereço: R. Cobre, 200 - Cruzeiro, Belo Horizonte - MG, 30310-190

E-mail: cristiana.muijder@fumec.br

ABSTRACT

Agriculture is a knowledge-rich sector that travels along paths of development and reaches the digital age. The objective of this article is to propose a model for competitive excellence in the 4.0 scenario of agriculture while considering the pillars of Digital Agriculture and Digital Transformation that have emerged in the literature. Through qualitative research, articles that contemplate the themes that were present in the bases Scopus, Embrapa and Capes were recovered and analyzed. In the end, it was identified that the elements: legal-political environment, strategic planning, digital transformation roadmap, and digital agricultural transformation, are important for agricultural excellence and the implementation of Agriculture 4.0.

Keywords: Agriculture; Digital Agriculture; Agriculture 4.0; Digital Transformation; Agricultural Excellence.

RESUMO

A agricultura é um setor rico em conhecimento que perpassa por caminhos de desenvolvimento e chega a era digital. Esse artigo tem por objetivo propor um modelo para excelência competitiva da Agricultura, no cenário 4.0, considerando os pilares da Agricultura Digital e Transformação Digital, emergidos pela literatura. Por meio de uma pesquisa qualitativa, artigos que contemplem as temáticas e que se encontravam presentes nas bases Scopus, Embrapa e Capes foram recuperados e analisados. Ao final, identificou-se que os elementos: ambiente político legal, planejamento estratégico, roteiro de transformação digital e transformação agrícola digital, são importantes para a excelência agrícola e para a implantação da Agricultura 4.0.

Palavras-chave: Agricultura; Agricultura Digital; Agricultura 4.0; Transformação Digital; Excelência Agrícola.

1 INTRODUCTION

The contemporary world, characterized by globalization and the invisible threshold of physical borders, demands new models of economy. Information and Communication Technologies (ICTs) open spaces for strategies that focus on automation and continuous generation of information and knowledge. "The traditional strategic planning process, based on episodic actions of the definition of vision and fixed priorities, for periods of four or five years, needs to be revisited" (EMBRAPA, 2014, p.16). It is necessary to adapt and improve business models to meet market globalization, export rules, consumer desires and to plan innovation systems (ANTUNES; DIAS; MAEHLER, 2016; BOLFE, 2016). It is important to envision technologies as strategic means that generate value, not as an end resource.

Agriculture, as well as the industry, develop and gather traditional actions, automated processes and intelligent machines (WANG, 2011). Digital agriculture becomes a way for modernization, integration, and automation of agriculture and promotes it as something economical, mechanical, intelligent, high quality and high yielding (ANDERSEN; JENSEN; SKOVSGAARD, 2016). However, automating farming mechanisms only generates data for farms. Handling data with austerity does not guarantee scientific practice or efficient application of agronomic knowledge. Digital agriculture addresses concerns(?) about cyber-physical grouping and arrives at Agriculture 4.0. Weltzien (2016) conceptualizes Agriculture

4.0 as the technology capable of automating cyber-physical systems through networks and different machines.

The purpose of this agriculture is to support cross-platform integration and enable systems to be interoperable. Rather than computing, agriculture 4.0 now encompasses the integration of tools and systems with physical and human resources to meet the production requirements of the industry and support their management (LIANG et al., 2005). However, aspects of Agriculture 4.0 are still related to technical and technological development, with algorithms and tools that automate some of the productive processes (SHAMSHIRI et al., 2018) and is widely applied as Digital Agriculture (WELTZIEN, 2016) . Changing this scenario requires new visions of strategies that affect the culture of labor operation, human and professional relations, and agricultural business models (VUPPALAPATI, 2017).

Weltzien (2016) stresses that there is no way to affirm a broad establishment of application of Digital Agriculture and its derivations since data alone supports only the times of the collection of the farms and is not enough for their strategies. Changing this scenario requires vision of strategies that affect work culture, human, social, and professional relationships and agricultural business strategies (Vuppalapati, 2017). Consequently, Digital Transformation is a tool that mitigates the complexities of unfolding digital agriculture, offering opportunities for the creation of value in the agricultural scenario. Vaz, Apolinário, Correa, Vacari, Gonzales, Drucker, Bariani, Evangelista & Romani (2017) characterize digital transformation as a means of revitalizing business and improving effectiveness, sustainability and efficiency through innovations in product and service offerings.

This article's objective is to propose a model for competitive excellence in Agriculture in the 4.0 scenario, while considering the pillars of Digital Agriculture and Digital Transformation that have emerged in the literature. In order to do this, the following question must be considered: what factors influence competitive excellence in the agricultural era 4.0, based on the pillars of Digital Agriculture and Digital Transformation? To reach the objectives and answer the research question, this article is divided into 6 sections. It begins with a brief contextualization of the thematic and the research objective in this section. In section 2, the concepts needed to understand the study are presented, followed by the methodological procedures in section 3. Section 4 reports the results of the study, proposing a research model. Prior to this proposition, the sector's complexities were reported in the digital age and the elements that emerged from the retrieved studies. Finally,

the final considerations (section 5) and the bibliographic references used (section 6) are discussed.

2 AGRICULTURAL VISION IN THE DIGITAL AGE

A generator of wealth, economic symbol and means of subsistence, agriculture, as well as industries, has developed and is inserted in the digital era. In order to meet the demand of the population, which also expands significantly, the aspects of innovation and construction of agricultural systems (Şerbu, 2014) have become key factors for the success of agriculture. Tang, Zhu, Zhou, Liu & Wu (2002) separate agriculture in three phases. The first, denominated by Primitive Agriculture is characterized by the work done by stoneware. The second, called Traditional Agriculture, is the use of tools and hardware. The third and current phase, called Digital Agriculture, is characterized by the use of advanced machines.

Digital agriculture becomes a path to modernization, integration, and automation of agriculture. It is economical, mechanical, intelligent, high quality and high performance (Andersen, Jensen & Skovsgaard, 2016). Digital agriculture is the macro view of the application of technologies in agriculture and was derived from the concept of Digital Earth in the 1990s (Shena, Basistb & Howardc, 2010). This type of agriculture is an essential factor for practices in the sector that gives rise to more specific and timely farming methods and processes, such as precision agriculture. Precision farming is characterized as a modern, high-tech farming method, which is based on advanced technological information and requires the development of digital agriculture for its techniques to be applied (Tang et al., 2002).

Weltzien (2016) points out that there is no way to affirm a broad establishment of application of Digital Agriculture and its derivations since data alone supports only the harvesting time of the farms, but they are not enough for their strategies. Digital Agriculture is developed for the denomination of Agriculture 4.0 when proposing the integration of the physical spaces to the digital spaces, next to the automation processes. Weltzien (2016) conceptualizes Agriculture 4.0 as the technology capable of automating cyber-physical systems through networks and different machines. The purpose of this agriculture is to support cross-platform integration and to make systems interoperable and as close as possible to realistic ideas. Rather than computerization, agriculture 4.0 now encompasses the integration of tools and systems to meet the production requirements of the industry and support its management (Liang, Hong, Fen & Xiang, 2005).

However, to a large extent, aspects of Agriculture 4.0 are still related to technical and technological development, with algorithms and tools that automate isolated parts of the productive processes (Shamshiri et al., 2018). It is also widely applied as Digital Agriculture (Weltzien, 2016). Modifying this scenario requires new visions of strategies that affect the culture of the work operation, human and professional relations and agricultural business models (Vuppapapati, 2017), proposing the integration of Digital Transformation to the Agricultural scenario.

3 DIGITAL TRANSFORMATION: THINKING ABOUT CREATING VALUE IN THE DIGITAL AGRICULTURAL ENVIRONMENT

The technologies currently applied create visions and strategies that affect the culture of the work operation, the human relations and the speed of the organizations change. Technology is the core operation of the business. According to the World Economic Forum (WEF) (2016), technologies that transform, value creation opportunities and that, when grouped into business models, provide unparalleled competitive advantages. The term Digital Transformation was inserted, in the beginning, as the implantation of technologies that facilitated the digitization and storage of organizational information (Sanchez & Zuniti, 2018). Over the years, and with the continuous evolution of technologies and their creative goals, digital transformation has improved and become concerned not only with storage but with the entire process of digitized operations (Rogers, 2016).

There is a junction of technology to business, reshaping the *modus operandi* of how business is done, communicated and developed. Another important factor in digital transformation is that customers do not just have the role of buying and selling, accepting or not a product. They are now part of connections that interact with each other and have great power of decision and influence (Rogers, 2016). The organization and the agricultural field remain the protagonists of the process, but now they are faced with active clients who know what they want, who participate in the business and who are already perceived as a source of information, innovation, and creators of products and services.

In the Digital Transformation scenario, technology works in favor of farms and companies, but with visualizing integration, growth, efficiency, and value creation, with the customer as the core of the transformation. It is a new way of doing business, capable of stimulating organizations, governments, and countries in the construction of digital policies for solutions to everyday problems, in the innovative (Goerzig & Bauernhansl, 2018) and

systematic (Kotarba, 2018) growth of the agricultural environment. This view also modifies the way to create new ventures (Demirkan, Spoher & Welser, 2016) and has technology as an enabling tool (Patel & McCarthy, 2001).

4 METHODOLOGICAL PROCEDURES

This research argues that that subjects related to practices and studies on digital agriculture and digital transformation provide excellent social, sectoral and marketing results and allow the application of agriculture in the 4.0 era. This defense is understood and emphasized through the analysis of present scientific studies. This qualitative research accomplishes that by collecting previous studies from the SCOPUS, CAPES and EMBRAPA databases (available at: www.scopus.com; www.periodicos.capes.gov.br; www.embrapa.br/seb/periodicos-da-embrapa, respectively) that included descriptors linking the topics researched

For the validation of the existence of studies that interact with the themes of Digital Agriculture and Digital Transformation in the 4.0 era, the junction of the descriptors Digital Transformation and Agriculture 4.0 were used. There was no return of studies correlating the terms in their abstract, keywords or titles. Deepening the factors identified by the paradigm of modern agriculture, the term agriculture 4.0, still recently explored, has been used interchangeably with Digital Agriculture. Although they have different meanings, they are consonant, expressed and understood in an egalitarian way (Weltzien, 2016).

For the solution of this demand, a new search was carried out contemplating the descriptors Digital Transformation and Digital Agriculture or Agriculture 4.0. As a result, among all the bases, a (01) scientific article belonging to Embrapa, which is titled "AgroAPI: creation of value for the Digital Agriculture through APIs" was obtained. The article reports the creation of an application to create value in agriculture, bringing principles of digital transformation, but focusing on the technological practices of agricultural digitization and proving the ideas of Weltzien (2016). The scarcity of results provides and raises the need for the research proposed in this article.

In order to arrive at works that were considered related and consistent with the relation of the terms proposed, a research was carried out based on the Digital Transformation in Agriculture; Digital Agriculture or Agriculture 4.0. This combination allows the current scenario, containing the proposed themes, to be understood in its entirety and becomes expedient for new propositions. The descriptors were used. The research was completed on

January 12 and 13, 2019 and had as an adaptation that of Dresch, Lacerda and Antunes Jr. (2015). A total of 156 articles were identified, of which 115 belong to the SCOPUS database, nine (09) belong to the CAPES database and 32 belong to the Embrapa Newspapers database. Consequently, the exclusion criteria and filters were applied. The first filter was withdrawn by duplicate studies. Of the total, a number of 13 were in duplicated .

In sequence, the abstracts and summaries were read to identify the proposed constructs and a better understanding of each subject. A total of 63 studies were performed, most of which presented technical reports and specific development of technologies and algorithms. The result portrays Bingwen's (2005) report in defending the deficiency of scientific development in the area. For the author, there is an excess of technical studies that report only algorithms or serve partitions of the agricultural sectors and not the integration as it is truly proposed. After the abstracts were read, the articles were downloaded and 18 of them were identified. Finally, the retrieved articles were read in their entirety, maintaining the same filter criteria (absence of model, relation of construct, among others). In the end, 33 articles were recovered. Among them, four were cited in the studies and although they were not recovered in the databases, they were included for to be identified as a relevant source to follow up on the investigation proposed here.

5 RESULTS AND DISCUSSIONS

Data and information that are captured and presented without preparation, "become unusable in the construction of knowledge" (Laville & Dionne, 1999, p 198). Therefore, prior to the results, a descriptive analysis of the articles was performed. It was observed that the beginning of the topics developed occurred in the year of 2002, with greater intensity from 2010 and representativeness in the year 2017. There was a gap of publications between the years of 2015 to 2010, spanning five years without publications of the referred subjects. The result is based on two biases: (i) the themes are recent and are still in discovery and/or; (ii) access to technologies leads to studies and the search for solutions to the problems of the agricultural environment and increases the number of studies in the area.

The authors of the studies from networks of knowledge, aligned themselves with the importance of the authors Wang, Y and Wang, X. Networks are sets of nodes and relations that demonstrate the interactions between the authors involved. These interactions are established by common values and interests (Moraes, Furtado & Tomáel, 2015). The authors represent the nodes and the loops that bind to each other, represent the existing interactions,

or the lack of them. Wang, Y and Wang, X are responsible for grouping clusters and maintaining relationships between authors in search of results for studies on the topics of digital agriculture or digital transformation.

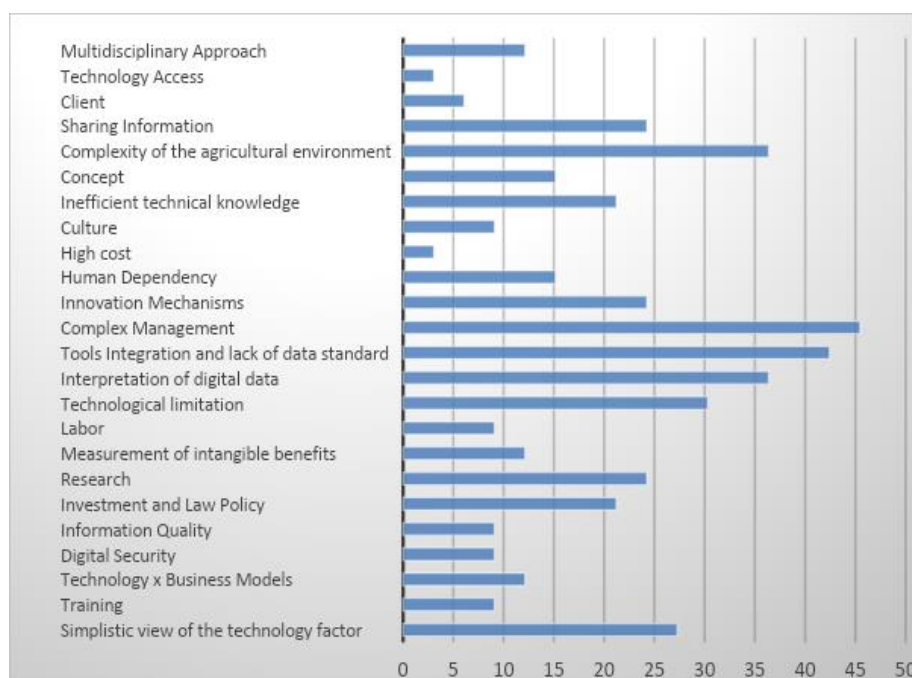
The authors share ideas, resources and stimulate the links of scientific research. The absence of these researchers would provoke the existence of isolated clusters that would not benefit science (Rocha, Costa & Silva, 2018). It is pointed out, then, the uniqueness of this type of research and the need for development on the world stage. For the presentation of the whole approach proposed in the study, the "Results" section is divided into three subsections: (I) survey of the factors hindering the application of digital agricultural transformation; (II) emerging factors of the studies retrieved to propose a model and, (III) proposing an agricultural model.

6 THE MISFORTUNES FOUND IN MODERN AGRICULTURE

When one speaks of a "digital" context, one is soon thinking of implementing systems and tools. The digital revolution excels at this scenario and provides resources for improving product and service innovations, whether for efficiency, effectiveness or sustainability (Dermikan, Spohrer & Welser, 2016). The challenges cited by the studies were raised, analyzed and consolidated. The survey provides a holistic view not only of the models but of the difficulties that need to be overcome, even if the models are applied.

The challenges faced by digital agriculture, through technological mechanisms and knowledge. On the one hand, the most reported difficulties are not in technology, but in its application and in the results that these bring to the agricultural sector. Agriculture faces challenges beyond its practices that although not fully controlled, directly impact production and make the management of agricultural processes complex, such as climatic variation, water scarcity, and social concern. (Nie et al. , 2010) (Picture 1).

Picture 1- Challenges of modern agriculture



Source: research data

The absence of integration of the technological tools and the lack of standard of the data generated, which do not make the systems scalable and efficient (Wang et al., 2017) are also mentioned. Wang et al. (2017) explain that current systems do not have data portability and do not allow them to be connected to tools of different brands, so they do not talk to each other and do not share information. There is a scenario of tools that collect data continuously, but which need to be treated by high statistics to be understood and still partitioned (Shamshiri et al., 2018). In terms of technology, tools are presented, as well as the absence of technical knowledge (Shamshiri et al., 2018) and digital knowledge (Weltzien, 2016). Most users are not trained to handle the technologies and interpret their information or do not have sufficient technical knowledge to do so.

Rajeswari, Suthendran, and Rajakumar (2017) emphasize that technologies alone have considerable values, but these, when not understood, generate still incipient values for real competitiveness. Perhaps these are the causes of the difficulty of understanding the benefits generated by these tools and the lack of mechanisms of innovation in the sector. Furthermore, tool development is applied to partial and highly technical contexts, therefore it does not serve the field comprehensively (YAO, WU, 2011; SHINDE et al., 2014). This makes the

technology simplistic, in relation to the vision one has about it, and it is complex in its use (Liang et al., 2003; NEHRA, NEHRA, 2005).

Wang et al. (2011) and Rajeswari, Suthendran and Rajakumar (2017) emphasize that managers and farmers themselves are often unaware of applied innovations and the very concept of Digital Agriculture. Therefore, they cannot apply it adequately. This lack of knowledge can also raise costs and demand costly research in the scenario (ALENCAR et al., 2017), which in turn is precarious in investments and projects of laws (YONG et al., 2003; RAJESWARI; SUTHENDRAN; RAJAKUMAR, 2017). Agricultural information by itself is already highly complex, either by the quantity generated, by the variety of factors that impact the sector, including the external environment, or by the lack of integration between systems and investments.

Digital Transformation combined with Digital Agriculture emerges as an outlet for market access, through the proposition of rapid cycles of innovation, value delivery (Rogers, 2016), high levels of collaboration (Wang, 2011) and market monitoring (Vaz et al., 2017). These factors support the reduction of research and production costs, a better management model, and even an easy perception of values when using technologies. Digital transformation offers integrated and intelligent solutions applicable to the reality of the field. The eminence of technologies exceeds farm thresholds and, consequently, puts the field in line with global production requirements and competitiveness factors.

6.1 PILLARS OF DIGITAL AGRICULTURE AND DIGITAL TRANSFORMATION, EMERGED FROM THE LITERATURE

In an attempt to propose an effective solution for agriculture in the digital age and propose a means of competitive excellence, the authors sought to identify the factors that emerged from the studies recovered by this article. The idea is that the union between the factors of digital agriculture and digital transformation propitiate the development and applicability of Agriculture in the 4.0 era, already quoted in the literature (Jayaraman et al., 2014, Massuruhá & Leite, 2016), but still unexplored (Weltzien, 2016).

Factors focused on knowledge, information sharing and human development, are pervaded by different models in both conjunctures. One does not negate the other and reinforces the idea that the opportunity for sustainable agricultural development can be

enhanced by integrating the factors of Digital Agriculture and Digital Transformation (Picture 2).

Picture 2- Factors of Digital Agriculture and Digital transformation

Digital Agriculture	Digital Transformation
<ul style="list-style-type: none"> ▪ Open source application ▪ Database with uniform structure and standard data on agriculture ▪ Government, industry and scientific systems information and cooperation ▪ Knowledge-based culture ▪ Agricultural technological infrastructure and structures ▪ Shared data and information system ▪ Decision and forecast business system ▪ Research and Innovation System ▪ Production System and Remote Services ▪ Learning systems and practical experience ▪ Systems of laws, investments and regulations ▪ Market Systems ▪ Systemic solutions, networks and mobile 	<ul style="list-style-type: none"> ▪ Open Systems Architecture ▪ Database with uniform structure and standard data on agriculture ▪ Value Chain ▪ Client ▪ Culture based on knowledge and collaboration ▪ Value Delivery ▪ Knowledge management ▪ Identification of skills and training ▪ Laws, investments and regulations ▪ Partnerships and co-creation ▪ Platform for cooperation and competition ▪ TD deployment process ▪ Digital Transformation Roadmap ▪ Shared system of shared agricultural data and information ▪ Business Management System ▪ Information System - production and remote services ▪ Research and Innovation System ▪ Agricultural Digital Solutions ▪ Systemic solutions and modern technologies

Source: research data

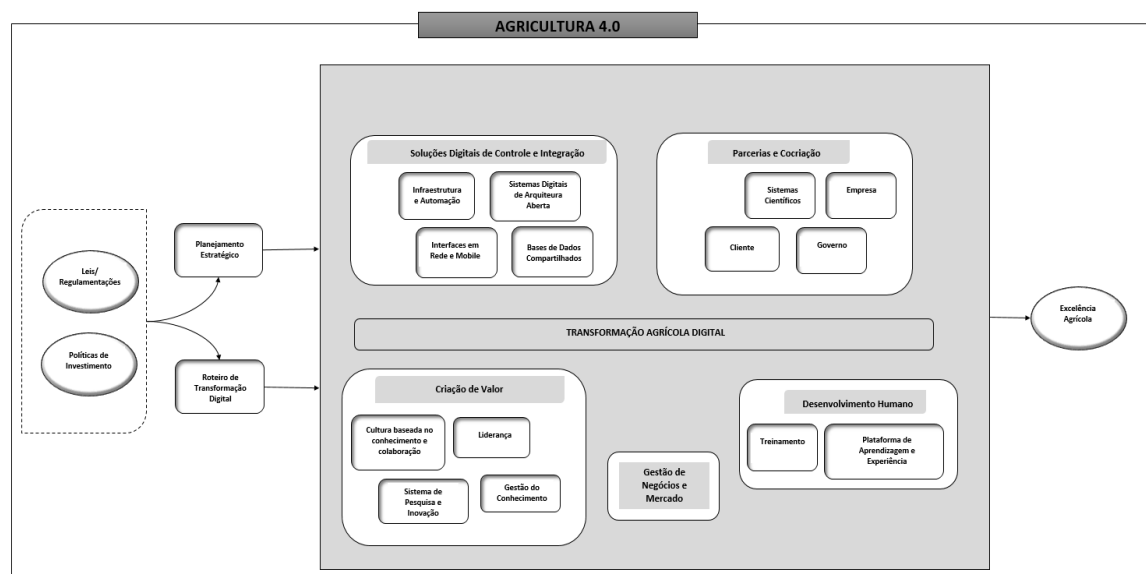
The factors of digital agriculture focus on the applicability of the tools that can be used in agriculture for the capture, storage, and sharing of field data. These tools are able to make production processes more manageable and field operations oriented and sustainable (Wang et al., 2017). In addition to the tools, , more than just maintaining them, digital agriculture proposes data standards and metadata for the integration of resources, supplying deficiencies of integration of models, as cited by Alencar et al. (2017) and Shamshiri et al. (2018). The factors of Digital transformation, in addition to the technological dismemberment, already mentioned by Digital Agriculture, bring the idea of planning, growth and value creation.

Based on value delivery methods (Vaz et al., 2017, Sanchez & Zuniti, 2018), knowledge management (Rogers, 2016), innovation and research (Vaz et al., 2017), digital transformation proposes to agriculture a holistic and market oriented view of production. In order to address these demands and the need to minimize agricultural sector gaps to competitive excellence, a model of Agriculture 4.0 is proposed. Such a proposal becomes a

great benefit since it is understood that common industrial management strategies are not satisfactory when applied to the agricultural sector.

6.2 PROPOSITIONS OF A MODEL FOR AGRICULTURAL FIELD ORIENTATION FOR COMPETITIVE EXCELLENCE

Digital agriculture is seen as a development strategy for the agricultural landscape around the world. With the objective of seeking competitive excellence in the agricultural field, a model that is aligned with the strategic objectives of the market and the driving forces of Digital Agriculture and Digital Transformation is proposed. The model has a macro view of five variables. The variables designate research, which maintains relations of causes and values (LAVILLE; DIONNE, 1995). These are: Regulatory Political Environment; Strategic planning; Digital Transformation Roadmap, Digital Agricultural Transformation, and Competitive Excellence. All variables considered the studies recovered. Through continuous interactions, digital and business solutions are delivered that are effective for the development of agriculture. The model is shown in picture 3.



Picture 3- Model Propose

Through the proposed model, it is assumed that digital agriculture should be considered a means and not an objective to be achieved by the agricultural sector. Technologies should be applied as a tool that adds value (Rogers, 2016), but consistent with the field business

models. It is necessary to adapt and improve business models, to meet market globalization, export rules (Vaz et al., 2017), meet consumer desires (Sánchez & Zuntini, 2018) and plan innovation systems (Rogers, 2016; Vaz et al., 2017).

Therefore, a second-order variable called Digital Agricultural Transformation is created. This variable is composed of Digital Control and Integration Solutions (Tang et al., 2002); Nie et al., 2010; Bingwen, 2011; Wang et al., 2016; Liu et al., 2017; Rajeswari, Shuthendran and Rajakumar, 2017; Shamshiri et al., 2018; Speranza and Ciferri, 2017; Vaz et al., 2017; Wang, 2017), Business and Market Management (Bingwen, 2005; Wang, 2011; Rogers, 2016; Souza et al., 2017; Fresco and Ferrai, 2018), Value Creation (Duan, 2010; Wang, 2011; Jayaraman et al., 2014; Shinde et al., 2014; Dermikan, Spoher and Welser, 2016; Rogers, 2016; Alencar et al., 2017; Sánchez and Zuntini, 2018), Partnerships and Co-creation (Wang, 2011; Shinde et al., 2014; Rogers, 2016; Vaz et al., 2017) and Human Development (Nehra and Nehra, 2005; Baozhu and Lei, 2011; Bigwen, 2011; Wang, 2011; Weltzien, 2016).

Agriculture is a field composed of a high volume of information. This information comes from many different sources and has different characteristics. It has information on spatial domain, temporal variability, machines, and production. Therefore, there is a need for digital tools that support the capture, processing, and storage of industry information (BINGWEN, 2011) and provide measurements that can be reliably used in agriculture. The implementation of digital solutions rests on the model as an AD practice that directly supports the rise of the agricultural field, providing useful and timely information (NEHRA; NEHRA, 2005). There is a suitable and realistic infrastructure (WANG et al., 2017), which provides the least human intervention (WANG et al., 2016); virtualisation technology for interface management (SHEN et al., 2011) and creation of virtual farms (SHAMSHIRI et al., 2018); shared database (SPERANZA, CIFERRI, 2017); systems in networks with virtual interfaces (SHAMSHIRI ET AL. 2018) and digital solutions with unified standards and open architectures (SPERANZA, CIFERRI, 2017)

The new business models require partnerships and interdependence to meet market challenges. Collaboration networks are formed, both client networks and networks of contacts and collaborations between companies (ROGERS, 2016). Relationships with suppliers, consumers, and universities, among others, are seen as organizational strategies for creating value and gaining competitive advantage. In these partnerships, Rogers (2016) reports the importance of the client as an opinion maker and supporter of the productive processes. As Wang (2011) reports, the partnership with companies, universities, scientific institutions and

government create possibilities for dynamic market analysis, with an open field of exploitation of international digital commerce (WANG, 2011).

These partnerships break the barriers of agricultural monopolies, mitigate technical barriers, and allow farmers of any size to be prepared for the market. The intention is to create multidisciplinary dialogues (FRESCO; FERRARI, 2018) with the objective of improving agricultural performance, either through resource availability, sharing of best practices or even crowdsourcing, as cited by Vaz et al. (2017). In the same vein, the research and innovation systems come as a pillar of the Digital Agricultural Transformation. The aim is to support digital agricultural revolutions and promote social development (DUAN, 2010). The mechanisms of innovation allied to production and education (LIANG et al., 2002) derive important projects that assist the sector in ascending.

On the one hand, activities that bring new ideas, techniques and methods should be recognized as tools to support the performance of the field. Therefore, it is believed that factors such as: Research and Innovation Systems, Knowledge Management, Knowledge-Based Culture and Collaboration, and Leadership Relationship are essential for agriculture. On the other hand, the agricultural sector is under a global market regime (HERLITZIUS, 2017), however Wang et al. (2011) show in their studies that agricultural producers present inept notions about the market. Moreover, this information does not even reach them in a timely manner (HU; ZHANG; DUAN, 2015). Nevertheless, age competition is composed of digital disintermediation (ROGERS, 2016), sectoral boundaries are fluid, and the definition of competitors has become complex.

Maintaining systems with market and business environment information optimizes farmers' decision-making, which is then provided with useful and time-sensitive information. Prices, harvests, world best practices, market analysis information, and industry forecasts can be shared. This will be an "open and broad field for the trade of international digital agriculture" (WANG, 2011, p. 91). Governments can be characterized as contributors, propose funding policies and investments based on system data, conduct business transactions via, issue alerts, and much more (SOUZA et al., 2017). A fully automated and digital agriculture cannot be expected. "Modern farms are expected to produce more quality incomes at lower costs in a sustainable and labor-dependent manner" (SHAMSHIRI et al., 2018, p.2). In this sense, one must worry about the development and talent of the whole team. Nehra and Nehra (2005) emphasize that farmers are often not aware of techniques and innovations and are not prepared to understand the data provided by digital tools.

Many farmers do not adopt technologies because of a lack of knowledge or limitations. It is in this sense that the Variable Human development is proposed. Insufficient knowledge, low technical and digital notions and lack of understanding of AD can lead to limiting and ineffective business and production. Capacity-building systems target farmers in the execution of their day-to-day activities, tool handling, and the creation of innovations and techniques. The possibility of a system and training bases creates links between farmers and scientists and promotes the generation of knowledge among all those involved (NEHRA, NEHRA, 2005; BIGWEN, 2011; WANG, 2011). It is these training programs that will enable the transfer of tacit knowledge that will support business growth strategies (De MUYLDER, et al., 2018) through connections with the producers themselves in problem-solving.

It is believed that the Digital Agricultural Transformation, composed by the integration of Digital Agriculture and Digital Transformation, directly influences the agricultural competitive excellence and is influenced by planning and strategy factors. Rather than technologies, agricultural sectors are influenced by external, non-dominating factors that need to be followed, such as the laws and regulations and the investment policies offered, which are presented in the model. Baozhu and Lei (2011) emphasize that the rules applied to decentralized investments and capital systems often provide low-level, small-scale, and even redundant agricultural processes. Incipient investments and weak legislation make agricultural development slow (WANG, 2011).

The model considers that the legal policy environment, composed of investment laws / regulations and policies, relates directly to the strategic planning and the Roadmap for the application of digital agricultural transformation. These factors, even if external to the sector, determine the rules by which sales and the production process will be guided. The definition of strategic planning and Digital Transformation guidelines also indicate the applicability models of field scanning. TANG et al., 2002, YANG, WANG and ZHUANG, 2010). The management models applied to industrial environments are not applicable to the sector, which presents a complex amount of information, requirements, inputs and risks.

Good work in strategic planning can imply good results in the application of Digital Agricultural Transformation, as well as avoid risks of computerization and waste (YANG, WANG; ZHUANG, 2010). It allows for progressive, innovative practices that holistically impact the levels of the agricultural field. In the same perspective, the Digital Transformation Roadmap needs to be defined to support the processes of change and focus on culture, innovation and collaboration. The scans will be understood and their values visualized, as

reported by Rajeswari, Shuthendran and Rajakumar (2017). In addition, through the Digital and Agricultural Digital Transformation solutions, there will be integrated technologies, automated processes with the application of intelligent systems, people skills and intelligence for interpretation and data application. The entire productive process will be based on policies and investments and on the plans consistent with the reality of the field, but with a focus on global development.

7 FINAL CONSIDERATIONS

Digitization has reached agriculture and there is now the quest for production excellence and competitive advantage. Rather than include technological resources, modern agriculture requires automation, integration, competition, and knowledge. However, what is found are technical applications that serve isolated parts of farms. In view of this, this article proposes integration of digital agriculture and digital transformation as a real application of Agriculture 4.0. This integration and model proposition can lead to the possibility of growth of the sector. As a result, internal and external factors are integrated into agriculture, which in turn seek the competitive excellence of the sector. External factors such as legal political environment, strategic planning and transformation roadmap are essential for digital agricultural transformation practices.

Digital agricultural transformation is characterized by the pillars of digital agriculture and digital transformation: digital integration and control solutions, partnerships and co-creation, business and market management, value creation and human development. It can be concluded that the factors of innovation, systems integration, automation, processes, and research are steps for agricultural development in the new century. More than scanning, Agriculture 4.0 becomes a means to reach more competitive and solidified levels. Technologies need to be integrated with business models and effectively serve customers and market regulations.

The objective is to develop agricultural competitiveness and generate actions that go beyond farms' barriers and increase the possibility of competition. Therefore, this article brought a vision beyond technical structures and developments in specific areas in agriculture. It should be noted that this survey took place on a specific basis and was not validated through field analysis. As a future proposal, it is intended to apply the model in the Brazilian agricultural scenario, to verify the impact of the factors and the relation of the constructs that compose it.

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