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Information Management School

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Information Management
Specialization in Information and Decision System

Understanding the determinants of evaluation, adoption and routinisation of ERP technology (Enterprise Resource Planning) in the context of agricultural farms.

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A thesis submitted in partial fulfillment of the requirements for the degree of Doctor in Information Management under the supervision of Prof. Tiago Oliveira

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NOVA Information Management School
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Doctoral Programme in **Information Management**

Understanding the determinants of evaluation, adoption and routinisation of ERP technology (Enterprise Resource Planning) in the context of agricultural farms.

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"That which is done out of
love always takes place
beyond good and evil."

Friedrich Nietzsche

"Fortune (*the luck*) favors the
prepared mind."

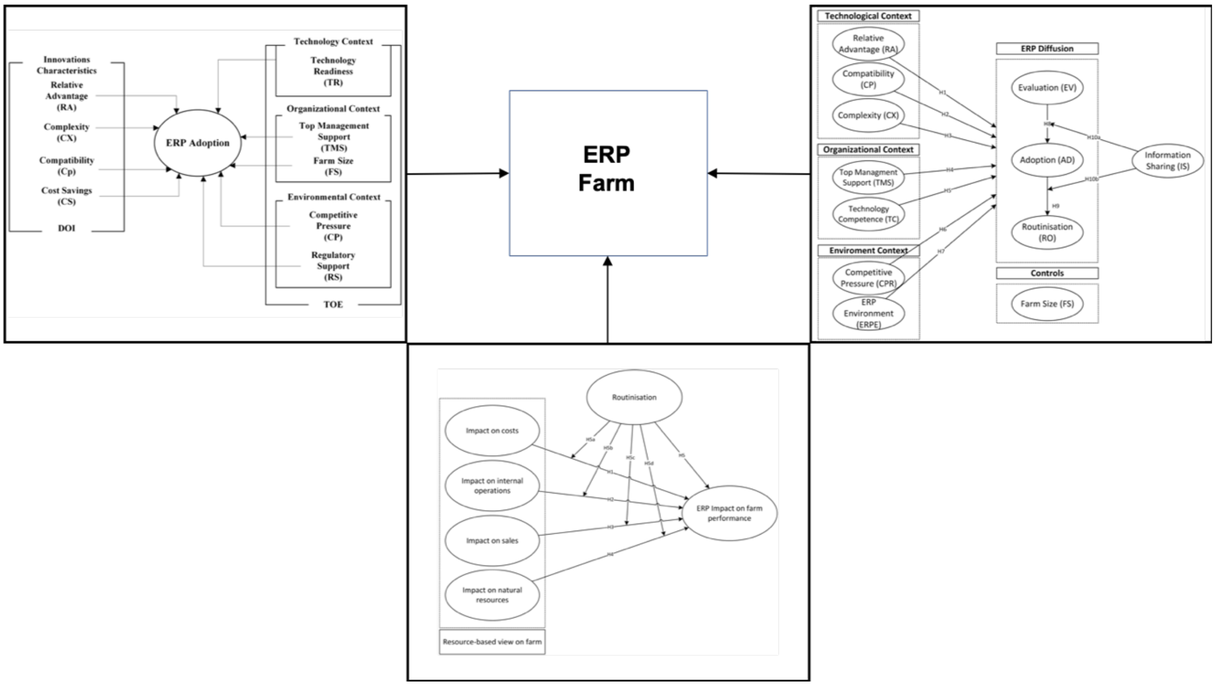
Louis Pasteur

Abstract

The purpose of this thesis is to investigate the determinants of the adoption of ERP (Enterprise Resource Planning) technology in agricultural farms in Brazil. The data were collected in 502 personal interviews with farmers of soy, corn, cotton, coffee, beans, wheat, peanuts, fruits, sugarcane and cattle raising, The data gathering instrument used for the quantitative research was built based on the result of the qualitative study in combination with three theories: Diffusion of Innovation Theory (DOI), Technology-Organization-Environment Framework (TOE), and Interorganizational Relations (IORs). Structural Equations (SEM) methodology was used to analyze the data and hypothesis. The results indicate the significant drivers for Evaluation, Adoption, and Routinisation. Also, we analyzed the ERP impact on farm performance based on resource-based view (RBV). We hope this work can bring a theoretical and practical contribution for the agribusiness field and also increase debates about the platforms on cloud computer based on ERP, Enterprise 2,0 and Industry 4.0. The results this thesis provide information to agribusiness owners, managers and administrators to promote and incentivize the use of ERP.

Keywords: Enterprise resources planning; Use of ERP technology. Management models. Agribusiness; Resource-based view on farm, Organizational impacts of ERP, Competitive advantage; Farms; Business analytics functionality; Industry 4.0.

Graphical Abstract



Publication

List of publication resulting from this these:

Chapter	Study name	Current Stage
5	Understanding the determinants of adoption of enterprise resource planning (ERP) technology within the agri-food context: The case of the Midwest of Brazil	Published in the International Food and Agribusiness Management Review. May 1, 2016
6	The adoption stages (Evaluation, Adoption, and Routinisation) of ERP based on business analytics functionality in the context of farms	Published in the Computers and Electronics in Agriculture. December 1, 2018
7	Performance perception and the Routinisation (RO) moderation on ERP Post-Implementation as determining factor of Competitive Advantage on Farms	Published in the Heliyon. May 17, 2019

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Sumário

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Chapter 1 – Introduction

1.1. Research context and motivation

Considering the growth of the world population, it is necessary to improve the efficiency of resources employed to produce food, fibers, proteins and energy. The importance and use of Information Technology (IT) in the agricultural sector is also growing, especially technologies related to Precision Agriculture and Smart Farming (Intelligence Agriculture) (Hoeren and Kolany-raiser 2018, p.109). Small, medium and large farms are rethinking their strategies concerning Information Technology including Enterprise Resource Planning - ERP to improve results.

From the economic point of view, agribusiness is considered a high relevance industry in Brazil. According CEPA-USP/CNA (2016) data base, Agribusiness represents 24% of Brazilian GDP (Gross Domestic Product) and 45% of all of Brazil's exportations in the year. In 2017, USDA ranked Brazil as the major world exporter for orange juice, sugar, coffee, soy and chicken and the second in beef and corn. Considering the market share, Brazil is the first world producer for orange juice, sugar and coffee as well as the second for beef, soy and chicken.

The farmers' inability to control the commodity prices in the world market, the exchange rate fluctuation, production costs and climate changes causes farmers to adapt and meet the market production demands. We consider the implementation of ERP based on business analytics functionality in the farms as the next relevant improvement capable to increase the food production in Brazil, when considering that results from another study that highlight the key role that the implementation of ERP Systems play as a moderator in the relations between different abilities, independence, feedback and work satisfaction in the context of technology-enabled organizational changes. (Morris and Venkatesh 2010).

1.2. Theoretical framework

1.2. **Agricultural Company**

According to Grant (1996), a firm or a company can be defined as the exploration of the coordination mechanisms through which it is integrated the specialized knowledge of its members. That is, a company integrates knowledge, both resident knowledge and the knowledge that can be created. Grant (1996) also explains that companies or firms can be defined differently by economic theories (prediction of firm behavior), organizational theory (analyzes the firm's internal structure and the relationships between its constituent units and departments, social theories (discusses why companies exist), transaction cost theory (focused on the relative efficiency of authority-based organization - hierarchies, contract-based organization - markets), firm behavior theory (integrating economic and organizational approaches to the firm theory) and the strategy schools (explains company performance and the determinants of strategic choice). Based on these concepts and our knowledge of this sector, we define the farm as an agricultural enterprise that incorporates minimal technical and economic knowledge, by using limited labor and capital resources, which makes decisions necessary to develop a particular production system (agricultural or livestock) for the purpose of achieving long-lasting productivity, perpetuating success for future generations, integrating production management by combining production technologies, and integrating the production chain of their business.

1.2.2 TOE, DOI and IOR

There are several models for acceptance and adoption of technology, including technology, organization and environment (TOE) framework, diffusion on innovation (DOI) theory and interorganizational relationships (IOR) theory.

TOE has consistent empirical support and is useful in the study of various types of technological adoptions (Y. M. Wang, Wang, and Yang 2010). On the other hand, DOI Theory studies the spread of innovations and how it is communicated through channels over time and inside a particular social environment (Rogers 1993). As implementing ERP on Analytic

Insights Platforms involves establishing IORs, including trust and information sharing, it is important to consider IORs when studying the diffusion of ERP to the cloud computing. Based on the past literature, this study used the TOE framework and DOI theory and extends it with the IOR attributes.

1.2.3 Extended unified theory of acceptance and use of technology (UTAUT 2)

Venkatesh et al. (2003) developed the unified theory of acceptance and use of technology (UTAUT). This model considers that three constructs are determinant for behavior and behavioral intentions: (i) expectation of performance, (ii) expectation of effort, (iii) social influence and facilitating conditions. Our intention is not to use the whole model. We want to have elements that allow us to better explain the Top Management Support construct for farmers' decision-making to adopt technology using Performance Expectancy, Effort Expectancy and Use Behavior.

1.2.4 RBV theory

Value-Based Resource Theory (RBV) argues that firms have resources: a subset that allows them to gain competitive advantage and a subset of resources that lead to superior long-term performance. Resources that are valuable and rare can lead to the creation of competitive advantage. This advantage can be sustained over longer periods of time, insofar as the company can protect against imitation, transfer or replacement of resources (J. B. Barney and Arikan 2001).

1.3. Research focus

The scope of this work is to overcome the aspects of the technologic variables and highlight the aftereffects of the technological implementations (Venkatesh, Davis, and Morris 2007b).

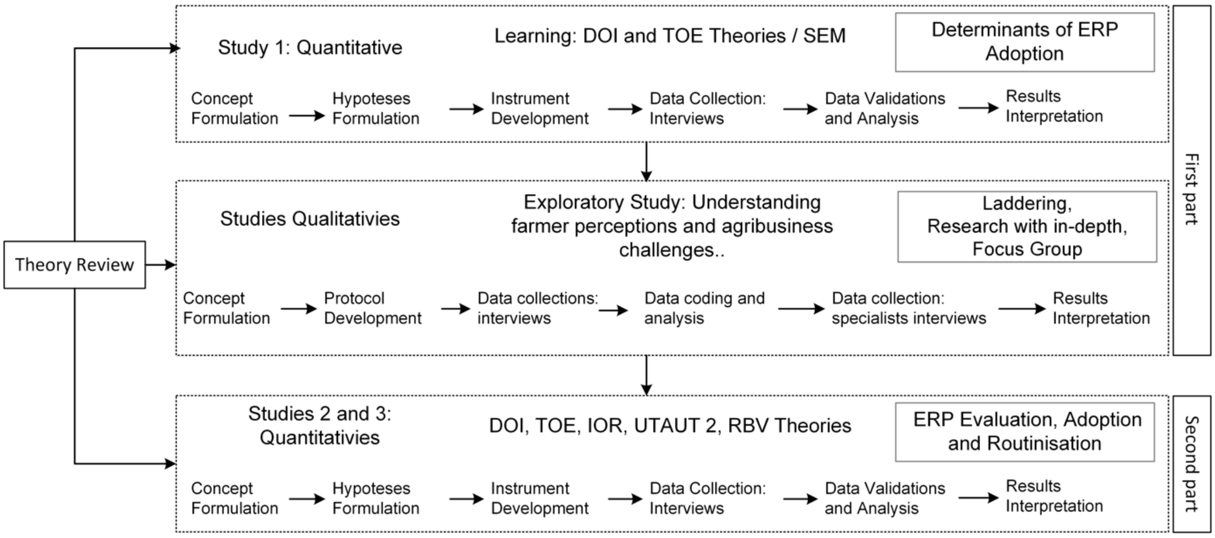
The purpose of the study is to evaluate the stages of technology diffusion. Our focus is to evaluate the consequences of the stages of adoption and technology implementation. Because farming requires intensive work in the land, new regulations are created everyday to enhance food and environment securities and, consequently, the number of best practice management tools to be applied on precision agriculture has also increased (Kaivosoja et al. 2014). However, it is still necessary to increase investments for ERP implementation on the farms (Sykes, Venkatesh, and Johnson 2014).

Although the conditions that define this type of organizations are not the same for all such as climate, region where it is located, type of farming or livestock, we believe it is possible to find a standard and customized method to manage farms. Considering the changing paradigm, we now face a more open relationship between the parts of the farm and also among a farm and its peers which allows more effective collaboration overall. We understand that the ERP based on business analytics functionality can fulfill all the needs for more sharable relations and it can also work efficiently as a standardized and customized method to manage farms.

1.4. Research methodology

This work seeks to instigate the integration of knowledge among the authors of this area of study with other areas on the diffusion of technology in the area of agriculture. The empirical work of this thesis is divided in two parts. The first part concerns an investigative work based on exploratory studies supported by in-depth interviews, focus group and laddering. These qualitative studies discussed the quantitative empirical results of study 1. The second part presents a research model supported by quantitative researches capable of understanding the determinants of ERP diffusion (Figure 1).

Figure 1 Main Exploratory and Quantitative Definitions to the Project



1.5. Research structure

This research is organized as follows: Chapter 2 is devoted to a literature review in terms of ERP - Enterprise Resource Planning including a discussion of Platforms of Analytical Insights Concepts and business analytics functionality in the context of farms in Brazil. Our focus was to compare different theories and models applied to the adoption of ERP and its value creation.

In Chapter 3 we developed a discussion on Agribusiness Challenges: understanding agribusiness challenges in qualitative research with in-depth interviews. In addition, we have included some findings from our qualitative research that sought understanding farmer perceptions about ERP, management model, technology, and levers for agribusiness. We used Hierarchical Value Map (HVM) method - Laddering in personal interviews, followed by focus group.

In Chapter 4, we developed the research model based on theories of technology adoption. We developed our data collection tool using the following theories: DOI, TOE, IOR, and RBV.

In Chapter 5, we empirically tested the farmers' perceptions for understanding the determinants of adoption of enterprise resource planning (ERP) technology within the agri-food context: The case of the Midwest of Brazil, using DOI and TOE theories.

In Chapter 6, we empirically tested the adoption stages (Evaluation, Adoption, and Routinisation) of ERP based on business analytics functionality in the context of farms, using DOI, TOE and IOR theories.

In Chapter 7 we empirically tested the performance perception and the Routinisation (RO) moderation on ERP Post-Implementation as determining factor of Competitive Advantage on Farms. In this chapter we use RBV theory.

In chapter 8 we include our conclusions: summary of findings, main contributions and limitations and future work.

The implications, limitations and considerations on the progress of this work have been discussed in each chapter 8.

1.6. Path of research

In the first year (July 2014) of the Doctoral Program we met the NOVA IMS and the guiding teachers to define our projects and negotiations to choose our advisor. At first I identified with some articles by teachers Tiago Oliveira and Pedro Ruivo. My idea was to develop a research model that could observe which management model should be adopted by Brazilian farmers to develop the condition of continuing to be one of the main players for producing energy, proteins, fibers and food on the planet. I left the first classes with the idea of empirically testing the determinants of ERP adoption as a technology capable of providing better performance for farms. At this moment I had a very good incentive from Professor Dr. Tiago Oliveira who accepted to be my advisor. At the end of the first year (July 2015) I was able to develop my first empirical study, with the theories DOI and TOE for "Understanding the determinants of adoption of enterprise resource planning (ERP) technology within the agri-food context: The case of the Midwest of Brazil "(chapter 5), published in April / 2017 in IFAMR - INTERNATIONAL FOOD AND AGRIBUSINESS MANAGEMENT REVIEW. In the same year of 2015, I decided to carry out some qualitative studies (Chapter 3) to understand the farmer's perceptions of technology adoption issues, especially in ERP - Enterprise Resource Planning. We also conducted qualitative interviews with leaders of this sector to understand the challenges of Brazil to accompany the growth of food production for the planet. We were able to observe very useful information that contributed to the formation of our data collection tool, based on the constructs chosen for this thesis.

The qualitative data gathered after the first phase was combined to the theories DOI, TOE, IOR, and RBV to create the instrument used for the quantitative research which was carried out with farmers in Brazil. As a result, we highlight the main findings in the qualitative research focusing on the challenges of agribusiness pointed on the in-depth interviews. Following this, we present the research model and the development of hypotheses. Finally, we present the research methodology, the final results and main findings.

In 2016 we began the work of personal interviews with the Brazilian farmers. We got 510 valid interviews with farmers held between April 2016 and August 2018.

On November 22, 2018 we had a second article accepted in the Journal Computers and Electronics in Agriculture: "The adoption stages (Evaluation, Adoption, and Routinisation) of ERP based on business analytics functionality in the context of farms" (Chapter 6).

On November 3 we submitted a paper in the Journal Heliyon which is under review (as of 04/12/2019): "Performance perception and the Routinisation (RO) moderation on ERP Post-Implementation as determining factor of Competitive Advantage on Farms" (Chapter 7). Figure 2 helps us to better understand the paths of our thesis.

Figure 2 Path of research

	Paper 1	Laddering	Focus Group	Research with in-depth	Project Constructs
	Understanding the determinants of adoption of ERP (Chapter 1)	Understanding Famer Perceptions (Chapter 3)	Focus Group (Chapter 3)	Understanding Abribusiness challenges (Chapter 3)	Consolidation of the Study (Chapter 4, 5 and 6)
Discussions	• Use DOI and TOE Theories for learning. • Practice SMART PLS: SEM Model.	Challenges: • Production cost; • Structural changes; • Productivity; • Consumer trends.	• ERP has value in status and prestige, success and ability; challenge; creativity; honesty-transparency; social harmony. • Innovation has value in success and ability; challenge; collectivity.	• Requirements and tools required for an ERP model for farms.	• Search for constructs for application in the project.
Conclusions	• The project has technical, managerial and scientific validity. • It is interesting to continue the discussion of this topic and its research problems.	Needs: • Management of land, assets and costs; • Cost control; • New knowledge of the agricultural frontier • Agriculture and livestock in cloud computers; • Access to the urban world.	• ERP and Innovation have value perception based on success, challenges, creativity and harmony at work. However, there is a limitation of how much these attributes represent. • It is necessary to find variables and constructs to measure the capacity of the attributes raised.	• Farmer's thinking is departmentalized. • Does not include sharing and integration of information. • Expanded agricultural frontiers for data sharing and integration must be broken down.	• Project Measurement Model.

1.7. Purpose

The purpose of this work is to study and investigate the determinants that affect the adoption, use and value of information systems technologies as a leverage tool to meet the demands of the agricultural commodities market.

The generation, transfer and adoption of technological innovations by the agricultural sector have been playing a highlighted role in agribusiness. Hundreds of varieties of grains, vegetables, fodder and fruits have been developed through science and technology adapted to different soil and climate conditions, cropping systems such as crop rotation, production diversification, implementation of sustainable agriculture and recognition of pests and diseases. It is also worth mentioning the development of superior lines and crossbreeding of animals with significant gains in productivity, rusticity and management practices of the productive process. This all happens with due attention to the adaptations of the different conditions of natural and socioeconomic resources.

In a future, highly competitive market, it will be necessary to develop information systems on analytical insights platforms or based on business analytics functionality platforms so that everyone adapts to the new market requirements: (a) development of biotechnologies with biosafety, (b) respecting both the advantages (high productivity, low costs, etc.) and the demands of the consumer (quality, safety, etc.). We believe through exploratory and qualitative studies that these advances will take place more on the side of adoption and use of information systems science technology than on the biological and exact sciences side.

1.8. Main Contribution

The results may provide information to agribusiness owners, managers and decision makers to promote the adoption of technologies in the area of information systems, communication technology and programs and training for farmers and their collaborators.

Scientific implications: contribute to the discussion to validate the key dimensions of ERP value in business analytics functionality platforms for farms: impact on costs, impact on production and productivity, impact on sales, procurement, revenues and contracts and impact on natural resources and sustainability. For this, we will propose a mixed method approach based on the combination of exploratory studies with industry experts and quantitative study with data collection through personal interviews. The combination of approaches has the potential to offer a more complete and reliable development of the theoretical and technical knowledge of the researched organizational environment.

Chapter 2 – Literature review of ERP

2.1. Concepts of ERP – Enterprise Resource Planning

This project will deal with the dichotomy "adoption versus non-adoption", routinization and continuity of use of ERPs in agricultural farms in Brazil. According to some authors (Ruivo, Oliveira, and Neto 2012a), the implementation of ERPs provide to the companies value creation, transactional efficiency, collaboration among people, and business analysis as important determinants in this process (Ruivo, Oliveira, and Neto 2012c). In this sense, we analyzed what ERP systems are and how they can collaborate with agricultural production companies.

We have been living a globalized economy for a few decades now, and the internationalization of operations is an essential factor for the integration of suppliers, partners and customers present around the planet (Yusuf, Gunasekaran, and Abthorpe 2004). Agribusiness is a globalized and internationalized activity as are most of the commodity sectors. The great need for food production has led to research being developed to maximize production potential and productivity. The application of technology in agriculture has generated several changes, so that the combination of software and hardware has been increasing Brazil's production (Abc 2012).

The effort to implement information and systems technologies such as enterprise resource planning (ERP) facilitates the desired level of business integration for decision making (Yusuf, Gunasekaran, and Abthorpe 2004). However, few researches have been developed to understand the ERP adoption processes in an agricultural property.

Much has been written about executing enterprise resource planning (ERP) in organizations of various sizes. The literature is replete with many case studies of the two successful and unsuccessful ERP implementations (Ehie and Madsen 2005). Enterprise Resource Planning is one of the most accepted choices for gaining competitive advantage for manufacturing companies. However, the successful implementation rate is low and many companies may not achieve the desired objectives (Z. Zhang et al. 2005). Understanding the ERP adoption criteria on agricultural properties in Brazil may provide important information for a decision-making process of the Farmer and the companies and consultants providing these services.

ERP systems, by their very nature, require simultaneous changes in business processes, information sharing, and data utilization, making them very difficult to implement (Amoako-Gyampah and Salam 2004). They integrate information packages and information processes in each functional area and among them, with the possibility of incorporating the best business practices (Kumar and Van Hillegersberg 2000). Tables 1 and 2 collaborate, with author adaptations to understand processes and information packets among functional areas (Madapusi and D'Souza 2012).

Table 1 ERP System Module description

Financial	This module constitutes the operational aspects of general accounting and financial information to a business unit.
Controlling	This module represents cost structures of a business unit and the factors that influence it.
Materials management	This module covers all the activities related to materials acquisition as purchases, inventory and storage.
Production Planning	This module covers the different phases, tasks and methodologies used on production planning and the own production process.
Sales and distribution	This module allows the management of all activities of sales and delivery of agricultural production, such as organization, sales and business opportunities, special negotiations, competition (local and global offers and demands), marketing, call supervision, communications planning with the market and billing.
IT Logistic	This module contains tools and reports necessary to analyze and manage management in supply chain forecasts.
Project System	This module covers all aspects of activities, resource planning, and complex task budgets.
Plant maintenance	This module takes care of the maintenance of farm systems and preservation areas, supports graphic representations, the connection to geographic information systems and detailed diagrams.
Quality management	This module deals with tasks involved in quality planning, inspection and control, and compliance with international quality standards to ensure that the business unit employs a unified approach to total quality management for all of its business areas.
Human Resources	This module includes all the business processes needed to efficiently manage the human resource needs of a business unit, such as personnel, payroll, recruitment, time management, training, benefits, workforce deployment, analytical data, and self-service delivery.
Supply Chain Management	This module extends the scope of ERP systems to include planning and execution capabilities to manage supply of the current and inter-business operations unit or inter-unit agricultural production.
Costumer Relationship Management	This module extends the scope of ERP systems to include automation functions such as sales, marketing, customer service and order management, collaboration management, and characteristics of trading or buyers of agricultural production.
E-commerce	This module facilitates access to ERP processes and data from anywhere in the world through web-enabled ERP systems and portals.
Advanced Strategic Planning	This module covers ERP systems to allow the manipulation of complex processes, such as product life considerations, alternate routing, accounting, intermediate storage, strategic matrix change, time considerations or planting windows, and capacity constraints on fix storage.

Source: authors

Table 2 Descriptions of Operational Performance Measures

Information availability	Refers to changes in the availability of real-time integrated information from the ERP system.
Quality of information	Quality of information refers to changes in the availability of consistent and reliable information from the ERP system.
Standardization	Standardization refers to the simplification and rationalization of business processes as well as the flow of information across the company.
Inventory Management	Inventory management refers to changes in inventory management processes that lead to significant reductions in inventory holdings, increased inventory turnover, and better control over input inventories (fertilizers, pesticides, seeds, limestone, etc.) and, of agricultural production.
On-time delivery	On-time delivery refers to changes in the production / order delivery cycle that facilitate on-time delivery / services to buyer's customers of agricultural production.

Source: authors

When discussing with the focus groups the requirements of tables 1 and 2, we observe that the thinking is still based on departmentalization rather than on integration and sharing of data. Perhaps the problem lies in communication, which plays roles in providing and obtaining information, as well as in creating understanding among organizational actors, leading to the formation of shared beliefs in the company. Communication is considered a critical element to allow changes in attitudes and behaviors (Amoako-Gyampah and Salam 2004).

In the dynamics of power, some levels in a company can develop noises of protests about new information systems rooted in reluctance to change. In addition, the theory of organizational information processing states that its performance is influenced by the level of adjustment between the mechanisms of information processing and the organizational context. Therefore, understanding the context of interdependence and differentiation among the organization's business units is important (Gattiker and Goodhue 2005).

Finding the critical factors and measures of success (Z. Zhang et al. 2005) can define an important differentiation of ERP implementation. Other studies indicate the critical issues that drive successful ERP deployment (Ehie and Madsen 2005). These critical issues are the principles of project management (responsible for 20.95% of the variance), feasibility and evaluation of ERP project in the company (12.81%), top management support (9.48%), business process and reengineering (8.60%), consulting services (8.03%), and cost / budget issues (8.28%), Human Development Resource and IT infrastructure were not listed as significantly correlated with successful ERP deployment. A cautious implementation process, with rules and support for change management and cultural readiness, brings together positive aspects for ERP implementations (Motwani, Subramanian, and Gopalakrishna 2005).

Internal organizational capabilities can influence the direction and extent of the financial benefits of adopting Enterprise Systems (ES). Business integration and transaction automation offered by ES are valuable tangible resources (Hendricks, Singhal, and Stratman 2007). The operational strategies of the companies are affected, mainly by the competitors (Rouyendegh, Bac, and Erkan 2014). The benefits obtained from the automation of business processes and the use of ERP systems improve decision making at all levels of the organization and a strategic alignment of the stages of ERP implementation with the company's business is required (Velcu 2010) and this is a fundamental factor for the farms that are characterized of agricultural commodities.

Researches related to the ERP theme show how the trust mechanisms between the IT provider and the ERP implementation company determine the expected usefulness derived from this business transaction: "Trust is a central and vital aspect of many business relationships of long term" (Gefen 2004), and when we talk about rural producers in Brazil, this aspect may become even more relevant.

The internationalization of operations makes it essential to take place within and across national boundaries in order to reach integrated supply chains and in this point Enterprise Resource Planning (ERP) contributes to the understanding of the desired level of this integration (Yusuf, Gunasekaran, and Abthorpe 2004).

In a global environment, companies have to focus on having a competitive advantage and implementing an ERP system to improve process efficiency is a great way, although each sector or company reacts differently to the adoption and implementation of ERP (Rouyendegh, Bac, and Erkan 2014).

ERP is, in many cases, implemented to support changes in an organization's essential structures, which may require organizational culture changes to support an integrated, cross-functional information nature. Thus, identifying how to facilitate knowledge sharing by identifying key cultural issues that must be overcome is important to the success of an ERP (M. C. Jones, Cline, and Ryan 2006). Radical innovations can have far-reaching consequences, whether intentional or not, which can lead to an increase in the variation of the expected returns. The combination of organizational elements, technology use, and innovation application factors can significantly increase company results by using an appropriate ERP (Karimi, Somers, and Bhattacherjee 2007).

Also, leadership is one of the determinants of a company's organizational culture, and the fit between organizational culture and an information system is critical to its success, so the increased chance of successful ERP implementation is, in essence, in leadership to foster an organizational culture desired for this purpose (Ke and Wei 2008). It is important for managers to clearly identify goals and priorities for ERP implementation phases and for contribution to performance improvement (Ram, Corkindale, and Wu 2013). However, the ERP execution processes and their earnings are different in each company (Rouyendegh, Bac, and Erkan 2014).

The implementation of ERP requires a high investment (Madapusi and D'Souza 2012; Zeng and Skibniewski 2013), is time consuming and resource demanding (Tsai et al. 2011), the risks are high and it is full of complex organizational factors because takes into account initially unknown requirements, low level of user acceptance and changes in the information and management environment, in addition to the complexity of the ERP system itself (Hung et al. 2012). Inability to respond to uncertainties can create high costs of missed opportunities (L. C. Wu, Ong, and Hsu 2008). Although ERP systems represent a significant investment, it is also an important source of operational performance improvement for companies (Madapusi and D'Souza 2012).

We can classify the agricultural properties of Brazil as small and medium-sized enterprises, in the great majority. Studies with small and medium-sized enterprises (SMEs) show that better strategic planning for information systems (IS) helps these companies recognize the potential benefits offered by ERP systems (Zach, Munkvold, and Olsen 2014). There are also some indicators that SMEs are not able to use ERP training experts to manage training activities for their staff (Esteves 2014). In this type of companies, there are indications that ERP's are Information Technology (IT) resources that are not only used as transaction processing systems, but also as front-end applications (Ruivo et al. 2013; Ruivo, Oliveira, and Neto 2012b).

If the goal is to maintain Brazil's agribusiness competitiveness, in order to increase its capacity to face internal and external threats, it is necessary to face and understand information that results from the lack of managers' data together with the feeling fear and inconvenience with this technology (Hakim and Hakim 2010). The level of adjustment between the application of an ERP and the organization model produces a more strongly dependent result (Sammon and Adam 2010).

A study on small and medium-sized enterprises in Portugal explores the post-implementation of ERP as a determinant of the company's performance in managing management accounting, financial accounting and fiscal accounting, as well as the management control of the company (Ruivo, Oliveira, and Neto 2014).

Many organizations are disappointed that they are unable to achieve their business objectives due to the underutilization of ERP systems (H.-W. Chou et al. 2014; H. W. Chou et al. 2014; Ruivo, Oliveira, and Neto 2012b) and in many cases do not meet the requirements for business process control, costs reduction and margin increase (Gajic et al. 2014), which makes it imperative to find ways to facilitate the use of ERP systems for organizations (H. W. Chou et al. 2014) and the development of an evaluation of influence of ERP on company performance indicators, combined with the need to understand the context in which planning for the formation of an ERP (Gajic et al. 2014) occurs in an agricultural property.

The social capital can have significant effects on the possible success in the post-implementation of the ERP on the factors: 1. Opportunity in learning; 2. Willingness to learn; and 3. Capacity gains (Ruivo, Oliveira, and Neto 2012b). Due to the complex features of ERP systems, it puts users ahead of challenges such as acquiring new knowledge and skills to perform their tasks and make decisions (Ruivo et al. 2012). On the other hand, self-efficacy directly facilitates the will to learn and the ability to learn (H. W. Chou et al. 2014; Esteves 2014).

2.2. Platforms of Analytical Insights Concepts and business analytics functionality

From what we can observe in Chapters 2 and 3, we conclude that we should not study the circumscribed farms on their borders. If a country's energy, protein, and fiber production grows and evolves in a global economy of scale, it should think of Enterprise Resource Planning on an extended frontier, think of a border of micro region, an extended model of resource utilization which we are calling Platform of Analytical Insights. We propose in this project to study ERP in cloud-based platforms of Analytical Insights.

Cloud computing (Mell and Grance 2011) greatly facilitates and benefits large data analysis by elastic provisioning of heterogeneous resources and services at infrastructure, platform and application levels on a pay-per-use basis with Service Level Agreement (SLA) (Zhao et al. 2016).

Platforms and middleware software tools on the cloud significantly increases interaction, cooperation and can also lead to innovative use of data (Y. S. Wang, Wu, and Wang 2009).

In the Web of Science database, we found only one relevant article (journal Q1 / Q2) on cloud computing that proposes a cloud-based remote sensing observation sharing (ROSCC) method to improve storage, processing and the ability to maintain remote observation, to better serve the visualization of maps for precision farming (L. Zhou et al. 2016).

2.3. Literature Review for Research Models

In order to observe the state of the art about the adoption of ERP, we analyzed several articles in the area. So, we could think of our research model. The table 3 shows some studies, which we have based on order to define our framework and research model.

Table 3 Literature review and research models

What is the study about?	What is the research question addressed?	What are the theories used?	What constructs from the theory are included in the study?	Method	Data	Source	Title
Was investigated changes in operational performance that result from enterprise resource planning (ERP) system implementation.	Offering a theoretically anchored rationale for the relationship between ERP systems implementation and operational performance.	IS-based OIPT (organizational information processing theory)	ERP system modules: -financials - controlling - plant maintenance - materials management - production planning - project system - sales and distribution - general logistics - quality management - human resources - SCM - CRM - e-commerce - APO/APS. Operational performance: - information availability - information quality - standardization - inventory management - on-time delivery	Regression models	The effective sample used for analysis was 203 firms	(Madapusi and D'Souza 2012)	The influence of ERP system implementation on the operational performance of na organization
Future and even current European farmers are experiencing that the managerial tasks for arable farming are shifting to a new paradigm, requiring increased attention to economic viability and the interaction with the surroundings. To this end, an integration of information systems is needed to advise managers of formal instructions, recommended guidelines and documentation requirements for various decision-making processes.	The concept of assisting services has to evolve in order to sustain the need of more automated decision processes in the future. New information management concepts and designs mean that farmers have to be ready to adopt new working habits and perhaps also undergo further training.	Core-Task analysis (CTA) method, farm management information system (FMIS), information and communication technology (ICT)	(a) a design aimed at the specific needs of the farmers, (b) a simple user-interface, (c) automated and simple-to-use methods for data processing, (d) a user-controlled interface allowing access to processing and analysis functions, (e) integration of expert knowledge and user preferences, (f) improved integration of standardized computer systems, (g) enhanced integration and interoperability, (h) scalability, (i) interchange-ability between applications, and (k) low cost.	Method, namely science-based modelling, analysis of orientation, practice-based of orientation, practice-based modelling of the core task, and integrated information modelling.	The data collection and processing are na automated monitoring system, whereas the report and plan sub-systems are to be initiated by the farm manager.	(Sørensen et al. 2011b)	Functional requirements for a future farm management information system
This paper assesses the applicability of ERP systems in the agri-food domain by investigating the experiences of agri-food companies that already have implemented an ERP system	The research has analyzed the drivers and barriers for adoption of ERP in the Dutch horticultural sector.	Theoretical framework for analysis, which classifies the factors that are important for the adoption of ERP systems. These factors can either be barriers or drivers. The framework for analysis is based on a combination of: (i) innovation literature on adoption factors and (ii) ERP literature on factors that determine the success and/or failure of ERP implementations.	The main elements are the adoption unit (who is adopting?), the adoption object (what should be adopted?) and the adoption process (how?). The factors that influence adoption are twofold. The first type of adoption factors are concerned with the perception of the adoption unit (i.e. the company that is considering to implement ERP) about the adoption object (i.e. the ERP solution and the implementation partner). The second type of adoption factors are inherent characteristics of the adoption process (i.e. the orientation, selection and implementation phases) and the adoption unit (i.e. the implementing horticultural company). Below, these categories are further introduced, including a definition of the ERP adoption factors of each category.	Data gathering in in-depth structured interviews with industry experts	The data were collect by conduction in depth interviews with key experts of selected companies	(Verdouw, Robbemond, and Wolfert 2015)	ERP in agriculture: Lessons from the Dutch horticulture
IT innovation adoption, Adoption diffusion process, User acceptance of IT	In this paper, we develop a conceptual model for IT innovation adoption process in organizations.	Diffusion of innovation (DOI), Theory of reasoned action (TRA), Technology Acceptance	This study aims to theatrically construct an integrated model for IT adoption process in an organization. The model considers organizational	a) it was an empirical study on innovation adoption, b) the study	Acceptance models and frameworks used in the past research on technology adoption	(Hameed, Counsell, and Swift 2012)	A conceptual model for the process of IT innovation adoption in organizations

	A significant of research has been conduct in examining the process and factors influencing the adoption of IT in organizations. In spite of the significance of IT adoption and the vast amount of literature available, knowledge of IT adoption phenomenon for organizations is still limited.	Model (TAM), Theory of Planned Behavior (TPB)	IT adoption process and user acceptance of IT. To this end, we explore past literature on the stages of innovation adoption, theories of innovation adoption, models of technology acceptance and popular frameworks developed by researchers for organizational adoption with factors considered to influence IT adoption. The study then extracts prominent theories, models and frameworks used in Information System (IS) literature for IT innovation adoption and user acceptance. In addition, the study identifies factors that influence innovation adoption in different contexts.	examined innovation adoption in organizations, c) dependent variables included initiation, adoption, implementation, infusion, integration, assimilation, or usage and, d) the study performed the analysis at an organizational context or individual level in an organizational setting			
This paper introduces a theoretical framework that draws substantially on the work of Douglass North, and examines how an institutional dimension can be incorporated into the three components of the OLI paradigm.	The prevailing ownership-based theories of the firm are increasingly being challenged by new forms of organizing, as exemplifies by the Asian network multinational enterprise (MNE). We believe that an institutional approach, that tries to bridge both the macro and micro levels of analysis, and that encompasses both formal and informal institutions.	MNE theory and OLI paradigm	The network MNE comprises many different types of cross-border organization from 19th century trading companies and "traditional" business groups, such as those found in Latin America and Asia, to new cellular or network-based forms of organization, many of which have originated in Asia, and the emergence of the metanational MNE. How far these new forms of organization present a fundamental challenge to the existing theories of the MNE and the OLI on eclectic paradigm in particular, has been the subject of recent debate.	Theoretical framework that draws substantially on the work of Douglass North	formal and informal institutions affecting the OLI configuration of firms	(Dunning and Lundan 2008)	Institutions and the OLI paradigm of the multinational enterprise
This study examines the effects of environmental, organizational and top managers characteristics on the initiation, adoption decision and implementation of innovation.	This article focuses on the adoption of innovation in organizations and contributes by addressing three issues in this body of work.	DOI	adoption of innovation in organizations, process of adoption, environmental antecedents of adoption, organizational antecedents of adoption, complexity and size, economic health, external communication, managerial antecedents of adoption, age, gender, education, tenure in position and in management, attitude toward innovation.	the source of our data to test the above hypotheses is a survey conducted in 1997 by the International City/County Management Association (ICMA) about "reinventing government" in the United States.	questionnaire mailed twice to the city managers/chief administrators of 2858 cities with a population of 10.000 or more, from which 1276 responses were returned.	(Damanpour and Schneider 2006)	Phases of the Adoption of Innovation in Organizations: Effects of Environment, Organization and Top Managers
Adoption, Evidence-based treatments and practices, Organization, Innovation, Implementation	This paper compared constructs theorized to be related to adoption of innovations proposed in existing theoretical frameworks in order to identify characteristics likely to increase adoption of innovation	EBP evidence-based practices	Socio-political and external influence, organizational characteristics, Innovation characteristics, soft/individual characteristics, client characteristics	a) interacting components within experimental and control settings, b) difficulty of behaviors required by those delivering or receiving the intervention, c)	This paper applies a narrative synthesis approach that incorporates aspects of realist review methods to summarize theories and constructs associated with innovation adoption.	(Wisdom et al. 2014)	Innovation Adoption: A Review of Theories and Constructs

				groups or organizational levels targeted by the intervention, d) variability of outcomes, e) degree of flexibility of the intervention permitted, f) degree of dependence on context in witch interventions take place.			
Innovation, Adoption, Diffusion, Organizations, Technology acceptance	The objective of this paper is discussing the main findings on organizational adoption and integrate them within a framework. The framework that we propose addresses the adoption decision at two levels, the organizational level and the individual adopter within an organization.	Organizational innovation adoption, individual innovation acceptance in organizations	The innovation and adoption process in organizations; Organizational innovation adoption (- determinants of the organizational level adoption, - perceived innovation characteristics, - adopter characteristics, - supplier market activity, - Targeting, - communication, - risk reduction, - social network, - environmental influences, - network externalities, - competitive pressures), Intra-organizational acceptance: individual innovation adoption in organizational contexts (-attitude toward the innovation, - organizational facilitators, - personal innovativeness, - social influences), Current issues and opportunities for future research (-non adoption, - intra organizational acceptance: disposition and the acceptance of innovations, - network externalities, - marketing actives, - international adoption, - the role of internet and electronic commerce)	Literature, individual decisions	The marketing domain, during the late 1960s and early 1970s, a number of studies of innovation adoption and diffusion.	(Frambach and Schillewaert 2002)	Organizational innovation adoption, A multi-level framework of determinants and opportunities for future research
Mobile business, mobile business value, usage, Technology-Organizational-Environment framework, Resource Based-Theory	The present study fills this gap in the literature through the analysis of the value m-business can provide for firms, the value of m-business includes the impact on marketing and sales, internal operations, and procurement.	TOE, RBT, DOI	Relative advantage, compatibility, complexity, technology competence, technology integrations, managerial obstacles, competitive pressure, partner pressure, mobile environment, mobile business e\usage, impact on marketing and sales, impact on internal operations, impact on procurement, M-business impact on firm performance. Control: industry.	This research uses a mixed method research design, interviews are first conducted to develop a model to asses m-business usage	Data collected from 180 Portuguese organizations	(Picoto, Bélanger, and Palma-dos-Reis 2014)	An organizational perspective on m-business: usage factors and value determination
Technology adoption, e-Readiness, Technology-organization environment, (TOE) model, Technology readiness index (TRI), e-Maintenance	This study offers managers and vendors a frame af reference to analyze firm´s situation before initiating new innovations. In case of e-maintenance technology,	TOE, TRI	Technological infrastructure, technological competence, perceived E-M benefits, perceived E-M challenges, maintenance priority, firm size, competitive pressure, optimism, innovativeness, discomfort, insecurity.	AMOS 7.0	829 managers	(Aboelmaged 2014)	Predicting e-readiness at firm-level: Na analysis of technological, organizational and environmental (TOE) effects on e-maintenance

	adoption strategies sould be built around fostering level of employees' technological knowledge and skills, technology infrastructure as well as sustaining potential benefits and encountering potential challenges associated with e-maintenance technology.						redness in manufacturing firms
Cloud computing, IT adoption, Diffusion of innovating (DOI), Technology-organization-environment (TOE)	The purpose of this study is to understand the determinants of the adoption of cloud computing and its relative advantage to organizations.	DOI and TOE	Security concerns, cost savings, relative advantage, complexity, compatibility, technological readiness, top management support, firm size, competitive pressure regulatory support.	Structural equation modeling (SEM) was used to empirically assess the research model. Measurement model, Structural model.	369 firms in Portugal	(Tiago Oliveira, Thomas, and Espadanal 2014)	Assessing the determinants of cloud computing adoption: Na analysis of the manufacturing and services sectors
Cloud computing; agricultural information systems; harvest labor management, wireless mesh networks	Specialty crops are defined by USDA "as fruits and vegetables, tree nuts, dried fruits, horticulture and nursery crops(include floriculture)". The production of specialty crops is important to U.S. agricultural industry. A challenge for special-crop industry is how to capitalize on these opportunities, increasing the efficiency of production and reducing its cost.	Labor monitoring devices (LMDs); labor management software (LMS)	1) how to collect and transmit real-time harvest data in an orchard? 2) how to process voluminous real-time harvest data and provide concurrent access to stakeholders across global? 3)how to deliver results in na intuitive and meaningful way to growers, to help them make data-driven decisions?	Accruing labor data; mapping yield with harvest data; labor monitoring devices; application-layes protocol	special-crop industries	(Tan, Haley, and Wortman 2015)	Cloud-based harvest management system for specialty crops
Task technology fit; United theory of acceptance and usage of technology; Mobile banking; User adoption	This extant research focuses on explain user adoption from technology perceptions such as perceived usefulness, perceived ease of use, interactivity, and relative advantage.	TTF; UTAUT	H1: Task characteristics, technology characteristics, task technology fit, performance expectancy, effort expectancy, social influence, facilitating conditions, user adoption	CFA, PLS and LISREL 8.72	Universities and service halls of China Mobile and China Unicom branches. Received a total of 265 questionnaires.	(T. Zhou, Lu, and Wang 2010)	Integrating TTF and UTAUT to explain mobile banking user adoption
Virtual words; organizational adoption; Technology-Organization-Environment; Framework; Institutional theory	The purpose of this study was understanding why organizational adoption of virtual worlds much has been much slower than expected, by empirically identifying factors that influence organizational intent to adopt virtual worlds.	TOE and DOI	Relative advantages, compatibility, security concerns, top management support, organization size, organization readiness, firm scope, mimetic pressure, coercive pressures, normative pressures, intensity of competition, intent to adopt virtual words, social desirability, firm age, industry effect.	smart PLS 2.0 M3	The Hoovers Company Information Database includes various information on more than 85 million companies within 900 industry segments (i.e., company overview, company history, financials, and operations).	(Yoon and George 2013)	Why aren't organizations adoption virtual worlds?

Unified theory of acceptance and use of technology (UTAUT); UTAUT2; habit; hedonic motivation; price value; mobile internet; cosumer; technology adoption	This paper extends the unifed theory of acceptance and use of technology to study acceptance and use of technology in a consumer context.	UTAUT; UTAUT2	Performance Expectancy, effort expectancy and social influence. Our proposed UTAUT2 incorporates three constructs into UTAUT: hedonic motivation, price value, and habit. Individual differences, namely, age, gender and experience, are hypothesized to moderate the effects of these constructs on behavioral intention and technology use.	A questionnaire survey method was used to collect most of the data in this study, while a secondary data source (Hoovers Company Information Database) was used to collect data regarding firm size and two control variables (firm age and industry type). The Hoovers Company Information Database includes various information on more than 85 million companies within 900 industry segments (i.e., company overview, company history, financials, and operations).	4127 consumers use mobile internet technology, Hong Kong	(Viswanath Venkatesh, Thong, and Xu 2012)	Consumer acceptation and use of information technology: extending the unified theory of acceptance and use of technology
Agricultural systems; Data; Models; Knowledge products; next generation	The purpose of this special issue of agricultural systems is to lay the foundation for the next generation of agriculture systems data, models and knowledge products.	ICT - information and communication technology	Connecting people and models: use cases and knowledge products: farming system, information user, beneficiaries, outcomes.	case narratives	Small-holder farms; commercial crop enterprises	(Antle, Jones, and Rosenzweig 2017a)	Next generation agricultural system data, models and knowledge products: Introduction
Low-cost, E-commerce, Innovativeness, trust, UTAUT, Information technology acceptance, Internet marketing	This paper examines determinants of purchasing flights from low-cost carrier websites. In doing so an extended unified theory of acceptance and use of technology (UTAUT) model is proposed building on earlie work.	UTAUT; UTAUT2; ICT, LCC	Performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, habit, price-saving orientation, innovativeness, trust, information quality, perceived security, perceived privacy, behavioral intention, use behavior.	Measurements; sample and data collection; questionnaire	1096 Spanish consumers of LCC flights	(Escobar-rodríguez and Carvajal-trujillo 2014)	Online purchasing tickets for low cost carriers: Na application of the unified theory of acceptance and use of technology (UTAUT) model.
Tractor, farm implements, ISOBUS, soft systems methodology, farm management information system, agricultural robots	Management of farming operations is currently changing toward a systems perspective integrating the surroundings in terms of environmental impact, public entities and	ICT, ISOBUS	Based on the proposed conceptual model of current FMMIS and the proposed root definition mentioned earlier, the derived situational elements of CATWOE are listed below: customer, actors, transformation process, world-view, ownership, environment constraints.	soft system methodology	15 farm managers	(Fountas, Sorensen, et al. 2015)	Farm machinery management information system

	documentation of quality and growing conditions.						
Strategic IS implementation, multi-dimensional view of IS strategy, strategic change, information systems use, cognitive entrenchment	Claims that strategic investments in information technology (IT) are instrumental to firms' long-term survival are now regarded as truisms. The truth behind these truisms, however, is that IT investment's matter only as far as IT capabilities become embedded in new organizational practice.	Multi-dimensional view of IS strategy	IT systems and enterprises standardization at paper pack; papermill in context; strategic intent underlying MES; MES in practice; MES implementation as practice; The fallacy of perceived determinism; The role of entrenchment	interviews on site observations and reviewing documents	implementation and when system was in use	(Arvidsson, Holmström, and Lyytinen 2014)	Information systems use as strategy practice: A multi-dimensional view of strategic information systems implementation and use
TOE, Cloud computing, framework	This paper builds on Tornatzy et al.'s technology organization environment framework to investigate the factors influencing cloud computing adoption. Another objective purposed is to conceptualize and understand how IT governance processes and structures moderate those factors.	TOE	Relative advantage, complexity, compatibility, firm size, top management support, IT expertise of business users, competition intensity, regulatory environment, cloud computing adoption. Moderators: governance structure, governance processes.	quantitative study	24 global enterprises across various industries	(Borgman et al. 2013)	Cloud rise: Exploring cloud computing adoption and governance with the TOE Framework
Big data, cloud computing, hadoop	Addressing big data is challenging and time demanding task that requires a large computational infrastructure to ensure successful data processing and analysis.	Big data	Scalability; availability; data integrity; transformation; data quality; heterogeneity; privacy; legal/regulatory issues; governance.	cases studies	5 cases studies	(Hashem et al. 2015)	The rise of "big data" on cloud computing: review and open research issues
Decision support tools; decision support systems; evidence-based decision-making; human-computer interactions; sustaineble; intensification	This study finds a plethora of agricutural decision support tools in operation in the UK, yet, like others studies, shows that their uptake is low. Decision support tools are designed to help users make more effective decisions by leading them through clear decision stages and presenting the likelihood of various outcomes resulting from different options	DST - decision support tools	Pefomance, ease of use, peer recommendation, trust, cost, habit, relevance to suer, farmer-adviser compatibility, facilitating condititons, compliance, level of marketing, uotake, use. Moerators: age, scale of business, famring type, IT education	395 different tools	Farmers and advisers in the UK	(Rose et al. 2016)	Decision support tools for agriculture: Towards effective design and delivery

ERP; enterprise systems; financial performance; post-implementation success	A company implements an information system with the expatiation that it will produce financial benefits and that these benefits can be maximized using proper managerial techniques. The accountability of investments in information systems is a frequent subject of study.	ERP	Technological competence, relationship with outside experts, top management's knowledge of project success, top management's emocional support, long-range plans, sharing of information between departments, net sales, net income before extraordinary items, earnings before interest and taxes, return on assets, return on investment.	Using econometric analysis - regression models	55 companies that implemented ERP before 2003	(Galy and Sauceda 2014)	Post-implementation practices of ERP systems and their relationship to financial performance
Green IT, process virtualization, TOE, PVT, DOI	Green information technology tools and practices contribute to environmental sustainability and business processes virtualization.	TOE, PVT - process virtualization theory, DOI	Sensory readiness, relationship readiness, synchronism readiness, identification and control readiness, champion support, resource commitment, firm size, regulatory support, competition intensity, green IT initialization, green IT Integration, green IT maturation. Control: industry.	Structured Equation Modeling	251 European firms	(Thomas, Costa, and Oliveira 2016)	Assessing the role of IT-enabled process virtualization on green IT adoption
Mobile banking; technology adoption; TTF; UTAUT; initial trust model	Mobile banking enables customers to carry out their banking tasks via mobile devices. We advance the extant body of knowledge about m-baking adoption by proposing a model for understanding the importance and relationship between the user perception of m-banking, initial trust in m-baking services, and the fit between the technology and m-baking task characteristics.	TTF - task technology fit; UTAUT; ITM - initial trust model	Technology characteristics, task characteristics, task technology fit, performance expectancy, effort expectancy, social influence, facilitating conditions, initial trust, firm reputation, structural assurances, personal propensity to trust, behavioral intention, adoption. Moderators: gender and age.	Sample of 194 individuals applied partial least squares	Conducted in Portugal, one the European Union	(Tiago Oliveira et al. 2014)	Extending the understanding of mobile banking adoption: When UTAUT meets TTF and ITM
Web technology, web implementation, IT management, innovation assimilation, structuring actions, metastructuring actions.	This paper draws upon institutional theory and the conceptual lens of structuring and metastructuring actions to explain the importance of three factors- top management championship, strategic investment rationale, and extent of coordination- in achieving higher levels of web assimilation within an organization.	Technology assimilation	1: structures of signification; 2: structures of legitimization; 3: structures of domination	Survey methodology. Test a nomological network of relationship	525companies	(Chatterjee, Grewal, and Sambamurthy 2002)	Shaping up for E-commerce: Institutional enablers of the organizational assimilation of web technologies
Big data, cloud computing; decision support systems; internet of things	The developed application is focused upon individual farmers or farmer cooperatives,	Theory of technology assimilation	The data model of in farm integrates all information relevant to farm: fields and land parcels, crops, farming activities on fileds and inputs and	farm-related	Farmers on a winter	(Paraforos et al. 2016)	A farm management information system using future internet technologies

	who wish to perform precision agriculture via the usage of mobile devices and modern technology.		resources used to plan and execute theses activities. The data model organizes the information in a hierarchical manner, where farm is at the top level. A farm consists of a set of crops each one cultivated in one more fields and executed as a series of tasks activities.				
Agroforestry; adoption; agricultural innovation; sustainability; analytical framework; attitudes; knowledge; decision-making; sub-Saharan Africa	Despite the great potential of agricultural innovations, the uptake by smallholder farmers in sub-Sharan Africa seems to be slow. We reviewed existing theories and frameworks for the uptake of agricultural innovations and found that these tend to emphasize the role of extrinsic factors such as the characteristics of the adopter and the external environment in the decision-making process.	Theories of decision making	caharacteristics of the farmer: personal characteristics, socioeconomic characteristics, peronality characteristics, social networks, status characteristics, familiarity with technology. Characteristics of the external environment: geographical setting, societal culture, political conditions. Characteristics of agriculrtural innovations: benefits, costs. Knowledge, perceptions, attitudes. communication and extension. Adoption.	Analytical framework	Smallholder farmers in sub-Saharan Africa	(Meijer et al. 2015)	The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa
Big data; analytics; data center; distributed systems	One of the major applications of future generation parallel and distributed systems is in big-data analytics. Data repositories for such applications currently exceed exabytes and are rapidly increasing in size. Beyond their sheer magnitude, these datasets and associated applications considerations pose significant challenges for method and software development.	The state-of-the-art in big-data analytics	1: memory/storage; 2: processing landscape for data analytics; 3: network resources for data analytics; 4: energy considerations in big-data analytics	Data often resides on platforms with widely varying computational and network capabilities.	Internet Technologies	(Kambatla et al. 2014)	Trends in big data analytics
Information technology, TOE, Technology adoption, TAM	The purpose of this paper is to review the literature on information technology adoption in organizations to understand the need of integrated models for technology adoption. It further makes na attempt to identify key parameters to integrate technology acceptance model (TAM) and	TOE; TAM	The research papers are accessed from the popular databases from 2000 to 2012. The selected papers have addressed technology adoption in context of recent technologies such as e-commerce, ERP, Rfid, EDI and knowledge management, etc. The paper attempts to review the studies based on TAM model and TOE framework to identify relevant set of variables for adoption of these technologies in organizations.	Literature review	Popular data bases	(Gangwar, Date, and Raoot 2014)	Review on IT adoption: insights from recent technologies.

	technology organization environment (TOE) framework for firm level technology aoption. This integration is intended to improve predictive power of resulting model.						
Integrated agricultural systems models; crop models; economic models; livestock models; use cases; agricultural data	We review the current state of agricultural systems science, focusing in particular on the capabilities and limitations of agricultural systems model. We discuss the state of the models relative to five different Use cases spanning field, farm, landscape, regional, and global spatial scales and engaging questions in past, current, and future time periods.	Crop models, economic models, livestock models, uses cases	Cropping system and grassland models; factors to which cropping and grassland systems respond; components of cropping system models- crop, soil, atmosphere, management; approaches; additional considerations for modeling grasslands; reduced form summary crop models; livestock systems; animal performance models; integrated livestock systems models; modeling pests and diseases of crops and livestock; near-future pest and disease threats; economic models; farm management linear programing models; econometric production models; risk behavior models; spatial equilibrium models; structural models; calibrating optimization models; computable general equilibrium models; integrated bio-economic models; landscape/watershed, water and environment quality; aggregate agricultural system models.	Use cases	Use cases spanning fiel, farm, landscape, regional, and global spatial.	(S. J. C. Janssen et al. 2017)	Toward a new generation of agricultural system data, models, and knowledge products: State of agricultural systems science
Post-adoption intention, enterprise 2.0, TOE, IS continuance, subjective norm, PLSPM	This paper extends the IS continuance model to improve our understanding of the determinants of E2.0 post-adoption.	TOE, IS continuance.	Confirmation, perceived usefulness, form size, firm scope, subjective norms, competitive pressure, satisfaction, intention to renew E2.0.	Smart PLS 2.0 M3	China. 22056 qualified responses.	(Jia, Guo, and Barnes 2017a)	Enterprise 2.0 post-adoption: Extending the information system continuance model based on the technology-organization-environment framework

Source: authors

Chapter 3 – Agribusiness Challenges: understanding agribusiness challenges in qualitative research

3.1. Introduction

Agribusiness is not the only one, but it is undoubtedly the greatest chance open to Brazilian society for global insertion in the next 25 years, thus promoting the economic, social and environmental development of our society.

We just need to know how to do this. Of course, we have to have strategic planning with clear and achievable goals, with courageous actions taken by bold individuals and companies, and determining indicators to be achieved.

Brazil can grow even more in global agribusiness as food and environmental potential. Brazil can generate many opportunities to promote the sustainable inclusion of products, people and companies.

Our idea is that for this to happen we need to start acting now even going through the 2015-2017 triennium full of turbulence.

3.2. In-depth interviews

We conducted in-depth qualitative interviews with 10 professionals with expert status in agribusiness to explore the challenges of this sector for the coming years. We asked the interviewees two questions. We asked to each specialist to expose their personal opinion about the challenges, threats and, requirements for agribusiness development in Brazil and abroad.

We should briefly outline the challenges we must face at this time in order to reach a threshold that will be humanity's greatest challenge in 2050: to produce protein, food, fiber and energy for 9.2 billion people. The bold italics are those of the researcher who sought to highlight the points that should be pursued for the construction of the quantitative research model. So, these are the challenges:

a. **Increased production costs** burdened by the increase in **labor costs**, labor, low qualification of our workers, **environmental attention**, crime, **logistical operation**,

storage, **tax complexity**, energy (electric and fossil and natural fuels), the bureaucracy of the Brazilian State, credit interest, corruption, inflation control, **loss of efficiency of regulatory agencies**, and "ideological" cost.

b. To understand the structural changes in Agribusiness in relation to global **price volatility**, **climate risks**, **sustainability pressures** and carbon economics, interference from **government policies**, access to technology and information, **concentration of producers**, behavior **the diversification of agricultural activity**, the **demand for capital**, **land and water use**, the **need for scale**, the organization of purchasing groups, the **formation of mega-companies in production**, **digital agriculture**, genetics and biotechnology, **offers of management platforms** and the **succession of properties** and **leaderships** of the sector.

c. To understand **consumer trends**, marketing, food and agribusiness strategies involving issues of **brand origin**, **label information**, gourmet cooking and **healthy** fun and social **food** lines, with the development of projects with influencers (universities, scientists, bloggers, ...), **food on the go**, new sources of protein, creation of consumer clubs on **digital platforms**, expansion of the movement "**buy local production**", social network information, traceability, Internet of things as new ways to buy products.

However, it is evident in all the interviews that there is a need in the short term to **evaluate the models of management of the agricultural and livestock properties of Brazil.** This subject is related to the structural changes for which agricultural production must pass in the short and medium term, observing the following opinions:

d. Need for **good land management of assets and costs** via individual actions of rural producers. **We can deduce that this implies the development of an Enterprise Resource Planning (ERP)** of an agricultural property. Perhaps this idea cannot only be involved with the property itself.

e. The Rural Producer, while continuing to **ensure cost control**, should act more effectively quickly. We need to understand, with the producers, what their **Value-Based Resources** are. Developing value from the inside of the farm gate, observing the opportunities discussed so far, can be a strategy for the development of a **management platform for agricultural business activity**.

f. It seems that there is a **different concept of the agricultural frontier of property for the management of integrated regional spaces**. So, this implies a management model on **platforms of analytical insights** where sharing and collaboration between producers will be critical.

g. The need for an **integration of activities** and thinking, mainly, in the **digital agriculture**. It should be part of this **evolution some form of cloud computing and the internet of things in platforms** that allow access to information and analysis by inserting many variables of the activities of technologies of production, purchase, commercialization, climate, allowing the management by square meter of integrated regional spaces.

h. **Predict access to the urban world for information on the production** and export of food, protein, fiber and energy. A platform, which in a longer-term future, can allow **this integration with the consumer of food, food marketing and accompany changes in behavior.**

3.3. Focus Group

In Master Business Administration (MBA) classrooms of Strategic Management of Agribusiness of the Getúlio Vargas Foundation in Brazil, we developed a Focus Group model. Focus Groups were formed with Farmers and business executives from agribusiness companies. We noted the lack of knowledge and an appropriate ERP process for an agricultural property.

In these Focus Groups (Table 4), the following subjects were always intensely discussed: the tools for planting, seed selection, soil management / handling, crop protection, marketing of the rural producer (sale and production), financial management, property management, operational management and IT tools as an integration of the various databases. It is still difficult for farmers and industry professionals to think about Enterprise Resource Planning (ERP) in an integrated way, not just Integrated Database.

Table 4 Development of Tools to Assist and Support Producers in Decision Making

Discussed tools	Facilitates Rural Producer Decision	Gains Identified in the Agribusiness Chain
Planting tools and seed selection	Personalized or customized culture rotation, seed selection, seeding of populations with variable densities with multiple hybrids and seeding season.	Increase of productivity and greater food production.
Soil management tools	Trustable recommendation based on science for amendment / correction / rectification and fertilization of the soil, (NPK, limestone and agricultural gypsum / land plaster), variable-rate application technology, customized micronutrients application.	Optimized utilization of fertilizers and correctives / rectifiers. Soil conservation for future generations.
Crop protection tools	Pest and fungal damage risk alerts with personalized recommendation of localized spraying and appropriate product suggestion. Optimize more effective active principles.	Sustainability and the Environment.
Rural producer's Marketing tools	Productivity projection, production sales tools, production sales tools, price on the sale date, crop-planning tools for a more efficient harvest. Forecasting and climate analysis tools. Tools to understand the consumer of food.	Guarantee of deliveries of agricultural commodities to the food industry and exporters.
Financial Management tools	IT systems for important reporting to insurance agencies, insurance maps and documents, production costs, purchasing transactions, and benchmarks with other farms.	Risk control to the entire chain.
Property management tools	Assessment of the productivity of the property to assist the purchase or lease of land. Calculation of ROI (return on investment) for expansion of planting or pasture areas.	Business perpetuity and food safety.
Operational management tools	Priorities of planting, harvesting and logistics adequate to minimize the cost and time of operations. Tools using satellites and technologies to monitor the climatic conditions of the field, tracking plant by plant with updated approximations of color, height, protein content and risk of disease in the plant.	Decrease in the cost of production and increase of income for the producer.
IT tools and equipment	Integration of all agricultural and livestock activity information into a central database for the development of competitive production intelligence.	Risk control for all the chain.

Source: authors

3.4. Understanding Farmer Perceptions – Laddering

3.4.1 Introduction

Laddering refers to an in-depth and individual interview technique used to understand how customers translate the product attribute into association with meanings using means-end chain theory (Reynolds, Thomas J. Gutman 1988).

The method used to measure this chain was the laddering through qualitative interviews. In this method the product attributes are generated. Then, we carried out an inference of how these attributes are linked to the personal relevant consequences and life values that are present in the consumer's mind. In these in-depth qualitative interviews, the goals are to identify the attributes and benefits associated with the product under study and the means-end chains associated with the consumption of the product under analysis. For this, two approaches that correspond to the method can be used.

The first corresponds to the sequence: attributes -> consequences (benefits) -> values. This approach called ladder up follows the following steps (Reynolds, Thomas J. Gutman 1988; Reynolds, Gengler, and Howard 1995). In the first step, respondents were asked to indicate one of the attributes that characterized the product analyzed and describe what it means. In the second, we aimed to investigate what benefits are perceived as associated with this attribute. For this, we aimed to realize the benefit in the answer to "why is this attribute important?". We wanted to understand what consequence that attribute has on issues that were more abstract and emotional, rather than practical and functional. After understanding the relationship between attributes and consequences, the respondent was asked to describe "why is important to have these sensations (benefits)?". We sought associations between these responses with the values that had already been shown.

The perception of the meaning of the value for the respondent should be the same defined in the List of Value. If the value description does not match, the value is described according to the presentation of the theory and their agreement is asked. In the second step, after the characterization of the value, we requested that respondents described what feelings were associated with the idea of value. We sought, at that moment, to capture the benefits that may be associated with consumption of the product. Finally, in the third step, the respondents were asked to look for attributes that they perceive in the product analyzed.

Data collection was carried out with students of the Executive Education (FGV Management/MBA - Agribusiness) at the Fundação Getúlio Vargas. The profiles of these students according to the activity are defined as: agricultural producers; agricultural engineers, managers, or economists working in the areas of input management in resales, cooperatives, banks, machinery dealers, equipment, crop protection companies; engineers working in manufacturers of tractors, implements and harvesters; veterinarians; zoo veterinarian technicians; and professionals of companies that purchase production: trading companies and cooperatives. The questionnaires were distributed to respondents and the moderator gave the instruction on how to fill them out. Then, 30 minutes was made available to the individual responses. After that, respondents had 30 minutes to discuss some points that they considered interesting to discuss with the entire group. Samples were collected on: Goiânia - GO: 07/30/2015; Cuiabá - MT: 06/12/2015; Uberlândia - MG: 05/29/2015 and Rio Verde - GO: 04/17/2015. Table 5 show Theory Laddering of the Schwartz, 1992.

Table 5 Value Dimension (Schwartz 1992)

Dimension	Motivations
Power	Social power, Wealth, Authority, Preserving my public image, social recognition.
Achievement:	Ambitious, Influential, Capable, Successful, Intelligent, Self-respect
Hedonism:	Pleasure, Enjoy life.
Stimulation:	An exciting life, A varied life, Daring.
Self-direction:	Freedom, Creativity, Independent, Choosing own goals, Curious, Self-respect.
Universalism:	Equality, Unity with nature, Wisdom, A world of beauty Social justice, Broad-minded, Protecting the environment, A world at peace.
Benevolence:	Helpful, Responsible, Forgiving, Honest, Loyal, Mature Love, True Friendship.
Tradicion:	Respect for tradition, Devout, Accepting my portion in life, Humble, Moderate.
Conformity:	Obedient, Self-discipline; Politeness, Honouring of parents and elders.
Security:	National security, Reciprocation of favours, Family security, Sense of belonging, social order, Healthy, Clean.

Source: Schwarts,1992

3.4.2 Results

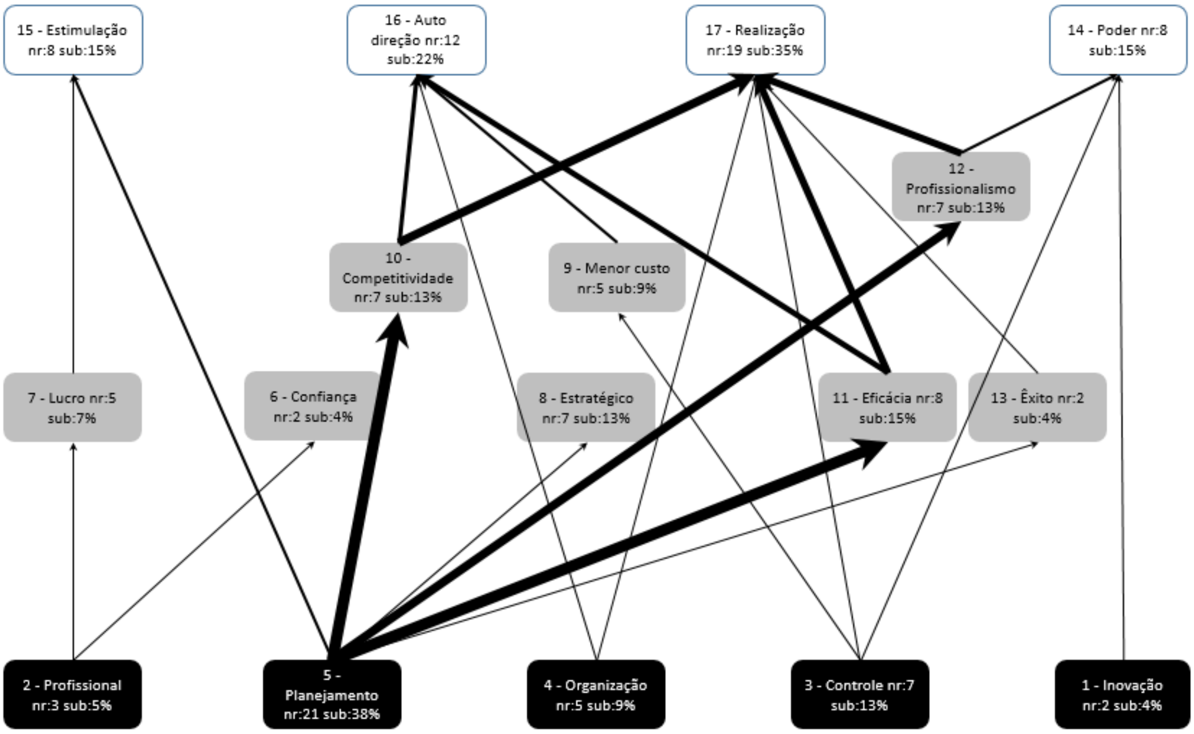
This is where we want to draw attention to this study: a knowledge leap in the use of strategic resources of farmers can change an entire cultural scenario of this professional's profile. (Wood et al. 2014).

Important: as this study is about farmer's perception on the investigated subject, we kept the results on the figures in Portuguese. We translated to English the same results that are in the tables.

3.4.2.1 Value chain of the meaning of Management Model

Figure 3 shows the Hierarchy of Value Map to the perceptions of Management Model.

Figure 3 Hierarchical Value Map (HVM) – Management Model



Tables 6 and 7 shows that the Management Model is connected with the meaning of Power, Stimulation, Self-Direction, and Realization. In the discussion section of this chapter we will present our conclusions.

Table 6 Codes and Elements of the Value Chain of the meaning of Management Model

ATRIBUTES	CONSEQUENCES	VALUES
1. Innovation	6. Trust	**14. Power**
2. Professional	7. Profit	**15. Stimulation**
3. Control	8. Strategic	**16. Self-direction**
4. Organization	9. Lower cost	**17. Realization**
5. Planning	10. Competitiveness	
	11. Effectiveness	
	12. Professionalism	
	13. Success	

Table 7 HVM Model Interpretation and analysis – Management Model

Attribute	Formed Chain	Meaning
2. Professional	2 (5%) - 7 (7%) - 15 (15%)	Stimulation
	2 (5%) - 6 (4%)	Trust
5. Planning	5 (38%) - 15(15%)	Stimulation
	5 (38%) - 10 (13%) - 17 (35%)	Realization
	5 (38%) - 10 (13%) -16 (22%)	Self-direction
	5 (38%) - 8 (13%)	Strategic
	5 (38%) - 12 (13%) - 14 (15%)	Power
	5 (38%) - 12 (13%) - 17 (35%)	Realization
	5 (38%) - 11 (15%) - 16 (22%)	Self-direction
	5 (38%) - 11 (15%) - 17 (35%)	Realization
	5 (38%) - 13 (4%) - 17 (35%)	Realization
4. Organization	4 (9%) - 16 (22%)	Self-direction
	4 (9%) - 17 (35%)	Realization
3. Control	3 (13%) - 9 (9%) - 16 (22%)	Self-direction
	3 (13%) - 17 (35%)	Realization
	3 (13%) - 14 (15%)	Power
1. Innovation	1 (4%) - 14 (15%)	Power

3.4.2.2 Value Chain of the Meaning of Enterprise Resource Planning (ERP)

Table 8 and 9 show the interpretations for the Enterprise Value Planning Hierarchy Map found in Figure 4.

Table 8 Codes and Elements of the Meaning of Enterprise Resource Planning (ERP)

ATTRIBUTES	CONSEQUENCES	VALUES
1. Environment	4. Feasibility	12. Stimulation
2. Resources	5. Essential	13. Kindness
3. Management	6. Profit	14. Realization
	7. Assertiveness	15. Self-Direction
	8. Investment	16. Security
	9. Optimization	17. Power
	10. Facilitation	
	11. Success	

Figure 4 HVM - Enterprise Resource Planning (ERP)

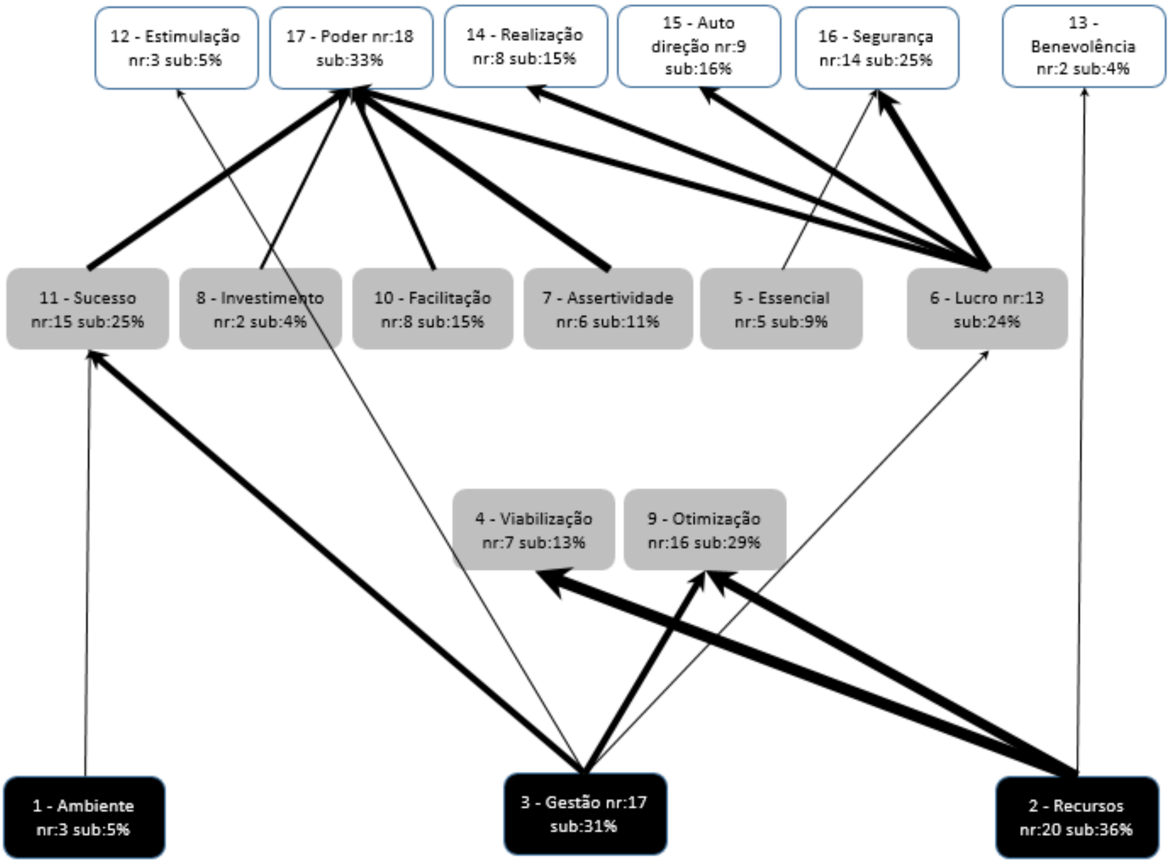


Table 9 HVM Chain Interpretation and Analysis - Enterprise Resource Planning (ERP)

Attribute	Formed Chain	Meaning
1. Environment	1 (5%) - 11 (25%) - 17 (33%)	Power
3. Management	**3 (31%) - 11 (25%) - 17 (33%)**	Power
	3 (31%) - 12 (5%)	Stimulation
	3 (31%) - 9 (29%)	Optimization
	3 (31%) - 6 (24%) - 16 (25%)	Safety
	3 (31%) - 6 (24%) - 15 (16%)	Self Directing
	3 (31%) - 6 (24%) - 14 (15%)	Achievement
	3 (31%) - 6 (24%) - 17 (33%)	Power
2. Resources	**2 (36%) - 4 (13%)**	Viabilization
	2(36%) - 9 (29%)	Optimization
	2 (36%) - 13 (4%)	Benevolence

3.4.2.3 Value Chain of Innovation Meaning

Tables 10 and 11 show the interpretations for the Innovation Value Hierarchy Map found in Figure 5.

Table 10 Codes and Elements of the Values Chain of the Meaning of Innovation

ATRIBUTES	CONSEQUENCES	VALUES
1. Novelty	4. Challenge	12. Realization
2. Different	5. Success	13. Stimulation
3. Technology	6. Profit	14. Security
	7. Differentiation	
	8. Competitiveness	
	9. Effectiveness	
	10. Optimization	
	11. Creativity	

Figure 5 Hierarchical Values Map (HVM) – Innovation

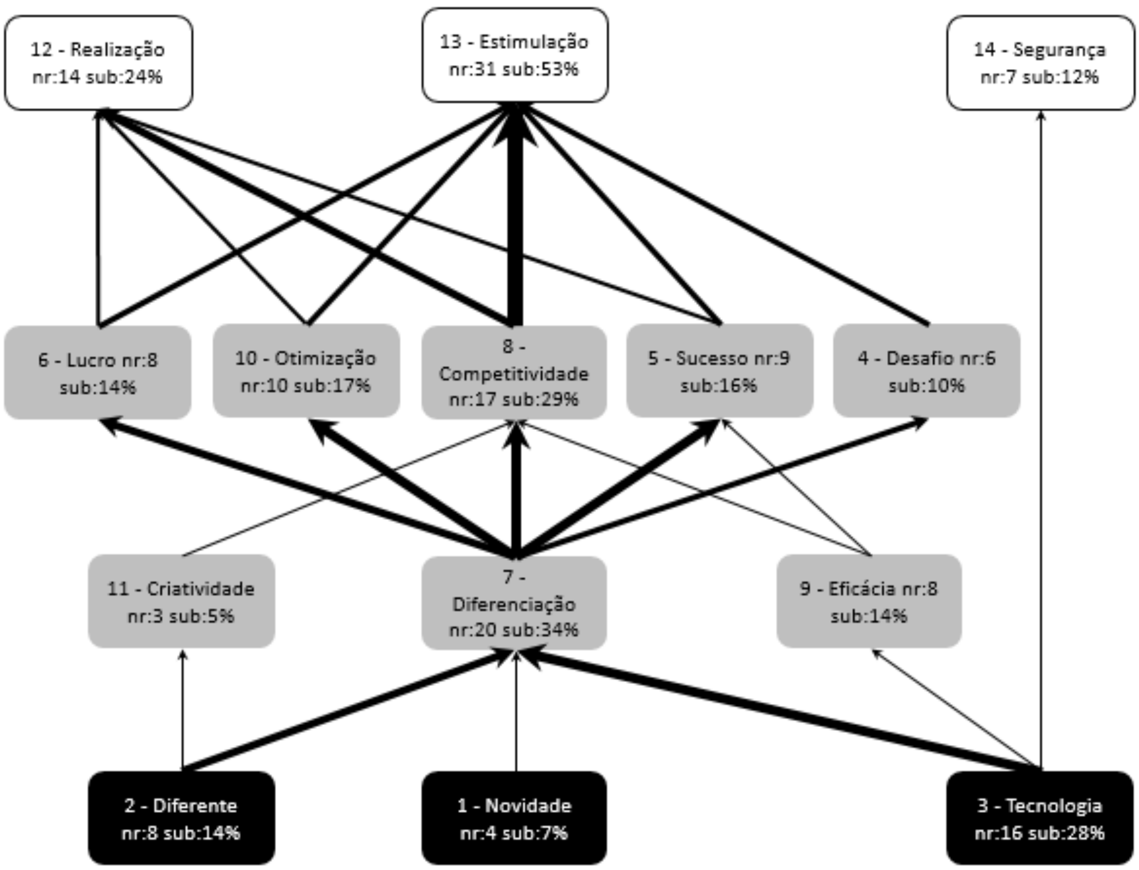


Table 11 *Interpretations and Analysis of HVM Chains – Innovation*

Attribute	Formed Chain	Meaning
2. Different	**2 (14%) - 11 (5%) - 8 (29%) - 12 (24%)**	Realization
	2 (14%) - 11 (5%) - 8 (29%) - 13 (53%)	Stimulation
	2 (14%) - 7 (34%) - 6 (14%) - 13 (53%)	Stimulation
	2 (14%) - 7 (34%) - 6 (14%) - 12 (24%)	Realization
	2 (14%) - 7 (34%) - 10 (7%) - 12 (24 %)	Realization
	2 (14%) - 7 (34%) - 10 (7%) - 13 (53 %)	Stimulation
	2 (14%) - 7 (34%) - 8 (29%) - 12 (24%)	Realization
	2 (14%) - 7 (34%) - 8 (29%) - 13 (53%)	Stimulation
	2 (14%) - 7 (34%) - 5 (16%) - 12 (24%)	Realization
	2 (14%) - 7 (34%) - 5 (16%) - 13 (53%)	Stimulation
	2 (14%) - 7 (34%) - 4 (10%) - 13 (53%)	Realization
1. Novelty	**1 (7%) - 7 (34%) - 6 (14%) - 13 (53%)**	Stimulation
	1 (7%) - 7 (34%) - 6 (14%) - 12 (24%)	Realization
	1 (7%) - 7 (34%) - 10 (7%) - 12 (24 %)	Realization
	1 (7%) - 7 (34%) - 10 (7%) - 13 (53 %)	Stimulation
	1 (7%) - 7 (34%) - 8 (29%) - 12 (24%)	Realization
	1 (7%) - 7 (34%) - 8 (29%) - 13 (53%)	Stimulation
	1 (7%) - 7 (34%) - 5 (16%) - 12 (24%)	Realization
	1 (7%) - 7 (34%) - 5 (16%) - 13 (53%)	Stimulation
	1 (7%) - 7 (34%) - 4 (10%) - 13 (53%)	Stimulation
3. Technology	**3 (28%) - 7 (34%) - 6 (14%) - 13 (53%)**	Stimulation
	3 (28%) - 7 (34%) - 6 (14%) - 12 (24%)	Realization
	3 (28%) - 7 (34%) - 10 (7%) - 12 (24 %)	Realization
	3 (28%) - 7 (34%) - 10 (7%) - 13 (53 %)	Stimulation
	3 (28%) - 7 (34%) - 8 (29%) - 12 (24%)	Realization
	3 (28%) - 7 (34%) - 8 (29%) - 13 (53%)	Stimulation
	3 (28%) - 7 (34%) - 5 (16%) - 12 (24%)	Realization
	3 (28%) - 7 (34%) - 5 (16%) - 13 (53%)	Stimulation
	3 (28%) - 7 (34%) - 4 (10%) - 13 (53%)	Stimulation
	3 (28%) - 9 (14%) - 8 (29%) - 13 (53%)	Stimulation
	3 (28%) - 9 (14%) - 8 (29%) - 12 (24%)	Realization
	3 (28%) - 9 (14%) - 5 (16%) - 12 (24%)	Realization
	3 (28%) - 9 (14%) - 5 (16%) - 13 (53%)	Stimulation
	3 (28%) - 14 (12%)	Security

3.4.2.4 Chain of Values of the meaning of Levers for Agribusiness

Tables 12 and 13 show the interpretations for the Value Hierarchy Map on Agribusiness Leverage perception found in Figure 6.

Table 12 Codes and Elements of the Chain of Values meaning of Leverage for Agribusiness

ATRIBUTOS	CONSEQUÊNCIAS	VALORES
1. Future	7. Investment	13. Power
2. Demand	8. Efficiency	14. Conformity
3. Economy	9. Productivity	15. Security
4. Predictability	10. Information	16. Universalism
5. Management	11. Perpetuity	17. Stimulation
6. Technology	12. Development	

Figure 6 Hierarchical Values Map (HMV) – Levers for Agribusiness

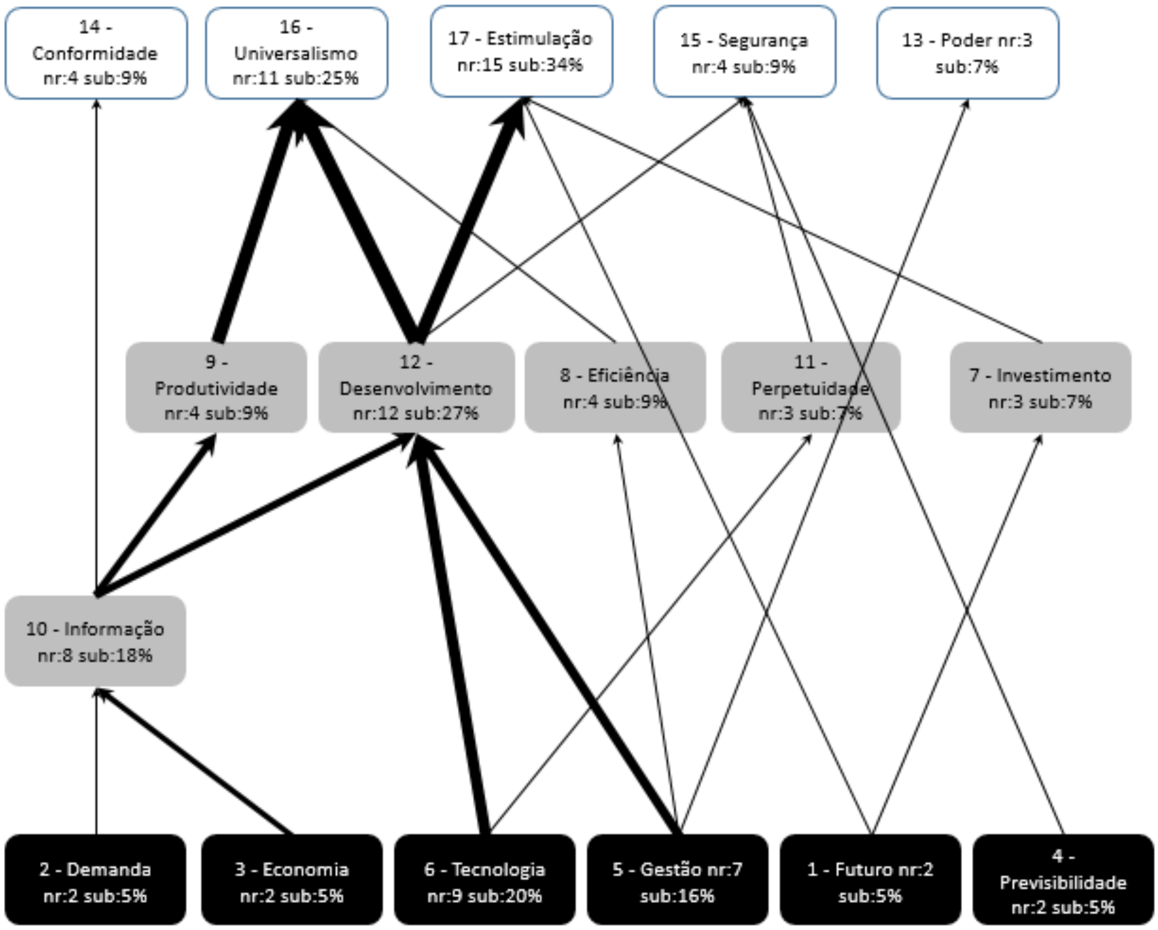


Table 13 *Interpretation and Analysis of MHV Chains – Levers to Agribusiness*

Attribute	Formed Chain	Meaning
2. Demand	2 (5%) - 10 (18%) - 14 (9%)	Conformity
	2 (5%) - 10 (18%) - 9 (9%) - 16 (25%)	Universalism
	2 (5%) - 10 (18%) - 12 (27%) - 16 (25%)	Universalism
	2 (5%) - 10 (18%) - 12 (27%) - 17 (34%)	Stimulation
	2 (5%) - 10 (18%) - 12 (27%) - 15 (9%)	Security
3. Economy	3 (5%) - 10 (18%) - 14 (9%)	Conformity
	3 (5%) - 10 (18%) - 9 (9%) - 16 (25%)	Universalism
	3 (5%) - 10 (18%) - 12 (27%) - 16 (25%)	Universalism
	3 (5%) - 10 (18%) - 12 (27%) - 15 (9%)	Security
	3 (5%) - 10 (18%) - 12 (27%) - 17 (34%)	Stimulation
6. Technology	**6 (20%) - 12 (27%) - 17 (34%)**	Stimulation
	6 (20%) - 12 (27%) - 16 (25%)	Universalism
	6 (20%) - 12 (27%) - 15 (9%)	Security
	6 (20%) - 11 (7%) - 15 (9%)	Security
5. Management	**5 (16%) - 12 (27%) - 16 (25%)**	Universalism
	5 (16%) - 12 (27%) - 17 (34%)	Stimulation
	5 (16%) - 12 (27%) - 15 (9%)	Security
	5 (16%) - 8 (9%) - 16 (25%)	Universalism
	5 (16%) - 13 (7%)	Power
1. Future	**1 (5%) - 17 (34%)**	Stimulation
	1 (5%) - 7 (7%) - 17 (34%)	Stimulation
4. Predictability	4 (5%) - 15 (9%)	Security

3.4.2.5 Value Chain of meaning of Technology

Tables 14 and 15 show the interpretations for the Value Hierarchy Map on the Technology perception found in Figure 7.

Table 14 Codes and Elements of the String of Values of the Meaning of Technology

ATTRIBUTES	CONSEQUENCES	VALUES
1. Cost reduction	7. Sustainable	17. Universalism
2. Efficiency	8. Development	18. Self-Direction
3. Management	9. Objective	19. Power
4. Productivity	10. Effectiveness	20. Security
5. Survival	11. Profit	21. Stimulation
6. Innovation	12. Optimization	22. Realization
	13. Sustainability	
	14. Perfection	
	15. Future	
	16. Reference	

Figure 7 Hierarchical Value Map (HVM) – Technology

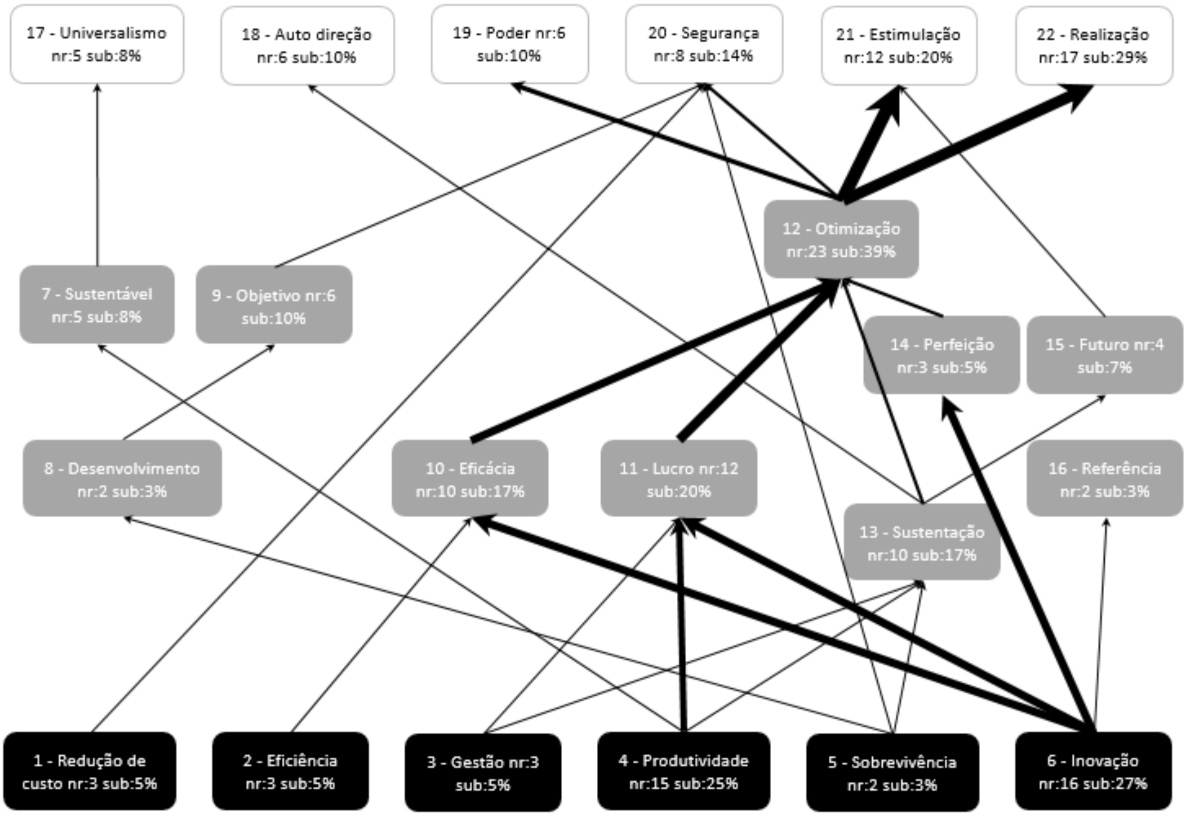


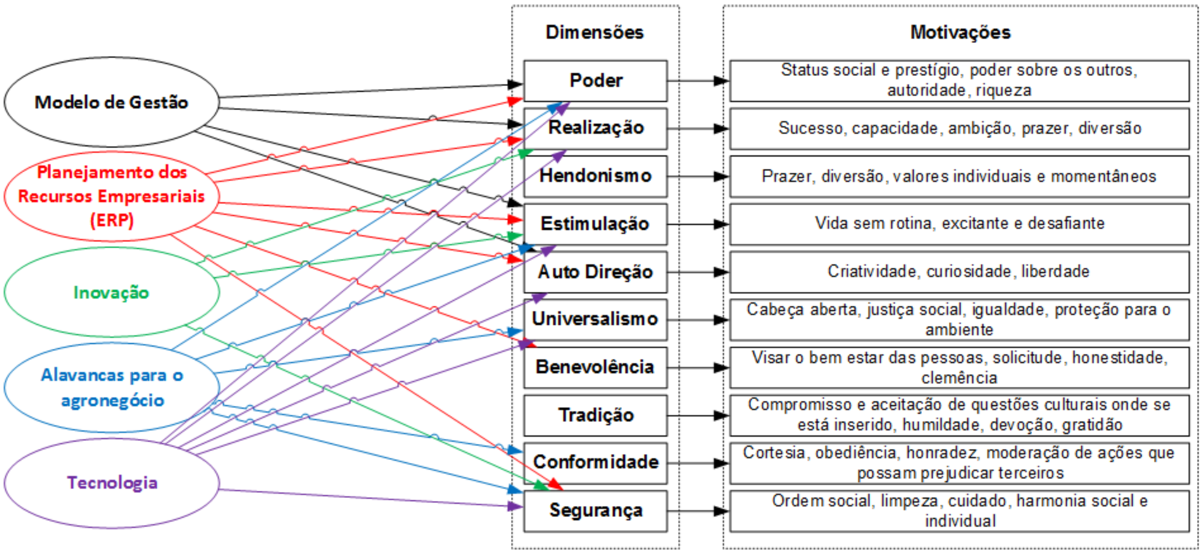
Table 15 Interpretation and analysis of MHV chains – Technology

Attribute	Formed Chain	Meaning
1. Cost reduction	1 (5%) – 20 (14%)	Security
2. Efficiency	2 (5%) – 10 (17%) – 12 (39%) – 19 (10%)	Power
	2 (5%) – 10 (17%) – 12 (39%) – 20 (14%)	Security
	2 (5%) – 10 (17%) – 12 (39%) – 21 (20%)	Stimulation
	2 (5%) – 10 (17%) – 12 (39%) – 22 (29%)	Realization
3. Management	3 (5%) - 11 (20%) - 12 (39%) - 19 (10%)	Power
	3 (5%) – 11 (20%) – 12 (39%) – 20 (14%)	Security
	3 (5%) – 11 (20%) – 12 (39%) – 21 (20%)	Stimulation
	3 (5%) – 11 (20%) – 12 (39%) – 22 (29%)	Realization
	3 (5%) - 13 (17%) - 18 (10%)	Self direction
	3 (5%) - 13 (17%) - 12 (39%) - 19 (10%)	Power
	3 (5%) - 13 (17%) - 12 (39%) - 20 (14%)	Security
	3 (5%) - 13 (17%) - 12 (39%) - 21 (20%)	Stimulation
	3 (5%) - 13 (17%) - 12 (39%) - 22 (29%)	Realization
	3 (5%) - 13 (17%) - 15 (7%) - 21 (20%)	Stimulation
4. Productivity	4 (25%) - 7(8%) - 17 (8%)	Universalism
	4 (25%) - 11 (20%) - 12 (39%) - 19 (10%)	Power
	4 (25%) - 11 (20%) - 12 (39%) - 20 (14%)	Security
	4 (25%) - 11 (20%) - 12 (39%) - 21 (20%)	Stimulation
	4 (25%) - 11 (20%) - 12 (39%) - 22 (29%)	Realization
	4 (25%) - 13 (17%) - 18 (10%)	Self direction
	4 (25%) - 13 (17%) - 12 (39%) - 19 (10%)	Power
	4 (25%) - 13 (17%) - 12 (39%) - 20 (14%)	Security
	4 (25%) - 13 (17%) - 12 (39%) - 21 (20%)	Stimulation
	4 (25%) - 13 (17%) - 12 (39%) - 22 (29%)	Realization
	4 (25%) - 13 (17%) - 15 (7%) - 21 (20%)	Stimulation
5. Survival	5 (3%) - 8 (3%) - 9 (10%) - 20 (14%)	Security
	5 (3%) - 20 (14%)	Security
	5 (3%) - 13 (17%) - 18 (10%)	Self direction
	5 (3%) - 13 (17%) - 12 (39%) - 19 (10%)	Power
	5 (3%) - 13 (17%) - 12 (39%) - 20 (14%)	Security
	5 (3%) - 13 (17%) - 12 (39%) - 21 (20%)	Stimulation
	5 (3%) - 13 (17%) - 12 (39%) - 22 (29%)	Realization
	5 (3%) - 13 (17%) - 15 (7%) - 21 (20%)	Stimulation
6. Innovation	6 (27%) - 10 (17%) - 12 (39%) - 19 (10%)	Power
	6 (27%) - 10 (17%) - 12 (39%) - 20 (14%)	Security
	6 (27%) - 10 (17%) - 12 (39%) - 21 (20%)	Stimulation
	6 (27%) - 10 (17%) - 12 (39%) - 22 (29%)	Realization
	6 (27%) - 11 (20%) - 12 (39%) - 19 (10%)	Power
	6 (27%) - 11 (20%) - 12 (39%) - 20 (14%)	Security
	6 (27%) - 11 (20%) - 12 (39%) - 21 (20%)	Stimulation
	6 (27%) - 11 (20%) - 12 (39%) - 22 (29%)	Realization
	6 (27%) - 14 (5%) - 12 (39%) - 19 (10%)	Power
	6 (27%) - 14 (5%) - 12 (39%) - 20 (14%)	Security
	6 (27%) - 14 (5%) - 12 (39%) - 21 (20%)	Stimulation
	6 (27%) - 14 (5%) - 12 (39%) - 22 (29%)	Realization
	6 (27%) - 16 (3%)	Reference

3.4.3 Discussion and Conclusions

Figure 8 shows the interactions in the value matrix of each of the qualitative variables studied. Our intention was to interpret and discuss these results with experts from the Brazilian agribusiness sector. Individual in depth interviews were conducted with these experts. In the interviews, we presented these results in order to reach some conclusions. To facilitate, we divided the discussions into Management Model, Enterprise Resource Planning (ERP), Innovation, Technology and Levers for agribusiness. In these discussions we have included findings from our Group discussions with the respondents shortly after completing the questionnaires.

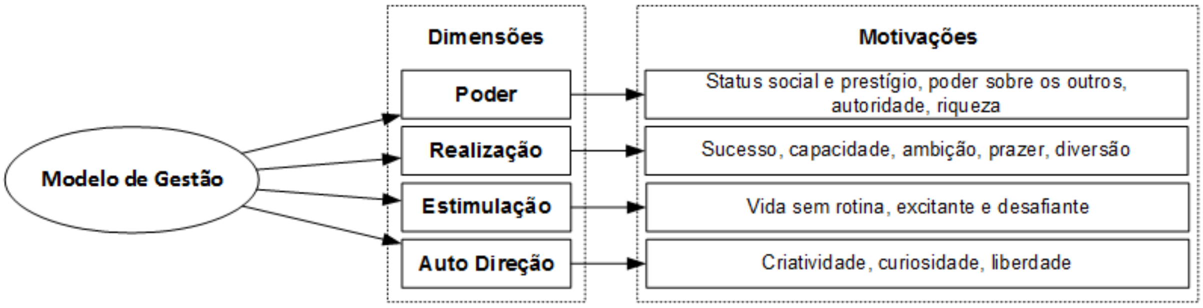
Figure 8 Measurement of Links in the Hierarchy of Value Matrix



3.4.3.1 Management Model

The main conclusion of the presentation of Figure 9 is that the absence / lack of a management model is of increasing concern in the fresh-cut food production sector. This concern is already on the radar of farmers. The motivations for formulating a Management Model are: to promote social status, success through accomplishment, a challenge and the courage to create something new for problem solutions. The new model should involve the areas of the farm, such as purchasing, sale, production and sustainability.

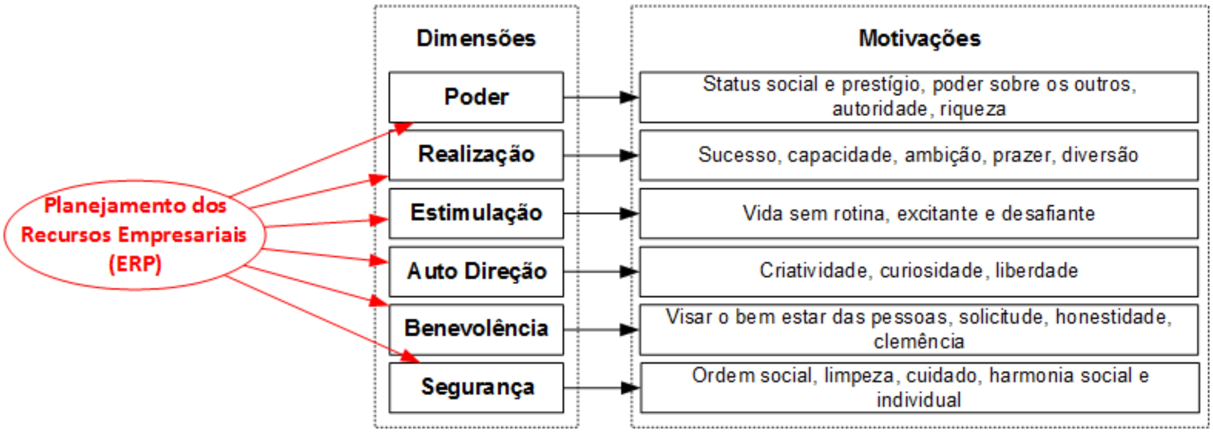
Figure 9 Management Model



3.4.3.2 Enterprise Resource Planning (ERP)

The discussion from Figure 10 shows that the motivation for adopting ERP is to make information for decision-making clearer and more transparent to promote well-being among farm professionals with order, harmony, and common goals. ERP must involve the production areas, productivity, technology and logistics both internal and external to the farm. It is important to involve research and technology diffusion agencies, such as Public Agencies and Universities.

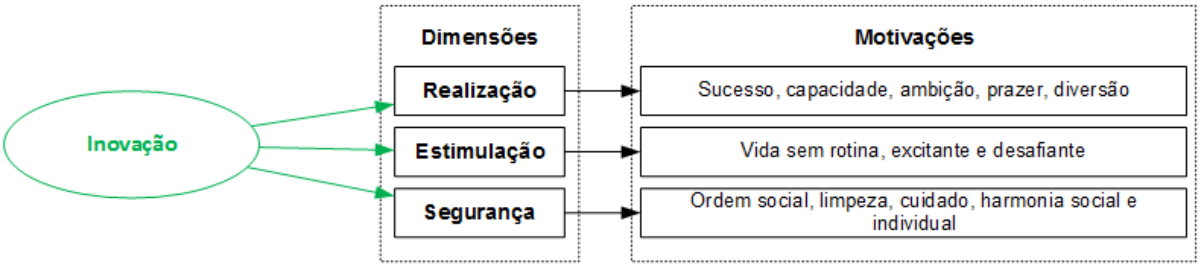
Figure 10 Enterprise Resource Planning (ERP)



3.4.3.3 Innovation

The discussion from Figure 11 shows that the motivation for adopting innovation is closely linked to technology adoption and should no longer be circumscribed in the environment of using better seeds, fertilizers, and more effective plant protection products. The movement must be guided from now on to all other operational, tactical and strategic processes and tools that can create value for a farm.

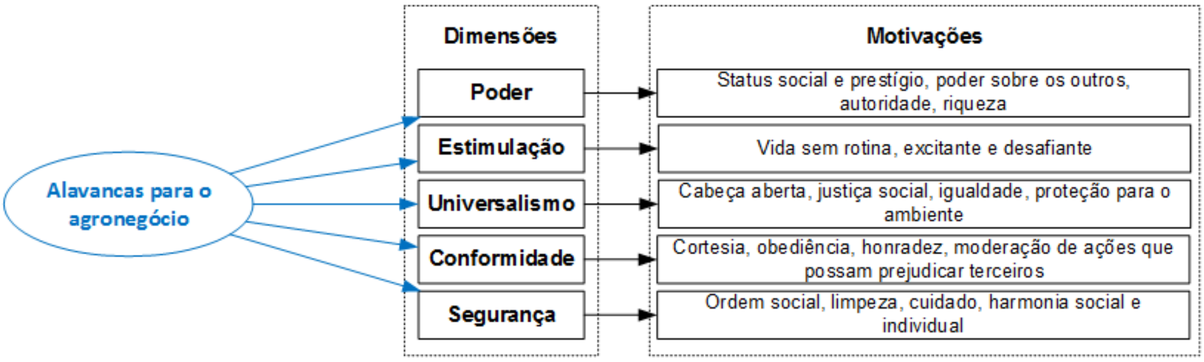
Figure 11 Innovation



3.4.3.4 Levers for the Agribusiness

The discussion from Figure 12 shows that the motivations for the levers for the development of agribusiness should be seen differently, especially referring to the borders of the farm and the frontiers of knowledge. If we want, as a country, to continue as one of the main players in the international market, we must think more collectively and less individually. This is linked to business security and compliance. This involves collaborative actions among farmers to change the paradigm of perfect competition among commodity producers.

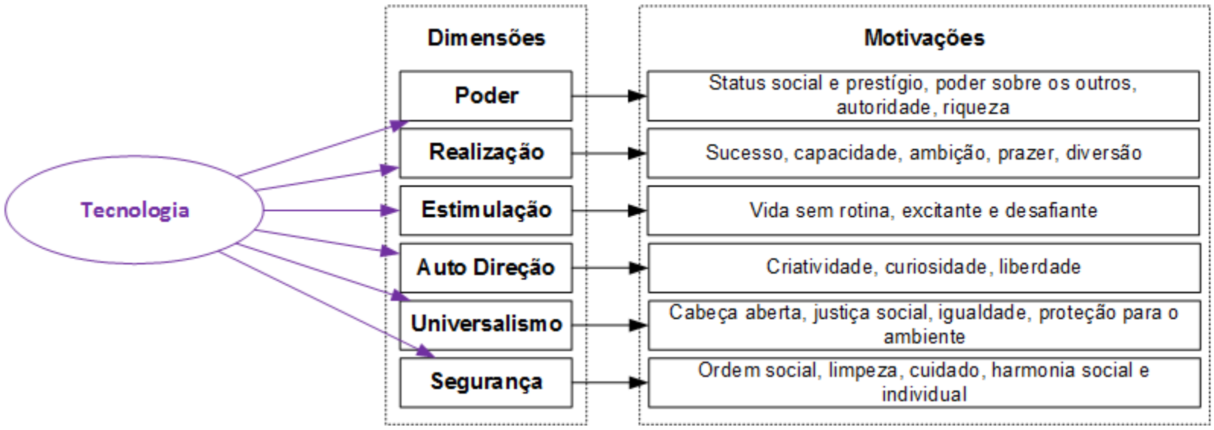
Figure 12 Levers for the Agribusiness



3.4.3.5 Technology

Technology is seen and discussed as the main paradigm of agribusiness in Brazil. What may be at stake in this Value is a business vision that allows farms to operate more strategically and less operationally. It is to give freedom of choice to farm employees to make decisions considering the reduction of risks inherent to the business: climate, financial, foreign exchange, inputs, planting windows and international market. These conclusions were drawn as discussed in Figure 13.

Figure 13 Technology



3.4.4 Implications for research and practice

This study is exploratory and is based on quantitative information from 75 interviewees and in-depth interviews with 10 (ten) agribusiness specialists from Brazil. The cultural differences of different producer groups and regions of Brazil could affect the results. However, we needed ideas and exploratory subsidies to help us build our constructs. In a move towards agribusiness globalization, the value of more cross-cultural research is clear. However, the results of this study have implications for researchers and professionals. For the researchers, this study provides a basis for the validation of the constructs to know the determinants of adoption and utilization of ERP by the farms and improvement of the organizational models of acceptance, as a starting point for future research. For professionals, understanding key issues in defining the research model to be proposed and their adaptations is crucial to designing, refining, and implementing ERP based on analytical insights platform technology on the farm. By understanding the key factors that affect ERP acceptance and use, constraints and particularities, consultancies can evolve by adapting their strategies for ERP development by aligning functionality with real farmers' needs, adapting marketing strategies, service development, design and educational content based on technology, leveraging benefits, increasing acceptance and reinforcing use.

3.5. Limitations and future research

For future research we recommend developing the Focus Group methodology to promote discussions of the opinions rose in the in-depth interviews.

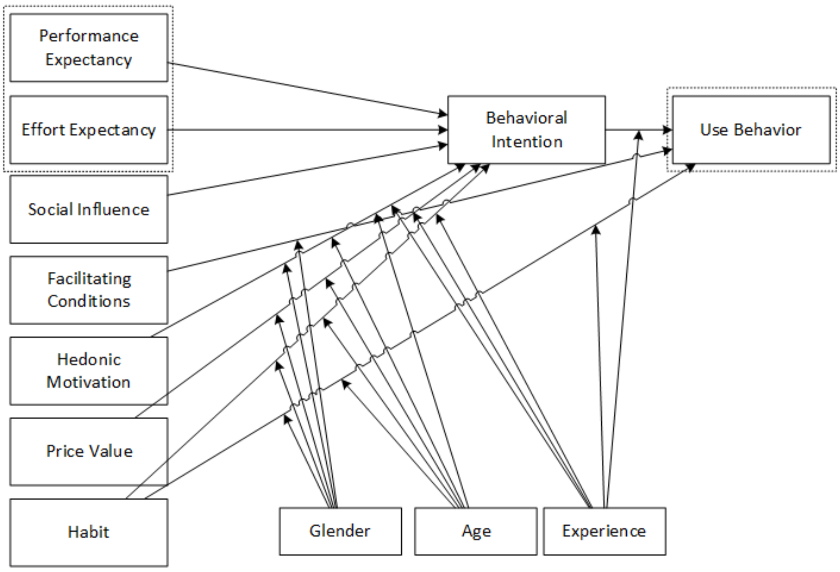
From the studies carried out in these exploratory projects we will start the discussion phase of constructs and theories for the development of the empirical work of data collection and definitions of statistical analysis tools. However, this chapter of qualitative research was carried out from the study 1: Understanding the determinants of adoption of enterprise resource planning (ERP) technology within the agri-food context: The case of the Midwest of Brazil. This may lead to discussions among researchers about the order of search types.

Chapter 4 – Quantitative Adoption Models

4.1. Extended unified theory of acceptance and use of technology (UTUAT 2)

Venkatesh et al. (2003) developed the unified theory of acceptance and use of technology (UTAUT). This model considers that three constructs are determinant for behavior and behavioral intentions: (i) expectation of performance, (ii) expectation of effort, (iii) social influence and facilitating conditions. Since its inception in 2003, researchers have been testing UTAUT to explain the adoption of technology, especially in organizational contexts (Viswanath Venkatesh, Thong, and Xu 2012). Later, this theory was broadened to study the acceptance and use of technology in the context of the consumer (Viswanath Venkatesh, Thong, and Xu 2012), adding three constructs to the original model: hedonic motivation, price value and habit, which changed some existing relationships in the original conception of UTAUT, and introduced new relationships. Individual differences (age, gender, and experience) had the hypothesis to moderate the effects of constructions on behavioral intent and the use of technology. This model - UTAUT2 - is shown in Figure 14.

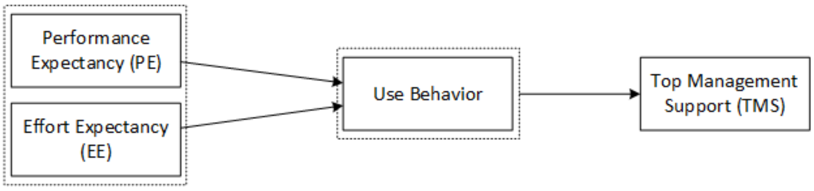
Figure 14 UTAUT2 Model



Our intention is not to use the whole model. We want to have elements that allow us to better explain the Top Management Support construct for farmers' decision-making to adopt technology using Performance Expectancy, Effort Expectancy and Use Behavior, as shown in Figure 15.

We did not get any results with this investigation. The mistake is to consider that we could use Top Management Support with a dependent variable.

Figure 15 Adapted model UTAUT 2



Therefore, we define the constructs as shown in Table 16.

Table 16 Constructs to the Figure 15

Please rate the following statements, where 1 means strongly disagree and 7 totally agree.				
(6) Performance Expectancy (PE) /R	PE1	I consider that the use of ERP allows me to accomplish tasks more quickly	(1~7)	(Viswanath Venkatesh, Thong, and Xu 2012)
	PE2	I consider that the use of ERP would increase my productivity		
	PE3	I consider that the use of ERP would improve my performance		
(7) Effort expectancy (EE) /R	EE1	My interaction with the implementation of an ERP would be clear and understandable	(1~7)	(Viswanath Venkatesh, Thong, and Xu 2012)
	EE2	It would be easy for me to become more skilled with the implementation of ERP		
	EE3	I would think the ERP system easy to use		
	EE4	I believe that learning to operate an ERP system for decision making would be easy for me		
(8) Innovation Behavior (IB) /R	IB1	The implementation of an ERP system is innovative	(1~7)	Results from the Exploratory Study
	IB2	Like the challenge of doing something I've never done as the implementation of an ERP system		
	IB3	I follow the latest technology. So I want to use an ERP		
	IB4	I am really interested in few things only. ERP is not one		
	IB5	I like to try new things. So using an ERP stimulates me.		
	IB6	I like my life is always the same, week after week.		
Please rate the following statements, where 1 means strongly disagree and 7 totally agree.				
(9) Top Management Support (TMS) /R	TMS1	Top Management is actively involved in establishing a vision and formulate strategies for the use of an ERP	(1~7)	(Chan and Chong 2013)
	TMS2	Top Management communicates its support for the use of ERP		
	TMS3	Top Management is likely to analyze the occurrence of risks involved in implementing an ERP		
	TMS4	I´m willing to take risks (financial and organizational) involved in the adoption of new management models - ERP - Enterprise Resource Planning		

4.2. TOE, DOI and IOR Theories

TOE Framework identifies the process used by a company to adopt and implement innovations by considering the technological, organizational and environmental context (Louis

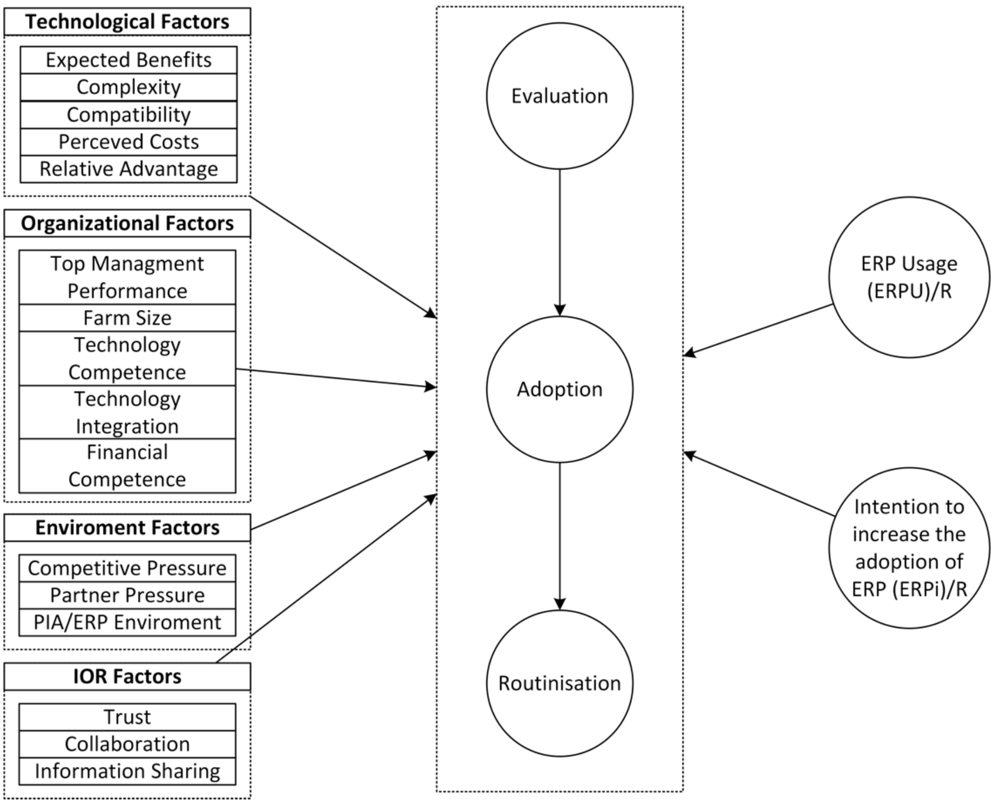
G.. Tornatzky and Fleischer 1990). The technological context embraces relevant internal and external technology as tools and processes while the organizational context is related to the company's features and its assets such as company size, hierarchy, process procedures, administrative structure, human resources, extra resources and employee connections. The environmental context is influenced by market elements such as the size and structure of the industry, company's competitors, macroeconomics and the regulatory environment. All three contexts can present opportunities and threats, which influence how a company sees, searches and adopts new technologies.

TOE has consistent empirical support and is useful in the study of various types of technological adoptions (Y. M. Wang, Wang, and Yang 2010). However, the measures specified in the three factors vary according to the types of technologies studied. Despite TOE's popularity, (Shang, Chen, and Liu 2005; Yee-Loong Chong and Ooi 2008) have stated that TOE often neglects the impact of interorganizational relationships (IOR). In his study of e-business adoption among small and medium-sized enterprises, Chong et al. (2009a) found that IORs are able to determine e-business adoption decisions in the supply. As implementing ERP on Analytic Insights Platforms involves establishing IORs, including trust and information sharing, it is important to consider IORs when studying the diffusion of ERP to the cloud computing. Based on the past literature, this study used the TOE framework and extends it with the IOR attributes.

On the other hand, DOI Theory studies the spread of innovations and how it is communicated through channels over time and inside a particular social environment (Rogers 1993). Each individual is deemed to hold different levels of innovation acceptance. This paradigm of diffusion was spread during the fifties and sixties among sociology researchers of rural areas (Valente and Rogers 1995).

DOI and TOE Theories have been widely used in studies concerning the adoption of innovative technology and they have consistent empiric support (Tiago Oliveira, Thomas, and Espadanal 2014). The benefits of merging TOE concepts to reinforce the DOI theory are already well recognized (Hsu, Kraemer, and Dunkle 2006b). Using DOI and TOE together helps to provide a more comprehensive perspective about technology adoption including the technological context aspects, organizations and external environment (Kevin Zhu, Kraemer, and Xu 2006b). DOI and TOE Theories (Figure 16) complement each other successfully (Park, Eo, and Lee 2012). Figure 16 shows how we combine DOI, TOE, and IOR Factors.

Figure 16 Research Model combining TOE, DOI and IOR



Thus, we set for our study the constructs and the analysis variables in Table 8.

Table 17 Constructs to Figure 16

Please rate the following statements, where 1 means strongly disagree and 7 totally agree.				
(1) Expected Benefits (EB) /R	EB1	ERP provides accurate information for decision making in a timely manner.	(1~7)	(Chan and Chong 2013)
	EB2	ERP provides an efficient way to manage the inputs		
	EB3	ERP provides an efficient way to manage the production		
	EB4	ERP helps to capture data quickly and provides necessary analyzes for the main decision-making on a farm: planting, treat, harvest and sell.		
	EB5	ERP helps reduce inventory costs.		
(2) Complexity (CX) /R	CX1	My company believes that an ERP is complex to use	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014)
	CX2	My company believes that the development of ERP is a complex process		
	CX3	I believe that the use of ERP is very complex for production operations		
	CX4	The skills required to adopt an ERP are too complex for agricultural property's staff.		
(3) Compatibility (CP) /R	CP1	Management your farm through an ERP is compatible with your current sales process	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014)
	CP2	Buy through the implementation of ERP is compatible with your current purchasing process		
	CP3	Management through an ERP is compatible with my organizational culture		
	CP4	ERP is compatible with my company current experience with similar systems		
(4) Perceived costs (PC) /R	PC1	ERP is more cost effective than other types of technology to Farm Management Templates.	(1~7)	(Chan and Chong 2013)
	PC2	Our organization can avoid unnecessary costs and save time by using an ERP.		
	PC3	ERP saves costs related to the time and effort.		
	PC4	The benefits of a management model - ERP best suited for my needs are less than the costs of adoption		
	PC5	With the adoption of a more appropriate ERP there is a reduction in the general and environmental costs (naturals and sustainable resources)		
(5) Relative Advantage (RA) /R	RA1	Rate the level which your organization expects the ERP helps in the sales process and improve the productivity.	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014)
	RA2	Rate the level which your organization expects the ERP helps reduce costs. (supply purchase, machines, equipment, labor, diesel…)		
	RA3	Rate the level which your organization expects the ERP helps in the purchasing process		
	RA4	Rate the level that your organization expects an ERP helps in the production storage process		
	RA5	Rate the level that your organization expects an ERP helps in the logistics process in order the production to arrive on time at their destination.		
(10) Farm Size (FS) /R	FS1	The capital of my farm is high compared to my neighbors.	(1~7)	(Chan and Chong 2013)
	FS2	The revenue from my Farm is high compared to my neighbors.		
	FS3	The number of employees of my farm is high compared to my neighbors		
(11) Technology Competence (TC) /R	TC1	The technology infrastructure of my Farm is available to support an ERP implementation	(1~7)	(Chan and Chong 2013)
	TC2	Inside the farm there are skills needed to implement a more efficient ERP model		
	TC3	The farm knows how an ERP model can be used to support operations.		

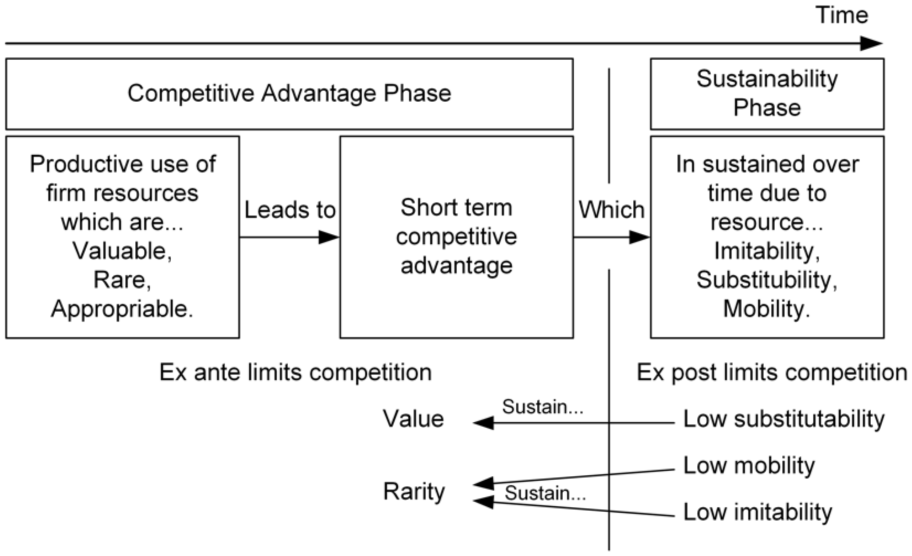
	TC4	Most of my tractors and harvesters have mobile communication technologies		
	TC5	I regularly use precision agriculture: from planting to harvest		
(12) Technology Integration (TI) /F	TI1	Rate as that your processes and management tools are electronically integrated with the internal databases and information systems	(1~7)	(Kevin Zhu, Kraemer, and Xu 2006b)
	TI2	My databases and information systems are integrated electronically with my suppliers.		
	TI3	Please rate how much your company's databases and information systems are electronically integrated with the suppliers and business customers (buyers of agricultural production)		
(13) Financial Competence (FC) /F	FC1	My Farm has the financial resources for the purchase of hardware and software necessary for the implementation of an ERP	(1~7)	(Chan and Chong 2013)
	FC2	My Farm has the financial resources to make workflow changes to accommodate the implementation of an ERP system		
	FC3	I believe getting line of credit to finance the ERP implementation in my farm.		
(14) Competitive Pressure (CPR) /R	CPR1	My farm suffers a competitive pressure to implement ERP	(1~7)	(Chan and Chong 2013)
	CPR2	My Farm will have competitive disadvantage if we do not implement ERP.		
	CPR3	Pressure level originated by competitors in the local market		(Wei, Lowry, and Seedorf 2015)
	CPR4	Pressure level originated by competitors in the national market		
	CPR5	Pressure level caused by trading and buyers of my production is very high.		
(15) Partner Pressure (PP) /F	PP1	The Buyers of your production are requiring	(1~7)	(Hsu, Kraemer, and Dunkle 2006b)
	PP2	To improve the coordination between your suppliers and buyers		
	PP3	Raw material suppliers are requiring		
	PP4	The official banks are demanding the implementation of ERP to facilitate approval of pre-costing and costing credit.		
(16) ERP Environment (ERPE) /F	ERPE1	There is adequate availability for integrated decision making important for the farm	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014)
	ERPE2	There is adequate availability of devices that make the integration of all data from crop production (ground, fertilizer, cultural tracts, quality standards, ...		
	ERPE3	There is adequate availability of information on safety standards for use in shared management systems		
	ERPE4	There is adequate availability of computer standards for the implementation of ERP systems		
	ERPE5	There is adequate availability of system applications that enable paradigms break on the farm		
	ERPE6	There is a suitable ERP system on the market to meet the farm's needs		
(17) Trust (T) /R	T1	Our Farm trust that confidential proprietary information shared with business partners through ERP will kept confidential	(1~7)	(Chan and Chong 2013)
	T2	It must have a previous business relationship with my organization in order to have business using ERP as base.		
	T3	ERP Implementation requires trusting our trading partners as we have to share information online.		
(18) Collaboration (CO) /R	CO1	Processes and business procedures have been clearly documented between my organization and business partners.	(1~7)	(Chan and Chong 2013)

	CO2	ERP can help clarify business processes and procedures between the Treasury and trading partners		
	CO3	Our Farm is satisfied with our collaboration current business with trading partners.		
	CO4	Business flow can be even better analyzed with an ERP system implementation		
(19) Information Sharing (IS) /R	IS1	The introduction of an ERP implies a greater visibility and transparency of business transactions between trading partners.	(1~7)	(Chan and Chong 2013)
	IS2	My Farm would be comfortable in sharing our information, business transactions with trading partners.		
ERP Diffusion				
(20) Evaluation (EV) /R	EV1	My Farm intends to use ERP, if possible.	(1~7)	(Chan and Chong 2013)
	EV2	My Farm collects information about ERP market with the possible intention of using it.		
	EV3	My Farm has conducted a pilot test to evaluate an ERP		
(21) Adoption (AD) /R	AD1	My Farm invests resources to adopt ERP	(1~7)	
	AD2	The purchase, production and sales tasks (business activities) from our farm require the ERP usage		
	AD3	Functional areas in my farm require the use of ERP		
(22) Routinization (RO) /R	RO1	We have integrated with back-end ERP chain systems / legacy / chain of existing supplies.	(1~7)	
	RO2	Real time distribution of information is collected through the integration of delivery systems with ERP		
	RO3	Real time inventory information is collected by integrating inventory systems with ERP applications		
	RO4	ERP is being implemented together with the buyers of our production		
	RO5	ERP is being implemented together with our raw material suppliers		
	RO6	ERP is being implemented to meet the requirements of the Forest Code (environmental sustainability)		
	RO7	ERP is being implemented to meet the requirements of research and agribusiness development. (integrated with the systems of public and private research institutes.		
(24) Intention to increase the adoption of ERP (ERPi) /R	ERPi1	If there is a better ERP solution, it should be used for the application domain I am in charge of.	(1~7)	(Benlian and Hess 2011)
	ERPi2	Our company should increase the existing level of adopting ERP-based cloud computing applications.		
	ERPi3	I support the further adoption of ERP-based applications.		
(23) ERP usage (ERPU) /R	ERPU1	Please rate as your employees have access to the information in order to take right decisions independently from the leadership	(1~7)	(Kevin Zhu, Kraemer, and Xu 2006b)
	ERPU2	Please rate as your employees daily immediately make decisions in the farm when needed		
	ERPU3	Please rate as your internal process is conducted in an integrated and coordinated manner		
	ERPU4	Please rate as your production sales activities are supported by an integrated and consistent information platform.		
	ERPU5	Please rates your purchasing activities are supported by an integrated and consistent information platform.		
	ERPU6	Please rate as the production and productivity activities are supported by an integrated and consistent information platform.		
	ERPU7	Please rate as the activities of natural and sustainable resources care are supported by an integrated and consistent information platform.		

4.3. The resource-based view of the firm

Value-Based Resource Theory (RBV) argues that firms have resources: a subset that allows them to gain competitive advantage and a subset of resources that lead to superior long-term performance. Resources that are valuable and rare can lead to the creation of competitive advantage. This advantage can be sustained over longer periods of time, insofar as the company can protect against imitation, transfer or replacement of resources (J. B. Barney and Arikan 2001). In general, empirical studies using the theory have strongly supported resource-based view. Figure 17 illustrates the RBV Theory.

Figure 17 Research Model the Resource-based View of the Firm (Wade and Hulland 2004)



Therefore, we propose the research model for these constructs as shown in Figure 18.

Figure 18 Research Model RBV Theory

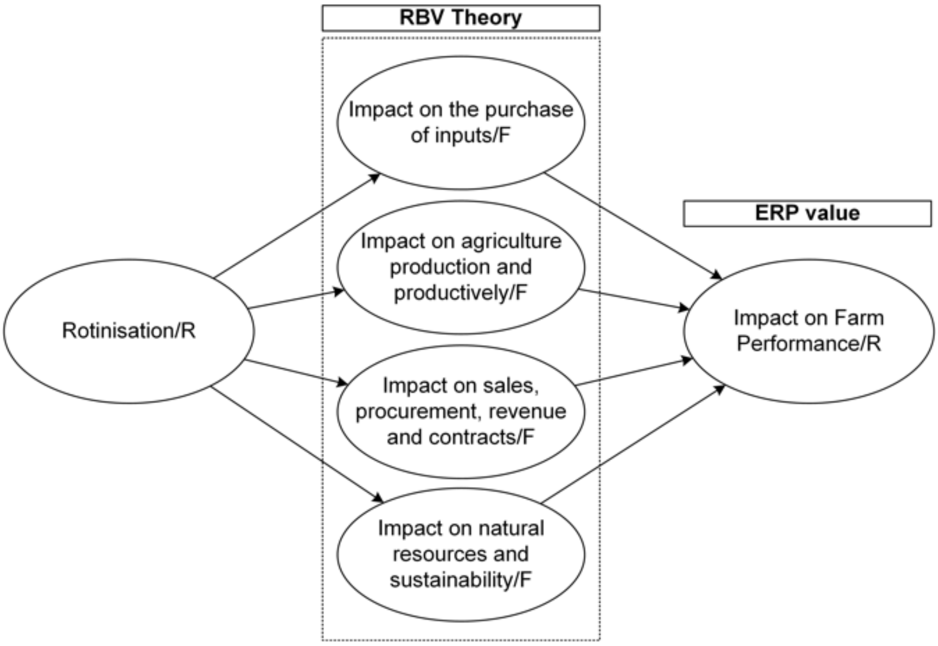


Table 18 defines the constructs and analysis variables to our project.

Table 18 Constructs to Figure 18

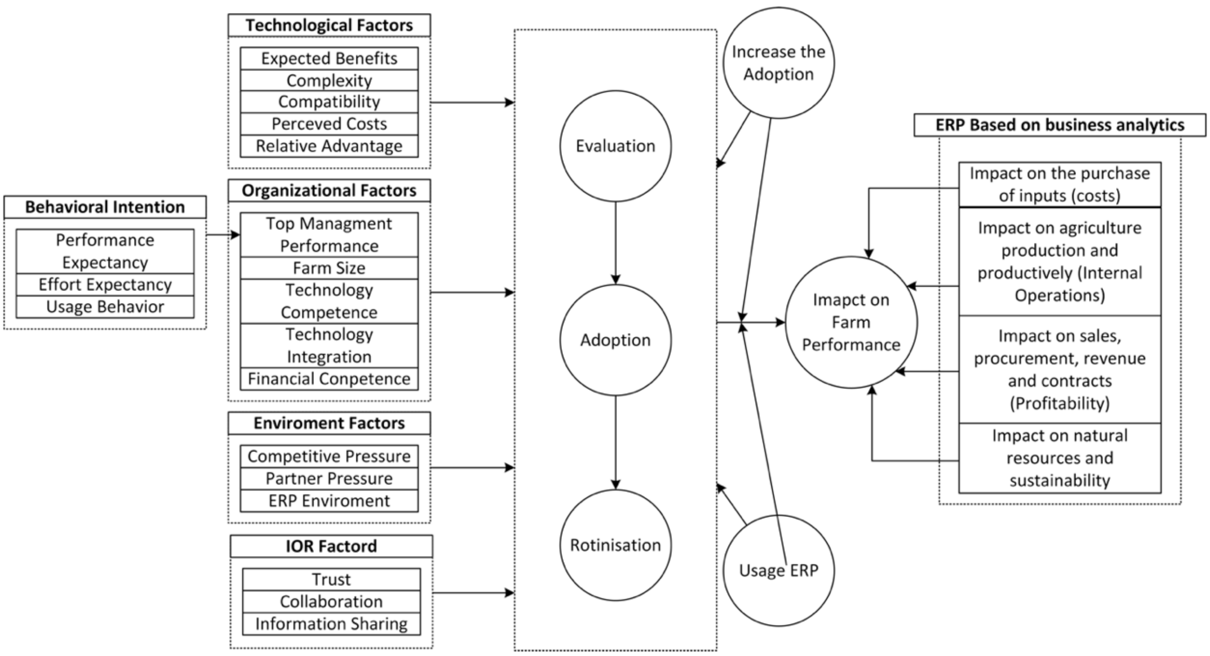
Please evaluate the impact that ERP can have on the statements bellow where 1 means very low impact and 7 very high impact				
(25) Impact on the purchase of inputs (costs) (IC) /F	IC1	Increase employee productivity	(1~7)	(Chan and Chong 2013) and Results from the Exploratory Study
	IC2	Facilitate communication among employees		
	IC3	Increase the compression of business processes		
	IC4	Improve organizational flexibility		
	IC5	Ensure that the corporate systems and information are accessible from any location		
	IC6	Reduce the number of employees		
	IC7	To improve the decision-making process during higher business risks times		
	IC8	Reduce the farm administration workload		
	IC9	Improve the efficiency of staff		
	IC10	Improve employee learning		
	IC11	Have better quality information		
	IC12	Improve coordination with suppliers		
	IC13	Reduce supply purchase costs		
	IC14	Facilitate communication with the suppliers		
(26) Impact on agriculture production and productively (Internal Operations) (IO) /F	IO1	Make internal operations more efficiently (examples: speed up processing in the planting timeframe, reduce bottlenecks in harvesting timeframes, reduce errors using pesticides and fertilizers, notification of isolated health problems, emergency situations of pest control, disease and herbs, climate,...)	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014) and Results from the Exploratory Study
	IO2	Increase control of the whole operation		
	IO3	Increase motivation of all employees		
	IO4	Increase the analysis capacity of business risks		
	IO5	Increase control of internal farm logistics		
(27) Impact on sales, procurement, revenue and	IS1	Increase the farm profitability	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014) and Results from the
	IS2	Reduce inventory costs		
	IS3	Facilitate sales management with buyers		
	IS4	Increase the ability to have a clearer business future view		

contracts (IS) /F	IS5	Increase the value of: my farm, my partners and my contracts.		Exploratory Study
(28) Impact on natural resources and sustainability (RN) /F	RN1	Natural resource guarantee for the future	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014) and Results from the Exploratory Study
	RN2	Has the land as an investment		
	RN3	Long-term care for future generations		
	RN4	Environmental preservation.		
Please rate the level which you agree for the following statements: 1 means strongly disagree and 7 totally agree				
(29) ERP Impact on Farm Performance (IP) /R	IP1	In terms of impact in your farm business the ERP system can be a success	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014)3)
	IP2	The ERP will improve the overall performance of my farm		
	IP3	From my farm standpoint, deployment costs of an ERP outweigh the benefits		
	IP4	ERP should have a significant positive effect on my farm		

4.4. Combined Structural model: DOI, TOE, IOR, UTAUT2 and RBV

We built a questionnaire to meet all the requirements of this project. And, if it were possible, we defined a structural model to visualize a possible article with all the constructs studied up to this moment, as can be seen in Figure 19.

Figure 19 Structural Model DOI and TOE and IOR and UTAUT2 and RBV



4.5. Data collection fieldwork.

502 personal interviews were conducted, conducted by the researcher himself, between the 04/13/2016 to 05/20/2018. The questionnaire was structured with a Likert scale between

1 and 7. All questions were applied as can be seen in tables 16, 17 and 18. In addition to these questions, we have gathered the following information in Table 8.

Table 19 Sample Characterization Questions

Farm Characterization

1. At what stage of the adoption of a Management Resource Model with Enterprise Resource Planning (ERP) is your farm currently involved?

Does not consider this possibility	1
Is under evaluation - example: a pilot project	2
Has evaluated, but does not intend to adopt the technology	3
Has evaluated and intends to adopt the technology	4
Already adopted	5

2. If your farm considers adopting the ERP in the future, how long do you expect its adoption to take place?

The farm does not consider the adoption of ERP	1
Less than 1 year	2
Between 1 and 2 years	3
Between 2 and 5 years	4
More than 5 years	5
The farm has already adopted the ERP	6

3. Please indicate your main culture

4. Please indicate the total planted area (ha)

5. Please indicate in which UF (State) is your main planting area located?

35. Please indicate:	1 Very limited	2	3	4	5	6	7 Very good
What is your level of knowledge regarding the questions in this questionnaire?	1	2	3	4	5	6	7
What is your experience about using an ERP system?	1	2	3	4	5	6	7
What is your degree of knowledge about USP - University of São Paulo?	1	2	3	4	5	6	7

36. What is your function on the farm?

37. If you are interested in receiving the results of this study, please inform:

Name:
E-mail:
Landline and cellphone:

The introduction to the questionnaire was explicated and was read by all interviewees, as follows on Table 20.

Table 20 Research explanation

Imagine being able to bring together intelligent and consistent analysis to make decisions that can create competitive advantages in the local market and the international market. This in real time and in a few minutes. Speed will be the great differential for farms: speed for decision-making and speed for action and results. The farm that democratize your data and put the necessary intelligence in the hands of their employees, so they can make decisions based on data, will be in a better position to defend, transform and act in their markets. A model of ERP management - Enterprise Resource Planning based on business analytics functionality can be a farm management solution designed to simplify analyses and deliver real-time business opportunities. This model is an integrated set of technologies and agreements between farms, cooperatives, suppliers, trades and official agronomic research institutes. The ultimate goal will be to resolve business issues and create new opportunities to gain competitive advantage for the Rural Producer. It is a change of the "way of doing things". It is about adopting a data-driven culture within a farm to solve business problems in an agile manner, driving the change to greater effectiveness of integrated Brazilian agribusiness. And who should be the vector of this change is the Rural Producer. Therefore, your response is very important for the development of this Management Model. All your answers will be treated confidentially and will remain anonymous, as per the research ethics code. According to Resolution 510 of the National Council for Research Ethics (CONEP), you may request and should receive clarification on the research and have guaranteed your right to withdraw at any time during the interview. Thank you for your cooperation. Professor Master Caetano Haberli Junior Professor Dr. Tiago Oliveira Professor Mitsuro Yanaze

Chapter 5 – Understanding the determinants of adoption of enterprise resource planning (ERP) technology within the agri-food context: The case of the Midwest of Brazil

Abstract

The object of this study is to investigate the determinants of adoption of Enterprise Resource Planning (ERP) technology in agricultural farms located in the Central-West region of Brazil. The data was collected from 200 in-depth interviews with soy, corn and cotton farmers from the State of Mato Grosso, Brazil. Structural Equations methodology was used to analyze the data and hypothesis. The conceptual model was proposed by combining Diffusion of Innovations and Technology-Organization-Environment theories. The results provide information to agribusiness owners, managers and administrators to promote and incentivize the use of ERP. Politicians and farmers can evaluate each scenario and support their political and administrative decisions through the evaluation of socioeconomic and environmental performances of agricultural exploration as a result of technological innovation. This leads to a need for an analytical tool for the farmers, with the objective of supporting the adoption of optimized ERP for agri-food activities.

Keywords: enterprise resources planning, ERP technology, management models, agribusiness

5.1. Introduction

Although the Brazilian agricultural production represents a significant share of total world food production, Brazilian farms do not have a well-organized business structure, neither do they have adequate control of their production process to reach a new level of efficiency and effectiveness. This is due to a lack of Enterprise Resource Planning in the farms. As a result, it can cause considerable production loss (Orsi, L., De Noni, I., Corsi, S., & Marchisio 2017).

The decision makers in the agricultural sector deal with volatile and risk variables such as management of physical storage, controlling transportation costs, exposure to climate issues, vulnerability to weeds, pests and diseases. The ERP system can minimize the risks on decisions taken on this environment.

The purpose of this study is to understand the determinants of the adoption of ERP (Enterprise Resource Planning) as a management model compatible with the farms needs, and also to evaluate the benefits of this model to provide improvement in the competitiveness among farms. The only few researches found on the topic explores daily operational routines focusing essentially on production and productivity. It is difficult to find studies regarding the applicability of ERP through an organizational and processual point of view, specifically regarding the direct effects of the use of this technology and some aspects of this business. Brazil is a major world food producer (Table 1). This scientific study evaluates the best practices for Enterprise Resource Planning in Brazilian farms to uphold the country's position among the main world producers of protein, fiber and energy.

Studies about the conceptual model of future farm management information system debates how farmer's paradigms are changing the management tasks in order to achieve economic sustainability and interaction to the environment (Sørensen et al. 2010). In 2011, (Sørensen et al. 2011b), developed a study to support and guide the functional requirements for a future management information system.

The paper concerning ERP in agriculture, "Lessons learned from the Dutch horticulture", evaluates and explores the experiences of the applicability of ERP in agri-food companies (Verdouw, Robbemond, and Wolfert 2015). In a paper about farm management information system called, "Current situation and future perspectives", the authors acknowledge that information systems in the farms evolved from only keeping records to more complex systems supporting production management (Fountas, Carli, et al. 2015).

In order to fulfill the increased demands from partners, consumers, government organizations and food processing companies, farms need to develop a knowledge-based economy which shares information and organized data (J. Wolfert et al. 2010).

These needs inspired us to establish an integrated research model by gathering the determinants of adoption of an adequate ERP and combining the TOE (Technology - Organization - Environment) (Louis G.. Tornatzky and Fleischer 1990) and DOI framework (Diffusion of innovation Theory) (Rogers 1993). The purpose of this model is to provide information to decision-makers (i.e. politicians and farmers) and to encourage the evaluation of the farm's results based on its resource planning choices. This motivation is the result that can be seen on the performances from innovations on the socioeconomical, environmental and agricultural exploration. (S. Janssen and van Ittersum 2007).

To evaluate the research model and investigate the determinants, we collected the data of 200 soy, corn and cotton producers in the Mato Grosso, MT State. Therefore, this study presents a holistic evaluation of the determinants to make a theoretical contribution to the adoption of ERP for agricultural farms.

5.2. Agri-business in Brazil and background about ERP

Brazilian agri-business has been improving in the last decade. Brazilian farmers excelled in production techniques and overcame technological issues to reach high productivity levels comparable to the larger world food producers. This progress can be certified by looking at Brazil's position on the world ranking of food production and food exports in 2013/2014 (Table 21).

Table 21 Brazil position in the World Ranking of Food Producing - (%)

	Orange Juice	Sugar	Coffee	Soy	Beef	Chicken	Corn	Pork	Cotton
Brazil Export Market Share (%)	77	47	27	42	21	36	24	8	13
Brazil Production Market Share (%)	54	22	32	31	16	11	9	3	6
World Export Ranking - Brazil	1º	1º	1º	1º	1º	1º	2º	4º	3º
World Production Ranking - Brazil	1º	1 º	1º	2º	2º	3º	3º	4º	5º

Source: USDA and Agri-Business Sector Value, 2015/2016. Author's analyses.

ERP Systems require simultaneous changes in the business process, information sharing and the use of complex data (Amoako-Gyampah and Salam 2004). They process information from different functional areas and integrate them to identify and incorporate the best business practices (Kumar and Van Hillegersberg 2000). An understanding of the processed and integrated information from different functional areas (Madapusi and D'Souza 2012) can support ERP development for agribusiness companies. Finding the critical elements of the simultaneous changes that are going on and identifying the success drivers can define a different approach to implement ERP (Z. Zhang et al. 2005).

According to Ruivo, Oliveira and Neto (2012a), the implementation of ERP allows companies to increase its value, achieve trade efficiency, enhance internal collaboration and improve business analysis which are important determinants in this process. (Ruivo, Oliveira, and Neto 2012b) Therefore, we will analyze how the ERP systems can contribute to agricultural production organizations.

Agribusiness is part of a globalized economic environment. Universal operations are indispensable to the integration of providers, partners and customers (Yusuf, Gunasekaran, and Abthorpe 2004). The increasing necessity for food production has led to new research in order to optimize its productivity. This has been achieved by the increased use of technology which incorporates the ideal combination of specific software and hardware (Abc 2012).

Efforts to adopt information technology and systems such as Enterprise Resource Planning - ERP, suppor business integration and decision-making (Yusuf, Gunasekaran, and Abthorpe 2004).

Management principles and techniques, sustainability and evaluation of the farm project, management support, process reengineering, consulting and budget services are crucial elements for ERP's implementation (Ehie and Madsen 2005). Considering the innovation process has two main stages of adoption and implementation (Damanpour and Schneider 2009), the overall results can be significantly increased by a combination of organizational factors as well as the use of technology and innovation (Karimi, Somers, and Bhattacherjee 2007). Benefits obtained from the automation of business processes and the use of the ERP system improve decison-making in all organizational levels (Velcu 2010) which applies to agribusiness companies. However, it is necessary to face and accept the issue that managers still do not have the knowledge and technical skills to handle the system and processes which can produce inaccurate data gathering and some mistrust regarding the use of this technology (Hakim and Hakim 2010). ERP implementation is a slow process and demands resources (Tsai et al. 2011). An understanding of the process and information packages among functional areas is necessary (Madapusi and D'Souza 2012). Although ERP implementation represents a significant investment (Madapusi and D'Souza 2012 Zeng and Skibniewski 2013), it can have an important impact in the organization's operational and process performances (Madapusi and D'Souza 2012). Besides the high investment level, implementation risks are also high. Countless complex elements in the organization can interfere in the implementation such as user's low-level of acceptance of the technology, changes in the information environment, instability in the management environment and the complexity of the ERP system (Hung et al. 2012).

On the other hand, after a successful ERP implementation, it is possible to observe relevant effects in the social capital which is the (a) learning opportunity, (b) desire to learn and (c) increase in abilities. Those results can be attributed to the complexity of the ERP system which compels users to solve challenges, acquire knowledge and develop new abilities to run tasks and make decisions (Ruivo, Oliveira, and Neto 2012b).

It is important for the managers to set the priorities and goals to be reached in each ERP implementation phase which will contribute to the maximization of the whole process (Ram, Corkindale, and Wu 2013). The improvements in process efficiency achieved by the ERP system can deliver the competitive advantage needed by organizations in a global market context where their strategies are affected by many different elements especially the competing companies (Rouyendegh, Bac, and Erkan 2014).

The ERP implementation process and the achievements reached by it are distinct for each organization (Rouyendegh, Bac, and Erkan 2014). According to studies of SMEs (Small and Medium Enterprises), improvements in strategic planning for Information Systems (IS) helps the companies to understand the benefits that the ERP system can offer (Zach, Munkvold, and Olsen 2014).

It is also important to state that ERP experts are not easy to find in the market which can deliver an extra challenge to SMEs as they need to train and capacitate their employees on the use of this tool (Esteves 2014). A particular study of SMEs in Portugal shows that ERP implementation was a determinant for the company's performance in management, finance and tax accounting as well as the company's management control (Ruivo, Oliveira, and Neto 2014). Although it is possible to find good results in the field, a considerable number of companies do not reach the expected goals after implementing the ERP system, These failures can be accounted for by the improper use of the system and its full resources (H. W. Chou et al. 2014); (Ruivo, Oliveira, and Neto 2012b).

In many cases, the use of ERP does not achieve business process control, costs reductions, increase in profits and an influence on the companies key's performance indicators (Gajic et al. 2014). Therefore, organizations must find ways to simplify the use of the system because once the system reaches its efficiency, it will provide the direct learning ability and desire to the users (H. W. Chou et al. 2014). It is important to understand that any progress on the use of the strategic assets will also contribute directly to business development (Wood et al. 2014).

5.3. Methodology

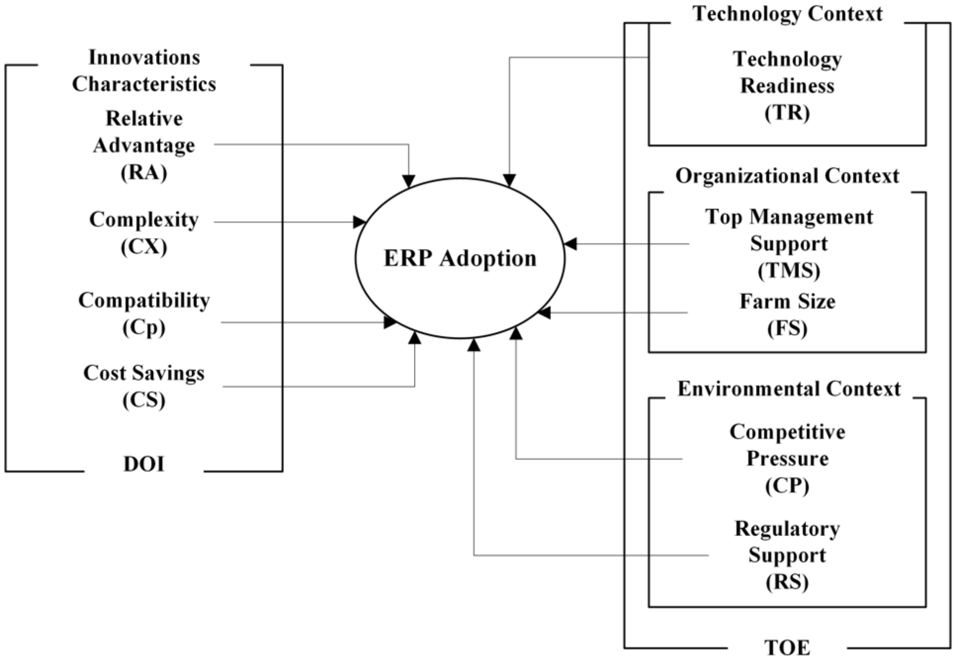
The study is focused on the innovation adoption phase. Two theories are usually used to explore similar cases in organizations of distinct nature; Diffusion of Innovations Theory - DOI (Rogers 1993) and Technology, Organization and Environment - TOE Framework (Louis G.. Tornatzky and Fleischer 1990).

TOE Framework identifies the process used by a company to adopt and implement innovations by considering the technological, organizational and environmental context (Louis G.. Tornatzky and Fleischer 1990). The technological context embraces relevant internal and external technology as tools and processes while the organizational context is related to the company's features and its assets such as company size, hierarchy, process procedures, administrative structure, human resources, extra resources and employee connections. The environmental context is influenced by market elements such as the size and structure of the industry, company's competitors, macroeconomics and the regulatory environment. All three contexts can present opportunities and threats which influence how a company sees, searches and adopts new technologies.

On the other hand, DOI Theory studies the spread of innovations and how it is communicated through channels over time and inside a particular social environment (Rogers 1993). Each individual is deemed to hold different levels of innovation acceptance. This paradigm of diffusion was spread during the fifties and sixties among sociology researchers of rural areas (Valente and Rogers 1995).

DOI and TOE Theories have been widely used in studies concerning the adoption of innovative technology and they have consistent empiric support (Tiago Oliveira, Thomas, and Espadanal 2014). The benefits of merging TOE concepts to reinforce the DOI theory are already well recognized (Hsu, Kraemer, and Dunkle 2006b). Using DOI and TOE together helps to provide a more comprehensive perspective about technology adoption including the technological context aspects, organizations and external environment (Kevin Zhu, Kraemer, and Xu 2006b). DOI and TOE Theories (Figure 20) complement each other successfully (Park, Eo, and Lee 2012).

Figure 20 Research Model combining TOE and DOI



This paper presents a conceptual model combining DOI and TOE and also includes nine constructs. Based on the DOI theory, the constructs' relative advantage (RA), complexity (Cx), compatibility (Cp) and cost savings (CS) were selected. The first three (RA, Cx and Cp) are attributes of innovation. Technology readiness (TR), top management support (TMS), farm size (FS), competitive pressure (CP) and regulatory support (RS) are constructs used from the TOE theory. The TR construct is related to the technological context, TMP and FS are related to the organizational context and CP and RS are related to the environmental context.

Rogers 1993 addresses 5 adoption factors, i.e. relative advantage, compatibility, complexity, trialability and observability. The trialability and observability are not widely used in IT innovation studies (Chong et al. 2009). Following the general orientation of the research IS, we disconsidered these two attributes because they are not relevant to the ERP technology (Tiago Oliveira, Thomas, and Espadanal 2014). In many IT innovation studies Trialability and observability are excluded because they are not consistently related to the diffusion process of innovation (R. Martins, Oliveira, and Thomas 2016).

Rogers (1993) defines Innovation Relative Advantage as the degree in which innovation is understood as a better option than the idea it is replacing at that moment. Studies confirmed that RA is a significant variable and is positively related to innovation adoption (Premkumar and Roberts 1999). Innovations that present clear benefits on creating strategic efficiency (i.e. the increase in the number of prizes received for harvest or credit; the anticipation of business) and operational efficiency (i.e. the reduction on expenses funding) have greater chances of adoption. If the benefits of ERP technology exceed the benefits of current practices and procedures, the adoption of ERP technology would be positively influenced. H1(+): Relative Advantage (RA) has a positive influence on ERP adoption.

Complexity (Cx) is the degree that an innovation is considered to be relatively hard to understand and use (Rogers 1995). There is a better chance of approval if new technology is integrated and assimilated in business operations during the implementation phase. ERP can also gather real-time information to support main decisions in complex operations. However, its complexity creates some doubts about its implementation and for this reason, it decreases the chances of approval. Therefore, complexity is negatively associated to adoption: H2(-): Complexity has a negative influence on ERP adoption.

Compatibility (Cp) is the perception and degree of alignment with previously established values (Valente and Rogers 1995). This is an important determinant of innovation adoption (L G Tornatzky and Klein 1982). ERP adoption can support high risk decisions by anticipating the purchase of an input material such as seeds and fertilizers, the optimum timing to acquire defense products for crops considering historical weather data and forecasts which have an impact on pests and crop diseases, as well as the sale and production of crops considering macroeconomical forecast. “The main motivation for bringing this hypothesis is because the industry trend on operating in a volatile and high risk environment (Xouridas 2015). H3(+): Compatibility has a positive influence on ERP adoption.

Innovation adoption which leads to cost savings are considered good for the company. If the cost can be controlled and accounted for, there is a higher likelihood of companies adopting the technology (L G Tornatzky and Klein 1982). Cost savings is verified as a relevant variable for innovation adoption. H4(+): Cost savings has a positive influence on ERP adoption.

Expertise is an important factor which is positively related to new technology adoption (Nordin, Noor, and Saad 2014). Companies which are not familiar with information technology (IT) are probably not aware of innovations or are more resistant to adopting new technologies. Organization features including structural elements and specialized human resources affect the technological context concerning innovation adoption. H5(+): Technology readiness has a positive influence on ERP adoption.

Many studies show that the top management is creating a supportive environment with adequate resources for new technology adoption (Premkumar and Roberts 1999). The support from the top management plays a relevant role in innovation adoption because it guides budget relocation, integration of services and reengineering of processes (H. W. Chou et al. 2014). The top management is one of the determinants of the organization's culture. The adjustment of the organization's culture because of information systems is indispensable for ERP implementation success. Therefore, the success of ERP implementation increases as the top management promotes and supports it within the organization culture (Ke and Wei 2008). H6(+): Top management performance has a positive influence on ERP adoption.

Studies indicate that the organization size is related to the impact of new technologies adoption (Kevin Zhu, Kraemer, and Xu 2006b). Large farms should have larger budgets for improvements, and they are capable of experiencing innovations faster them small properties. Moreover, large farms are more capable of raising funds from banks and investors. Going against the odds, some small farms are capable of taking risks in new technology. (C. Martins, Oliveira, and Popovic 2014). H7(+): Farm size has a positive influence on ERP adoption.

Competitive pressure is the force a company experiences from similar competitors in the same industry (Gatignon and Robertson 1989). One characteristic of the agribusiness is a commoditized market, which strives towards a perfect competition environment. This scenario makes the adoption of new technologies like ERP a non-essential tool for the competitive strategy in the market, because it only delivers process innovation instead of product innovation. Otherwise, considering the global competition, this external pressure from producer countries can become relevant and can be strategic for the company. H8(+): Competitive pressure has a positive influence on ERP adoption.

In Brazil, the government regulation to support the adoption of new technologies is not clearly defined yet. This hypothesis is concerned about the legal protection of farm activities.

H9(-): Regulatory support has a negative influence on ERP adoption.

A proper tool was developed and adapted to collect data from the companies in this study. To evaluate other studies concerned about the same constructs in the Table 3, we examined papers found related to researches in the agribusiness. Some of the constructs were not found in the same study field and to fulfill the gap, we extended the research to other commoditized markets.

Interviews were realized between August 1st and 21st of 2014 in Mato Grosso - MT, Central-West region of Brazil. The tool applied to collect data was a structured survey focused on measuring the variables/determinants of ERP adoption described in the Table 2. The questions proposed were based on the DOI and TOE theories and were validated by applying in-depth interviews (Boyce and Neale 2006a) with ten agribusiness consultants.

A quantitative method was used in this study and personal interviews with owners or farms managers were conducted on site (farms).

Experts and researchers in the agriculture sector collected data through personal interviews. Consistency was maintained by using a 5-point ranking system varying from “strongly disagree” to “strongly agree” for the evaluation of DOI variables such as relative advantage, complexity, compatibility and cost savings as well as TOE variables like technology readiness, top management performance, farm size, competitive pressure and regulatory support.

We have found some qualitative evidences during the interviews: (i) How can an ERP help me to solve my management problems? (Lambim, 2000); (ii) Does the ERP can solve my long term problems? (Bloch and Richins 1983). Therefore, we have noticed that the perception of the ERP process and ERP image can have a strong influence on the farm management and also on the individual's behavior . (De Toni and Schuler 2007). The interviews were conducted with the necessary care considering these aspects.

Table 22 Data collection tool: Quantitative Variables

Constructs	Items		Authors Reference
Relative Advantage	RA1	ERP allows more efficiency in managing business operations	(Gul et al. 2014; Helitzer et al. 2014; Sarker and Ratnasena 2014)
	RA2	An adequate ERP use improves operations quality	
	RA3	An adequate ERP use allows a faster execution of specific assignments	
	RA4	Using ERP - Enterprise Resource Planning enables new opportunities	
	RA5	ERP allows increment of business productivity	
Complexity	CX1	ERP use requires high mental effort	(Batz, Peters, and Janssen 1999; Montedo 2012; Peshin 2013)
	CX2	It is frustrating to use ERP.	
	CX3	It is too complex to use ERP on commercial operations	
	CX4	It is too complex to use ERP on production operations	
	CX5	Adoption of ERP requires complex skills from farm's employees	
Compatibility	Cp1	I can't find an ERP that fits this farm's work structure	(Fu et al. 2007; Gerber, Hoffmann, and Kugler 1996)
	Cp2	I can't find a perfectly compatible ERP for my business operation	
	Cp3	I can't find an ERP compatible with the culture and corporate values of my farm	
	Cp4	I can't find an EPR compatible with computers and programs (hardware and software) in my farm	
Cost Savings	CS1	ERP benefits outweigh its adoption cost	(Ghadim, Pannell, and Burton 2005; Pannell, Llewellyn, and Corbeels 2014; Sangle 2011)
	CS2	ERP adoption reduces overall and environmental costs	
	CS3	ERP adoption costs are low	
Technology Readiness	TR1	There is enough knowledge in the farm to use ERP to support its operations	(Nordin, Noor, and Saad 2014)
	TR2	There are required skills in the farm to implement a more effective ERP	
Top Manager Performance	TMP1	Farm's management supports ERP implementation	(H. W. Chou et al. 2014)
	TMP2	Farm's top management plays a strong leadership role and gets involved in the ERP process	
	TMP3	Farm's Top management is inclined to take risks (economic and organizational) to adopt an ERP	
Farm Size	FS	From 2.471 to 4.942 acre From 4.943 to 7.413 acre From 7.415 to 9.884 acre Above 9.885 acre	(Premkumar and Roberts 1999)
Competitive Pressure	CP1	The farm believes its own ERP influences other businesses in the same region	(K Zhu et al. 2004; K Zhu, Kraemer, and Xu 2003)
	CP2	The Farm is under external market pressure to adopt an ERP	

	CP3	Some farmers from the same region use ERP	
Regulatory Support	RS1	There is no legal protection for agriculture activities	(Kevin Zhu et al. 2006)
	RS2	Existing laws and regulations are enough to protect agriculture activities	
ERP Adoption (ERPA)	ERPA1	At this moment, what would you say about the possibility of adopting ERP? - I have never considered it. - There is a pilot project running - I've already considered the possibility and I will not adopt it - I want to adopt it in the future - I've already adopted it (less than 1 year)	(Hong et al. 2008)
	ERPA2	How long will it take to adopt ERP in your farm? - Less than 1 year - 1 to 2 years - 2 to 5 years - More than 5 years - I don't know.	

Source: Adapted by the authors

We used "simple random sampling" as the criteria to select the sample for this study. In addition to the inquiries on Table 22, farmers were asked about their job position in the farm, level of education, how they managed the farm, whether there were other professionals working in the farm administration, precision agriculture. These questions gave us qualitative information about the interviewees. The sample is composed of 200 valid interviews with soy, corn and cotton producers with medium (2,471 to 9,884 acre) and large farm sizes (above 9,885 acre). This can be seen in Table 23. Small producers were not included in this study because the ERP system can be easily found in medium and large farms.

The survey sample is composed of interviewees with the following profiles. Interviewees with college degrees made up 19%, 14.5% had incomplete college degrees while 38.5% had high school certificates. The interviewees' average age was 38 years. 56.5% responded that there were other specialized professionals in management positions in their farms while 30.5% were the only ones in charge. 75.5% of the interviewees performed at least one precision agriculture operation in the crops waiting to achieve: (i) 86.1% reduced costs of planting, caring for and harvesting crops; (ii) 76.2% reduced loses related to pests; (iii) 28.5% prevented weather conditions and (iv) 12,6% obtained sustainability participation credits (low carbon rates agriculture).

Table 23 Table Sample Distribution

Culture	Total %	Base
Soy	43.5	87
Corn	41.0	82
Cotton	15.5	31
Total	**100.0**	**200**

5.4. Results

Structural Equation Modeling (SEM), was applied in this study. SEM combines statistical data and qualitative causal assumption for testing and estimating causal relations. Researchers recognized the possibility of distinguishing between measuring models and structures and have started to consider the measurement error (Henseler, Ringleand, & Sinkovics, 2009). It is possible to find two different divisions of SEM techniques. They are the covariance technique and the technique based on variance. Based on the variance technique, it is possible to use the Partial Least Squares (PLS) in cases where not all items in the data are normally distributed (p <0,01, based on Kolmogorov-Smirnov test) or the research model was not tested in the concerning literature or if the research model is considered complex. In this case, we used de SMART PLS 2.0 M3 software (Ringle, Wende, & Will, 2005) to analyze relations defined by the theoretical model.

The model was evaluated in two steps; First, the variables were analyzed to determine their capability to measure each one of the constructs. Second, the structural relations were analyzed among the constructs (Table 24).

Table 24 Measurement Model

	Latent Variables									
	RA	CX	CP	CS	TR	TMP	FS	CP	RS	ERP Adoption
RA1	**0.775**	-0.243	0.302	0.101	0.389	0.354	0.130	0.398	-0.107	0.456
RA2	**0.775**	-0.070	0.222	0.294	0.350	0.331	-0.025	0.414	-0.108	0.444
RA3	**0.765**	-0.123	0.334	0.165	0.471	0.429	0.044	0.354	-0.113	0.450
Cx1	-0.130	**0.636**	-0.283	0.395	-0.083	0.097	-0.134	-0.055	0.348	-0.136
Cx2	-0.190	**0.766**	-0.357	0.166	-0.214	-0.024	-0.141	-0.026	0.439	-0.229
Cx3	-0.140	**0.780**	-0.346	0.270	-0.044	0.085	-0.097	0.103	0.277	-0.159
Cx4	-0.090	**0.736**	-0.350	0.244	-0.106	0.112	-0.153	0.091	0.332	-0.210
Cp1	0.356	-0.396	**0.838**	-0.112	0.198	0.002	0.029	0.167	-0.326	0.351
Cp2	0.323	-0.420	**0.882**	-0.168	0.254	-0.031	0.086	0.138	-0.411	0.356
Cp3	0.245	-0.319	**0.790**	-0.239	0.158	-0.032	0.040	0.051	-0.307	0.247
Cp4	0.233	-0.317	**0.662**	-0.209	0.044	-0.046	0.114	0.056	-0.264	0.202
CS2	0.236	0.240	-0.125	**0.818**	0.201	0.256	-0.077	0.146	0.119	0.173
CS3	0.152	0.318	-0.223	**0.799**	0.093	0.213	-0.046	0.132	0.236	0.166
TR1	0.426	-0.124	0.156	0.139	**0.819**	0.237	0.087	0.310	-0.124	0.377
TR2	0.446	-0.151	0.212	0.166	**0.847**	0.336	0.027	0.409	-0.155	0.407
TMP1	0.458	0.014	0.084	0.226	0.384	**0.826**	0.050	0.325	-0.039	0.375
TMP2	0.355	0.061	-0.026	0.235	0.160	**0.774**	-0.048	0.202	0.089	0.303
TMP3	0.173	0.169	-0.248	0.177	0.174	**0.568**	-0.016	0.262	0.158	0.171
FS	0.065	-0.181	0.079	-0.076	0.067	0.003	**1.000**	-0.090	-0.165	0.170
CP1	0.423	0.007	0.168	0.135	0.435	0.305	-0.064	**0.859**	-0.041	0.315
CP3	0.396	0.067	0.047	0.147	0.252	0.271	-0.086	**0.762**	0.068	0.249
RS1	-0.164	0.453	-0.372	0.178	-0.228	0.023	-0.154	-0.022	**0.952**	-0.251
RS2	0.004	0.286	-0.293	0.201	0.095	0.131	-0.100	0.087	**0.544**	-0.092
ERPA1	0.587	-0.247	0.376	0.237	0.497	0.414	0.153	0.357	-0.220	**0.975**
ERPA2	0.546	-0.259	0.354	0.168	0.416	0.378	0.178	0.324	-0.262	**0.971**
AVE	**0.595**	**0.535**	**0.635**	**0.654**	**0.694**	**0.535**	**1.000**	**0.659**	**0.601**	**0.947**
Reliability Composition	**0.815**	**0.821**	**0.873**	**0.790**	**0.819**	**0.771**	**1.000**	**0.794**	**0.737**	**0.973**

Note: Relative Advantage (RA), Complexity (CX), Compatibility (CP), Cost Savings (CS), Technologic Readiness (TR), Top Management Performance (TMP), Competitive Pressure (CP), Regulatory Support (RS)
Source: Research data

Measurement model validation was evaluated based on 3 criteria: construct reliability, convergent validity and discriminant validity. The reliability of each construct is a measurement of internal consistency of its indicators and presents the adequacy of measurement scale. To evaluate its reliability, we adopted a composite reliability indicator which is considered better compared to Cronbach's Alpha which can underestimate results (Hock and Ringle 2010). Following the reliability indicator, values for reliability composite above 0.700 are adequate. Based on Table 5, it is possible to observe values above 0.700 for reliability composite which indicates an adequate model.

Convergent validity evaluates the extension in which the indicator is capable of measuring a latent variable (construct). It can be verified by observing patterns of factorial loading and average variance extracted (AVE). Factorial loading above 0.700 (IM et al, 1998) and variances above 0.5 (HAIR ET AL, 2005) were accepted as high and significant. At Table

5, it is possible to find only 4 variables (Cx1, Cp4, TMP3 and RS2) which have factorial loading below 0.700. Since items with factorial loading below 0.400 should be removed from the analysis, we kept all the constructs in the study because all of them presented variances above 0.500. These results are an assurance that the indicators are legitimate representatives of the analyzed constructs.

The construct's discriminant validity was evaluated using two criteria: Fornell-Larcker and Cross-loadings. Fornell-Larcker advocates that the square root of AVE needs to be greater than the correlation of the construct (Fornell and Larcker 1981). Cross-loadings requires loading of each indicator to be greater than the cross-loadings (Chin 1998; Götz, Liehr-Gobbers, and Krafft 2010; Grégoire and Fisher 2006). As presented in Table 5, the square roots of AVE (diagonal elements) are greater than the correlation between each structures pairs (elements outside of diagonal). Table 25 also presents loading patterns higher than cross-loadings. In conclusion, both criteria were satisfied.

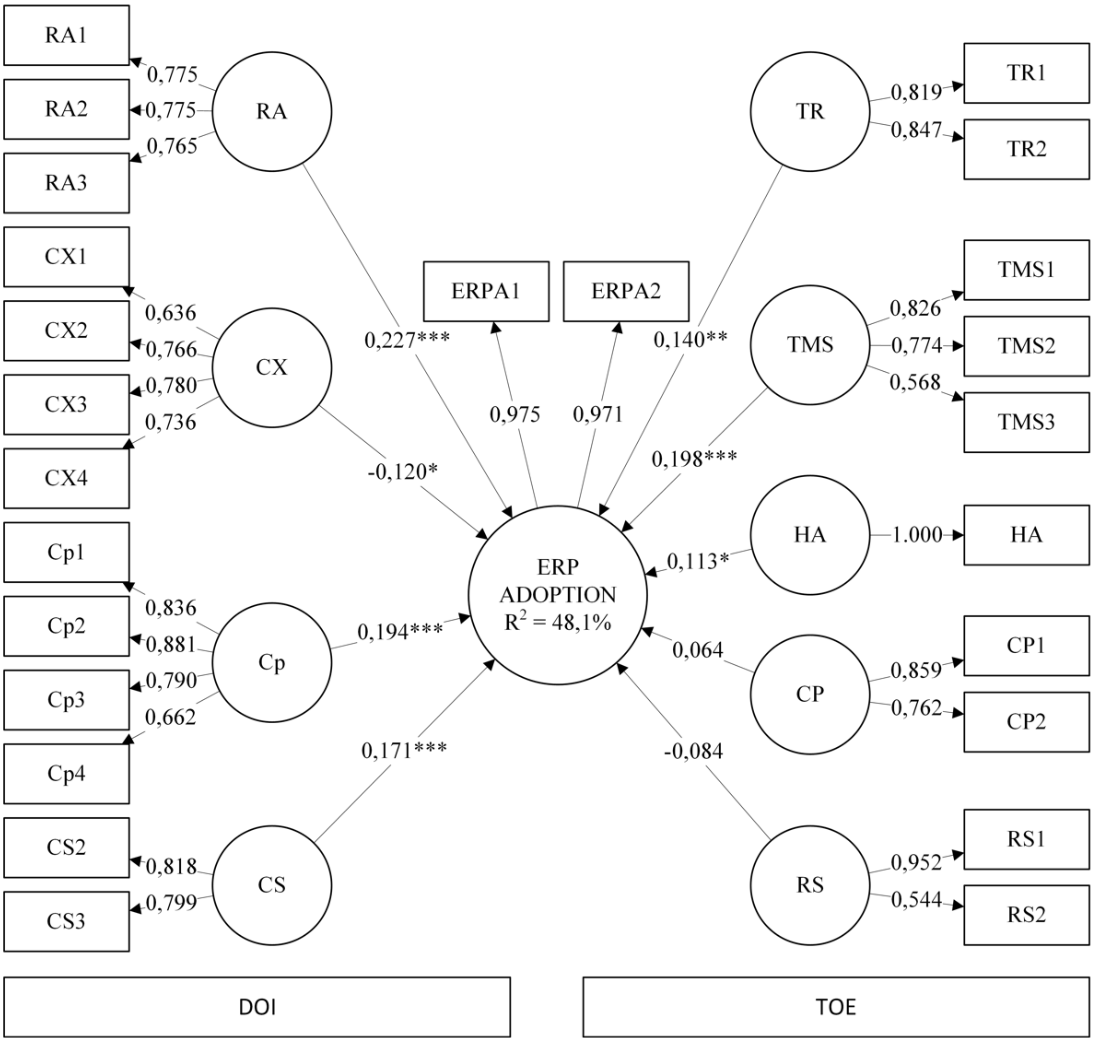
Table 25 Correlation between constructs and median variance extracted from square root (diagonal)

	RA	CX	CP	CS	TR	TMP	FS	PC	RS	ERPA
RA	**0.771**									
CX	-0.190	**0.732**								
CP	0.371	-0.460	**0.797**							
CS	0.241	0.344	-0.214	**0.808**						
TR	0.523	-0.166	0.222	0.183	**0.833**					
TMP	0.481	0.082	-0.029	0.290	0.346	**0.731**				
FS	0.065	-0.181	0.079	-0.076	0.067	0.003	**1.000**			
PC	0.504	0.041	0.140	0.172	0.433	0.355	-0.090	**0.812**		
RS	-0.141	0.484	-0.416	0.218	-0.168	0.061	-0.165	0.009	**0.775**	
Adoption	0.583	-0.259	0.376	0.210	0.471	0.408	0.170	0.350	-0.247	**0.973**

According to the results, we can conclude that the measuring model presents construct reliability, convergent validity and discriminant validity. For this reason, it is adequate to test the structural model.

To perform the analysis of the structural relations model, the statistical significance of the independent variables was evaluated to explain the ERP adoption. In addition, the R2 related was also evaluated. The results showed that the proposed model could explain 48.1% of variation in ERP adoption (Figure 21). The construct indicators are represented by rectangles and constructs are represented by circles.

Figure 21 Measurement Model



On Table 26, it is possible to confirm the hypothesis presented in this work. To reach those results, the signal and significance of the structural model coefficients were evaluated. This was the signal between the explanatory variables (independents) and ERP adoption (dependent variable). The significance levels of factorial loads were estimated using a bootstrap of 5,000 samples.

The following results have indicated statistical significance: Relative Advantage (=0.227, p < 0.01), Top Management Performance (=0.198, p < 0.01), Compatibility (=0.194, p < 0.01), Cost Savings (=0.171, p < 0.01), Technology Readiness (=0.140, p < 0.05), Complexity (= - 0.120, p < 0.10) and Farm Size (=0.113, p < 0.10). To sum up, hypotheses H1, H2, H3, H4, H5, H6 and H7 were validated. On the other hand hypotheses H8 and H9 could not be validated in this study.

Table 26 Table Hypotheses Analysis

Hypotheses	Results
H1$^{(+)}$ **Relative Advantage has a positive influence on ERP adoption**	Validated (= 0.227***)
H2$^{(-)}$ **Complexity has a negative influence on ERP adoption**	Validated (= - 0.120*)
H3$^{(+)}$ **Compatibility has a positive influence on ERP adoption**	Validated (= 0.194***)
H4$^{(+)}$ **Cost savings has a positive influence on ERP adoption.**	Validated (= 0.171***)
H5$^{(+)}$ **Technology readiness has a positive influence on ERP adoption**	Validated (= 0,140**)
H6$^{(+)}$ **Top management support has a positive influence on ERP adoption**	Validated (= 0.198***)
H7$^{(+)}$ **Farm size has a positive influence on ERP adoption.**	Validated (= 0.113*)
H8$^{(+)}$ **Competitive pressure has a positive influence on ERP adoption.**	Not Validated (= 0.064)
H9$^{(-)}$ **Regulatory support has a negative influence on ERP adoption**	Not Validated (= - 0.084)

Source: Research data. p < 0,10 *, p < 0,05 **, p < 0,01 ***

5.5 Discussions and Conclusions

Relative Advantage is the most important variable to explain ERP adoption. When the Relative Advantage increases a standard unit, ERP adoption increases 0.227 standard units subsequently. On the other hand, Regulatory Support and Competitive Pressure were not significant to ERP adoption. ERP is a process innovation and not a product innovation. However, agribusiness is about the production of agricultural commodities and competitive pressure does not apply among producers in this business. Soy, corn and cotton producers compete with producers worldwide but they do not necessarily compete with local producers. Agribusiness is an industry with perfect competition which is characterized by the lack of product differentiation and the similarities regarding the structure of cost among the farm. Future studies can explore in-depth the competitive pressure among farmers. Relative Advantage allows an anticipation of the harvest during the harvest period which gives farmers a negotiation advantage with the buyers. Since regulatory support for the sector is relatively recent, farmers need more time to understand in-depth and adapt to its rules. Besides this, the more the tools fit, the greater the possibility of ERP adoption. On the other hand, when it is less complex, the possibility of adoption is higher. To increase the chances of ERP system adoption, the providers will have to have a better understanding of its tools and technological processes, which is the hardware and software, used in the farms. However, without top management support ERP adoption cannot succeed. The gateway to ERP adoption is in the farm owner's hands.

We believe this study can contribute to the development of processes and tools with indicators related to this market. This paper can also help consultants who want to develop ERP systems for farms, by bringing features which are related to ERP adoption in the rural segment. Nonetheless, this paper can also motivate new research about the adoption of technology related to the farm organizations' resource planning particularly for universities connected to the rural sector.

The study's contribution is directly related to the determinants of ERP adoption for farmers. This paper did not discuss the ERP's specificities for the rural sector. This sector presents some particularities as there are high levels of uncertainty in production due to weather or there is a high number of small or medium companies. These characteristics interfere negatively to ERP adoption compared to others sectors such as industrial sector. The following studies can contribute to the determination of the sector's specific features. We have also considered relevant studies about diffusion states (i.e. intention, adoption and use) and explored if the determinants of intention, adoption and use are the same.

The next step is to consider the study of innovation adoption including the theory of individual behavior on farmers and the value that this adoption can deliver to the sales process, production process, procurement process and contracts. Because what we have so far is limited to research about Innovation Diffusion which explores innovation adoption from the individual decision maker's point of view, as farmers, doctors and consumers (Fliegel and Kivlin 1966a, 1966b). The only innovation factors measured are the ones observed by an individual adopter (Damanpour and Schneider 2009). In addition, this paper does not discuss ERP development or the impact of cloud computing, the internet of things or analytic insight platform on the future of the ERP system. For next studies, we are considering to research the trends of ERP with the same target audience, including Platform of Analytical Insights, Internet of Things and Cloud Computing.

Share knowledge and experiences can provide a healthy competitive environment in the agricultural sector for all countries. Usually, farmers are scattered, disorganized, deficient in resources and also exposed to natural disasters, market uncertainties and pricing failures (Ahmad, Ahmad, and Jamshed 2016). Future researches can be based on gathering "the wealth of scientific knowledge and agricultural domains in a cloud-based ERP to develop an e-agriculture platform of resources planning. It can contribute to strength the agriculture activity of a region or a country. The major questions will be: (1) Can we feed 8.5 billion people in 2030? (www.unric.org). (2) Can we get more of our land to control losses? (3) Can we better protect the environment while sharing more sustainable decisions? The answers for these questions must come from result of new production process applied in the field and in the crops, also from the controls of the production processes and from the management sharing.

Chapter 6 – The adoption stages (Evaluation, Adoption, and Routinisation) of ERP based on business analytics functionality in the context of farms

Abstract

Agriculture is a complex industry based on science. Agriculture relies on systems of climate-standard analysis: solar energy, heat, moist and systems for the area of field operation patterns: soil chemical composition, plant nutrition, genetic improvement, pest and disease control, harvesting. We believe that the new paradigm to increase efficiency in this segment goes through the adoption of enterprise resource planning (ERP) systems. Our empirical study is about the use and diffusion of ERP systems in a view of interoperability between different software packages with a view on business analysis functionality when taking a step further in farm management information system (FMIS). We hope this work can bring a theoretical and practical contribution for the agribusiness field and also increase debates about the platforms on cloud computer based on ERP, Enterprise 2.0 and Industry 4.0. The research presented in this study was carried out with 375 farmers in Brazil. The data gathering instrument used for the quantitative research was built based on the result of the qualitative (in-depth) study in combination with three theories: Diffusion of Innovation Theory (DOE), Technology-Organization-Environment Framework (TOE), and Inter-organizational Relations (IOR). The construct information sharing (IS) taken from IOR was applied to perform a moderator role on the measurement of ERP adoption stages. The results indicate the significant drivers for evaluation, adoption, and routinisation. Also, as a result, it was found that Information Sharing influence the relationship between evaluation and adoption positively. Moreover, the theoretical and managerial implications of the research results are also debated in the paper.

Keywords: Farms; ERP systems; Business Analytics Functionality; FMIS; Industry 4.0.

6.1 Introduction

ERP systems has been fundamental in the operation and management of supply chains with continuous integration of processes, real-time and updated data access to maintain competitiveness in global and local markets (Reitsma 2018). ERP systems are defined as complete and packaged software solutions that seek to integrate processes and functions into a holistic view of business from a single IT and information architecture (Costa et al. 2016; Klaus, Rosemann, and Gable 2000). Acar, Tarim, Zaim, Zaim, & Delen (2017) explain ERP as an integrated system for automating the flow of materials, information and financial resources using a shared information flow by combining business processes. Almajali, Masa'deh, & Tarhini (2016), define ERP as a backbone of business intelligence (BI) by providing integrated analysis of the processes involved from suppliers to customers - into an integrated system with shared data and visibility. It would be important to consider ERP systems with a BI module in considering that BI is a tool to drive causality analysis and business diagnostics, as it provides a data-driven approach to linking strategic business goals to tactical policies and operational actions (C. H. Wang 2016). For example, imagine a database with climatic historical information, with a history of the incidence of pests, diseases, crop management and production results, combined with historical agricultural commodity prices. This can become a set of useful information to support decisions. This requires database, data storage, and data mining. It would be useful to think of a BI module.

Brazil is going through a paradigm shift to be able to contribute to the increase in world food production. It is necessary to discuss the implementation of ERP systems on farms. Farmers' inability to control the price of commodities, the exchange rate fluctuation, production costs, climate changes and assets management contribute to continue adapting to meet de demands of production. We considered the implementation of business analysis based on ERP on farms as the next relevant improvement able to increase the food production to the world. From the economic point of view, agribusiness is considered a high relevance industry in Brazil. According CEPA-USP/CNA (2016), Agribusiness represents 24% of Brazilian GDP (Gross Domestic Product), which means US$ 87 billion of the Brazilian export income, or 45% of all of Brazil's exportations in the year. In 2017, USDA ranks Brazil as the major world export country for orange juice, sugar, coffee, soy and chicken and the second in the ranking for beef and corn. Brazil is also the first world producer for orange juice, sugar and coffee as well as the second for beef, soy and chicken. It also has a strong world participation in the production of corn and pork (Table 27).

Table 27 Ranking and World Market Share (2016/2017)

	Orange Juice	Sugar	Coffee	Beef	Soy	Chicken	Corn	Pork
Export	1º	1º	1º	2º	1º	1º	2º	4º
	76%	45%	27%	19%	43%	36%	21%	10%
Market Share	1º	1º	1º	2º	2º	2º	3º	4º
	52%	21%	32%	19%	32%	15%	9%	35%

Source: USDA (2017), adapted and actualized from (Haberli, Oliveira, and Yanaze 2017)

Brazilian agriculture has reached high-level performance by virtue of the farm owners. Despite the instability of the macro-economic scenario and the farmer's inability to control the commodity price in the world market, the exchange rate fluctuation and climate changes, the Brazilian farmer keeps adapting to meet world market demands. The scope of this work is overcome the aspects of the technologic variables and highlight the aftereffects of the technological implementations (Morris & Venkatesh, 2010; Venkatesh, Davis, & Morris, 2007). The propose of this study is to evaluate the stages of technology diffusion using the Information Sharing to moderate the relations between the stages. According to Al-Jabri & Roztocki, (2015) several researches indicate the importance of IT in increasing transparency through the sharing of information between individuals and organizations. Information sharing may become relevant to the successful implementation of the ERP systems and to the ERP systems diffusion stages of our study. Our focus is to determine the key drivers for the spread of ERP systems (evaluation, adoption and routinisation) on farms. Because farming requires intensive work in the land, new regulations are created everyday to enhance food and environment securities and, consequently, the number of best practice management tools to be applied on the precision agriculture has also increased (Kaivosoja et al. 2014). However, it is still necessary to increase investments for ERP implementation on the farms (Sykes, Venkatesh, and Johnson 2014).

Although the conditions that define this type of organization as climate, region, type of farming or livestock, are not the same for all the farmers, we believe it is possible to find a standard and customized method to manage farms. Considering the changing paradigm, we now face a more open relationship between the parts of the farm and also between a farm and its peers which allows more effective collaboration overall. We think that ERP systems can fulfill the interoperability needs (Bibri and Krogstie 2017; Nawaratne et al. 2018) to contribute to a more customized method of managing farms.

The empiric work of this article is divided on two parts. The first part concerns an investigative work based on an exploratory study supported by in-depth interviews. The second part presents a research model supported by a quantitative research capable to understand the ERP diffusion determinants. The qualitative data gathered after the first phase was combined to the theories Diffusion of Innovation (DOI) theory, Technology-Organization-Environment (TOE) Framework and Information Sharing (IS) taken from Inter-organizational Relations (IOR) to create the instrument used for the quantitative research which was carried out with 375 farmers in Brazil. As a result, we highlight the main findings in the qualitative research focused on the challenges of agribusiness pointed on the in-depth interviews. Following this, we present the research model and the hypotheses development. Finally, we present the research methodology, the final result and main findings.

We conclude the study demonstrating the implications of the research results and indicating options for future studies.

6.2 Theoretical Background

Our study considers that the ERP systems should have a module to provide business analytics functionality. For this reason, we consider studies on farm management information system (FMIS). Sørensen, Pesonen, Bochtis, Vougioukas, & Suomi, (2011a) studied FMIS that represent the data elements identified for the specific case of fertilization, within the area of field operations. Sørensen et al.(2010). FMIS is defined as a planned system for the collecting, processing, storing and dissemination of data in the form of information needed to carry out the operations functions of the farm. Management information systems (MIS) are integral parts of the overall management system in a purposeful organization and form parts of tools such as enterprise resource planning (ERP) and general information systems (IS). Fountas et al., (2015) cites in his study the ISOBUS protocol (international organization for standardization ISO, 1997) that plays an important role in the development of precision agriculture, and considers the challenge of integrating the data captured by these technologies in a consistent agricultural management system (FMIS). The term farming machine management information system (FMMIS) is used in the article by Fountas et al., (2015) to describe the approach based on information decision-making processes for field operations in a tractor-centric approach to lead to FMIS architecture. Carli, et al., (2015) concluded that the evolution of FMIS should take into account the human nature of business processes, specifically for the marketing / sales and supply chain functions, where social aspects are more relevant. Carrer, de Souza Filho, Batalha, & Rossi (2015) investigated the impacts of personal aspects and aspects of the decision making process on the technical efficiencies of citrus farms in Brazil. These authors considered the indexes of seven FMIS: (i) electronic cost control spreadsheets; (ii) electronic records of input stock; (iii) electronic records of production, productivity and incidence of pests per plot of land; (iv) use of integrated decision support systems (DSSs); (v) use of Internet to access market information; (vi) adoption of precision agriculture techniques; and (vii) traceability and quality certifications. The main conclusion of Carrer et al., (2015) is that the adoption of FMIS is positively related to the efficiency of the citrus-based farms analysed. Our contribution takes this into account by focusing on the relevant levels of global competitiveness for which Brazil "competes" (Table 1). Agriculture is becoming a data-intensive business by bringing together efforts that address a number of factors: ecological footprint, product safety, job well-being, nutritional responsibility, plant and animal health and welfare, responsibility economic and market presence (Kaloxylos et al. 2012). Our contribution is to think of ERP systems for competitive decision-making with a vision in the farm business analysis functionality, as well as the domain of field operations with precision agriculture (PA).

Due to the fact that modern agriculture requires a complex administrative environment, it also requires information systems developed based on strict requirements (Verdouw, Robbemond, and Wolfert 2015). Kharuddin, Foong and Senik (2015), found how the decisions based on reason can affect the ERP adoption and also how the organization performance is affected by the general measurement of the economics benefits. The success of ERP implementation is significantly related to the effects of its absorption capacity, communication and trust on the intention ERP use (Mayeh, Ramayah, and Mishra 2016). In the other hand, the impacts of the ERP benefits are still unknown (Nwankpa 2015). It is important to consider that entrepreneurs and managers also need to settle an index to measure ERP systems performance in order to demonstrate its value inside the organizations (H. J. Li, Chang, and Yen 2017). Sharma & Daniel suggest a holistic understanding of ERP adoption by overcoming the technical and economical perspectives and considering its social, cultural and structural influences (Sharma and Daniel 2016). Mahmud, Ramayah and Kurnia claim that because of the complex nature of ERP, its successful implementation rate is lower that 49% in the whole world (Mahmud, Ramayah, and Kurnia 2017). By studying the determinants of ERP diffusion (EV, AD and RO) we can contribute to a greater success in the implementation of ERP systems in farms. For this, we predicated our paper on diffusion of innovation theory (DOI), technology-organization-environment framework (TOE) and inter-organizational relations theory (IOR).

DOI Theory studies the innovation dissemination and how it is communicated through channels in a unique private environment over-time (Rogers 1993); (Valente and Rogers 1995). It considers that each person has a different level of acceptance of innovation.

TOE framework suggests the factors that define the behaviour regarding the adoption of technology or systems which are divided in three contextual categories: Technological, Organizational, and Environmental (Louis G.. Tornatzky and Fleischer 1990). The Technological context is related to the internal and external technologies tools and processes (Oliveira & Martins, 2011). Organizational context is related to the company's resources and assets such as the company's size, hierarchy, procedures, administrative structure, human resource, extra resources and connection between works (Chong et al. 2009). Environmental context is affected by market aspects such as size and industry composition, competition, macroeconomics and governmental rules (Wu & Subramaniam, 2009).

Although TOE framework is frequently applied, some authors argue that TOE ignores the impact of the inter-organizational relationships (IOR) (Shang, Chen, and Liu 2005; Yee-Loong Chong and Ooi 2008).

The DOI and TOE theories have consistent empiric support and are widely applied in studies related to adoption of new technologies (Oliveira, Thomas, & Espadanal, 2014). As appointed by (Hsu, Kraemer, and Dunkle 2006a), the benefits of using both theories combined are already recognized and in our work, the combined use of theories helps to achieve more comprehensive perspective about the adoption of technology considering technological, organizational and environment contexts (Kevin Zhu, Kraemer, and Xu 2006a).

According to Chong et al. (2009) IOR are capable of defining decisions regarding e-business adoption in the supply chain (Yee-Loong Chong et al. 2009b). Considering the implementation of ERP requires IOR existence and also confidence and information sharing, it is important to consider IOR every time EPR diffusion is contemplated. In our study, we use the TOE framework and also information sharing, one of IOR attribute, as moderator variable.

As many other industries or organizations, farms are a part of a complex, global, competitive and unpredictable business environment. With the growth of Internet usage in organizations, only the use of the TOE framework may become obsolete to explain the decisions about adopting ERP systems (Chan, Yee-Loong Chong, and Zhou 2012).

Our understanding is that for the Brazilian farmer the Information Sharing (IS) construct can generate more obstacles than the Compatibility (CP) construct to the diffusion of the standards of the technological systems. With that in mind, Information Sharing form the IORs Theory and other factors play a key role on decisions of technology adoption in organizations (Huang, Z., Janz, B. D. & Frolick 2008; Yee-Loong Chong et al. 2009b).

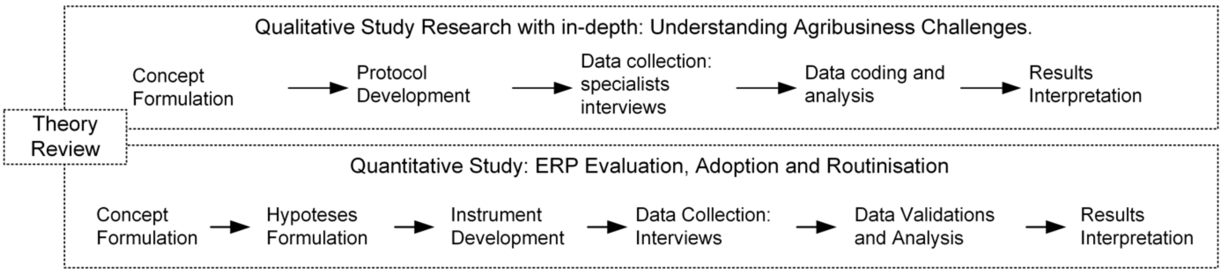
Valente and Roger (Valente and Rogers 1995) indicated that technology diffusion happens over time and in stages that are related to the decision-making process to implement new technologies. In conclusion, (a) IT diffusion is dynamic and complex, it is not regular over time; (b) The analysis in multiple stages of technology diffusion provides information about IT diffusion problems and answers to them; (c) A new technology may not be fully implemented even when it is presented and welcomed with enthusiasm (Chan and Chong 2013).

Many research models only consider research the dichotomy between adoption or no adoption of technology. And, in order to innovate the data collection for ERP systems, we selected the diffusion model based on three stages: evaluation, adoption, and routinization. This model which considers that adoption is not mandatory for the general use of technology (Hsu, Kraemer, and Dunkle 2006a) is already applied in previous studies (Chan and Chong 2013; S. Kim and Garrison 2010; Sahin et al. 2006; I. L. Wu, Chuang, and Hsu 2014).

6.3 Qualitative research with in-depth interviews: Exploring agribusiness

According the Figure 11, the research is presented in two parts: qualitative and quantitative studies**.**

Figure 22 Research outline



To understand the agribusiness challenges for the next few years, we employed a qualitative research based on in-depth interviews (Boyce and Neale 2006b; Myers 1997) with 10 recognized experts in the area. We asked to each specialist to expose their personal opinion about the challenges, threats (Table 28) and requirements for agribusiness development in Brazil and abroad (Table 29). We correlated the main finds to the constructs proposed for this study (DOI, TOE and IOR) and the result is presented on Table 16 and 17.

Those interviews revealed that the agribusiness is considered the greatest resource to project Brazil as a major player in the world economy in the next 15 years. This event will promote economic, social and environmental development for the country. However, it is necessary to define success indicators to be reached, set a strategic planning with attainable and coherent objectives and encourage bold business performances from companies and individuals. Brazil has a high potential for agribusiness development, and it can contribute for global agribusiness on building opportunities for sustainable inclusion of products, people and companies.

According to our qualitative study, we concluded that it is necessary to evaluate the stages of ERP adoption beyond the farm's borders. If the production of a region grows enough to overcome the local demand, it becomes part of the world economy. The ERP also needs to fit the farm's needs and overcome its limits. In other words, ERP needs to be able to be applied not only inside the farm but should cover all the region where it belongs. ERP also needs to improve itself by working in an extended model in order to maximize the use of resources (Zhao et al. 2016).

Table 28 Correlation Matrix: Qualitative findings to support qualitative Constructs.

Challenge	Threats	Constructs Correlation
Increment of production cost	✓ Environmental care, (1) ✓ Operation, (1) ✓ Storage, (1) ✓ Regulatory Agencies inefficient. (1) ✓ Tax complexity, (2)	Relative Advantage (1) Complexity (2)
Understanding agribusiness structural changes	✓ Formation of large producing companies, (2) ✓ Management platforms availability, (3) ✓ Access to information and technology, (4) ✓ Producer behaviour, farming diversity (4) ✓ Global commodities price volatility, (5) ✓ Weather awareness, (5) ✓ Sustainability and low-carbon economy compliances, (5) ✓ Large producing areas, small number of producers (5) ✓ Capital requirement, (5) ✓ Use of land and water, (5) ✓ Large scale production, (5) ✓ Large companies, ✓ Digital Farming, (6) ✓ Business and leadership succession. (7)	Complexity (2) Compatibility (3) Routinisation (4) Competitive Pressure (5) Technology Competence (6) Top Management Support (7)
Understanding consumer behaviour marketing, food strategies and agribusiness trends	✓ Brand birth origin, (8) ✓ Label content, (8) ✓ Creation of Consumer clubs on digital platforms, (9) ✓ Increase of purchase from local producers, (9) ✓ New purchasing habits: social media research, tracking, internet of things. (9)	ERP Environment (8) Information Sharing (9)

Table 29 The Brazilian outlook: agribusiness development and challenges.

Needs	Development Needs	Constructs Correlation
Land assets and costs management	✓ Development of Enterprise Resource Planning System in the farm	In all the constructs
Ensure cost control: Management platform for agribusiness	✓ Purchasing, Producing, Stoking and Selling control. ✓ Inside the farm, understand what are the resources based on value	Future Studies
Changing on farming border concept in order to integrate regional management	✓ Analytics Insights Platform or Business Analytics Functionality management model capable to promote sharing and collaboration among producers	Information Sharing Complexity Compatibility
Integrating Activities: Evaluate digital farming	✓ Cloud computing and Internet of things: Information access and analysis with multiple variables for production technology activities, purchasing, trading, weather, management of integrated regional space square meter	Compatibility ERP Environment Information Sharing Evaluation Adoption Routinisation
Access to production information from urban areas	✓ Integration with food consumer and food marketing, follow the consumer behaviour changes.	ERP Environment

6.4 Quantitative Research Model and Study Hypothesis

Considering the item 6.2, Theoretical Background, and item 6.3, Exploring Agribusiness Needs, we study the stages of diffusion for the three levels: evaluation, adoption, and routinization as dependent variables (Chan and Chong 2013). The determinants of ERP's use applied in the research model (Figure 23) was selected from TOE framework and DOI theory from previous researches concerning adoption of technology (Lai, Lai, and Lowry 2016; Tiago Oliveira, Thomas, and Espadanal 2014; Picoto, Bélanger, and Palma-dos-Reis 2014; Ruivo et al. 2012; Ruivo, Oliveira, and Neto 2014). Moreover, TOE Theory made it possible to identify the stages of diffusion and the most relevant determinants. On the other hand, DOI theory helped to identify the more visible determinants on technological and organizational elements inside the farms. Furthermore, the variable Information Sharing based on factors of Inter-organizational Relations (IORs) was included in the research to performing a moderation role on technologies adoption decisions in the organizations (Huang, Z., Janz, B. D. & Frolick 2008; Yee-Loong Chong et al. 2009a). Table 30 shows the instrument of our research model.

Figure 23 Research model for the three phases of adoption of ERP systems

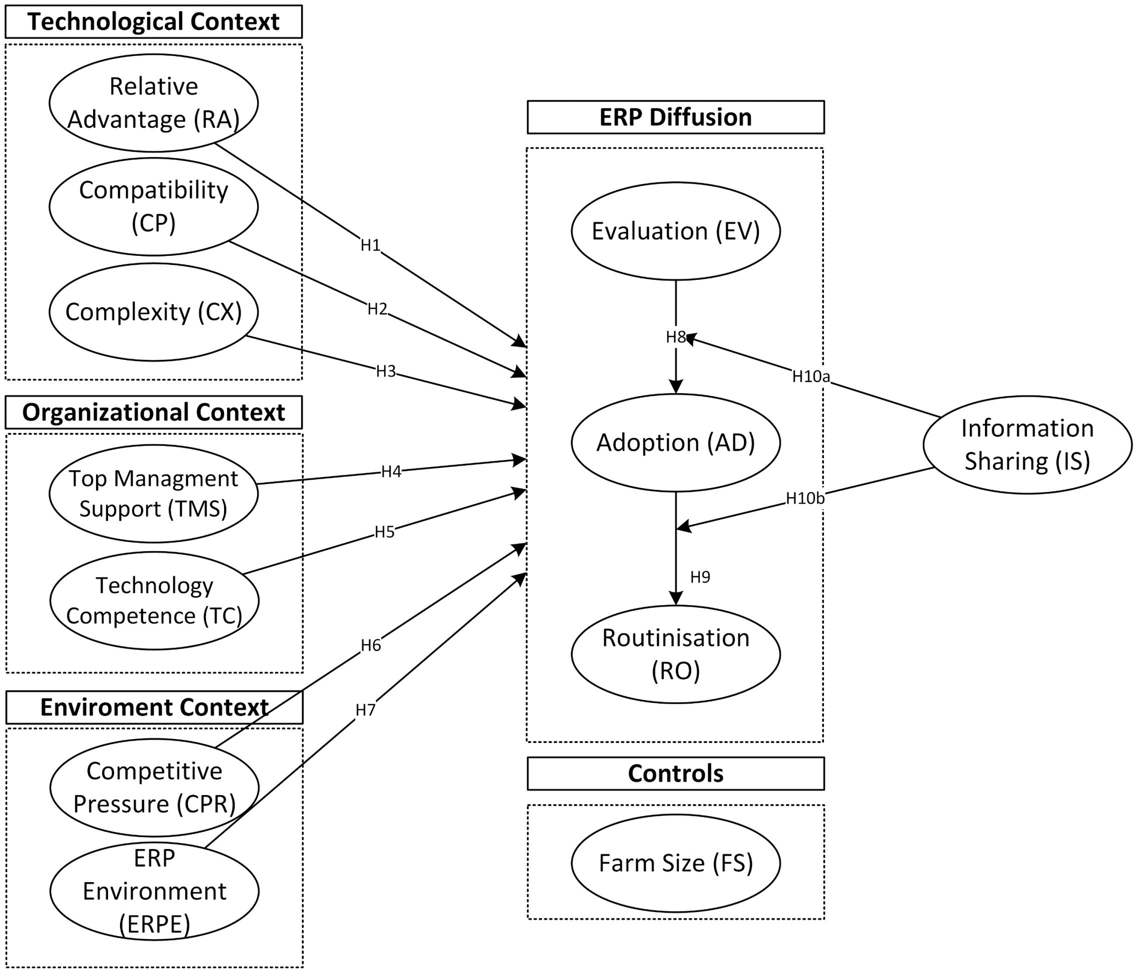


Table 30 Instrument the adoption stages ERP

Please rate the following statements, where 1 means strongly disagree and 7 totally agree (1~7).			
Relative Advantage (RA)/R	RA1	Rate the level that your organization expects the ERP help in the sales process and improve the productivity.	(Picoto, Bélanger, and Palma-dos-Reis 2014)
	RA2	Rate the level that your organization expects the ERP help to reduce costs. (supply purchase, machines, equipment, labour, diesel, etc.…)	
	RA3	Rate the level that your organization expects an ERP help in the production storage process	
	RA4	Rate the level that your organization expects an ERP help in the logistics process in order the production to arrive on time at their destination	
Compatibility (CP)/R	CP1	Buy through the implementation of ERP is compatible with your current purchasing process	(Picoto, Bélanger, and Palma-dos-Reis 2014)
	CP2	Management through an ERP is compatible with my organizational culture	
	CP3	ERP is compatible with my company's current experience with similar systems	
Complexity (CX)/R	CX1	My company believes that an ERP is complex to use	(Picoto, Bélanger, and Palma-dos-Reis 2014)
	CX2	My company believes that the development of ERP is a complex process	
	CX3	I believe that the use of ERP is very complex for production operations	
Top Management Support (TMS)/R	TMS1	Top Management is actively involved in establishing a vision and formulate strategies for the use of an ERP	(Chan and Chong 2013)
	TMS2	Top Management communicates its support for the use of ERP	
	TMS3	Top Management is likely to analyse the occurrence of risks involved in implementing an ERP	
Technology Competence (TC)/R	TC1	The technology infrastructure of my Farm is available to support an ERP implementation	(Chan and Chong 2013)
	TC2	Inside the farm there are skills needed to implement a more efficient ERP model	
Competitive Pressure (CPR)/R	CPR1	My farm suffers a competitive pressure to implement ERP	(Chan and Chong 2013; Kevin Zhu and Kraemer 2005)
	CPR2	My Farm will have competitive disadvantage if we do not implement ERP.	
	CPR3	Pressure level originated by competitors in the local market	
ERP Environment (ERPE)/F	ERPE1	There is adequate availability for integrated decision making which is important for the farm	(Picoto, Bélanger, and Palma-dos-Reis 2014)
	ERPE2	There is adequate availability of devices that make the integration of all data from crop production	
	ERPE3	There is adequate availability of information on safety standards for use in shared management systems	
	ERPE4	There is adequate availability of computer standards for the implementation of ERP systems	
	ERPE5	There is adequate availability of system applications that enable paradigm break on the farm	
	ERPE6	There is a suitable ERP system on the market to meet the farm's needs	
Evaluation (EV)/R	EV1	My farm collects information about ERP market with the possible intention of using it	(Chan and Chong 2013)
	EV2	My farm has conducted a pilot test to evaluate an ERP	
Adoption (AD)/R	AD1	My farm invests resources to adopt ERP	
	AD2	The purchase, production and sales tasks (business activities) from our farm require the ERP usage	
	AD3	Functional areas in my farm require the use of ERP	
Routinization (RO)/R	RO1	We have integrated with back-end ERP chain systems / legacy / chain of existing supplies	
	RO2	Real time distribution of information is collected through the integration of delivery systems with ERP	
	RO3	Real time inventory information is collected by integrating inventory systems with ERP applications	
	RO4	ERP is being implemented together with the buyers of our production	
	RO5	ERP is being implemented together with our raw material suppliers	
	RO6	ERP is being implemented to meet the requirements of the Forest Code (environmental sustainability)	
	RO7	ERP is being implemented to meet the requirements of research and agribusiness development (integrated with the systems of public and private research institutes	
Information Sharing (IS)/R	IS1	The introduction of an ERP implies a greater visibility and transparency of business transactions between trading partners	(Chan and Chong 2013)
	IS2	My farm would be comfortable in sharing our information, business transactions with trading partners	
Farm Size (FS)/R	FS1	The capital of my farm is high compared to my neighbours.	(Chan and Chong 2013)
	FS2	The revenue from my Farm is high compared to my neighbours.	
	FS3	The number of employees of my farm is high compared to my neighbours	

Therefore, we suggest the following hypotheses for this study:

Relative Advantage (Alam 2009) was adapted from Picotto et al. (2014) and according to our qualitative studies, is a latent variable justified by the opportunities created by an ERP to improve the selling process, cost reduction, buying process, storage and logistics (on time and full time). The research results suggest that these factors are essential for the farm's performance. Therefore, we set the following hypotheses for the study:

H_{1a}: Relative Advantage (RA) has a positive influence on ERP Evaluation (EV).

H_{1b}: Relative Advantage (RA) has a positive influence on ERP Adoption (AD).

H_{1c}: Relative Advantage (RA) has a positive influence on ERP Routinisation (RO).

Compatibility (CP) (Bradford and Florin 2003) adapted from Picoto et al. (2014) and according to our qualitative studies, is a latent variable justified by the opportunities of an ERP be compatible with the selling process, buying, organizational culture and farm's information infrastructure. The research results suggest these factors can be controlled by the farmer to improve financial performance. Therefore, we set the following hypotheses for the study:

H_{2a}(+): Compatibility (CP) has a positive influence on ERP Evaluation (EV).

H_{2b}(+): Compatibility (CP) has a positive influence on Adoption (AD).

H_{2c}(+): Compatibility (CP) has a positive influence on ERP Routinisation (RO)

Complexity (CX) (Rajan and Baral 2015) also adapted from Picoto et al. (2014) and according to our qualitative studies, is a latent variable justified by its use on production operation, with a complex development process and necessary competences for adoption. The research results suggest that under qualified workers can effect the technology diffusion decision. Based on that, we set the following hypotheses for the study:

H_{3a}(-): Complexity (CX) has a negative influence on ERP Evaluation (EV).

H_{3b}(-): Complexity (CX) has a negative influence on ERP Adoption (AD).

H_{3c}(-): Complexity (CX) has a negative influence on ERP Routinisation (RO).

Top Management Support (TMS) (Jia and Barnes 2017) adapted from Chan and Chong

(2013) and according to our qualitative studies, is latent variable justified by the direct involvement of TMS with the support communication, also for the attention on analysis of technological diffusion risks and for strategic planning for ERP use based on analytical insights platforms. The decision to maintain a corporate system already in use has a significant impact on the company's performance and sustainability. The final decision of the management team is not guided only for individual cognitive belief but also for a majority opinion expressed by a shared view. The research results suggest that Top Management has strong influence on diffusion of technology decision. Therefore, the hypotheses are:

H_{4a}(+): Top management support (TMS) has a positive influence on ERP Evaluation (EV).
H_{4b}(+): Top management support (TMS) has a positive influence on ERP Adoption (AD).
H_{4a}(+): Top management support (TMS) has a positive influence on ERP Routinisation (RO).

Technology Competence (TC) (J. Kim, Lee, and Cho 2016) adapted from Chan and Chong (2013) and according to our qualitative studies, is a latent variable justified by infrastructure, ability, knowledge, support to operation, wireless communication with tractors and combines and use of precision agriculture. The research results suggest that infrastructure and knowledge can generate integration beyond the farm's borders and technology diffusion. Therefore, the hypotheses are:

H_{5a}(+): Technology Competence (TC) has a positive influence on ERP Evaluation (EV).
H_{5b}(+): Technology Competence (TC) has a positive influence on ERP Adoption (AD).
H_{5c}(+): Technology Competence (TC) has a positive influence on ERP Routinisation (RO).

Competitive Pressure (CPR) (Ruivo, Oliveira, and Neto 2014), adapted from Chan and Chong (2013) and according to our qualitative studies, is a latent variable justified by the pressure imposed by local and international competitors, pressure from buyers and banks and also, competitive disadvantage due to absence of ERP system use. The research results suggest that CPR has an important influence on the stages of technology diffusion. Therefore, the hypotheses are:

H_{6a}(+): Competitive pressure (CPR) has a positive influence on ERP Evaluation (EV).

H_{6b}(+): Competitive pressure (CPR) has a positive influence on ERP Adoption (AD).

H_{6c}(+): Competitive pressure (CPR) has a positive influence on ERP Routinisation (RO).

ERP Environment (ERPE) (Kanellou and Spathis 2013), adapted from Picoto et al. (2014) and according to our qualitative study, is a latent variable used as a formative variable. Formative variables assumes that the formative indicators fully capture the content domain of the constructs under consideration (Hair Jr, Sarstedt, Hopkins, & Kuppelwieser, 2014 p.118,119). According to this, we evaluate on the quantitative research: the decisions concerning data integration, safety rules, standards and adequacy of computer and applications as an appropriate set of indicators. Therefore, the hypotheses are:

H_{7a}(+): ERP Environment (ERPE) has a positive influence on ERP Evaluation (EV).

H_{7b}(+): ERP Environment (ERPE) has a positive influence on ERP Adoption (AD).

H_{7c}(+): ERP Environment (ERPE) has a positive influence on ERP Routinisation (RO).

Evaluation (EV) adapted from Chan and Chong (2013) and according to our qualitative studies allowed the exploration of questions about ERP considering its use and continuity, including ERP data gathering in the market and also a pilot test to evaluate it. Adoption (AD) also adapted from Chan and Chong (2013) and according to our qualitative studies allowed the exploration of questions about the request of ERP and the usage on farm operations (i.e. buying, production and selling). Routinisation (RO) likewise adapted from Chan and Chong (2013) and according to our qualitative studies allowed an evaluation of ERP integration with production chain systems, integrated systems, stock controls, implementation with buyers and providers, with the requirements of Rural Environmental Registry (“Cadastro Ambiental Rural” - CAR) and with the requirements of researches for development of food production. Therefore, the hypotheses are:

H_8(+): Evaluation (EV) has a positive influence on Adoption (AD).
H_9(+): Adoption (AD) has a positive influence on Routinisation (RO).

Information Sharing (IS) (I. L. Wu, Chuang, & Hsu, 2014), adapted from Chan and Chong (2013) and according to our qualitative studies, is applied as a moderator variable. It is necessary to track the effects of an ERP on the variables Evaluation (EV), Adoption (AD) and Routinisation (RO). The research results suggest that Information Sharing can hold two levels of integration improvement on supply chain, operation and strategy. Therefore, the hypotheses are:

H_{10a}(+): Information Sharing (IS) will moderate the effect of ERP Evaluation (EV) on ERP Adoption (AD), such that the effect will be stronger among farms with higher level of information sharing
H_{10b}(+): Information Sharing (IS) will moderate the effect of ERP Adoption (AD) on ERP Routinisation (RO), such that the effect will be stronger among farms with higher level of information sharing.

6.5 Methodology

The measurement items were adapted from (Chan and Chong 2013; Picoto, Bélanger, and Palma-dos-Reis 2014; Wei, Lowry, and Seedorf 2015) and from the exploratory studies developed by the Authors (Table 17 and 18).

Based on the present literature and our exploratory results, the interview questionnaire was created in English and a professional translator translated the final version to Portuguese.

After that, it was translated to English one more time by a professional translator with the aim of securing translation equivalence (Brislin 1970).

The Portuguese version was first applied as a pre-test in two phases: (a) a small number of questionnaires were applied to farmers with larger farms where ERP was already in use. In this moment the terminology, instruction's clarity and response format was evaluated. The questions, with some exceptions, were measured using a numerical scale varying from 1 for completely disagree to 7 for completely agree. (b) The questionnaire was modified and tested once more with 36 farmers using 22 personal interviews and 14 internet interviews. The results of the pre-test demonstrated that the measurement scale was reliable and valid.

The pre-test also demonstrated some problems on the Internet interview methodology and we decided to apply the questionnaire in person only. With that, between June 2016 and July 2017, a sample of 375 complete answers was collected. It is composed of 71% soy and corn farmers, 14% cattle raising and milk producers, and the rest of the 15% were sugar cane, coffee, cotton, fruits and bean farmers. Our sample has a concentration of 64% of farms from Midwest region, which is justified by the major concentration of farms in this region. During the interview, we identified 24% that already uses ERP (Table 31).

Table 31 Research Sample composition

Agriculture Type	
Soy – Corn	71%
Cotton	2%
Coffee	2%
Sugar Cane	8%
Fruits	2%
Cattle Raising	14%
Beans	1%
Regions	
MAPITOBA (Maranhão, Piauí, Tocantins and west of Bahia)	19%
Midwest (MT, MS, GO)	64%
South East (SP, MG)	10%
South (RS, PR)	7%
Phases of ERP Adoption	
Never considered adoption	12%
Pilot Test	21%
Have researched about but do not consider adoption	10%
Have researched and consider adoption	33%
Already in use	24%
Number of interviews: 375	

6.6 Results

The paper's research analysis is focused on confirming the measurement method and test of hypotheses. Structural equation modelling (SEM) with partial least squares (PLS) was used to perform a simultaneous evaluation of measurement quality (model) and constructs relationship (structural model). SmartPLS (v3.2.6) is used in this study to evaluate the measurement properties and the test hypotheses (Henseler, Ringle, and Sarstedt 2014) and Ringle, Wende and Becker, 2015 in http://www.smartpls.com.

6.6.1 Measurement Model

For the assessment of the measurement model, different analyses were performed according to the nature of the construct (i.e., reflective or formative).

The reflective measurement model assessment was performed for internal consistency, indicator reliability, convergent validity, and discriminant validity (Hair Jr et al. 2014). The internal consistency was evaluated by Cronbach's alpha and composite reliability. All latent variables show good performance in terms of internal consistency with Cronbach's alphas between 0.66 and 0.95 and composite reliabilities between 0.80 and 0.97. To evaluate convergent validity, we used average variance extracted (AVE) that should be higher than 0.50. Table 21 shows the validity of our model. As can be seen in Table 32, all constructs present AVE values above 0.5 (between 0.55 and 0.81), indicating that the constructs represent one dimension and the same underlying construct, and also that the constructs is able to explain more than a half of the variance of its indicators. Overall, the instrument presents good indicator reliability. Indicator reliability was evaluated on Table 32 and presents a good result.

Table 32 Reflective Measurement Model

Constructs	Composite Reliability (CR)	AVE
Relative Advantage (RA)	0.830	0.553
Compatibility (CP)	0.886	0.722
Complexity (CX)	0.848	0.653
Top Management Support (TMS)	0.850	0.656
Technology Competence (TC)	0.895	0.810
Competitive pressure (CPR)	0.834	0.626
Evaluation (EV)	0.780	0.644
Adoption (AD)	0.887	0.724
Routinisation (RO)	0.946	0.714
Information Sharing (IS)	0.883	0.791
Farm Size (FS)	0.918	0.788

Table 33 PLS Loadings and cross-loadings the adoption stages ERP

Constructs	RA	CP	CX	TMS	TC	CPR	ERP E	EV	AD	RO	IS	FS
Relative Advantage (RA)												
RA1	**0.67**	0.25	0.07	0.28	0.23	0.14	0.29	0.14	0.22	0.10	0.17	0.02
RA2	**0.65**	0.09	-0.06	0.40	0.30	0.15	0.26	0.19	0.12	0,11	0.15	0.02
RA3	**0.80**	0.06	0.02	0.35	0.39	0.29	0.28	0.24	0.25	0.19	0.06	0.08
RA4	**0.83**	0.15	0.08	0.29	0.41	0.40	0.32	0.26	0.31	0.31	0.10	0.17
Compatibility (CP)												
CP1	0.17	**0.84**	0.19	0.26	0.26	0.02	0.36	-0.10	0.27	0.23	0.10	0.28
CP2	0.16	**0.88**	0.13	0.27	0.19	0.04	0.38	-0.08	0.29	0.22	0.11	0.28
CP3	0.11	**0.83**	0.23	0.22	0.26	0.07	0.41	-0.12	0.26	0.26	0.13	0.32
Complexity (CX)												
CX1	0.00	0.13	**0.72**	0.09	0.00	0.03	0.09	-0.12	0.00	0.04	0.06	0.09
CX2	0.03	0.21	**0.85**	0.10	-0.04	0.02	0.13	-0.24	0.04	0.06	0.07	0.13
CX3	0.07	0.16	**0.85**	0.06	0.16	0.23	0.15	-0.18	0.09	0.19	0.09	0,17
Top Management Support (TMS)												
TMS1	0.38	0.15	0.07	**0.85**	0.28	0.19	0.26	0.26	0.10	0.11	0.04	0.06
TMS2	0.36	0.28	0.05	**0.84**	0.15	0.05	0.29	0.10	0.14	0.17	0.08	0.12
TMS3	0.28	0.36	0.14	**0.73**	0.15	0.04	0.31	0.02	0.15	0.08	0.11	0.12
Technology competence (TC)												
TC1	0.45	0.26	0.05	0.22	**0.91**	0.31	0.51	0.25	0.37	0.36	0.10	0.21
TC2	0.38	0.23	0.07	0.23	**0.89**	0.39	0.44	0.26	0.28	0.35	0.12	0.19
Competitive Pressure (CPR)												
CPR1	0.24	0.16	0.22	0.01	0.29	**0.76**	0.21	0.13	0.24	0.27	0.11	0.17
CPR2	0.39	0.14	0.14	0.24	0.37	**0.84**	0.30	0.27	0.34	0.31	0.16	0.07
CPR3	0.20	-0.19	-0.08	-0.02	0.23	**0.77**	0.01	0.38	0.17	0.14	0.10	-0.07
ERP Environment (ERPE)/F												
ERPE1	0.36	0.24	0.02	0.28	0.57	0.27	**0.76**	0.24	0.33	0.26	0.15	0.13
ERPE2	0.15	-0.02	-0.21	0.17	0.23	0.21	**0.24**	0.33	0.14	0.00	0.04	-0.05
ERPE3	0.30	0.38	0.15	0.29	0.39	0.18	**0.81**	0.05	0.31	0.35	0.04	0.16
ERPE4	0.29	0.41	0.12	0.38	0.31	0.16	**0.72**	0.07	0.30	0.29	0.11	0.15
ERPE5	0.22	0.28	0.03	0.28	0.30	0.17	**0.60**	0.15	0.25	0.21	0.08	0.07
ERPE6	0.20	0.29	0.01	0.18	0.24	0.17	**0.64**	0.13	0.26	0.24	0.08	0.14
Evaluation (EV)												
EV2	0.10	-0.02	-0.23	0.10	0.07	0.15	0.03	**0.69**	0.25	0.10	-0.06	0.06
EV3	0.32	-0.14	-0.16	0.18	0.32	0.35	0.09	**0.90**	0.33	0.20	-0.02	-0.07
Adoption (AD)												
AD1	0.24	0.24	0.07	0.12	0.36	0.28	0.37	0.35	**0.84**	0.57	0.01	0.12
AD2	0.33	0.35	0.11	0.15	0.33	0.30	0.41	0.26	**0.92**	0.53	0.12	0.09
AD3	0.23	0.23	-0.04	0.14	0.20	0.26	0.21	0.34	**0.79**	0.37	0.11	0.12
Routinisation (RO)												
RO1	0.25	0.26	0.08	0.12	0.30	0.24	0.35	0.23	0.56	**0.84**	0.02	0.14
RO2	0.23	0.24	-0.03	0.18	0.26	0.27	0.32	0.22	0.50	**0.81**	0.01	0.11
RO3	0.24	0.24	0.04	0.15	0.30	0.22	0.31	0.20	0.49	**0.83**	0.02	0.07
RO4	0.22	0.24	0.20	0.08	0.36	0.30	0.36	0.11	0.51	**0.86**	0.05	0.13
RO5	0.19	0.27	0.16	0.09	0.35	0.29	0.39	0.14	0.48	**0.86**	0.10	0.18
RO6	0.25	0.23	0.19	0.16	0.38	0.27	0.37	0.14	0.44	**0.85**	0.04	0.18
RO7	0.23	0.19	0.13	0.13	0.36	0.28	0.31	0.15	0.47	**0.87**	0.05	0.15
Information Sharing (IS)												
IS1	0.14	0.14	0.11	0.09	0.08	0.06	0.16	-0.08	0.08	0.03	**0.91**	0.15
IS2	0.11	0.10	0.06	0.06	0.13	0.22	0.08	0.01	0.08	0.06	**0.86**	0.08
Farm Size (FS)												
FS1	0.07	0.29	0.14	0.05	0.17	0.02	0.15	-0.02	0.06	0.09	0.05	**0.86**
FS2	0.09	0.30	0.14	0.13	0.16	0.02	0.19	-0.03	0.08	0.11	0.12	**0.88**
FS3	0.19	0.31	0.16	0.10	0.24	0.13	0.23	-0.01	0.16	0.19	0.14	**0.92**

Table 34 Discriminant Validity Model (Fornell–Larcker Criterion) AVE and latent variables correlations the adoption stages ERP

	RA	CP	CX	TMS	TC	CPR	ERPE	EV	AD	RO	IS	FS
Relative Advantage (RA)	**0.743**											
Compatibility (CP)	0.173	**0.850**										
Complexity (CX)	0.050	0.214	**0.808**									
Top Management Support (TMS)	0.424	0.293	0.093	**0.810**								
Technology Competence (TC)	0,461	0.276	0.064	0.248	**0.900**							
Competitive Pressure (CPR)	0.363	0.055	0.118	0.123	0.383	**0.791**						
EPR Environment (ERPE)/F	0.383	0.462	0.181	0.335	0.522	0.215	**F (*)**					
Evaluation (EV)	0.287	-0.121	-0.230	0.185	0.280	0.335	0.083	**0.803**				
Adoption (AD)	0.316	0.324	0.065	0.156	0.361	0.327	0.394	0.366	**0.851**			
Routinisation (RO)	0.269	0.280	0.130	0.152	0.390	0.311	0.420	0.200	0.584	**0.845**		
Information Sharing (IS)	0.146	0.137	0.095	0.084	0.116	0.150	0.131	-0.045	0.093	0.046	**0.889**	
Farm Size (FS)	0.117	0.341	0.168	0.110	0.223	0.073	0.230	-0.023	0.125	0.162	0.133	**0.886**

Notes: (*) Formative Measurement model

The discriminant validity was tested with two criteria: the Fornell-Larcker (1981) (AVEs should be greater than the squared correlations and each indicator should have a higher correlation to the assigned construct than to any other construct) and the cross loadings analysis. As can be seen in Table 33 and Table 34 both criteria are satisfied for all constructs and indicators, which indicates that the instrument has good discriminant validity.

For the formative measurement model evaluation, the multicollinearity and the significance and sign of weights were assessed. Regarding multicollinearity, the VIF for each indicator was computed and is presented in Table 35. For all items, the VIF is below the cut-off value of 3.3 (Sarstedt et al. 2014). Table 35 also presents the weights and their significance. Some of the indicators are not statistically significant (ERPE4 and ERPE5) with loadings greater than 0.5. This reveals that the formative construct has significance and relevance of weights.

Table 35 Formative Measurement Model

Constructs	Indicator	Loadings (Convergent validity)	VIF (*)	Outer Weights	t-value	p-value Significance Level
ERP Environment (ERPE)/F	ERPE1	0.757	1.68	0.547	3.179	***
	ERPE2	0.237	1.54	-0.395	2.031	**
	ERPE3	0.806	2.17	0.424	2.394	**
	ERPE4	0.724	2.45	0.147	0.911	NS
	ERPE5	0.597	2.19	0.046	0.289	NS
	ERPE6	0.636	1.32	0.321	2.655	**

Notes: (*) Collinearity of indicators: Each indicator's tolerance (VIF) value should be higher than 0.20 (lower than 5).
NS = not significant. *p<0.10. ** p<0.05. *** p<0.01.

6.6.2 Structural Model

After assessing that the measurement model holds good psychometric proprieties, we assessed the structural model. We will address the assessment of the structural model results. This involves examining the model's predictive capabilities and the relationships between the constructs. First, we test if the model present collinearity issues, as show on Table 36. The variance inflation factor (VIF) values range between 1.088 and 1.738 what demonstrates that doesn´t exist any collinearity issues in structural model.

Table 36 Collinearity Assessment the adoption stages ERP

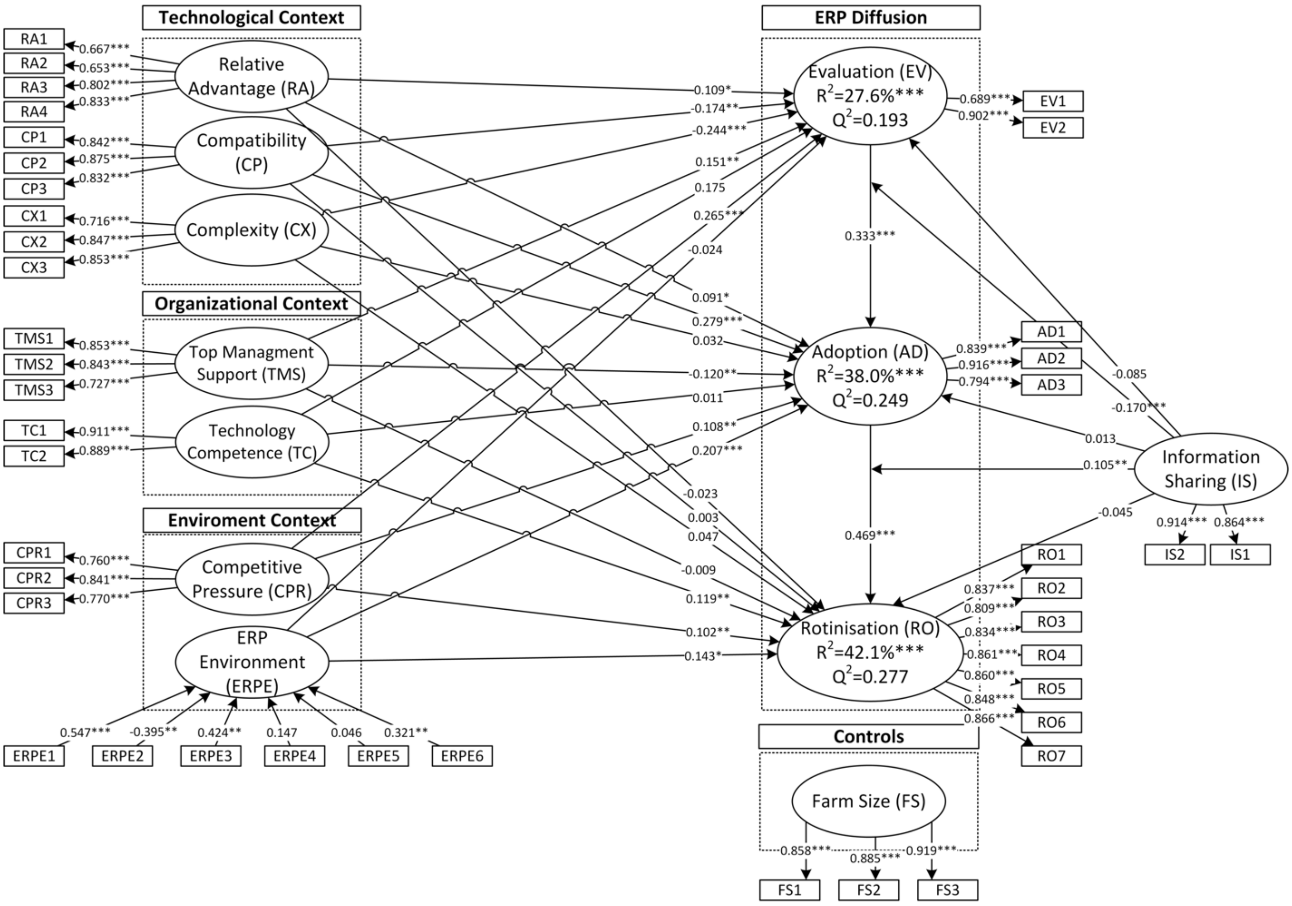
Constructs	VIF		
	EV	AD	RO
Relative Advantage (RA)	1.577	1.596	1.603
Compatibility (CP)	1.450	1.492	1.528
Complexity (CX)	1.088	1.173	1.093
Top Management Support (TMS)	1.320	1.352	1.326
Technology Competence (TC)	1.682	1.738	1.698
Competitive Pressure (CPR)	1.273	1.378	1.343
EPR Environment (ERPE)/F	1.715	1.718	1.783
Evaluation (EV)	-	1.303	-
Adoption (AD)	-	-	1.398
Routinisation (RO)	-	-	-
Information Sharing (IS)	1.057	1.069	1.061
Farm Size (FS)	1.176	1.176	1.177
IS*EV	-	1.035	-
IS*AD	-	-	1.064

Notes: The VIF value should be lower than 5.

Figure 24 presents a structural model that the research model explains: 27.6% of variation in ERP Evaluation (EV), 38.0% of variation in ERP adoption (AD), and 42.1% of variation in ERP routinisation (RO). The significance of paths was calculated applying a bootstrapping procedure generating 5000 random samples (Hair Jr et al. 2014). The results, also reported in Figure 3, show that: TC ERPE, IS -> EV; CX, TC, and IS -> AD; RA, CP, CX, TMS, and IS -> RO don´t present statistically significant path coefficients.

The model also shows that EV explains AD ($\hat{\beta}$= 0.333***) and AD explains RO ($\hat{\beta}$= 0.469***) (Figure 13).

Figure 24 Research Model for three levels of diffusion of ERP based on business analytics functionality.



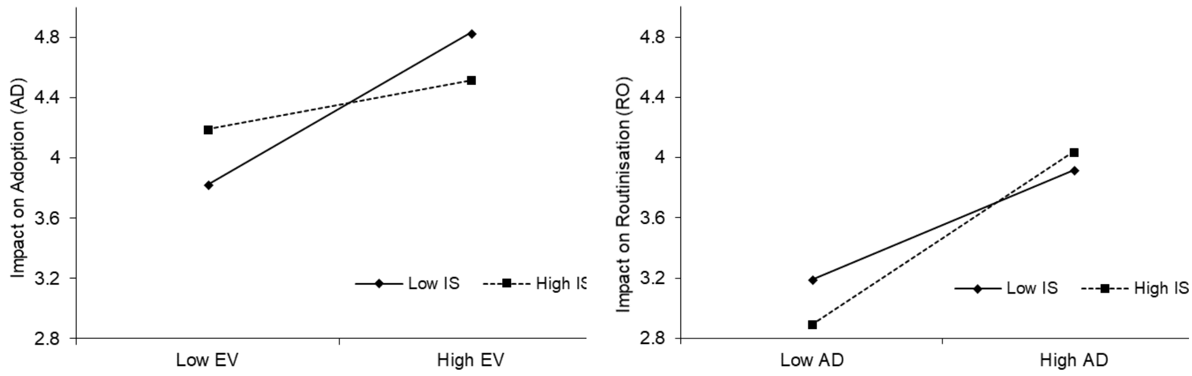
6.6.3 Control variable: Farm Size

The Farm Size control variable was added to the model to see if different farm sizes had an effect to explain ERP adoption stages. The study suggests that for small, medium or large farms, there are no significant results that could give us clues to differentiation. This reveals that the farm size isn't a driver for ERP adoption stages (evaluation, adoption, and routinization).

6.6.4 Moderator Variable Values

We can conclude that Information Sharing (IS) moderates the effect of evaluation on adoption ($\hat{\beta}$ = - 0,170 ***), and the effect of adoption on routinisation ($\hat{\beta}$ = 0,105 **). Based on Figure 25, we can conclude that the lower the Information Sharing (IS) the greater the effect of EV on AD. In another hand, the greater the Information Sharing (IS), the greater the effect of Adoption (AD) on Routinisation (RO). Therefore, the evaluation significance of ERP to explain its adoption will be greater for farms with lower level of IS, consequently the H10a is not supported. The significance of Information Sharing (IS) between Adoption (AD) and Routinisation (RO) will be on farms with higher IS evaluation, thereby confirms the H10b.

Figure 25 Moderators effects



On Table 37 we can find the validation analysis of Hypotheses created for the study.

Table 37 Hypotheses Analysis

Hypotheses	Results
H_{1a}(+): Relative Advantage (RA) has a positive influence on ERP Evaluation (EV).	V ($\hat{\beta}$ = 0.109*)
H_{1b}(+): Relative Advantage (RA) has a positive influence on ERP Adoption (AD).	V ($\hat{\beta}$= 0.091*)
H_{1c}: Relative Advantage (RA) has a positive influence on ERP Routinisation (RO).	NV ($\hat{\beta}$= - 0.023)
H_{2a}(+): Compatibility (CP) has a positive influence on ERP Evaluation (EV).	NV ($\hat{\beta}$= - 0.174**)
H_{2b}(+): Compatibility (CP) has a positive influence on Adoption (AD)	V ($\hat{\beta}$= 0.279***)
H_{2c}(+): Compatibility (CP) has a positive influence on ERP Routinisation (RO).	NI ($\hat{\beta}$= 0.003)
H_{3a}(-): Complexity (CX) has a negative influence on ERP Evaluation (EV).	V ($\hat{\beta}$= - 0.244***)
H_{3b}(-): Complexity (CX) has a negative influence on ERP Adoption (AD).	NI ($\hat{\beta}$= 0.032)
H_{3c}(-): Complexity (CX) has a negative influence on ERP Routinisation (RO).	NI ($\hat{\beta}$= 0.047)
H_{4a}(+): Top management support (TMS) has a positive influence on ERP Evaluation (EV).	V ($\hat{\beta}$= 0.151**)
H_{4b}(+): Top management support (TMS) has a positive influence on ERP Adoption (AD).	NV ($\hat{\beta}$= - 0.120**)
H_{4a}(+): Top management support (TMS) has a positive influence on ERP Routinisation (RO).	NI ($\hat{\beta}$= - 0.009)
H_{5a}(+): Technology Competence (TC) has a positive influence on ERP Evaluation (EV).	NI ($\hat{\beta}$= 0.175)
H_{5b}(+): Technology Competence (TC) has a positive influence on ERP Adoption (AD).	NI ($\hat{\beta}$= 0.011)
H_{5c}(+): Technology Competence (TC) has a positive influence on ERP Routinisation (RO).	V ($\hat{\beta}$= 0.119**)
H_{6a}(+): Competitive pressure (CPR) has a positive influence on ERP Evaluation (EV).	V ($\hat{\beta}$= 0.265***)

H_{6b}(+): Competitive pressure (CPR) has a positive influence on ERP Adoption (AD).	V ($\hat{\beta}$= 0.108**)
H_{6c}(+): Competitive pressure (CPR) has a positive influence on ERP Routinisation (RO).	V ($\hat{\beta}$= 0.102**)
H_{7a}(+): ERP Environment (ERPE) has a positive influence on ERP Evaluation (EV).	NI ($\hat{\beta}$= - 0.024)
H_{7b}(+): ERP Environment (ERPE) has a positive influence on ERP Adoption (AD).	V ($\hat{\beta}$= 0.207**)
H_{7c}(+): ERP Environment (ERPE) has a positive influence on ERP Routinisation (RO).	V ($\hat{\beta}$= 0.143*)
H_8(+): Evaluation (EV) has a positive influence on Adoption (AD).	V ($\hat{\beta}$= 0.333***)
H_9(+): Adoption (AD) has a positive influence on Routinisation (RO).	V ($\hat{\beta}$= 0.469***)
H_{10a}(+): Information Sharing (IS) will moderate the effect of ERP Evaluation (EV) on ERP Adoption (AD), such that the effect will be stronger among farms with higher level of information sharing	NV ($\hat{\beta}$= - 0.170***)
H_{10b}(+): Information Sharing (IS) will moderate the effect of ERP Adoption (AD) on ERP Routinisation (RO), such that the effect will be stronger among farms with higher level of information sharing.	V ($\hat{\beta}$= 0.105**)

Notes: p < 0.10 *, p < 0.05 **, p < 0.01 ***

6.7 Discussions and Conclusions

Our discussion is focused on the following question: How are ERPs a mandatory component of an appropriate management model on farms? We believe that the new paradigm for Brazil to continue to contribute to the increase in world food production goes through adoption of ERPs. Our results indicate that: (a) RA (H1a and H1b) are valid hypotheses in the diffusion phases of ERP on EV and AD, indicating the importance of controlling sales, purchasing and logistics focused on operational efficiency, as well as reducing costs to explain the ERP EV and the ERP AD. (b) Routinisation (RO) is measured by the integration of ERP with back-end systems, to be installed in conjunction with purchasers of farm production, input suppliers, inventory systems, forest code requirements, requirements research and distribution of information in real time. Thus, it is possible to say that with the use (of the routinisation) (RO) ERP can give farmers greater support to make high-risk decisions, considering the macroeconomic environment of agribusiness and volatility in a commodity environment. (c) ERPE (H7b and H7c) as a valid hypothesis to explain AD and RO indicating a better understanding of the farmer of the global competitive environment is important to explain the ERP AD and ERP RO.

Relative Advantage (RA) does not influence Routinisation, on the other hand, Relative Advantage has positive influence on Evaluation (EV) ($\hat{\beta}$= 0.109*), and Adoption (AD) ($\hat{\beta}$=

0.091*). Relative Advantage is a variable defined by the degree where innovation is considered as a better option than the idea it is replacing at that moment (Rogers 1993). It is confirmed by studies in the area that RA is a significant variable and is positively related to innovation adoption (Premkumar and Roberts 1999). Innovations with a better chance to be adopted are the ones able to delivery evident benefits on creating strategic efficiency, increase of number of bonuses earned through sales, cost reduction, procurement, stocking and logistics focused on operational efficiency. The adoption of ERP systems happens when it proves to deliver more benefits than the current technology applied.

Compatibility (CP) has no positive influence on Evaluation and Routinisation but has strong positive influence on Adoption ($\hat{\beta}$= 0.279***). This result can be considered a red flag for the companies responsible for the development of this type of technology. Compatibility (CP) is considered as the degree of perception and alignment of the new technology with the companies' values (Valente and Rogers 1995). Compatibility is also an important determinant for innovation adoption (L G Tornatzky and Klein 1982). CP has a negative influence on ERP evaluation (EV), invalidating our H2a hypothesis. This means that compatibility must take special attention from ERP developers to the evaluation phase. Also, CP is not statistically significant on ERP routinization (RO) and is not a valid hypothesis (H2c). CP has only the hypothesis (H2b) valid about adoption (AD). Therefore, ERP compatibility with the current purchasing process, farm organizational culture, and farmer experience with similar systems is important at the evaluation (EV) stage and adoption (AD) stage.

Complexity (CX) has no influence on Adoption and Routinization and has negative influence on Evaluation ($\hat{\beta}$ = - 0.244***). Complexity can be understood as the degree where innovation is perceived relatively difficult to understand and use (Rogers 1995). If in the implementation phase the new technology is integrated and used on the business operation, it will increase the chances for its acceptance. ERP can collect information on real time and can also be used to support decisions on complex operations. However, the complexity of the system can generate doubts about its implementation and consequently it decreases the chances for its approval. As the hypotheses were not confirmed in the research, we can conclude that there is no complexity for the diffusion of ERP. Once more, results indicate the necessity of change on the farmer's paradigm.

When Top Management Support (TMS) works with right resources, it can provide a proper environment support for the adoption of new technologies (Premkumar and Roberts 1999). This support is important for the innovation adoption as it guides the budget relocation, integration of services and process reengineering (H. W. Chou et al. 2014). Considering the farm's environment where, according to the results of our research, the farmer is not only an entrepreneur but also a controller resistant to changes, TMS plays a decisive role once it is one of the most important elements to define the culture of an organization. For the diffusion of ERP to succeed in the farm, it is necessary to integrate the organizational culture to the information system. Therefore, the success of ERP implementation increases as the TMS promotes and supports it on the organization culture (Ke and Wei 2008). The traditional belief of testing crop growth in farm soil and not in research laboratories combined to the results of this qualitative study on the farms, generate the results of valid hypotheses for Evaluation (β = 0.151**) and not valid for Adoption ($\hat{\beta}$ = - 0.120**). There is no influence for Routinization.

Technology Competence (TC) indicates that innovation capable to produce marginal changes are the ones able to introduce new features, new versions of technology already in use or combine technologies in use in the way to incentivize innovative actions of technology diffusion (Urbach and Müller 2012). The positive influence of TC over AD was not proved. On the other hand, TC has positive influence on EV ($\hat{\beta}$= 0.175**) and on RO ($\hat{\beta}$= 0,119**). We find in the literature papers that cite the importance of interoperability for the adoption of FMIS (Fountas, Carli, et al. 2015; Fountas, Sorensen, et al. 2015) not only in agriculture, but and also in other industry segments (Bibri and Krogstie 2017; Nawaratne et al. 2018). Therefore, we expected to find strong relationships between TC and AD, which did not happen. When we conducted our qualitativies studies we found farmers who have already adopted some ERP or FMIS on their farms due to the interoperability of the system. At this point, they declare that they have greater security to evaluate their technological competence when they experience system interoperability after adoption. That is why we have strong TC relations on evaluation (EV) and not on adoption (AD), indicating that TC and interoperability are important and perceived only with the use of ERP.

Competitive Pressure (CPR) is the competition among peers in the same business (Gatignon and Robertson 1989). Agribusiness is a commodity market in a perfect competition (Irvine 2016). Likewise, agribusiness scenario is not favourable for new technologies adoption because new technologies cannot deliver product innovation but can only delivery process innovation, which is not so essential for a farm's competitive strategy. Considering the global competition, producer countries can pressure the market and the adoption of new technologies can became a relevant strategy for the farms. It can explain the validity for hypotheses Evaluation ($\hat{\beta}$ = 0.265***), Adoption ($\hat{\beta}$ = 0.108**) and Routinization ($\hat{\beta}$ = 0.102**).

Although the results for ERP environment (ERPE) formative variables present significant loading rates, the results for the integration of production data, implementation of ERP based on cloud computer and the decentralization of main decisions present the lowest loadings rates. ERPE has no influence on Evaluation and positive influence on Adoption ($\hat{\beta}$ = 0.207**) and Routinization ($\hat{\beta}$ = 0.143*). This result can indicate that the adoption and routinization of new technologies increases when the farmers has higher level of ERP environment.

Furthermore, H9(+) and H10(+) were validated in the research as Evaluation present positive influence on Adoption ($\hat{\beta}$ = 0.333***) and Adoption has positive influence (β = 0.469***) on Routinization.

The control variable (Farm Size) is not important to explain ERP Evaluation, Adoption and Routinisation. These results can be understood as the size of the farm does not change the farmer's concern about ERP. In Brazil, it is possible harvest up to three crops per year and also integrate farming-livestock-forest (ILFP - *Integração Lavoura-Floresta-Pecuária*) in the same plot. Considering that the country has a large arable area, different climate and soil the diffusion of ERP can increase the continued use of the soil and also delivery more efficiency to the process.

Table 38 Hypotheses analysis: results ERP total, results ERP adopters, results ERP non-adopters

Hypotheses	Results ERP Total (N=375)	Results ERP Adopters (N=167)	Results ERP Non-Adopters (N=208)
H_{1a}(+): Relative Advantage (RA) has a positive influence on ERP Evaluation (EV).	V ($\hat{\beta}$= 0.109*)	NI	NI
H_{1b}(+): Relative Advantage (RA) has a positive influence on ERP Adoption (AD).	V ($\hat{\beta}$= 0.091*)	V ($\hat{\beta}$= 0.234**)	NI
H_{1c}(+): Relative Advantage (RA) has a positive influence on ERP Routinisation (RO).	NI	NI	NI
H_{2a}(+): Compatibility (CP) has a positive influence on ERP Evaluation (EV).	NV ($\hat{\beta}$= -0.174**)	NI	NV ($\hat{\beta}$= -0.217**)
H_{2b}(+): Compatibility (CP) has a positive influence on Adoption (AD)	V ($\hat{\beta}$= 0.279***)	V ($\hat{\beta}$= 0.279**)	V ($\hat{\beta}$= 0.298***)
H_{2c}(+): Compatibility (CP) has a positive influence on ERP Routinisation (RO).	NI	NI	NI
H_{3a}(-): Complexity (CX) has a negative influence on ERP Evaluation (EV).	V ($\hat{\beta}$= -0.244***)	V ($\hat{\beta}$= -0.271**)	V ($\hat{\beta}$= -0.171**)
H_{3b}(-): Complexity (CX) has a negative influence on ERP Adoption (AD).	NI	NI	NV ($\hat{\beta}$= 0.120**)
H_{3c}(-): Complexity (CX) has a negative influence on ERP Routinisation (RO).	NI	NI	NI
H_{4a}(+): Top management support (TMS) has a positive influence on ERP Evaluation (EV).	V ($\hat{\beta}$= 0.151**)	V ($\hat{\beta}$= 0.213**)	V ($\hat{\beta}$= 0.150**)
H_{4b}(+): Top management support (TMS) has a positive influence on ERP Adoption (AD).	NV ($\hat{\beta}$= - 0.120**)	NI	NI
H_{4a}(+): Top management support (TMS) has a positive influence on ERP Routinisation (RO).	NI	NI	NI
H_{5a}(+): Technology Competence (TC) has a positive influence on ERP Evaluation (EV).	V ($\hat{\beta}$= 0.175**)	NI	V ($\hat{\beta}$= 0.213**)
H_{5b}(+): Technology Competence (TC) has a positive influence on ERP Adoption (AD).	NI	NI	NI
H_{5c}(+): Technology Competence (TC) has a positive influence on ERP Routinisation (RO).	V ($\hat{\beta}$= 0.119**)	NI	V ($\hat{\beta}$= 0.186**)
H_{6a}(+): Competitive pressure (CPR) has a positive influence on ERP Evaluation (EV).	V ($\hat{\beta}$= 0.265***)	NI	V ($\hat{\beta}$= 0.425***)
H_{6b}(+): Competitive pressure (CPR) has a positive influence on ERP Adoption (AD).	V ($\hat{\beta}$= 0.108**)	NI	V ($\hat{\beta}$= 0.163**)
H_{6c}(+): Competitive pressure (CPR) has a positive influence on ERP Routinisation (RO).	V ($\hat{\beta}$= 0.102**)	V ($\hat{\beta}$= 0.162**)	NI
H_{7a}(+): ERP Environment (ERPE) has a positive influence on ERP Evaluation (EV).	NI	NI	NI
H_{7b}(+): ERP Environment (ERPE) has a positive influence on ERP Adoption (AD).	V ($\hat{\beta}$= 0.207**)	V ($\hat{\beta}$= 0.257**)	NI
H_{7c}(+): ERP Environment (ERPE) has a positive influence on ERP Routinisation (RO).	V ($\hat{\beta}$= 0.143*)	NI	NI
H_8(+): Evaluation (EV) has a positive influence on Adoption (AD).	V ($\hat{\beta}$= 0.333***)	V ($\hat{\beta}$= 0.354***)	V ($\hat{\beta}$= 0.306***)
H_9(+): Adoption (AD) has a positive influence on Routinisation (RO).	V ($\hat{\beta}$= 0.469***)	V ($\hat{\beta}$= 0.470***)	V ($\hat{\beta}$= 0.434**)
H_{10a}(+): Information Sharing (IS) will moderate the effect of ERP Evaluation (EV) on ERP Adoption (AD), such that the effect will be stronger among farms with higher level of information sharing	NV ($\hat{\beta}$= -0.170***)	NI	NV ($\hat{\beta}$= -0.161***)
H_{10b}(+): Information Sharing (IS) will moderate the effect of ERP Adoption (AD) on ERP Routinisation (RO), such that the effect will be stronger among farms with higher level of information sharing.	V ($\hat{\beta}$= 0.103**)	NI	V ($\hat{\beta}$= 0.142**)

Notes: $p < 0.10$ *, $p < 0.05$ **, $p < 0.01$ ***. V = Validated, NV = Not Validated, NI = Not Influence.

Table 38 shows some significant differences between the total sample, the sample of the adopters and the sample of the non-adopters. We highlight some important results. RA has a stronger positive influence on AD (H_{1b}) among the adopters ($\hat{\beta}$= 0.234**) compared to the total sample ($\hat{\beta}$= 0.091*) and has no influence among non-adopters: this may indicate that RA is only perceived after the adoption of ERP. In the total sample CP has a negative influence on EV (H_{2a}) and among non-adopters ($\hat{\beta}$= 0.271**). CP continues to have a positive influence on AD in the three samples. This may indicate the CP is only perceived after the adoption of the ERP. CX has no influence on AD (H_{3b}) in the total and adopters samples, however it is a non-valid hypothesis for non-adopters ($\hat{\beta}$= 0.120**) for having a positive influence: this may indicate that there is no negative influence of CX for the adoption and routinization phases. The hypothesis H_{5a}, TC on EV has positive influence for non-adopters ($\hat{\beta}$= 0.213**) and TC has no influence on RO (H_{5c}) among ERP adopters. These two hypotheses (H_{5a} and H_{5c}) may indicate that TC has a positive influence on EV and after ERP routinisation, even among non-adopters. Finally, IS has no moderating effect between AD and RO among ERP adopters (H_{10b}): this may indicate that after adoption, IS becomes a working routine. Future research may discuss these points more deeply.

6.8 Research and Practice Implications

Our study offers theoretical and practical contributions to the agribusiness field. To researches in the area, the study provides a validity model of diffusion of ERP based on business analytics functionality for farms where it is possible to identify significant background use for management challenges: relative advantage, compatibility, complexity, technological competence, competitive pressure and the ERP environment. The study also confirms the structural value of TOE and DOI for organizational studies.

Concerning the agribusiness professionals point of view, this paper presents the relative importance of ERP multiple impacts on the farm organizational adoption stages: Evaluation (EV), Adoption (AD) and Routinisation (RO). Also, it presents the moderators impacts of Information Sharing (IS). Likewise, the research provides a list of metrics and impacts that can be useful to professionals to evaluate their own initiatives concerning ERP systems with business analytics functionality and also to scale the stages of the process on the farms where it is applied.

Equally important is that the governmental agencies devote effort to encourage professional improvement to the farmers in order to stimulate sustainable agriculture practices (Mathijs 2003), which in our opinion, includes diffusion of ERP systems with business analytics functionality.

6.9 Study Limitations and Future Researches

Some limitations of this study need to be observed. It is necessary to consider the subjectivity of the impact measures once they are based on the executive perceptions of ERP impact on their farm. Besides that, the study also considers data collected in one country only.

Future studies should consider the technological integration, business partners and provider's pressure and the impact the constructs can have on the company's value formation.

In addition, the impacts of correct understanding of the questions and evaluated concepts driven by the education level of the interviewees could also be considered as another limitation of the study. Finally, we also point out as limitation the unfamiliarity on ERP adoption's cost by the interviewees.

We suggest the development of concepts for Enterprise 2.0 and Cloud Platform in future (Boulos, Maramba, and Wheeler 2006; Jarche 2010; Jia, Guo, and Barnes 2017b; Kaloxylos et al. 2014a; Koch and Richter 2009a; Paroutis and Al Saleh 2009; Rong-ying and Bi-kun 2013; Y. H. Wang and Wu 2009; Williams and Schubert 2011; Zhao et al. 2016; L. Zhou et al. 2016).

In the future, it is also necessary to consider the concepts about Industry 4.0. The Industry 4.0 is part of a process to add value to the knowledge management. GPS Technology for farming and livestock has increased the significance for more computerization in the agricultural sector, described as Intelligence Agricultural and Agriculture of Precision. Based on that and according to the section 3 of this paper, we are now encouraging the debate about Industry 4.0 to promote future debates about Agriculture 4.0.

The challenges of data management, its transformation in knowledge and the use of this knowledge to support strategic decisions delivered important contributions for the area in the past years we can point the Industry 4.0 as an example (Theorin et al. 2015). Industry 4.0

leads a transformation in the present factories in order to overcome some threats as product short life cycle, customized products customized and products in heavy global competition (Weyer et al. 2015). Industry 4.0 is also intimately related with Internet of things (IoT) (Nukala et al. 2016), cyber physical system (CPS) (Dumitrache et al. 2017), information and communications technology (ICT) (Weyer et al. 2015), enterprise architecture (EA) and enterprise integration (EI) (Lu 2017).

It is the forth industrial revolution, made possible by technologies developed based on the internet evolution that create production, products and smart services (Wollschlaeger, Sauter, and Jasperneite 2017). However, it is still possible to find some gaps between the empiric test and the field applications of the Industry 4.0 (Liao et al. 2017).

Consequently, the results of Industry 4.0 are still not completely known and the use of its technological requirements is not entirely clear to the academic field and the same happens on practical applications on the field (Qin, Liu, and Grosvenor 2016).

We intent to discuss new challenges and trends for future researches based on the ideas presented in this work.

Chapter 7 - Performance perception and the Routinisation (RO) moderation on ERP Post-Implementation as determining factor of Competitive Advantage on Farms.

Abstract

This study discusses the perceptions of the routinisation effects on the post-implementation and post-adoption of the enterprise resource planning (ERP) in farms. A theoretical model and nine hypotheses were proposed using factors according to the literature of resource-based view (RBV) approach and on the ERP impact on farm performance perceptions. This study contributes to the literature by testing empirically the moderation effect of routinisation on the RBV. A qualitative interview was applied to larger farmers where ERP was already in use and for the quantitative approach a sample of 448 answers was collected composed of 74% grain farmers, 14% cattle raising and milk producers, and 13% sugar cane and fruits farmers. The results reveal that the model explains 63% of the variation in the impact on farm performance. Our results show that routinisation moderates only the relationship between the impact on internal operations with impact on farm performance. The conclusions confirm the necessity to expand the RBV approach to the farmer perceptions, exploring other factors like the benefits and the impact of natural resources in the routinisation process. Finally, we propose a discussion of the development of Agriculture 4.0 in a resource-based view for the development of competitive advantage in the context of farms.

Keywords: Agriculture

7.1 Introduction

The implementation and adoption of enterprise resource planning (ERP) has attracted researches over the last two decades and companies continue seeking ways to achieve strategic competitive advantages with these technologies (Nwankpa 2015). Few studies have been focusing on the perception of value to the farmers over the implementation of this technology (Alexy et al. 2018). This empirical study contributes to the literature demonstrating how farmers perceive their competitive advantage on a more integrated way on interorganizational environments on ERP post-implementation phase. This is because some studies indicate that ERP systems have been fundamental in supply chain management, with continuous process integration, and real-time data access to maintain business competitiveness (Reitsma 2018). Acar et al. (2017), explain ERP as an integrated system to automate the flow of materials, information, and financial resources into a shared information flow. They are also defined as software solutions that seek to integrate processes and functions into a holistic view of business (Costa et al. 2016; Klaus, Rosemann, and Gable 2000). Almajali, Masa'deh, & Tarhini (2016), define ERP as a backbone of business intelligence (BI). BI is a tool to conduct causal analysis and business diagnostics as it provides a data-driven approach for linking strategic business goals to tactical policies and operational actions (C. H. Wang 2016).

We introduce in our model the routinisation (Ro) as a moderator variable. A study by Wohlgemuth & Wenzel (2016a), explains routinization as an important aspect in regarding a better understanding of the capacities by which companies reconfigure their knowledge base. Wohlgemuth & Wenzel (Wohlgemuth and Wenzel 2016b) indicate different effects of routinization at different organizational levels at both the strategic and operational levels to support the dynamic capabilities of firms. According to Cohendet & Llerena (2003), routinization enhances the collective action ability of organizations by supporting the promotion of regularity and predictability of individual behavior for action, organizational memory creation, the incorporation of successful solutions, and storage of knowledge. Our study uses Routinization (RO) as a moderating variable adapted from Chan and Chong (2013) with our qualitative studies. This allowed for an evaluation of ERP integration with production chain systems, integrated systems, inventory controls, implementation with buyers and suppliers, legal requirements, and research requirements for the development of food production on farms.

To measure the performance of the farm (IFP) we use the Resource-based view theory (RBV). RBV explains firm sustainable competitive advantage as a result of firm resources that are rare, valuable, difficult or impossible to imitate or duplicate, and difficult to replace (Bromiley and Rau 2016). These authors present an alternative to RBV that they called the practice-based view (PBV) for operations management in explaining the full range of company performance based on transferable practices. Our study considers these alternatives seeking to establish the relationship between the company's resources, strategic agility, competitive advantage (Hemmati et al. 2016), including the vision of an efficient operation. Kellermanns, Walter, Crook, Kemmerer, & Narayanan (2016), say that RBV aims to help researchers understand why some companies enjoy a competitive advantage in order to outperform other firms. However, they conclude that researchers have not yet arrived at a consensual definition of exactly what these resources and their dimensions are. Based on this and on Chan & Chong (2013), Picoto, Bélanger, & Palma-dos-Reis (2014), and results from the exploratory study, we defined the RBV resources and their dimensions for this study. We then propose the dimensions that evaluate the perception on the impact on agricultural performance (PFI) in the post-adoption phase of the ERP. The value features defined in the model are impact on costs (IC), impacts on internal operations (IO), impact on sales (IS) and impacts on natural resources and sustainability (INR). In response to firm resources that are rare, valuable, difficult or impossible to imitate or duplicate, and difficult to substitute for RBV and PBV, developed on the basis of empirical research, we propose an approach that involves a more holistic view (Fletcher 2001) of the value perceived by the adoption of ERP in the performance of farms. We can say that our research is original, as we did not find equivalent research with farmers from Brazil.

This empirical research with a holistic view helps to understand if the perceived benefits of implementing ERP result in a high quality of agricultural and livestock production, followed by the development of an organizational culture capable of promoting improvements in the production of proteins, fibers and energy with a vision for the development of competitive advantage of farms. However, there are limitations in this study that should be observed. RBV offers a comprehensive concept to provide the mechanisms that explain why certain organizational characteristics have influences on competitive advantage or performance. However, it is necessary to deepen this discussion for what these mechanisms are. In addition, we need to note that impact measurements are subjective and are based on farmers' perceptions of ERP on their farms. Our intention in this article is to alert researchers to further discuss the implications of RBV use in this sector.

However, our research intends to make three contributions. First is to propose the resources of RBV / PBV and its dimensions to understand the resources of this theory for this segment. That is why we use qualitative and quantitative methodologies. Second, use routinisation (RO) to moderate ERP value relationships in farm performance (IFP) and discuss the possible "failures" of management of rural producers. Third, this allowed us to study which resources have the same and different dimensions to evaluate which are the most strategic and the most operational. Finally, we include in our final discussions considerations on industry 4.0 in order to encourage the development of agriculture 4.0.

7.2 Theory

Some studies already explored RBV in farms. Researching entrepeneur behaviour in new and existing business on european agriculture, Pindado and Sánchez (2017) studied how resource view, risk-taking, proactivity, and innovation affect this proccess. Kurkalova and Carte (2017) evaluate the economic value of the sustainable production utilizing simulation models to identify the benefits of green information systems.

Factors related to innovative, sustainable and oriented to succession in family farming strategies have already been addressed (Suess-Reyes and Fuetsch 2016). The interrelation between the decisions of innovation and exports for food and agricultural companies, as such, can be the source to competitive advantage (Alarcón and Sánchez 2016). There is a difference of performance of large and small farms in the analysis of the role of collaboration in innovation contribution (González-Benito, Muñoz-Gallego, and García-Zamora 2016).

Market orientation, innovation, learning and human capital orientation have been studied to measure the effects of these resources on primary agriculture (Micheels and Gow 2014). In order to study transitions to agro-ecological agricultural systems in the Mississippi River Basin towards integrated socio-ecological analysis. Blesh and Wof (2014), evaluated ecological and farm-enterprise resources, cognitive resources, relations with peers: farmer networks, knowledge organizations and agricultural policy. In Romania, authors defined agricultural green energy and competitive advantage of companies as natural resource-based view (Holban, Boteanu, and Petrescu 2013). Organizational and environmental factors as moderators of the relation between multidimensional innovation and performance were used to study the resources: market orientation, competitive advantage, business performance, product performance, company performance, entrepreneurial orientation and strategic orientation in manufacturing companies (García-Zamora, González-Benito, and Muñoz-Gallego 2013). The previous study contained four sectors of activity: agriculture, construction, industry, and services.

Microeconomic productivity and export market transitions were the drivers studied to identify the evidence of the dynamics of the export market and productivity for the tradable sectors (including agriculture, industry, and construction) of the United Kingdom (Harris and Li 2012). The physical, human and financial and social capitals were the resources studied for farms and sustainable agriculture (Gafsi 2006).

This paper helps to contribute to this literature by exploring the case of Brazilian farmer perception over the improvements after a technology adoption. Improvements on the agricultural systems usually occurred with external enforcement like negative crises or new laws regarding consumers' demands and concerns about food safety for instance or other crises. These positive environment for improvements usually reduces this farmer motivation after the impacts of these disasters (S. J. C. Janssen et al. 2017). The case of Brazilian farmers is important due to the volume of protein, fiber and energy production by these farmers (Haberli, Oliveira, & Yanaze, 2017). Brazil has land, production technology, people, water, sun and climate that can develop a more productive and sustainable agriculture, specially with the support of a management model based on an ERP technology.

7.3 Materials & Methods

The research model of this paper is based on the results of the qualitative study and RBV theory model (J. Barney 1991; J. B. Barney and Arikan 2001) moderated by routinisation (Ro) dimension (Chan and Chong 2013) among the views and values of impact on: costs (purchase of inputs) - IC; internal operations (agriculture production and production) - IIO; sales (procurement, revenue and contracts) - IS; and natural resources and sustainability (INR); with impact on farm performance (Figure 2). We focused on discussing the effects on RBV performance in the post-adoption phase of ERP based on business analytics functionality in the context of farms.

A study by Wade (2004), explored and critically evaluated the use of enterprise RBV by information system (IS) researchers for providing a brief review of resource-based theory and suggesting extensions to make RBV more useful for empirical research on IS. In addition, the RBV provides a way for IS researchers to understand the role of the IS within the company. Once the role of IS resources has been explored and defined, it can be compared on equal terms with the roles played by other company resources to eventually form an integrated understanding of firms' long-term competitiveness (Wade and Hulland 2004).

The RBV was adopted as a theoretical basis to understand the influences of investments in information technology (IT) in business competence. Companies can achieve competitive gain or improve operational effectiveness by combining resources with internal IT capacity. Companies can use their IT assets to achieve efficient performance for the development of competitive advantage (Son et al. 2014).

Thus, our construct is focused on important farm problems with a holistic approach that incorporates global management solutions for farmers (climate, soil, plants, pests and diseases), automation and integration in data collection, validate suitable and dynamic models, comprehensive and easy-to-understand information, assisting the decision maker by providing necessary information, communication of the benefits, combining systems and bidirectional push and pull communication with end-users and other external audiences (Rossi et al. 2014), as an example of communication with the "urban world". Researchers have extended the resource limit for external entities to complement the traditional RBV limitation. In contrast to traditional RBV, ERP-View can explain the achievement of competitive advantage in a more integrated way, where it emphasizes the network aspect of interconnected companies in conceptualizing how companies can reinforce their competitive advantage in interorganizational environments (Son et al. 2014).

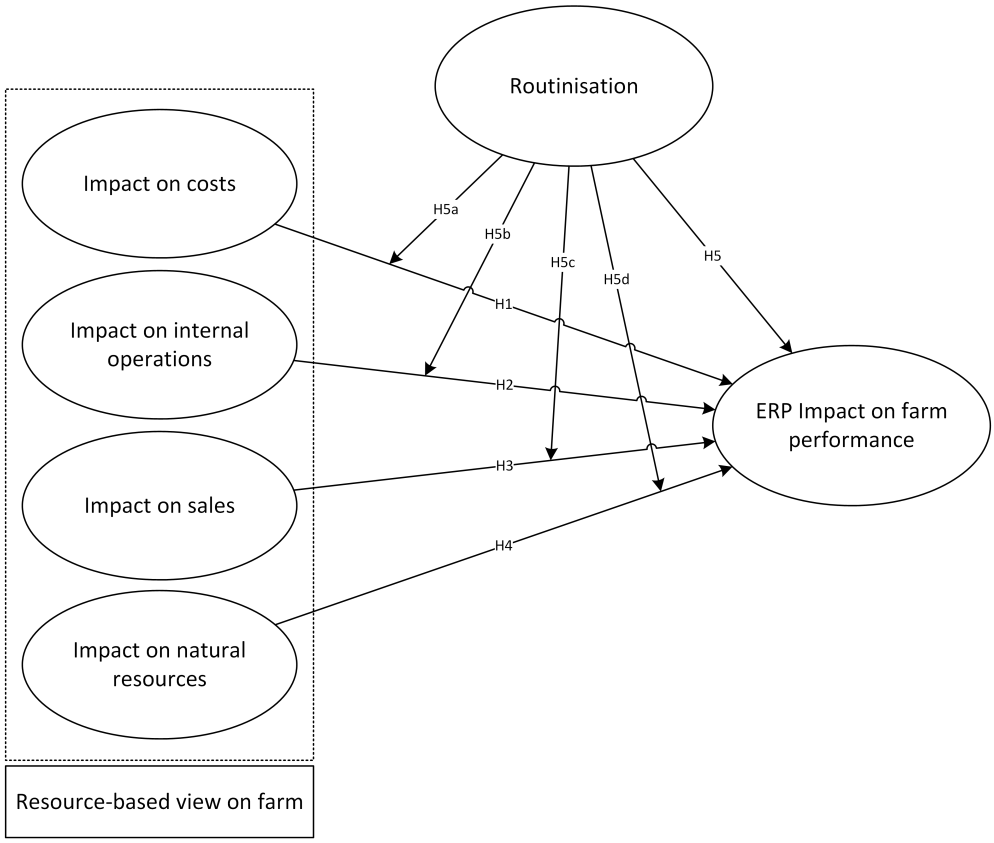
We also observed that ERP systems on post-implementation phases were associated to reduced risks. The risk reduction effect was stronger for ERP systems with greater reach of more significant functional and operational modules (Tian and Xin Xu 2015). This study also shows that the risk reduction effect of ERP systems has become greater when the operational environments of companies present greater uncertainty, which happens in the agro-food environment. We have included in our research model the perception about the vision and value for farms of ERP systems based on business analytics functionality, evidencing the strategic, functional and operational benefits of post-adoption ERP systems, which can be observed in the instrument of data collection in Table 39. In this context, our hypotheses have been formulated. As our model has many observed constructs and variables, with formative and reflexive measurements, we opted for modeling of structural equations based on variance or partial least square (PLS) estimation models (Hair Jr et al. 2014). Figure 26 shows the structure of our model.

Table 39 Instrument of data collection

Please evaluate the impact that ERP can have on the statements bellow where 1 means very low impact and 7 very high impact				
Impact on cost (IC) /F	IC1	Increase employee productivity	(1~7)	(Chan and Chong 2013) and Results from the Exploratory Study
	IC2	Facilitate communication among employees		
	IC3	Increase the compression of business processes		
	IC4	Improve organizational flexibility		
	IC5	Ensure that the corporate systems and information are accessible from any location		
	IC6	Reduce the number of employees		
	IC7	To improve the decision-making process during higher business risks times		
	IC8	Reduce the farm administration workload		
	IC9	Improve the efficiency of staff		
	IC10	Improve employee learning		
	IC11	Have better quality information		
	IC12	Improve coordination with suppliers		
	IC13	Reduce supply purchase costs		
Impact on internal operations (IIO) /F	IIO1	Make internal operations more efficiently (examples: speed up processing in the planting timeframe, reduce bottlenecks in harvesting timeframes, reduce errors using pesticides and fertilizers, notification of isolated health problems, emergency situations of pest control, disease and herbs , climate,...)	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014) and Results from the Exploratory Study
	IIO2	Increase control of the whole operation		
	IIO3	Increase motivation of all employees		
	IIO4	Increase the analysis capacity of business risks		
	IIO5	Increase control of internal farm logistics		
Impact on sales (IS) /F	IS1	Increase the farm profitability	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014) and Results from the Exploratory Study
	IS2	Reduce inventory costs		
	IS3	Facilitate sales management with buyers		
	IS4	Increase the ability to have a clearer business future view		
	IS5	Increase the value of: my farm, my partners and my contracts.		
Impact on natural resources (INR) /F	INR1	Natural resource guarantee for the future	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014) and Results from the Exploratory Study
	INR2	Has the land as an investment		
	INR3	Long-term care for future generations		
	INR4	Environmental preservation.		
Please rate the level which you agree for the following statements: 1 means strongly disagree and 7 totally agree				
Impact on farm performance (IFP) /R	IFP1	In terms of impact in your farm business the ERP system can be a success	(1~7)	(Picoto, Bélanger, and Palma-dos-Reis 2014) and Results from the Exploratory Study
	IFP2	The ERP will improve the overall performance of my farm		
	IFP3	ERP should have a significant positive effect on my farm		
Please rate the following statements, where 1 mean strongly disagree and 7 totally agree.				
Routinisation (Ro) /R	Ro1	We have integrated with back-end ERP chain systems / legacy / chain of existing supplies.	(1~7)	(Chan and Chong 2013) and Results from the Exploratory Study
	Ro2	Real time distribution of information is collected through the integration of delivery systems with ERP		
	Ro3	Real time inventory information is collected by integrating inventory systems with ERP applications		
	R04	ERP is being implemented together with the buyers of our production		
	Ro5	ERP is being implemented together with our raw material suppliers		
	Ro6	ERP is being implemented to meet the requirements of the Forest Code (environmental sustainability)		
	Ro7	ERP is being implemented to meet the requirements of research and agribusiness development. (integrated with the systems of public and private research institutes.		

Notes: F – formative construct; R – reflective construct.

Figure 26 Structural Model Based on RBV



7.3.1 Impact on costs (IC): buying process and impact on the purchase of inputs

Cost is a resource that can be controlled by the farmer. The dilemma of the experts interviewed is to comprehend, together with the farmers, if there are decision criteria of purchase of inputs and what they are. Not only understand the criteria, but also knowing how they can be ranked in order of priority to generate value and vision based on this resource. Thus, we observed that in this cost issue, information and communication technologies (ICTs) offer great potential to improve efficiency, effectiveness and productivity, yet they remain underutilized in agriculture (O'Grady and O'Hare 2016).

Considering the qualitative studies and adapting the construct of Picoto, Bélanger, & Palma-dos-Reis (2014) and Ruivo, Oliveira, Johansson, & Neto (2013), we constructed our Impact on costs (IC) dimension with the analysis of the variables based on increased employee productivity, facilitating communication, understanding business processes, organizational flexibility, access to information from anywhere, reduction in the number of employees, more assertive decision-making in times of greater risk, reduced administrative workload, employee efficacy and learning, access to better quality information, suppliers coordination and in the costs of acquiring inputs. Therefore, our hypothesis is:

H1(+): The impact on costs (IC) occasioned by the implementation of ERP has a positive impact on farm performance (IFP).

7.3.2 Impact on internal operations (IIO): production process and Impact on agriculture, production and productivity

The qualitative discussions for the impact on internal operations (IIO) is that there is a belief that the Brazilian farms need to reorient themselves in the management issues of their activities and that ERP systems can contribute to the development of production and productivity. ERP are complex software packages that integrate business information and processes within and among business functional areas (Davenport 2000). On the other hand, there is a growing strategic emphasis on food security on the planet, which has the permanent support of the United Nations (www.ONU.org) to ensure access to food as a demand that can contribute to world peace (http://agenciabrasil.ebc.com.br; http://www.fao.org). The study shows that important advances in agricultural systems occurred when there were concerns about food security or other crises such as major disasters. These advances reduce after the immediate impacts of these disasters (J. W. Jones et al. 2017). Our qualitative research has concluded that the connection between the 8 billion people in the world will not only be realized through the Internet. It will be carried out, essentially, by the food chains, organized, restructured and realigned in ERP based on business analytics functionality in farms. Brazil has land, production technology, people, water, sun, climate and can develop a more sustainable agriculture when developing management model in ERP.

The dimension impact on internal operation (IIO) was considered the most important when analyzing our qualitative studies and other academic studies (Picoto, Bélanger, and Palma-dos-Reis 2014; Ruivo, Oliveira, and Neto 2012c, 2014). Our construct was developed through analysis of variables on internal operations as the most effective: planting season procedures, bottlenecks in the harvest seasons, control of the use of pesticides and fertilizers, notification of isolated sanitary problems, pest control in emergency situations, diseases, weeds and climate; in addition to those, the motivation of the employees, capacity of analysis of risks of the business and the internal logistics of the farm are also important. Therefore, our hypotheses are:

H2$^{(+)}$: The improvement impact on internal operations (IIO) occasioned by the implementation of ERP has a positive impact on farm performance (IFP).

7.3.3 Impact on sales (IS): process and impact on procurement, revenue and contracts

Qualitative discussions in this area revolved around some farmers' "boxing" on issues involving impact on the purchase of inputs (IC) and Impact on procurement, revenue and contracts (IS). Purchases are based on the US Dollar (US$). Sales are made by agricultural commodity prices on the world market. The vision based on this process of sales process is always that of the farmer "cheering" to fall of production of other players (countries) caused by climate, plagues and diseases and to the increase of world consumption of the commodities. Perhaps, studying the farmer's bargaining power in this construct would not be the ideal to find value perception and vision.

Our qualitative studies and observations in other academic studies on ERP adoption revealed that the dimension of Impact on sales, procurement, revenue and contracts (IS) (Picoto, Bélanger, and Palma-dos-Reis 2014) can be measured through the variables of the profitability of the farm, inventory costs, sales management, the ability to have a clearer view of the business in the future and the value of the farm, value of business partners and contracts. Therefore, our hypotheses are:

H3(+): The increase in the efficiency impact on sales (IS) caused by the implementation of ERP has a positive impact on the performance of the farm (IFP).

7.3.4 Impact on natural resources (INR) and sustainability: land management and natural resources

There is a growing concern among the respondents about land use, maintenance and preservation of natural resources. The worsening of this subject is ruled by the fact that the world population will reach 9.2 billion people by 2050 (www.onu.org), so we will need to produce food, protein, fiber and energy for another 2 billion people by then. By 2050, with an estimated population of over 9.2 billion, the Earth will have 6 billion inhabitants, almost 90% of the current population, living in urban space. Not taking care of these natural resources and not recognizing the vision and the dynamic capacities of the farms for their management and creation of value can cause an imbalance in the supply of food for the planet. In this context of integration and recognized dynamic capabilities allied to a good strategy are considered necessary to sustain superior business performance, especially in rapidly changing global environments (Teece 2016).

It is important to emphasize that in the view of the interviewees in the qualitative study, farmers have a perception that they are protectors of natural resources and that already carry out sustainable activities of preservation.

Natural resources and sustainability are gaining global importance in many sectors. A study shows that the final objective of promoting circular economy (CE) is the association of environmental pressure with economic growth (Ghisellini, Cialani, and Ulgiati 2016). Another study in the field of agricultural production shows that conservation agriculture (CA) understands that minimal soil disturbance, crop residue retention and crop diversification is widely promoted to reduce soil degradation and improve agricultural sustainability (Powlson et al. 2016). Soil degradation is a growing threat to the sustainability of agriculture around the world (D. Zhang et al. 2016). On the other hand, the production of food, fiber and energy depends directly on natural resources and sustainability, as our qualitative studies show. In this way, we evaluate the dimension of Impact on natural resources (INR) and sustainability with the variables: guaranteeing natural resources for the future, having land as an investment, taking care of land for future generations and preserving the environment as one all. Therefore, our hypotheses are:

H4$^{(+)}$: The value impact on natural resources (INR) caused by the implementation of ERP has a positive impact on farm performance (IFP).

7.3.5 Routinisation (Ro)

We used routinisation (Ro) (Chan and Chong 2013) as a moderating dimension between resources drivers. We relate the perceptions about moderating values, such as: integration of an ERP into analytical insight platforms with sales systems and supply chains, real-time harvest visualization, implementation with buyers, integration with suppliers, with the requirements of the forest code, with the requirements of research and development of agribusiness integrated with the systems of public and private research institutes. These are based on the conclusions of our qualitative studies. However, we also consider other researchers who have worked with the adoption-diffusion process with three phases: initiation, adoption and routinisation (Jei and Sia 2011; Kevin Zhu, Kraemer, and Xu 2006a). Other authors argue that routinisation is an aspect of technology incorporation while the second component of incorporation is infusion (Zmud and Apple 1992). Kim (2003) noted that the technology lifecycle models argue that routinisation is one of the post-adoption stages. In these aspects, we are influenced by Hossain et. all of which explain integration as the stage at which organizations integrate their internal and external processes after their adoption and that infusion is the extent to which the full potential of innovation is exploited and incorporated into operational or managerial operations. Routinisation means the "large-scale deployment" that occurs when innovation is practiced in operational functions and is not treated as noble technology (Hossain, Quaddus, and Islam 2016). Therefore, the following hypothesis was formulated:

H5(+): Routinisation (Ro) has a positive impact on Farm Performance (IFP).

H5a(+): Routinisation (Ro) moderates the relationship between the impact on cost (IC) and impact on farm performance (IFP) in such a way that the greater the routinisation (Ro), the greater its impact in this relation.

H5b(+): Routinisation (Ro) moderates the relation between the impact on internal operation (IIO) and the impact on farm performance (IFP) in such a way that the greater the routinisation (Ro), the greater its impact in this relation.

H5c(+): Routinisation (Ro) moderates the relationship between impact on sales (IS) and the impact on farm performance (IFP) in such a way that the greater the routinisation (Ro) the greater its impact in this relation.

H5d(+): Routinisation (Ro) moderates the relation between the impact on natural resources (INR) and sustainability and the impact on farm performance (IFP) in such a way that the greater the routinisation (Ro) the greater its impact in this relation.

7.4 Methodology

The methodology adopted in our study incorporates two approaches: a qualitative with the method of in-depth interviews (Boyce and Neale 2006b; Myers 1997) and a quantitative with a holistic method.

In the qualitative approach, the interviews were carried out with 10 professionals and agribusiness experts with the following profile: consultants in the areas of macroeconomics, marketing consultants, leaders of associations, decision makers of research and teaching organizations, former minister of agriculture and journalist of the sector. We explored with these interviewees how the ERP can collaborate to develop competitive advantage in farms. ERP are complex information systems capable of creating operational efficiency through the integration of business and data processes (Trinh-Phuong, Molla, and Peszynski 2012). Farms must find ways to acquire, assimilate and exploit their resources to meet the changing and competitive business environment. Next, we asked each professional or expert to explain their thoughts, experiences, expectations and changes perceived in agribusiness in the world and in Brazil. Finally, we asked two other questions: (a) what the challenges for the production of food, protein, fiber and energy are for the next five years in the world and also in Brazil, and (b) what must we do to succeed.

The quantitative approach was first applied as a pre-test in two phases: (a) a small number of questionnaires were applied to farmers with larger farms where ERP was already in use. In this moment the terminology, instruction's clarity and response format was evaluated. The questions, with some exceptions, were measured using a numerical scale varying from 1 for totally disagree to 7 for totally agree. (b) The questionnaire was modified and tested once more with 35 farmers using 20 personal interviews and 15 Internet interviews. The results of the pre-test demonstrated that the measurement scale was reliable and valid.

The pre-test also demonstrated some problems on the Internet interview methodology and we decided to apply the questionnaire in person only. With that, between June 2016 and November 2017, a sample of 448 complete answers was collected. It is composed of 74% grain farmers, 14% cattle raising and milk producers, and the rest of the 13% were sugar cane and fruits farmers. Our sample has a concentration of 54% of farms from Midwest region, which is justified by the major concentration of farms in this region. During the interview, we identified 23% which already uses ERP and 20% are conducting a pilot test (Table 40). Although the research was not formally passed by an Ethics Committee, all precautions were taken regarding the safety of the research participant, according to Resolution number 510 of the CONEP - Brazilian National Council of Ethics in Research. The participant was given the option of clarification and assured his right to withdraw at any time during the interview.

The quantitative research analysis is focused on confirming the measurement method and test of hypotheses. Structural equation modeling (SEM) with partial least squares (PLS) was used to perform a simultaneous evaluation of measurement quality (model) and constructs relationship (structural model). SmartPLS (v3.2.6) is used (Ringle et al., 2015) in this study to evaluate the measurement properties and the test hypotheses (Henseler, Ringle, and Sarstedt

2014)

Table 40 Research Sample composition

Agriculture Type	
Grain (*)	74%
Cattle Raising	14%
Sugar Cane	10%
Fruits	3%
Regions	
Midwest (MT, MS, GO)	54%
MAPITOBA (MA, PI, TO, West BA, PA)	21%
South East (SP, MG)	15%
South (RS, PR)	10%
Phases of ERP Adoption	
Never considered adoption	14%
Pilot Test	20%
Have researched about but do not consider adoption	9%
Have researched and consider adoption	34%
Already in use	23%
Number of interviews: 448	

Note: (*) soybean, corn, cotton, wheat, coffee, beans, peanuts.

7.5 Results and Discussion

Although there are technologies for the farm production with data integration, its adoption by individual farmers and agricultural enterprises depends on a number of additional factors. Among them, we highlight the issues of usability and the identification of best practices as our qualitative exploratory studies indicated. Agricultural approaches centered on the farmer are needed to the concept of ERP based on business analytics functionality to be adopted and used, making it sustainable in the future (Figure 27).

Figure 27 Model for Understanding agribusiness challenges

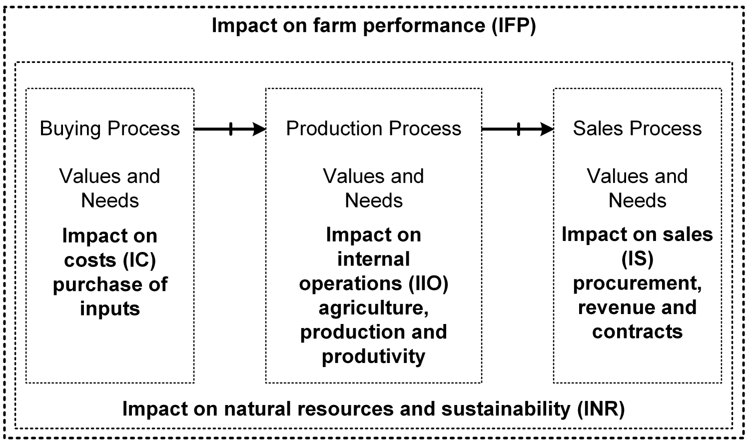


Figure 27 shows the model generated with the qualitative phase results of our study. The impact on farm performance (IFP) can be explained by the values and needs of purchasing processes, production processes, sales processes and processes of attention with natural resources and sustainability. Several conclusions of the qualitative study served to make the adaptations in the constructs of the firm and valuable resources to measure the RBV that are in Table 39.

At this point, our study contributes to defining RBV / PBV resources (Bromiley and Rau 2016) to measure the value of farms' performance in the post-adoption phase of ERP, by providing useful information for a discussion of public policies for the sector. Experts have answered that farm frontiers should be extended to the boundaries of the micro region to which they are situated: the resource-based view must also be extended considering these new boundaries. This can work with the development of ERP systems based on business analytics functionality. Sharing and collaboration among producers will be important for this platform to work. Wolfert et al., (2017) following a structured approach, has developed a conceptual framework that shows that the reach of big data applications in smart farming goes beyond primary production is influencing the entire food supply chain. This paper tried not to lose this point of view.

The consensus that there should be a deeper discussion about cloud computing and the Internet of things based on business analytics functionality. It is necessary that the farms have more access to information and analysis of the activities of technologies of production, purchase, commercialization, and climate for the management by micro region as integrated regional spaces. The rapid developments in the Internet of Things (IoT) and cloud computing are driving the phenomenon of what is called smart farming (Sundmaeker et al. 2016; S. Wolfert et al. 2017). This allows us to discuss analytical insights platforms. This smart farming push with ERP based on business analytics functionality may cause changes in the roles and power relationships among different players in the current networks of the food supply chain. However, Capalbo, Antle, & Seavert (2017), concludes that research on models of the next generation of agricultural systems show that the organization of data and information are the most important current limitation both for decision support on the farm and for investment in research and political decision-making. One of the major challenges in this area is the reliability of data for farm management decision-making, both for current conditions and for scenarios of changes in biological and socioeconomic conditions (Capalbo, Antle, and Seavert 2017). This paper sought to keep this idea on the radar.

The integration of the agricultural world with the urban world is increasingly in the forefront of discussions in this sector. However, little progress has been made. It seems that by developing routines to create a platform among farm data for discussions of regional production strategies, the urban world may have access to field information. The conclusions of this qualitative research say that it is necessary to have other integrations: (a) with consumers to understand changes in consumer behavior, (b) marketing department of food companies, (c) with specialized media (d) with the distribution channels of food, protein, fiber and energy, and (e) with governments (municipal, state, and federal) involving the world's leading agribusiness leaders. Even because many of the major advances in information and communication technologies (ICT) of the last decade have not been fully utilized in information systems for agricultural farms (Antle, Jones, and Rosenzweig 2017b).

For the assessment of the measurement model, different analyses were performed according to the nature of the construct (i.e., reflective or formative). The reflective measurement model assessment was performed for internal consistency, indicator reliability, convergent validity and discriminant validity (Hair Jr et al. 2014). The internal consistency was evaluated by Cronbach’s alpha and composite reliability. All latent variables show good performance in terms of internal consistency with Cronbach’s alphas between 0.89 and 0.93 (Table 3) and composite reliabilities between 0.93 and 0.94 (Table 3). To evaluate convergent validity, we used average variance extracted (AVE) that should be higher than 0.50 (Table 3). As can be seen in Table 41, all constructs present AVE values above 0.5 (between 0.70 and 0.83), indicating that the constructs represent one dimension and the same underlying construct, and also that the constructs is able to explain more than a half of the variance of its indicators.

Table 41 **Reflective Measurement Model**

Constructs	Composite Reliability (*)	AVE	Cronbach's Alpha
ERP Impact on Farm Performance (IFP)	0.934	0.825	0.894
Routinisation (Ro)	0.943	0.703	0.932

Notes: (*) Values between 0.70 and 0.90 can be regarded as satisfactory. Values above 0.95 are not desirable.

Overall, the instrument presents good indicator reliability. Indicator reliability was evaluated on Table 42 and presents a good result, since the general rule says that the external loads (standardized) should be of 0.708 or more for the formative measurements.

Table 42 Loadings and cross-loadings

Constructs	IC	IIO	IS	INR	IFP	Ro
Impact on Farm Performance (IFP)/R						
IFP1	0.66	0.66	0.71	0.51	**0.93**	0.10
IFP2	0.65	0.68	0.69	0.48	**0.92**	0.12
IFP3	0.60	0.61	0.62	0.45	**0.88**	0.16
Routinisation (Ro)/R						
Ro1	0.13	0.20	0.13	0.04	0.15	**0.87**
Ro2	0.08	0.16	0.10	0.06	0.13	**0.84**
Ro3	0.09	0.18	0.11	0.02	0.13	**0.86**
Ro4	0.08	0.16	0.10	0.03	0.11	**0.84**
Ro5	0.10	0.16	0.11	0.04	0.11	**0.84**
Ro6	0.08	0.16	0.12	0.05	0.08	**0.80**
Ro7	0.05	0.14	0.09	0.04	0.06	**0.81**

With the results analyzed in Tables 41, 42 and 43 we believe that we collaborated with the research with the definitions and adaptations that we proposed in the constructs routinisation (Ro) as a moderating variable and the impact on farm performance (IFP) as an independent variable (Appendix A). New studies should discuss these results and constructs to deepen these results.

The discriminant validity was tested with two criteria: the Fornell-Larcker (1981) (AVEs should be greater than the squared correlations and each indicator should have a higher correlation to the assigned construct than to any other construct) and the cross loadings analysis. As can be seen in Table 41 and Table 42 both criteria are satisfied for all constructs and indicators, which indicates that the instrument has good discriminant validity.

Table 43 Discriminant Validity Model (Fornell –Larcker Criterion) and latent variables correlations

Constructs	IC	IIO	IS	INR	IFP	Ro
Impact on costs (IC)/F	F (*)					
Impact on internal operations (IIO)/F	0.757	F (*)				
Impact on sales, (IS)/F	0.752	0.815	F (*)			
Impact on natural resources (INR)/F	0.531	0.483	0.615	F (*)		
Impact on Farm Performance (IFP)/R	0.704	0.720	0.741	0.532	**0.908**	
Routinisation (Ro)/R	0.111	0.201	0.131	0.044	0.138	**0.839**

Notes: (*) F = formative construct; R = reflective construct. The Fornell-Larcker criterion is an option to evaluate discriminant validity. It compares the square root of the AVE values with latent variable correlations. Specifically, the square root of the AVE of each construct must be greater than its greater correlation with any other construct.

For the formative measurement model evaluation, the multicollinearity and the significance and sign of weights were assessed. Regarding multicollinearity, the VIF for each indicator was computed and is presented in Table 6. For all items, the VIF is below the cut-off value of 3.3 (Sarstedt et al. 2014). Table 44 also presents the weights and their significance. Some of the indicators are not statistically significant (IC2, IC3, IC4, IC6, IC10, IC11, IC12, IIO2, IS3, INR3, INR4) when viewed by the outer weights, however, with loadings greater than 0.5. This reveals that the formative construct has significance and relevance of weights.

Table 44 Formative Measurement Model

Constructs		Loadings (Convergent validity)	VIF (*)	Outer Weights	t-value Loadings	t-value Other Weights	Confidence Intervals (**)
Impact on costs (IC)	IC1	0.778***	2.464	0.224**	18.065	2.678	(0.676, 0.845)
	IC2	0.690***	2.354	0.048 ns	10.702	0.557	(0.542, 0.791)
	IC3	0.668***	2.247	-0.066 ns	11.958	0.741	(0.545, 0.764)
	IC4	0.737***	2.482	0.123 ns	14.279	1.488	(0.614, 0.817)
	IC5	0.696***	2.041	0.204**	12.973	2.929	(0.571, 0.778)
	IC6	0.495***	1.487	0.048 ns	8.963	0.786	(0.374, 0.590)
	IC7	0.846***	2.160	0.374***	21.600	4.813	(0.743, 0.896)
	IC8	0.529***	1.924	-0.141*	8.840	1.749	(0.396, 0.630)
	IC9	0.805***	2.572	0.287***	23.052	3.395	(0.720, 0.856)
	IC10	0.583***	1.889	-0.015 ns	10.769	0.230	(0.463, 0.677)
	IC11	0.684***	2.134	0.057 ns	12.179	0.748	(0.553, 0.772)
	IC12	0.612***	2.521	-0.039 ns	11.016	0.471	(0.485, 0.704)
	IC13	0.599***	2.367	0.169**	11.417	2.043	(0.481, 0.687)
Impact on internal operations (IIO)	IIO1	0.795***	1.754	0.355***	20.442	4.243	(0.709, 0.861)
	IIO2	0.777***	2.266	0.117 ns	13.075	1.172	(0.636, 0.871)
	IIO3	0.591***	1.454	0.099*	11.150	1.711	(0.479, 0.688)
	IIO4	0.835***	1.892	0.377***	18.769	4.311	(0.734, 0.907)
	IIO5	0.819***	1.979	0.311***	18.490	4.041	(0.716, 0.890)
Impact on sales, (IS)	IS1	0.867***	2.152	0.373***	31.575	5.570	(0.803, 0.911)
	IS2	0.708***	1.757	0.155**	15.820	2.409	(0.614, 0.789)
	IS3	0.766***	2.180	0.095 ns	19.832	1.241	(0.681, 0.836)
	IS4	0.881***	1.995	0.439***	33.000	7.063	(0.818, 0.923)
	IS5	0.690***	1.651	0.156**	14.115	2.661	(0.583, 0.775)
Impact on natural resources (INR)	INR1	0.874***	2.479	0.365**	19.756	2.384	(0.766, 0.941)
	INR2	0.872***	2.080	0.472***	22.257	3.987	(0.772, 0.925)
	INR3	0.792***	2.421	0.072 ns	14.066	0.504	(0.655, 0.877)
	INR4	0.813***	2.219	0.261 ns	12.426	1.630	(0.663, 0.915)

Notes: (*) Collinearity of indicators: Each indicator's tolerance (VIF) value should be higher than 0.20 (lower than 5). NS = not significant. *p<0.10. ** p<0.05. *** p<0.01.

After assessing that the measurement model holds good psychometric proprieties, we assessed the structural model. Now, we will address the assessment of the structural model results. This involves examining the model's predictive capabilities and the relationships between the constructs. We tested if the model presented collinearity issues, (Table 45) which demonstrates that doesn´t exist any collinearity issues in the structural model.

Table 45 Collinearity Assessment

Constructs	VIF ERP Impact on Farm Performance (IFP)/R
Impact on costs (IC)/F	2.958
Impact on internal operations) (IIO)/F	3.851
Impact on sales (IS)/F	4.312
Impact on natural resources (INR)/F	1.670
Routinisation (Ro)/R	1.092
Ro*IC	2.773
Ro*IIO	3.496
Ro*IS	4.429
Ro*INR	1.734

Notes: The VIF value should be lower than 5.

In observing the results of the measurement model and the structural model of Tables 44 and 45, we concluded that we developed formative constructs: IC, IIO, IS and INR, interesting to be evaluated by new studies in this sector. This contributes to encourage discussions about resources that are firm and to establish the relationship between these resources as strategic agility, competitive advantage and which could be studied in the light of dynamic capabilities theory (Hemmati et al. 2016).

The Figure 28 presents the structural model results. In this figure we can observe other indicators of quality of fit of the model: Predictive Relevance (Q2) and Coefficient of Determination (R2). Values above 0.35 of Q2 indicate that an exogenous construct has a large predictive relevance for a given endogenous construct. Our model has Q2 = 0.484 indicating good result. R2 represents the combined effects of exogenous latent variables on the endogenous latent variable. It is difficult to provide basic rules for acceptable R2 values, as this depends on the complexity of the research model and discipline (Hair Jr et al. 2014). This study shows a R2 = 63% considered as very good result.

Figure 28 Research Model

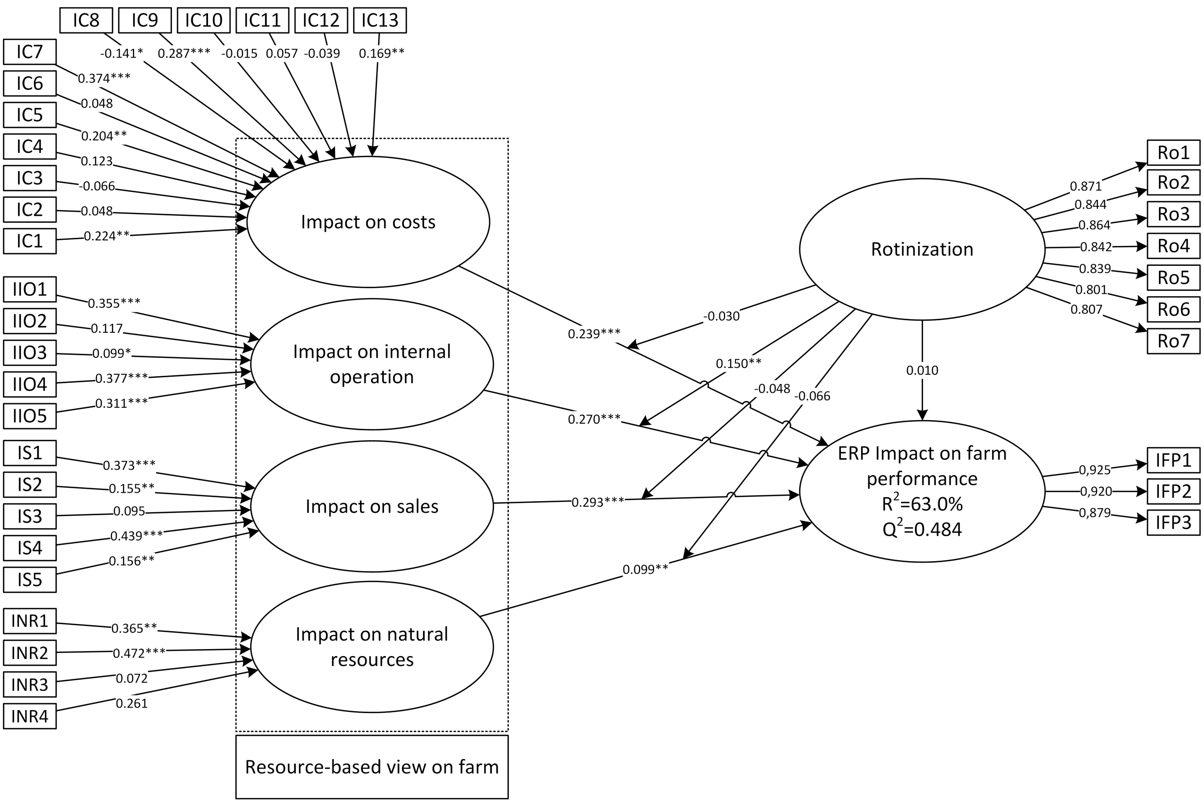


Table 46 shows the validation framework of the hypotheses designed for the study.

Table 46 Hypotheses Analysis

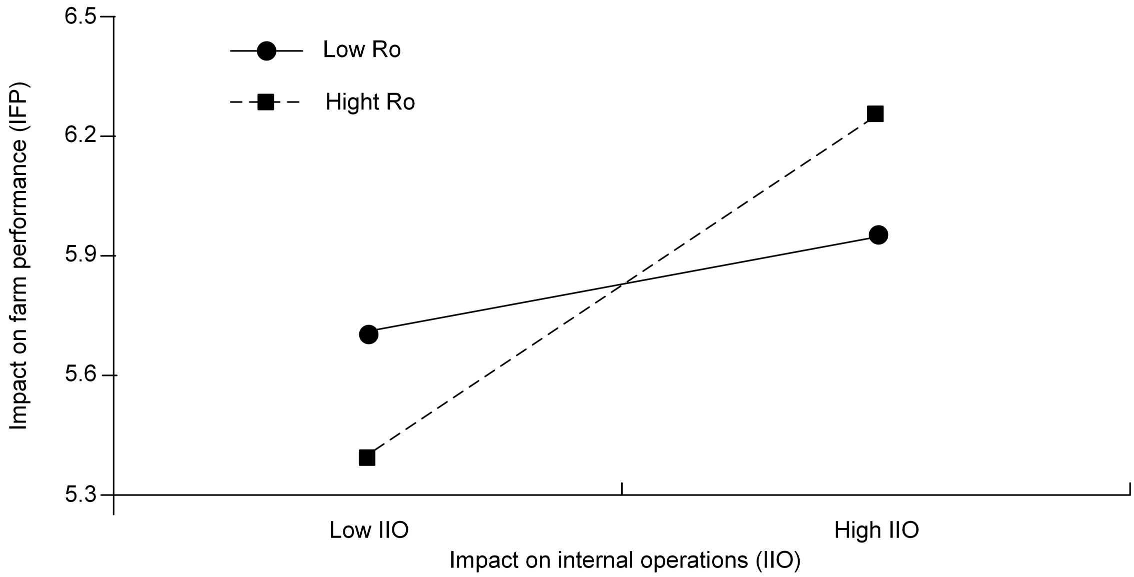
Hypotheses	**Results**
H1$^{(+)}$: The impact on costs (IC) occasioned by the implementation of ERP has a positive impact on farm performance (IFP).	Validated ($\hat{\beta}$ = 0.239***)
H2$^{(+)}$: The improvement impact on internal operations (IIO) occasioned by the implementation of ERP has a positive impact on farm performance (IFP).	Validated ($\hat{\beta}$ = 0.270***)
H3$^{(+)}$: The increase in the efficiency impact on sales (IS) caused by the implementation of ERP has a positive impact on farm performance (IFP).	Validated ($\hat{\beta}$ = 0.293***)
H4$^{(+)}$: The value impact on natural resources (INR) caused by the implementation of ERP has a positive impact on farm performance (IFP).	Validated ($\hat{\beta}$ = 0.099**)
H5$^{(+)}$: Routinisation (Ro) has a positive impact on farm performance (IFP).	Not Validated ($\hat{\beta}$ = 0.010)
H5a$^{(+)}$: Routinisation (Ro) moderates the relationship between the impact on cost (IC) and impact on farm performance (IFP) in such a way that the greater the routinisation (Ro), the greater its impact in this relation.	Not Validated ($\hat{\beta}$ = - 0.030)
H5b$^{(+)}$: Routinisation (Ro) moderates the relation between the impact on internal operation (IIO) and the impact on farm performance (IFP) in such a way that the greater the routinisation (Ro), the greater its impact in this relation.	Validated ($\hat{\beta}$ = 0.150**)
H5c$^{(+)}$: Routinisation (Ro) moderates the relationship between impact on sales (IS) and the impact on farm performance (IFP) in such a way that the greater the routinisation (Ro) the greater its impact in this relation.	Not Validated ($\hat{\beta}$ = - 0.048)
H5d$^{(+)}$: Routinisation (Ro) moderates the relation between the impact on natural resources (INR) and sustainability and the impact on farm performance (IFP) in such a way that the greater the routinisation (Ro) the greater its impact in this relation.	Not Validated ($\hat{\beta}$ = - 0.066)

Source: Research data. p < 0,10 *, p < 0,05 **, p < 0,01 ***

Our model did not validate the hypothesis that routinisation had a positive impact on the impact of farm performance. We expected that routinisation could moderate the relations between impact on costs, impact on sales, and impact on natural resources with impact on farm performance. This did not happen. However, the routinisation only moderates with the relation between the impacts on internal operations (IIO) with the impact on farm performance

(IFP). The higher the routinisation (Ro), the higher will be the impact among the internal operations on the impact on farm performance, as Figure 29 shows. This may show a bias on the part of the farmer about the other resources that can be firm and valuable in determining competitive advantages. We will discuss this result below.

Figure 29 Moderator variable analysis



Li, Liao, and Lei (2006) use a Know and Zmud (1987) model for the ERP implementation process that contains 6 steps: initiation, adoption, adaptation, acceptance, routinisation and infusion (initiation, adoption, adaptation, acceptance, routinisation and infusion). Its conclusion is that it is necessary to analyze the main activities of knowledge management (KM) of each stage. For routinisation the KM activities are: knowledge accumulation, knowledge sharing, knowledge creation and the application of new KM tools. Alomari, Amir, Azman, Sofiah, and Auzair (2018) consider the ERP system measurements based on the combination of four attributes of the business process that are integration, standardization, routinisation and centralization of the business process. We believed that the hypotheses H5, H5a, H5c and H5d would be validated, but only the hypothesis H5b was validated, showing that routinisation moderates the relations among the internal operations and the performance in the farm. The resources of internal operations, mainly because they are production and productivity, already have the strong control of the farmer, given the indicators of this sector. There is a concern about the non-validation of other hypotheses, which shows a competitive advantage perception bias for costs, sales and natural resources as resource-based view, or it shows an opportunity for consulting firms to develop projects on the issues of learning and training for these strategic skills and knowledge. This is a consequence and a warning of our study that must be explored by the companies that serve the farmers and the public policy leaders: the resources obtained by adopting the ERP on costs, sales and natural resources are significant and impact on farm performance, but, perhaps, may not be considered firm and valuable, both on the strategic and operational sides. This can be considered a management knowledge bias of the business.

Results of the Abughazaleh, Zabadi, Aballah, & Shurrab (2018) study shows that the internal organizational forces, that consist of continuous support, system user interactions and the different views of stakeholders, helps to mobilize the organization for a faster adoption of the technology. We consider that this is also important to discuss the independent variables used in each of our construct.

To assess the absorption and assimilation capacity of ERP systems in the implementation and post-implementation phases, Nandi & Vakkayil (2018) consider the risks of failures as multiple challenges: (a) broad scope of the project; (b) changes in business processes; (c) strategy, technology, culture and management systems; (d) human resources and structure; (e) levels of commitment of all the organization.

When looking at the loadings of the variables for the construct of the impact on costs (IC), it is noticed that the ones that contribute the most to its explanation are: to improve the decision-making process during higher business risks times ($\hat{\beta}$ = 0.374***); improve the efficiency of staff ($\hat{\beta}$ = 0.287***); increase employee productivity ($\hat{\beta}$ = 0.224**); ensure that the corporate systems and information are accessible from any location ($\hat{\beta}$ = 0.204**); reduces supply purchase costs ($\hat{\beta}$ = 0.169**); and negative to reduce the farm administration workload ($\hat{\beta}$ = - 0.141*). As this is a high-risk activity, what we can discuss is the concern of farmers with decision-making at the right time and the right dose. To make less and less mistakes in day-to-day work decisions should be even more crucial to this audience. However, it was surprising that there was no significance for the following drivers: understanding business processes, organizational flexibility, and coordination with suppliers. It is imperative to understand these farmers behavior in further research. Nevertheless, it seems that including the importance of understanding business processes, organizational flexibility, and coordination with suppliers should be statistically significant to contribute to farm cost impacts. Researchers and consultants should rely on these findings to understand the practical requirements of these findings so that consultancies and ERP providers can offer these analytical platforms.

The loadings of the most significant variables that explain the construct impact on internal operation (IIO) are: increase the analysis capacity of business risks ($\widehat{\boldsymbol{\beta}}$ = 0.377***), make internal operations more efficiently ($\widehat{\boldsymbol{\beta}}$ = 0.355***), increase control of internal farm logistics ($\widehat{\boldsymbol{\beta}}$ = 0.311***), and increase motivation of all employees ($\widehat{\boldsymbol{\beta}}$ = 0.099 *). We can conclude that although IIO is an area where farmers may have more control, the opportunities for developing ERP systems with these variables on an analytical platform is critical.

The loadings of the most significant variables that explain the impact on sales (IS) construct are: increase the ability to have clearer business future view ($\widehat{\boldsymbol{\beta}}$ = 0.436***), increase the farm profitability ($\widehat{\boldsymbol{\beta}}$ = 0.373***), increase the value of: my farm, my partners and my contracts. ($\widehat{\boldsymbol{\beta}}$ = 0.156**) and reduce inventory costs ($\widehat{\boldsymbol{\beta}}$ = 0.155**). Although the rural producer has a more immediate, centralizing and conservative view, he is concerned about having a clearer vision of the future of his business. Risk control is always present in the perception of value impacts, and can be, in practice, developed in systems and processes capable of dealing with these business challenges. Academically, our contribution is relevant because the research puts a measure in what the business can offer of vision of future in a solution in platforms of analytical insights to the rural producer of Brazil.

For the construct Impact on natural resources and sustainability (INR), the most significant variables are: the land as an investment ($\hat{\beta}$ = 0.472**), and natural resource guarantee for the future ($\hat{\beta}$ = 0.365**) and not only as an extractive asset. This may mean that there is a significant paradigm shift in this sector. The variable long-term care for future generations and environmental preservation statistical significance that can be explained by the "nature" of the farmer. In his mind, agricultural production should be seen as an asset for the preservation of natural resources and not only as a producer of food, fiber, protein and energy.

7.6 Conclusions

In this section, we will highlight important points of this study, which goes through the resources for the farms to become value-added enterprises with ERP, how it is possible to combine firm resources to create value in this competitive environment, the special attention that the agents of this sector must give to processes of knowledge management of farmers and in the validation of four key dimensions of value generation after ERP adoption by farmers.

This study highlights that agricultural enterprises can have significant resources that have the potential to create a new value for farmers and farms to become value-added ventures by making a more dynamic and adaptive ERP implementation with sustainable competitive advantages (Bromiley and Rau 2016). An important set of results is that the links between the impacts on costs (IC), internal operation (IIO), sales (IS) and natural resources (INR) are positive and significant.

We also believe that the resources studied in this paper (constructs and their drivers) need to be combined with the capacity of appropriation of the value generated from the creativity and resources of the farm (Grande 2011). We discuss our findings based on Bromiley & Rau (2016), practice-based vision model (PBV). The PBV explains that because of the limited rationality, companies often do not know or do not use all the techniques that can benefit them. We conclude, as our results show, that in post-adoption of ERP on farms it is possible to combine firm, rare, valuable, hard-to-duplicate, and difficult-to-substitute resources to create value for the competitive environment of the property.

Alexy et al., (2018), argue that firms consist of packages of complementary resources, which forms an apparent tension between the assertion that RBV control is a necessary condition for competitive advantage compared to empirical observation of strategies solid and successful to deliver value. Therefore, we discuss our results considering the researchers' experience with the findings in our qualitative and quantitative studies. At this point we conclude that the agents of this segment should pay special attention to the farmers' knowledge management processes (KM) so that they can develop a value-based vision with the development of strategic and operational competitive advantages. We conclude that the resource management processes of knowledge should be treated as strategic.

From the four variables analyzed, this article concludes the impacts on farm performance and how routinisation moderates these relationships.

Firstly, the impact on costs (IC) provided by ERP implementation is the third most significant impact of agricultural performance. This is also a formative construct and thus it is necessary to carry out a more detailed analysis of its indicators or variables. For example, two indicators were important for this construct: the perception of improved decision making, especially in times of increased business risk and greater employee efficiency. However, two indicators are not significant for their training: perceptions about improving the efficiency of business processes and coordination with suppliers. We conclude that farmers, by better understanding the value of farm processes and coordinating actions with suppliers with ERP adoption, can make this resource even more firm and rare, contributing to the market. At this point we can say that this is an operational resource and not least for this.

Secondly, the improvement in the impact of internal operations (IIO) on post-adoption of the ERP is the second positive driver in the impact on agricultural performance (IFP). The internal operations (IIO) are the business area that the farmer tends to exercise greater control.

It is in this resource that the farmer can develop value to increase his production and his productivity. Their concern is very strong with the increase and efficiency of the whole operation: planting, control, care, harvesting, risk assessment and storage. The importance of having reliable data for the strategic analysis of internal operations as a need for farms to seek opportunities and neutralize threats through ERP systems, paying particular attention to the impact of collaboration and analysis on managerial control (Ruivo, Oliveira, and Neto 2014). IIO is the only resource that routinisation (Ro) moderates in relation to its impact on farm performance (IFP). We conclude the importance of processes within managerial control as resources that can become valuable to the farmer. Developers and ERP providers who are able to develop this resource for farmers have been able to propose value packages to further transform internal operations (IIO) resources into firm and valuable by helping to create more value for farms. So we can say that we have a strategic resource here. However, any neglect in this productive chain within the farm as a resource can mean losses that may be irrecoverable.

Thirdly, the increase in impact of sales efficiency (IS) caused by ERP implementation is the most significant positive factor in the impact on farm performance (IFP). However, the driver that measures the ease of managing sales with buyers is weak to explain this construct, which shows the farmer's low bargaining power. Marc, Florian, Malte, and Stephan (2010) say RBV theory suggests that a company's resources are at the basis of its ability to gain competitive advantage. This explains why the importance of IC for farm performance (IFP). The study by (Marc, Florian, Malte, & Stephan (2010), provided several interesting insights for strategy research in measuring sales and distribution (S & D) impacts on company performance. However, we can conclude that farmers have some problems with knowledge management, with management of costs and sales management processes. The point here is to discuss what knowledge they have about their value chain. Our contribution is to propose a future discussion with all stakeholders in this sector so that this resource becomes firm, difficult to replace and more strategic and less operational.

Fortly, the impacts that generate value on natural resources (INR) caused by ERP implementation has a smaller positive impact on farm performance (IFP). The result of two drivers of this construction surprised us: the long-term care of the land for future generations and environmental preservation did not have the strength to explain the perception of impacts on natural resources and sustainability. The production of food by the farmers is an activity that presupposes controls on the natural resources for the generation of value for the business. By looking at our qualitative data they prove this statement. But our quantitative data demonstrate this very weak relationship. Developers and ERP providers who can make the farmer better understand this resource and how it can become more firm, rare and difficult to replace can stand out in the service of this segment.

Our research validates those four key dimensions of ERP value. Therefore, the study supports the use of RBV and PBV as a theoretical basis for value studies of ERP initiatives for organizational performance of farms. By identifying the relationship between ERP usage and perceptions of vision and value, the survey provides decision makers with a way to assess the potential impacts that ERP on analytic insights platforms may have on Brazilian farms.

We listed the limitations of this study that must be observed. (a) It is crucial to better understand which critical factors we should work in future research on values related to natural resources and sustainability. Brazil, as one of the biggest players in the world production of food, fiber, protein and energy, with arable land area and with great responsibility on world production, it was expected that this resource were more firm, valuable, rare and with greater statistical significance. (b) Another important limitation is to better measure the moderating effects of routinisation in the relationships of impacts on the farm processes. (c) Also, the impact measurements are subjective and are based on farmers' perceptions on ERP on their farms. (d) As we highlighted in our conclusion, the formative measurement model makes some negative or insignificant weight. This complicates the interpretation of the meaning for these formative variables. Therefore, new variables should be studied for those that we did not manage to obtain significant statistical values.

Future studies should include dynamic capabilities theory to better define vision and value drivers. The strength of a company's dynamic capabilities helps shape its proficiency in designing business models that influence company boundaries for the feasibility of specific strategies (Teece 2016, 2017).

In addition, our idea is to initiate discussions for the development of concepts for Enterprise 2.0 and Cloud Platform (Boulos, Maramba, and Wheeler 2006; Jarche 2010; Jia, Guo, and Barnes 2017a; Kaloxylos et al. 2014b; Koch and Richter 2009b; Paroutis and Al Saleh 2009; Rong-ying and Bi-kun 2013; Williams and Schubert 2011; L. Zhou et al. 2016) for the Brazilian farms. We can also encourage discussion about the value of digital supply chain (DSC) as an intelligent process to generate new forms of revenue and commercial value for organizations and farms by providing new technological and analytical methods (Büyüközkan and Göçer 2018).

It is also necessary to consider the concepts of Industry 4.0, considered the fourth industrial revolution (Wollschlaeger, Sauter, and Jasperneite 2017), which deals with the challenges of data management, its transformation in knowledge and the use of this knowledge to support strategic decisions (Theorin et al. 2015). Industry 4.0 leads a transformation in today's factories in order to overcome some threats such as short product lifecycle, customized custom products and products in heavy global competition (Weyer et al. 2015). We can also observe that the concept of Industry 4.0 lacks a clear understanding and is not yet fully established in practice (Hofmann and Rüsch 2017). It is still possible to find some gaps among the empirical test and the field applications of Industry 4.0 (Liao et al. 2017). The results of Industry 4.0 are not yet fully understood and the use of their technological requirements is not entirely clear to the academic field, and so are practical applications in the field (Qin, Liu, and Grosvenor 2016). Industry 4.0 is closely related to the Internet of Things (IoT) (Nukala et al. 2016), cybernetic physical system (CPS) (Dumitrache et al. 2017), information and communication technology (TIC) (Weyer et al. 2015), enterprise architecture (EA) and enterprise integration (EI) (Lu 2017).

We believe that our study provides a resource-based view in the context of Brazilian farmers to discuss the development of Agriculture 4.0 in addition to provoking a discussion for future studies including also the dynamic capabilities theory (DC).

Chapter 8 – Conclusions

8.1 Summary of findings

In papers 1 and 2 (chapter 5 and 6) we used some similar constructs. Table 47 shows some differences found in the influence of constructs in the adoption of ERP system.

Table 47 Comparação de constructos entre as pesquisas

Construct	N= 200 MT Paper 1	N = 375 Brazil Paper 2 ERP Total	Adopters (N=167)	Non-adopters (N=208)
RA	$\hat{\beta}$ = 0.227***	$\hat{\beta}$ = 0.091*	$\hat{\beta}$ = 0.234**	NI
CX	$\hat{\beta}$ = - 0.120*	NI	NI	$\hat{\beta}$ = 0.120**
CP	$\hat{\beta}$ = 0.194***	$\hat{\beta}$ = 0.279***	$\hat{\beta}$ = 0.279**	$\hat{\beta}$ = 0.298***
TMS	$\hat{\beta}$ = 0.198***	$\hat{\beta}$ = - 0.120**	NI	NI
CPR	NI	$\hat{\beta}$ = 0.108**	NI	$\hat{\beta}$ = 0.163**

These results for the constructs of Table 47 deserve some analysis. Between one study and another, with different publics and regions of Brazil, it shows that relative advantage (RA) has different influences on ERP adoption (AD). Complexity (CX) should be studied better in future studies. We propose to work with dynamic capabilities theory (DC) to better understand farmers' perceptions of complexity.

Compatibility (CP) shows that ERP developers should have concerns about this construct when proposing products to farmers. Top Management Support (TMS) has a negative influence on adoption (AD). This shows an evolution of the capacities of the farms to train, to contract and to promote processes of delegation of responsibilities, and this seems to us to be a novelty between one paper and another. This may have led to the observed difference between the competitive pressures between the papers.

Therefore, we suggest the following highlights to summarize our results:

- ✓ ERP can **increase earnings** through greater **control in sales, costs reduction, buying, inventory and logistics** focused on operational efficiency.

- ✓ It can give to the farmer a better **support to take high-risk decisions**, considering the macroeconomic environment of agribusiness and volatility on a commodities environment.

- ✓ Better of the global competitive environment.

- ✓ Our study offers theoretical and practice contributions to the agribusiness field.

- ✓ The study provides a validity model of diffusion of ERP based on business analytics functionality for farms where it is possible to identify significant background use for management challenges: relative advantage, compatibility, complexity, technological competence, competitive pressure and the ERP environment.

- ✓ This study highlights that agricultural enterprises can have **significant resources that have the potential to create new value** for farmers and farms to become value-added ventures by being more dynamic and adaptive implementation of ERP.

- ✓ **The research also validates four key dimensions of ERP value**: impact on costs, impact on internal operation (production and productivity), impact on sales (procurement, revenue and contracts), and impact on natural resources and sustainability. The first three of these impacts are critical to the farm's performance.

- ✓ The study **provides a validity model of diffusion of ERP based on business analytics functionality** platform for farms, where it is possible to identify significant background use for theories DOI, TOE, IORs and RBV.

- ✓ This study **combines qualitative approach** based on interviews with experts **with a quantitative approach** composed by data collected on personal interviews.

- ✓ The study presents **the relative importance of ERP multiple impacts on the farm** organizational adoption stages: Evaluation (EV), Adoption (AD) and Routinisation (RO).

✓ The study presents **the moderators impacts of Information Sharing (IS), and Routinisation (RO)**.

8.2 Main Contributions

We understand that ERP based on business analysis functionality can meet all the needs of most shareable relationships and can also work efficiently as a standardized and customized method to manage farms.

We believe that we are delivering to the authorities, farmers, leaders, consultants, ERP system providers in Brazil a guide that could be the starting point of a paradigm shift for fiber, protein and energy production.

8.3 Limitations and future work

We believe that our study provides a resource-based view in the context of Brazilian farmers to discuss the development of Agriculture 4.0 in addition to provoking a discussion for future studies including also the dynamic capabilities theory (DC).

The limitations of this thesis are related to some aspects that could have deserved a greater attention on the part of the author. They are:

✓ The empirical work was based only on Brazilian farmers. Comparison with other farmers in other countries could validate constructs more clearly.

✓ The sample was concentrated in grain farmers and in the Midwest region of Brazil.

✓ There is still a low understanding of the concept of information sharing as a factor in creating competitive advantage. We could better explore this topic in exploratory research.

✓ We found few jobs that could help us to better understand the agricultural firms' valuable assets.

- ✓ We could discuss more deeply a digital management concept and not just discuss, like many other articles, digital agriculture.

Appendix

Appendix 1 Data collection instrument in Brazilian Portuguese

Planejamento dos Recursos Empresariais: Adoção, Utilização e Valor

Imagine conseguir reunir análises inteligentes e consistentes para tomar decisões que possa permitir criar vantagens competitivas no mercado local e no mercado internacional. Isto em tempo real e em poucos minutos.

A velocidade será o grande diferencial para as fazendas: velocidade para tomada de decisão e velocidade para ação e resultados. A fazenda que democratizar seus dados e colocar a inteligência necessária nas mãos de seus funcionários para que eles possam tomar decisões baseadas em dados, estarão em melhor posição para defender, transformar e agir em seus mercados.

Um Modelo de Gestão **ERP – Planejamento dos Recursos Empresarias** baseado em **funcionalidades analíticas de negócio** poderá ser uma solução de gestão da fazenda projetado para simplificar as análises e entregar em tempo real oportunidades de negócios. Este modelo é um conjunto integrado de tecnologias e de acordos entre fazendas, cooperativas, fornecedores, trades e institutos de pesquisas agronômicas oficiais. O objetivo final será o de resolver questões de negócios e criar novas oportunidades para obtenção de vantagem competitiva para o Produtor Rural.

Trata-se de uma mudança do "jeitão de fazer as coisas". Trata-se de adotar uma cultura orientada a dados dentro de uma fazenda para resolver problemas de negócios de forma ágil, impulsionando a mudança para maior eficácia do agronegócio brasileiro integrado.

E quem deve ser o vetor desta mudança é o Produtor Rural. Por isso, sua resposta é muito importante para o desenvolvimento deste Modelo de Gestão.

Todas as suas respostas serão tratadas confidencialmente e permanecerão anônimas, conforme o código de ética da pesquisa. De acordo com a Resolução 510 do Conselho Nacional de Ética em Pesquisa (CONEP), você pode solicitar e receber esclarecimentos sobre a pesquisa e ter garantido seu direito de desistir a qualquer momento durante a entrevista.

Muito obrigado pela sua colaboração.

Professor Mestre Caetano Haberli Junior
Professor Dr. Tiago Oliveira

Caracterização da Fazenda

1. Em que fase da adoção de um Modelo de Gestão com Planejamento dos Recursos Empresariais (ERP) a sua fazenda está envolvida atualmente?

Não considera esta possibilidade	1
Está em avaliação – exemplo: um projeto piloto	2
Tem avaliado, mas não tem a intenção de adotar a tecnologia	3
Tem avaliado e tem a intenção de adotar a tecnologia	4
Já adotou	5

2. Caso a sua fazenda considera a adoção do ERP no futuro, em quanto tempo prevê que a sua adoção se concretize?

A fazenda não considera a adoção do ERP	1
Menos de 1 ano	2
Entre 1 e 2 anos	3
Entre 2 e 5 anos	4
Mais de 5 anos	5
A fazenda já adotou o ERP	6

3. Por favor, indique qual a sua principal cultura
4. Por favor, indique qual a área total plantada (ha)
5. Por favor, indique em qual UF (Estado) está localizada sua principal área de plantio?

Caracterização do Planejamento dos Recursos Empresariais
Responda numa escala entre 1 e 7, onde 1 significa discorda totalmente e 7 concorda totalmente

6. Por favor, classifique as seguintes afirmações sobre Benefícios Esperados:
Um ERP – Planejamento de Recursos Empresariais, pode fornecer informações para a tomada de decisão em tempo hábil como plantar, tratar, proteger, colher e vender.
ERP pode fornecer uma maneira eficiente de gerenciar os insumos.
ERP pode fornecer uma maneira eficiente de gerenciar a produção.
ERP ajuda a capturar dados de forma rápida e fornece análises necessárias para as principais tomadas de decisão em uma fazenda: plantar, tratar, colher e vender
ERP ajuda a reduzir os custos de inventário.

7. Por favor, classifique as seguintes afirmações sobre Complexidade:
Minha fazenda acredita que um ERP é complexo para usar
Minha fazenda acredita que o desenvolvimento de ERP é um processo complicado e complexo.
Eu acredito que o uso de ERP é muito complexo para operações de produção.
As competências necessárias para adotar um ERP é complexo demais para os funcionários das fazendas.

8. Por favor, classifique as seguintes afirmações sobre Compatibilidade:
Gerenciar minha propriedade através de um ERP é compatível com o meu processo de vendas atual.
Comprar insumos através da implantação de um ERP é compatível com o meu processo de compras atual.
Gerenciar através de um ERP é compatível com a minha cultura organizacional.
ERP é compatível com a infraestrutura de informações existente na fazenda.

9. Por favor, classifique as seguintes afirmações sobre custos percebidos:
ERP é mais rentável do que outros tipos de tecnologia para modelos de gestão agrícola.
A nossa organização pode evitar custos desnecessários e economizar tempo usando um ERP – Planejamento dos Recursos Empresariais
ERP ajuda economizar os custos relacionados com o tempo e esforços da produção agrícola.
Os benefícios de um modelo de gestão - ERP mais adequado para as minhas necessidades são maiores do que os custos dessa adoção.
Com adoção de um ERP mais adequado há uma redução de custos gerais e ambientais.

10. Por favor, classifique as seguintes afirmações sobre vantagens relativas:
Minha fazenda espera que um ERP ajude no processo de vendas da produção.
Minha fazenda espera que um ERP ajude na redução dos custos gerais. (Compra de insumos, mão de obra, máquinas e equipamentos, diesel.)
Minha fazenda espera que um ERP ajude no processo de compras.
Minha fazenda espera que um ERP ajude no processo de armazenamento da produção
Minha fazenda espera que um ERP ajude no processo de logística para a produção chegar a tempo no seu destino.

11. Por favor, classifique as seguintes afirmações sobre expectativa de desempenho:
Eu considero que o uso de ERP me permitiria realizar tarefas mais rapidamente.
Eu considero que o uso de ERP iria aumentar a minha produtividade.
Eu considero que o uso de ERP iria melhorar o meu desempenho.

12. Por favor, classifique as seguintes afirmações sobre expectativa de esforço:
Minha interação com a implantação de um ERP seria clara e compreensível.
Seria fácil para eu ser mais eficaz com a implementação de ERP.
Eu acharia o sistema ERP fácil de usar
Eu considero que aprender a operar com um sistema ERP para tomada de decisões seria fácil para mim.

13. **Por favor, classifique as seguintes afirmações sobre comportamento para inovação**
Eu considero inovadora a implantação de um sistema ERP
Gosto do desafio de fazer algo que nunca fiz como a implantação de um sistema ERP
Sigo as últimas tendências tecnológicas. Por isso quero usar um ERP
Interesso-me realmente apenas por algumas coisas. ERP é uma delas
Gosto de experimentar coisas novas. Por isso, usar um ERP me estimula.
Eu não gosto que minha vida seja sempre a mesma, semana após semana.

14. Por favor, classifique as seguintes afirmações sobre o apoio dos proprietários ou principais gestores:
Como líder eu estou ativamente envolvido em estabelecer uma visão e formular estratégias para a utilização de um ERP.
Como líder eu comunico o meu apoio ao uso de ERP.
Como líder eu estou atento para analisar a ocorrência de riscos envolvidos na adoção e na implementação de um ERP – Planejamento dos Recursos Empresariais.
Eu estou disposto a assumir riscos (financeiros e organizacionais) envolvidos na adoção de novos modelos de gestão – ERP.

15. Por favor, classifique as seguintes afirmações sobre o tamanho da propriedade:
O capital investido em minha fazenda é elevado em comparação com os meus vizinhos.
A receita da minha fazenda é elevada em comparação com os meus vizinhos.
O número de empregados de minha fazenda é elevado em comparação com os meus vizinhos

16. **Por favor, classifique as seguintes afirmações sobre a competência tecnológica**
A infraestrutura de tecnologia da minha fazenda está disponível para suportar uma implementação de ERP
Dentro da fazenda existem habilidades e conhecimentos necessários para implementar um modelo de ERP mais eficiente
A fazenda sabe como um modelo de ERP pode ser utilizado para apoiar operações.
A maioria dos meus tratores e colheitadeiras estão equipados com tecnologias de comunicação móvel.
Eu utilizo regularmente a Agricultura de precisão: do plantio à colheita.

17. Por favor, classifique as seguintes afirmações sobre a integração de tecnologia:
Os meus processos e ferramentas de gestão estão integrados por via eletrônica com os bancos de dados e sistemas de informações internos e externos.
Os meus bancos de dados e sistemas de informação estão integrados eletronicamente com os fornecedores.
Os meus bancos de dados e sistemas de informação estão integrados com os clientes comerciais (compradores de produção agrícola).

18. Por favor, classifique as seguintes afirmações sobre competência financeira:
Minha fazenda têm os recursos financeiros para a aquisição de hardware e software necessários para a implementação de um ERP.
Minha fazenda têm os recursos financeiros para fazer alterações de fluxo de trabalho para acomodar a implementação de um sistema ERP.
Eu acredito conseguir linha de crédito para financiamento da implantação de ERP em minha fazenda.

19. **Por favor, classifique as seguintes afirmações sobre pressão competitiva**
Minha fazenda sofre pressão competitiva para implementar o ERP
Minha fazenda terá uma desvantagem competitiva se não implementar um ERP
O nível de pressão para implantação de ERP originado pelos concorrentes no mercado local é muito alto.
O nível de pressão para implantação de ERP originado pelos concorrentes no mercado internacional é muito alto.
O nível de pressão para implantação de ERP originado pelas tradings e compradores de minha produção é muito alto.

20. Por favor, classifique as seguintes afirmações sobre pressão dos parceiros:
Os compradores de minha produção estão exigindo a implantação de ERP.
Um ERP irá melhorar a coordenação entre os meus fornecedores e meus compradores.
Os fornecedores de insumos (fertilizantes, sementes e defensivos...) estão exigindo a implementação de um ERP.
Os bancos oficiais estão exigindo a implantação de ERP para facilitar aprovação de crédito de pré-custeio e de custeio.

21. Por favor, classifique as seguintes afirmações sobre o ambiente para ERP:
Há disponibilidade adequada para uma decisão de integração de dados importantes para a fazenda.
Há disponibilidade adequada de dispositivos que fazem a integração de todos os dados da produção agrícola para uma gestão compartilhada (solo, fertilizantes, tratos culturais, defesa vegetal, colheita por talhão, padrão de qualidade...).
Há disponibilidade adequada de informações sobre normas de segurança para uso em sistemas de gestão compartilhada.
Há disponibilidade adequada de padrões de computador para a implementação de sistemas ERP.
Há disponibilidade adequada de aplicativos do sistema que permitem quebrar paradigmas na fazenda, tais como descentralizar as principais decisões.
Há um sistema de ERP adequado no mercado para atender às necessidades da fazenda.

22. Por favor, classifique as seguintes afirmações sobre confiança:
A nossa fazenda confia que as informações proprietárias confidenciais compartilhadas com parceiros comerciais através de ERP será mantida em sigilo.
É preciso ter uma relação de negócios anterior com a minha fazenda a fim de realizar negócios que usa o ERP como base.
A adoção de um ERP exige confiar nos nossos parceiros comerciais quando temos que compartilhar informações online – através de computadores.

23. Por favor, classifique as seguintes afirmações sobre colaboração:
Processos e procedimentos empresariais têm sido claramente documentados entre a minha fazenda e os parceiros comerciais.
ERP pode ajudar a esclarecer processos e procedimentos de negócio entre a Fazenda e os parceiros comerciais.
Nossa Fazenda está satisfeita com a atual colaboração do negócio com os parceiros comerciais.
O fluxo dos negócios pode ser ainda melhor analisado com a implementação do sistema ERP.

24. Por favor, classifique as seguintes afirmações sobre compartilhamento de informações:
A introdução de um ERP implica numa maior visibilidade e transparência das transações comerciais entre os parceiros comerciais.
Minha fazenda ficaria confortável em compartilhar informações e operações de negócios com parceiros comerciais.

25. Por favor, classifique as seguintes afirmações sobre avaliação de ERP:
Minha fazenda pretende usar ou continuar utilizando ERP.
Minha fazenda coleta informações sobre o mercado e produtos de ERP com a possível intenção de usá-lo ou continuar usando.
Minha fazenda tem realizado um teste piloto para avaliar um ERP.

26. Por favor, classifique as seguintes afirmações sobre adoção de ERP:
Minha fazenda investe recursos para adotar ERP
As atividades de compra, produção e venda de nossa fazenda requerem o uso de ERP.
Áreas funcionais em minha fazenda requerem o uso de ERP.

27. Por favor, classifique as seguintes afirmações sobre a rotina de ERP:
Temos ERP integrado com sistemas de venda da produção e cadeias de suprimentos existentes.
Informações de colheita em tempo real é realizado através da integração de sistemas com aplicações de ERP.
Informações de inventário em tempo real é coletado através da integração de sistemas com aplicativos de ERP
ERP está sendo implementada em conjunto com os compradores ou *trades* de nossa produção.
ERP está sendo implementada em conjunto com os nossos fornecedores de matérias-primas e insumos.
ERP está sendo implementado para atender as exigências do código florestal (CAR – Cadastro Ambiental Rural).
ERP está sendo implementado para atender as exigências da pesquisa e do desenvolvimento do agronegócio (Integrado com os sistemas dos institutos de pesquisas públicos e particulares).

28. Por favor, classifique as seguintes afirmações sobre o uso de ERP:
Responda numa escala entre 1 e 7 onde 1 significa muito ruim e 7 muito boa
Por favor, avalie a medida em que os seus funcionários têm acesso a informações para decisões corretas para trabalhar de forma independente das lideranças.
Por favor, avalie a medida em que os seus funcionários tomam decisões do dia a dia da fazenda imediatamente quando necessário.
Por favor, avalie a medida em que os seus processos internos são conduzidos de forma integrada e coordenada
Por favor, avalie a medida em que as suas atividades de vendas da produção são suportadas por uma plataforma de informações integrada e consistente.
Por favor, avalie a medida em que as suas atividades de compras são suportadas por uma plataforma de informações integrada e consistente.
Por favor, avalie a medida em que as atividades de produção e de produtividade são suportadas por uma plataforma de informações integrada e consistente.
Por favor, avalie a medida em que as atividades de cuidar dos recursos naturais e sustentáveis são suportadas por uma plataforma de informações integrada e consistente.

29. Por favor, classifique as seguintes afirmações sobre a intenção de implantar ou aumentar a adoção do ERP:
Responda numa escala entre 1 e 7, onde 1 significa discorda totalmente e 7 concorda totalmente
Se houver uma solução mais evoluída, então deve ser utilizada como aplicação dominante como atualização do modelo de gestão.
A minha fazenda deve aumentar o nível existente de adoção de aplicações e sistemas baseadas em ERP.
Apoio que tenha maior adoção de aplicações e sistemas baseados em ERP.

30. Por favor, avalie os impactos em valor sobre os custos da fazenda que o ERP pode ter sobre as declarações:
Responda numa escala entre 1 e 7, onde 1 significa impacto muito baixo e 7 impacto muito alto
Aumentar a produtividade dos funcionários.
Facilitar a comunicação entre os funcionários.
Aumentar a compreensão dos processos de negócio.
Melhorar a flexibilidade organizacional.
Proporcionar que os sistemas corporativos e as informações sejam acessíveis a partir de qualquer local.
Reduzir o número de empregados
Melhorar a tomada de decisão em épocas de maior risco para o negócio.
Reduzir a carga de trabalho de administração da Fazenda
Melhorar da eficácia dos funcionários.
Melhorar a aprendizagem do empregado.
Ter informações de melhor qualidade.
Melhorar a coordenação com fornecedores de insumos.
Diminuir os custos de aquisição de insumos.
Facilitar a comunicação com fornecedores de insumo.

31. Por favor, avalie os impactos em valor sobre a produção e a produtividade da fazenda que o ERP pode ter sobre as declarações:
Realizar as operações internas mais eficientemente (exemplo: acelerar o processamento nas janelas de plantio, reduzir os gargalos nas janelas de colheita, reduzir erros na utilização de defensivos e fertilizantes, notificação de problemas sanitários isolados, situações urgentes de controle de pragas, doença e ervas, clima)
Aumentar o controle de toda a operação.
Aumentar motivação de todos os funcionários.
Aumentar a capacidade de análise de riscos do negócio.
Aumentar o controle da logística interna da fazenda.

32. Por favor, avalie os impactos em valor sobre a vendas, aquisições e contratos da fazenda que o ERP pode ter sobre as declarações:
Aumentar a rentabilidade da Fazenda.
Reduzir de custos de inventário.
Facilitar a gestão de vendas com os seus compradores.
Aumentar a capacidade de ter uma visão mais clara do negócio no futuro.
Aumentar o valor da minha fazenda, dos meus parceiros e dos meus contratos.

33. Por favor, avalie os impactos em valor sobre os recursos naturais e sustentabilidade da fazenda que o ERP pode ter sobre as declarações:
Garantia dos recursos naturais para o futuro.
Ter a terra como investimento.
Cuidados para as gerações futuras.
Preservação do meio ambiente.

34. Por favor, avalie os impactos em valor sobre a performance da fazenda que o ERP pode ter sobre as declarações:
Em termos dos impactos nos negócios de sua fazenda, o sistema de ERP poderá ser um sucesso.
O ERP irá melhorar significativamente o desempenho geral de minha fazenda.
Do ponto de vista da minha fazenda, os benefícios de implantação de um ERP superam os custos.
ERP deverá ter um efeito positivo e significativo sobre a minha fazenda.

35. Por favor, indique:
Responda numa escala entre 1 e 7, onde 1 significa muito limitado e 7 muito bom
Qual o seu grau de conhecimento relativo às questões deste questionário?
Qual é a sua experiência sobre a utilização de um sistema ERP?
Qual o seu grau de conhecimento sobre a USP – Universidade de São Paulo?

36. Qual é a sua função na Fazenda?
37. Se estiver interessado em receber os resultados deste estudo, favor informar:

Nome:
E-mail:
Fone fixo e Móvel:

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