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Performance, farmer perception, and the routinisation (RO) moderation on ERP post-implementation

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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.

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 et al., 2000). Almajali et al., (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 (Wang, 2016).

We introduce in our model the routinisation (Ro) as a moderator variable. A study by Wohlgemuth and Wenzel (2016), explains routinization as an important aspect in regarding a better understanding of the capacities by which companies reconfigure their knowledge base. Wohlgemuth and Wenzel (2016) 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 and 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

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Table 1
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 et al., 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 et al., 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 et al., 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 et al., 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.

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 et al., (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

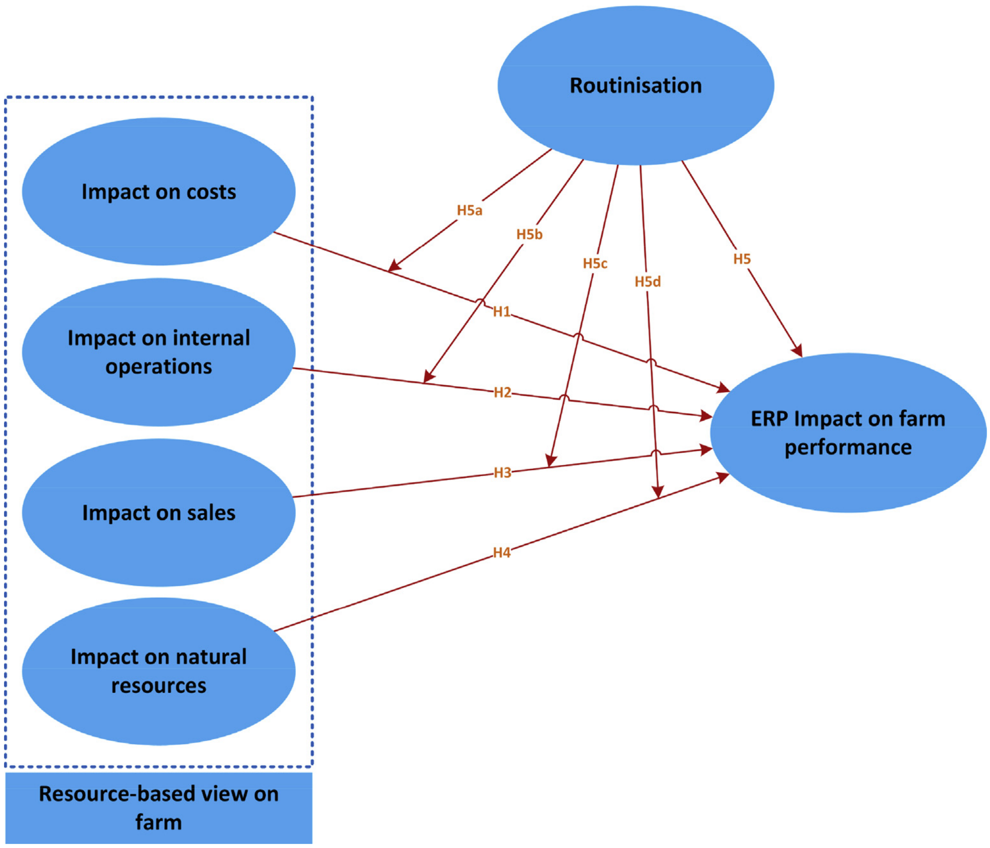

Fig. 1. Structural model based on RBV

Table 2
Research Sample composition.

Agriculture Type	
Grain (*)	74%
Cattle Raising	14%
Sugar Cane	10%
Fruits	2%
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, and peanuts.

what these resources and their dimensions are. Based on this and on Chan and Chong (2013), Picoto et al., (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.

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 Carter

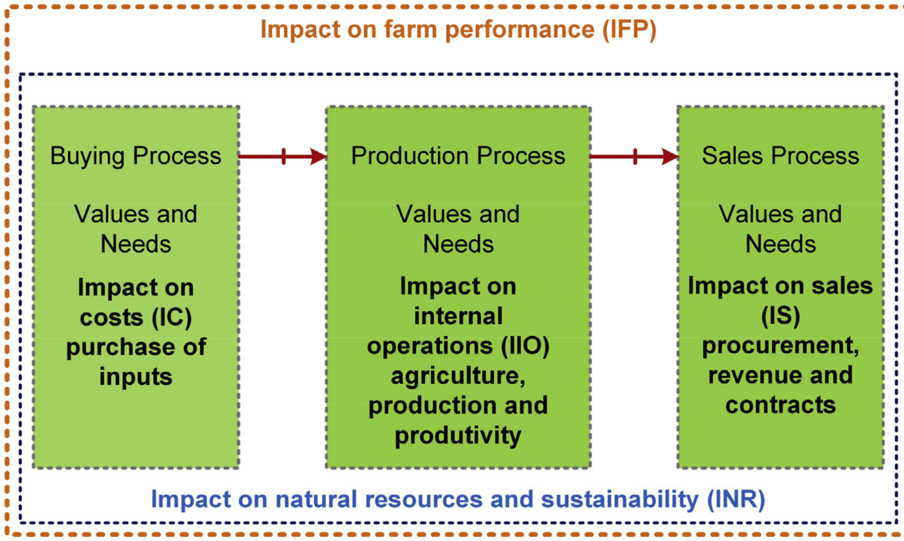

Fig. 2. Model for Understanding agribusiness challenges.

Table 3
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 above 0.95 are not desirable because they show that all variables are measuring the same phenomenon and therefore unlikely to be a valid measure of the construct.

Table 4
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**

Bold means that Alpha Cronbach are higher than 0.708.

(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 et al., 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

Table 5
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.

towards integrated socio-ecological analysis. Blesh and Wolf (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 et al., 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 et al., 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

Table 6
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.

Table 7
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.

farmer motivation after the impacts of these disasters (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 et al., 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.

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 (Fig. 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 and Hulland (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

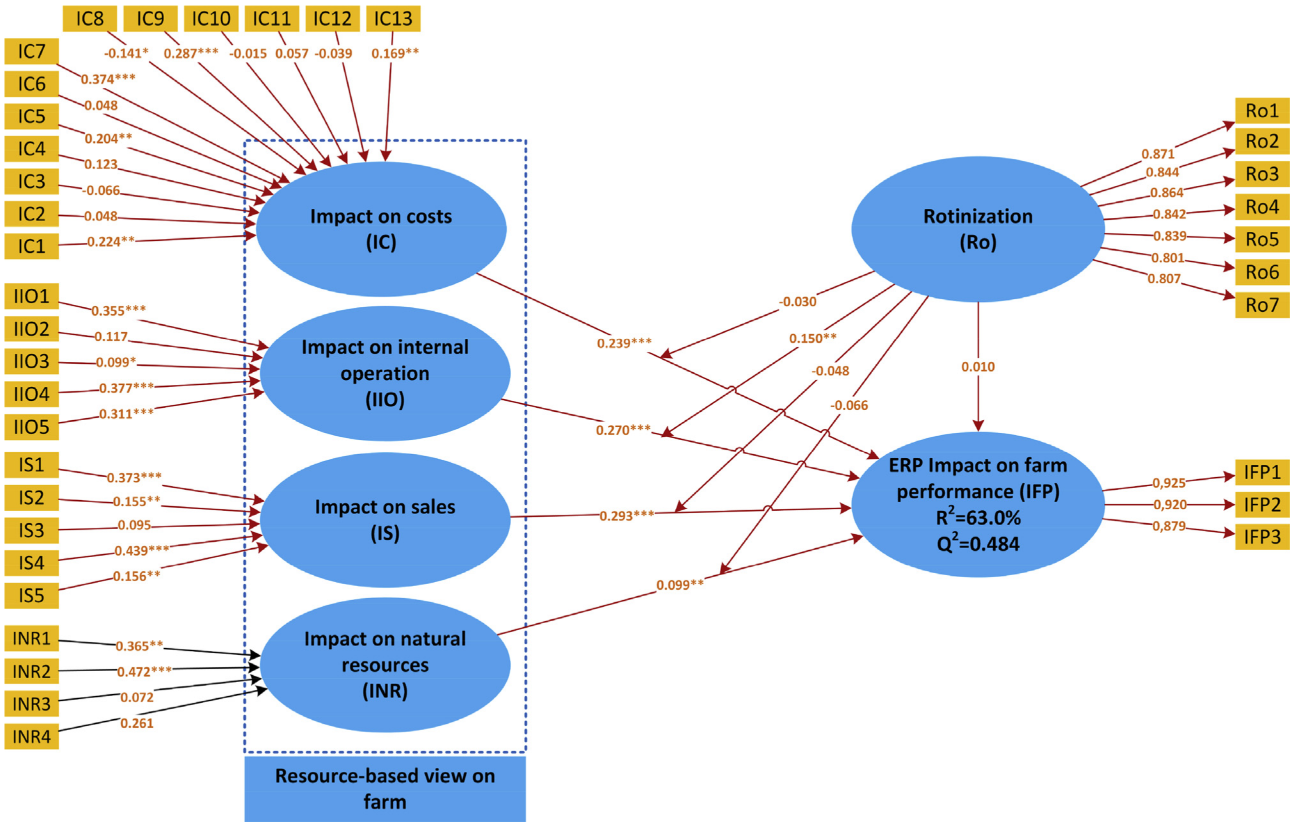

Fig. 3. Research model.

Table 8
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 ***.

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 1. 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 et al., 2014). Fig. 1 shows the structure of our model.

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 et al., (2014) and Ruivo et al. (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.

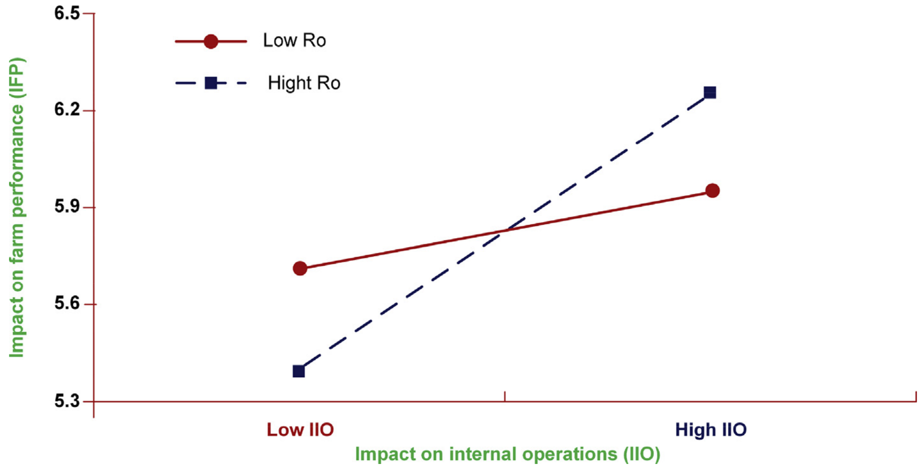

Fig. 4. Moderator variable analysis.

Therefore, our hypothesis is:

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

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 (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 et al., 2014; Ruivo et al., 2012; Ruivo et al., 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).

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 et al., 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).

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 et al., 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 (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).

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; Zhu et al., 2006). 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 et al., 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.

4. Methodology

The methodology adopted in our study incorporates two approaches: a qualitative with the method of in-depth interviews (Boyce and Neale, 2006; 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 et al., 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 are the challenges for the production of food, protein, fiber and energy 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 2). 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 et al., 2014).

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 (Fig. 2).

Fig. 2 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 1.

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; 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 et al. (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 et al., 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 et al., 2017).

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 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 3, 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.

Overall, the instrument presents good indicator reliability. Indicator reliability was evaluated on Table 4 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.

With the results analyzed in Tables 3, 4, and 5 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 (Table 1). 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 3 and Table 4 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 6. For all items, the VIF is below the cut-off value of 3.3 (Sarstedt et al., 2014). Table 6 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.

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 7), which demonstrates that doesn't exist any collinearity issues in the structural model.

In observing the results of the measurement model and the structural model of Tables 6 and 7, 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).

Fig. 3 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 et al., 2014). This study shows a R2 = 63% considered as very good result.

Table 8 shows the validation framework of the hypotheses designed for the study.

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 Fig. 4 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.

Li et al. (2006) use a Kwon 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 et al., (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 et al. (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 and 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 (= 0.374***); improve the efficiency of staff ($\widehat{\beta} = 0.287$***); increase employee productivity ($\widehat{\beta} = 0.224$**); ensure that the corporate systems and information are accessible from any location ($\widehat{\beta} = 0.204$**); reduces supply purchase costs ($\widehat{\beta} = 0.169$**); and negative to reduce the farm administration workload ($\widehat{\beta} = -0.141$*). 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 ($\widehat{\beta} = 0.377$***), make internal operations more efficiently ($\widehat{\beta} = 0.355$***), increase control of internal farm logistics ($\widehat{\beta} = 0.311$***), and increase motivation of all employees ($\widehat{\beta} = 0.099$ *). 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 ($\widehat{\beta} = 0.436$***), increase the farm profitability ($\widehat{\beta} = 0.373$***), increase the value of: my farm, my partners and my contracts ($\widehat{\beta} = 0.156$**) and reduce inventory costs ($\widehat{\beta} = 0.155$**). 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 ($\widehat{\beta} = 0.472$**), and natural resource guarantee for the future ($\widehat{\beta} = 0.365$**) 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.

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 and 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 et al., 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 et al., (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 et al. (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 et al., 2006; Jarche, 2010; Jia et al., 2017; Kaloxylos et al., 2014; Koch and Richter, 2009; Paroutis and Al Saleh, 2009; Rong-ying and Bi-kun, 2013; Williams and Schubert, 2011; 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 et al., 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 et al., 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).

Declarations

Author contribution statement

Caetano Haberli Junior: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Tiago Oliveira, Eduardo Eugênio Spers, Mitsuru Yanaze: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

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