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# RELATIONSHIP BETWEEN KNOWLEDGE MANAGEMENT AND INNOVATION IN THE APPLE PRODUCTIVE CHAIN

## RELAÇÃO ENTRE GESTÃO DO CONHECIMENTO E INOVAÇÃO NA CADEIA PRODUTIVA DA MAÇÃ

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### ABSTRACT

The constant changes which have shaped the companies environment have mobilized researchers to investigate the factors that lead them to innovate and reach higher levels of performance. In this context, knowledge management has been considered as a driving force for development and crucial for innovation. However, little attention has been paid to the use of these concepts in the agribusiness sector. Thus, this study aimed to analyze the relationship between knowledge management processes and innovation in the apple production chain in the Southern Region of Brazil from the links of production and packing-houses. For that, a quantitative, descriptive study was carried out through a survey with 166 actors of the apple production chain, whose analysis was made using the structural equation modeling technique. The results obtained provided strong support for the hypothesized relation, which showed that knowledge management significantly influences both product and process innovation. The conclusions of this study provide a theoretical and empirical basis for a better understanding of the importance of knowledge management and innovation to improve the performance of the apple production chain.

**Keywords:** Knowledge Management, Innovation, Apple Productive Chain.

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## RESUMO

*As constantes mudanças que vem configurando o ambiente das empresas têm mobilizado pesquisadores a investigar os fatores que as levam a inovar e alcançar níveis superiores de desempenho. Nesse contexto, a gestão do conhecimento tem sido considerada como propulsora para o desenvolvimento e crucial para a inovação. Contudo, pouca atenção tem sido dada para a aplicação destes conceitos no setor do agronegócio. Desse modo, este estudo teve por objetivo analisar a relação entre processos de gestão conhecimento e inovação na cadeia produtiva da maçã da Região Sul do Brasil a partir dos elos de produção e packing-houses. Para tanto, realizou-se um estudo quantitativo, descritivo aplicado por meio de uma survey, com 166 atores da cadeia produtiva da maçã, cuja análise foi feita a partir da técnica de modelagem de equações estruturais. Os resultados obtidos forneceram forte apoio para a relação hipotetizada, a qual mostrou que a gestão do conhecimento influencia significativamente a inovação, de produto quanto de processo. As conclusões deste estudo fornecem uma base teórica e empírica que colabora para uma melhor compreensão sobre a importância da gestão do conhecimento e inovação para melhorar o desempenho da cadeia produtiva da maçã.*

**Palavras-chave:** Gestão do Conhecimento, Inovação, Cadeia Produtiva da Maçã.

## 1 INTRODUCTION

The discontinuities in the economic and social context increase the importance of knowledge and accelerate the pace of innovation to support competitiveness in ever-changing business environments (MOUSTAGHFIR; SCHIUMA, 2013). Knowledge is considered a driving force in economy today and crucial for organizations to survive (HIDALGO; ALBORS, 2008; WANG; WANG, 2012). Therefore, over the last decade, the importance of knowledge has been highlighted in both academic and business literature (NICOLÁS; CERDÁN, 2011; TAGLIAVENTI; MATTARELLI, 2006), which demonstrate that knowledge contributes to productive activities, an also it's closely linked to innovation, performance and competitive advantage (DANG; UMEMOTO, 2009; JOSHI; NISSEN; COOPER, 2014).

Innovation, on the other hand, is seen as an important area by organizations, as most competitors in a given industry currently have the same level of management skills, so focusing on innovation is a key factor for differentiation (LIAO et al., 2010). There is a growing interest in the literature to identify the main factors that promote innovation (JIMÉNEZ; COSTA; VALLE, 2014). Among these points, several studies have highlighted that innovation comes from the continuous renewal of knowledge. Thus, the main activity to be performed by an organization that aims to innovate is to reconfigure its existing knowledge assets and resources and explore new knowledge (NONAKA; TAKEUCHI, 2002; JIMÉNEZ; COSTA; VALLE, 2014).

Despite the recognized importance of knowledge for innovation, it requires further studies, especially those related to flow management in different contexts, as it represents a way to optimize knowledge (DECAROLIS; DEEDS, 1999). This way, knowledge-rich organizations are those in which these flow smoothly from those who own them to those in need (WARD; WOOLER, 2010).

Despite the importance of these two constructs for organizations, Andreeva and Kianto (2011) report that most studies on knowledge and innovation processes are based on data from knowledge-intensive companies, while little evidence is observed in less knowledge-intensive sectors. This matter is also addressed by Dasgupta and Gupta (2009) who point out that, although the area of innovation and knowledge management has a high potential for research, they should address other sectors than just technology-intensive industries, highlight that this research should be extended to other sectors and also enable the results to be more generalized.

In this context, this study aimed to analyze the relationship between knowledge management processes and innovation in the apple production chain of the Southern Region of Brazil from the view of the production links and packing-houses.

## 2 THEORETICAL FRAMEWORK

### 2.1 KNOWLEDGE MANAGEMENT

Given that knowledge is based on professional skills and experience and the ability to absorb new knowledge, the way knowledge is managed affects the results of the organization. However, Dasgupta and Gupta (2009) warn that despite knowledge being an important strategic resource, it is not easy to manage it, especially tacit knowledge. Therefore, systems that help this management play an important supporting role in the organization (DARROCH, 2005). In this sense, knowledge management is characterized by Dasgupta and Gupta (2009) as a system that shapes a collaborative environment which enables the capture and sharing of existing knowledge and creates opportunities to generate new knowledge, and it also provides tools and approaches required to apply it in order to achieve stated goals.

It can be observed through the definitions found in the literature that there are several points of view concerning the activities which knowledge management should incorporate (ALAVI; LEIDNER, 2001; BOUTHILLIER; SHEARER, 2002; MOHAMED; ARISHA, 2013). Taking the activities into consideration, Inkinen, Kianto and Vanhala (2015) describe them as a set of management practices that can be manipulated and controlled in order to improve the effectiveness and efficiency of organizational knowledge resources.

Although different authors identify different processes, Alavi and Leidner (2001, p. 114) and Mohamed and Arisha (2013, p. 878) advocate that they can all be grouped into four main processes: knowledge creation and acquisition, storage and retrieval of data, knowledge transfer and sharing and application.

Studies on knowledge management and their applicability in the strategic processes of organizations highlight the importance of research on knowledge processes (creation, acquisition, storage, sharing, transfer and utilization) for innovation and performance of organizations. Associated to this, Table 1 summarizes the definitions developed in the literature on the knowledge management processes used in this study.

Table 1 - Definitions of knowledge management processes included in the model

<b>Knowledge management processes</b>	<b>Definition</b>
Knowledge Creation	Development of new knowledge within the boundaries of organization.
Knowledge Acquisition	Search, identification and capture of new knowledge from outside the company.
Knowledge storage	Knowledge becoming part of organizational memory.
Knowledge sharing	Focused and intentional transmission and receipt of knowledge from a donor to a recipient.
Knowledge utilization	Exploration and application of knowledge for formal benefits.

Source: authors.

## 2.2 INNOVATION IN AGRIBUSINESS

Questions about innovation and the factors that influence it are themes that have been driving the interest of academics and professionals over decades. Schumpeter's work (1934) played a crucial role in defining this construct which, according to the author, is the driving force for economic development. Innovation is highlighted as an important factor for the prosperity and growth of organizations, as well as for the entire economy (Schumpeter, 1934). However, even before that, in spite of this term being not widely used, the processes associated with innovation and economic and technological change were seen as important (BAREGHEH; ROWLEY; SAMBROOK, 2009).

Dasgupta and Gupta (2009) suggest that innovation is a learning process where valuable ideas are transformed into new forms of added value for both the organization and its stakeholders. Therefore, it is vital for business performance, especially in hostile environments, where it represents not only a means of growth, but also survival (DASGUPTA; GUPTA, 2009).

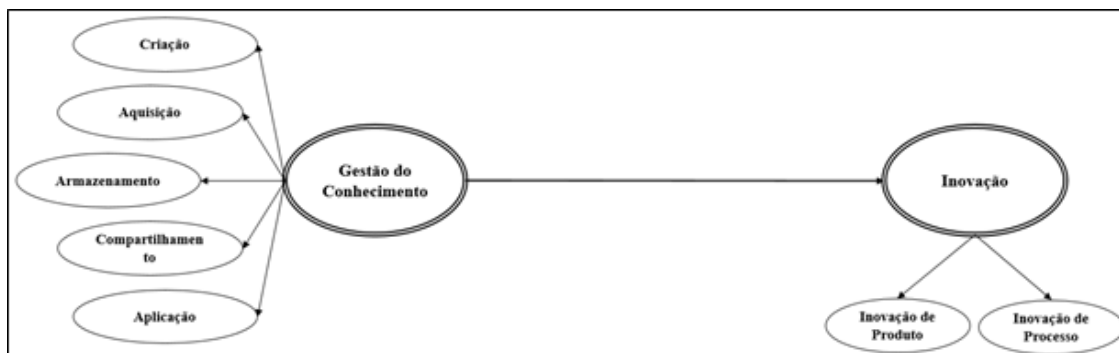
Innovation has been highlighted as the main driver of agricultural productivity and sustainability growth (OECD, 2013; LÄPPLE; RENWICK; THORNE, 2015; OZCELIK, 2016), and it involves the continuous use of new and existing knowledge that comes from different domestic and international sources. (MUTENJE et al., 2016).

According to Läpple, Renwick and Thorne (2015), up until recently, innovations in the agricultural sector have been seen as stemming from a linear process involving the participation of public sector research and extension institutes. However, it is currently debated that agricultural innovation emerges from the interaction between different actors, such as agricultural systems, supply chain, shaped by institutions, practices, behaviors and social relations in a specific context (LÄPPLE; RENWICK; THORNE, 2015; MUTENJE et al. ., 2016). That is, agricultural innovation evolves as a result of interactions between different individuals or systems (LÄPPLE et al., 2016). These agents interact and contribute to the production, sharing and use of knowledge (DOLINSKA; d'AQUINO, 2016).

## 3 RESEARCH MODEL AND HYPOTHESES

Knowledge management processes are critical factors for innovation. Thus, the research model of this work attempts to demonstrate that knowledge management, analyzed from a second-order construct, influences the innovation results of actors in the apple production chain. Figure 1 represents the research model.

Figure 1 – Research Model



Sources: authors.

### 3.1 KNOWLEDGE MANAGEMENT AND INNOVATION

Existing literature suggests that knowledge processes are closely related to each other and generally impact on innovation (ANDREEVA; Kianto, 2011). Therefore, the activities that enable and encourage the generation of ideas, while supporting their dissemination and use, should be associated, giving the company the opportunity to achieve better results (ESTERHUIZEN; SCHUTTE; TOIT, 2012). However, the literature provides discrepant views of this relation. For example, Kianto (2011) provided empirical evidence of the link between knowledge processes and innovation.

The theoretical study developed by Abou-Zeid and Cheng (2004) presented a model where certain types of innovation are more supported by knowledge creation, while others are more supported by the application of knowledge. At the same time, Darroch (2005) suggests that the process of acquisition, diffusion and responsiveness to knowledge has a positive impact on innovation in the organization. Zhou and Uhlener (2009) studied the link between external knowledge acquisition and internal knowledge sharing and innovative behavior in the company, where they found that external procurement practices play a key role in promoting innovation while internal sharing practices do not seem to have a significant influence.

Overall, it can be observed that most research suggests different sets of processes, and in some cases even controversial connections between processes of knowledge and innovation (ANDREEVA; Kianto, 2011). At this point, Andreeva and Kianto (2011) add up that these various points of view can be occasioned by examining only the direct impact of these activities on innovation. Therefore, for a better understanding, this study proposes a model that integrates the following knowledge processes: knowledge creation, knowledge acquisition, knowledge storage, knowledge sharing / transfer and knowledge application, as well as its impact on innovation, besides examining the possibility of mediated relations. Thus, the following hypothesis was formulated:

**H1: Knowledge management is positively connected to innovation.**

## 4 METHODS

### 4.1 SAMPLE AND DATA COLLECTION

In order to validate the proposed model, a survey was conducted with 166 players from the apple production chain, specifically the segments of production and packing-houses of the states of Santa Catarina and Rio Grande do Sul, through a survey. Therefore, it was used a quantitative research, as Creswell and Panoclarck (2007) suggest that the purpose of quantitative research is to observe how the data provided by the respondents fit into an existing theory.

Data collection involved the application of a structured questionnaire (with answers structured in a 5-point Likert scale, ranging from 1 - strongly disagree to 5 - strongly agree) through an electronic form link sent by email or direct contact with the participants.

The proposed indicators emerged from scales found in the literature and were selected because they offer detailed measurements for their indicators, as described in Table 2.

Table 2 - Data Collection Instrument

	<b>Constructs</b>	<b>Observable Variables</b>	<b>Source</b>
<b>Knowledge management</b>	<b>Knowledge Creation</b>	<p>My organization ...</p> <p><b>CR1</b> - Conducts training for its employees.</p> <p><b>CR2</b> - Frequently presents new ideas about our products.</p> <p><b>CR3</b> - Frequently presents new ideas about our methods and work processes.</p> <p><b>CR4</b> - Develops a new method if a traditional method is no longer effective.</p> <p><b>CR5</b> - Uses existing knowledge creatively for new applications.</p>	Adapted from Mafabi, Munene and Ntayi (2012) and Andreeva and Kianto (2011)
	<b>Knowledge Acquisition</b>	<p>My organization ...</p> <p><b>AC1</b> - Acquires knowledge from our competitors.</p> <p><b>AC2</b> - Acquires knowledge from research institutions, including universities, laboratories and research institutes.</p> <p><b>AC3</b> - Acquires knowledge from other industry sources such as associations, customers and suppliers.</p> <p><b>AC4</b> - Acquires knowledge of professionals and specialized technicians.</p> <p><b>AC5</b> - Encourages our employees to attend fairs and exhibitions.</p>	Adapted from Andreeva and Kianto (2011) and López, Peón and Ordás (2004)
	<b>Knowledge Storage</b>	<p>My organization</p> <p><b>ST1</b> - Has a system for storing knowledge</p> <p><b>ST2</b> - Has a system to retrieve knowledge</p> <p><b>ST3</b> - Has access to necessary information</p> <p><b>ST4</b> - Enables employees to access information online</p> <p><b>ST5</b> - Regularly update the knowledge base</p>	Adapted from Mafabi, Munene and Ntayi (2012)
	<b>Knowledge Sharing</b>	<p><b>SH1</b> - In my organization, information and knowledge are actively shared among employees</p> <p><b>SH2</b> - In my organization, employees and managers exchange a lot of information and knowledge</p> <p><b>SH3</b> - My organization shares knowledge and information with strategic partners</p> <p><b>SH4</b> - Our employees are systematically informed of changes in procedures, instructions and regulations</p>	Adapted from Andreeva and Kianto (2011)
	<b>Knowledge Application</b>	<p>My organization ...</p> <p><b>AP1</b> - Has processes for applying knowledge learned from mistakes</p> <p><b>AP2</b> - Has processes for applying the knowledge learned from the experiences</p> <p><b>AP3</b> - Has processes to use knowledge to solve new problems</p> <p><b>AP4</b> - Uses knowledge to improve efficiency.</p> <p><b>AP5</b> - Can locate and apply knowledge to changing competitive conditions</p>	Adapted from Gold, Malhotra and Segars (2001)

<b>Innovation</b>	<b>Product Innovation</b>	<p style="text-align: center;">My organization ...</p> <p><b>I</b>PRO1 Develops new products, clones or cultivars</p> <p><b>I</b>PRO2 Invests in environmentally friendly fruit production</p> <p><b>I</b>PRO3 Invests in improving the quality of its products.</p> <p><b>I</b>PRO4 Invests in research to find new product varieties</p> <p><b>I</b>PRO5 Discharged products are quickly replaced</p>	Adapted from Trienekens et al. (2008)
	<b>Process Innovation</b>	<p style="text-align: center;">My organization ...</p> <p><b>I</b>PCE1 Invests in the acquisition of new machines</p> <p><b>I</b>PCE2 Invests in work process improvement</p> <p><b>I</b>PCE3 Seeks to adopt latest production technologies</p> <p><b>I</b>PCE4 Responds quickly to customer needs</p> <p><b>I</b>PCE5 Is flexible to deliver products according to customer demands.</p>	Adapted from Trienekens et al. (2008)

Source: authors.

For data analysis we used the structural equation modeling technique through the AMOS statistical software, where the assumptions of its application were previously guaranteed through the normality, multicollinearity and linearity analyzes of the data.

## 5 RESULTS

### 5.1 MEASUREMENT MODEL

Internal consistency, reliability, convergent validity, and divergent validity were examined to assess the quality of the measurement model. For this, the reliability of the internal consistency was tested through the values presented by Cronbach's alpha and the composite reliability. Table 1 shows the values of such tests, where it can be seen that the values obtained for both tests are above 0.7, demonstrating the internal reliability (HAIR et al., 2009). Then the convergent validity was verified through the analysis of the values obtained for mean extracted variance and for the factor loadings of the measurement items, which should be greater than 0.5, preferably greater than 0.7., while extracted variance and reliability values should remain above 0.5 and 0.7 (respectively), as shown in Table 1, most constructs meet the suggested criteria (HAIR et al. 2009).

Finally, discriminant validity was tested using the Fornell-Larcker (1981) criterion, which suggests that the mean extracted variance of each latent variable should be greater than the square correlations with all other latent variables (Table 1). Most indicators have loads for the respective constructs, pointing out that the values of mean extracted variance (main diagonal) are greater than the values of shared variance (below diagonal). Except between the SH and CR constructs that presented higher values. At this point, Bagozzi and Yi (2012) point out that discriminant validity is not always obtained when two constructs, despite different definitions, are highly related. Given that discriminant validity was found for most items, it was decided to maintain such relationship, which is under observation.



Table 1: Reliability and validity test results

	CA	CR	AVE	CR	AC	ST	SH	AP	IPRO	IPCE
CR	0,9	0,8	0,5	0,45						
AC	0,9	0,8	0,5	0,09	0,48					
ST	0,8	0,8	0,5	0,16	0,25	0,47				
SH	0,8	0,9	0,6	0,50	0,06	0,21	0,65			
AP	0,8	0,8	0,4	0,07	0,17	0,29	0,11	0,40		
IPRO	0,8	0,8	0,4	0,26	0,10	0,15	0,28	0,09	0,43	
IPCE	0,9	0,8	0,5	0,17	0,16	0,10	0,19	0,01	0,38	0,49

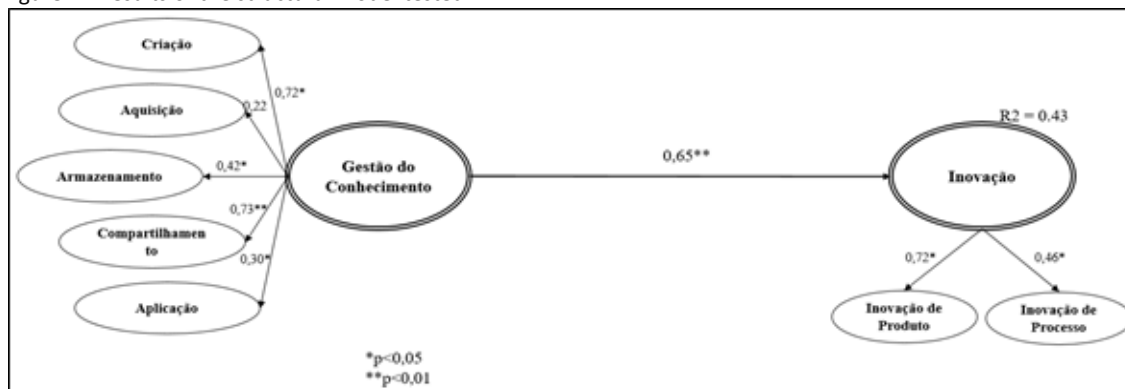
Notes: CA = Cronbach's Alpha; CR = Compound Reliability; AVE = Average Variation Extracted; CR = Knowledge Creation; AQ = Knowledge Acquisition; AR = Knowledge Storage; CO = Knowledge Sharing; AP = Knowledge Application; IPRO = Product Innovation; IPCE = Process Innovation.

## 5.2 STRUCTURAL MODEL AND HYPOTHESIS TESTS

Looking at Figure 2, it is possible to identify that, regarding the knowledge management construct, the processes of creation and sharing made a major contribution to its formation. In relation to the innovation construct, the product typology had the greatest contribution.

Moreover, the results of the analysis described in Figure 2 demonstrate that the hypothesis formulated for this research was supported, since knowledge management has a direct and positive influence on innovation ( $\beta = 0.65$ ;  $t = 3.137$ ;  $p < 0.002$ ).

Figure 2 - Results of the structural model tested



Source: authors.

Also, the values of R2 were calculated, that is, the amount of variation of the construct explained by the model. It can be seen from the general model that 43% of innovation is explained by its antecedent, knowledge management. Given this, it is clear that this research provided an empirical view that helps in a better understanding of the importance of knowledge management as a way to stimulate innovation in organizations, where knowledge management and innovation constructs were analyzed from second order constructs.

Thus, the results show that knowledge management is effective in increasing innovative processes of an organization, ability to compete in new markets, as well as improving the quality of its products, which ultimately will provide better performance and competitive sustainable advantage.

In this sense, it is necessary to associate actions that enable and encourage the generation of ideas, while supporting their dissemination and use, giving the company the opportunity



to obtain better results in innovative terms (ESTERHUIZEN; SCHUTTE; TOIT, 2012). This research shows that knowledge management is effective for enhancing innovative processes of an organization, ability to compete in new markets, as well as improving the quality of its products, which ultimately provide better performance and sustainable competitive advantage.

## 6 CONCLUSIONS

The general objective of this research was to analyze the relationship between knowledge management processes and innovation in the apple production chain of Southern Brazil from the view of production links and packing-houses. Therefore, the results obtained from a structural equation modeling approach provided strong support for the hypothesized relationship and reveal important theoretical and practical implications.

The main findings of the research prove the importance of the role of knowledge management in innovation, showing that the processes that stimulate flow in an organization are paramount to innovation in agribusiness organizations. Given this, increasingly these actors must seek to implement management strategies in order to leverage knowledge, adding value and making individuals collaborate on new information, extracting vital data and processing it appropriately to the needs of the company.

In terms of theoretical implications, this study confirmed the consensus in the literature that knowledge management contributes directly to innovation, implying that this relationship represents an important source of competitive advantage over the years. Thus, due to the importance of innovation in agribusiness, its antecedents represent an important issue to be investigated. This research contributes to this line of thinking by analyzing the importance of knowledge management processes as a mechanism that drives innovation in the companies, demonstrating their individual effects on innovation.

In terms of managerial implications, the importance of establishing strategic policies to stimulate knowledge management is emphasized, seeking to promote trust within the chain, facilitating the links between producers, suppliers, customers and research institutes. Such factors will impact on individual and organizational skills, creating conditions for increasing innovation at the supply chain level.

As seen, the results of this study provide managers with pointers to the importance of implementing better practices related to knowledge management, as they represent an important resource to improve innovation and consequently improving performance in the organization. In addition, it demonstrated the importance of providing mechanisms to create, disseminate and store knowledge relevant to the sector.

Regarding the limitations, the findings of this article are based on data from actors in the apple supply chain. Although they are believed to be relevant to other chains, they should be viewed with caution when generalized to other contexts. Future research, in this way, may investigate the constructs approached here in other productive chains, verifying their behavior in another agribusiness context. Moreover, the sample size, although adequate for the application of the structural equation modeling technique, is not significant for the apple productive chain population, so the generalization of the research findings is limited. Thus, it is suggested expanding the sample in future studies.

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Contribution	[Author 1]	[Author 2]	[Author 3]	[Author 4]
1. Definition of research problem	√	√		
2. Development of hypotheses or research questions (empirical studies)	√	√	√	
3. Development of theoretical propositions (theoretical work)	√	√		
4. Theoretical foundation / Literature review	√	√		√
5. Definition of methodological procedures	√	√	√	
6. Data collection	√	√		
7. Statistical analysis	√	√		√
8. Analysis and interpretation of data	√	√	√	√
9. Critical revision of the manuscript			√	√
10. Manuscript writing	√	√	√	√
11. Other (please specify)				