The impact of internal supply chain integration on perceived product quality: A case study of Moulin de Laghouat Spa

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Abstract:

This study examines the relationship between internal Supply chain integration (ISCI) and Perceived product quality (PPQ) in Moulin de Laghouat company. Inter-functional Coordination (CRD), cooperation (COP), and collaboration (CLB) are introduced as dimensions of the ISCI. In this research, A path model analysis was used to evaluate the model through partial least squares structural equation modeling (PLS-SEM). The analysis of collected data from thirty employees of Moulin de Laghouat company in Algeria was performed using SmartPLS 3. Findings indicate that ISCI and CRD had an impact on PPQ. Simultaneously, both COP and CLB as dimensions of (ISCI) have no significant effect on PPQ. Results show that Moulins de Laghouat should adopt an efficient information system by implementing an ERP system to help different departments coordinating their activities. Moreover, reach a higher level of cooperation and collaboration within ISCI.

Keywords: integration; supply chain; product quality.

JEL classification codes: M10; M11.

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اثر التكامل الداخلي لسلسة الامداد على الجودة المدركة للمنتج: دراسة حالة مؤسسة مطاحن الاغواط

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الملخص:

تبحث هذه الدراسة العلاقة بين التكامل الداخلي لسلسلة الامداد و الجودة المدركة للمنتج في شركة مطاحن الاغواط بالجزائر. حيث يعتبر كل من التنسيق، التعاون و المشاركة ابعاد للتكامل الداخلي. تحليل مسار البيانات تم باستخدام طريقة نمذجة المعادلات الهيكلية باستخدام المربعات الصغرى الجزئية وذلك بالاعتماد على برنامج SmartPLS 3. و اسفر تحليل البيانات المجمعة بواسطة الاستبيان لعينة مكونة من ثلاثون عامل الى وجود تاثير للتكامل الداخلي لسلسلة الامداد و التنسيق على الجودة المدركة للمنتج. بينما كل من التعاون و المشاركة لم يكن لهم اثر على الجودة المدركة للمنتج. بينت نتائج الدراسة انه يتوجب على مؤسسة مطاحن الاغواط اعتماد نظام معلومات فعال يعزز التنسيق، التعاون و المشاركة بين اقسامها و وظائفها، و يكون ذلك من خلال تبني نظام لتخطيط موارد المؤسساتERP للوصول الى سلسلة امداد داخلية متكاملة.

الكلمات المفتاحية: تكامل؛ سلسلة الامداد؛ جودة المنتج.

رموز تصنيف JEL: M10؛M11 .

*: المؤلف المرسل.

Introduction

Over the last decades, Supply chain management (SCM) has gained substantial interest among academics and practitioners. With the competition is being fiercer, companies cannot face the intensified competition alone and stay in the race. Successful companies link their operations to external suppliers and customers in a typical chain (Frohlich & Westbrook, 2001a). In other words, the completion has been transformed from competition between independent companies and brands to whole chains competing with each other. Supply chain integration (SCI) is an essential element of a manufacturer's strategy to face competition and stay in the race by providing adequate product quality. In supply chain management, the supplier and distributor and internal operations between departments should work together harmoniously to provide adequate product quality to the customers. The supply chain integration (SCI) as a new concept means working together in an integrative is way competition has turned to be between supply chains other than between independent companies. In this context, some literature has studied Supply chain integration as two dimensions, Internal and External supply chain integration. Others have stied SCI as three dimensions; supplier Integration, Customer integration, and Internal supply chain integration (ISCI) (Boon-itt, 2009; Flynn et al., 2010a). According to Frohlich & Westbrook, (2001b), integrating the supply chain begins with integrating internal processes. This paper investigates the impact of internal supply chain integration ISCI and the inter-functional coordination, Cooperation, and Collaboration on the perceived product quality PPQ in Moulin de laghouat.

Problem definition:

The central problem which this study tried to answer is as fellow:
To what extent does the Internal supply chain integration contribute to the Product quality in Moulin de laghouat?

Secondary questions
to what extent coordination influences Product quality?
To what extent Cooperation affects Product quality?
To what extent collaboration influences Product quality?

Study Hypothesis:

A hypothesis is proposed to answer the above questions are as following:

H1. There is no statistically significant impact of the internal supply chain integration on the perceived product quality in Moulin de laghouat SPA at $\alpha<5\%$

In the light of this central hypothesis. sub-hypotheses are extracted to be tested:

H2. There is no statistically significant effect of the coordination on the enhancement of perceived product quality in Moulin de laghouat SPA at $\alpha<5\%$

H3. There is no statistically significant effect of the Cooperation on the enhancement of perceived product quality in Moulin de laghouat SPA at α<5%

H4. There is no statistically significant effect of the Collaboration on the enhancement of perceived product quality in Moulin de laghouat SPA at α<5%

Aim of the study: This Study aims to assess how the perceived product quality will be improved by integrating the internal supply chain.

Literature review

Previous studies have emphasized the impact of SCI on Product quality, firm performance, and competitivity. In this section, we show various reviews related to this research.

- Rosenzweig et al., (2003) "The influence of an integration strategy on competitive capabilities and business performance: An exploratory study of consumer products manufacturers" in this paper, the authors investigate the relationship between supply chain integration and business performance. Moreover, the mediation role of manufacturing competitive capabilities, using a sample of manufacturers from 35 countries. Results provide empirical evidence that supply chain integration improves business performance through competitive capabilities.

- Koufteros & Vonderembse, (2005) "Internal and External Integration for Product Development: The Contingency Effects of Uncertainty, Equivocality, and Platform Strategy" this study considers that internal integration affects the level of external integration using contingency theory, contextual variables moderate the relationship between integration strategy and performance, collected data from 244 manufacturing companies from various industries. The results show that both internal and external integration positively influence product innovation and quality.

- Boon-itt, (2009) "The effect of internal and external supply chain integration on product quality and innovation: evidence from Thai automotive industry" In this paper, the researchers explored the impact of internal supply chain integration ISCI and the external integration of the supply chain on product quality and innovation, with a sample of 151 automotive companies operating in Thailand by using survey questionnaires to collect data. The authors found that the ISCI had a substantial impact on the product's quality. Otherwise, integration with the supplier would have been stronger.

- Flynn et al., (2010b) "The impact of supply chain integration on performance: A contingency and configuration approach." In this study, the researchers examined the impact of SCI on performance. A total of 1356 questionnaires were distributed, 617 usable questionnaires were

returned. In this study, the researchers using a contingency and configuration approach and found a strong positive relationship between ISCI and customer integration CI on firm performance dimensions.

- Wong et al. (2011) "The contingency effects of environmental uncertainty on the relationship between supply chain integration and operational performance". This paper empirically studies the relationship between supply chain integration SCI and operational performance in the contingency effect of environmental uncertainty. They found a strong impact of the ISCI on product Quality PQ under environmental uncertainty in Thailand's automotive industry.

- Arawati, (2011) "Supply Chain Management, Product Quality, and Business Performance" In this paper, the author aims to study the critical variables of supply chain management SCM. that would affect product quality and business performance. Two hundred fifty responses were collected and analyzed using SPSS from Malaysian manufacturing companies. The study's findings show a positive effect of SCM on enhancing product quality and business performance capabilities. They used a sample of consumer product manufacturers from 35 countries. Results provide empirical evidence that supply chain integration improves business performance through competitive capabilities.

- Boon-itt, (2011) "Achieving Product Quality Performance: The Roles of Supply Chain Integration and Information Technology". in this study, the researcher focuses on the effect of IT types on the relationship between supply chain integration SCI and product quality PQ performance. A sample of 111 Thai suppliers and automakers shows a positive impact of internal integration on product quality using different IT types.

- Lotfi et al., (2013) "The Relationships between Supply Chain Integration and Product Quality." Researchers in this paper suggested that the ISCI increases product quality. This study, as articulated in literature reviews.

- Lu et al., (2018) "From supply chain integration to operational performance". This paper examines the impact of Supply chain integration on operational performance. Furthermore, how market uncertainty may moderate this relationship in 65 automotive companies in China shows a non-linear relationship between SCI and OP.

Internal supply chain integration (ISCI)

There are many definitions of the same concept of ISCI in literature, such as Internal integration, cross-functional, inter-functional, inter-departmental integration (Swink & Schoenherr, 2014).

In general, The ISCI can be defined as the degree to which a manufacturer integrates its organizational structures, practices, and processes into collaborative and coordinated operations

to satisfy the requirements of its customers (Flynn et al., 2010b). It is a complete alignment of processes through roles. Such as procurement, production, logistics, marketing, sales, and distribution (Hatani, L., Djumahir, Z. D., & Wirjodirjo, 2013), That requires holistic performance across departmental boundaries of the operations (Basnet, 2013)—and involving the incorporation of all internal functions, from material management to manufacturing as well as sales and distribution (Hosseini Baharanchi, 2009).

The interdepartmental interaction, Collaboration, and working together is primarily a question of information exchange and sharing (Zhao et al., 2011) in a cohesive organization (Kahn & Mentzer, 1996). Supply chain integration is divided into internal and external SCI. While Supplier integration (SI) and customer integration (CI) represent the external integration of the supply. The ISCI is the internal integration (II) (Flynn et al., 2010a; Swink & Nair, 2007; Wong et al., 2011).

Determinants of the internal supply chain integration

Departments should coordinate their activities in the Internal supply chain, cooperate to minimize conflicts, and finally collaborate to attain a high integration level. The integration is based on various interactions between the companies involved (departments and functions in ISCI), starting from harmonized or synchronized operations (coordination) to operate together as equal partners (Cooperation) and functioning as one unit (Collaboration) (Kotzab et al., 2019). The difference between Coordination (CRD), Cooperation (COP), and Collaboration (CLB) is not clear, and they Can be used interchangeably, Which causes ambiguity(Hammer, 2006). These determinants can be described as Bellow :

1. **Coordination:**
   In SCM, coordination aims to reach a general optimization Inside a given network Among the supply chain(Hammer, 2006) to achieve a harmonized interdependent function process (Kanda & Deshmukh, 2008). Kotzab et al., (2019) consider coordination as combining to an integral whole, working jointly, and joint operation.

2. **cooperation:**
   Cooperation is the alignment of a common objective and a joint aim. It does not mean a close working relationship with one another, but rather a constructive approach towards each other (Hammer, 2006). Anderson & Narus (1990) define Cooperation as A related or concerted complementary activity between companies in interdependent relationships to achieve common goals.

3. **collaboration**
   Cross-functional Collaboration in SCM includes multiple business activities across departmental and firm boundaries. (Eng, 2006)
   Collaboration is a process of decision making among interdependent parties that involves joint ownership of decisions and collective responsibility for outcomes(Keller & Daugherty, 2001).

Perceived Product quality (PPQ)

Quality assesses the company's ability to design and produce products that meet customer expectations (Hall, R. W., Johnson, H. T., & Peter, B. B. (1991). The efficiency of joint efforts

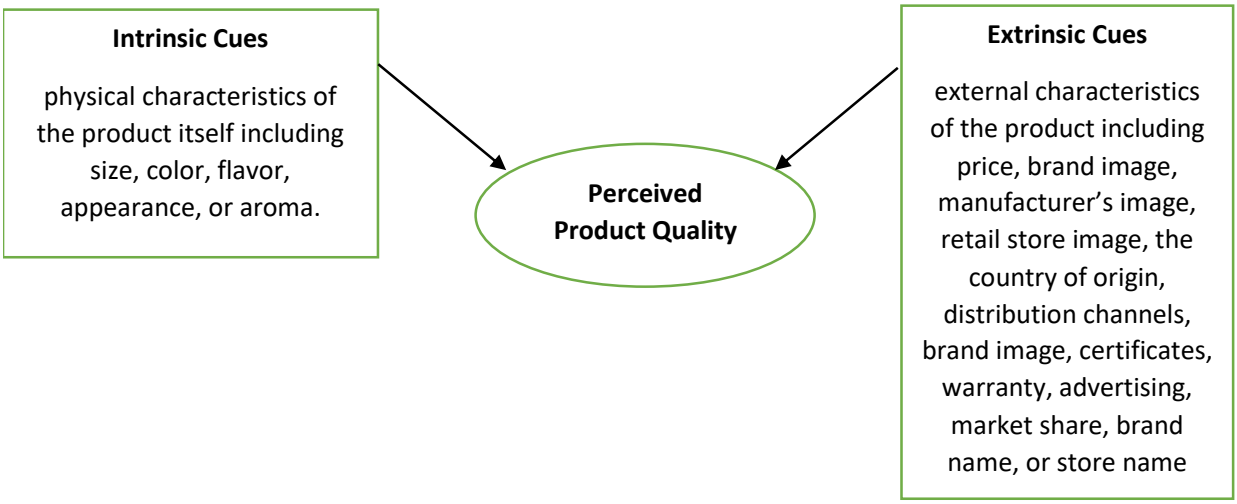
is a critical factor in the development and operation of responsive production systems designing and producing high-value goods for customers (Doll & Vonderembse, 1991). Zeithaml (1988) defines the perceived quality as "the consumer's judgment about a product's overall excellence or superiority." Perceived product quality is the consumer's perception of components of tangible and intangible characteristics of the product, including "performance, features, reliability, conformance, durability, serviceability, and aesthetics, etc. (Vantamay, 2007)

Quality judgment may be based on various product cues, such as physical properties, and extrin sic cues, such as price, brand name, store image, and promotion. (Nevid, 1981)

Determinants of perceived product quality:

According to Stone-Romero et al., (1997) there are two determinants of PPQ, intrinsic cues and extrinsic cues. both intrinsic and extrinsic cues influence the perceived quality of products.

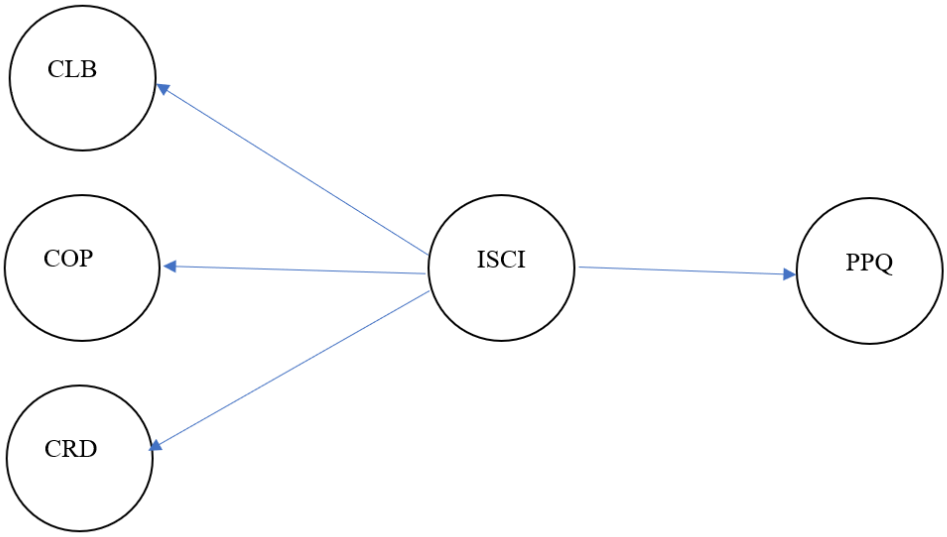
Figure N° 1
Model of determinants of perceived product quality



Source : Vantamay, 2007

The hypothetical relationships among the variables are shown in The conceptual framework in Fig. 2.

Figure N° 2
The Conceptual Framework



Source : by authors

Materials and Methods

A path model analysis was used to evaluate the Model through partial least squares structural equation modelling (PLS-SEM) analysis. This statistical technic has been chosen considering the small size simple, the prediction perspective of a theoretical framework, and the lack of normality distribution(Hair et al., 2019).

Assessing PLS-SEM requires the completion of two stages. Stage 1 examines the measurement model by assessing composite reliability and validity. Step 2 sets the structural Model (Sarstedt et al., 2020) by checking significance, coefficient of determination, predictive relevance, and hypothesis testing. To analyze the collected data, and test hypotheses, Smart PLS version 3.3.2 software is used to evaluate the measurement and structural Model and test the hypotheses. In this study, there is two conceptual Model. The first one is a 2nd order model (reflective-reflective), and it is used to check the significance of the main hypothesis. This Model is composed of one (1) endogenous latent variable (PPQ) and a 2nd order one (exogenous latent variable ISCI) as an independent variable. Based on the study of Hatani, L., Djumahir, Z. D., & Wirjodirjo (2013), coordination, Cooperation, and Collaboration are three low order latent variables reflecting the higher-order variable (ISCI). In this phase, a repeated indicators approach has been applied to assess this Model. This method consists of checking the measurement model for all the lower constructs. Then manually calculating the convergent validity and internal consistency reliability, and discriminant validity of the second-order latent variable (Sarstedt et al., 2019). After that, the structural Model will be assessed. The second Model is created to

assesses the impact of the three dimensions of the ISCI on the PPQ. Based on Bonner and nelson (1985) study, rich flavor, natural taste, a pleasing aroma, etc. are sensory signals that determine the perceived quality of 33 Food categories. We measure PPQ by choosing four determinates shown in the questionnaire. A five-point Likert style scale is considered to measure this variable.

Sample and data collection

For this study, a survey was applied in February 2020 to a random sample of 42 employees from all departments of Moulin de Laghouat, a subsidiary of AGRODIV group that works in the agri-food industry field in Algeria. Thirty valid surveys were returned.

Results and discussion

In this section it was considered important to provide evidence of construct reliability and validity to assess the measurement model then going to structural model assessment before addressing hypothesis testing

Measurement model assessment

As mentioned in Materials and methods. The first step consists of checking the Reliability and Validity of the first-order (lower order) measurement model and manually calculating the convergent validity and internal consistency reliability.

Construct Reliability and Validity

The Construct Reliability and Validity outputs show that Cronbach's alpha of all the latent variables is above 0,7. AVE values above 0,5, and CR is greater than 0,7 (Table n° 1). those Values indicate that the Model's construct is reliable and valid (Sarstedt et al., 2020). As for the higher-order latent variable construct (ISCI), values are calculated manually, following the recommended steps by Marko Sarstedt et al. (Sarstedt et al., 2019)

Table N°1

Construct reliability and validity.

	Cronbach Alpha	**Rho A**	**C R**	**AVE**
CRD	*0,863*	0.866	0.917	0.785
COP	0.809	0.823	0.877	0.645
CLB	0.771	0.774	0.852	0.592
ISCI	0.710*	0.901*	0884*	0,721*
PPQ	0.735	0.875	0.825	0.548

* Manually calculated values

Source: outputs of Smartpls.

Assessment of discriminant validity

To find support to the first-order components. The Heterotrait-monotrait ratio of correlations (HTMT) criterion is used to check discriminant validity. The results show that all HTMT values are below 1 (Table°2). That provides evidence to support discriminant validity (Henseler et al.,

2015). The discriminant validity between the higher-order construct (ISCI) and its lower-order ones is not considered because of the repeated indicators (Sarstedt et al., 2019)

Table N°2
Discriminant validity (first-order construct).

	CLB	COP	CRD	ISCI	PPQ
CRD					
COP	0,971				
CLB	0,561	0,495			
ISCI	-	-	-		
PPQ	0,453	0,491	0,581	0,584	

Source: outputs of Smartpls.

Structural model assessment

The structural Model has been evaluated following the standard model evaluation, Using bootstrapping resampling technic. Results show that the relationship between ISCI and PPQ is significant $P < 0.05$. the construct ISCI has a moderator effect on PPQ (0.493) while the R2 value is (0.243). As for the predictive relevance Q2, according to (Geisser, 1974). The value based on blindfolding is (0.083) this number is larger than 0 and less than 0.25, which means that the Model has a small predictive accuracy for the (PPQ). Finally, the assessment of the predictive power of the out of sample model. results show that all the PLS structural equation of the PPQ values (RSME and MAE) are smaller than those of the Naïve linear Model (LM).

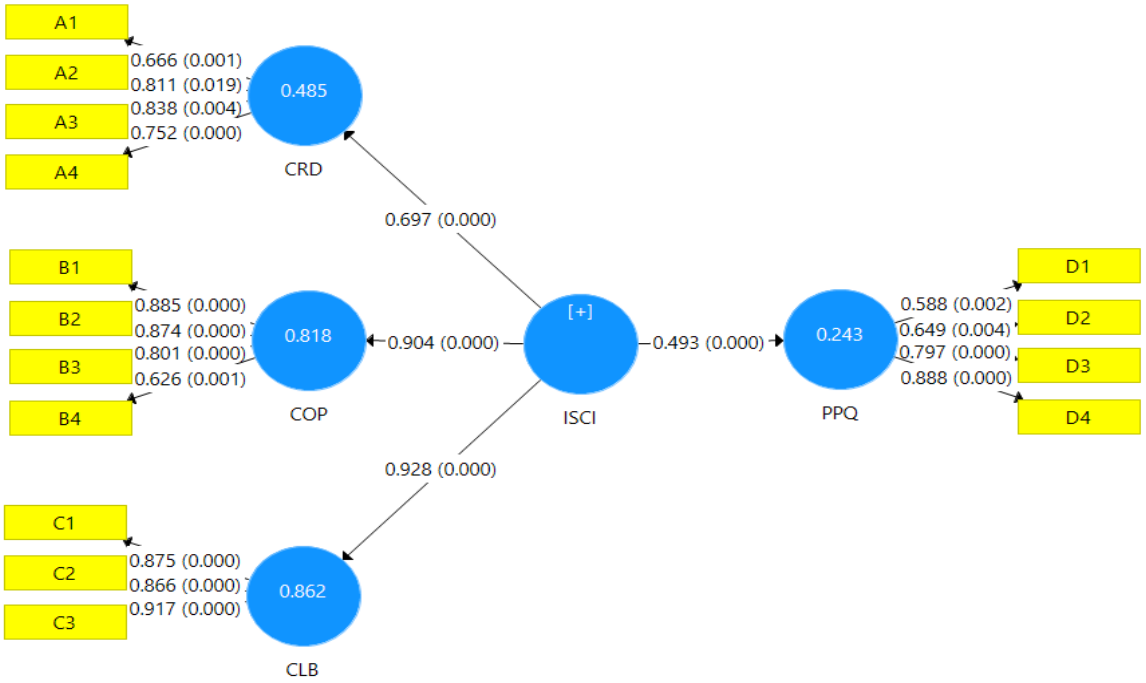
Hypothesis testing

The main hypothesis H1 is supported and significant at $(p)< 0.05$ statistics $(t) = 3.919$, $p=0,000$. indicates that the perceived product quality is influenced positively by Internal supply chain integration in Moulin de Laghouat. Figure N°3 showing factor loading and path coefficient between ISCI and PPQ.

Before checking the secondary hypotheses, another research model has to be created and assessed. The new Model links the coordination, cooperation, and Collaboration directly to the perceived product quality directly. The measurement model assessment shows that all internal consistency and convergent validity values are at a satisfactory level and the discriminant validity. For the structural model assessment, the results are also at a satisfactory level. The sub-hypotheses checking results are shown in Table N°3.

Figure N°3

factor loading and path coefficient between ISCI and PPQ.



Source : outputs of Smartpls.

H2 There is a statistically significant effect of the Coordination on the Perceived product quality in Moulin de laghouat SPA at (p)< 0.05

H3 There is no statistically significant effect of the Cooperation on the Perceived product quality in Moulin de laghouat SPA at (p)< 0.05

H4 There is no statistically significant effect of the Collaboration on the Perceived product quality in Moulin de laghouat SPA at (p)< 0.05

Table N°3

Path coefficients of the structural model and significance testing results Path

Relationship	coefficient	Mean β	STDEV	T Stat	P value	Empirical evidence
ISCI-> PPQ	0.493	0.573	0.117	4.203	0.000	Accepted
CRD->PPQ	0.490	0.504	0.212	2.309	0.021	Accepted
COP->PPQ	-0.012	0.038	0.296	0.042	0.967	Rejected
CLB-> PPQ	0.031	0.069	0.315	0.098	0.922	Rejected

Source: outputs of Smartpls.

Conclusion

Based on this study's empirical results, internal supply chain integration affects the Moulin de Laghouat company's perceived product quality. However, Cooperation and Collaboration as a dimension of the integration do not impact the perceived product quality contrary to the coordination between departments, which positively impacts the Perceived product quality. Findings also show poor interdepartmental communication. To better manage and reinforce internal integration, it is recommended to use the new technologies of information and communication as well as inventory management. This study primarily focused on the internal supply chain integration on the perceived product quality. Future research might include other Agri-food industry companies based in Algeria to understand better the role of internal integration on product quality and performance. Since the first step in building a complete supply chain integration (with suppliers and customers), other industries' research could focus on internal supply chain integration in the future.

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