LOGISTICS INTEGRATION PROCESSES

IN THE FOOD INDUSTRY

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Abstract

This paper analyses the integration process that firms follow to implement Supply Chain Management (SCM). This study has been inspired in the integration model proposed by Stevens (1989). He suggests that companies internally integrate first and then extend integration to other supply chain members, such as customers and suppliers.

To analyse the integration process a survey was conducted among Spanish food manufacturers. The results show that there are companies in three different integration stages. In stage I, companies are not integrated. In stage II, companies have a medium-high level of internal integration in the Logistics-Production interface, a low level of internal integration in the Logistics-Marketing interface, and a medium level of external integration. And, in stage III, companies have high levels of integration in both internal interfaces and in some of their supply chain relationships.

Key words

Supply Chain Management, Food industry, Logistics integration process.

JEL codes

L290, L660, M100, M110

1. Introduction

The process industries cover a wide range of businesses and realize a considerable portion of GDP in many countries. However, few Operations Management research has paid attention to this type of industries. The aim of this paper is to analyse the Supply Chain Management (SCM) implementation model in a particular process industry: the food manufacturing.

Integration along the supply chain is a topic of interest and importance among logistics managers and researchers because it has been considered a source of better supply chain performance (Shapiro, 1984; Scott & Westbrook, 1991; Byrne & Javad, 1992; Gustin, Stank & Daugherty, 1994; The Global Research Team at Michigan State University, 1995; Christopher, 1998; Cooper, 1993; Ellram & Cooper, 1993; and Christiansee & Kumar, 2000) and competitive advantage (Christopher, 1998). However, few empirical studies analyse the integration process (Stank, Keller & Daugherty, 2001; and Gimenez & Ventura, 2003).

During the 1990's some companies initiated an integration process through the implementation of the SCM approach. SCM is *"the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders"* (Lambert, Cooper & Pagh, 1998). This integrative philosophy involves internal and external integration. Internal integration refers to the coordination, collaboration and integration of Logistics with other functional areas, while external integration refers to the integration of a firm's logistics activities with those of their customers and suppliers (Stock, Greis & Kasarda, 1998).

Stevens (1989) suggests that companies integrate internally first, and then, extend integration to other supply chain members. Companies usually follow an integration

process that goes through three different stages. In stage I, there is no integration. In stage II companies are internally integrated: their logistics activities are integrated with the activities of other functional units, such as Purchasing, Production and Marketing. And, in stage III, the internal integration achieved in stage II is extended to other supply chain members, such as customers and suppliers.

The objectives of this paper are: (1) to analyse the integration process (internal – external integration); (2) to compare the integration in the Logistics-Production interface with the integration in the Logistics-Marketing interface, and (3) to explore the integration stage of Spanish food manufacturers.

Our contribution to the existing body of knowledge on integration topics is to obtain an in depth knowledge of the integration process, comparing two levels of internal integration (Logistics-Marketing and Logistics-Production) and analysing the relationship between these internal integration levels and the level of external integration. We will describe the integration model that Spanish food manufacturers are following.

The remainder of the paper is structured as follows. Section two briefly examines the literature on logistics' integration topics; section three describes the research methodology; section four presents the research results and section five draws the conclusions and managerial implications from this work.

2. Literature review

2.1. Previous logistics' integration research

Many studies consider internal or external integration from the logistics' point of view (Daugherty, Sabath, & Rogers, 1992; Larson, 1994; Daugherty, Ellinger & Rogers, 1995; Groves & Valsamakis, 1998; Stank, Crum & Arango, 1999; Stank, Daugherty &

Autry, 1999; Ellinger, Daugherty & Keller, 2000; Ellinger, Taylor & Daugherty, 2000; Scannell, Vickery. & Dröge, 2000; and Stank, Daugherty & Ellinger, 2000), but very few consider both integration levels simultaneously (Stank, Keller & Daugherty, 2001; Gimenez & Ventura, 2003 and 2003b).

The studies of Stank, Keller & Daugherty (2001) and Gimenez & Ventura (2003 and 2003b) share a common aim: to analyse the impact of internal and external integration on performance. The integration-performance models of these authors included also a relationship between the levels of internal and external integration. All of them found that these levels of integration are positively correlated. This suggests that they positively influence each other.

Our study follows a similar framework to the one used by Stank, Keller & Daugherty (2001) and Gimenez & Ventura (2003 and 2003b), but it differs from them in some points:

- Stank, Keller and Daugherty (2001) conducted a multi-industry analysis to study the relationship between integration and performance, while we consider the integration process of companies that belong to the same industry. Other differences between this study and ours are: first, they consider a unique level of internal integration, while we compare the integration achieved in two internal interfaces (Logistics-Marketing and Logistics-Production). And, second, they consider a unique level of external integration for each firm, while we consider that the level of external integration has to be related to a particular relationship (of the firm) and not to the firm itself.

- Gimenez & Ventura (2003 and 2003b) conducted a survey in the Spanish grocery sector to analyse the integration-performance relationship. While the first paper (Gimenez & Ventura, 2003) only considers internal integration in the

Logistics-Production interface, the second one (Gimenez & Ventura, 2003b) considers two internal interfaces (Logistics-Production and Logistics-Marketing), as we do in this study. Regarding the level of external integration, we share their approach: to relate the level of external integration to particular relationships and not to the firm itself. The main difference between the works of Gimenez & Ventura (2003 and 2003b) and this paper is that they analyse if there is any relationship between the level of internal and external integration without studying the integration process itself, while we focus on the integration process.

2.2. The integration model

This paper considers internal and external integration. Internal integration refers to the coordination, collaboration and integration of Logistics with other functional areas (Stock, Greis & Kasarda, 1998). This paper considers internal integration in two different interfaces: Logistics-Marketing and Logistics-Production. We consider these interfaces for two reasons: first, the coordination between these areas is vital to produce and serve what customers demand, how and when they want. And, second, Logistics is an organizational function which shares responsibilities with Marketing and Production (Casanovas & Cuatrecasas, 2001). The combination of the integration levels achieved in these two interfaces are shown in figure 1. At one extreme is a strategy of little or no integration (Option 1). At the other end of the continuum is a strategy with high levels of integration in both internal interfaces: Logistics-Marketing and Logistics-Production (Option 4). And, in between these polar extremes are companies whose strategies involve integration in the Logistics-Marketing interface (Option 3) or the Logistics-Production interface (Option 2).

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Figure 1. Internal integration
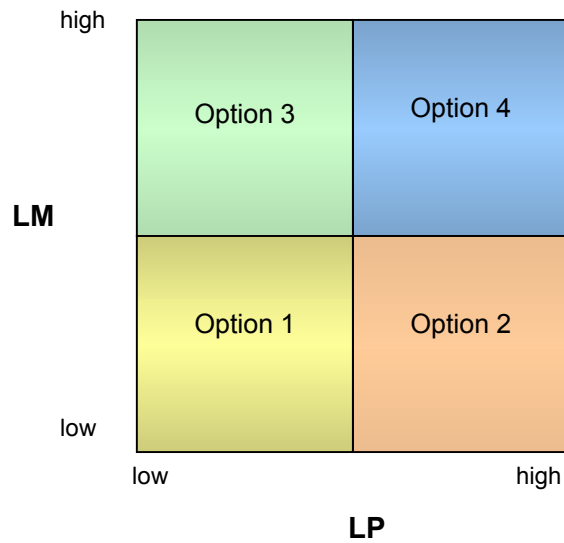
External integration refers to the integration of a firm's logistics activities with those of their customers and suppliers (Stock, Greis & Kasarda, 1998). When external integration is considered, the model shown in figure 1 is transformed into the model shown in figure 2, where the height represents the level of external integration.

Figure 2. Internal and external integration
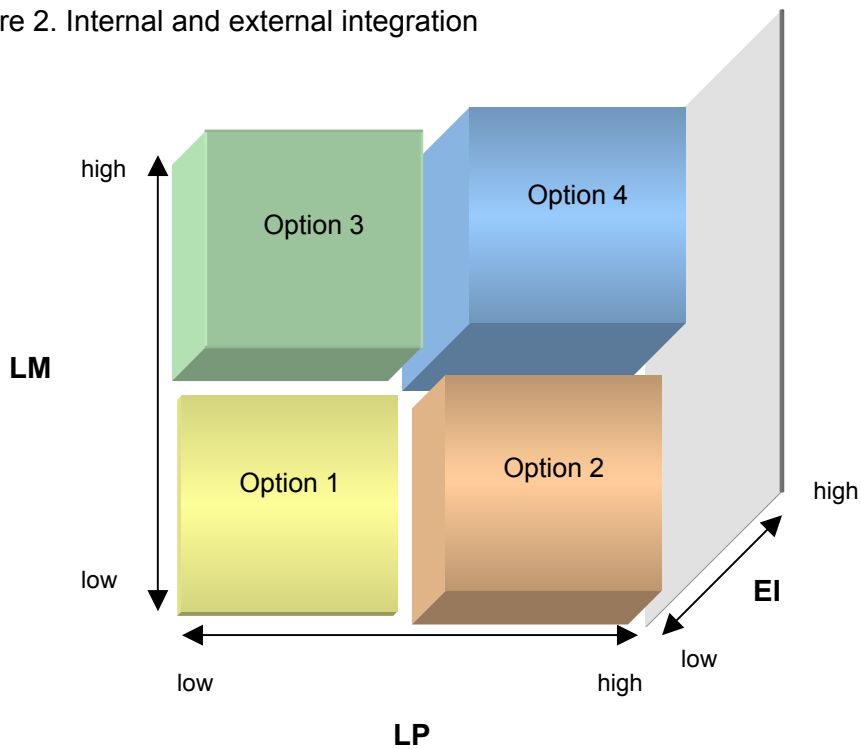
The first set of hypotheses relates to the interrelationship of internal and external collaboration. The literature suggests that firms must achieve a relatively high degree of collaboration among internal processes before initiating supply chain arrangements (Stevens, 1989). The inability to integrate fully within the firm's logistics operations is a leading cause of strategic alliance failure. Breakdowns in internal collaboration inhibit delivery of promised performance levels (The Global Logistics Team at Michigan State University, 1995).

Hypothesis H1a. Firms must achieve a relatively high degree of collaboration among internal processes before initiating external integration.

However, interviews we conducted in preparation for this research raised concerns regarding this relationship. One leading FMCG (Fast Moving Consumer Good) manufacturer had initiated an external integration arrangement with one grocery retailer without being internally integrated. This case leads us to the following hypothesis:

Hypothesis H1b. Firms must achieve a relatively high degree of external integration before initiating internal integration.

Stevens (1989) suggests that external integration is an extension of the internal integration achieved in a previous stage. Accordingly, companies with a low internal integration strategy (Option 1) should present a low level of external integration and companies implementing the full internal integration strategy (Option 4) should have the highest levels of external integration. And, given the partial nature of the internal integration achieved by companies implementing Options 2 and 3, the level of external integration of these companies should logically fall between the low internal integration (Option 1) and full internal integration (Option 4) approaches. These arguments lead to the following set of hypotheses:

Hypothesis H2a. Companies adopting a full internal integration strategy (Option 4) will have the highest levels of external integration.

Hypothesis H2b. Companies adopting either a Logistics-Production (Option 2) or a Logistics-Marketing (Option 3) integration strategy will have medium levels of external integration.

Hypothesis H2c. Companies adopting a low internal integration strategy (Option 1) will have the lowest levels of external integration.

3. Methodology

3.1. Data collection

The survey was developed in two stages. First, we identified relevant measures of internal and external integration. And, then, we held a series of meetings with logistics professors and logistics managers to gauge the content and face validity of the survey.

Data were collected from a sample of Spanish manufacturers of the food sector. These companies were selected from the Spanish data base "Fomento de la Producción 25.000 empresas". We restricted ourselves to the food manufacturers and chose those companies with a sales figure in 1999 equal to or higher than 30 million euros. The resulting sample had 172 companies. By sampling an entire country, the research controlled for many confounding factors like telecommunications infrastructure, costs and the overall economy. And, by focusing only on one industry we controlled for other confounding factors, such as the level of implementation of SCM in the industry (there are industries, such as the automotive, where SCM has been implemented for years), the level of competence and the industry's environment.

The data collection was conducted during the spring-summer of year 2001. Given the strategic focus of the research, it was decided to mail the questionnaire to the Logistics or Supply Chain executive of each firm. The industry breakdown of the sample is shown in Table 1. As early notification of prospective respondents is believed to increase response rates (Fox, Crask & Kim, 1988), we decided to telephone each firm and ask for their participation in the study. From the 172 companies, only one company refused to participate in the study. The total number of complete questionnaires was 51, which represents a 29,82% response rate. Potential participants were asked to provide sensitive and confidential data, so the response rate of 29,82% is considered very satisfactory, especially when compared to the response rate of other studies. For example, Groves & Valsamakis (1998) used data from a survey with a response rate of 15%; Stank, Daugherty & Autry (1999) worked with a 20,2% response rate, and Stank, Keller & Daugherty (2001) worked with a 11,5% response rate.

Table 1. Sample breakdown for manufacturers by sector

SAMPLE CHARACTERISTICS		
Sales volume (million €)		
More than 600	1	1,96%
401 – 600	0	0%
201 – 400	7	13,73%
101 – 200	20	39,22%
51 – 100	13	25,49%
30 – 50	10	19,61%
Sectors		
Food - Fish and preserved products	6	11,76%
Food - Dairy products	5	9,80%
Food - Wheat	4	7,84%
Food - Dried fruit	2	3,92%
Food - Meats	5	9,80%
Food - Preserved vegetables	2	3,92%
Food - Drinks	15	29,41%
Food – Oils	4	7,84%
Food - Varied products	8	15,69%

We conducted an analysis of non-response bias based on the procedure described in Armstrong and Overton (1977) and Lambert and Harrington (1990). We numbered the responses sequentially, in the order they were received, and compared late responses with early responses. No noticeable pattern among the variables could be detected to indicate the existence of a non-response bias. Accordingly, non-response bias is unlikely to be an issue in interpreting the results of this study.

3.2. Scale development

Respondents were asked to rate on multi-item scales their degree of internal integration in the Logistics-Production and Logistics-Marketing interfaces, and their level of external integration in two supply chain relationships. Internal integration was considered in these two interfaces because, as stated before, the coordination between them is vital to produce and serve what customers demand, how and when they want. And, external integration was analysed for particular relationships because we consider that companies usually strategically segment their relationships (Kraljic, 1983; Copacino, 1990; Anderson and Narus, 1991; Cooper and Gardner, 1993, Dyer, Cho and Chu, 1998; Tang, 1999, Masella and Rangone, 2000) and establish high collaborating relationships with some supply chain members and arm's length relationships with others. Therefore, each firm was asked to think about two manufacturer-retailer relationships. The first relationship was supposed to be the most collaborating one, and the second the least collaborating relationship.

Table 2 shows the items used to measure the levels of integration. These scales were ground in the literature (Ellinger, Daugherty & Keller, 2000; Stank, Daugherty & Ellinger, 2000) and exploratory and confirmatory factor analyses were used to ensure reliability. All scales were unidimensional using principal components, except internal integration in the Logistics-Production interface (IILP). The exploratory factor analysis

(shown in Appendix A) showed that IILP1 was related with a different factor. As a result, the first proposed measure for internal integration in the Logistics-Production interface (IILP1) was discarded. The scales were summed averages of the measurement items and reliability (see Cronbach's α in Table 3) was very satisfactory. Table 3 also shows the measures' Pearson correlation.

Table 2. Variables

VARIABLES
Internal Integration Logistics-Production (scale of 1 to 10)
IILP1: Informal teamwork
IILP2: Shared ideas, information and other resources
IILP3: Established teamwork
IILP4: Joint planning to anticipate and resolve operative problems
IILP5: Joint establishment of objectives
IILP6: Joint development of the responsibilities' understanding
IILP7: Joint decisions about ways to improve cost efficiencies
Internal Integration Logistics-Marketing (scale of 1 to 10)
IILM1: Informal teamwork
IILM2: Shared ideas, information and other resources
IILM3: Established teamwork
IILM4: Joint planning to anticipate and resolve operative problems
IILM5: Joint establishment of objectives
IILM6: Joint development of the responsibilities' understanding
IILM7: Joint decisions about ways to improve cost efficiencies
External Integration (scale of 1 to 10)
EI1: Informal teamwork
EI2: Shared information about sales forecasts, sales and stock levels
EI3: Joint development of logistics processes
EI4: Established work team for the implementation and development of continuous replenishment programs (CRP) or other ECR practice
EI5: Joint planning to anticipate and resolve operative problems
EI6: Joint establishment of objectives
EI7: Joint development of the responsibilities' understanding
EI8: Joint decisions about ways to improve cost efficiencies

Source: Internal integration variables were adopted from the literature (Ellinger, Daugherty Keller, 2000; Stank, Daugherty & Ellinger, 2000), while external integration variables were designed adapting the internal integration variables to a supply chain relationship.

Construct validity was established by testing whether the items in a scale all loaded on a common factor when within-scale factor analysis was run. Appendix B shows that all eigenvalues exceeded the threshold of 1,0, which supports each scale's dimensionality.

Table 3. Model measurement and correlation matrix

MODEL MEASUREMENT AND CORRELATION MATRIX				
SCALE	1	2	3	4
1. IILP	,9436			
2. IILM	,5884**	,9553		
3. R1IE	,4839**	,3803**	,9643	
4. R2IE	,3765**	,3155*	,7433**	,9472

Cronbach's α are in italics on the diagonal.
** significant at P<0,01.
* significant at P<0,05.

3.3. Cluster analysis

Cluster analysis was used to determine the stages of integration of the Spanish food manufacturers. A K-means cluster analysis was used. This non-hierarchical algorithm requires the researcher to determine the number of groups to obtain. The most appropriate number of clusters was determined using a split-half analysis. We selected a four-cluster option as the starting point for the split-half analysis (theoretically there can be four combinations of the Logistics-Production and Logistics-Marketing integration levels, see Figure 1) and tested four-, three- and two-cluster models. The three-cluster solutions in each of the two split-halves shared the most similarities. But, the decision to employ a three-cluster model was also based on interpretability. Moving from four- to three- cluster solution combined similar clusters, whereas moving from three- to two-cluster solution forced together dissimilar clusters. Also, as it can be

appreciated in Figure 3, it seems that the three-cluster model is the most suitable one.

Table 4 shows the results of the cluster analysis.

Figure 3. Dispersion graphic and intuitive clusters
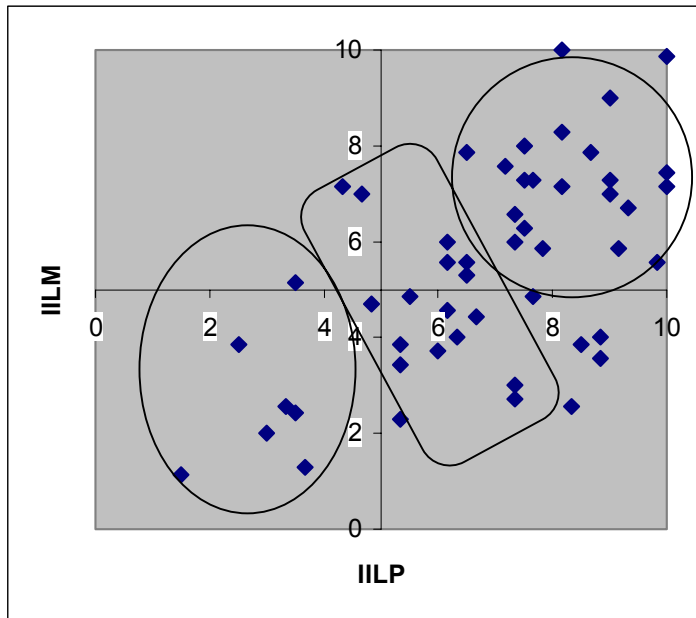
Table 4. Cluster analysis

CLUSTER ANALYSIS				
FOUR-CLUSTER MODEL	**1**	**2**	**3**	**4**
IILP	6,05	3,26	8,73	7,13
IILM	5,99	2,22	7,61	3,74
Number of cases	14	7	17	13
THREE-CLUSTER MODEL	**1**	**2**	**3**	
IILP	8,48	3,29	6,63	
IILM	7,50	2,59	4,63	
Number of cases	20	8	23	
TWO-CLUSTER MODEL	**1**	**2**		
IILP	7,91	5,03		
IILM	6,71	3,29		
Number of cases	32	19		

To validate the results of the cluster analysis we ran a discriminant analysis (see Table 5). The discriminant analysis classified 98% of the companies as the cluster analysis did, indicating extremely good differentiation and a correct classification.

Table 5. Discriminant analysis

DISCRIMINANT ANALYSIS

	Initial number of cases	Predicted group membership			Total
		1	**2**	**3**	
Number	**1**	20	0	0	20
	2	0	8	0	8
	3	1	0	22	23
%	**1**	100	0	0	100
	2	0	100	0	100
	3	4,3	0	95,7	100

Percent of "grouped" cases correctly classified: 98%.

4. Results

4.1. Internal integration

The cluster analysis has revealed that, according to the internal integration stage achieved, there are three different groups of companies in the Spanish food sector (see Figure 4). *Cluster 1* is made of firms with a high level of internal integration in both interfaces: Logistics-Marketing and Logistics-Production (being higher in this latter interface). In *cluster 2* companies have a low level of internal integration in both interfaces, while in *cluster 3* firms have a low-medium level of integration in the Logistics-Marketing interface while a medium-high level of integration in the Logistics-Production interface.

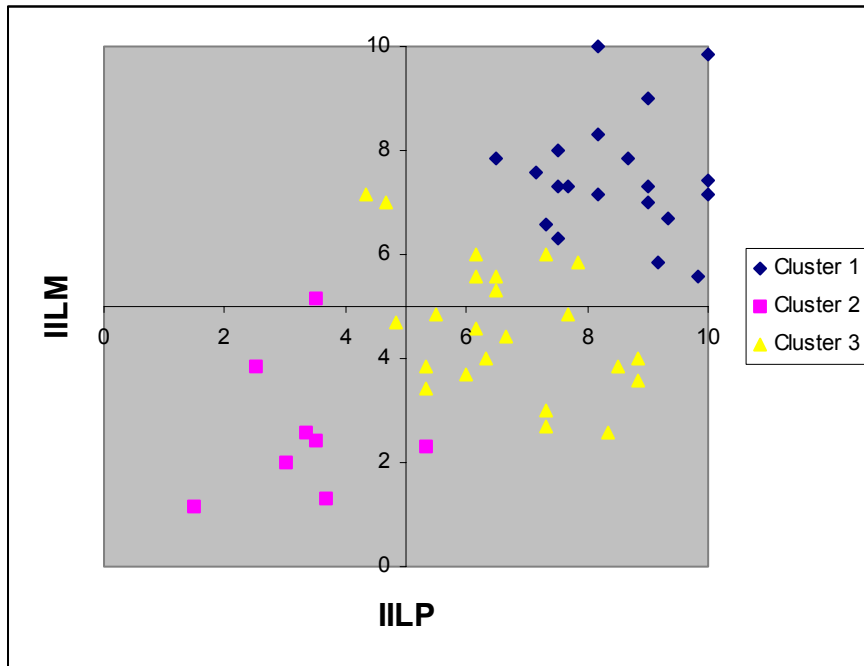Figure 4. Clusters identified with the K-means method

Table 6 summarises the mean values of the items and scales for each one of the clusters. As it can be appreciated, IILP1 (Informal team work with people from the Logistics and Production departments) has a value higher than five in all the clusters. This means that despite not being integrated in the Logistics-Production interface, people from both functional areas work together as an informal team. When there is no integration in the Logistics-Production interface both functional areas do not share ideas, information or other resources; there is neither a joint planning to anticipate and resolve operative problems and neither a joint establishment of objectives, responsibilities or decisions about ways to improve cost efficiencies ... Therefore, what is the role of these informal teams? Further research should investigate the role and aims of these informal teams.

As it can be appreciated in Figure 4 and Table 6, integration in the Logistics-Production interface is always higher than the integration in the Logistics-Marketing interface. This

could be due to the fact that in Spain Logistics has traditionally been considered an area within the Operations domain.

Analysing the clusters where there is some integration (clusters 1 and 3), it can be appreciated that in both interfaces (the Logistics-Production and the Logistics-Marketing), the items that have obtained a higher rate among their scales have been II4 (IILP4 and IILM4) (see Table 6). This means that the aspect on which these three functional areas collaborate most is in the "joint planning to anticipate and resolve operative problems". Other items with a high rate in the integration evaluation are II7 (IILP7 and IILM7): "Joint decisions about ways to improve cost efficiencies". Among the items with a lower rate within their scales, we can find II5 (IILP5 and IILM5): "Joint establishment of objectives". These findings suggest that these three functional areas may collaborate more in the operational aspects than in the strategical ones; however, further research should investigate this result.

The findings also suggest that there can be integration in the Logistics-Production interface despite not being integrated in the Logistics-Marketing interface. However, without Logistics-Production integration there cannot be integration in the Logistics-Marketing interface. Also, the existence of the "NO Logistics-Production, NO Logistics-Marketing"-, the "Logistics-Production, NO Logistics-Marketing"- and the "Logistics-Production, Logistics-Marketing"- clusters suggests that companies may follow an integration process where they integrate first in the Logistics-Production interface and then in the Logistics-Marketing interface (see Figure 5).

Table 6. Descriptive statistics by cluster

DESCRIPTIVE STATISTICS BY CLUSTER						
	Cluster 1		Cluster 2		Cluster 3	
	Mean	Sd deviation	Mean	Sd deviation	Mean	Sd deviation
INTERNAL INTEGRATION LOGISTICS-PRODUCTION						
IILP1 (not included in the IILP scale)	7,85	2,13	5,75	2,60	6,70	1,79
IILP2	8,15	1,90	3,75	1,39	6,87	1,66
IILP3	8,10	1,33	3,63	2,00	6,22	1,98
IILP4	8,95	1,00	3,38	1,30	7,39	1,53
IILP5	8,20	1,96	2,50	0,76	6,09	1,95
IILP6	8,65	1,31	3,38	1,19	6,57	1,53
IILP7	8,85	1,84	3,13	1,55	6,65	1,70
IILP (Scale)	**8,48**	**1,07**	**3,29**	**1,09**	**6,63**	**1,32**
INTERNAL INTEGRATION LOGISTICS-MARKETING						
IILM1	7,50	1,70	3,00	2,20	5,22	1,86
IILM2	7,60	1,31	2,75	1,39	4,61	1,23
IILM3	7,15	1,42	3,00	1,51	4,30	1,66
IILM4	8,20	1,36	2,63	1,60	4,91	1,88
IILM5	7,10	2,05	2,00	1,77	4,09	1,70
IILM6	7,45	1,85	2,13	1,73	4,39	1,92
IILM7	7,50	1,73	2,63	1,77	4,91	1,38
IILM (Scale)	**7,50**	**1,15**	**2,59**	**1,33**	**4,63**	**1,27**
EXTERNAL INTEGRATION MOST COLLABORATING RELATIONSHIP						
R1EI1	6,20	2,48	3,63	2,56	5,26	1,98
R1EI2	7,30	2,45	4,00	2,27	5,70	2,84
R1EI3	6,85	2,58	4,13	2,70	5,52	2,54
R1EI4	6,20	2,75	2,88	2,36	4,96	2,88
R1EI5	6,80	2,26	3,75	2,25	5,35	2,59
R1EI6	6,10	2,90	2,88	1,96	4,22	2,88
R1EI7	6,15	2,87	2,75	1,98	4,96	2,48
R1EI8	6,35	3,01	3,63	2,07	4,70	2,93
R1EI (Scale)	**6,49**	**2,41**	**3,45**	**1,85**	**5,08**	**2,31**
EXTERNAL INTEGRATION LEAST COLLABORATING RELATIONSHIP						
R2EI1	3,20	1,94	1,50	1,07	2,52	1,78
R2EI2	3,50	2,12	1,63	0,92	2,30	1,43
R2EI3	3,65	2,28	2,13	0,83	2,26	1,60
R2EI4	2,95	2,04	1,13	0,35	2,04	1,74
R2EI5	3,25	1,74	1,38	0,52	2,35	1,77
R2EI6	3,00	1,65	1,38	0,52	1,74	1,36
R2EI7	3,15	1,73	1,50	0,53	2,52	2,13
R2EI8	3,25	2,15	1,38	0,74	1,83	1,34
R2EI (Scale)	**3,24**	**1,59**	**1,50**	**0,42**	**2,20**	**1,46**

Figure 5. Three internal integration stages model
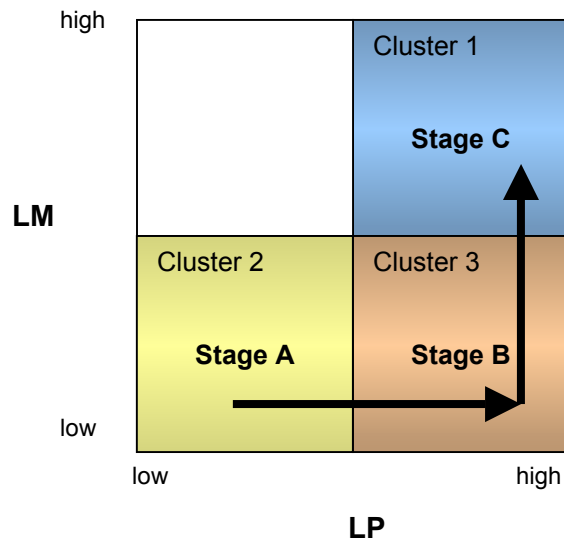
4.2. External integration

Regarding external integration for the most integrated relationship (Relationship 1), we can appreciate that the item that has obtained a highest rate is R1EI2 "Shared information about sales forecasts, sales and stock levels". This suggests that the way supply chain partners collaborate most is through the sharing of information.

How are firms approaching external integration? Do companies in each one of the three internal integration stages establish collaborating relationships with other supply chain members? Table 7 summarises the results of the integration levels of Relationship 1 (the most collaborating relationship) and Relationship 2 (the least collaborating relationship). In order to determine if a relationship is an externally integrated relationship it needs to have a rate of five or higher in its external integration scale, otherwise it is classified as a non-integrated relationship.

Table 7. Supply chain relationships by cluster

SUPPLY CHAIN RELATIONSHIPS BY CLUSTER		
	Integrated relationships	**Non-integrated relationships**
Cluster 1 (IILP, IILM)		
R1	15 (75%)	5 (25%)
R2	4 (20%)	16 (80%)
Cluster 2 (NO IILP, NO IILM)		
R1	1 (12,5%)	7 (87,5%)
R2	0 (0%)	8 (100%)
Cluster 3 (IILP, NO IILM)		
R1	10 (43,48%)	13 (56,52%)
R2	2 (8,70%)	21 (91,3%)

Table 7 shows that in cluster 1, fifteen companies had an externally integrated relationship in their most collaborating relationship (R1), and among these companies, four had also an integrated relationship in their least collaborating relationship (R2). In cluster 2, only one company had an integrated relationship and it was in its most collaborating relationship (R1). And finally, in cluster 3, ten firms had an externally integrated relationship in their most collaborating relationship (R1), and among these ten companies only two had also an externally integrated relationship in their least collaborating relationship (R2). These findings and the values of the scales R1EI and R2EI in Table 6 suggest:

1. Companies in cluster 1 (fully internally integrated) have a higher level of external integration than companies in clusters 2 and 3 (see the values of the scales R1EI and R2EI in Table 6, and the percentages of integrated relationships in R1 and R2 in Table 7). Companies fully internally integrated
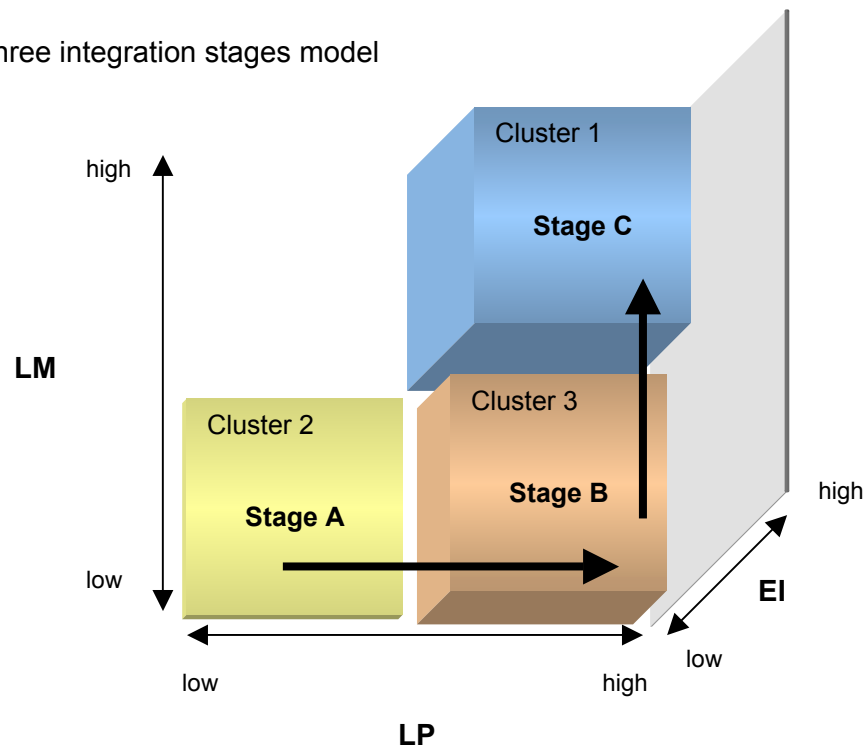
(cluster 1) also have externally integrated relationships with their least collaborating retailers. In cluster 3 (firms integrated only in the Logistics-Production interface), there are also some companies with externally integrated relationships with their least collaborating customers, but less than in cluster 1. These findings support for hypothesis H2a: Companies adopting a full internal integration strategy (Option 4: Integration in the Logistics-Production and Logistics-Marketing interfaces) will have the highest levels of external integration.

2. There is a very low level of external integration in companies with a low level of internal integration in both internal interfaces: Logistics-Production and Logistics-Marketing (cluster 2). The scale values for R1EI and R2EI in Table 6 are below five, and the percentages of integrated relationships in R1 and R2 in Table 7 are also very low. These results support for hypothesis H2c: Companies adopting a low internal integration strategy (Option 1: Low internal integration in the Logistics-Production and Logistics-Marketing interfaces) will have the lowest levels of external integration.

3. Hypothesis H2b, that companies adopting either a Logistics-Production (Option 2) or a Logistics-Marketing (Option 3) integration strategy have medium levels of external integration, was partially supported, as this hypothesis could not be tested for companies integrated only in the Logistics-Marketing interface. Companies only integrated in the Logistics-Production interface (cluster 3 – Option 2) have a medium level of external integration. Values of R1EI and R2EI of cluster 3 in Table 6 are between the values of R1EI and R2EI of clusters 1 (full internal integration) and 2 (no internal integration). Also, the percentages of integrated relationships of cluster 3 are between the percentages of clusters 1 and 2.

4. The positive correlations between internal and external integration (see Table 3) imply that they influence each other. Internal collaboration may influence external collaboration and vice versa. The influence of external collaboration on internal collaboration has to be understood as an incentive to internal integration: if firms want to collaborate with external customers and suppliers, they need to enhance internal integration. The low level of external integration of non-internally integrated companies, and the fact that the higher the level of internal integration the higher the level of external integration, suggest that firms first internally integrate and then extend the collaboration to other supply chain members. This supports H1a and rejects H1b.

Figure 6 summarises these findings. It shows that the integration process that Spanish food manufacturers are following consists of three sequential stages. First, is stage A, where there is no integration. Second, is stage B where there is a medium-high level of integration in the Logistics-Production interface, a low-medium level of internal integration in the Logistics-Marketing interface and a medium level of external integration. And finally, is stage C, where companies increase their level of internal integration in both internal interfaces (Logistics-Production and Logistics-Marketing) and increase also their level of external integration.

Figure 6. Three integration stages model

5. Conclusions and managerial implications

Only 30% of the companies in the sample have implemented SCM (there are only fifteen companies in cluster 1 which have externally integrated relationships). However, there are many companies in their way to implement it. Firms have realised that enhanced competitiveness requires that companies ceaselessly integrate within a network of organizations – firms ignoring this challenge are destined to fall behind their rivals.

As their future survival lies on integration, a good understanding of the integration process is a key aspect. And, in this area, our study has a main implication for managers pursuing integration: in the integration process, firms must achieve a relatively high level of collaboration among internal functions before initiating any external integration. A prerequisite for successful SCM is internal integration (Lambert, Cooper & Pagh, 1998). Internal integration refers to the collaboration and coordination of Logistics with other functional areas, such as Production and Marketing. Such

collaboration and coordination means that these functional areas must have formal teamwork and share ideas, information and other resources. Integration also means that there is a joint planning to anticipate and resolve operative problems, a joint establishment of objectives, a joint development of the responsibilities' understanding and a joint establishment of decisions about ways to improve cost efficiencies.

Managers pursuing integration have to take actions to promote this sharing of information and joint planning. These actions cover a wide range of aspects: first, there is the need to change the organisational structure, including (1) the establishment of the key business processes to be managed by formal cross-functional workteams and (2) the modification of the criteria on which functional managers are evaluated. One way to coordinate activities within the firm is to identify the key business processes and manage them using cross-functional teams. Cooper, Lambert & Pagh (1997) extensively describe the key business processes that could be linked across the firm and the supply chain. Another way to promote integration is to change the criteria on which managers are evaluated. Gimenez (2003) describes some examples where a wrong manager evaluation system led to cost-inefficient purchasing decisions (in terms of total cost of ownership).

Second, there is the need to train people on the benefits that integration can bring. Change management and people training play a key role in an integration process, as they are crucial to minimise the barriers to implementing SCM.

Our study suggests that Spanish food manufacturers seem to initiate integration by coordinating Logistics and Production. As stated before, this might be due to the fact that, in Spain, Logistics has been considered an area under the Operations and Production domain. This finding does not imply that companies have to implement SCM by integrating first in this interface. Firms should initiate integration in the interface

where it is easier and where integration benefits can be obtained early. This will encourage further integration efforts.

The results also show that the highest levels of external integration are associated to companies with the highest levels of integration in the Logistics-Production and Logistics-Marketing interfaces. This implies that although integration has been started only in the Logistics-Production interface, when higher levels of external integration are pursued, there is the need to integrate also in the Logistics-Marketing interface. Therefore, managers pursuing supply chain integration need to pay attention to all internal interfaces.

Another implication for managers is how to approach external integration. The results have shown that sharing of information (about sales, sales forecasts and stocks) and joint planning and development of logistics processes play again a key role in the integration process. This implies that there is the need to move from an arm's length type of relationships to a more partnership approach, where trust and sharing of information are vital.

Our study has contributed to the existing knowledge by providing a description of how Spanish food manufacturers are approaching integration. However, our paper has some limitations: first, in the analysis of external integration, it has only considered one side of the manufacturer-retailer relationship. And, second, due to the reduced number of cases in each cluster, a statistical comparison of means to analyse the integration differences has not been possible.

Further research should investigate the integration processes in other industries and countries. It should also consider other internal interfaces, such as Logistics-Purchasing and Production-Purchasing, and investigate the business processes that are critical and/or beneficial to integrate and manage within and between firms.

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Appendix

Appendix A. Exploratory factor analysis

	Factors				
	1	**2**	**3**	**4**	**5**
R2EI5	**,896**	,244	,113	,101	
R2EI7	**,829**	,250		,114	
R2EI6	**,824**	,264	,131	,167	
R2EI8	**,810**	,251	,235		
R2EI2	**,793**	,254	,113	,139	
R2EI4	**,772**	,284			,151
R2EI3	**,736**	,465			,157
R2EI1	**,576**	,490	,155		,253
R1EI5	,337	**,870**	,179	,141	
R1EI3	,298	**,869**		,180	
R1EI8	,401	**,850**		,156	
R1EI1	,139	**,777**	,175	,117	,334
R1EI7	,491	**,757**	,112	,250	
R1EI6	,488	**,712**	,108	,291	
R1EI2	,396	**,702**	,268	,129	-,115
R1EI4	,464	**,658**	,191	,208	
IILM3		,271	**,891**	,104	,162
IILM4			**,884**	,222	
IILM6	,114		**,878**	,216	
IILM5	,148	,244	**,840**	,169	
IILM2	,178		**,833**	,335	
IILM7	,111	,135	**,804**	,336	
IILM1			**,768**	,152	,448
IILP6		,166	,361	**,835**	
IILP4	,118	,161	,285	**,834**	,162
IILP7	,265	,238	,312	**,806**	
IILP5		,285	,278	**,802**	
IILP3	,113	,130	,229	**,726**	,495
IILP2	,272		,245	**,632**	,560
IILP1				,273	**,874**

Principal component analysis. Rotation method: Varimax with Kaiser.

Appendix B. Within-scale factor analysis

Internal integration Logistics-Production

		Factor loading
	IILP4	,916
	IILP6	,908
	IILP5	,891
	IILP7	,881
	IILP3	,875
	IILP2	,838
Eigenvalue	4,703	
Percent of variation	78,38%	
Kaiser-Meyer-Olkin	,861	
Bartlett test of sphericity	287,714	
Significance	,000	

Principal component analysis

Internal integration Logistics-Marketing

		Factor loading
	IILM3	,934
	IILM2	,911
	IILM6	,907
	IILM4	,903
	IILM5	,885
	IILM7	,871
	IILM1	,824
Eigenvalue	5,561	
Percent of variation	79,44%	
Kaiser-Meyer-Olkin	,910	
Bartlett test of sphericity	354,484	
Significance	,000	

Principal component analysis

External integration (relationship 1)

		Factor loading
	R1EI5	,954
	R1EI8	,943
	R1EI7	,936
	R1EI3	,934
	R1EI6	,905
	R1EI2	,851
	R1EI4	,851
	R1EI1	,784
Eigenvalue	6,432	
Percent of variation	80,40%	
Kaiser-Meyer-Olkin	,922	
Bartlett test of sphericity	488,881	
Significance	,000	

Principal component analysis

External integration (relationship 2)

		Factor loading
	R2EI5	,935
	R2EI6	,880
	R2EI7	,872
	R2EI3	,870
	R2EI8	,863
	R2EI2	,840
	R2EI4	,831
	R2EI1	,762
Eigenvalue	5,888	
Percent of variation	73,61%	
Kaiser-Meyer-Olkin	,800	
Bartlett test of sphericity	401,364	
Significance	,000	

Principal component analysis