The decision making process of your company is really integrated?

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Abstract

The paper describes the development of a study of production planning decision-making process. The internal and the external integration of the supply chain have become essential for many industries. However, according to a global survey of the supply chain: companies have put so much attention about supply chain integration that they have forgotten about the internal integration. The literature about internal integration defines it as a key element in the performance of the company and the entire supply chain. Besides there is a problem of misconception of their own level of internal integration. Companies could trust to be integrated based in misconceptions or incomplete information. This could lead to miss valuable synergies that could reduce the overall cost.
Using a survey among production planning practitioners, we investigate the decision-making process of the internal planning, operation scheduling and inventory control at the shop level. The degree of integration is analysed using the decision-making process and other drivers suggested in other studies. We conclude that many companies have a misalignment in the implementation of their philosophies. Consequently, the possibility of enhance is lost by silo decisions and managers should implement the internal integration practices in the different areas of the production planning.

Keywords: Production planning, Silo view, Decision making

1. Introduction

There is a substantial scientific and nonscientific literature on supply chain collaboration and management and supply chain integration. The literature highlights the advantages of this integration; successful cases are reported in the different industries, such as manufacturing and automotive (Landry, 1998; Akintoye et al., 2009). Some researchers, such as de Souza and Ledur (2011), have empirically confirmed a positive relationship between supply chain management and operational performance; they assume that creating alliances with members of the same chain improves its competitive advantage, reflected by superior performance of all members.

Unexpectedly, the results obtained in the global survey of supply chain highlight that "supply chain managers often perceive that their companies are more accomplished in external integration efforts than they are in internal efforts" (Poirier et al., 2008).

Integration is a term used in several field, one of the general meaning is "Process of attaining close and seamless coordination between several departments, groups, organizations, systems, etc. although they are not compound into an entity"

Integration could be achieved through interaction or communication activities with among the functional departments. Other literature characterizes as an act that stimulates teamwork, share of resources and collective goals.

Topolsek et al. (2009) highlight the importance of internal integration as a prerequisite for a successful external integration. Each company must first make sure to achieve a high level of internal integration and then integrate itself as a competitive company of the supply chain.

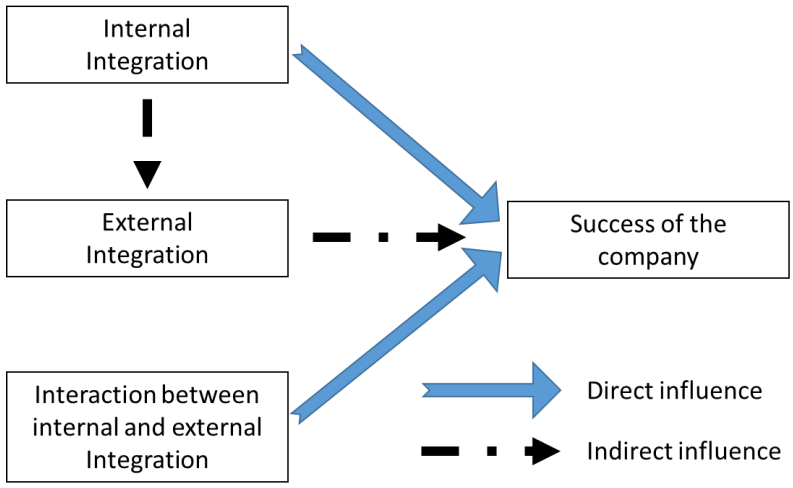

Figure 1. Influences of the internal and external integration adapted from (Topolsek et al 2009).

Lee (2002) emphases that information sharing though the use of IT, and a tight coordination allow us control efficiency the supply chain. All this are facilitated by the use of Internet. Despite the news and papers about the use of IT decision systems in enterprises that control each area of the companies and all the integration theories, we want to investigate the current degree of integration of the different departments at the shop level.

Since, there is a lack of information about specific types of integration in the production planning area (Williams et al., 2013). We want to research on the integration of the production planning through a survey to know the current integration degree of the industry.

Because an increase in the awareness of key structural decision in internal integration facilitates external integration with customers and suppliers (Langowitz, 1988; Millson et al., 1992)

The aim of this study is to measure the internal integration in the production planning area. Using a survey among production planning professionals from different industrial sectors, we evaluate the degree of internal integration and information sharing in the different parts of the company. Late, we evaluate the effect of the performance of an integrated decision making process.

The remainder of the paper is organized as follows: literature review, objective, methodology, questionnaire design, data analysis, results, and conclusion, followed by the references.

2. Literature Review

2.1. Internal integration

Internal integration is the core competence derived from linking internal activities to best support the (internal or external) client at the lowest cost. This total cost concept requires that all the components are managed holistically and they are taken into consideration (Bowersox, 2002). One example is an increase of the logistic cost by using air transportation, justify by the decrease the inventory cost, resulting in an overall lower cost.

Souder and Sherman (1993) defined as "a state of high-level values, common objectives and collaborative values." The goal of the integration should be eliminate traditional silo departments and enhance the coordination among the areas.

Internal integration is the missing link in establishing how visibility affects the responsiveness of the supply chain. Accurate, timely, and complete information is not enough if there is a lack of internal integration (Williams et al., 2013).

Narasimhan and Kim (2001) place great emphasis to use of strategies for information system utilization to persuade the integration. Zailani and Premkumar (2005) found that traditional managers are concerned about their own functions inside their departments and with bureaucratic tasks with a prejudice in the integration.

2.2. Information sharing

The information sharing refers to exchange of information among the interested users of this information. There is a discussion on the use of IT in different areas such as inventory, where Mishra et al. (2013) found evidence that firms' IT capabilities have significant positive effects on their inventory efficiency. Lee (1992) warn us to the use of inefficient information systems, which could cause more losses than benefits. For example, when the retrieve and input of information is tedious, laborious and many manual processes exist. In addition, when the information is not accurate or it is outdated.

Other mayor problem is the data integration and communication among the systems, for example, when the company uses different software, and those do not speak among each other's highlight the importance of IT system for the integration (Lee, 2002)

Heeks (2002) analyze several failures of information technologies implementations, giving as one of the failure reasons the design gap (the mismatch between IS and local user actuality needs).

2.3. Main integration drivers and measurements

Pagell (2004) developed a model of the drivers for the internal integration; he claims that a better integration fosters the strength and competencies of the firm. He highlights the business structure and the measurements and rewards cross-functional teams, job rotations, top management support, information technology, and communications as drivers for performance.

Frohlich and Westbrook (2001) measure the integration of the supply chain using arcs of integration, and eleven years later (Schoenherr and Swink, 2012), continue this study recognizing internal integration as the strength of the relationship between outward arcs and other performance indicators.

3. Objective

As mentioned in the introduction a proper internal and external integration are beneficial for the performance of the company and the entire supply chain. However, despite that literature emphasis the internal integration for a successful external integration, the companies has decrease the focus of internal integration (Poirier et al., 2008).

Integration should occur between internal and external functions. Inside the organization, the different departments should work together. The focus is on the internal planning process. In particular, the survey investigated the decision-making processes related to internal planning, operations scheduling, and production activity control at the shop floor level (be it a job shop/parts manufacturing or assembly department).

Several studies have revealed that some companies fail despite that the different departments are achieving their objectives because of a "silo view" and make decision in complete isolation without considering other departments' opinions (Capasso and Dagnino, 2012). We want to know if the decision makers in the different stages, share the same department or person.

A study of the complexity of the organizations performed by Malhotra and Mackelprang (2012) warns us that the complexity of the organization is continually increasing. The matter that obtains an advantage of an integrated supply chain is more complex than the research expected.

One of the keystone of this article is the misalignment between the *perceived* integration and the *real* integration. For example, the decision-making process of a functional department should take into consideration variables and constraints of other functional department in order to be integrated.

The objective of this article is to measure the degree of integration of the company through the analysis of the decision making process, the business structure, the information sharing, and the own integration perception. Moreover, analyse their impact in the performance.

Proposition 1. *Higher perceived performance should be the result of the perceived integration.*

Proposition 2. *It is possible measure the misalignment between the perception of the integration of the supply chain and the integration degree calculated using the drivers proposed by Pagell (2004).*

Proposition 3. *A higher level of information share system increases the internal integration of the company.*

***Proposition 4**: Group orientation could explain better the relationship with the production planning performance process.*

4. Methodology

The methodology used for to address the hypothesis presented in this research was a survey, following the steps proposed by Forza (2002), which could be summarized as follows: link to the theoretical level, design, pilot-test, collect data for theory testing, analyse the data, and conclude.

One definition of *internal integration* is proposed by Zhao (2011) as "the degree to which a firm can structure its organizational practices, procedures and behaviours into collaborative, synchronized and manageable process." In addition, it includes the use of data and information system, real-time data, integration of the different activities, and

cross-functional cooperation. Finally, internal integration identifies that the company should not act as functional silos but as an integrated process.

From the main drivers that are proposed by Pagell (2004), we focus on the structure, the measurements and rewards, job rotations, information technology, and communications as drivers for performance in order to measure the degree of integration of production planning and to get further knowledge of the integration of the schedule of production, inventory, and replenishment.

Past studies (Swamidass and Newell, 1987) has described the difficulty to obtain financial measure, despite the additional difficult to isolate the plant from the others departments and business units, although is preferable obtain objectives measure this are difficult to compare in different sectors, and production structure, then we decide to ask for perceptual measurements of managerial performance.

To study the internal integration degree, we decided to give questionnaires to production planner specialists regarding their perception of the production planning process and its degree of integration.

5. Questionnaire design

To collect the data, a semistructured questionnaire was developed that contained open-ended and closed-ended questions. The questionnaire survey looks at the production planning specialists in different plants (we define *production plant* as the unit of analysis in order to make a better comparison for different-size plants) and, in some cases, compares the results from among plants from the same company.

We ran a pre-test using a company with several plants; the comments received from the pre-tester helped us modify the scales and questions.

The questionnaire, accompanied by a cover letter, was sent through two methods: e-mail and LinkedIn. In the first one, we emailed different companies and then asked to forward to the production planning responsible. The second and most successful was through LinkedIn, we look for groups of professional of production planning practitioners, and we found mainly two groups APICS and POMS. We sent a personal small message invited them to participate in the study. We obtained 72 answers, 56 valid entries, and 16 invalid entries since they did not complete the questionnaire.

This research was considered exploratory. The questionnaire was designed to be answered between 15 and 20 minutes. It consists of 23 questions, with a majority of multiple-choice questions and Likert scales, and with 4 long open questions.

Three versions of the questionnaire (English, Italian, and Spanish) were done to facilitate the answers of the respondents, especially for the open questions. The web-based survey tool Typeform© was used. Some scales are inspired from Koste et al. (2004) to capture some flexibility attributes. To avoid problems with confidentiality issues, and increase the response rate, we do not ask for any personal data neither financial information of the company, all the data was threated anonymously.

Respondents were asked to describe their decision-making and planning algorithms or software that they use, with respect to the following:

1. Characteristics of their production facility (size, workers, products and clients)
2. Degree of perceived integration and performance
3. Decision drivers
    a) Business structure (job rotation, goals, philosophy)
    b) Information sharing (IT, software, inventory tracking)

c) Decision making process at shop level (input, variables and constraints taken account)

6. Data analysis

Before to start with the analysis, a data cleaning was done, we eliminated 16 incomplete answers and an open question since the majority of the answers were extremely basic. Data analysis were undertaken taken using the functional language and environment to statistics STATA© and R© 3.0.2. with RStudio© v0.98.

6.1. Characteristics of their production facility

In this part, we characterize the sample. We use multiple question and the descriptive statistics are presented in the Table 1. The table 1 contains the composition of the sample based the size of the production capacity, sectors, and the production structure.

The sample is composed from different sectors with a highlight in the Automotive and car component sector; the companies with more than 50 employees in the production facility represent more than 50% of the sampling. Finally, the production structure is more represented by the Job shop but all the production structure are represented with at least 17%.

Table 1 - Sample statistics

Employees				
	Frequency	Percent	Valid Percent	Cumulative Percent
< 010 employees	14	25,0	25,0	25,0
< 050 employees	11	19,0	19,0	44,0
< 250 employees	20	35,0	35,0	80,0
> 250 employees	11	19,0	19,0	100,0
Total	56	100,0	100,0	
Sector				
	Frequency	Percent	Valid Percent	Cumulative Percent
Automotive / Components	18	32,0	32,0	32,0
Defense	5	8,0	8,0	41,1
Electric	3	5,0	5,0	46,0
Electronics	8	14,0	14,0	60,0
Energy	3	5,0	5,0	66,1
Food and Beverage	7	12,0	12,0	78,0
Manufacturing	3	5,0	5,0	83,0
Personal Care	5	8,0	8,0	92,0
Telecom	4	7,0	7,0	100,0
Total	56	100,0	100,0	
Structure				
	Frequency	Percent	Valid Percent	Cumulative Percent

Assembly line / Repetitive (semicontinuous, high volume)	14	25,0	25,0	25,0
Batch processing (moderate volume and variety)	15	26,0	26,0	51,0
Job shop (small lots, low volume, general equipment)	17	30,0	30,0	82,0
Projects (Non routine jobs)	10	17,0	17,0	100,0
Total	56	100,0	100,0	

6.2. Degree of perceived integration and performance

We use a Likert scale, to measure the perceived degree of internal integration, and performance of the production planning (see Table 2). Where 1 mean nonintegrated or poor performance or and 5 is fully integrated or good performance respectively. Where nobody perceive their performance as a poor performance, and in general they perform highly. The perceived integration has a bigger standard deviation and range.

Table 2. Perceived integration and performance

	Mean	Std Dev	Min	Max
Perceived integration	3.23	1.24	1	5
Perceived performance	3.63	0.84	2	5

In order to test our first proposition: Higher perceived performance should be the result of the perceived integration. We make a regression analysis to explain the behaviour of the performance because of the integration (see table 3). The perceived integration in not statistically significant at the 0.05 level. The coefficient is positive which indicate that higher integration is related to higher performance. For our preposition 1, we could assume that there are correlated, but the integration is not enough to explain the performance.

Table 3. Regression analysis

Perceived performance	Coefficients	Std. Err.	t	P>|t|
Perceived integration	0.08	0.09	0.89	0.38
Constants	3.36	0.32	10.54	0.00

6.3. Decision drivers

Business structure. We coded the multiple option questions scale following the next equivalences- For Job rotation was assigned a zero if it is not allowed up to 5 points if it is strongly advised. It is interesting highlight that only two respondents answered that was strongly recommended, despite of many rotation ideas, it is not widely implemented in the companies. For the structure, we assign 5 to assembly line and 1 to project base. For the number of variants, 5 was for a single product and 1 when each product is different.

The philosophy we assigned 0, 1, or 2. Since LEAN, JIT, TOC persuade the integration we assigned two points if they mention it. 1 point for any other and if no philosophy or they do not know it 0 point.

For Goals, if they are based on single performance we assigned the minimum of 1, as they include more areas we rate up to 5 for the entire company. For the decision-making we assign two points if the decision of the three areas was performed by the same department, one if only2 shared department, and zero otherwise.

Information sharing. For the use of IT/Optimization software, we assign 0, 1 or 2 points according with the given software. In order to measure how efficient is one of the most common use of the IT in the production planning. We measure the level of the integration of the system for the inventory management, assigning 5 points, if they do it automatically, 3 points if they do it manually, 2 points if they do it for some products, a 1 point if they do not do it.

Decision making process. The most difficult part to integrate to the integration index was the open question since the transformation from text to a numeric value is always subjective. The open question asked about the schedule, replenishment, inventory, and exception management. We assigned one point for the index for each part of the description of the decision-making process that took into consideration something that was not from this area (e.g., for the replenishment, if they answered constraints related to scheduling or production, they got an integration point.

The maximum assigned points was 5. We limit the assign to 5 mentions per type of answer, since a long answer has more chances to mention other items, the size of the answers varies a lot, answer shorter that 100 characters was discarded (10 were eliminated). The rest of the scales were rated on a five-point Likert scale.

In the Figure 2, the scree plot of the factor analysis is display. In order to underlying the factors that explain these results, and start to test our second proposition, we perform an exploratory factor analysis. The eigenvalues of the first 4 factors was 4.17, 1.49, 0.62 and 0.52. We decide to accept the first two components using the typical threshold of 1. The Cronbach alpha test resulted in an average inter item covariance of 0.30 and a reliability coefficient of 0.76.

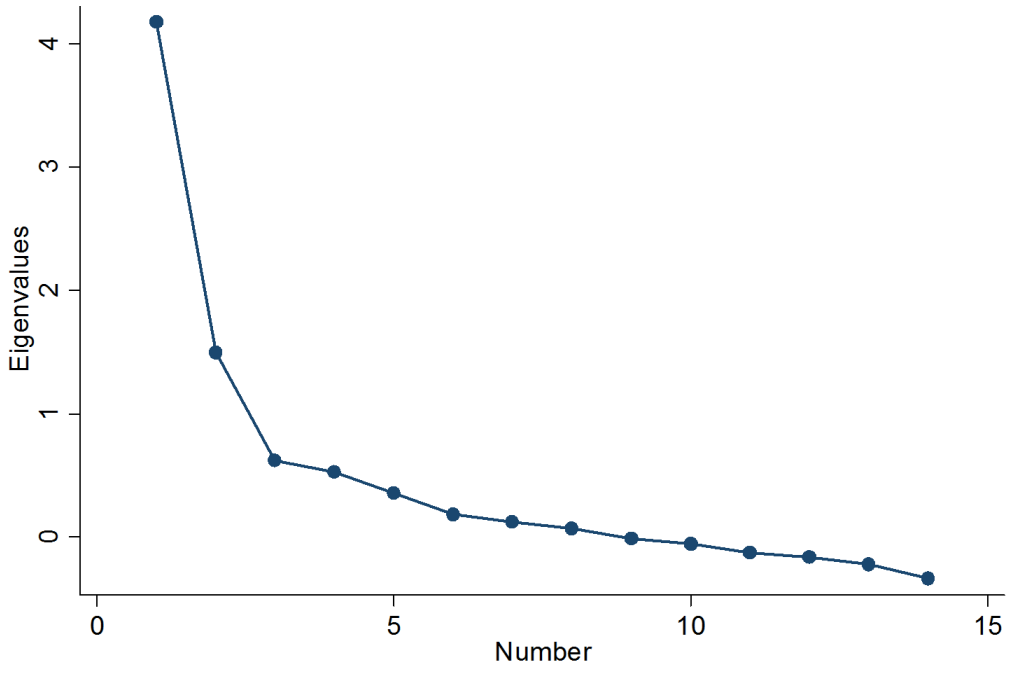

Figure 2. Scree plot of eigenvalues after factor.

To maximize the square of variance of the two factor that we will retain we use a Varimax rotation. We are going to rename Factor 1 as an integration factor, and Factor 2 as a complexity factor.

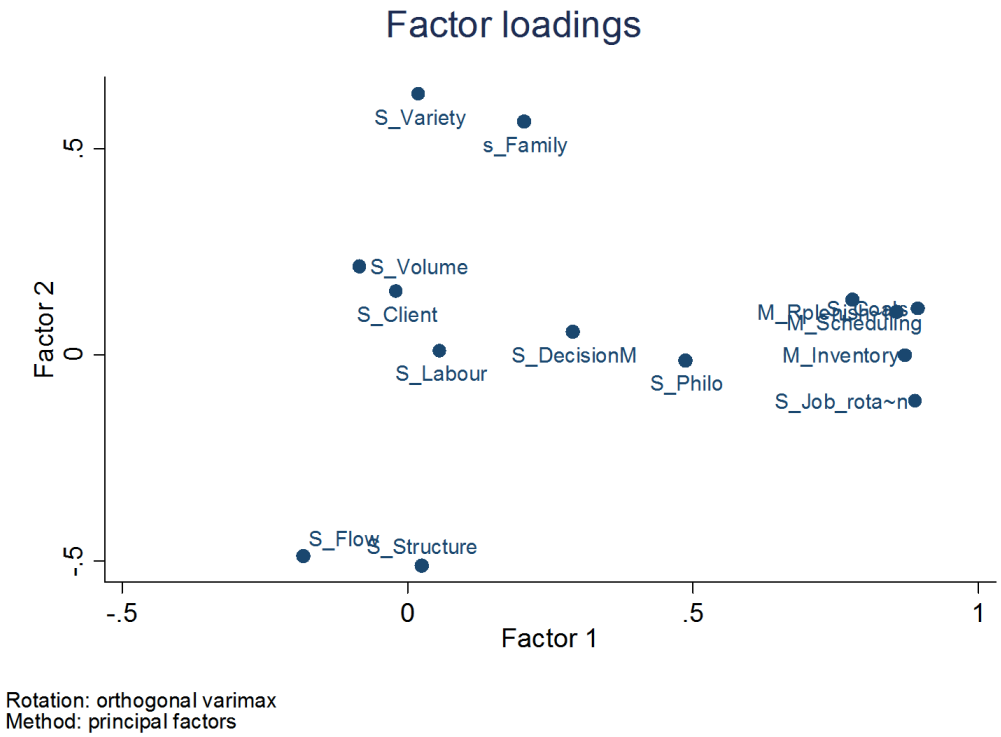

Figure 3. Plot of the factor loadings after varimax rotation.

Using the two factors obtained in the previous step (complexity and integration), the normalize value of the score of IT, and the inventory integration of the IT we explain the perceived integration (see Table 4). Let's focus in the only predictor that is statistically significant at 95% level is the ones related with IT. In addition, the other predictor related with information sharing is important for the result. It is interesting that the IT and the inventory integration explain the perceived integration instead of the indirect measure of integration and the complexity. The use of an information sharing system makes the companies believe that they are integrated without evaluate the others factors. For the second proposition we could measure the perceived integration using the different drivers described by Pagell (2004).

Table 4. Perceived integration factors

Perceived integration	Coefficients	Std. Err.	t	P>|t|
Integration	0.13	0.12	1.12	0.27
Complexity	0.06	0.13	0.45	0.65
Score of IT	0.35	0.12	5.24	0.00
Inventory Integration	0.19	0.10	1.92	0.07
Constants	0.00	0.10	0.03	0.98

For the third proposition, we want to know if I higher level of information share system could increase the internal integration. We assume than one of the main influencer in the perception of the integration was the use of information systems (IS) or information technologies (IT), we run a correlation analysis between this two variables and we find a strong correlation among the use of information sharing system (See Table 5). However many authors such as (Gunasekaran and Ngai, 2004) have state that IS by itself it is not enough to guarantee the integral integration of the supply chain. However, it is impossible have it without an IS system. Then we could say that IT is necessary but not sufficient.

Table 5. Correlation between Integration and IT

	Perceived integration	**Information Sharing**	**System Inventory Int**
Perceived integration	1.00		
System Inv Int	0.27	1.00	
Information Sharing	0.71	0.13	1.00

The clusters use the multiple predictors to explain the relationship among the variables. To test our fourth proposition, that according with Kaufmann and Carter (2006) is related with the performance. The data were cluster analyzed using principal component analysis. We use the k-mean clustering technique using a Euclidean distance, the number of groups selected was 4, despite the proposed limit by Lehman(1979) to be limited between n/30 and n/60. Since a 2 groups oversimplify the explanation and a bigger one give us few elements in each group.

The clusters were tested first using ANOVA to test the differences in the defining variables among the cluster. Second Scheffe pairwise comparison of mean were performed to determine which pairs where significantly different. The results are presented in the Table 5. Table 5, presents the cluster means and the standar deviasion and the relative ranking of the emphasis of the characteristic among the group. The numbers in the parentheses show the group number from which this group was significantly different to the other groups.

Table 6. ANOVA post hoc test

	Cluster				
	1	**2**	**3**	**4**	F=Value (p=probability)
Perceived Performance	**0.89**	**-0.56**	**-1.10**	**0.50**	**15 (0)**
Pairwise	(2,3)	(1,4)	(1,4)	(2,3)	
Std. Dev.	0.31	0.79	0.61	0.79	
Rank	1	3	5	3	
Perceived integration	**-0.39**	**-0.75**	**-0.08**	**0.81**	**16.09 (0)**
Pairwise	(4)	(4)	(-)	(1,2)	
Std. Dev.	0.94	0.83	0.41	0.62	
Rank	4	5	3	2	
System Inventory Int	**-0.40**	**-0.88**	**-0.04**	**-0.94**	**34.42 (0)**
Pairwise	(4)	(3,4)	(2,4)	(1,2,3)	

Std. Dev.	0.52	0.48	0.76	0.64	
Rank	5	6	2	6	
System Sharing	**-1.03**	**0.33**	**-1.16**	**0.44**	**12.3 (0)**
Pairwise	(2,4)	(1,3)	(2,4)	(1,3)	
Std. Dev.	0.74	0.81	0.82	0.77	
Rank	6	1	6	4	
Measure complexity	**-0.22**	**-0.65**	**-0.52**	**0.85**	**17.7 (0)**
Pairwise	(4)	(4)	(4)	(1,2,3)	
Std. Dev.	0.82	0.22	0.23	0.97	
Rank	3	4	4	1	
Measure integration	**0.75**	**-0.28**	**0.24**	**-0.91**	**3.96 (0.013)**
Pairwise	(2,4)	(1)	(-)	(1)	
Std. Dev.	0.72	0.85	0.55	0.68	
Rank	2	2	1	5	
No. Firms	**8**	**20**	**6**	**21**	
Percent	15%	36%	11%	38%	

7. Result and discussion

The four clusters are named according with their characteristic:

Cluster 1: Highly integrated

The first cluster account for the remaining 15% with 8 units. They perceived themselves as a High Performance companies. The reason for that is that they also achieve a highly measure of integration and a medium complexity. They do not claim to have super integrated information sharing system or everything automated, but they achieve overcome this difficulties with other practices such as personal rotation, or the philosophies used.

Cluster 2: High IT

The second cluster account 36% of the firms, with 20 units. They use complex IT systems to result in a high integrated firm. But, they perceived themselves with a low-medium performance and one of the explanation is that they lack of communication among their IT system. Also, they recognize this problem because they do not perceive themselves very integrated.

Cluster 3: Bad performers

This cluster of 6 units is the less numerous of the three clusters with a 11% of the population. They are highly integrated, but they are not performing good, since they have the lowest information sharing. They are only using some inventory tracking but the information systems are not spread among the company the decision makers take the decision in insolation, and in the analysis of the open questions hardly mention any item that there is no typically for this area.

Cluster 4: Misaligned

This cluster of 21 units is the most numerous of the three clusters with a 38% of the population. This is the most interesting cluster since, thy have a high complexity, and the majority claims a high degree of integration but they achieve a low score for integration. They do not encourage the main drivers of the integration, such as personal rotation, they

give incentives mainly in personal performance, in the open questions they do not mention any concept of other areas. They perceive a medium performance of the production planning process. This opens an interesting question about if there is also a misperception of the performance or they are achieving averaged. Unfortunately, with the information collect we cannot triangulate the information to answer this question.

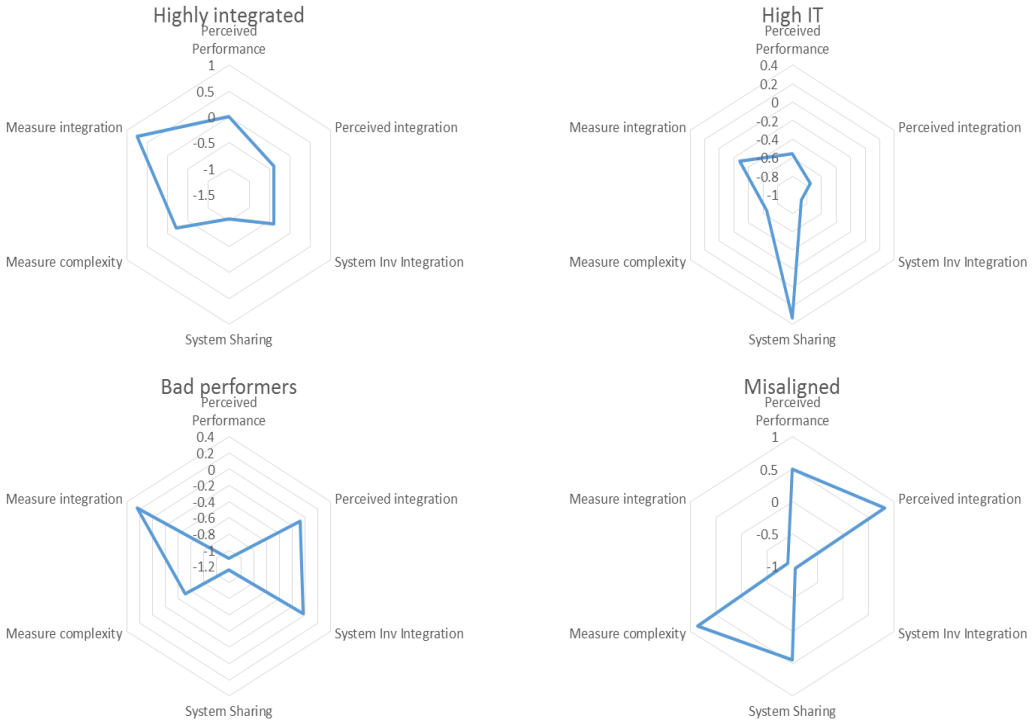

Figure 4. Graphs of the four clusters.

OpCos under the same Company.

From our sample, we get six companies which belong to two group (similar IP address or mail affiliation). Despite that for the number of respondents we cannot get any statistical analysis, we could obtain some interesting insights, that will be analyzed in the next part of this research. The first interesting part that was our initial assumption was that the Operational Companies (OpCos) from the same group will behave in the same way.

The only question that was answer pretty similar was the how the goals are defined, that at least for all the OpCos of the company are common. For the philosophies that they claim to implement they answer with different theories, that despite that could be similar like Lean or JIT are not the same. A detailed analysis of the open question, we realize that the answer as far from each other as any other company of the same cluster.

There are potential synergies that may be realized by combining or standardizing activities such as R&D, manufacturing, purchasing or distribution. (Dessein et al, 2010).

Other possible problems caused loose of synergies is the lack of knowledge sharing, since the best practice are not spread around the group. Or if the knowledge is spread is difficult to spread because of the lack of standardization.

8. Summarizing

For the Proposition 1, we use a linear regression to analyze the interaction of the perceived integration and perceived performance, which was not enough to explain the performance.

For proposition 2, we use the drivers proposed by Pagell to measure the internal integration, we use a Factor analysis to make a reduction of the variables used. We keep two factors that we named as Integration and complexity. In addition, we realize that the perception of integration is different to the one that is measure, mainly explained a problem of a misperception.

For the proposition 3, we use a correlation matrix to measure the degree of correlation between the perceived performance and the use of an Information system, which was very high.

For the Proposition 4, we use a cluster technique to identify the different firms. We obtain 4 clusters: the Highly integrated, the high IT, the Bad performers and the misaligned. We run a pair wise analysis to measure the different among the groups.

8.1. Implications

There is a general agreement that competitive supply chains employs well internal integrated process, that many times is misconceived for only use software. The election and integration the software is a major task that should be carried carefully. However, exist other opportunities areas where we could improve the internal integration.

One that should be highlighted is take into consideration in the decision making process more parts, invite the other stake holders of the other process to explain and understand the cost and implication of the changes that can help the other functional areas (remember the example of a higher transportation cost).

We were surprised about the results for Job rotation, which apparently is a policy easy to implant, for only 12% of the companies is strongly advised, for the majority of the firms they have it but they do not encourage it or it is difficult to get it. On the other hand, we were glad to find that the performance of the whole company is part of the goal performance of more than 55% of the firms.

9. Conclusions

The analysis of the open question gave us interesting results that went beyond the scope that we assigned. We got a better knowledge of the integration level though the accounting of mentions of other variables and constraints of other functional areas. Some plants claim a higher integration, but they do not take into consideration other decision factors outside their area, in other words, they continue with the silo view.

In order to get a better understanding of the results obtained through the survey, we performed some face-to-face interviews to enrich the perception and get a deeper vision than what we got from tables and matrix.

With one of the plants further interviewed, we realize that they have reported that they have an IT software, lean philosophy, and they claimed to be integrated, but the interesting fact was that when they explained their decision making, they only reported constraints and variables of the department; they are still pursuing the excellence of their operating silos, not the overall performance. The biggest problem is that they have the perception of integration.

It is very interesting when we have multiple answers from the same company that there is a misalignment in the internal planning process and decision-making activities in all the operation companies (OpCos) of the group. We expected that the same decision

pattern was kept among the group. We realized that at a group level, there is no clear and unifying vision of how the internal planning process should be taken. We suggest that the contribution of all internal companies could help devise a similar map that would help the sharing of knowledge and good practices.

A great opportunity area is to try to get more information from the IT / Optimizer used and in which information contains. Unfortunately, many answer are proprietary system, or even the one that use a specific software like SAS© they do not detail which modules they use, and then it was impossible to give a better score for the use of IT. Only the use of IT is the subject of single researches.

Other opportunity area is the open question, which give us really valuable information for a deeper analysis of the decision making process of the different companies, a content analysis or data mining techniques could help us to extract more information.

The main limitation is the sample size, which does not allow examining if this behavior depends of the geographic localization of the plant, since we do not have enough data of each subgroup to make a proper analysis.

In the next stage of this research, we are planning to launch a second wave of request of survey to get a larger sample in order to generalize this conclusion to different sectors, and countries. Another interesting step of this research is conduct the studio to inside big companies and understands how the behavior and integration of the different Operative Companies is. Creating a bigger database of different will allows obtaining many managerial insights. An immediately feedback tool base on other results will increase the response rate.

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References

Akintoye, A., McIntosh, G., & Fitzgerald, E. (2000). A survey of supply chain collaboration and management in the UK construction industry. *European Journal of Purchasing & Supply Management*, *6*(3), 159-168.

Bowersox, D. J., Closs, D. J., & Cooper, M. B. (2002). *Supply chain logistics management* (Vol. 2). New York: McGraw-Hill.

Capasso, A., & Dagnino, G. B. (2012). "Beyond the "silo view" of strategic management and corporate governance: Evidence from Fiat, Telecom Italia and Unicredit." *Journal of Management & Governance*, pp. 1-29.

de Souza Miguel, P. L., & Ledur Brito, L. A. (2011). Supply Chain Management measurement and its influence on Operational Performance. *Journal of Operations & Supply Chain Management*, *4*(2).

Dessein, W., Garicano, L., & Gertner, R. (2010). Organizing for synergies.*American Economic Journal: Microeconomics*, *2*(4), 77-114.

Forza, C. (2002). Survey research in operations management: a process-based perspective. *International journal of operations & production management*,*22*(2), 152-194.

Frohlich, M. T., & Westbrook, R. (2001). "Arcs of integration: an international study of supply chain strategies." *Journal of operations management*, 19(2), pp.185-200.

Gunasekaran, A., & Ngai, E. W. (2004). Information systems in supply chain integration and management. *European Journal of Operational Research*,*159*(2), 269-295.

Heeks, R. (2002). Information systems and developing countries: Failure, success, and local improvisations. *The information society*, *18*(2), 101-112.

Landry, J. T. (1998). Supply chain management-The case for alliances. Harvard Business Review 22.

Langowitz, N. (1988). An exploration of production problems in the initial commercial manufacture of products. *Research Policy*, **17,**43–54.

Lehmann, D. R. (1979). *Market research and analysis* (Vol. 3). Homewood, IL: Irwin.

Lee, H. L., & Billington, C. (1992). Managing supply chain inventory: pitfalls and opportunities. *Sloan management review*, *33*(3).

Lee, H. L. (2002). Aligning Supply Chain Strategies with Product Uncertainties.*California management review*, *44*(3).

Kaufmann, L., & Carter, C. R. (2006). International supply relationships and non-financial performance—a comparison of US and German practices. *Journal of Operations Management*, *24*(5), 653-675.

Koste, L.L., Malhotra, M.K., Sharma, S., (2004). "Measuring dimensions of manufacturing flexibility." *Journal of Operations Management* 22, pp.271–296

Malhotra, M. K., & Mackelprang, A. W. (2012). Are internal manufacturing and external supply chain flexibilities complementary capabilities?. *Journal of Operations Management*, 30(3), pp. 180-200.

Millson, M. R., Raj, S. P., & Wilemon, D. A. (1992). A survey of major approaches for accelerating new product development. *Journal of Product Innovation Management*, **9**(1), 53–69.

Mishra, S., Modi, S. B., & Animesh, A. (2013). "The relationship between information technology capability, inventory efficiency, and shareholder wealth: A firm-level empirical analysis." *Journal of Operations Management*, 31(6), pp. 298-312.

Narasimhan, R., & Kim, S. W. (2001). Information system utilization strategy for supply chain integration. *Journal of business logistics*, *22*(2), 51-75.

Pagell, M. (2004). Understanding the factors that enable and inhibit the integration of operations, purchasing and logistics. *Journal of Operations Management*, 22(5), pp. 459-487.

Poirier, C. C., Swink, M., & QUINN, F. J. (2008)." Sixth annual global survey of supply chain progress: still chasing the leaders." *Supply Chain Management Review*, 12(7).

Schoenherr, T., & Swink, M. (2012). "Revisiting the arcs of integration: Cross-validations and extensions." *Journal of Operations Management*, 30(1), pp. 99-115.

Souder, W. E., & Sherman, J. D. (1993). Organizational design and organizational development solutions to the problem of R&D-marketing integration. *Research in Organizational Change and Development*, *7*(2), 181-215.

Swamidas, P. and Newell, W. (1987), "Manufacturing strategy, environmental uncertainty and performance: a path analytic model", Management Science, Vol. 33 No. 4, pp. 509-24.

Topolšek, D., Lipičnik, M., & Gajšek, B. (2009). The importance of internal integration for a successful external integration of the supply chain. *POSLOVNA LOGISTIKA U SUVREMENOM MENADŽMENTU BUSINESS LOGISTICS IN MODERN MANAGEMENT*, *29*(1), 45.

Williams, B. D., Roh, J., Tokar, T., & Swink, M. (2013). "Leveraging supply chain visibility for responsiveness: The moderating role of internal integration." *Journal of Operations Management*, 31(7), pp. 543-554.

Zailani, S., & Rajagopal, P. (2005). Supply chain integration and performance: US versus East Asian companies. *Supply Chain Management: An International Journal*, *10*(5), 379-393.

Zhao, X., Huo, B., Selen, W., & Yeung, J. H. Y. (2011). The impact of internal integration and relationship commitment on external integration. *Journal of Operations Management*, *29*(1), 17-32.