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# Focusing information in manufacturing: a knowledge management perspective

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## Keywords

Manufacturing, Management, Knowledge workers, Strategic information systems

## Abstract

This paper addresses, from a knowledge management perspective, the following question: How are companies choosing the information that is considered more important for the management of the manufacturing process? We analyze empirically, from a strategic approach, how different types and sources of information may influence information characteristics like accuracy, access, and timing. In addition, we also evaluate how information is related to manufacturing competencies and performance. The results indicate that customer-focused information and information technologies (IT) are the most important aspects that influence information characteristics.

## Introduction

The increasing access to and use of information have led manufacturing to face new managerial challenges. In this context, information can be considered as a central resource for the managers together with other traditional resources like raw materials, equipment and people. Furthermore, the increasing environmental dynamism has stressed information as vital for the current competitive conditions.

In this research, we are seeking to identify how manufacturing companies are searching for strategic information. Given that currently there is an increasing offer of information sources, are the companies trying to focus in specific sources? Or is the search for a greater number of types and sources of information an increasing trend? Additionally, we may question how information may influence some competitiveness driving forces.

Are companies with distinct performance levels developing closer relationships with customers? Or, may different types and sources of information and information characteristics influence companies' performance?

This article is structured according to the following sequence: the first section presents the theoretical background on organizational knowledge and information; the next section shows the general theoretical premises; the last sections present the empirical results and the first conclusions.

## Conceptual basis

**Information and organizational knowledge**  
Manufacturing companies have been facing rapid changes in their environments in

the last decades. To Bettis and Hitt (1995), the current dynamism in competitive environments has led to decreasing forecastability and increasing risks. In this manner, information and knowledge are becoming the most important competitive resources.

As information is becoming a central input in current competitive environments, companies should identify which information is more important for their competitiveness. Also, as response time in dynamic environments may be a decisive characteristic, shorter times to find the relevant information may decrease the total response time. The expression "economies of knowledge", proposed by Roth (1996) is in point. "Economies of knowledge" occur when "the firm is able to use its business acumen, combined with skilled people and experienced with advanced technologies, to create an organization that consistently identifies, assimilates, and exploits new knowledge more efficiently and effectively than the competition" (Roth, 1996, p. 1). "Economies of knowledge" are required for a company to reach strategic timing.

The competitive driving forces in this context are the internal competencies, considered for use as an output from organizational knowledge. Information obtained from suppliers, customers, market place and internal functions is considered the main input to organizational knowledge. According to Kogut and Zander (1992), *know-what* is a kind of knowledge based on information, which may be transferred without loss of integrity because the syntactical rules are known. On the other hand, *know-how* is related to how to operate efficiently in a knowledge cumulative process. Therefore, information is a "precious" resource for *know-how* and *know-what*. Cornella (1994) stresses that many companies become frustrated when they



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sometimes fail to access the needed information even with high investments in information technologies (IT).

### **The costs of information**

Considering information as input, how easy is it for companies to obtain it? Von Hippel (1994) calls an information “sticky” when it is costly to acquire, transfer, and use. In this manner, he does not agree with those who see information as a costless factor because there are presently many new information sources. Nonaka (1995) argues that in dynamic environments companies should not only process information efficiently but also create new information and knowledge. This efficiency, however, will certainly have implicit costs for the company.

Besides the cost issue, information is sometimes not easily or directly understood. Von Hippel (1994) stresses that the process of information transfer assumes different codes, some being explicit and being of a tacit nature. According to him, in a problem-solving effort, there is a tendency to carry out innovation-related problem-solving activity to the locus of “sticky” information due to the information transfer costs. On the other hand, when an information is located in more than one site, he proposes an iterative action among the sites, often based on trial-and-error orientation.

### **Knowledge integration, alignment and sources of information**

The concept of alignment is useful when the idea of information transfer is related to aspects like cross-functional integration. Venkatraman (1990) considers that the alignment approach is always present as an underlying concept in articles on strategy. Among several definitions for alignment, Venkatraman considers that alignment may shortly be used as a definition of strategy. In this approach, he includes researchers who define strategy as “pattern of interactions”, or “internal consistency” among a set of important decisions.

In studies on manufacturing strategy, Skinner (1969) based his manufacturing task concept on a similar approach. Giffi *et al.* (1990) follow an identical approach when they characterize the strategic process as a set of choices (structural, infrastructural and integration-related). Similarly, the product-process matrix (Hayes and Wheelwright, 1985) is a well-known framework, which also can be related to the alignment idea.

Information and knowledge may be considered as key aspects in an internal alignment process. Knowledge being a cumulative process (Cohen and Levinthal,

1990), information provides the inputs for the organizational knowledge to attain internal (as well as external) alignment. Internal alignment can be the main result from cross-functional activities. Venkatraman (1990) followed this orientation when he analyzed the alignment among marketing, manufacturing and administrative decisions. On the other hand, alliances with suppliers or customers are examples of external alignment. Helper and Sako (1995), although not using explicitly the alignment definition, followed a similar approach when they studied supply chain relationships in the automobile industry.

Thus, when the needed information is obtained, companies’ functions may (and should) exchange it internally. This orientation allows knowledge integration and consequently internal alignment.

### **Information and knowledge: their influence on competitiveness**

The risks and uncertainties inherent in dynamic environments have increased the importance of organizational knowledge. According to Leonard-Barton (1992), factories will tend to be “learning laboratories” in order to adapt to environmental changes. Therefore, organizational knowledge allows the companies to better deal with constant external changes and to be able to reorganize their internal processes when changes occur. Liebeskind (1996, p. 94) defined knowledge as “... information whose validity has been established through tests of proof”. To Cohen and Levinthal (1990), information assimilation is related to pre-existing knowledge. In this manner, learning is a cumulative process and there are gains in the learning process when the subject is known (Garvin, 1998).

Ward *et al.* (1994) considered the importance of a cross-functional approach for manufacturing management, especially during the strategic process. These authors’ approach may be considered with a similar view to the process of knowledge integration/creation. At the same time, cross-functionality is the basis for knowledge and competencies creation (Grant, 1996). There is almost a common sense that when knowledge is shared throughout the company, it is continuously created and improved (Brown, 1998; Quinn *et al.*, 1998; Grant, 1996; Davenport *et al.*, 1998).

Information and knowledge may be considered as resources as well as other overall assets, capabilities, organizational processes, and attributes. Companies control them in order to improve their efficiency and effectiveness (Daft, 1983). In this paper, we

consider internal competence from a resource-based view perspective. Based on Barney (1991), a company's competencies should be able to provide an output valuable to customers, based on a rare resource, imperfectly imitable, and without substitutes easily found.

### Characteristics of information acquired

Marchand (1996) argues that there are trade-offs when we consider information and environment conditions. In moderate conditions, consistence and accuracy are the central aspects sought by the companies. The first aspect is related to the consistence among data from different areas. Accuracy has to do with obtaining the correct information.

Wilkinson and Cerullo (1997) state that information can be considered with quality when it is relevant, accurate, accessible, concise, clear, quantifiable, and consistent. Companies can seek for "customized" information in order to improve their internal competencies. Marchand (1996) exemplifies with chemical industry. While companies from moderate competition conditions are seeking for improvements in their supply chain, manufacturing process, distribution and finance controls, in situations with a high level of competition, "... the focus of management information is on creating value primarily by improving information use and quality in customer data, after-sales service, order-fulfillment and only secondarily by defining more consistent information for upstream processes such as financial reporting and controls" (Marchand, 1996, p. 3).

### Propositions

Considering information as a resource with increasing importance for manufacturing management, to what extent is it easy for manufacturing to get strategic information? We consider that easy *access* to the needed information is the first step towards the creation of organizational knowledge. Second, is the *accuracy* relevant in the process of manufacturing management? We expect that not only companies are tending to focus on specific information sources but they are also seeking the "right" information as well. Complementarily, concerning the importance of the *timing of the information*, companies' access to strategic information before their competitors also may be a competitive advantage, especially in more dynamic environments.

The propositions advanced here consider two fundamental aspects. The first one concerns how the types of information are updated (Figure 1). The types of information consist of information from internal processes, consumers and marketplace. The second aspect concerns the sources of information – we consider a set of seven, from internal sources to computer-based ones (Figure 1). There was no intention to explore the whole possibilities related to information sources. We sought to list those that we assume more relevant to manufacturing management. Finally, we also analyzed three driving factors for competitiveness, which are relevant in the current competitive conditions – organizational knowledge, cross-functionality and internal competencies.

### Access to information

We analyzed to which extent it is easy for manufacturing companies to get the needed information. We evaluate if the access to information is influenced by the regularity that different types of information are updated. Additionally, we analyzed whether manufacturing has sought to spread out or to focus on specific information sources and formulate the following propositions:

- P1a.* Manufacturing's easy access to important information is related to the frequency that different types of information are updated.
- P1b.* Manufacturing's easy access to important information is related to focus on specific information sources.

### Accuracy

Easy access is not the only relevant aspect when firms are searching for information. Considering information as a competitive resource, the quality of the information accessed is also a relevant characteristic. Some current pitfalls related to information are caused by a possible inconsistency between quantity versus quality created by IT:

- P2a.* Consumers' information accuracy is related to the frequency that different types of information are updated.
- P2b.* Consumers' information accuracy is related to focus on specific information sources.

### Timing of information

We consider that "economies of knowledge" require "accelerated enterprise-wide learning" (Roth, 1996). At the same time, information access is often related to the adoption of new technologies (Ginsberg and Venkatraman, 1992). In this manner, technology adoption and

Ely Laureano Paiva,  
Aleda V. Roth and  
Jaime Evaldo Fensterseifer  
*Focusing information in  
manufacturing: a knowledge  
management perspective*

Industrial Management &  
Data Systems  
102/7 [2002] 381–389

regularity of information update may guide the timing to obtain strategic information:

- P3a.* Timing to obtain strategic information is related to the frequency that different types of information are updated.
- P3b.* Timing to obtain strategic information is related to focus on specific information sources.

### Information and competitiveness

In order to evaluate how the information characteristics influence competitiveness, we consider three central aspects related to information. The first aspect is organizational knowledge. The second one is manufacturing's cross-functional orientation. We based our approach on the model of Ward *et al.* (1994) to manufacturing's integration in the business unit's strategic process. This model is closely related to knowledge integration and internal alignment, and suited to the current competitive environment. Finally, internal competencies are the third aspect analyzed within a knowledge-based approach. Even though internal competencies are apparently not related to information, they are built on learning "from contacts with their markets, customers and external environment" (Zahra and Das, 1993, p. 99):

- P4a.* Manufacturing companies' competitiveness is directly related to manufacturing organizational knowledge, which is influenced by information characteristics.
- P4b.* Manufacturing companies' competitiveness is directly related to manufacturing cross-functionality, which is influenced by information characteristics.
- P4c.* Manufacturing companies' competitiveness is directly related to

internal competencies responsiveness, which are influenced by information characteristics.

### Research design methodology

This research used a survey methodology to collect the data. We used a five-point scale to evaluate managers' answers. The questions applied are presented in the Appendix.

The steps followed during this research were:

- 1 discussion about the framework with other researchers and with two companies;
- 2 pilot test with 19 companies (nine responses – 47.36 per cent);
- 3 first mail of the definitive questionnaire to the chosen sample; and
- 4 second mail to no responder companies.

### Sample

A total of 243 companies located in the southern region of Brazil composed the sample. These companies were chosen from SEBRAE's (Brazilian Service for Companies Support) database. All these companies have more than 100 employees and belong to the food, electronics, transport, and machine industries. Seven companies declined to participate. We received answers from CEOs, vice-presidents, manufacturing directors, and manufacturing managers.

The response rate was 32.10 per cent (78 companies). The analysis of no response bias was based on a Chi-square test evaluating the rates of response for industry and size. There was no identified bias in this analysis.

### Methodology

We analyzed the first six propositions (*P1a*, *P1b*, *P2a*, *P2b*, *P3a* and *P3b*) stated above, using a multiple regression analysis. For these propositions the following factors as dependent (criterion) and independent (predictors) variables were used:

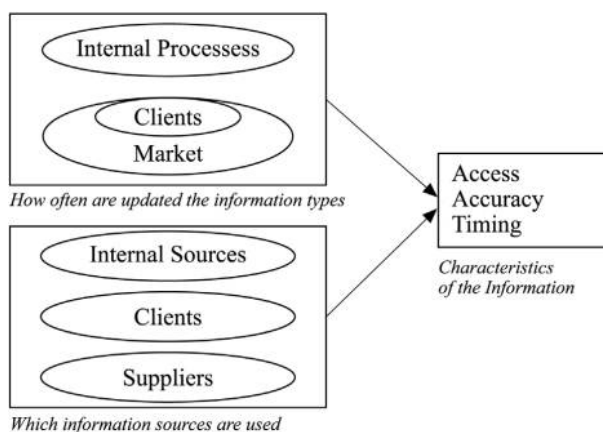
- 1 *Predictors (independent variables):*
  - frequency of information update;
  - information sources.
- 2 *Criterion (dependent variable) – information characteristics:*
  - access to information;
  - information accuracy;
  - timing of information.

According to Hair *et al.* (1995), the weights of the predictor (independent) variables indicate their contribution to the overall prediction.

For the last propositions (*P4a-c*), a multiple regression analysis was used with a dummy variable related to competitiveness. Dummy

**Figure 1**

Characteristics of information and types and sources of information



variables are independent variables which are useful when someone is seeking to evaluate the effect of different levels of non-metric variables (competitiveness, in this case) in the prediction of criterion variables (Hair *et al.*, 1995). We analyzed possible relationships between organizational knowledge, cross-functionality, internal competencies, and information characteristics (Figure 2):

- 1 *Predictors (independent variables) – information characteristics:*
  - access of information;
  - information accuracy;
  - timing of the information.
- 2 *Criterion (dependent variable) – competitiveness factors:*
  - organizational knowledge;
  - cross-functionality;
  - internal competencies responsiveness.

#### Validity and reliability

“Validity is concerned with how well the concept is defined by the measures, while reliability relates to the consistency of the measures” (Hair *et al.*, 1995, p. 9). We used a factor analysis to confirm the three constructs analyzed above. The results from the factor analysis are shown in Table I. We analyzed the Cronbach’s coefficients in order to evaluate the degrees of reliability for the same constructs. Table II shows that all the constructs present Cronbach’s coefficients above the value recommended of 0.70 (Nunnally, 1969).

## Results

The first analysis present the results related to the three information characteristics considered – access, accuracy and timing. The questions included in the questionnaire are identified with a  $Q_i$  notation, where  $i$  is the number of the question. These questions are presented in the Appendix and they are a selected part of the complete questionnaire.

We analyzed the first six propositions ( $P1a$ ,  $P1b$ ,  $P2a$ ,  $P2b$ ,  $P3a$  and  $P3b$ ) using a multiple regression analysis (Tables III and IV), and a multiple regression analysis with a dummy variable to evaluate the last three propositions ( $P4a-c$ ) (Table V).

#### Access to information

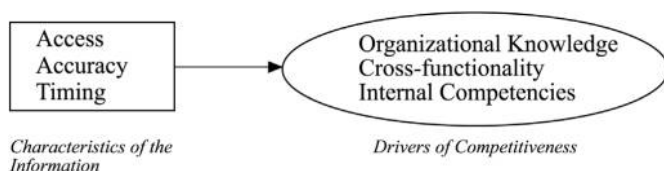
We asked manufacturing managers how easily they get important information. The results show that the main aspect related to access (Q9) is the variable (Q1b) (customers’ information updated) (Table III). Other types of information had no statistically significant results (internal processes and market data). These findings indicate a possible way to seek reduction in the costs of information in manufacturing management, looking for the information that is the most applicable in the day-by-day manufacturing activities. When we analyze the focus on specific information sources (Table IV), access to information showed a statistically significant relationship only with computer-based systems for internal data. Surprisingly, JIT system (Q12) indicated a negative relation. This result leads to a question related to the role of information systems with real-time information and in an integrated way, which does not happen in the traditional view of JIT, without electronic *kanban* for instance. This finding may be interpreted as an indication of increasing adoption of computer-based systems for manufacturing management. These systems provide real-time information, which is the basis for quick decisions. Therefore,  $P1a$  and  $P1b$  were confirmed.

#### Accuracy

We used the variable Q16 to evaluate the information accuracy for consumers’ needs. Also in this case, customers’ information is the type of information that manufacturing most frequently updates, as we expected (Table III). The lack of statistical significance for marketplace information suggests that focusing in specific customers’ information instead of general market information is more relevant for manufacturing processes. The statistical significance of the variable Q2 (internal sources for changing internal policies) suggests that decentralized-participatory processes contribute to information accuracy (Table IV). When we analyzed what kind of information sources lead to more accurate information about consumers’ needs, the results also indicate that computer-based systems with customers (Q7) is statistically significant (Table IV). This finding enhances again the importance of this type of information source and the role of IT. Therefore, we may state that closer activities with customers may provide the most accurate information to support revenues and consequently manufacturing management. The results confirm the  $P2a$  and  $P2b$ .

**Figure 2**

How information relates to competitiveness



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Aleda V. Roth and  
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*Focusing information in  
manufacturing: a knowledge  
management perspective*

Industrial Management &  
Data Systems  
102/7 [2002] 381–389

**Table I**

Factor analysis related to the competitiveness constructs

Item	Cross-functional orientation (Factor 1)	Internal competencies (Factor 2)	Manufacturing knowledge (Factor 3)
<b>Q27C – decisions related to the business unit's strategy of growth</b>	0.84	0.08	0.08
<b>Q27B – Cross-functional activities to decide about budget decisions related to long-term investments</b>	0.77	0.07	0.13
<b>Q10 – Manufacturing participates directly in activities to choose new business strategies and directions</b>	0.68	0.17	0.11
<b>Q27A – Cross-functional activities to decide about manufacturing strategies, marketing and R&amp;D</b>	0.56	0.32	0.21
<b>Q34D – Manufacturing decisions related to providing characteristics in the products, which the customers do not find similar substitute easily</b>	-0.06	0.84	0.07
<b>Q34C – Manufacturing decisions related to creating resources not easily imitable by the competitors</b>	0.16	0.75	0.27
<b>Q34B – Manufacturing decisions related to seeking competitive resources, which the competitors do not have</b>	0.42	0.56	0.28
<b>Q34A – Manufacturing decisions related to providing characteristics in the products that are valued by the customers</b>	0.33	0.51	0.26
<b>Q29 – Quick change in competitive capabilities if the competitors threaten the sales</b>	0.20	0.50	0.39
<b>Q28 – Quick ad option of new process technologies available in the industry</b>	0.20	0.45	0.23
<b>Q19 – Manufacturing clearly knows the performance of main competitors</b>	0.14	0.30	0.74
<b>Q20 – Manufacturing clearly understands the existing threats in the marketplace</b>	-0.05	0.24	0.71
<b>Q21 – Manufacturing knows how to explore the company's internal resources</b>	0.27	0.14	0.56
<b>Q18 – Manufacturing clearly understands the primary opportunities to be explored in the marketplace</b>	0.38	0.10	0.46
<b>Q22 – Manufacturing knows how to seek more integration with other company's areas to reinforce the internal resources</b>	0.38	0.30	0.41

**Table II**

Cronbach's coefficient related to the used constructs

Construct	Cronbach coefficient (Standardized)
<b>1. Organizational knowledge</b>	0.72
<b>2. Cross-functional orientation</b>	0.81
<b>3. Internal competencies</b>	0.90

### Timing of information

We evaluated the relationship between the types of information updated and timing to obtain strategic information about consumers before competitors (Q17) (Table III). However, no significance was found between the variables related to types of information and timing. On the other hand, when we analyzed the timing related to

different sources of information, we found statistically significant results (Table IV). In this aspect, computer-based systems with customers (Q7) and alliances with customers (Q31) are positively related to timing. Technologies like EDI allows on time information, which is a key input for quick decisions. Activities related to alliances with customers are related to knowledge integration. Therefore, both aspects lead to quick exchange of new information, which may allow obtaining important information before the competitors. Surprisingly, suppliers' alliances (Q30) have a negative relationship with timing. This finding may indicate a possible lack of integration between the parts. Shortly, just the *P3b* was confirmed.

Ely Laureano Paiva,  
Aleda V. Roth and  
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*Focusing information in  
manufacturing: a knowledge  
management perspective*

Industrial Management &  
Data Systems  
102/7 [2002] 381–389

### Competitiveness and information characteristics

Using a dummy variable for competitiveness, we evaluated how the three key factors for competitiveness are influenced by information characteristics (access, accuracy, and timing) (Table IV). The three aspects are organizational knowledge, cross-functionality, and internal competencies. The dummy variable considers whether the companies are market leaders (equal to one) or not market leaders (equal to zero). The results indicate that market leaders and non-market leaders have different levels of organizational knowledge and cross-functionality. This result reinforces the importance of internal alignment and

knowledge integration for competitiveness. Access to information presented statistically significant results for all the constructs related to competitiveness. This finding suggests that when manufacturing obtain the needed information, competitiveness is strengthened. Nevertheless, the results only confirmed *P4a* and *P4b*.

### Managerial implications

The results indicate that at the same time that companies are facing an “information age”, there is a probable search for specific types and sources of information. The first relevant aspect is the importance of customers’ information for manufacturing processes. This is a clear trend in the type of information updated and information sources focused by manufacturing managers in this study.

These results may indicate a search for reducing the costs of information, focusing on more relevant ones. Therefore, the idea of “focused information” is a possible representation when companies are searching for strategic information. In this way, information is not a costless resource for managers when they are dealing with their day-by-day and strategic activities.

The second relevant aspect is the influence of computer-based systems on the information sources analyzed. These technologies allow real-time and integrated information, which are extremely important in dynamic situations as presently companies are facing.

Still analyzing the information sources, the higher influence of customers’ information than suppliers’ information may indicate underlying issues as a possible lack of trust in the relationship between suppliers and companies. This finding deserves further analysis in depth.

The driving factors for competitiveness showed distinct results. The most relevant result is related to organizational knowledge. Access and accuracy are the information characteristics with statistically significant influence over organizational knowledge, which corroborates several studies that consider information as the main input for knowledge. The most competitive companies presented higher levels of organizational knowledge and cross-functionality. Access and timing of information also influence positively cross-functionality and internal competencies. We may state that information exchange among a company’s functions may reduce time to get strategic information and, consequently, it leads to faster responses.

**Table III**

Regression of type of information updated on information characteristics

Update frequency by type of information	Access	Accuracy	Timing
<b>Q1a – internal data</b>	0.089	-0.082	-0.057
<b>Q1b – customer data</b>	0.270**	0.302**	0.172
<b>Q1c – market data</b>	-0.023	-0.056	0.170
<b>R<sup>2</sup></b>	0.208***	0.164**	0.006*

Notes: \* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.001$

**Table IV**

Regression analysis of information sources on information characteristics and competitiveness driving forces

Information sources	Access	Accuracy	Timing
<b>Q3 – internal sources (IS) for strategic planning</b>	0.220	-0.203	-0.228
<b>Q2 – IS for changing internal policies</b>	0.005	0.294*	0.218
<b>Q4 – computer-based systems for internal data</b>	0.301**	0.090	-0.094
<b>Q7 – computer-based systems with customers</b>	0.066	0.132*	0.272***
<b>Q12 – JIT</b>	-0.135*	-0.059	-0.052
<b>Q14 – strategic planning</b>	-0.031	0.003	-0.005
<b>Q30 – alliances with suppliers</b>	0.067	0.120	-0.222*
<b>Q31 – alliances with customers</b>	0.135	0.159	0.443
<b>R<sup>2</sup></b>	0.234***	0.216**	0.257***

Notes: \* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.001$

**Table V**

Regression of information characteristics on competitiveness factors using a dummy variable

Information characteristics	Knowledge	Cross-functionality	Internal competencies
<b>Dummy variable</b>	0.301*	0.379*	0.057
<b>Access (Q9)</b>	0.192**	0.238*	0.295**
<b>Accuracy (Q16)</b>	0.330***	-0.101	-0.019
<b>Timing to get information (Q17)</b>	0.040	0.247**	0.313***
<b>R<sup>2</sup></b>	0.402***	0.110*	0.191**

Notes: \* $p < 0.05$ ; \*\* $p < 0.001$ ; \*\*\* $p < 0.000$



## Conclusions

This article sought to show how manufacturing companies are searching for the needed information in an "information age". The results suggest the trend to focus on specific types and sources of information together with the adoption of computer-based systems. Customers' information is included in both cases. Furthermore, the results related to manufacturing cross-functional orientation reveal the importance of knowledge integration. Finally, information characteristics like access and accuracy influence organizational knowledge, a clear competitive driving force according to the results.

One of the limitations of this study is related to the small sample used. Therefore, we need caution in any result generalizations.

As indications for future research, we may list: studies analyzing the influence of other information characteristics on the needed information for manufacturing management; and, studies on specific industries to evaluate the influence of environmental dynamism on the type and sources of information used.

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**Appendix**

**Figure A1**  
Questions applied from the questionnaire

Q1 – Indicate how often the data are updated.

	Half yearly Or More	Monthly	Weekly	Daily	Real Time
a. Internal	1	2	3	4	5
b. External	1	2	3	4	5
c. From market place	1	2	3	4	5

Q2 – Manufacturing managers’ opinions are used as input into the policy settings for manufacturing within a participatory process.

	Never	Rarely	Sometimes	Frequently	Always
	1	2	3	4	5

Q3 – Manufacturing managers’ opinions are used as input into the planning within a decentralized-participatory process.

	Never	Rarely	Sometimes	Frequently	Always
	1	2	3	4	5

Q4 – Manufacturing uses computer-based measurement systems to evaluate internal data related to manufacturing performance.

	Never	Rarely	Sometimes	Frequently	Always
	1	2	3	4	5

Q7 – Manufacturing uses computer-based systems to receive information directly from customers.

	Never	Rarely	Sometimes	Frequently	Always
	1	2	3	4	5

Q9 – Indicate the extent to which is easy to manufacturing to get important information.

	Never	Rarely	Sometimes	Frequently	Always
	1	2	3	4	5

Q12 – Indicate the degree to which Just-in-time has been implemented in the business unit.

Degree of Implementation				
No use	Beginning	Moderate	High	Total
Stage	Use	Use	Use	Implementation
1	2	3	4	5

Q14 – Written strategic plans are in phase for the business unit.

Degree of Implementation				
No use	Beginning	Moderate	High	Total
Stage	Use	Use	Use	Implementation
1	2	3	4	5

Q16 – Indicate the extent to which manufacturing has accurate information about customers’ needs.

	Never	Rarely	Sometimes	Frequently	Always
	1	2	3	4	5

Q17 – Indicate the extent to which manufacturing obtains relevant strategic information about customers before the main competitors can get access it.

	Never	Rarely	Sometimes	Frequently	Always
	1	2	3	4	5

Q30 – The company has developed alliances with other suppliers to develop new products and technologies.

	Never	Rarely	Sometimes	Frequently	Always
	1	2	3	4	5

Q31 – The company has developed alliances with other customers to develop new products and technologies.

	Never	Rarely	Sometimes	Frequently	Always
	1	2	3	4	5

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