

# Complementarities between JIT purchasing practices: An economic analysis based on transaction costs

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## Abstract

The objective of this paper is to analyse the complementarities and interrelationships between the different JIT purchasing practices which have extended in industrial markets in recent years. The incorporation of trust as an explicative element in a framework based on Transaction Costs Economics leads us to propose that the success of logistics-related JIT purchasing practices, which fundamentally transform the physical exchange process, depends on the implementation of additional practices which transform the way of governing and controlling the relationships and which support and rely on a co-operation climate. Empirical tests carried out over a sample of 148 Spanish auto components suppliers confirm this reasoning. © 2000 Elsevier Science B.V. All rights reserved.

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## 0. Introduction

During the last decade or more, industrial supply structures have undergone significant changes derived from an evolution from adversarial relationships to co-operative relationships based on the generation of trust [1–5]. This trend has given rise to concepts such as ‘partnership sourcing’, ‘subcontracting’ or, when special attention is paid to logistics issues, ‘JIT purchasing’. The advantages of implementing JIT purchasing have been pointed out by several authors [6–9]. They tend to highlight the Japanese origin of such a way of managing

the purchasing function and use comparisons between Western and Japanese plants as the basis of empirical studies.

Nevertheless, JIT purchasing encompasses various groups of practices, whose interrelationships have scarcely been studied from an economics point of view. It is possible to distinguish between operational or logistical practices, which imply new physical ways of carrying out the transactions, and complementary practices, which imply new ways of governing and controlling such transactions. Most of the latter practices, to a greater or lesser extent, require, facilitate or generate mutual adaptation and co-operation between supplier and buyer. Some other practices aim at establishing controls and safeguards to assure reliability and competence on the part of the supplier. An important question that arises is: Is it possible to successfully

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implement operational practices without implementing complementary practices?, or, in a different way: Are there, indeed, complementarities between the two groups of practices?

The distinction between operational and complementary practices, although not previously used in the literature, highlights the difference between implementing JIT delivery programmes with or without partnership sourcing arrangements. A number of works [2,10–12] report how suppliers are impaired when a partnering atmosphere does not accompany JIT programmes, that is, when purchasers try to reduce inventory without taking into account the whole JIT philosophy. The existence of complementarities between operational and complementary practices would provide evidence that this behaviour also prevents purchasers from realising many of the potential benefits associated with JIT purchasing.

In order to answer the questions above, the paper is structured as follows. Firstly, a framework fundamentally based on Transaction Costs Economics (TCE) and incorporating trust as an explicative variable is introduced. This framework, in addition to overcoming some criticisms of TCE, leads to the existence of a certain space between pure market and hierarchy for co-operative relationships. Subsequently, in Section 2, this framework is applied to JIT purchasing and two hypotheses about the interconnections between operational and complementary practices and their consequences are posed. In Section 3, the empirical methodology to test the hypotheses is commented upon and, in the following section, the analysis and results are presented and discussed. The paper ends in Section 5 with a brief exposition of the main conclusions.

## 1. Trust in a TCE framework

### 1.1. Transaction cost economics: Principles, research and critics

The first works which gave rise to TCE [13–15] pose the problem of the selection of the most suitable governance structure for transactions. In this preliminary literature, two extreme alternatives, the

market and the hierarchy, are considered, and two assumptions about human nature are made: human agents are subject to bounded rationality and at least some of the agents are given to opportunism [16]. A firm will choose the governance structure which minimises the sum of production and transaction costs, and the analysis of the latter costs fundamentally comprises costs of selecting and searching trading partners, negotiating and writing contracts and monitoring and controlling the execution of such contracts.

TCE focuses on three variables which seem to play an essential role in the selection of the most efficient governance structure: the degree of transaction specificity, uncertainty, and the frequency with which transactions occur. These three dimensions are carefully examined to reach one of major propositions of the TCE theory: *vertical integration becomes the most efficient option insofar as transaction specificity, uncertainty and frequency increase* [14].

Although, in its origin, TCE focuses on the decision to make or buy, Williamson recognises the existence of intermediate modes of organisation [14], transactions in the middle range [15] or hybrids [17]. The TCE framework, initially concentrated on the study of vertical integration, starts to be applied to what Joskow [18] calls ‘non-conventional’ contractual relationships between buyers and suppliers. That is, relationships which, although not integrated within the organisation, are lasting, continuous and co-operative. At this point, Williamson [14] establishes some links between economics, organisational theory and contract law, and determines the contracts and governance forms most suitable for each type of transaction. The main conclusion is that *intermediate or relational governance structures are suitable for recurrent transactions with medium levels of specificity and uncertainty*.

Many authors have empirically tested the relevance of the Williamson’s variables for the decision to vertically integrate. Most of them focus on repetitive transactions so that frequency is assumed rather than tested. The effect of specificity is studied in several articles [19–23], many of which mainly reveal the importance of human specificity. Uncertainty, which is closely related to human bounded

rationality, it is studied in many other works [24,25], and there exist a number of articles which confirm the importance of both dimensions, specificity and uncertainty, at the same time [26–29]. It is possible to conclude that, although TCE might not take into account every factor determining the selection of the governance structure for a relationship, it presents three dimensions which to a great extent influence such selection.

Nonetheless, TCE has been also criticised [30–34]. The negative view of human behaviour, the scarce value given to moral issues, the lack of social context and the risk neutrality assumed for the decision makers are some of the arguments raised against this theory.

There is no doubt that TCE is an approach purely based on economic efficiency. Trust is ignored as an explicative element and risk controller [35]. Nevertheless, trust, rather than to annul this theory, can be used to complement and explain some of its deficiencies [36].

### *1.2. Trust and co-operation in a TCE framework*

The meanings and taxonomies of trust proposed by each academic discipline which have tackled this concept differ from one another significantly. In the supply relationships field, Sako [37] distinguishes between three types of trust: trust in that the other party will execute the contract, called contractual trust; trust in that the other part will be competent, call competence trust; and, trust in that the other party is committed to the relationship and will do, whenever possible, more than what is specified in the contract, called goodwill trust.<sup>1</sup> The two first types, namely contractual and competence trust, are necessary to carry out any kind of relationship. What really distinguishes co-operative relationships from competitive relationships is that the former depend on and are sustained by the existence of goodwill trust, which is not present in the latter. This type of trust and its dependence on

social and moral norms can be added as a fourth explicative element to the three (specificity, uncertainty and frequency) considered within the TCE framework.

The concepts of Sako [37], who distinguishes between a current costs component and an investment costs component of transaction costs, are specially useful to illustrate the effect of trust. The current costs component refers to the costs derived from negotiating, controlling and executing the transaction. It comprises the costs of searching information, selecting suppliers, negotiating and drafting contracts and controlling and executing the transaction as well as the logistics costs. This current component would comprise bureaucratic, supervision and agency costs when the transaction is vertically integrated. The investment costs component refers to the costs derived from those activities devoted to the generation of trust and to promote the mutual adaptation between buyer and supplier.<sup>2</sup> These costs would not be incurred in competitive relationships or vertically integrated transactions.

Transaction costs in co-operative relationships have a investment costs component which is not present in adversarial relationships. Nonetheless, it must be taken into account that this component can be reduced as the relationship is getting closer and closer, because the major investments (adapting and promoting communications) are presumably made at the beginning of the relationship. When the relationship involves a medium degree of specificity and large volumes of trade (recurrent transactions) and has reached high levels of closeness, the increase in the investment costs component devoted to the generation of trust is probably insignificant compared to the reductions achieved in the current costs component. Indeed, Chiles and McMackin [40] do not take this component into account in their study.

With respect to the production costs, they will probably be lower in the adversarial relationships

<sup>1</sup> There are direct similarities between the classification of Sako [37] and the distinction between strong, semi-strong and weak trust of Barney and Hansen [38].

<sup>2</sup> Many of the techniques proposed to generate trust (see, for example, [39]) entail costs. For example, the organisation of meetings or the training of the personnel in charge of the relationship implies some costs.

because the supplier tendering the best price will be chosen. In the case of co-operative relationships, it might be necessary to reject better prices and to assume higher production costs in order to manage continuity and generation of trust. In turn, the co-operation and joint effort might give rise to technological and design improvements, which would reduce production costs in the long-term. Furthermore, production costs will, in any case, be lower than they would be if the transaction were vertically integrated, because co-operative relationships allow scale economies and the benefits of specialisation. Table 1 summarises the above arguments and shows how, although trust generates some costs, it can reduce others.

Thus, recurrent transactions which imply high trading volume for both parties might involve lower total costs under co-operative arrangements than in adversarial environments, mainly in the long term. When frequency is high and, therefore, investment costs per transaction are low, intermediate or co-operative relationships might outperform vertical integration in some situations in which adversarial relationships would not, something anticipated by Williamson [14] when he

matches relational contracting with recurrent transactions. These situations can be characterised in terms of specificity.

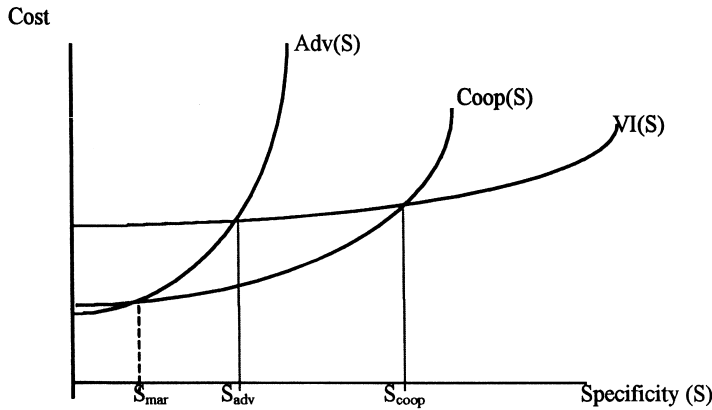
Adapted from Williamson [17] and Chiles and McMackin [40], Fig. 1 illustrates the reasoning for a given medium degree of uncertainty.  $VI(0) > Adv(0)$  and, probably,  $Coop(0)$  is in between. However,  $VI'(S) < Coop'(S) < Adv'(S)$  and, as specificity goes up, there will be a point,  $S_{mar}$ , as from which the effect of trust on the reduction of the current costs component overpasses the investment costs component, and co-operative relationships become more efficient than adversarial ones. There will also be two more critical points,  $S_{adv}$  and  $S_{coop}$ , from which the costs of vertical integration will be lower than the costs of adversarial and co-operative relationships, respectively. Trust, in the form of a co-operative relationship, raises the degree of specificity beyond which vertical integration would be the most efficient governance structure (from  $S_{adv}$  to  $S_{coop}$  in Fig. 1).

Trust also reduces uncertainty and complexity and minimises the negative effects of human bounded rationality. It makes possible a fluid, plentiful and timely exchange of information, a higher

Table 1  
Transaction and production costs for different governance structures when the degree of specificity is medium: The effect of trust<sup>a</sup>

Costs		Adversarial relationships	Co-operative relationships (trust based)	Vertical integration
Transaction costs	Current costs component (Costs of searching information and selecting suppliers, costs of negotiating, drafting and controlling contracts, logistics costs)	High (Many suppliers, high risk of opportunistic behaviour)	Low (Due to the investments in generating trust)	High (Bureaucratic, supervision and agency costs)
	Investment costs component (Cost derived from the generation and maintenance of trust)	Low (There are no investments)	Medium (It might be reduced in the long-term, when the relationship matures)	Low (There are no investments)
Production costs	Costs of manufacturing the product	Low (The lowest price is chosen)	Medium (It might be reduced in the long-term, due to joint improvements)	High (No scale economies, no specialisation)

<sup>a</sup>Source: Based on ideas of Sako [37].



**Adv (S)** : Transaction and production costs in an adversarial relationship as a function of specificity

**Coop (S)** : Transaction and production costs in a co-operative relationship as a function of specificity

**VI (S)** : Transaction and production costs in a vertically integrated relationship as a function of specificity

**S<sub>mar</sub>** : Degree of specificity as from which a co-operative relationship are more efficient than an adversarial one

**S<sub>adv</sub>** : Degree of specificity as from which vertical integration is the most efficient option in adversarial environments

**S<sub>coop</sub>** : Degree of specificity as from which vertical integration is the most efficient option in co-operative environments

Fig. 1. Effect of trust on cost by specificity.

capacity to influence the other party and to reach common objectives and, in general, a richer knowledge about the behaviour that the other party will develop [40]. Therefore, trust means that the reasoning on specificity outlined above and included in Fig. 1 is also valid for higher degrees of uncertainty.

Following Dyer [41], it might be said that, for a given degree of specificity, the cost of the safeguards used to protect against opportunism is changing. Trust is understood as the cheapest of the possible safeguards, so that co-operation is the most efficient governance structure for certain specificity, uncertainty and frequency intervals.

## 2. Application to JIT purchasing

### 2.1. Components of JIT purchasing

The practices characterising JIT purchasing or, more generally, 'lean supply' have been reviewed and analysed by many authors [6,42–47]. As a summary of their papers, Table 2 lists the main JIT purchasing practices, which are divided into

two groups. These are, on one hand, operational practices, which might also be called logistical practices and essentially affect the physical exchange process, and, on the other hand, complementary practices, which fundamentally affect the governance structure and control procedures in the relationship. The latter practices are additionally divided into three subgroups: practices which aim at promoting and facilitating the establishment of close and collaborative relationships (panel practices), at involving one party in the activities of the other (involvement practices), and at assuring quality and suppliers' reliability (quality practices). The two first subgroups are directly linked to the existence of a climate of trust and co-operation between buyer and supplier and might be seen as a consequence as well as a cause of this climate. With respect to the quality practices, although on one hand they can be associated with co-operative environments because they pursue the elimination of receiving inspections and imply more information exchange and mutual knowledge, on the other hand, these practices might be also considered as a group of safeguards which are established to assure the competence of the supplier. Therefore,

Table 2  
Characteristic practices of JIT purchasing

Operational practices	Complementary practices		
	Panel practices	Involvement practices	Quality practices
Kanban with suppliers	Shared risks and benefits	Participation of suppliers in design activities	Selection and assessment of suppliers based on quality and reliability
Frequent deliveries	Single supplier	Supplier development programmes	Quality certification
Minimal stock	Long-term contracts	Visits of engineers to suppliers	Control and penalisation of reliability and quality faults
Delivery day and time previously specified	Lasting relationships		
Standardised containers	Programmes devoted to improve the supply relationships		
Geographical concentration (through plants or warehouses)	Mutual help to sort out problems		
Electronic Data Interchange (EDI)	Exchange of accounting information (production costs) Price computed according to the actual costs		

they seem to be additional guarantees of the existence of trust. In spite of this, complementary practices, taken as a whole, seem to foster and be identified with a climate of co-operation and collaboration between both parties in the relationship.

2.2. *Connection between operational and complementary JIT purchasing practices*

The complementary practices by themselves, what has been called partnership sourcing in the literature [48–51], are being successfully applied by many companies [1,52]. In contrast, the operational practices are inherent in JIT environments and can be considered as a step forward from partnership sourcing. In this paper, it is proposed that operational practices yield better benefits when they are accompanied by complementary practices. Hence, companies introduce operational JIT purchasing practices along with complement-

ary practices, although the reverse effect might not happen. The objective of this section is to apply the theoretical framework presented in the previous section to justify this proposition.

The implementation of JIT purchasing practices usually alters the specificity of the relationship significantly. These effects can be summarised according to the main types of specificity mentioned by Williamson [53]:

- *Site specificity.* The firms engaged in operational JIT purchasing practices make investments in sub-assembly plants and regulatory warehouses. Although these investments are usually assumed by the suppliers, the buyers also set up receiving and consolidation platforms and, in some cases, they manage the warehouses and organise collecting routes.
- *Physical specificity.* The operational JIT purchasing practices also involve investments with high

physical specificity. The use of containers, the electronic codification of transport labels, the implementation of EDI, the construction of delivery docks adapted to a particular supplier or the physical connection of plants (for example, conveyors between plants) are some of these specific assets.

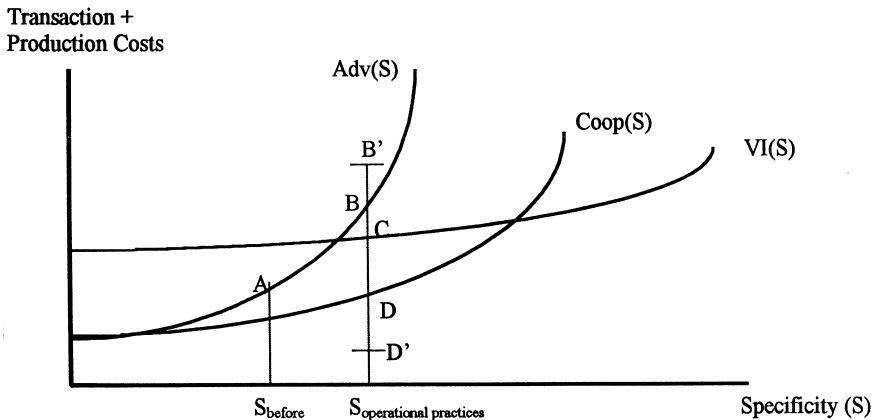
- *Human specificity.* The personnel in charge of the relationships will probably acquire some know-how in logistics, that, in many cases, would be specific to each relationship, and will develop some routines which would allow both parts to communicate more effectively. An important part of the value of this know-how and mutual knowledge would disappear if the relationship finishes.

On account of TCE, it can be concluded that *the operational JIT purchasing practices implemented separately from complementary practices would bring about an increase in costs because they involve an increase in specificity.* This reasoning involves passing from point A to point B in Fig. 2. Nonetheless, TCE developments consider production and logistics costs invariable for each governance structure when specificity changes, but the isolated imple-

mentation of operational JIT purchasing practices increases such costs because:

- if supplier quality and reliability is not assured, stock reductions might lead to production stoppages and to the consequent increase of production costs
- the small size and high frequency of shipments imply more transportation costs and, although they can be reduced by means of geographical concentration and EDI, a supplier is unlikely to accept these conditions if something more is not promised (benefits sharing, for example).

Thus, the actual costs would probably exceed those given by point B in Fig. 2. The company would probably reach a new point B'. Vertical integration might then become the most appropriate governance structure (as shown in Fig. 2) because, in that case, the firm would be at point C. The generation of trust and co-operation in the form of complementary JIT purchasing practices (especially panel and involvement practices) would let the company pass to the point D. Nonetheless, costs might be additionally reduced because the combined implementation of complementary and operational practices would allow the company to



**Adv (S)** : Transaction and production costs in an adversarial relationship as a function of specificity

**Coop (S)** : Transaction and production costs in a co-operative relationship as a function of specificity

**VI (S)** : Transaction and production costs in a vertically integrated relationship as a function of specificity

**S<sub>before</sub>** : Specificity of the transaction before applying any JIT purchasing practice

**S<sub>operational practices</sub>** : Specificity of the transaction after applying operational JIT purchasing practices

Fig. 2. Effect of operational and complementary practices on costs by specificity.

reduce logistics and production costs and to reach point D' in Fig. 2. This reduction is managed through, for example, the elimination of waste, mainly inventory, and the generation of joint improvements.

Thus, the benefit obtained from the implementation of complementary practices once the company has implemented operational practices is higher than that obtained in the original situation. Furthermore, the costs with any of the governance structures at the initial stage ( $S_{\text{before}}$ ) could be reduced when implementing operational and complementary practices as a whole.

This reasoning allows us to pose the following hypothesis:

**Hypothesis 1.** The implementation of operational JIT purchasing practices motivates the implementation of complementary JIT purchasing practices.

It is worth making additional reflection about this connection between operational and complementary practices. The implementation of some (not all) complementary JIT purchasing practices along with the operational practices might also reduce costs and generate a positive balance. For example, supply base reduction can contribute to reducing logistics costs and the use of long-term contracts can reduce negotiating costs. In any case, the buyer would perceive some economic benefits, but they would be lower than those obtained from the complete implementation of the whole package of complementary practices. It might be said that the higher the implementation of complementary practices and, therefore, the closer the relationship, the larger the separation between Adv(S) and Coop(S) and, hence, the lower the costs in the relationship. In addition to the economic benefits, there will probably be other kinds of indirect benefits derived from the continuous, flexible and fluid flow of products from the supplier to the buyer. This reasoning lead to the following hypothesis:

**Hypothesis 2.** The higher the implementation of complementary JIT purchasing practices by a firm which has applied operational JIT purchasing, the better the costs-related and non-costs-related benefits.

### 3. Empirical methodology

The survey is the research design that seems more suitable for an positivistic study like this. The data collection method chosen was the postal questionnaire. Given that plentiful literature confirms that, in many cases, the automotive industry is the first one adapting new production and supply techniques, the Spanish auto components industry was chosen as the population over which to conduct the survey. One constraint was introduced: the companies should have more than 50 employees. A database with 397 auto components manufacturers was built from different information sources.<sup>3</sup> A couple of phone calls were made to each company in order to personalise the questionnaire to the purchasing and logistics manager and to ask such a manager to collaborate in the research. This process allowed us to obtain 148 (37%) fully completed questionnaires.

Table 3 shows how the measures of JIT purchasing were constructed. Several items were selected to measure the degree of implementation of each group of practices (operational, panel, involvement and quality). The surveyed managers were asked to mark the percentage of supplies to which each one of the practices was applied. In order to facilitate the completion of the questionnaire, Likert scales were used: 1 (none), 2 (few, 1–25%), 3 (less than half, 25–50%), 4 (more than half, 50–75%), 5 (almost all, 75–100%) and 6 (all).<sup>4</sup> Principal component analysis was applied to each group of items and the

<sup>3</sup> The sources used were:

- Repertorio de Fabricantes Españoles de Equipos y Componentes de Automoción 97, published by the Spanish Institute of Foreign Trade (Instituto Español de Comercio Exterior, ICEX),
- List of companies associated to ODETTE (<http://www.odette.es>),
- Dun&Bradstreet 1998 database of the 50 000 largest Spanish companies,
- List of suppliers given by some assemblers.

<sup>4</sup> The weighted delivery frequency was the only item not directly answered. It was constructed as  $5(A - 1) + 3(B - 1) + C - 1$  from three questions: percentage of supplies delivered several times a day ( $A$ ) with weight 5, percentage of supplies daily delivered ( $B$ ) with weight 3 and percentage of supplies delivered two or three times a week ( $C$ ) with weight 1.



Table 3  
Reliability and validity of the JIT purchasing measures

	Loadings
<i>Implementation of operational JIT purchasing practices</i>	
Usage of kanban systems	0.577
Weighted delivery frequency	0.828
Stocks of less than one day of production	0.682
Specification of the exact day and time for deliveries	0.691
Supplied in containers (not packaging)	0.650
Their manufacturers with plants or warehouses within 20 km	0.559
Their manufacturers connected by EDI	0.595
Cronbach $\alpha$ : 0.7791	% explained variance: 41.65%
<i>Implementation of panel JIT purchasing practices</i>	
Frequent meetings and communications with their manufacturers (at least one a fortnight)	0.372
Bought to a single supplier	0.488
Long-term contracts with their manufacturers (product life cycle)	0.610
Their manufacturers have been suppliers since the component was created	0.496
Programmes devoted to improve the relationship	0.648
Sharing of marginal benefits	0.706
Support to their manufacturers to sort out problems	0.700
Willingness to increase co-operation with their manufacturers	0.645
Access to the accounting books of their manufacturers	0.651
Price calculation based on actual costs	0.647
Cronbach $\alpha$ : 0.8014	% explained variance: 36.62%
<i>Implementation of involvement JIT purchasing practices</i>	
Visits of engineers to their manufacturers to find possible productive improvements	0.745
Offering of training and development courses	0.840
Their manufacturers design and develop the components	0.793
Their manufacturers actively participate in the development of our products	0.590
Cronbach $\alpha$ : 0.7312	% explained variance: 55.97%
<i>Implementation of quality JIT purchasing practices</i>	
Suppliers chosen according to their quality and reliability as well as the price	0.811
Control and penalisation of faults. Renewal of contracts depending on that control	0.843
Manufacturers with at least one of the ISO9000 quality certifications	0.684
Cronbach $\alpha$ : 0.6794	% explained variance: 61.23%
<i>Implementation of complementary JIT purchasing practices</i>	
Implementation of panel JIT purchasing practices	0.838
Implementation of quality JIT purchasing practices	0.741
Implementation of involvement JIT purchasing practices	0.815
Cronbach $\alpha$ : 0.7157	% explained variance: 63.87%

factor with more explicative power was taken as a measure of the implementation of each group of practices.

A measure for the implementation of complementary practices was obtained with the same methodology from the measures of panel, involve-

ment and quality practices. In this way it was assured that all the practices were equally represented. All the constructs show satisfactory proofs of reliability (Cronbach  $\alpha$ ) and validity (loading on a single factor). The item loadings were  $> 0.40$  in practically all the cases, and  $> 0.6$  for most of

Table 4  
Reliability and validity of the measure of results

How do you think your company performs as compared with competitors as for the following aspects? <sup>a</sup>	Loadings
Design of products	0.635
Capacity to reply to the request of the customers	0.609
Quality of the final products	0.721
Stock level of purchased products (Inverse scale)	0.446
Supply costs (administrative, inspection, stock, supply cuts, etc.) (Inverse scale)	0.570
Problems, misunderstandings and controversy with suppliers (Inverse scale)	0.643
Capacity to co-ordinate with suppliers	0.641
Cronbach $\alpha$ : 0.7206	% explained variance: 37.75%

<sup>a</sup>Measured with a 5-point Likert scale: Very inferior (1), somewhat inferior (2), equal (3), somewhat superior (4), very superior (5).

them. The variance explained by the extracted factor is quite high and, obviously, it is smaller in those constructs based on a larger number of items.

A subjective measure based on the relative perceptions of the surveyed managers was used to approximate the supply results. It is the opinion of the authors, based on the conduction of case studies and field research, that companies usually have good idea of their capacities and results relative to their direct competitors. Because of this, each company was asked to mark according to a Likert scale of 5 points if they feel very inferior (1), somewhat inferior (2), equal (3), somewhat superior (4) or very superior (5) to their competitors as regards some aspects (e.g. product design) affecting their performance in terms of the basic objectives of operations management: quality, speed, dependability, flexibility and cost (see [54]). Given the subjectivity of the questions, all of them were reduced to a single measure by principal component analysis. Table 4 shows reliability and validity proofs of the construct, which measures how well the purchasing function performs as compared with competitors.

With regard to data analysis, the following section starts off from graphical analysis and applies simple regression, cluster analysis and ANOVA to test the first hypothesis. With respect to the second hypothesis, the explicative power of the implementation of complementary practices on the results is analysed in each one of the clusters which prove to have significant differences as regards the implementation of operational JIT purchasing practices.

## 4. Results and discussion

### 4.1. Hypothesis 1

Fig. 3 shows scatter diagrams which represent the sample according to the degree of implementation of operational JIT purchasing and each one of the other measures of JIT purchasing: complementary practices as a whole (a), panel practices (b), involvement practices (c) and quality practices (d). The visual analysis of these diagrams leads to two preliminary conclusions:

1. The implementation of complementary practices increases insofar as the implementation of operational practices rises.
2. Practically none of the companies reached high implementation levels of operational practices without implementing complementary practices, although there seem to be some companies which reach high implementation levels of complementary practices without implementing operational practices (the points have the shape of a right-angle triangle with the right-angle in the upper left corner of the diagram).

In order to test the statistical significance of the first of these conclusions and confirm Hypothesis 1, simple regression was applied to each one of the cases (see Table 5). In this way, it is possible to know the explicative power of the implementation of operational practices on the implementation of complementary practices. In the four cases, the

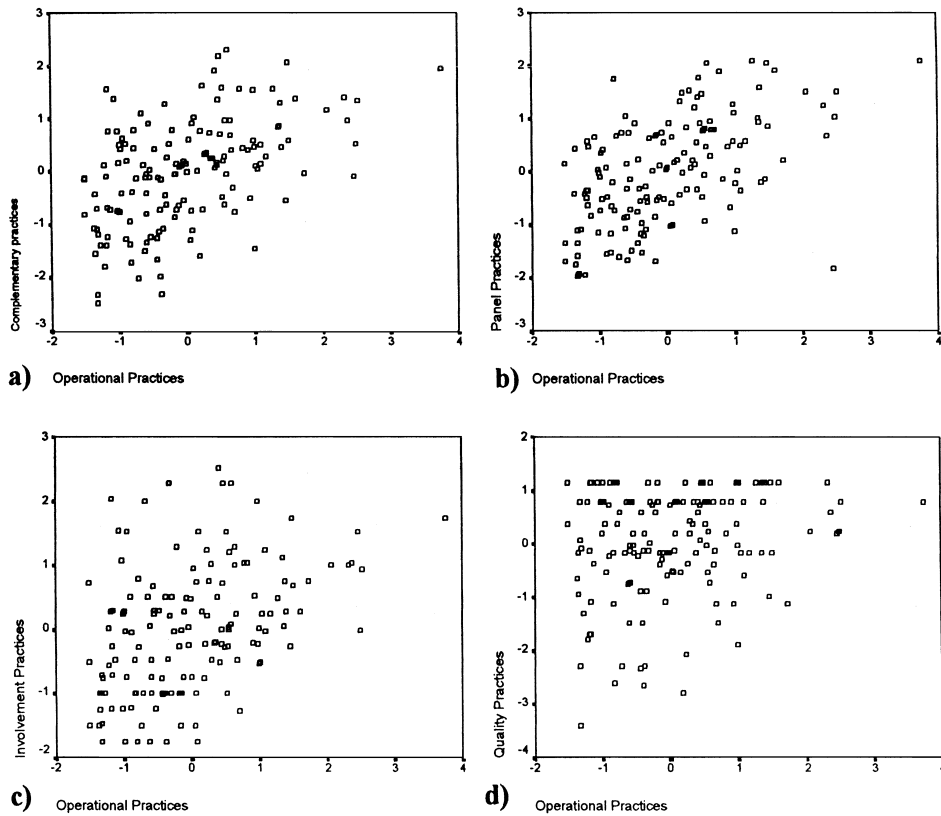


Fig. 3. Scatter diagrams of operational practices and other JIT purchasing practices.

Table 5  
Effect of operational practices on complementary practices  
(simple regression)

Dependent	Operational practices	
	$R^2$	$\beta$ ( $t$ value)
Complementary practices	0.242	0.497 (6.918)**
Panel practices	0.292	0.540 (7.751)**
Involvement practices	0.184	0.429 (5.733)**
Quality practices	0.041	0.202 (2.499)*

\*\*  $p = 0.01$ .

\*  $p = 0.05$ .

variance explained by the operational practices is statistically significant ( $p = 0.01$ , except for quality practices  $p = 0.05$ ). Nevertheless, it is worth mentioning that the heteroscedasticity apparent in diagrams (c) and (d) in Fig. 3 explains why the percentage of variance explained in the associated regression analysis is lower.

As Hypothesis 1 proposes, those companies implementing operational practices tend to accompany them with complementary practices. The question now is whether, as the second of the conclusions extracted from the visual analysis of diagrams states, there are some companies that, in spite of not having high implementation levels of operational practices, have chosen to adopt higher levels of complementary practices. That is to say, whether there are companies which incline to partnership sourcing ( $\approx$  complementary practices) without altering their logistical processes

( $\approx$  implementing operational practices). The sample was divided into four groups by means of nonhierarchical cluster analysis applied to the four basic measures of JIT purchasing (operational, panel, involvement and quality practices). After 10 iterations, the analysis provided the results in Table 6. The SPSS 8.0 program, which was used to conduct the analysis, selects as initial seed points the most distant four observations in the sample according to the Euclidean distance. The reason for choosing four clusters is that the clustering coefficient of an exploratory hierarchical cluster analysis previously conducted registered a significant and disproportionate increase in the step from four to three clusters.

Table 6  
Size and means of the four clusters<sup>a</sup>

	Cluster			
	1	2	3	4
Number of companies	24	48	50	26
Mean operational practices	– 0.67	– 0.70	0.52	0.92
Mean panel practices	– 1.05	– 0.56	0.40	1.24
Mean involvement practices	– 0.95	– 0.51	0.24	1.38
Mean quality practices	– 1.67	0.39	0.01	0.81
Mean complementary practices	– 1.51	– 0.31	0.28	1.44

<sup>a</sup>Nonhierarchical cluster analysis taking as initial seed points the most distant observations according to the Euclidean distance and applying the SPSS 8.0 algorithm.

Table 7  
Analysis of the differences between means

Anova Pares	Operational practices	Panel practices	Involvement practices	Quality practices	Complementary practices
	$F = 43.471^{**}$	$F = 74.708^{**}$	$F = 68.687^{**}$	$F = 79.127^{**}$	$F = 189.679^{**}$
Tukey tests by pairs (difference between means and significance)					
1–2	0.038	0.485*	0.441*	2.063**	1.197**
1–3	1.182**	1.451**	1.190**	1.678**	1.790**
1–4	1.588**	2.285**	2.330**	2.482**	2.951**
2–3	1.220**	0.966**	0.749**	0.385*	0.593**
2–4	1.626**	1.800**	1.889**	0.419**	1.754**
3–4	0.406 <sup>†</sup>	0.833**	1.140**	0.804**	1.161**

\*  $p = 0.05$ .

\*\*  $p = 0.01$ .

<sup>†</sup>  $p = 0.10$ .

The means of each cluster were compared with ANOVA tests and the subsequent application of Tukey tests to each pair of clusters (see Table 7). The companies in each cluster have different behaviours as regards the complementary practices (with the aggregated measure as well as the basic measures). In general, the numerical order of the clusters coincides with the increasing order of implementation of such practices. With respect to the operational practices, clusters 1 and 2 are not statistically different, and even the differences between clusters 3 and 4 are only significant at the level  $p = 0.10$ . The conclusion is that there are a group of companies (cluster 2) that, although it has similar implementation levels of operational practices to cluster 1, it has reached higher implementation levels of complementary practices that even surpass the levels of cluster 3 as regards the quality practices. This confirms that, although the operational practices motivate the complementary practices, the latter are not always accompanied by the former: some companies choose to strengthen their supply relationships although their logistical processes remain unchanged. Nevertheless, this strategy always includes additional safeguards which try to minimise the risk of failure (quality practices).

Clusters 3 and 4 show advance stages of implementation of JIT purchasing, and the 26 companies of cluster 4 can be considered as the most advanced with respect to this way of managing supply relationships.

Table 8  
Influence of complementary practices on results (simple regression in each cluster)

	Results	
	$\beta$ (t value)	$R^2$
Complementary practices (cluster 4)	0.404	0.636 (4.033)**
Complementary practices (cluster 3)	0.057	0.239 (1.704) <sup>†</sup>
Complementary practices (clusters 1 and 2)	0.107	0.328 (2.902)**

\*\* $p = 0.01$ .

<sup>†</sup> $p = 0.10$ .

#### 4.2. Hypothesis 2

Table 8 shows the statistics of a simple regression analysis of the implementation of complementary practices and the results (dependent) applied separately to each one of the clusters, except for cluster 1 and 2, which have been joined into one. In this way, the companies in the sample are divided into three groups which represent three levels of implementation of operational JIT purchasing practices. It can be seen that an important and significant part of the variance of the results is explained by the implementation of complementary practices in cluster 4 (the most advanced companies). Furthermore, this explicative power is far lower in the other two clusters, specially in cluster 3. Thus, the data confirm Hypothesis 2 and, in addition, show that an increase in the implementation of complementary practices yields more benefits when the company has reached certain implementation levels of operational practices.

### 5. Summary and conclusions

A TCE-based framework has been used to propose hypotheses about the relationships and complementarities between different practices which characterise advanced procurement techniques such as JIT purchasing. Firstly, the effect of trust on

vertical relationships was analysed. It was theoretically shown how this element makes the market the most efficient governance structure for degrees of specificity and uncertainty in which traditional competitive relationships would not outperform vertical integration. Co-operative relationships, based on trust generation, displace vertical integration from certain intervals of medium specificity and uncertainty.

Two groups of JIT purchasing practices, namely operational and complementary, were distinguished. The first group is inherent in JIT environments and it fundamentally affects the physical exchange process, whereas the second group of practices affects the way of governing and controlling the supply relationships. Complementary practices motivate and depend on the existence of trust and co-operation, but they also incorporate some safeguards related to the quality and reliability of suppliers. It was argued that the increase in specificity derived from the implementation of operational JIT purchasing practices raises transaction and production costs unless the firm promotes collaboration and mutual adaptation through complementary JIT purchasing practices. Nevertheless, companies might apply complementary practices separately, as a kind of partnership sourcing, without transforming their logistical processes. The empirical study carried out in the Spanish auto components industry has supported this reasoning. Those companies which implement operational practices also tend to implement complementary practices. Furthermore, among the companies with the lowest implementation levels of operational practices, two statistically different groups with respect to the implementation of complementary practices were identified. This proves that there are companies which choose to adopt more complementary practices even when their logistical processes continue to be managed with traditional procedures.

A company may introduce more or less complementary practices and intensify collaboration and mutual adaptation with their suppliers to different degrees. According to the theoretical arguments used in this study, when the implementation of operational practices is high, the benefits directly derived from supply management rise as the

company implements more and more complementary practices. This proposition has been confirmed over the 26 companies in the sample which have the largest degrees of implementation of JIT purchasing and, in particular, operational JIT purchasing. In addition, the sample reveals that the marginal benefits derived from the implementation of complementary practices are specially important when the company has reached certain implementation levels of operational JIT purchasing practices.

Once again, a TCE framework provides economic arguments to explain behaviour patterns and change processes in the form of carrying out industrial relationships. In the same way, it permits the analysis of the complementarities and connections between advanced purchasing practices. Thus, in response to the question posed in the introduction, we conclude that the success of operational JIT purchasing practices depends on the presence of complementary practices. The isolated implementation of operational practices would not only bring about negative consequences for the suppliers, as pointed out in many works [2,10–12], but it would also prevent the buyer from realising many of potential benefits associated to the implementation of the whole package of JIT purchasing practices.

New research proposals arise from this paper. Although the data analysis here addresses the links between complementary and operational practices, some more evidence about the links between these practices and firm efficiency should be generated. The implementation of the whole package of JIT practices seem to be better than the implementation of only some practices, but, does this global implementation lead to improved efficiency? Furthermore, in order to increase the validity of conclusions, more objective measures of results should be found and applied.

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