# Capabilities and Operational Performance: Case Study in Automotive Supply Chain

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***Abstract*— Sharing of operational capabilities in the supply chains brings benefits to the companies involved. However, studies on operational capabilities in the Brazilian supply chain are still non-existent. The current article investigates the effects of operational capabilities on operational performance in the automotive supply chain. An explanatory cross-section survey was employed. The sample used concentrates on the southeast region of Brazil where there is the largest concentration of automakers. Employing the Exploratory Factor Analysis (EFA) and regression analysis, the results show that three operational capabilities have positive and significantly operational performance. These operational capabilities are cooperation, improvement and customization.**

***Keywords*—** *Supply Chain Management, Operational Capabilities, Case Studies, Inter-Organizational Relationships*

## 1. Introduction

Process integration and collaborative practices in the supply chain has attracted the attention of many academics [1], [2] and practicing managers. Sharing of operational capabilities generates innovation and improvement of product and process and may increase the firms' performance [3], [4], [5].

Studies advocate that resources and capabilities can be developed externally through alliances and strategic partnership instead of just internally [6], [7]. Schoenherr and Swink [8] presented that Supply Chain Integration (SCI) generates abilities and knowledge that improves transaction efficiency, problem solving and new products identification. Consequently, firms develop collaborative competences that are key to improve operational performance, such as flexibility and delivery.

In the literature on supply chain management and operational strategy there are still few studies that explore operational capabilities as the focus on manufacturing processes [9], [10]. Operational capabilities refer to the development of idiosyncratic routines, customized processes and distinct skills developed in the manufacturing process, seeking differentiation on the competition [10]. Operational capabilities enable successful supplier integration and strategic partnership [11].

Lockstrom, Schadel, Moser and Harrison [11] analyzed the integration of suppliers in the context of 35 automotive firms in China, measuring five categories and levels of integration. Seven categories of operational capabilities, which would be necessary for integration and collaboration of the practices with the suppliers, were also identified. However, this study did not analysis in detail the relationship between capabilities and operational performance. It identified the need for their existence, pointing them out as criticisms, as they would facilitate integration with suppliers.

On the other hand, emerging markets have been major players in the world economy, especially the four biggest emerging economies: Brazil, Russia, India and China (BRIC). These countries grew more than 45% between the early 1990s to 2010, leading to rapid increase of foreign direct investments and development financing [12]. Furthermore, they have been the stage for offshore manufacturing locations and have exhibited great purchase power. Emerging countries have grown in different ways and various factors are sources of

their growth, such as geography, resources and institutions [13].

In terms of supply chain management, BRIC´s countries companies present operational challenges, such as: (a) deficiencies of transport infrastructure and complexity of urban and trade concentration, that affect delivery cost in Brazil; and (b) insufficient qualification of suppliers, that led expressive investments in machine tools and training from buyers to improve skills and capabilities of their suppliers in the Chinese automotive firms [14].

The current article investigates the effects of operational capabilities on operational performance in one automotive supply chain. Studies on operational capabilities in the Brazilian supply chain are still non-existent. Only deficiencies in the adoption of supply chain integration practices were revealed in previous studies [15], [16], [17]. Based on these previous gaps our study proposes to answer the following research question: Can operational capabilities affect operational performance?

The other sections of this article are presented in the following sequence: theoretical review, research methodology, presentation of results, discussions, conclusions, limitations and future research.

## 2. Theoretical review

### 2.1 Operational capabilities

Operational capabilities are considered part of the organizational capabilities, are skills, processes and specific routines, developed in systems of operations, which are used in the solution of problems by means of operational resources [10]. Operational capabilities are developed on the basis of resources, such as: technology, operational practices, social interaction, culture and organizational structure. Chavez *et al.* [9] defined seven categories of operational capabilities, and two posteriors studies [10], [18] complemented this study, clarifying the understanding of six categories.

The concept of operational capabilities possesses two perspectives in the literature [10]. The first concerns performance results, whose definitions are well-established and are frequently investigated through the capabilities of quality, cost, flexibility and delivery [19], [20], [21], [22]. On the other hand, the second is aimed at processes in operations management [2], [10], [18]. The capabilities are considered as core manufacturing capabilities [9]; they are: "firm-specific sets of skills, processes, and routines, developed within the operations management system, that are regularly used in solving its problems through configuring its operational resources [18].

This perspective being still very incipient. It requires greater understanding, as the terminology can be confused with definitions such as resources or competences [10]. Our study is aimed at this perspective, also seeking to better clarify this gap. Table 1 presents a synthesis of the definitions of operational capabilities aimed at manufacturing processes.

It is noteworthy that the concept of practices differs from the concept of operational capabilities. The former possesses a focus on process improvement and learning, having competitors as the parameter, whereas the latter refers to the development of idiosyncratic routines, customized processes and distinct skills, seeking differentiation, also based on the competition [10]. Integration and collaboration practices with the suppliers have undergone significant investigation over the last 20 years, and their adoption makes provision for sharing resources and capabilities in the supply chain [28]. Dyer and Singh [29], in proposing relational view, presented resources and capabilities that are critical for firms to be able to extend to other partner enterprises, instead of being controlled and considered the property of a single firm. Firms that combine resources in a unique manner, by means of idiosyncrasies, may obtain relational rents and competitive advantages.

Cao and Zhang [6] developed the concept of collaborative advantage, which refers to the strategic benefits obtained by the partnerships in the supply chain. The collaborative advantages mentioned by these authors were: achievement of efficiency in the process, flexibility, synergy in the businesses, quality and innovation. The concept of

**Table 1.** Definition and variables of operational capabilities

| Construct | Variable | Definition | Study |
|---|---|---|---|
| Operational cooperation capabilities | Skills to solve problem | Differentiated set of skills, processes, and routines to create healthy, stable relationships with multiple internal functional areas and external supply chain partners | [9], [23], [24] |
| | To be proactive | | |
| | Trust | | |
| | Sharing data from information technology | | |
| | Multifunctional cross-firm team | | |
| | Integrated product development practices | | |
| | Investments the qualification of its team to meet the requirements of the company – client | | |
| Operational improvement capabilities | Evaluation feedback of suppliers | Differentiated set of skills, processes, and routines for incremental enhancement and reinforcement of existing operations processes. | [9], [25] |
| | Design process has been modified and extended to better serve the needs of client company | | |
| | Improve processes continuously | | |
| Operational customization capabilities | Assemblers visit suppliers for meetings and audits | Differentiated set of skills, processes and routines for creating knowledge through the extension and customization of processes and systems of operations | [2], [26] |
| | Investments and innovations in product and process technologies | | |
| | Acceptable limit for nonconformance of products due to customization | | |
| | To be flexible for negotiation with company-client | | |
| Operational responsiveness capabilities | Agility in distribution channels, which are integrated into the customer system | Differentiated set of skills, processes and routines to react quickly and easily to changes in input or output requirements. | [9], [27] |
| | Supplier assessment and qualification focused on rapid customer response | | |

mutual benefits means improvements or opportunities obtained through of resources and operational capabilities shared among firms in the supply chain, for example, (a) rapid acquisition of market information through exchange of technical knowledge, (b) improvement in the production process, and (c) increase in the operational competences.

## 2.2 Operational performance

Operational performance can be measured by multiple criteria such as cost, quality, delivery, flexibility and the environmental priority [30], [31]. Oh and Rhee [32] analyzed automakers' competitive advantage evaluating the operational performance of their suppliers' New Product Development (NPD) capability. The performance variables used by the authors were: cost, quality, customer satisfaction and product mix.

Efficiency can be measured by performance indicators that can give a diagnosis of the real situation of the organization. These indicators are classified into five categories: cost, quality, flexibility, speed and reliability. These effects lead to indicators internal and external to the organization because they are directly related to the productivity of production processes [33], [34].

For Bowersox, Closs and Cooper [35], shows continuity of long-term maintenance of relationships in the supply chain depends on three key activities: (1) mutual operational goals and strategies, (2) measuring performance via dual, and (3) formal and informal mechanisms for feedback of the productive system (systemic view of the business).

Guarnieri [36] show the importance of multi-criteria analysis of performance indicators, providing a method that separates the critical suppliers, which suggests the need for a differentiated development of suppliers according to the degree of strategic importance and that the supply will be critical for the company. They use the technique of Analytic Hierarchy Process (AHP) indicators of five categories: quality, price, delivery, technology and flexibility.

Cannon, Doney, Mullen and Petersen [37] suggest that supplier performance is important to establish the trust of buyers and thus establish a partnership with a long-term orientation.

Martins and Alt [38] and Whipple and Roh [39] point traditional aspects are emphasized in the evaluations: cost, quality, timeliness, innovation, flexibility, productivity, and training facilities and financial management. They emphasize that the

relationship between buyer and customer supply chain is vulnerable and depends on a negotiation mechanism to mitigate this vulnerability and provide the understanding between the parties.

Martins and Alt [38] and Kenion and Meixell [40] indicate that the evaluation of suppliers include the following performance indicators: experience, flexibility, financial stability, potential for strategic partnerships, quality management of operational processes, human resources policy, applied technology and logistics costs.

Valk, Wynstra and Axelsson [41] conducted a study on the relationship between customer and supplier, creating the perception that a level of performance is the result of several dimensions: key objectives, capabilities of customers and suppliers, communication and adaptation to the competitive environment. This study was conducted in the service sector, but contributes to the proposed standard to allow an effective interaction between supplier and customer.

Investment in innovation is also considered crucial to maintaining a level of operating performance, because even though this aspect can increase costs, makes the conditions for meeting the requirements demanded by the customer [42].

Gattorna [43] explain that the measurement of is important for a holistic view of supply chain management. They present a model that suggests that the structure of the supply chain organizational design, human resources, information technology and performance measurement must fit the strategy of managing the supply chain. Performance measurement needs to be guided by strategic directions that provide a systemic view of supply chain to support the business competitively.

Kerzner [33] propose a model of production management that uses the performance indicators cost, quality, flexibility, reliability and speed as a strategic manufacturing goals, because they are considered important for monitoring the results of the production strategy.

These indicators can define the strategic objectives of production and must be aligned with the objectives of the suppliers that make the supply of the productive system. This alignment between sourcing strategy and manufacturing strategy is central to the strategy of the supply chain [44].

Inman, Lair and Green Jr. [45] deepen the concept of systemic, with the studies on organizational performance and show a model that relates the input and output elements of the production system, according to systems theory and the theory of constraints. This perspective puts the performance indicators within a context that emphasizes the search for efficiency, showing the need of correlation between the performance indicators.

In the automotive sector, the focus is on performance improvement process or product that can be translated into large scale production, for this, the incentive for investment in technology and cost reduction, because these two features are measured by indicators of quality and price accordingly. A survey was conducted with first-tier suppliers, second and third layers, identifying the levels of the supply base [46].

## 3. Methodology

In accordance with the objective of the present work, the method used in the empirical research was identified as an explanatory cross-section survey. The concept of survey is justified, for it uses a quantitative method through structured questions, and the data gathering was done on a sample of the population under study; it is explanatory as it tests the theory and causal relations among variables; and it is cross-section type as the data were collected in the same time [47], [48].

The questionnaire was performed a pre-test with three suppliers for a better understanding of the issues in terms of clarity and objectivity, minimizing the impact of subjectivity. The measure of the constructs came from a review of the relevant literature. Survey participants in the sample are managers or professionals in the areas of procurement, commercial quality. All companies have the same access / treatment / opportunity to the factors under study, information on contract and procurement process.

The data collected in this study assume a probability sample survey in the automotive segment for access to records of a labor union and the indication of a professional. After an initial contact by phone or in person, the questionnaire is available by e-mail or in person.

Contacts with suppliers are by e-mail, by phone or in person. All suppliers have had initial contact by e-mail and, where necessary, to contact you by phone or in person. For access to these suppliers, it was considered a database of the labor union and the appointment of professionals. 100 contacts were made, obtained 61 responses, but four contacts were discarded because they did not meet fully the requirements stated in the study: having a contract of at least two years in the automotive supply chain, supply, directly or indirectly, a product or service for automaker vehicles.

According to Sindipeças [49], there are 500 companies registered in Brazil, where the focus is in the southeast region, with 354 companies. We collected 57 valid samples, or a response rate of 16,1% (57/354). This response rate was similar to that in other Operations Management (OM) studies [20], [30], [50], [51], [52], [53]. The measure of the constructs came from a review of the relevant literature. This region was chosen because it has the largest concentration of companies in the industry under study, with suppliers with national distribution, which supply all 17 automakers installed in Brazil [54].

## 4. Data analysis and results

To address the potential concern of common method bias from using a field survey technique, we initially analyzed the positive and significant correlations between the construct variables in accordance with the Spearman correlation coefficient. Then we conducted an Exploratory Factor Analysis (EFA) by way of Principal Component Analysis (PCA) and varimax rotation. The values recommended by the researched literature [55] for evaluation of these criteria are described in Table 2.

**Table 2.** Acceptable values for Exploratory Factorial Analysis. Adapted from Hair Jr., Anderson, Tatham and Black [55]

| | |
|---|---|
| Loading | ≥ 0,30 |
| Criteria for latent root (eigenvalue) | ≥ 1,00 |
| Communality | ≥ 0,50 |
| Measures of sampling adequacy | ≥ 0,50 |
| Accumulated variance | ≥ 60% |

The evaluation of the criteria for latent root (eigenvalue) and the screen test selected five latent factors (Table 3).

Analysis of the Measures of Sampling Adequacy (MSA), the factor loadings and the communalities of each variable led to the exclusion of those variables that presented unacceptable values [55].

Convergent and discriminant validities were then assessed. Estimated correlation between factors are not excessively high (>0.85) indicates discriminant validity. And indicators specified to measure a common underlying factor all have relatively high standardized loading on that factor indicates convergent validly.

Subsequently, the direct effects of the four constructs of operational capabilities (independent variables) on the operational performance (dependent variable) were analyzed through regression analysis and the ordinary least squares technique. The results are shown in Table 4. The construct of operational responsiveness capabilities was excluded due to evaluation of regression analysis. This construct did not present positive and significant correlation with operational performance.

## 5. Discussions

The results show that companies are mostly multinational (58,5%), subsidiaries (57,7%) and medium sized (57,7%), with 50 to 500 employees. These data show that most companies may indicate better conditions to productive capacity and infrastructure to attend the requirements of automakers.

Regarding the unit under study, 57.7% of the companies are subsidiaries of multinational companies, 32.7% are local companies, 5.8% are headquarters of a subdivision of the corporation and only 3.8% are subsidiaries of a corporation subdivision of the corporation.

Regarding the size of the company, it is estimated that 57.7% of companies have 50 to 500 employees, 30.8% have more than 2000 employees.

**Table 3.** Results of the Exploratory Factorial Analysis and Reliability

| **(a) Operational cooperation capabilities** | **Loading** | **Communality** |
|---|---|---|
| Skills to solve problem | 0,861 | 0,741 |
| To be proactive | 0,788 | 0,620 |
| Trust | 0,761 | 0,580 |
| Sharing data from information technology | 0,709 | 0,502 |
| Investments in training for supplies | 0,824 | 0,679 |
| KMO: 0,808 / Accumulate Variance: 62,456% / Cronbach's α: 0,836 | | |
| **(b) Operational improvement capabilities** | **Loading** | **Communality** |
| Evaluation feedback of suppliers | 0,855 | 0,731 |
| Design process has been modified and extended to better serve the needs of client company | 0,872 | 0,761 |
| Improve processes continuously | 0,868 | 0,754 |
| KMO: 0,723 / Accumulate Variance: 74,859% / Cronbach's α: 0,822 | | |
| **(c) Operational customization capabilities** | **Loading** | **Communality** |
| Investments and innovations in product and process technologies | 0,763 | 0,583 |
| Acceptable limit for nonconformance of products due to customization | 0,836 | 0,699 |
| To be flexible for negotiation with company-client | 0,791 | 0,626 |
| KMO: 0,663 / Accumulate Variance: 63,590% / Cronbach's α: 0,712 | | |
| **(d) Operational responsiveness capabilities** | **Loading** | **Communality** |
| Agility in distribution channels, which are integrated into the customer system | 0,899 | 0,809 |
| Supplier assessment and qualification focused on rapid customer response | 0,899 | 0,809 |
| KMO: 0,500 / Accumulate Variance: 80,857% / Cronbach's α: 0,752 | | |
| **(e) Operational Performance** | **Loading** | **Communality** |
| Quality | 0,820 | 0,673 |
| Delivery | 0,780 | 0,608 |
| Cost | 0,745 | 0,555 |
| KMO: 0,654 / Accumulate Variance: 61,189% / Cronbach's α: 0,671 | | |

**Table 4.** Regression analysis results

| **Independent variables** | **Beta** | **p-value** | **Tolerance** | **FIV** |
|---|---|---|---|---|
| Operational cooperation capabilities | 0,403 | 0,00 (t = 4,457) | 0,713 | 1,402 |
| Operational improvement capabilities | 0,393 | 0,00 (t = 4,084) | 0,631 | 1,586 |
| Operational customization capabilities | 0,216 | 0,034 (t = 2,178) | 0,592 | 1,689 |
| Adjusted $R^2$: 0,673 F: 39,460 (p: 0,00) | | | | |

Our study found that cooperation capability affect positive and significantly operational performance (B=0,403 and t=4,47). Cooperation capability include variables of collaboration, trust, information sharing and training. Our study corroborates with previous studies have analyzed the direct effects of interorganizational collaboration on supply and business performance [6], [56], [57], or the moderating effects of interorganizational collaboration on supplier outcomes and buyer performance [51]. The operational capability of cooperation refers to skills in information sharing and decision-making for solving problems and settling interorganizational conflicts during troubled periods [18]. Firms need to cooperate in order to deal with problems that happen in a global environment, such as supplier diversity (number of suppliers, nature of the relationship with specific suppliers, location of suppliers) and labor diversity. Our findings are also supported by the study by Oliva and Watson [58], in which organizational and functional alignment in supply chain planning is important and results in synchronized actions. These authors found that supply chain planning requires cross-functional collaboration, primarily to understand the state of the supply chain and the organization's needs. This process determines and carries out an approach for creating sustainable value based on assessment of the information. Engagement encourages participants to trust that other participants will adhere to the plans, which promotes alignment. Handfield, Cousins, Lawson and Peterson [59] argued that a strong relationship with stakeholders provides procurement executives with the opportunity to establish supply chain goals; this becomes the basis for the effective communication of needs to external suppliers. Consequently, this interaction enables the development of the capability of responsiveness, since firms will coordinate activities more effectively.

The results of our survey present operational capabilities of improvement affect positive and significantly the operational performance (B=0,393 and t=4,084). The operational capabilities of improvement can be achieved through evaluation

of suppliers, NPD and practices of process improvement. From the study carried out by Bhaskaran and Krishnan [1] it is evident that firms share revenue and development costs in the joint development of products. Cousins, Lawson, Petersen and Handfield [3] related dimensions of the information processing theory to the buying firm's product development process. Ragatz, Handfield and Scannell [60] analyzed the use of management practices for supplier integration in new product development. This research extends the examination of NPD practices in the supply chain and found that this practice has a positive and direct impact on operational performance. When suppliers are involved with product and process development, they will have a faster product cycle and better product quality [61]. Additionally, the relationship between buyers and suppliers over the last 2–3 years contributes towards improving performance and transferring knowledge between partners [62]. Consequently, partners may transfer technologies and develop competences to design, modify and extend processes and products to better serve customer needs.

Additionally, the results of the effects of capability of customization on the operational performance are positive and significative (B=0,216 and t=2,17).

## 6. Conclusions

This study raises the reflection on the relationship management and providers a more holistic and strategic view of supply chain management, whereas the long-term relationship is an essential premise for the competitiveness of the organizations participating in the chain.

The relationship between operational capabilities and practices is relatively recent. Wu, Melnyk and Flynn [18] validated six constructs of operational capabilities in a sample with several industries. These authors clarified the concepts on practices, operational capabilities and resources. Our article proposed to investigate how the operational capabilities affect from operational performance in supply chain. Then, we are extending the concepts on previous studies [9], [18], since we analyzed the operational capabilities related to operational performance in supply chain.

The motivation for our research was to explore the effects of operational capabilities on operational performance. Our findings revealed that operational capabilities of improvement, customization and collaboration influenced positively and significantly operational performance. We believe that other performance constructs can be validated, provided firms do in fact adopt performance and become aware of the need and benefit to measure them. It is worth noticing the considerable number of missing data in our interviews. One of the reasons being that some firms had adopted the measurements only six months previously, while the research spanned two years. We believe that with better training of employees a culture of measuring performance could be developed and hence a medium-term data gathering could be instilled.

### 6.1 Limitations and future research

The principal limitation of this research lies in the size of the sample because they were collected fifty-seven samples. Although this sample is representative for the population size, a larger number of respondents would allow further analysis that can deepen the level of knowledge on the subject under study.

Future research may consider the capabilities identified in this study to verify its application in other sectors.

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