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Management Decision

Emerald Article: Planning, capabilities, and performance: an integrated value approach

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Article information:

To cite this document:
Marcelo Bronzo, Marcos Paulo Valadares de Oliveira, Kevin McCormack, (2012),"Planning, capabilities, and performance: an integrated value approach", Management Decision, Vol. 50 Iss: 6 pp. 1001 - 1021

Permanent link to this document:
http://dx.doi.org/10.1108/00251741211238300

Downloaded on: 29-06-2012

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Planning, capabilities, and performance: an integrated value approach

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Abstract

Purpose – How do planning and capabilities affect operational performance? This paper aims to formulate hypotheses comprising correlations amongst those constructs in an integrated approach for industrial companies, considering the source, make and deliver process areas.

Design/methodology/approach – Based on a survey of 164 Brazilian industrial companies, analysis of data was conducted including descriptive statistics, evaluation of a research model's internal scale reliability, statistical construct path analysis, and structural equation modeling.

Findings – The findings indicate that planning and capabilities must be taken as inter-related initiatives that jointly influence operations performance. Significant correlations were found amongst these constructs in the source, make and deliver process areas. The model tested on this study was able to explain 84 percent of the variation in the overall performance of the companies sampled.

Research limitations/implications – The reference model was tested using a diversified sample of Brazilian industrial organizations and did not include service or other types of organizations, thereby limiting the generalizability of the results and conclusions. The findings suggest a balanced weight of operations capabilities and planning. Both play an important role on performance. These results can drive organizational strategy, indicating that companies should look to their capabilities, but that developing planning activities driven to the market should be considered mandatory.

Originality/value – Whereas some aspects of the relationship between planning and performance as well as the relationship between capabilities and performance have been reviewed in early contributions, few studies have addressed these complex mediations using an integrated process value approach.

Keywords Operations planning, Operations capabilities, Operations performance, Process management, Structural equation modelling, Operations management, Organizational planning, Brazil

Paper type Research paper

Introduction

It is widely accepted that operations planning must be conducted in alignment with the development of operations capabilities. However, the importance of operations planning efforts on performance while simultaneously considering the influence of operations capabilities is not clear.

The authors thank the Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) for financial support of this study.

Management Decision
Vol. 50 No. 6, 2012
pp. 1001-1021
© Emerald Group Publishing Limited
0025-1747
DOI 10.1108/00251741211238300

Those issues become even more relevant when a process perspective is considered. This process perspective must take into consideration three distinct process areas to evaluate operations planning, capabilities, and performance as components of the value chain. The value chain is a concept described and popularized by Porter (1985), presented as a set of primary and support activities that must be strategically oriented and managed in order to create and sustain competitive advantages for firms. Amongst the elements of the value chain, three fundamental process areas can be identified:

(1) source: dealing with upstream flows and interfaces with supplier's processes;
(2) make: considering the transformation flows within organizational boundaries; and
(3) deliver: dealing with downstream flows and interfaces with customer processes.

This paper seeks to discuss the operations planning and operations capabilities as important formative constructs for operations performance. It compiles the main results of a research effort that has as its central objective an evaluation of the influence of those formative constructs on performance using a sample of 164 Brazilian companies. The specific objectives of the research were:

- to identify operations capabilities in the source, make and deliver process areas;
- to characterize the planning in the source, make and deliver process areas
- to describe statistically performance in the source, make and deliver process areas;
- to describe statistically the relationships between the model's constructs (planning, capabilities, performance);
- to estimate the weights of the formative factors by identifying path parameters amongst research constructs.

The theoretical background for this study is presented in section 2. The main contributions for operations planning, capabilities, and performance are compiled in sections 2.1, 2.2, and 2.3 and a set of measures is identified in section 2.4. Section 2.5 presents some of the gaps addressed by this research and summarizes the literature review. A conceptual model is then introduced in section 3, a methodological approach is described in section 4, and section 5 describes an empirical investigation to test the conceptual model. Final remarks in section 6 discuss and juxtapose the managerial and academic implications.

2. Theoretical background

2.1 Operations planning

Operations planning is a complex task. It is part of the managers' responsibility to plan activities relevant to products, manufacturing processes, technology selection, material flows, and control systems (Hurtubise *et al.*, 2004). According to Landeghem and Vanmaele (2002), planning operations in value chains encompasses information processing and the utilization of results to coordinate actions to fulfill a customer's desires. In a more expansive perspective, these signals are relayed to supply chain partners through supply chain execution systems. Several planning models have been developed with the goal of providing relevant information for management about the various operational activities in a supply chain (Verderame and Floudas, 2009).

To ensure coherence between operational decisions amongst different functional areas, planning is an adequate starting point for successful strategy implementation. Planning helps companies achieve vertical and horizontal coherence within operational decisions and it improves horizontal communication as well.

Should planning be managed as an integrated system? Operations planning should create a balance for the process areas while including the source, make and deliver requirements. Although companies exploit its resource configuration, they are also constrained in the utilization of these resources due to managerial capabilities (Andersén, 2011). Thus, the effectiveness of operations planning and the presence of certain managerial capabilities are important conditions in order to streamline resource (re)configuration and superior operations performance.

This integrated perspective must be considered mandatory once planning is involved in managing the process areas trade-offs.

2.2. Operations capabilities

According to Stank *et al.* (2005), capabilities include a company's capacity to:

- target customer demands in different segments;
- be agile and manage lead times adequately (for customer order processing, manufacturing orders, purchasing orders, product development, transit time, among others);
- integrate multiple processes and activities aimed at reducing costs and increasing responsiveness;
- share information about products and markets with other chain members, integrate processes, and mitigate risks; and
- promote permanent monitoring of operations and align such efforts with customers' fundamental requirements and demands.

All of these elements have an impact on a company's strategies and, consequently, on its operating model. They also impact the combination of planning and resources needed to meet strategic goals.

Operations planning is a process that is highly related to the set of company capabilities (Mason-Jones *et al.*, 2000; Hoeck, 2000; Hoeck *et al.*, 2001). Managing those capabilities in a balanced and integrated system with dispersed resources, and different process areas can emerge as powerful competitive weapons. As pointed out by Teece *et al.* (1997), the term "capabilities" emphasizes the key role of management in adapting, integrating, and reconfiguring resources and competences appropriately. Under the operations management perspective, in order to fulfill the customer's requirements, capabilities have to be in place, sustaining and balancing different competitive priorities in the source, make and deliver process areas.

Do organizational capabilities lead to the creation of competitive advantage, adding more value to the customers? This seems to be the case, but this is not guaranteed only because a firm possesses valuable or rare resources and idiosyncratic capabilities. Previous contributions on this topic, such as those of Landroguez *et al.* (2011) and Andersén (2011), demonstrate empirically the importance of planning efforts to create new valuable strategies, recombining existing resources and firms' capabilities.

By measuring its capabilities, a company can gather critical information helping it to balance different priorities and requirements while simultaneously addressing strategic objectives in the source, make and deliver process areas.

2.3 Operations performance

To approach operations performance successfully, it is necessary to consider the concept of a performance measurement system. According to Neely *et al.* (1995), this concept must be properly differentiated from the concepts of performance measuring and metrics. Performance measuring aims to quantify, through metrics, the effectiveness and efficiency of a whole process or an action within a process. On the other hand, performance measurement systems are characterized as a group of metrics used to quantify both the effectiveness and efficiency of a company's actions and processes. Neely *et al.* (1995) state that one of the persistent problems related to performance measurement is the contrasting aspects of the numerous systems and models in the literature developed to measure organizational performance. However, there are common features to a performance measurement system that can be identified:

- they must be inclusive, implying that the measurement of all relevant aspects of process performance assessment be included;
- they must be generic enough to allow for performance comparison under disparate operating conditions;
- they must be based on measurement, allowing for quantification of required data; and
- they must be consistently based on metrics aligned with the strategic objectives of a company's business unit.

In the context of operations processes, it is important to highlight that performance measurement systems usually classify metrics into two groups:

(1) cost factors, including manufacturing costs and productivity elements linked to the company's final results, net profit, and profitability; and

(2) non-cost factors, including attributes such as lead time, flexibility, and quality among other performance factors that are not necessarily expressed in monetary terms (De Toni and Tonchia, 2001; Neely *et al.*, 1995; Neely, 1999).

Alternatively, Beamon (1999) espouses the idea that a supply chain measurement system must emphasize three types of performance measures:

(1) resource measures to recognize that efficient resource management is critical to profitability;

(2) output measures to recognize that customers will turn to other supply chains in the absence of acceptable output; and

(3) flexibility measures based on the idea that supply chains must be capable of responding to change in an uncertain environment.

Early contributions from Skinner (1969, 1974) raised a discussion about different trade-offs of competitive priorities in operations management practices considering the

variables of cost, quality, time, technological constraints, and customer satisfaction. In the same direction, Slack *et al.* (1995) proposed that an operating system must meet the broad competitive and strategic objectives of quality, speed, reliability, flexibility, and cost.

It is relevant to understand how performance variables inter-relate and how to manage the trade-offs raised from these relations. Cuthbertson and Piotrowicz (2008) suggest that it is problematic to define a common set of measures without a clear understanding of where an organization is located within the supply chain. Taking these issues into consideration, the supply chain operations reference (SCOR) model can be positioned as a powerful tool to address these challenges. The SCOR model emphasizes process orientation (a horizontal focus) and de-emphasizes organizational or functional orientation (vertical focus) (Bolstorff and Rosenbaum, 2003). However, Shepherd and Gunter (2006) discuss that despite the power of the SCOR set of measures, it is still important to understand the factors that can influence its implementation, management, and control in organizations.

A vast body of conceptual and empirical contributions can be linked to the theme of operations performance that directly addresses the problem of performance from a value chain perspective.

An operations performance measurement system demands an encompassing approach that considers not only the many trade-offs that are to be managed between different competitive priorities (such as quality, cost and velocity) but also a decisive value chain perspective that includes the source, make and deliver process areas of the system. In this sense, companies cannot blindly aim for better performance results by considering each cycle individually; they must adopt a systemic approach in order to enhance overall performance.

2.4 Measuring operations planning, capabilities, and performance

Considering the overall contributions from the literature briefly introduced in previous section, a set of items can be linked to each process area as presented in Table I.

One of the most important objectives of operations management is to achieve effectiveness regarding the development and sourcing of necessary capabilities for business processes. In this sense, capabilities can be defined as special types of resources that are organizationally embedded. They are non-transferable firm-specific resources whose purpose is to improve the productivity of other resources (Makadok, 2001). Distinctively, operations planning must be in place processing information and using the results to coordinate actions (Landeghem and Vanmaele, 2002). Moreover, planning must be grounded in equilibrium to identify the goals to be reached in terms of cost, reliability, flexibility, quality, and velocity and to determine how to put in place the necessary capabilities to reach those goals. For the aims of this research, while the operations planning construct is considered to be related with how to orchestrate firm resources in order to implement strategies, the operations capabilities construct is considered to be related to the ability of firms to use their resources effectively and efficiently.

As shown in Table I, there are complex relationships to be considered when it comes to these issues. One example could be taken regarding responsiveness on replenishments, since companies must plan their operations to establish how costs on raw materials should be sacrificed and identify the necessary investments to

Process area	Capabilities to . . .	Constructs Planning of . . .	Performance of . . .
Source	Control quality Improve flow velocity Reduce raw materials costs Consistency Flexibility Manage relationships Develop new sources Utilize on-time event management	Quality control Process improvement Raw materials Process consistency Process flexibility Relationships Source channel Risk management	Best quality on raw materials On-time delivery Low cost on raw materials Availability of raw materials Responsiveness on replenishments Low inventory levels on raw materials
Make	Reduce production costs Control production quality Improve responsiveness Reduce waste Improve flow velocity Consistency Flexibility Align supply versus demand Reduce setup costs	Production Quality control Process improvement Process consistency Process flexibility Setup optimization	Low production costs Best quality on products High capacity utilization Scrap/waste reduction Low setup times Production on-time
Deliver	Reduce distribution costs Flexibility Control delivery quality Develop distribution channels Improve picking velocity Improve delivery lead times Consistency Control order process quality Manage relationships	Quality control Process improvement Transport Process consistency Process flexibility Relationships Distribution channel Risk management Communication channels IT infrastructure	Best quality on order fulfillment Low cost on delivery Order flexibility Responsiveness on delivery Responsiveness on order processing Customer satisfaction On-time delivery Fast delivery Low stock-out Order assortment accuracy First-time delivery Shipping documentation Invoice accuracy Defect-free products Mitigation of distribution risks

Table I.
Process area items

develop capabilities in terms of flexibility with suppliers. Another example is based on customer satisfaction as a performance metric in the deliver process area. Amongst the many items that can potentially affect customer satisfaction, consistency is the most relevant. Certainly, there are many ways in which operations management can enhance firms' capabilities to achieve consistency goals, and therefore planning is a fundamental process to be in place. This strategic fit – between planning and performance metrics – must be aligned to consistency objectives in the way that firms employ resources and tacit competencies.

2.5 Summary of literature review

The process areas of source, make and deliver should be viewed from an end-to-end and cross-functional perspective, for which not only is internal integration mandatory for many firms, but also external integration with customers' and suppliers' core primary processes.

Taken as core process areas of a value chain, source, make and deliver are to be tuned and balanced with a firm's overall strategic planning goals. One of the most important objectives – if not the most important objective – of operations management is to be effective with regard to the development of necessary resources and capabilities to support operations strategic planning. Operations planning effort involves not only distinctly clarifying the relevant goals to be achieved in each process area but also identification of how a firm's resources and capabilities are to be managed to meet overall performance goals. Some typical situations can be cited here. Take, for example, the case of a company that seeks to ensure a competitive cost advantage in a particular market. The requirement in this case is to have an operations strategy that gives priority to lean and efficient processes. Conversely, firms seeking competitive advantages by customizing their products focus on product and process flexibility in their operations strategy.

The theoretical framework introduced earlier presents some conceptual and empirical contributions on this subject. As a common element in many of these contributions, there are recommendations stressing the need for a systemic and broader approach to study business process performance. While it is possible to find theoretical support for the relationships between operational planning and performance as well between firm capabilities and performance, the interplay between planning and capabilities and its impact on performance are not clear. In the same way, the role played by each of the process areas when the systemic context of operations planning, capabilities, and performance are taken into account remains obscure. Therefore, it is possible to identify theoretical gaps that empirical research should address:

- As a concept, operations performance can be taken as a dependent variable influenced by operations planning efforts and firm capabilities. In this sense, it is beneficial to model the effects of planning and capabilities on a company's operations performance.
- Operational trade-offs are likely to be balanced when considering the influence of one process area over another. For example, the trade-offs on planning between source and make or on capabilities between deliver and make are still not clear.
- Referred to as critical competitive priorities (quality, speed, reliability, flexibility, and cost), it is relevant to take the perspectives of planning, capabilities, and performance when evaluating these issues. Since there are many intuitive relationships regarding these complex relationships, operations management knowledge benefits if more evidence is found regarding such relationships in the source, make and deliver process areas.

The next section of this paper introduces the model developed for this study. Its structure is based on the contributions presented in previous sections. Hypotheses that fill the gaps identified above are also discussed.

3. The research conceptual model

The conceptual model proposed in this paper draws on issues formerly addressed by a broad research program led by the Massachusetts Institute of Technology (MIT) called the Supply Chain 2020 Project. Carried out by the MIT Center for Transportation and Logistics, this research program aimed to identify and analyze the most significant innovations and factors that will be critical to the success of supply chains in the next decade. The project is an ambitious research program involving educational institutions, research centers, global consultancy firms, MIT students, and other international collaborators. The preliminary findings reported in phase I of the project indicate that at least four fundamental characteristics are consequences of excellence in supply chain management (Lapide, 2005, 2006):

(1) the enhancement of business strategy principles and practices for the companies participating in the supply chain;

(2) the development of a unique and distinct operating model designed to sustain the competitive edge defined by the company's business strategy;

(3) constant monitoring and assessment through a balanced set of operational performance objectives and performance metrics; and

(4) the development and customization of a restricted set of business practices that reinforce each other to support the company's operating model and strategy with its respective supply chains.

Such findings significantly influenced the initial development of the nomothetic model introduced in this paper. However, there is one fundamental difference: while the research program led by MIT focuses on identifying and characterizing excellence dimensions in the supply chain context, the fundamental approach for the model presented here is defined by the process areas of source, make and deliver from a company's perspective. The latent constructs developed and used in this research are presented in Table II. A sample of the questions used for each latent variable can be found in the Appendix. It was proposed to measure the items using a five-point scale.

The final model explored in this study is shown in Figure 1. The model proposes a systemic view of the role of capabilities and planning and suggests a relationship with operations performance. By following a process approach for accessing the dynamic relationships amongst the constructs of capabilities, planning, and performance, the areas of source, make and deliver were considered for each one of these three main constructs.

It is important to point out that although the composition of the variables and constructs in the model was influenced by the SCOR model and its perspectives on source, make and deliver, the "return" process area was not included in the final research model. This decision was based upon the finding that the return process area is not sufficiently developed and institutionalized in many companies. Furthermore, when the SCOR area of planning was taken into account, it was considered to be a major construct of the model represented by operations planning and composed of variables from source, make and deliver process areas.

In relation to the model proposed here, four hypotheses are offered with the purpose of guiding the investigation process and answering the main research question: what is the influence of operations capabilities and operations planning over operations performance? Four hypotheses were tested in this research:

Constructs	Number of items	Range
Capabilities		
Source capabilities	8	$8 \leq x \leq 40$
Make capabilities	9	$9 \leq x \leq 45$
Deliver capabilities	9	$9 \leq x \leq 45$
Planning		
Plan source	8	$8 \leq x \leq 40$
Plan make	6	$6 \leq x \leq 30$
Plan deliver	10	$10 \leq x \leq 50$
Performance		
Performance on source	6	$6 \leq x \leq 30$
Performance on make	6	$6 \leq x \leq 30$
Performance on deliver[a]	15	$8 \leq 15 \leq 75$

Notes: [a]This construct was divided into two parts. The first part refers to overall performance composed of three items measured using a five-point scale such that its score sum ranges from 3 to 15. The second part refers to perfect order performance on delivery, composed of 12 items measured on a five-point scale such that its score sum ranges from 12 to 60

Table II. Constructs, number of items, and possible score ranges for latent variables

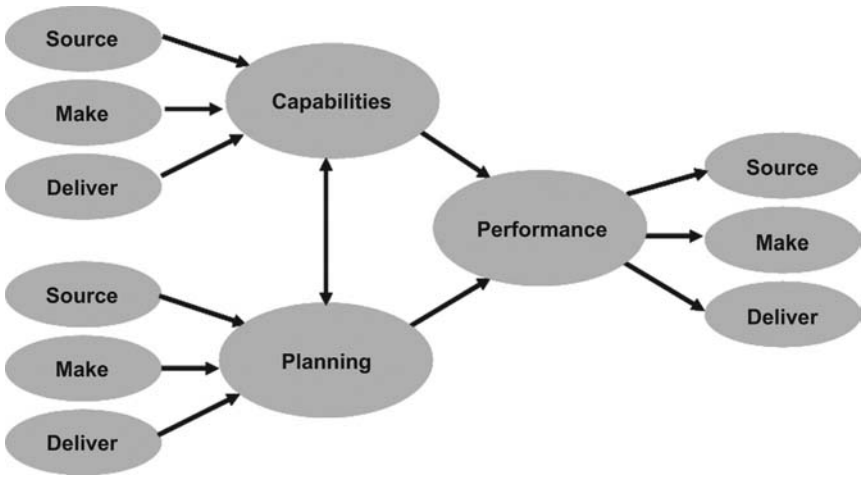

Figure 1. The research conceptual model

H1. There is no positive correlation amongst capabilities, planning and performance in the source process area.

H2. There is no positive correlation amongst capabilities, planning and performance in the make process area.

H3. There is no positive correlation amongst capabilities, planning and performance in the deliver process area.

H4. There is no positive correlation amongst capabilities, planning and performance in the source, make and deliver process areas.

The next section discusses the methods that guided the investigation effort, the gathering of data, and the statistical procedures used.

4. Methods

In this study data were gathered with a self-administered survey using a sample of cross-industry supply chain professionals from 164 Brazilian companies. Although Brazilian companies are not leading best practices in supply chain management processes, the country has a significant economic influence in terms of internal markets and international trade. It is widely agreed that Brazil is one of the world's four largest emerging economies, along with Russia, India and China, and an international player with massive growth potential. For this research, a database composed of the largest 500 companies in terms of revenue was used to build a list of potential subjects.

A questionnaire was sent to professionals who were actively and significantly engaged in the management of the operational functions or supply chain processes in the selected companies. One key respondent from each company constructed a diversified sample, composed of companies from various economic sectors. These sectors included raw materials suppliers, food and beverages, building/construction, machinery and equipment, clothing, metal components, plastic and rubber products, chemical products, and textile products.

Since this was the initial empirical testing of the model, the first phase of data collection was used as a pilot to validate the electronic survey instrument and calculate the recommended sample size for final data collection. The electronic survey instrument consisted of 77 items grouped into subsections related to the focal constructs. For the pilot sample, the questionnaire was given to 30 respondents representing companies from diverse segments.

Using the data from this pilot sample, an estimate of the population variance was calculated using the "plan source" latent construct as a reference for sample size calculation. This construct had the largest variance amongst those collected (357.77) with a standard deviation of 18.91. The calculation of the final sample used a confidence interval of 95 percent and an error (E) of 3. The pre-test standard deviation was 77.40. The final sample size was then determined by using the formula suggested by Anderson *et al.* (2007). With a recommended sample size of 153 respondents calculated, the final sample was collected.

The Data Analysis section that follows presents the test of the proposed hypotheses and the evaluation of the conceptual model. It addresses the correlation, reliability analysis and of the scales and structural model composition, as evaluated with a partial least squares algorithm. Details about each statistical procedure are presented along with section development.

5. Data analysis

The final sample consisted of 164 respondents representing a response rate of 32.8 percent out of the 500 potential companies identified in the previous list. This final sample was composed of companies from numerous Brazilian industries including raw material suppliers, food and beverages, building/construction, machinery and equipment, clothing, metal products, plastic and rubber products, chemical, and textile companies. Table III summarizes the distribution of these industries in the sample.

Industry	Cases	Percentage
Raw materials supplier	54	32.9
Food and beverages	24	14.6
Building/construction	16	9.8
Machinery and equipment	16	9.8
Clothing	14	9.1
Metal products	11	7.3
Plastic and rubber products	9	5.5
Chemical	9	5.5
Textile	9	5.5
Total	164	100

Table III. Sample composition

A summary of the descriptive statistics of this research, considering the sum of the scores for each research model's constructs, is presented in Table IV. Considering the three process areas – i.e. source, make and deliver – the results for each construct were obtained by taking the sum of the scores for each construct's respective items to calculate the ranges, averages, and standard deviations.

The second step was to test the correlations among the constructs of capabilities, planning, and performance. The aim of this test was to identify possible significant relationships between pairs of models' structural constructs, initially not considering the process areas. Table V shows the results obtained by the Pearson correlation test on these relationships. The results suggest the presence of strong positive correlations in all cases.

As shown in Table V, the Pearson correlation coefficients between capabilities and planning (0.810), capabilities and performance (0.784), and planning and performance

Construct	Process area	Range	Average score	Standard deviation
Capability	Source	$8 \leq x \leq 40$	27.26	5.7
	Make	$9 \leq x \leq 45$	32.05	6.51
	Deliver	$9 \leq x \leq 45$	33.10	6.51
Planning	Source	$9 \leq x \leq 45$	26.81	7.37
	Make	$6 \leq x \leq 30$	21.35	5.67
	Deliver	$10 \leq x \leq 50$	30.71	8.92
Performance	Source	$6 \leq x \leq 30$	21.37	4.15
	Make	$6 \leq x \leq 30$	20.45	4.85
	Deliver	$3 \leq x \leq 15$	10.13	2.68
	Perfect order on deliver	$12 \leq x \leq 60$	45.89	7.48

Table IV. Descriptive statistics of the model's structural constructs

Correlation	Value
Sum of capabilities and sum of planning	0.810
Sum of capabilities and sum of performance	0.784
Sum of planning and sum of performance	0.722

Note: Results are significant at the 0.01 level (two-tailed)

Table V. Correlation table

(0.722) were all significant at the 0.01 level. These analyses address the hypotheses in a broader perspective and present initial evidence to refute all the null hypotheses of no correlations amongst the constructs in the model. The next step in this analysis was to investigate if a significant correlation is present when considering source, make and deliver independently. To this end, the following correlations were investigated:

- among source capabilities, plan source, and performance on source;
- among make capabilities, plan make and performance on make; and
- among deliver capabilities, plan deliver and performance on deliver.

The results for these correlation tests are summarized Table VI.

Analyzing Table VI, it is clear that there are moderate positive correlations among capabilities, planning and performance within the source process area. These analyses directly address *H1-H3*, refuting the null hypotheses of no correlations amongst the constructs in the model in the source, make and deliver process areas. Taking the make process area into consideration, the results indicate a strong positive correlation amongst all constructs investigated. On the other hand, for the deliver process area, in spite of the correlation test results between capabilities and planning indicate a strong and positive relationship, the others were also positive but the intensity was moderate.

In order to evaluate the constructs' scales internal consistency, Cronbach's α coefficients were calculated. The first step was to calculate α values for all of the 77 variables of the data collection instrument, which resulted in 0.973. This result, presented in Table VII, demonstrates a good indicator for internal consistency and the instrument's reliability.

To assess the internal validity of the constructs, Cronbach's α coefficients for the nine first-order latent variables of the proposed model were calculated. As shown in Table VII, all α coefficients were acceptable for internal consistency and reliability, thus allowing the research to move forward.

5.1 Path coefficients between constructs of the research

The next and final step was to study the structural composition of the research model to describe mathematically the weights for each formative indicator of the latent

Table VI. Correlations for the fundamental process areas of source, make and deliver

Correlation	Source	Make	Deliver
Capabilities and planning	0.623	0.719	0.707
Capabilities and performance	0.683	0.739	0.507
Planning and performance	0.598	0.758	0.462

Note: Results are significant at the 0.01 level (two-tailed)

Table VII. Cronbach's α coefficients

Construct	Source	Make	Deliver
Capabilities	0.791	0.861	0.879
Planning	0.916	0.901	0.911
Performance	0.856	0.874	0.847

constructs of capabilities and planning on performance and, consequently, test the research hypotheses. Based on this composition, it was possible to build a generic structural equation representing the model, as follows:

$$\text{Performance} = \beta_1 * \text{Capabilities} + \beta_2 * \text{Planning} + \xi, \quad (1)$$

where β_1 and β_2 represent the path coefficients, and ξ represents error.

At this point, the research used multivariate analysis to understand the relationships among the constructs. In order to identify the path coefficients, the partial least squares (PLS) algorithm was used. PLS is a multivariate data analysis technique that can evaluate the relationships of multiple dependent (endogenous) variables with multiple independent (exogenous) variables. This method aims to identify the underlying factors or linear combination of the independent variables that best model the dependent variables. PLS can deal efficiently with data sets where there are many variables that are highly correlated and involve substantial random noise. PLS is primarily intended for causal-predictive analysis in situations of high complexity (Jöreskog and Wold, 1982). The results gathered from PLS are presented in Tables VIII and IX and show the correlation coefficients among constructs and the path coefficients found for the latent constructs of the model.

As shown in Table VIII, high correlation values between capabilities and planning (0.835), capabilities and performance (0.874), and planning and performance (0.882) corroborate the propositions of this research and refute *H4*. It is possible to assume that superior performance in companies' operations in source, make and deliver results from a balanced weight of the items of capabilities and planning. It is also relevant to point out the strong explanatory power (R^2) of the model in explaining performance results. Figure 2 summarizes these results.

Besides the high positive correlation values and respective weights that were found between each of the models' independent constructs (capabilities and planning) and the model-dependent construct of performance, the results also highlight the existence of a strong positive correlation between planning and operations capabilities in operations and their balanced influence over performance. The high correlation between the constructs of planning and capabilities is not a counter-intuitive result. In the research

Table VIII. Correlation coefficients among latent constructs of the model

	Capabilities	Performance	Planning
Capabilities	–		
Performance	0.874	–	
Planning	0.835	0.882	–

Note: Results are significant at the 0.01 level (two-tailed)

Table IX. Path coefficients (β_1 and β_2), communalities, and R^2

	Weights/performance	Communalities	R^2 performance
Capabilities (β_1)	0.455	0.364	0.841
Planning (β_2)	0.503	0.467	

Note: Results are significant at the 0.01 level (two-tailed)

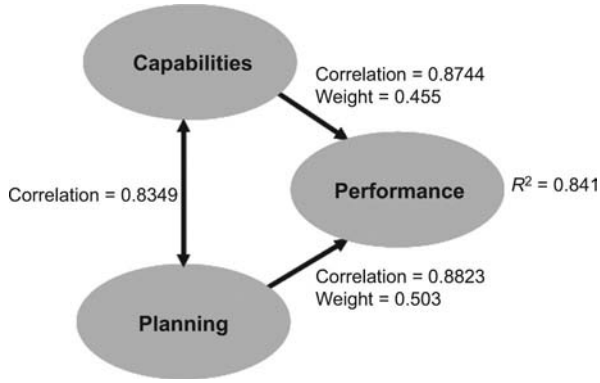

Figure 2.
Path coefficients amongst latent exogenous constructs in the research model

instrument developed from the general content of Table I, most of the items that comprise measurement of the planning construct are also treated as relevant for the composition of the capabilities construct. The high correlation that was found between the two constructs synthesizes common competitive priorities that are intrinsically related between planning and capabilities. Based on equation (1) and the path coefficients calculated by the PLS method, the final structural equation is presented:

$$\text{Performance} = 0.455^{*}\text{Capabilities} + 0.503^{*}\text{Planning} + \xi, \tag{2}$$

where ξ represents the error

It can be seen from equation (2) that performance results are influenced by a balanced weight of operations capabilities and planning. Both of them play an important role on performance.

By considering the weighs of these latent constructs, management decisions must be oriented by this balance to address superior results in operations performance.

For the purpose of evaluating the four null hypotheses that were stated earlier, the research findings are summarized in Table X.

In order to test the structural composition of the model, a bootstrapping technique was applied to compare the weights obtained in the original sample with the mean of weights of the generated samples. This test, by taking 200 random samples with 164 records each, enables a comparison between indexes generated by the original sample with the average of indexes generated by random samples. Thus, testing the generated samples by bootstrapping the nomothetical model with the jacknife technique, comparing indexes of the original sample with those of random samples, a t-statistic resulted in 7.64 ($p < 0.0001$) for the capabilities construct and 8.49 ($p < 0.0001$) for the planning construct. These results confirm the structural model indicating no significant difference between the original sample and random samples (Table XI).

As a final step, the model's quality indicators were examined. They are summarized in Table XII.

According to Tenenhaus *et al.* (2005), communality and redundancy values should assume positive values. Communality assesses the quality of the measurement model for each portion and represents the sum of the correlations in the reflexive items portion of a latent variable. The redundancy index measures the quality of the structural model for each endogenous portion of the measurement model. The results

Hypothesis	Conclusion
H1. There is no positive correlation amongst capabilities, planning and performance in the source process area	This null hypothesis was refused because the findings show evidence of positive correlations amongst those variables in the source process area
H2. There is no positive correlation amongst capabilities, planning and performance in the make process area	This null hypothesis was refused because the findings show evidence of positive correlations amongst those variables in the make process area
H3. There is no positive correlation amongst capabilities, planning and performance in the deliver process area	This null hypothesis was refused because the findings show evidence of positive correlations amongst those variables in the deliver process area
H4. There is no positive correlation amongst capabilities, planning and performance in the source, make and deliver process areas	This null hypothesis was refused because all correlations are positive and significant

Source: Research data

Table X. Conclusions about the hypotheses

	Original sample (O)	Sample mean (M)	SD	SE	*t*-statistic
Capability → Performance	0.455	0.480	0.060	0.060	7.641
Planning → Performance	0.503	0.502	0.059	0.059	8.494

Note: Results are significant at the 0.01 level (two-tailed)

Table XI. Bootstrapping results

Quality indicator	Value
R^2 at Performance	0.841
Redundancy at Performance	0.176
Communality at capability	0.364
Communality at planning	0.467
Communality at performance	0.297

Table XII. Model quality indicators

shown in Table XII can be considered favorable, indicating a good quality model, with communality values below 50 percent and a small, positive value for performance redundancy.

An adjusted global goodness-of-fit (GoF) statistic was also calculated. GoF is a geometric medium of the communalities and R values present in the model. According to Tenenhaus *et al.* (2005), GoF represents an index that can be used to validate models with PLS. The GoF metric obtained was 0.562, as shown below, indicating that the proposed model in this research is adjusted and validated:

$$\mathrm{GoF} = \sqrt{\overline{\mathrm{communality}} * \overline{R^2}} = \sqrt{\left(\frac{0.364054 + 0.466803 + 0.297099}{3}\right) * 0.841089}$$

$$= 0.5624. \tag{3}$$

It is important to point out that the model proposed in this paper may be particularly useful in describing the characteristics or behavior of data in samples from a given target population through techniques and tools structured for data collection and standardized treatment. Thus, through the development of typical survey research and through the use of different statistical techniques – descriptive statistics, factorial and cluster analyses, and structural equation modeling (SEM) – present and future research efforts can be partially or substantially oriented toward understanding and highlighting the predictive roots between operations capabilities, planning, and performance constructs.

6. Final remarks

This paper sought to present the main findings of a quantitative research examining the impacts of operations capabilities and planning efforts on performance by evaluating the process areas of source, make and deliver. Findings suggest important correlations between the constructs of capabilities, planning and performance and further suggest important opportunities for future research.

Although there are difficulties in gathering data on the most relevant variables for capabilities, planning, and performance, the model tested on this study was able to explain 84 percent of the variation in the overall performance of the sampled companies. This suggests the existence of a balanced contribution of capabilities and planning on performance variation and reinforces the mutual influence between these constructs. Certain statistical procedures were used to examine the data and to validate the research model. This included structural equation modeling and path analysis, the estimation of Cronbach's α coefficients, a bootstrapping technique, communality and redundancy calculations, and goodness-of-fit indicator. All four hypotheses were supported indicating statistical relevance of the relationships found in this study. It could be taken as valid for driving conceptual developments of a maturity model for operations capabilities and planning efforts encompassing source, make and deliver process areas. This is an important topic for operations management theoretical foundations, concepts, and best practices using a process area perspective and a value chain systemic approach.

For practitioners, the implications of this research include a clearer understanding that operations planning and the development of a firm's capabilities must be taken as interrelated initiatives that jointly influence operations performance. Moreover, operational trade-offs are likely to be balanced considering the influence of one process area over another based on the definition of a company's competitive priorities in quality, speed, reliability, flexibility, and cost. For academicians, it is beneficial to dedicate efforts on modeling the effects of planning and capabilities over companies' operations performance. Moreover, results implies important contributions for researchers in the field of operations management by addressing the process approach – considering the flows in process areas of source, make and deliver – in a systemic perspective. In this sense, research findings thus reinforce the existing theory and advances in the understanding of operations systems by unveiling the relationships amongst processes in source, make and deliver in both perspectives of operational planning and capabilities and its impacts over operational performance. Although the objectives of this research were met, this study has limitations that affect

its theoretical and practical implications. The main limitations of this study are summarized below:

- This study gathered data and produced useful information from companies with operations in different industrial segments. Although the sample consisted of companies from different sectors, the absence of service sector companies in the sample limits the relevance of research findings.
- This study is quantitative in nature and is therefore unable to support characteristics of a qualitative research design. A case study method could contribute additional information regarding the relationships among the constructs investigated in this study.
- This study focused on the impacts of capabilities and planning efforts on firm performance and investigated internal and inter-organizational process areas of source, make and deliver. The perspective of the extended supply chain was not considered in this present research and this limits its findings and applications.

Despite these limitations, the findings are robust and sound on many fronts suggesting several areas for future studies on a similar theme. The evidence gathered in this study suggests that the question is not if capabilities and planning are interrelated thus explaining performance results, but how those effects are created by synergistic and complex relationships among those constructs. By considering more closely this relationship, future studies could help to explain three questions:

(1) how strategic planning efforts streamline capabilities in operations;

(2) how new sets of resource capabilities of unique value and of imperfect mobility affect the scope and strategic orientation of business planning; and

(3) how the maturity levels of operations is affected by resource capabilities and strategic planning on the process areas of source, make and deliver.

Such future contributions can be of great relevance, contributing to highlight operations capabilities, planning and performance in a business process management perspective.

References

Andersén, J. (2011), "Strategic resources and firm performance", *Management Decision*, Vol. 49 No. 1, pp. 87-98.

Anderson, D.R., Sweeney, D.J. and Williams, T.A. (2007), *Statistics for Business and Economics*, Thomson Learning, London.

Beamon, B.M. (1999), "Measuring supply chain performance", *International Journal of Operations & Production Management*, Vol. 19 No. 3, pp. 275-92.

Bolstorff, P. and Rosenbaum, R. (2003), *Supply Chain Excellence: A Handbook for Dramatic Improvement Using the SCOR Model*, AMACOM, New York, NY.

Cuthbertson, R. and Piotrowicz, W. (2008), "Supply chain best practices – identification and categorization of measures and benefits", *International Journal of Productivity and Performance Management*, Vol. 57 No. 5, pp. 389-404.

De Toni, A. and Tonchia, S. (2001), "Performance measurement systems: models, characteristics and measures", *International Journal of Operations & Production Management*, Vol. 21 Nos 1/2, pp. 46-70.

Hoeck, R.I.V. (2000), "The thesis of leagility revisited", *International Journal of Agile Management Systems*, Vol. 2 No. 3, pp. 196-201.

Hoeck, R.I.V., Harrison, A. and Christopher, M. (2001), "Measuring agile capabilities in the supply chain", *International Journal of Operations & Production Management*, Vol. 21 Nos 1/2, pp. 126-47.

Hurtubise, S., Olivier, C. and Gharbi, A. (2004), "Planning tools for managing the supply chain", *Computers & Industrial Engineering*, Vol. 46, pp. 763-79.

Jöreskog, K.G. and Wold, H. (1982), "The ML and PLS techniques for modeling with latent variables: historical and comparative aspects", in Wold, H. and Jöreskog, K. (Eds), *Systems under Indirect Observation: Causality, Structure, Prediction*, Vol. I, North-Holland, Amsterdam, pp. 263-70.

Landroguez, S.M., Castro, C.B. and Carrión, G.C. (2011), "Creating dynamic capabilities to increase customer value", *Management Decision*, Vol. 49 No. 7, pp. 1141-59.

Lapide, L. (2005), "The four habits of highly effective supply chains", *Harvard Business Review*, May, pp. 3-6.

Lapide, L. (2006), "MIT's SC project: the essence of excellence", *Supply Chain Management Review*, April, pp. 18-24.

Landeghem, H.V. and Vanmaele, H. (2002), "Robust planning: a new paradigm for demand chain planning", *Journal of Operations Management*, Vol. 20, pp. 769-83.

Makadok, R. (2001), "Towards a synthesis of the resource-based and dynamic-capability views of rent creation", *Strategic Management Journal*, Vol. 22, pp. 387-401.

Mason-Jones, R., Naylor, B. and Towill, D.R. (2000), "Engineering the leagile supply chain", *International Journal of Agile Management Systems*, Vol. 2 No. 1, pp. 54-61.

Neely, A. (1999), "The performance measurement revolution: why now and what next?", *International Journal of Operations & Production Management*, Vol. 19 No. 2, pp. 205-28.

Neely, A., Gregory, M. and Platts, K. (1995), "Performance measurement system design: a literature review and research agenda", *International Journal of Operations & Production Management*, Vol. 15 No. 4, pp. 80-116.

Porter, M.E. (1985), *Competitive Advantage: Creating and Sustaining Competitive Performance*, The Free Press, New York, NY.

Shepherd, C. and Gunter, H. (2006), "Measuring supply chain performance: current research and future directions", *International Journal of Productivity and Performance Management*, Vol. 55 Nos 3/4, pp. 242-58.

Skinner, W. (1969), "Manufacturing: missing link in corporate strategy", *Harvard Business Review*, Vol. 47 No. 3, pp. 136-45.

Skinner, W. (1974), "The focused factory", *Harvard Business Review*, Vol. 52 No. 3, pp. 113-21.

Slack, N., Chambers, S., Harland, C., Harrison, A. and Johnston, R. (1995), *Operations Management*, Pitman, London.

Stank, T.P., Davis, B.R. and Fugate, B.S. (2005), "A strategic framework for supply chain oriented logistics", *Journal of Business Logistics*, Vol. 26 No. 2, pp. 27-45.

Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18 No. 7, pp. 509-33.

Tenenhaus, M., Vinzi, V.E., Chatelin, Y. and Lauro, C. (2005), "PLS path modeling", *Computational Statistics & Data Analysis*, Vol. 48, pp. 159-205.

Verderame, P.M. and Floudas, C.A. (2009), "Operational planning framework for multisite production and distribution networks", *Computers and Chemical Engineering*, Vol. 33, pp. 1036-50.

Further reading

MIT Supply Chain 2020 Project (2004), *Proceedings of the Supply Chain 2020 Project*, MIT Center for Transportation & Logistics, available at: http://ctl.mit.edu/search/node/2020%20project?page=1 (accessed June 17, 2010).

Appendix. A sample of questions used in the survey instrument

Operations capabilities indicators

Select an answer that best characterizes the situation of your company (1 = no/never, 5 = yes/always):

- Your company succeeds to modify or rapidly change volumes and delivery times with suppliers when necessary.
- Your company develops collaborative relationships with suppliers, aiming to reduce costs and/or improve processes with them.
- Your company develops collaborative relationships with suppliers, aiming to benefit the research and development of new products and/or services.
- The purchasing area of your company regularly controls the operational performance of its suppliers of raw material and services.
- Your company can reduce its work-in-process inventory levels without compromising the planned schedule as previously defined in its master production program.
- Your company can reduce, responsively and economically, machine setup times and production batch sizes.
- The information flow in the make process area is integrated with the supply and distribution areas of your company.
- Your company succeeds in delivering finished products in time as promised or required by clients.
- The physical distribution decisions take into consideration the constraints of the manufacturing and sourcing areas.
- Your company integrates the decisions of distribution with sales team

Operations planning indicators

Select an answer that best characterizes the situation of your company regarding the following points (1 = no/never, to 5 = yes/always):

- The supply planning of your company uses accessible, precise and reliable information provided by the manufacturing area.
- The supply planning encompasses the definition of paths and actions oriented to improve reliability in suppliers' delivery times.
- The supply planning aims to align the final objectives of the company with its major suppliers.
- The decisions related to production planning and control are shared dynamically with the company's procurement and sales teams.
- The physical distribution plan is aligned with the company's business strategies.
- The physical distribution plan is integrated with the sales and manufacturing plans.

Operations performance indicators

Select an answer that best characterizes the situation of your company (1 = no/never, 5 = yes/always):

- Performance on reliability on suppliers' lead-times.
- Performance on flexibility to change procurement orders with suppliers on volumes and products.
- Performance on manufacturing lead-times.
- Performance on reducing inventory levels of work in process (WIP) and finished products.
- Performance on reducing waste and rework on productive process.
- Performance on attending the planned distribution program.
- Performance on total distribution cost, considering the freight costs and inventories in transit.
- "perfect order" performance

Thinking generically about the situation when your company was not able to attend clients' orders with excellence, how often were the following problems identified? (1 = no/never to 5 = yes/always):

- Errors at customer order processing stage.
- Impossible to keep the requested schedule required by the client.
- Error in product picking.
- Delay in loading or delivery.
- Load damaged.
- Error in processing the client's payment.

(Note: For a full version of the questionnaire, please contact the authors.)

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