Int. J. Production Economics 138 (2012) 1–13

Contents lists available at SciVerse ScienceDirect

Int. J. Production Economics

journal homepage: www.elsevier.com/locate/ijpe

Review

Sales and operations planning: A research synthesis

Antônio Márcio Tavares Thomé [a], Luiz Felipe Scavarda [b,*], Nicole Suclla Fernandez [c], Annibal José Scavarda [d]

[a] Industrial Engineering Department, Pontifícia Universidade Católica do Rio de Janeiro, Brazil
[b] Center of Excellence in Optimization Solutions (NExO), Industrial Engineering Department, Pontifícia Universidade Católica do Rio de Janeiro, Rua Marquês de São Vicente, 225 sala: 950L 22453-900, Gávea, Rio de Janeiro (RJ), Brazil
[c] Electrical Engineering Department, Pontifícia Universidade Católica do Rio de Janeiro, Brazil
[d] School of Business and Management, American University of Sharjah, Sharjah and Universidade do Vale do Rio dos Sinos, Brazil

ARTICLE INFO

Article history:
Received 19 May 2011
Accepted 23 November 2011
Available online 2 December 2011

Keywords:
Supply chain management
Cross-functional alignment
Metrics
Collaboration
Integrated planning
Systematic review

ABSTRACT

Despite the growing body of literature on sales and operation planning (S&OP), efforts to synthesise the overall state of the art of research in this area are limited. Within this context, this paper provides a systematic review of the literature on S&OP. The purpose of this systematic review is twofold: (i) to integrate the highly dispersed work on S&OP in order to identify and analyse S&OP as a business process and (ii) to assemble quantitative evidence of its impact on the performance of the firm. A literature search framework is proposed, with 271 papers reviewed and classified. The framework embraces S&OP context information, inputs and goals, structure and processes, outcomes, and results. The major expected outcome in most papers was a cross-functional integration of plans, although few studies report on the integration of finance plans into S&OP. Despite the existence of common process descriptors and definitions of S&OP, there is a lack of unifying frameworks for maturity models, measurement of S&OP, and constructs related to the firm's performance. The need for additional scientifically sound survey or case study research on S&OP is emphasised. This paper contributes to a better understanding of S&OP's role as a determinant of firm's performance in the supply chain.

Contents

1. Introduction

Sales and operations planning (S&OP) is a tool that unites different business plans into one integrated set of plans. Its main purpose is twofold: (1) to balance supply and demand and (2) to build bridges between the business or strategic plan and the operational plans of the firm. S&OP addresses the key issue of alignment—a central theme

* Corresponding author. Tel.: +55 21 55 21 3527 1285/1286; fax: +55 2155 21 3527 1288.
E-mail addresses: mthome@bemfam.org.br (A.M. Tavares Thomé), lf.scavarda@puc-rio.br (L.F. Scavarda), nicolesf@aluno.puc-rio.br (N.S. Fernandez), annibal@esp.puc-rio.br (A.J. Scavarda).

0925-5273/$ - see front matter © 2012 Published by Elsevier B.V.
doi:10.1016/j.ijpe.2011.11.027

in the field of strategic management—from the perspective of both vertical and horizontal alignment. Vertical alignment "refers to the configuration of strategies, objectives, actions plans, and decisions throughout the various levels of the organisation", while horizontal alignment "can be defined in terms of cross-functional and intra-functional integration" (Kathuria et al., 2007).

Different definitions place S&OP at different levels in the hierarchy of business plans. Some authors associate it with the highest hierarchical planning level of manufacturing planning and control (MPC) systems. S&OP is visualised as a long-term planning tool not only for production but also for sales, demand forecasting, and resource capacity planning (Olhager et al., 2001; Olhager and Rudberg, 2002; Olhager and Selldin, 2007). In this view, the role of S&OP is to maintain a proper balance between supply and demand and to provide early warning signs when they become imbalanced (Vollmann et al., 2005). Others position S&OP at the tactical level as noted by Feng et al. (2008). The APICS dictionary defines S&OP as the following:

> "… a process to develop tactical plans that provide management the ability to strategically direct its businesses to achieve competitive advantage on a continuous basis by integrating customer-focused marketing plans for new and existing products with the management of the supply chain. The process brings together all the plans for the business (sales, marketing, development, manufacturing, sourcing, and financial) into one integrated set of plans. It is performed at least once a month and is reviewed by management at an aggregate (product family) level. The process must reconcile all supply, demand, and new product plans at both the detail and aggregate levels and tie to the business plan. It is the definitive statement of the company's plans for the near to intermediate term covering a horizon sufficient to plan for resources and support the annual business planning process. Executed properly, the sales and operation planning process link the strategic plans for the business with its execution and reviews performance measures for continuous improvement." (Cox and Blackstone, 2002).

The main features of S&OP are as follows: (i) it is a cross-functional and integrated tactical planning process within the firm; (ii) it integrates all of the plans of the business in an unified plan; (iii) it has a planning horizon from less than three months to over 18 months; (iv) it bridges strategy and operations (Feng et al., 2008); and (v) it creates value and is linked with the performance of the firm (Grimson and Pyke, 2007; Nakano, 2009).

Despite the growing body of literature on S&OP, efforts to synthesise the overall state of the art of research in this area are limited. As an attempt to fill this gap, this paper aims to go beyond the highly dispersed work on S&OP by providing a systematic review of the literature and key findings on the topic. The purpose of this review is twofold: (i) to gather and integrate findings on S&OP as a business process and (ii) to assemble quantitative evidence of its impact on the performance of the firm.

This paper is organised into multiple parts. First, the method for the research synthesis is described. Next, main findings and results are analysed and discussed organised in three broad categories: study identification, literature search synthesis framework, and study descriptors. Finally, the main conclusions and suggestions for future research are presented.

2. Methodology

A five-step process was adopted to select and retrieve papers: (i) computerised database selection, (ii) identification of keywords for search, (iii) criteria for exclusion of studies, (iv) manual review of selected abstracts by at least three authors, and (v) full-text review of selected papers. Two data-entry screens were prepared; one for the study identification and one for the study descriptors. They were populated during the retrieval process.

Three databases were selected for the search; these three databases consist of papers published in the large majority of scientific journals of interest to operations, organisational management, and social sciences research: EMERALD, EBSCO (including Academic Search Complete, Business Source Premier, CINAHL with Full Text, Information Science & Technology Abstracts [ISTA], Library, Information Science & Technology Abstracts with Full Text, Regional Business News, SocINDEX with Full Text and Academic Search Premier), and SCIENCEDIRECT. In accordance with recommendations for initial research synthesis (Cooper, 2010), the keywords selected were sufficiently broad to avoid artificially limiting results and still provided limitations to avoid undesirable results. In pseudo code, the following phrase was adapted to the search engines in each database: "Sales and Operations Planning" OR "S&OP" NOT "S OP". The last term was added to preclude articles in the field of chemistry from appearing in the results of the search.

Grey literature review was included in the search databases, and manual searches as reflected in the choice of bibliographic databases. Gray, grey or fugitive literature is synonymous (Rothstein and Hopewell, 2009). It was defined on the Third International Conference on Grey Literature in Luxembourg in 1997 as "that which is produced in all levels of government, academics, business and industry, in electronic and print formats not controlled by commercial publishers" (Auger, 1998). An alternate definition was proposed by McKimmie and Szurmak (2002) as including all material not identifiable through traditional index or bibliographic database and that are, therefore, hard to retrieve. Following Rothstein and Hopewell (2009), we adopt the more general definition by Weintraub (2000): "scientific grey literature comprises newsletters, reports, working papers, theses, government documents, bulletins, fact sheets, conference proceedings and other publications distributed freely, available by subscription or for sale". This definition allows the inclusion of bibliographic sources that goes beyond peer-reviewed academic journals, and that are likely to do not be selected otherwise.

Several classification schemes were proposed in the literature to judge the quality of primary research included in research synthesis. Threats to validity of research synthesis reported range from eleven (Cooper, 1984) to 21 (Matt and Cook, 1994) to 29 (Shadish et al., 2002); and yet to a list of 28 (Matt and Cook, 2009). Following Cooper (2010), we regrouped threats to validity in broad categories and used the categories as criteria for the exclusion of papers. The criteria were as follows: (i) lack of relevance of the construct of S&OP or poorly defined constructs of S&OP; (ii) poorly defined methodology, resulting in different strength of the evidence of S&OP effects. In judging primary study methodological quality, a classification scheme ranking papers by the strength of empirical evidence described was adapted from Lipsey and Wilson (2001) in six subgroups: (1) author's opinion only; (2) direction of effects; (3) per cent change; (4) per cent change and sample size (N); (5) means, standard deviation, and N; (6) regressions/correlations; (7) do not apply (see Valentine, 2009 for a full discussion about primary research quality in research synthesis). Papers based on author's opinion only were excluded from further analysis; (iii) an interactive process was adopted to ensure high levels of inter-coders reliability; (iv) causal relationship was only accepted based on clearly defined empirical evidences based on explicit mathematical modelling or case studies; (v) no cumulative results were extrapolated to a whole industry or set of countries, in order to avoid undue generalisation of firm-based findings.

The search returned 271 papers, and all abstracts were read by at least three authors. The full bibliography list is available upon request from the lead author. After reading the abstracts, duplicate papers and those not corresponding to the above criteria were excluded, resulting in 89 papers selected for full-text review. After a full-text reading, an additional 34 papers were excluded. Thus, 55 papers were included in the study identification and study descriptors. Those papers were reviewed and cross-examined by at least two authors.

The review process was interactive and resulted in high levels of agreement. First, three authors independently searched databases with different keywords. In a second round, a unified pseudo code for systematic search was agreed-upon. In the third round, criteria for exclusion was debated and summarised in the basic five-item list described above. In the fourth round, the full list of 271 abstracts were distributed to three authors and debated in four consecutive meetings. A high level of agreement among the authors was obtained from this screening process. Inter-ratters reliability after the third consecutive meeting, as measured by Cohen's kappa for three judges on abstract reviews, was 0.47 with a standard deviation of 0.12, which was significantly different from agreement by chance alone (Fleiss, 1971). The main reason for disagreement was the inclusion in the abstract's review of many articles from industry magazines that provided few explanation of the strength of the evidence upon which conclusions were based. Cohen's kappa nearly doubled (0.83) during the fourth review meeting, after consensus was reached about the exclusion of articles from industry magazines and trade journals.

3. Results and discussions

The results are presented in three broad categories: study identification, research synthesis framework and descriptors.

3.1. Study identification

Fig. 1 presents the number of papers retrieved for the systematic review analysis, totalling 55 papers. Interest in the subject is growing, as evidenced by the number of papers recently published on different aspects of S&OP. As depicted in Fig. 1, the growing number of publications on S&OP peaks in 2010.

The 55 articles included in the summary of results are listed in Table 1. Google Scholar (GS) was used for the citation quotes in Table 1. GS was chosen for four main reasons: (i) it is freely available on the Internet; (ii) it is reputedly fast; (iii) it includes scientific grey literature; and (iv) it compares favourably with fee-based citation databases such as Thomson ISI Web of Knowledge and Scopus. GS is used in scientific reviews in several disciplines (Harzing and van der Wal, 2008; Bornmann et al., 2009). The required cleaning was performed in GS to avoid duplicate entries (Rosenstreich and Wooliscroft, 2009). The number of citations

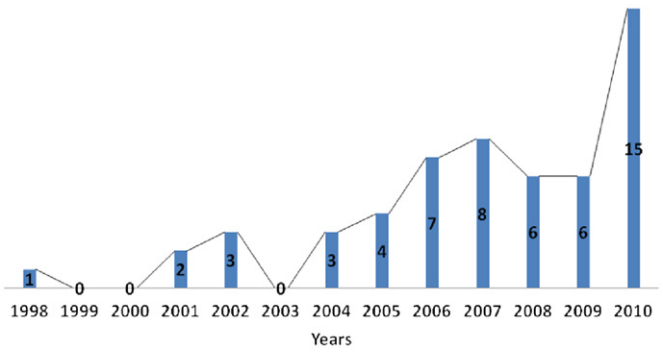

Fig. 1. Number of publications on S&OP by year ($N=55$).

Table 1
Papers selected by number of citations and by source.

Author	Year	Number of citations (GS)	Source
Gianesi	1998	16	IJOPM
Olhager et al.	2001	63	IJPE
Basu	2001	45	MBE
Lapide	2002	57	JBF
Malhotra and Sharma	2002	22	JOM
Olhager and Rudberg	2002	19	IJPR
Menzter and Moon	2004	19	SCMR
Lapide	2004a	9	JBF
Lapide	2004b	5	JBF
Lapide	2005	4	JBF
Bower	2005	3	JBF
Reyman	2005	1	JBF
McCormack and Locakmy	2005	1	GBCE
Collin and Lorenzin	2006	17	IJPDLM
Whisenant	2006	4	JBF
Sehgal et al.	2006	3	IJPPM
Muzumdar and Fontanella	2006	3	SCMR
Harwell	2006	1	JBF
Lapide	2006	6	JBF
Wallace	2006	2	JBF
Olhager and Selldin	2007	105	IJPR
Singhal J. and Singhal	2007	15	JOM
Slone et al.	2007	12	HBR
Hadaya and Cassivi	2007	12	IMDS
Grimson and Pyke	2007	10	IJLM
Lapide	2007	2	JBF
Burrows	2007	0	JBF
Chou et al.	2007	14	IJPE
Feng et al.	2008	9	IJPE
Affonso et al.	2008	6	PPC
Milliken	2008	0	JBF
Piechule	2008	0	JBF
Tohamy	2008	0	SCMR
Wallace and Stahl	2008	0	JBF
Lapide	2009a	0	SCMR
Lapide	2009b	0	SCMR
Chae	2009	4	SCMIJ
Nakano	2009	2	IJPDLM
Boyer	2009	0	JBF
Muzumdar and Viswanathan	2009	0	SCMR
Ivert and Jonsson	2010	1	IMDS
Godsell et al.	2010	0	SCMIJ
Chen Ritzo et al.	2010a	0	EJOR
Chen-Ritzo et al.	2010b	0	EJOR
Mellen et al.	2010	0	SCMR
Nielsen et al.	2010	0	CI
Oliva and Watson	2010	2	JOM
Goodwin et al.	2010	1	EJOR
Paiva	2010	1	IJPE
Olhager	2010	1	CI
Singh	2010	0	SCMR
Smith et al.	2010	0	JBF
Baumann	2010	0	JBF
Keal and Hebert	2010	0	Tr
Baumann and Andraski	2010	0	IE

EJOR—European Journal of Operations Research; GBCE—Global Conference on Business and Economics; HBR—Harvard Business review; IJLM—International Journal of Logistics Management; IJOPM—International Journal of Operations and Production Management; CI—Computer in Industry; IJPDLM—International Journal of Physical Distribution and Logistics Management; IJPE—International Journal of Production Economics; TR—Transfusion; IE—Industry Engineer; IJPPM—International Journal of Productivity and Performance Management; IJPR—International Journal of Production Research; IMDS—Industrial Management & Data Systems; JBF—The Journal of Business Forecasting; JOM—Journal of Operations Management; MBE—Measuring Business Excellence; PPC—Production Planning and Control; SCMIJ—Supply Chain Management—An International Journal; SCMR—Supply Chain Management Review.

was concentrated in a few lead authors coming from both peer-reviewed journals and scientific grey literature. In particular, Olhager and Lapide represented together 271 of the total of 497 citations. These authors had also published the largest number of papers on the subject.

3.2. A literature search synthesis framework

Conceptually, S&OP evolved from aggregate production planning (APP) in the early 1950s (Singhal J. and Singhal, 2007) to manufacturing resources planning (MRP II) in the mid-1980s. Most case studies and reports on MRP II trace the origins of S&OP back to practitioners' work (Wallace and Stahl, 2006; Dougherty and Gray, 2006). S&OP evolved into a business process that aligns sales and production within the firm and in the supply chain (Lapide, 2004a, 2005; Grimson and Pyke, 2007; Feng et al., 2008; Ivert and Jonsson, 2010).

Attempts to systematise survey research and case studies that define S&OP as a business process encompass the adoption of maturity models inspired by the Capability Maturity Model (CMM), which was proposed by the Software Engineering Institute at Carnegie Mellon University (Paulk et al., 1993). Early maturity models in S&OP referred to specific aspects of the process, such as information technology (Wing and Perry, 2001) and demand planning (Mentzer and Moon, 2004). Maturity models with a broader view were proposed more recently. Lapide (2005) considered three dimensions: people, processes, and technology. Ventana Research (2006) proposed a maturity model where the classification was made according to the firm position along the dimensions of people, process, technology, and performance management. Aberdeen Group proposed a model with a somehow similar classification: process, organisation, knowledge, technology, and performance (Viswanathan, 2009). Grimson and Pyke (2007) S&OP maturity model was built on the ones proposed by the Aberdeen Group and Lapide (2005). Their classification was made according to the firm position in five dimensions: meetings and collaboration (which evaluates the effectiveness of the human component in S&OP), organisation (which focuses on the corporate S&OP structure), measurements (which applies to both company performance as well as the effectiveness of the S&OP process), information technology (which focuses on an information process rather than a business process), and S&OP plan integration (which measures how effectively a company builds an integrated plan and how well the plan interfaces with the other four dimensions). Feng et al. (2008) position their S&OP maturity stages in three levels according to the integration of procurement, production, and distribution plans, ranging from decoupled to fully integrated set of plans. The AMR Research maturity model classifies organisations in four dimensions: balancing sales and operations, goals of the process, plan ownership, and metrics (Cacere et al., 2009).

S&OP maturity models were summarised by Grimson and Pyke (2007) and were further extended by Viswanathan (2009) and Cacere et al. (2009). From the least to the most advanced stage, maturity models consist of multiple evolutionary and successive stages in the advancement of business processes (Lapide, 2005). S&OP maturity models vary in the number of stages that they contain as well as in their description of inputs, process components, and outputs. Table 2 provides an overview to the different

Table 2
Overview of S&OP stages in maturity models.

Reference	Number of stages	Brief description of the stages
Wing and Perry (2001)	Three	The stages are (i) integrated planning solution; (ii) collaboration with trade partners; and (iii) network hub solutions. These stages are essentially based on information technology (IT).
Lapide (2005)	Four	The stages are (i) marginal; (ii) rudimentary; (iii) classic; and (iv) ideal. Enterprises start with sporadic meetings, decoupled planning not aligned with demand, and a "multitude" of spreadsheets. It gradually moves to an ideal stage characterised by event-driven meetings; integrated planning aligned with customers and suppliers; use of advanced S&OP software that are integrated with internal IT systems.
Ventana Research (2006)	Four	The stages are (i) tactical; (ii) advanced; (iii) strategic; and (iv) innovative. In the first stage, planning focuses on balancing supply and demand. At the advanced stage, formal planning and review meetings are instituted. S&OP advances to the strategic stage when the company uses S&OP to align operational planning with corporate strategic objectives. It finally reaches full maturity at the innovative stage, when performance management and incentives are aligned with the S&OP process.
Grimson and Pyke (2007)	Five	The five stages are (i) no S&OP process; (ii) reactive; (iii) standard; (iv) advanced; and (v) proactive. These stages range from a non-existent, silo culture to a paradigmatic proactive stage, in which meetings are event-driven; plans and software are fully integrated within the firm and with customers and suppliers. At this stage, the process aims to optimise profitability and performance is measured and rewarded accordingly. Intermediate stages are reactive, standard and advanced. A formal S&OP structure is empowered; formal meetings and integrated software are instituted throughout those intermediate stages. The financial function, new product introduction, and constrained plans are gradually integrated into the S&OP stages.
Feng et al. (2008)	Three	The stages are (i) decoupled plans; (ii) partially integrated plans; (iii) integrated plans throughout the supply chain. In the first stage sales, production, distribution and procurement plans are decoupled. At the second stage sales and production plans are integrated, but distribution and procurement plans are decoupled. In the third stage S&OP process is integrated throughout the supply chain.
Viswanathan (2009)	Three	The Aberdeen maturity model stages are (i) best in class (top 20%); (ii) average (mid 50%); and (iii) laggards (bottom 30%). The three metrics used to range industries are customer service level, average cash conversion cycle and average forecast accuracy at the product family level.
Cacere et al. (2009)	Four	The AMR Research model stages are (i) reactive; (ii) anticipative; (iii) collaborative; and (iv) orchestrate. At the reactive stage, plans are operational; factory capabilities prevail over sales; S&OP is measured by fill rates, asset utilisation, and inventory levels. At the second stage the goal is to match supply and demand. Operations still prevails over sales, but marketing function and the planning of factory capability are integrated into S&OP. The third stage is the collaborating stage, during which sales and operations are balanced into integrated and proactive "go-to-market" plans, composed of demand-driven, make and deliver processes. At the final stage, operations and sales carry equal weights in what is described as an optimised demand shaping plan. Its metrics are demand risk, customer services, cash flow, market share, and profit.

S&OP maturity models offering their respective number of steps with a brief description of each one.

The fact that different authors adopt several variants of maturity stages and dimensions suggests that it is difficult to summarise results and to acquire cumulative, evidence-based results in S&OP practice. To assist in summarising the empirical results, a research synthesis framework is proposed in Fig. 2 as a structuring tool to assemble S&OP descriptors from the extant literature. Study descriptors are summaries of moderator or intervening effects occurring between S&OP and its results; they include the study of artefacts and the completeness of reporting on procedures, measures, treatments, or results (Lipsey, 2009).

This framework depicts contextual information that defines the characteristics of the environment where the S&OP is developed. Contextual information includes region/country, industry, manufacturing strategy, product-process matrix (Hayes and Wheelwright, 1979), level of product aggregation (product family and/or SKUs), hierarchical planning (strategic versus tactical), and planning horizon (short, medium, or long term). Inputs to the S&OP process regroup functional plans, sales and demand forecasts, inventory, budgets, and operational constraints.

Structure and processes are described through the four basic dimensions of Grimson and Pyke (2007). Meeting and collaboration regroup participants and promote trust, commitment, and meeting regularity. Organisational aspects include empowerment and the degree of formalisation in the S&OP process (teams, number of steps, and agenda). Information technology is subdivided into systems, software, models, and simulations. Measurements are regrouped under S&OP metrics. From the perspective of vertical alignment, structures and processes are situated below business plans and corporate strategic planning but above operations. Outcomes regroup the fifth dimension of Grimson and Pyke's framework (2007) and consist of plan integration between operations, marketing, sales, and finances. The result of the system is summarised as profit optimisation.

The study descriptors of this synthesis framework are used to guide the analysis of the literature findings on S&OP offered in the next sub-section.

3.3. Study descriptors

In the sub-sections that follow, a review of research and key findings in each of the four framework categories is presented (context, inputs, structure and processes, and outcomes).

Categories used for analysis were derived from the basic definition of S&OP as an integrated set of plans (Cox and Blackstone, 2002) and from the research synthesis framework. The approach of summarizing findings according to the definition of S&OP was corroborated with specific findings from the framework and from the literature review. The resulting analytic categories are described in Tables 3–5. Context data was analysed in-light of the research synthesis framework. Inputs to the S&OP process were analysed in the broad areas of demand, source, production, delivery and finance, cross-classified by the analytical categories of plans, constraints, and others. Structure and processes and outcomes were scrutinised through the analysis of S&OP drivers (goals of the process) and metrics.

3.3.1. Context

Most of the papers retrieved from step v of the literature search were descriptive and normative, i.e., they explain how things should be with a focus on improving performance (Olhager and Rudberg, 2002; Lapide, 2002). As such, they contribute to the concepts and conceptual frameworks in the field of operations management and related areas. However, few case studies and surveys with clear descriptors of methodology, datasets, analysis, and results exist in the S&OP field. This result is consistent with observations that the bulk of S&OP development has taken place in industry (Wallace and Stahl, 2006; Dougherty and Gray, 2006;

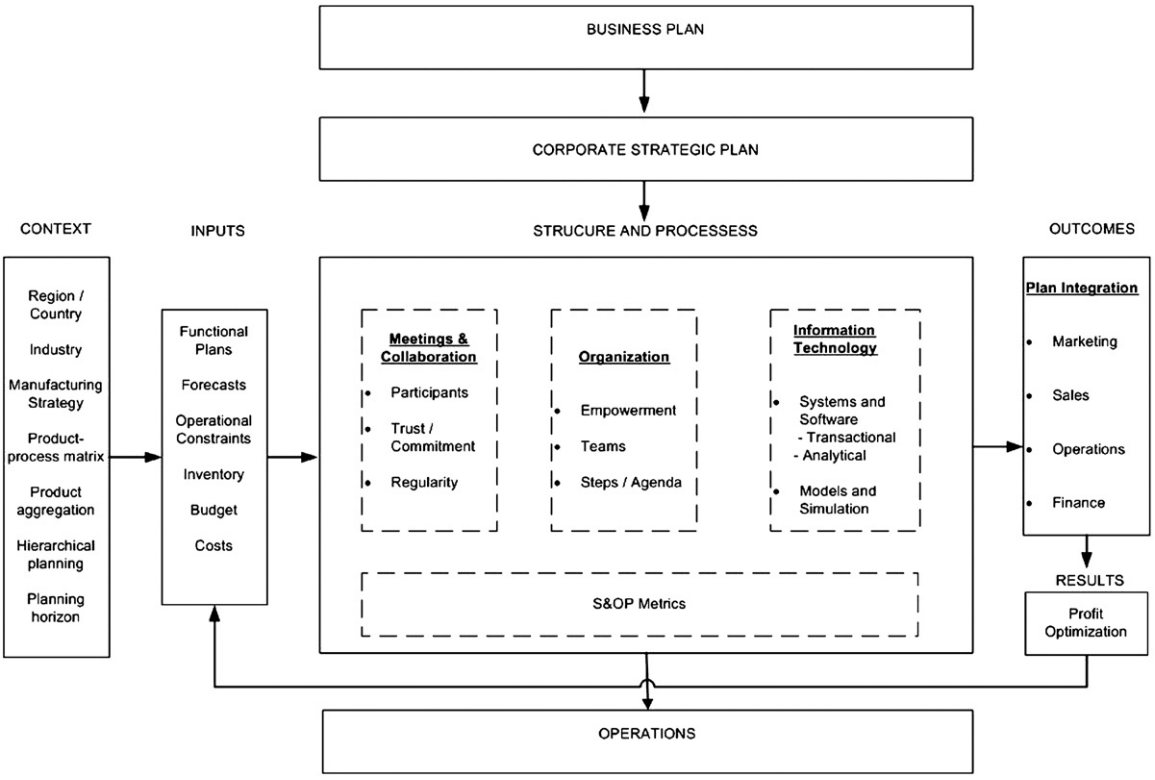

Fig. 2. Literature search synthesis framework.

Table 3
Classification of inputs to the S&OP process.

Type of inputs	Input levels		
	Plans	**Constraints**	**Other**
Demand			
Demand and functional plans (marketing and sales)	Ivert and Jonsson (2010), Gianesi (1998), Nakano (2009), Godsell et al. (2010), Collin and Lorenzin (2006), Hadaya and Cassivi (2007), Sehgal et al. (2006), Affonso et al. (2008), Bower (2005), Boyer (2009), Burrows (2007), Chen-Ritzo et al. (2010a), Feng et al. (2008), Grimson and Pyke (2007), Harwell (2006), Lapide (2002, 2004a, 2004b, 2005, 2006), Mentzer and Moon, (2004), Milliken (2008), Olhager and Rudberg (2002), Olhager et al. (2001), Olhager and Selldin (2007), Piechule (2008), Reyman (2005), Singhal J. and Singhal (2007), Slone et al. (2007), Wallace (2006), Wallace and Stahl (2008), Whisenant (2006), Malhotra and Sharma (2002), Nielsen et al. (2010), Oliva and Watson (in press), Chou et al. (2007), Paiva (2010), Olhager (2010), Singh (2010), Smith et al. (2010), Baumann(2010), Baumann and Andraski (2010)		
Sales/demand forecasts	Feng et al. (2008), Mellen et al. (2010), Mentzer and Moon, (2004), Lapide (2009a), Muzumdar and Fontanella (2006), Muzumdar and Viswanathan (2009), Tohamy (2008), Chen-Ritzo et al. (2010b), Oliva and Watson (in press), Goodwin et al. (2010), Paiva (2010), Singh (2010), Smith et al. (2010), Baumann (2010), Baumann and Andraski (2010)		
Demand impacts (e.g., competitors' actions)			Grimson and Pyke (2007), Lapide (2002)
Marketing and sales actions			Chen-Ritzo et al. (2010a), Grimson and Pyke (2007), Lapide (2004a, 2009b), Mentzer and Moon, (2004), Keal and Hebert (2010)
Information on customers			Hadaya and Cassivi (2007), Burrows (2007), Lapide (2004a, 2004b), Grimson and Pyke (2007)
Information on sales	Oliva and Watson (in press)		Burrows (2007), Mentzer and Moon, (2004), Piechule (2008)
Source			
Procurement/supply plan	Ivert and Jonsson (2010), Affonso et al. (2008), Chen-Ritzo et al. (2010a), Lapide (2002, 154), Lapide (2006), Whisenant (2006), Smith et al. (2010)		
Lead time		Affonso et al. (2008), Chen-Ritzo et al. (2010b), Olhager (2010)	
Supply capacity		Lapide (2004a), Olhager (2010)	
Supplier constraints		Chen-Ritzo et al. (2010a), Olhager (2010)	
Purchasing data	Olhager (2010)		Nakano (2009)
Information on supplier			Hadaya and Cassivi (2007), Burrows (2007), Grimson and Pyke (2007), Lapide (2004a)
Raw material forecast			Piechule (2008)
Production			
Production/capacity plan	Ivert and Jonsson (2010), Sehgal et al. (2006), Affonso et al. (2008), Bower (2005), Chen-Ritzo et al. (2010a), Feng et al. (2008), Harwell (2006), Lapide (2004b, 2006), Mentzer and Moon, (2004), Milliken (2008), Muzumdar and Viswanathan (2009), Olhager et al. (2001), Slone et al. (2007), Whisenant (2006), Nielsen et al. (2010), Oliva and Watson (in press), Chou et al. (2007), Singh (2010), Baumann (2010), Keal and Hebert (2010)		
Inventory	Ivert and Jonsson (2010), Gianesi (1998), Nakano (2009), Godsell et al. (2010), Collin and Lorenzin (2006), Hadaya and Cassivi (2007), Sehgal et al. (2006), Affonso et al. (2008), Bower (2005), Boyer (2009), Burrows (2007), Feng et al. (2008), Grimson and Pyke (2007), Lapide (2002, 2004a, 2004b, 2006, 2009a), Mellen et al. (2010), Mentzer and Moon, (2004), Milliken (2008), Muzumdar and Fontanella (2006), Muzumdar		

	and Viswanathan (2009), Olhager and Rudberg (2002), Olhager et al. (2001), Olhager and Selldin (2007), Piechule (2008), Reyman (2005), Singhal J. and Singhal (2007), Slone et al. (2007), Tohamy (2008), Wallace (2006), Wallace and Stahl (2008), Whisenant (2006), Malhotra and Sharma (2002), Goodwin et al. (2010), Smith et al. (2010), Baumann (2010), Baumann and Andraski (2010)		
Production capacity		Ivert and Jonsson (2010), Gianesi (1998), Nakano (2009), Godsell et al. (2010), Collin and Lorenzin (2006), Hadaya and Cassivi (2007), Sehgal et al. (2006), Affonso et al. (2008), Boyer (2009), Burrows (2007), Feng et al. (2008), Grimson and Pyke (2007), Lapide (2002, 2004a, 2004b, 2006), Mellen et al. (2010), Mentzer and Moon, (2004), Milliken (2008), Muzumdar and Fontanella (2006), Muzumdar and Viswanathan (2009), Olhager and Rudberg (2002), Olhager et al. (2001), Piechule (2008), Reyman (2005), Singhal J. and Singhal (2007), Slone et al. (2007), Tohamy (2008), Wallace (2006), Wallace and Stahl (2008), Whisenant (2006), Malhotra and Sharma (2002), Nielsen et al. (2010), Chou et al. (2007)	
Work-force level		Feng et al. (2008), Olhager et al. (2001), Singhal and Singhal (2007)	
Operational resources		Nakano (2009), Nielsen et al. (2010), Keal and Hebert (2010)	
Other operational constraints		Nakano (2009), Milliken (2008), Oliva and Watson (in press)	
Lead time		Affonso et al. (2008)	
Production time		Ivert and Jonsson (2010)	
Flexibility		Affonso et al. (2008)	
Contingencies (e.g. strikes)			Lapide (2002)
Delivery			
Distribution plan	Milliken (2008), Whisenant (2006), Olhager (2010), Baumann (2010)		
Delivery capacity		Hadaya and Cassivi (2007), Lapide (2004b)	
Lead time		Ivert and Jonsson (2010), Affonso et al. (2008), Mellen et al. (2010), Chou et al. (2007), Baumann (2010)	
Other constraints		Harwell (2006)	
Transportation status		Slone et al. (2007)	
Service capacity		Collin and Lorenzin (2006)	
Service level targets		Mellen et al. (2010), Smith et al. (2010), Baumann (2010)	
Finance			
Financial plans	Harwell (2006), Whisenant (2006), Oliva and Watson (in press), Chou et al. (2007), Singh (2010), Smith et al. (2010)		
Budgets		Gianesi (1998), Bower (2005), Grimson and Pyke (2007), Harwell (2006), Lapide (2002, 2004a, 2006), Mentzer and Moon, (2004), Tohamy (2008), Wallace (2006), Wallace and Stahl (2008), Whisenant (2006), Baumann (2010)	
Financial goals		Mentzer and Moon, (2004), Tohamy (2008), Singh (2010), Smith et al. (2010), Baumann (2010)	

Table 4
References to S&OP goals.

Goals	References
Alignment and integration	
Vertical alignment and integration	Ivert and Jonsson (2010), Gianesi (1998), Affonso et al. (2008), Bower (2005), Nielsen et al. (2010), Oliva and Watson (in press), Singh (2010), Smith et al. (2010), Baumann(2010), Keal and Hebert (2010)
Align/balance demand and supply	Chae (2009), Collin and Lorenzin (2006), Bower (2005), Boyer (2009), Chen-Ritzo et al. (2010a), Feng et al. (2008), Grimson and Pyke (2007), Lapide (2002), Lapide (2004a, 2005), Muzumdar and Fontanella (2006), Muzumdar and Viswanathan (2009), Olhager et al. (2001), Wallace (2006), Malhotra and Sharma (2002), Chou et al. (2007), Goodwin et al. (2010), Singh (2010), Smith et al. (2010), Baumann(2010), Keal and Hebert (2010)
Align different firm functions	Ivert and Jonsson (2010), Gianesi (1998), Nakano (2009), Hadaya and Cassivi (2007), Affonso et al. (2008), Chen-Ritzo et al. (2010a), Mentzer and Moon, (2004), Malhotra and Sharma (2002, 255), Oliva and Watson (in press), Chou et al. (2007), Paiva (2010), Singh (2010), Smith et al. (2010), Baumann and Andraski (2010)
Align/integrate plans	Ivert and Jonsson (2010), Bower (2005), Chen-Ritzo et al. (2010a), Feng et al. (2008), Harwell (2006), Lapide (2009b), Mellen et al. (2010), Mentzer and Moon, (2004), Tohamy (2008), Nielsen et al. (2010), Oliva and Watson (in press), Singh (2010), Smith et al. (2010), Baumann (2010), Keal and Hebert (2010)
Refines/adjusts/improves functional plans	Basu (2001), Collin and Lorenzin (2006), Bower (2005), Chen-Ritzo et al. (2010a), Harwell (2006), Lapide (2002, 2005, 2006, 2009b), Muzumdar and Fontanella (2006), Tohamy (2008), Wallace (2006), Oliva and Watson (in press), Smith et al. (2010), Baumann(2010), Keal and Hebert (2010)
Horizontal alignment within the supply chain	Gianesi (1998), Godsell et al. (2010), Hadaya and Cassivi (2007), Sehgal et al. (2006), Affonso et al. (2008), Lapide (2005), Mentzer and Moon, (2004), Nielsen et al. (2010), Baumann (2010)
Operational improvement	
Improve forecast	Bower (2005), Lapide (2002), Mentzer and Moon, (2004), Wallace and Stahl (2008), Nielsen et al. (2010), Baumann (2010), Keal and Hebert (2010)
Improve operational performance	Milliken (2008), Olhager and Selldin (2007), Nielsen et al. (2010), Goodwin et al. (2010), Olhager (2010)
Reduce/manage inventory and stock-outs	Collin and Lorenzin (2006), Muzumdar and Fontanella (2006), Piechule (2008), Reyman (2005), Paiva (2010), Baumann (2010)
Manage/balance/align volume and mix	Wallace (2006), Chen-Ritzo et al. (2010b), Olhager (2010)
Manage/balance/align capacity resources	Collin and Lorenzin (2006), Burrows (2007), Olhager and Rudberg (2002)
Manage constraints	Harwell (2006), Tohamy (2008)
Manage uncertainly and risk	Lapide (2009a, 2009b), Muzumdar and Fontanella (2006), Smith et al. (2010), Keal and Hebert (2010), Baumann and Andraski (2010)
Allocate critical resources	Milliken (2008)
Optimise supply capability	Collin and Lorenzin (2006)
Aid new product introduction	Godsell et al. (2010)
Measure value creation	Burrows (2007)
Measure/review business performance	Basu (2001), Bower (2005)
Results focused on a single perspective	
Improve business/supply chain performance	Bower (2005), Slone et al. (2007), Malhotra and Sharma (2002), Oliva and Watson (in press), Paiva (2010)
Improve revenue	Collin and Lorenzin (2006), Chen-Ritzo et al. (2010b)
Improve customer service	Nakano (2009), Boyer (2009), Burrows (2007), Piechule (2008), Reyman (2005), Chou et al. (2007), Keal and Hebert (2010)
Minimise business/supply chain costs	Affonso et al. (2008), Boyer (2009), Lapide (2004a, 2004b, 2005), Olhager et al. (2001), Singhal J. and Singhal (2007)
Minimise demand distortion	Hadaya and Cassivi (2007)
Conduct yield management/pricing	Collin and Lorenzin (2006), Singhal J. and Singhal (2007), Paiva (2010)
Results based on trade-offs	
Increase/optimise enterprise profits	Godsell et al. (2010), Grimson and Pyke (2007), Mentzer and Moon, (2004), Muzumdar and Fontanella (2006), Muzumdar and Viswanathan (2009), Tohamy (2008), Whisenant (2006), Chou et al. (2007), Singh (2010), Baumann(2010), Baumann and Andraski (2010)
Optimise customer service vs. inventory	Lapide (2004b)
Meet demand with reduced inventory	Lapide (2004a, 2004b, 2005), Mellen et al. (2010)
Meet customer needs with minimum cost	Sehgal et al. (2006), Milliken (2008), Slone et al. (2007), Paiva (2010)

Grimsom and Pyke, 2007). Moreover, many of the maturity models applied to S&OP have no common framework (Lapide, 2004a, 2004b, 2005; Mentzer and Moon, 2004; Grimson and Pyke, 2007).

There is a large array of contextual data from different countries, industries, company sizes, manufacturing strategies, product process-matrix, product aggregation level, planning hierarchy, and horizons (McCormack and Lockamy, 2005; Grimson and Pyke, 2007; Olhager and Selldin, 2007; Hadaya and Cassivi, 2007; Nakano, 2009; Collin and Lorenzin, 2006; Godsell et al., 2010).

Analysing a dataset of 15 US-based firms representing different sizes and combinations of processes and products, Grimson and Pyke (2007) did not find evidence to support the use of the product-process matrix of Hayes and Wheelwright (1979) as an S&OP descriptor. In contrast, several papers reported differences in S&OP approaches for make-to-order (MTO) and make-to-stock (MTS) contexts (Olhager et al., 2001; Olhager and Rudberg, 2002; Olhager and Selldin, 2007; Reyman, 2005; Collin and Lorenzin, 2006; Burrows, 2007; Grimson and Pyke, 2007; Piechule, 2008; Wallace and Stahl, 2008; Godsell et al., 2010; Chen-Ritzo et al., 2010a).

While most S&OP planning is done at the product family level, there are examples of SKU-based S&OP (Sehgal et al., 2006; Collin and Lorenzin, 2006) and S&OP processes that combine both product family and SKU for selected products (Bower, 2005; Singh, 2010). The literature positions S&OP on different hierarchy planning levels, being it either at the strategic level, at the tactical level, or trying to cover both. Olhager et al. (2001), Olhager and Rudberg (2002), and Olhager and Selldin (2007), for instance, situated S&OP at the strategic level of the manufacturing planning and control (MPC) system. These authors recognised not only that balancing supply and demand at aggregate or product levels is a

Table 5
Classification of metrics.

Type of metrics	Reference numbers
Plan	
Inventory turnover	Chae (2009), Paiva (2010)
Inventory level (e.g. days of inventory & stock value)	Chae (2009), Nakano (2009), Boyer (2009), Milliken (2008), Reyman (2005), Whisenant (2006), Singh (2010), Baumann and Andraski (2010)
Track variations in inventory level	Hadaya and Cassivi (2007)
Rate of obsolete inventory	Chae (2009), Boyer (2009), Reyman (2005), Paiva (2010)
Cash-to-cash cycle time	Chae (2009), Whisenant (2006), Paiva (2010)
Planning cycle time	Chae (2009)
Forecast volatility	Chae (2009)
Track variations in customer demand	Hadaya and Cassivi (2007)
Order fill rate	Boyer (2009), Singh (2010), Keal and Hebert (2010)
Product development cycle time	Grimson and Pyke (2007)
Level of customer perceived value of product	Burrows (2007)
Total production	Milliken (2008)
Source	
Lead time	Chae (2009)
Materials quality	Chae (2009)
Supplier fill rate	Singh (2010)
Track variations of deliveries with suppliers	Hadaya and Cassivi (2007)
Production	
Capacity utilisation	Chae (2009), Grimson and Pyke (2007), Lapide (2004b), Milliken (2008), Piechule (2008)
Production lead time	Chae (2009), Chou et al. (2007)
Production quality	Chae (2009)
Track variations in production	Hadaya and Cassivi (2007), Chou et al. (2007)
Flexibility (product, volume, mix)	Gianesi (1998), Chou et al. (2007)
Production costs	Gianesi (1998), Nakano (2009), Chou et al. (2007)
Human resource productivity index	Chae (2009)
Production capacity shortages	Lapide (2004b)
Delivery	
On-time delivery of goods	Godsell et al. (2010), Chae (2009), Boyer (2009), Milliken (2008), Reyman (2005)
Lead time	Nakano (2009), Chou et al. (2007)
Delivery reliability performance	Gianesi (1998)
Track variations in delivery capability	Hadaya and Cassivi (2007)
Delivery speed	Gianesi (1998), Nakano (2009), Olhager (2010)
Delivery flexibility	Gianesi (1998), Olhager (2010)
Distribution costs	Godsell et al. (2010), Milliken (2008), Singh (2010)
Customer satisfaction/retention	Sehgal et al. (2006), Lapide (2004b), Baumann(2010), Keal and Hebert (2010)
S&OP dashboard	
Accuracy of forecast techniques	Chae (2009), Bower (2005), Boyer (2009), Grimson and Pyke (2007), Lapide (2004a, 2004b), Milliken (2008), Reyman (2005), Whisenant (2006)
Adherence to sales, marketing and operations plan	Lapide (2004a, 2004b), Paiva (2010)
Forecast versus order	Chae (2009)
Total sales as a proportion of demand	Milliken (2008), Paiva (2010)
Variance regarding baseline forecasts and budgets	Lapide (2004a, 2004b)
Measurement of major strategic initiatives	Bower (2005)
Actual versus planned demand	Milliken (2008)
Actual versus planned production	Milliken (2008)
Actual versus planned inventory	Milliken (2008)
Actual quantities shipped versus quantities ordered	Milliken (2008)
End-results	
Gross profit return on space (GPROS)	Harwell (2006)
Return on net assets (RONA)	Keal and Hebert (2010)
Gross profit return on inventory (GPROI)	Harwell (2006)
Company/product profitability	Grimson and Pyke (2007), Singh (2010), Keal and Hebert (2010)
Contribution margin ($/lbs)	Milliken (2008)

tactical issue but also that this balancing might at times require the expansion of productive capacity, for example, which is clearly a strategic issue. Therefore, they classified S&OP as partly tactical and partly strategic. However, the dominant perception of the role of S&OP is at the tactical level. Most papers covering the planning function situated S&OP at the tactical level of the planning hierarchy, bridging the corporate strategic plan to operations. Planning horizons, usually situated between 6 and 18 months, can vary from 3 to 6 months (Gianesi, 1998) to a longer time span of over 18 months (Basu, 2001; Wallace, 2006; Godsell et al., 2010; Baumann, 2010; Smith et al., 2010).

3.3.2. Inputs

Study descriptors of inputs are presented in Table 3. The typology of inputs was organised by cross-tabulating the retrieved papers for this review (see Table 1) in the categories of demand, source, production, delivery, and finance with the input levels of plans, constraints, and others. Although planning processes are usually constrained plans, Table 3 reports them separately, reflecting their positioning in the original papers. The large majority of papers described inputs as plans for demand, sales, and production. Plans related to procurement, supply, distribution, and finance are also considered in the input category

of descriptors, but to a lesser extent. Production capacity is one of the most relevant operations restrictions to the S&OP process. Finance constraints are introduced mainly as budgetary restrictions and as financial goals (product margins and profitability).

Table 4 shows descriptors of S&OP goals. Balance of supply and demand, vertical and cross-functional alignment, integration of plans, their refinement and improvement, and horizontal alignment within the supply chain with customers and suppliers are important drivers to the S&OP process. Several studies focused on operational improvements in specific areas, such as forecast, inventory, management and balance of the mix and the volume of products, and capacity resources. They also focused on the operational aspects of managing risks and constraints, allocating resources, assisting in new product development, and improving measurement of value creation and business performance. End-result focused goals appeared as improvements of the performance of the business and of the supply chain, increased revenues, enhanced customer services, and minimisation of demand distortion. Descriptors were also presented as trade-offs, maximising profits or customer level at minimum inventory and supply chain costs. The integration of marketing practices of yield management and dynamic pricing appeared in few studies, reflecting the noted absence or low levels of integration of financial goals and financial plans into S&OP practice (Grimson and Pyke, 2007; Muzumdar and Viswanathan, 2009).

3.3.3. Structure and processes

Regarding the descriptors of S&OP structure and processes, the issue of who should participate in S&OP meetings was discussed mainly in the context of the firm: cross-functionality was sought through joint participation in meetings and communication channels by marketing, sales, production, logistics, sourcing, and to a lesser extent, finance. Some authors expanded participation to the supply chain, including both suppliers and customers (Gianesi, 1998; Basu, 2001; Collin and Lorenzin, 2006; Wallace, 2006; Hadaya and Cassivi, 2007; Singhal J. and Singhal, 2007; Slone et al., 2007; Grimson and Pyke, 2007; Nakano, 2009; Ivert and Jonsson, 2010), while others called this extension 'collaborative planning, forecasting and replenishment' (CPFR) (Smith et al., 2010; Baumann and Andraski, 2010). Most papers describing the S&OP process emphasised the need for regular meetings and for mechanisms to foster trust and confidence among the team. Meeting regularity varied from monthly to weekly; some authors suggested that frequent meetings are disruptive while others advocated an evolution from regular to event-driven, *ad hoc* meetings (Grimson and Pyke, 2007). Wallace and Stahl (2008) described a five-step monthly S&OP process used at most companies. The agenda for the first meeting is to gather and review data on actual supply and demand, inventory, backlog, and statistical forecasts. During the second meeting, the demand plan is reviewed, followed by a revision of supply plans in the third meeting. The fourth meeting is preparatory to the executive S&OP meeting. Decisions, recommendations, scenarios, and the agenda for the executive meeting are reviewed. The executive S&OP meeting closes the monthly process.

The existence of a formal S&OP structure and the empowerment of the S&OP team and of the individuals participating in the team are described as essential ingredients to the process (Lapide, 2002; Lapide, 2004a, 2005, 2006; Whisenant, 2006; Piechule, 2008; Singh, 2010). As a process descriptor, information systems are perceived as enabling technologies (Lapide, 2005), although some authors cautioned that at the initial stages, simple spread sheets can be used as S&OP scoreboards with the bulk of effort focused on strengthening the S&OP process and on empowering a formal team rather than heavily investing in complex and sophisticated information systems (Grimson and Pyke, 2007; Wallace and Stahl, 2008). The use of simulation techniques and mathematical models to optimise the integration of the supply and demand side of business as well as the role of advanced planning and scheduling systems (APS) in S&OP were discussed by Feng et al. (2008), Affonso et al. (2008), Ivert and Jonsson (2010), and Chen-Ritzo et al. (2010a), among others.

Metrics described in the S&OP literature are classified in Table 5. The five meta-processes of the SCOR framework (Supply-Chain Council, 2001) were adapted for the S&OP classification in Table 5, complemented by frameworks proposed by Gunasekaran et al. (2001), Gunasekaran et al. (2004), and Chae (2009). At the plan level, most measures related to production, inventory levels, demand and order forecast, cash to cash, and product development cycle time. Lead time, quality, and information are the essential metrics for sourcing. Capacity and resource utilisation, human resources productivity and production lead time, quality, costs, flexibility, variability, and shortages were regrouped under production. Delivery comprised timeliness, lead times, reliability, variability, speed, flexibility, costs, backlogs, and user satisfaction.

S&OP dashboards are instrumental in facilitating regular meetings and keeping up with a set agenda. Dashboards review functional plans and ensure adherence to the plans as measured by the comparison between planned and effected demand, production and inventory, a follow-up of forecast accuracy, and comparison of quantities shipped versus quantities ordered. End results are measured by profit rates and product margins. Although metrics were highlighted in many papers as being very important, none of the papers worked directly with metrics aimed at measuring the S&OP process itself.

3.3.4. Outcomes

The main outcome posited in the search synthesis framework was the integration of plans. It appears as an input in Table 3 in forty-four papers (as integrated demand and functional plans), fifteen papers quote integrated sales and demand forecasts, eight quotes procurement and supply planning, twenty-one refers to integrated production/capacity plan, and yet forty-one papers include plans for inventory as inputs to the S&OP process. Those papers reported partial or comprehensive integration among marketing, sales, and operations. The inclusion of finance plans in this integration was considered by a smaller number of papers, with only six papers clearly quoting finance planning as a key input into the S&OP process.

Among the 55 papers reviewed, just six papers analysed the impact of S&OP on the performance of the firm. Feng et al. (2008) applied a mixed integer-based programming model, concluding that a fully integrated S&OP model results in higher financial returns than partially integrated or decoupled planning. Olhager and Selldin (2007) found that S&OP and master planning play a mediating role between market uncertainty and the firm's results. Nakano (2009) found a positive relationship between internal and external alignments and their effects on performance. Hadaya and Cassivi (2007) found positive effects of collaboration and information systems on performance. McCormack and Lockamy (2005) found significant positive correlations between informal organisation, formal groups, integrating roles, and network building and performance. Oliva and Watson (in press) found, in a case study, that the existence of an effective S&OP process in itself enhances performance even when the landscape of incentives and rewards are contradictory and not prone to increase inter-functional integration within the firm and in the supply chain. In all cases, the performance of the firm was measured differently, making comparisons and cumulative meta-analysis difficult.

4. Conclusions

Despite the growing interest in S&OP as evidenced by the number of papers recently published, efforts to synthesise the state-of-the-art in S&OP have so far been rather limited. To fill this gap, this paper provides a systematic review of the extant literature. The review was based on a research synthesis framework gathering S&OP descriptors in the broad areas of context information, inputs, structure and processes, outcomes, and results. Two hundred seventy-one abstracts and 89 full-text papers were retrieved and 55 were analysed for the final review.

The theme of S&OP is treated predominantly in a prescriptive manner in the operations and organisational management literature. S&OP originated in industry, and several publications are still found in trade and industry magazines. Academic research in S&OP has been developed in past years, with a holistic approach to S&OP as a business process. S&OP processes vary according to industrial contexts and manufacturing strategies. Most papers focused on the aggregate level of a family of products, and process cycles ranged from 3 to 18 months. The dominating perception of the role of S&OP is that it is predominantly a tactical planning tool, deployed once business and strategic plans are set, bridging these plans to operations. Although S&OP has mainly focused on an intra-company perspective, it has been gradually extended to the supply chain. The latter is also referred in the literature as CPFR.

Inputs to the S&OP process were plans from different functional areas and constraints mainly related to finance (budgets) and operations (production capacity). There are also a large variety of S&OP drivers or goals, such as reducing inventories, improving forecasts, balancing supply and demand, integrating plans intra- and inter-firms, and improving results by optimising revenues and profits.

Discussions on organisational aspects of S&OP emphasise who should participate in meetings and regularity of these meetings. There is no single rule, but authors agree on the need to define formal S&OP teams; to empower participants; and to ensure the participation of top management, key customers, and suppliers from the beginning of the process. Trust and confidence among team members are also emphasised. Information systems are viewed as essential to align strategies and operations. However, it seems that there is no agreement on the level of investment in information systems, particularly at the initial stages of the process. While some authors recommended simple spread sheets, others demonstrated the positive effects of advanced planning systems in S&OP.

Few papers presented descriptors that include financial plans, goals, and participants from financial departments. The need to further integrate the financial function and its owners into the S&OP process was highlighted by some authors and warrants further research.

As for the description of the process, measurement issues were highly dispersed and metrics varied widely among authors. Future research on this topic is also suggested.

Facing such a diversified array of S&OP process descriptors, it is difficult to quantify findings within the boundaries of a well-established and accepted framework. The framework proposed in this paper, which was based on S&OP maturity models, was valuable to summarise findings, but it did not lead to quantitative comparisons and measurements. Clearly, descriptors were identified and reviewed in accordance with the first purpose of the paper, but this process did not lead to a statistical analysis of effect sizes. It seems that the literature in S&OP research is not yet ripe for meta-analysis.

Few survey papers on the effect of S&OP presented study descriptors in a detailed manner leading to a clear understanding of the strengths and limitations of the evidence presented. The S&OP effect on the results of the firm is mediated by different descriptors such as planning and control mechanisms, collaborative forecasting and planning, interorganisational information systems, and horizontal collaboration within the firm. It seems that there is at least partial evidence that the process in itself might make a difference for the performance of the firm, even when incentives and contracts are contradictory and do not encourage collaboration (Oliva and Watson, in press). The partial evidence identified so far leaves room for additional empirical investigation, through case studies and survey research work, of the S&OP process and its determinants and consequences for the performance of the firm and of the supply chain.

The diversity of the maturity models underlying the empirical research and differences in operational definitions of the performance of the firm precluded a statistical analysis of S&OP results based on the literature search. Some aspects of the S&OP process correspond to more traditional areas of research in operations management and might be further explored through research synthesis and meta-analyses; in particular, the sub-processes of vertical and horizontal alignment and their effects on new product development, the performance of the firm, and the supply chain.

The results presented in this paper are relevant for both practitioners and researchers.

Practitioners will be able to review a synthesis of different aspects of the S&OP process and have a better understanding of its role as a mediator of firm performance. There is at least partial evidence that cross-functional planning processes can mitigate the negative effect of misaligned organisational structures and contradictory incentives schemes on firm's performance. Formal and informal communications between functions, networking and internal integrating roles can boost performance. Furthermore, internal alignment seems to facilitate supply chain integration with both suppliers and customers, particularly when inter-organisational information systems favour supply chain integration.

Researchers may contribute further to the research on S&OP as a business process and for a better understanding of its effects on firm performance. There is still a lack of well documented case studies describing S&OP process in different cultures and industries. Demonstrating how the findings obtained for specific industries and cultures can be generalised has yet to be achieved. Empirical data obtainable through surveys and in-depth interviews with managers and stakeholders in the supply chain are still lacking. Additional case studies and survey research are necessary to corroborate findings and to reveal new venues for research questions and hypothesis tests regarding the role of sales and operation planning in the supply chain.

Acknowledgement

The Authors gratefully acknowledge MCT/CNPq (research projects: 309455/2008-1 and 307996/2011-5), CAPES/DFG (BRAGECRIM research project: 010/09) and PRONEM/FAPERJ. The authors are also very grateful to the two anonymous referees for their constructive suggestions.

References

Affonso, R., Marcotte, F., Grabot, B., 2008. Sales and operations planning: the supply chain pillar. Production Planning & Control 19 (2), 132–141.

Auger, C.P., 1998. Information sources in grey literature. Guide to Information Sources, Fourth ed. Bowker Saur, London.

Basu, R., 2001. New criteria of performance management: a transition from enterprise to collaborative supply chain. Measuring Business Excellence 5 (4), 7–12.

Baumann, F., 2010. The shelf-connected supply chain: strategically linking CPFR with S&OP at the executive level. Journal of Business Forecasting 29 (4), 21–27.
Baumann, F., Andraski, J., 2010. Collaborate, externally and internally. Industrial Engineer: IE 42 (6), 37–40.
Bornmann, L., Marx, W., Schier, H., Rahm, E., Thor, A., Daniel, H., 2009. Convergent validity of bibliometric google scholar data in the field of chemistry—Citation counts for papers that were accepted by Angewandte Chemie International Edition or rejected but published elsewhere, using google scholar, science citation index, scopus, and chemical abstracts. Journal of Informetrics 3 (1), 27–35.
Bower, P., 2005. 12 most common threats to sales and operations planning process. Journal of Business Forecasting 24 (3), 4–14.
Boyer Jr, J.E., 2009. 10 proven steps to successful S&OP. Journal of Business Forecasting 28 (1), 4–10.
Burrows III, R.P., 2007. Demand driven S&OP: a sharp departure from the traditional ERP approach. Journal of Business Forecasting 26 (3), 4–13.
Cacere, L., Barret, J., Mooraj, H., 2009. Sales and Operations Planning: Transformation from Tradition. Industry Value Chain Strategies. AMR Research, Boston, MA, USA.
Chae, B., 2009. Developing key performance indicators for supply chain: an industry perspective. Supply Chain Management: An International Journal 14 (6), 422–428.
Chen-Ritzo, C.-H., Ervolina, T., Harrison, T.P., Gupta, B., 2010a. Sales and operations planning in systems with order configuration uncertainty. European Journal of Operational Research 205 (3), 604–614.
Chen-Ritzo, C.-H., Ervolina, T., Harrison, T.P., Gupta, B., 2010b. Component rationing for available-to-promise scheduling in configure-to-order systems. European Journal of Operational Research Available from: 〈http://www.sciencedirect.com/science?_ob…/sdarticle.pdf〉 (accessed 20.12.10).
Chou, Y.-C., Cheng, C.-T., Yang, F.-C., Liang, Y.Y., 2007. Evaluating alternative capacity strategies in semiconductor manufacturing under uncertain demand and price scenarios. International Journal of Production Economics 105 (2), 591–606.
Collin, J., Lorenzin, D., 2006. Plan for supply chain agility at Nokia: lessons from the mobile infrastructure industry. International Journal of Physical Distribution & Logistics Management 36 (6), 418–430.
Cooper, H., 1984. The integrative research review: A systematic approach. Sage Publications, Newburry Park, CA.
Cooper, H., 2010. Fourth ed.Research synthesis and meta-analysis: A step-by-step approach. Applied Social Research Methods Series, 2. Sage Publications, Thousand Oaks, CA, USA.
Cox, J.F., Blackstone, J.H., 2002. APICS Dictionary, Tenth ed. APICS, Alexandria, VA, USA.
Dougherty, J., Gray, C., 2006. Sales & Operations Planning—Best Practices. Partners for Excellence, Belmont, NH. Trafford Publishing.
Feng, Y., Sophie D'Amours, S., Beauregard, R., 2008. The value of sales and operations planning in oriented strand board industry with make-to-order manufacturing system: cross functional integration under deterministic demand and spot market recourse. International Journal of Production Economics 115 (1), 189–209.
Fleiss, J.L., 1971. Measuring nominal scale agreement among many raters. Psychological Bulletin 76 (5), 378–382.
Gianesi, I.G.N., 1998. Implementing manufacturing strategy through strategic production planning. International Journal of Operations & Production Management 18 (3), 286–299.
Grimson, J.A., Pyke, D.F., 2007. Sales and operations planning: an exploratory study and framework. International Journal of Logistics Management 18 (3), 322–346.
Godsell, J., Birtwistle, A., van Hoek, R., 2010. Building the supply chain to enable business alignment: lessons from British American Tobacco (BAT). Supply Chain Management: An International Journal 15 (1), 10–15.
Goodwin, P., Önkal, D., Thomson, M., 2010. Do forecasts expressed as prediction intervals improve production planning decisions? European Journal of Operational Research 205 (1), 195–201.
Gunasekaran, A., Patel, C., McGaughey, R.E., 2004. A framework for supply chain performance measurement. International Journal of Production Economics 87 (3), 333–347.
Gunasekaran, A., Patel, C., Tirtiroglu, E., 2001. Performance measures and metrics in a supply chain environment. International Journal of Operations and Production Management 21 (1–2), 71–87.
Hadaya, P., Cassivi, L., 2007. The role of joint collaboration planning actions in a demand-driven supply chain. Industrial Management & Data Systems 107 (7), 954–978.
Harwell, J., 2006. Sales & operations planning in the retail industry. Journal of Business Forecasting 25 (3), 4–10.
Harzing, A.W.K., van der Wal, R., 2008. Google scholar as a new source for citation analysis. Ethics in Science and Environmental Politics 8 (1), 61–73.
Hayes, R.H., Wheelwright, S.C., 1979. Link manufacturing process and product life cycles. Harvard Business Review 57 (1), 133–140.
Ivert, L.K., Jonsson, P., 2010. The potential benefits of APS systems in sales-and-operations planning. Industrial Management & Data Systems 110 (5), 659–681.
Kathuria, R., Joshi, M.P., Porth, S.J., 2007. Organizational alignment and performance: past, present and future. Management Decision 45 (3), 503–517.
Keal, D.A., Hebert, P., 2010. Benefits to blood banks of a sales and operations planning process. Transfusion 50 (12), 2785–2787.
Lapide, L., 2002. New developments in business forecasting. Journal of Business Forecasting 21 (2), 12–14.
Lapide, L., 2004a. Sales & operations planning part I: the process. Journal of Business Forecasting 23 (3), 17–19.
Lapide, L., 2004b. Sales & operations planning part II: enabling technology. Journal of Business Forecasting 23 (4), 18–20.
Lapide, L., 2005. Sales & operations planning part III: a diagnostic model. Journal of Business Forecasting 24 (1), 13–16.
Lapide, L., 2006. Top-down & bottom-up forecasting in S&OP. Journal of Business Forecasting 25 (2), 14–16.
Lapide, L., 2009a. Risk and the planning process. Supply Chain Management Review 13 (7), 4–5.
Lapide, L., 2009b. The S&OP Rudder. Supply Chain Management Review 13 (2), 4–6.
Lipsey, M.W., Wilson, D.B., 2001. Practical meta-analysis. Sage, Thousand Oaks, CA.
Lipsey, W.L., 2009. Identifying interesting variables and analysis opportunities. In: Cooper, H.C., Hedges, L.V., Valentine, J.C. (Eds.), The Handbook of Research Synthesis and Meta-Analysis, Second edition , Russel Sage Foundation, NY, USA.
Malhotra, M.K., Sharma, S., 2002. Spanning the continuum between marketing and operations. Journal of Operations Management 20 (3), 209–219.
Matt, G.E., Cook, T.D., 1994. Threats to the validity of research syntheses. In: Cooper, H., Hedges, L.V. (Eds.), The handbook of research synthesis. , Russel Sage Foundation, NY, USA.
Matt, G.E., Cook, T.D., 2009. Threats to the validity of generalized inferences from research synthesis. In: Cooper, H., Hedges, L.V., Valentine, J.C. (Eds.), The Handbook of Research Synthesis and Meta-Analysis. , Russel Sage Foundation, NY, USA.
McCormack, K. Lockamy, A., 2005. The impact of horizontal mechanisms within sales and operations planning processes on supply chain integration and performance: a statistical study. In: Proceedings of the th Global Conference on Business & Economics, Oxford, UK. Available from: 〈http://www.drkresearch.org/Contact_Us/McCormackandLockamy4thGlobalConferncePaper_FinalVersion.pdf〉 (accessed 4.08.10).
McKimmie, T., Szurmak, S., 2002. Beyond grey literature: how grey questions can drive research. Journal of Agricultural and Food Information 4 (2), 71–79.
Mellen, C., Allen, B., Prokopets, L., 2010. Putting S&OP on the fast track. Supply Chain Management Review 14 (1), 40–45.
Mentzer, J.T., Moon, M.A., 2004. Understanding demand. Supply Chain Management Review 8 (4), 38–45.
Milliken, A.L., 2008. Sales & operations planning: building the foundation. Journal of Business Forecasting 27 (3), 4–12.
Muzumdar, M., Fontanella, J., 2006. The secrets to S&OP success. Supply Chain Management Review 10 (3), 34–41.
Muzumdar, M., Viswanathan, N., 2009. Integrated business planning: kicking S&OP up a notch. Supply Chain Management Review 13 (7), 34–41.
Nakano, M., 2009. Collaborative forecasting and planning in supply chains: The impact on performance in Japanese manufacturers. International Journal of Physical Distribution & Logistics Management 39 (2), 84–105.
Nielsen, P., Nielsen, I., Steger-Jensen, K., 2010. Analyzing and evaluating product demand interdependencies. Computers in Industry 61 (9), 869–876.
Olhager, J., Rudberg, M., 2002. Linking manufacturing strategy decisions on process choice with manufacturing planning and control systems. International Journal of Production Research 40 (10), 2335–2351.
Olhager, J., Rudberg, M., Wikner, J., 2001. Long-term capacity management: linking the perspectives from manufacturing strategy and sales and operations planning. International Journal of Production Economics 69 (2), 215–225.
Olhager, J., Selldin, E., 2007. Manufacturing planning and control approaches: market alignment and performance. International Journal of Production Research 45 (6), 1469–1484.
Olhager, J., 2010. The role of the customer order decoupling point in production and supply chain management. Computers in Industry 61 (9), 863–868.
Oliva, R., Watson, N., Cross-functional alignment in supply chain planning: a case study of sales and operations planning, Journal of Operations Management, in press, doi:10.1016/j.jom.2010.11.012. Available from: 〈http://www.sciencedirect.com/science?_ob=…/sdarticle.pdf〉 (accessed 17.12.10).
Paiva, E.L., 2010. Manufacturing and marketing integration from a cumulative capabilities perspective. International Journal of Production Economics 126 (2), 379–386.
Paulk, M.C., Weber, C.V., Chrissis, M.B., 1993. The Capability Maturity Model for Software, Version 1.1. edition [S.l.]: Software. Engineering Institute, Carnegie Mellon University, Pittsburgh, PA, USA.
Piechule, J., 2008. Implementing a sales and operations planning process at sartomer company: a grass-roots approach. Journal of Business Forecasting 27 (3), 13–18.
Reyman, G., 2005. How Johnsondiversey implemented S&OP in Europe. Journal of Business Forecasting 24 (3), 20–28.
Rothstein, H.R., Hopewell, S., 2009. Grey Literature. In: Cooper, H., Hedges, L.V., Valentine, J.C. (Eds.), The Handbook of Research Synthesis and Meta-Analysis, Second ed. , Russel Sage Foundation, NY, USA, pp. 103–125.
Rosenstreich, D., Wooliscroft, B., 2009. Measuring the impact of accounting journals using Google Scholar and the g-index. The British Accounting Review 41 (4), 227–239.
Sehgal, S., Sahay, B.S., Goyal, S.K., 2006. Reengineering the supply chain in a paint company. International Journal of Productivity and Performance Management 55 (8), 655–670.

Shadish, W.R., Cook, T.D., Campbell, D.T., 2002. Experimental and Quasi-experimental Designs for Generalized Causal Inference. Houghton Mifflin, Boston, MA, USA.
Singh, M.K., 2010. What makes a winning S&OP program. Supply Chain Management Review 14 (3), 22–27.
Singhal, J., Singhal, K., 2007. Holt, Modigliani, Muth, and Simon's work and its role in the renaissance and evolution of operations management. Journal of Operations Management 25 (2), 300–309.
Slone, R.E., Mentzer, J.T., Paul Dittmann, J., 2007. Are you the weakest link in your company's supply chain? Harvard Business Review 85 (9), 116–127.
Smith, L., Andraski, J.C., Fawcett, S.E., 2010. Integrated business planning: a roadmap to linking S&OP and CPFR. Journal of Business Forecasting 29 (4), 4–9.
Supply-Chain Council, 2001. Supply-ChainOperations Reference-model Overview of SCOR Version 5.0. Supply-Chain Council, Pittsburg.
Tohamy, N., 2008. The evolution of S&OP. Supply Chain Management Review 12 (5), 10–11.
Valentine, J.C., 2009. Judging the quality of primary research. In: Cooper, H., Hedges, L.V., Valentine, J.C. (Eds.), The Handbook of Research Synthesis and Meta-Analysis. , Russel Sage Foundation, NY, USA.
Ventana Research, 2006. Sales and operations Planning: Measuring Maturity and Opportunity for Operational Performance Management. Ventana Research, San Mateo, CA, USA.
Viswanathan, N., 2009. Sales and operations Planning: Integrate with Finance and Improve Revenue. Aberdeen Group, Boston, MA, USA.
Vollmann, T.E., Berry, W.L., Whybark, D.C., Jacobs, F.R., 2005. Manufacturing Planning and Control Systems for Supply Chain. McGraw-Hill, Irwin, NY, USA.
Wallace, T., 2006. Forecasting and sales & operations planning: synergy in action. Journal of Business Forecasting 25 (1), 16–36.
Wallace, T.F., Stahl, R.A., 2006. Sales & Operations Planning. The Executive Guide. T.F. Wallace & Company.
Wallace, T.F., Stahl, R.A., 2008. The demand planning process in executive planning S&OP. Journal of Business Forecasting 27, 19–24.
Weintraub, I., 2000. The impact of alternative presses on scientific communication. The International Journal on Grey Literature 1 (2), 54–59.
Whisenant, C., 2006. The politics of forecasting in sales and operations planning. Journal of Business Forecasting 25 (2), 17–19.
Wing, L., Perry, G., 2001. Toward twenty-first-century pharmaceutical sales and operations planning. Pharmaceutical Technology, 20–26.