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Empirical and theoretical perspectives in sales and operations planning

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Abstract

This paper's purpose is to evaluate empirical and theoretical perspectives in Sales and Operations Planning (S&OP). The methodology consists of a systematic literature review, analysing 292 publications from academics and practitioners. The results reveal that the empirical evidence has been initially obtained by practitioners and subsequently acquired by academics with a growing interest in recent years. Three main research streams are identified: S&OP and performance, implementation of S&OP, and contextualisation of S&OP designs. The investigation of theoretical foundations reveals an upward trend in external general theory usage and first signs of internal theory development in S&OP. The research findings call for more exploratory research to enhance the knowledge in the identified research streams and their interrelation. Herein, applying the design science approach is recommended to integrate practitioners into academic research. Further implications embrace a call for more theory-informed empirical S&OP research in a two-pronged agenda: applying general theories from other fields and developing internal theories through middle-range theorising. A limitation of this paper is its focus on empirical studies, not embracing conceptual papers. Applications of this paper's findings can help academics and practitioners to advance their understanding of the S&OP phenomenon. The awareness of study findings in the three main research streams, combined with empirical and theoretical research implications, can support the development of solutions to improve the S&OP effectiveness and evidence-based decisions in real-life settings. This work's originality lies in the analysis of the S&OP literature with the focus on the evolution of empirical evidence and the theoretical foundations.

Keywords Supply chain · Integrated business planning · Evidence-based management · Theory-informed research · Middle-range theory

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1 Introduction

Sales and Operations Planning (S&OP) is an emerging Operations Management (OM) topic with growing interest from academics and practitioners. It strives to balance demand and supply by aligning decisions of different functional areas to develop an integrated set of plans (Thomé et al. 2012a). S&OP combines vertical alignment, bridging strategy to operations throughout various levels of the organisation, with horizontal alignment, referring to cross-functional intracompany integration (Grimson and Pyke 2007). The high interest in S&OP is reflected by the increasing number of studies published and implementations in the industry (Tuomikangas and Kaipia 2014; Noroozi and Wikner 2017). However, there is still no unified perception of what S&OP embraces and how it works (Swaim et al. 2016; Scavarda et al. 2017; Kristensen and Jonsson 2018). Although there are first attempts to synthesise the research on this topic, the body of empirical evidence on S&OP remains highly fragmented (Thomé et al. 2012a; Noroozi and Wikner 2017), and there is no “unified agenda for future research on S&OP practices” (Kristensen and Jonsson 2018, p. 20). This hinders the development of a common understanding of S&OP.

To develop a common understanding of an emerging management topic, it is, on the one hand, essential to gather and investigate empirical evidence (Adams et al. 2017). Herein, practitioners’ contributions can provide important complementary material to academic research (Pawson et al. 2005; Adams et al. 2017). Practitioners can provide additional evidence, complement and contextualise findings from academic sources, and explore new themes (Adams et al. 2017). For S&OP, this is reflected by the calls for empirical research to understand its phenomenon better (Thomé et al. 2012a; Tuomikangas and Kaipia 2014; Kristensen and Jonsson 2018). On the other hand, it is helpful to apply theories from other fields to support the comprehension and explanation of certain phenomena in emerging topics (Amundson 1998; Defee et al. 2010; Spina et al. 2016). The awareness of theoretical foundations can help researchers and practitioners interpret research findings to better understand and solve real-life problems (Walker et al. 2015). Analysing how theories were applied has been the subject of investigation in various studies that investigated the evolution of OM topics (e.g., Defee et al. 2010; Spina et al. 2016). However, such an investigation has not yet been conducted for the topic of S&OP, which has recently been highlighted as a literature gap (Kristensen and Jonsson 2018).

To the best of the authors’ knowledge, no comprehensive study has investigated the S&OP literature focusing on analysing the evolution of empirical evidence and the theoretical foundations. The goal of this paper is to evaluate empirical and theoretical perspectives in S&OP by investigating current advances in this research domain and proposing a future research agenda towards the development of a common S&OP understanding. Hence, the following research questions (RQs) are posed:

RQ1: How has S&OP evolved as a research domain?

RQ2: What are promising directions for future developments in S&OP research?

The RQs are addressed by a systematic literature review (SLR), an approach that investigates and consolidates the accumulated knowledge of a research domain within one study in a transparent and replicable way (Tranfield et al. 2003; Denyer et al. 2008). Following the guidelines from Adams et al. (2017), the SLR is extended beyond scientific publications and embraces material from practitioners published in the grey literature (i.e., generally not available in scientific databases and without the formal academic reviewing process of scientific publications, Krawczyk-Sokolowska et al. 2019). The use of grey literature is appropriate since S&OP has its origin in the industry (Ling and Goddard 1988). This paper complements previous SLRs in S&OP (Thomé et al. 2012a b; Tuomikangas and Kaipia 2014; Noroozi and Wikner 2017; Kristensen and Jonsson 2018) by several means. It focuses on the assessment of evidence-based research in S&OP, investigating its evolution from non-scientific seminal works written by practitioners to scientifically rigorous studies written by academics. It also systematically analyses the different methodologies applied, contingencies considered, and empirical evidence observed, and organises the literature findings into main research streams. Furthermore, this paper offers a first comprehensive investigation of the theoretical foundations of S&OP research, analysing the theory usage in S&OP studies. As studies that do not directly address theories can still contribute to theory building through developing and applying models and frameworks (Spina et al. 2016), this analysis is enriched by adopting Meredith's (1993) theory development approach to assessing in how far available frameworks and models contribute to theory building in S&OP. The analysis of this paper leads to an agenda that provides future research directions to enhance the S&OP understanding for both academics and practitioners.

The remainder of this paper is structured as follows. Section 2 provides the literature background for this research, emphasising the importance of empirical evidence and theoretical foundations. Section 3 presents the research methodology adopted. Section 4 presents the research findings addressing RQ1, while Sect. 5 offers directions for future S&OP research to answer RQ2. Finally, Sect. 6 presents the conclusion and research limitations.

2 Literature background

S&OP is an emerging OM topic. Emerging topics are usually characterised by a dispersed knowledge base, a missing common understanding, inconsistent and proliferating constructs, and a lack of unifying theories (Burgess et al. 2006; Adams et al. 2017). To investigate the evolution of such emerging topics, it is important to analyse the accumulated empirical evidence and the application of theory in the topic, as well as their interrelation (Chicksand et al. 2012; Burgess et al. 2006; Spina et al. 2016). Such investigations are important to help a topic mature (Defee et al. 2010; Spina et al. 2016).

Empirical evidence is paramount for investigations in OM topics. The term empirical can be defined as “knowledge based on real-world observations or experiment” (Flynn et al. 1990, p. 251). According to Rousseau et al. (2008, p. 480), “evidence is the essence of human knowledge. It deals with the regularities our senses and measuring tools can detect.” Accordingly, empirical evidence refers to regularities observed and measured in real-life settings. Particularly in emerging topics, practitioners are a valuable source of empirical evidence (Adams et al. 2017). Their assumptions and questions are important to drive research (Pawson et al. 2005) and provide important evidence to explore new phenomena (Adams et al. 2017). Practitioners can increase the findings’ relevance, but without scientific rigour, empirical evidence can mislead management into the common flaws of basing decisions solely on the grounds of “obsolete knowledge, personal experience, specialist skills, hype, dogma, and mindless mimicry of top performers” (Pfeffer and Sutton 2006, 5). Therefore, practice and research should inform each other in a way of bridging relevance and rigour (Vermeulen 2005).

This corresponds to the call for evidence-based management practices, defined as “the complementary use of scientific evidence and local business evidence” (Rousseau et al. 2008, 481). Evidence-based management is grounded on the premise that practical decisions should be made on the best available evidence (Pfeffer and Sutton 2006). For this, the awareness of the quality of evidence is essential. A proxy measure for the quality of evidence can be provided by the external validity or generalisability of research findings (Valentine 2009). Generalisability refers to the degree or the likelihood with which a result is replicable across different populations, settings, times, and contexts. Therefore, these study parameters should be disclosed transparently in empirical research, for instance, through reporting the sample size, the contingencies of the studied organisations, and the applied data analysis methods. In evidence-based research, the quality of evidence is often investigated through the analysis of research designs (Reay et al. 2009), an investigation that has been conducted for several OM topics (Defee et al. 2010; Chicksand et al. 2012; Spina et al. 2016).

Moreover, empirical evidence cannot be comprehended without theory and vice versa (Dubois and Gadde 2002). On the one hand, empirical evidence is necessary for building and testing theories to uncover new facts not yet explained or understood (Colquitt and Zapata-Phelan 2007). On the other hand, theory is important to predict outcomes, describe and explain a process or sequence of events or phenomenon, and organise the complexity of the empirical world (Colquitt and Zapata-Phelan 2007). Scholars should clearly state the theories being applied in their empirical studies to remove misinterpretations and facilitate the understanding of their findings (Defee et al. 2010).

OM topics count with several well-established theories based on real-life observations and with general theories (GTs) borrowed from other disciplines (Amundson 1998; Walker et al. 2015). Different literature reviews evaluated the theoretical foundations adopted in OM topics by identifying the percentage of papers using theories and the prevailing theories used (e.g., Defee et al. 2010; Chicksand et al. 2012; Walker et al. 2015; Spina et al. 2016). Most of these literature reviews report an upward trend in theory usage in recent years, indicating the increasing importance

of theory-informed research in OM topics. Furthermore, the increase in theory application is associated with the maturity increase of a research domain (Spina et al. 2016). The literature reviews reveal that most theories used in studies of OM topics are of a general nature and borrowed from external disciplines like organisation, economics, or strategic management. Resource-based view (RBV), Transaction cost economics (TCE), and contingency theory are the prevailing theories identified.

The application of such GTs from external disciplines can further the understanding of observed phenomena, and thus improve the maturation of an OM topic (Defee et al. 2010; Spina et al. 2016). The advantage of applying GTs resides on their high level of abstraction and ability to capture broad conceptual relationships that can be extended and applied in several knowledge domains and across disciplines (Stock 1997; Spina et al. 2016). However, GTs might not capture important concepts and relationships that are domain-specific, as they are too general and abstract and not designed to study the phenomenon of interest (Stank et al. 2017). Theories, which are domain-specific and more narrowly focussed, are also called middle-range theories (MRTs) (Merton 1968). MRTs “are built upon years of empirical research on particular problems within a field of study, and they allow scholars in a maturing discipline to synthesise and apply the rich accumulation of empirical findings to current problems.” (Stank et al. 2017, p. 1). The advantage of MRTs is their ability to capture specific concepts and relationships bound to a particular domain and context, which can help to elucidate phenomena that are missed by GTs.

GT and MRT are complementary, and theory development comprises both. Even when studies are not explicitly grounded on theories, they can be based on constitutive elements of theory development, such as frameworks and models, and, therefore, still contribute to theory building. In other words, in line with Spina et al. (2016, p. 27), studies that are not grounded on a GT are not necessarily a-theoretical, but rather not referring to “a shared and recognised theory”. This point is better explained below with the assistance of Fig. 1, which is consistent with Meredith’s (1993) theory development approach, embracing a cycle with successive loops of descriptions, explanations, and validations of models and frameworks.

Figure 1 shows the progression from description to theory. It equally demonstrates that models and frameworks can be used to build and validate theories. This is an important distinction for emerging topics, where models and frameworks are

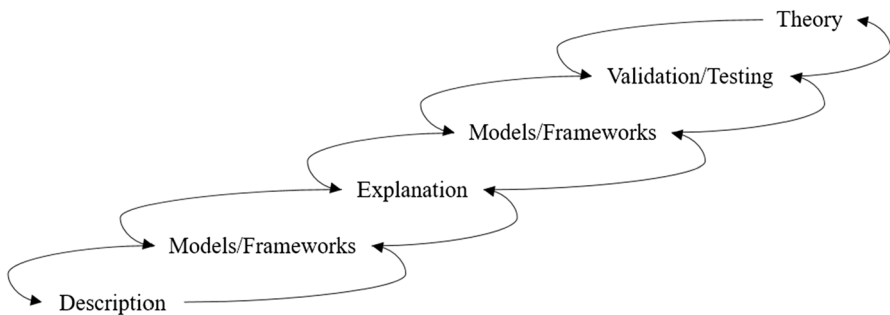


Fig. 1 Theory development cycle (adapted from Meredith 1993)

often used without a clear reference to theories. There is a general logic of theoretical abstraction, progressing from empirical observations to the formulation of models and frameworks governing relationships between observed phenomena, which would eventually merge into a theory (Schmenner and Swink 1998). Theory building starts with descriptions of the phenomena based on empirical observations, which is important to ensure that the findings are not “disconnected from the real world and irrelevant to the reality of the problems facing managers” (Meredith’s 1993, p. 4). Herein, the first-hand knowledge of practitioners plays a central role (Adams et al. 2017). Throughout the cycle, “descriptive models are expanded into explanatory frameworks, which are tested against reality until they are eventually developed into theories as research study builds upon research study. The result is to validate and add confidence to previous findings, or else invalidate them and force researchers to develop more valid or more complete theories” (Meredith 1993, p. 3).

3 Research methodology

This section offers the methodology for investigating the OM topic of S&OP. The paper applies an SLR (Tranfield et al. 2003; Denyer et al. 2008), following the step-by-step approach proposed by Thomé et al. (2016). In the initial step, the scope of the research, the research questions, the coding schemes, and the expected results were determined. They were noted in the research protocol, which also embraced the exclusion criteria, statistical procedures for reliability checks, and procedures for quality assessments and coder training (Thomé et al. 2016).

In the second step, the authors retrieved studies by applying the keywords "Sales and Operations Planning" OR "Sales & Operations Planning" to the SCOPUS, Web of Science, and EBSCO databases, with no timeframe restrictions. Additionally, following Tuomikangas and Kaipia (2014), Journal of Business Forecasting was added and searched manually, as it is a recognised source for grey literature on S&OP. The literature was firstly screened in December 2017 and once again in January 2019 for an update. The search procedure retrieved 603 studies for initial analysis after removing duplicates. Subsequently, these were analysed by three reviewers, applying the following exclusion criteria, firstly to abstracts and then to full text: (i) studies not addressing S&OP or its elements treated in isolation; (ii) studies without knowledge based on real-world observations; (iii) studies presenting preliminary findings later reported in final, complete papers (e.g., the content of conference papers later published in journals); (iv) pure sales materials (e.g., advertisements for technology vendors and consultancy services); (v) studies not in English; (vi) studies that could not be obtained or accessed. A two-step approach was conducted for the abstract analysis. Forty randomly chosen abstracts were analysed initially as part of the training process to align the application of the exclusion/inclusion criteria among the reviewers. After that, the remaining abstracts were examined. The paper selection process continued with the full-text reading of papers retrieved from the abstract analysis. To avoid missing out on relevant studies in the sample (Sageder et al. 2018; Sageder and Feldbauer-Durstmüller 2019), complementary backwards and

forward snowball searches added 84 studies, resulting in a total sample of 687. From this sample, 395 studies were not selected for further analysis as a result of the application of the exclusion criteria. Most of the studies (324 in total) were excluded as they were not related to S&OP or they were pure sales materials (exclusions criteria i and iv). Twenty-five studies were removed as they did not rely on real-world observations being either purely conceptual papers or teaching cases (exclusion criteria ii); five were excluded as they were presenting preliminary findings that were embraced in upcoming studies published by the same authors (exclusion criteria iii); eleven were removed as they were not in English (exclusion criteria v); and 30 studies could not be obtained, a result in line with Kristensen and Jonsson (2018). For measuring the inter-raters' reliability, Krippendorff's alpha was calculated. It was 0.87 for the abstracts and 0.96 for the full text and, therefore, above the acceptable threshold of 0.80 (Krippendorff 2004). Ultimately, 292 studies were retrieved for further analysis in the following steps.

In steps 3 and 4, data gathering and quality evaluation, the authors populated a concept matrix with coding schemes. To enable the analysis of the quality of empirical evidence and theoretical foundations, the following study parameters were obtained:

1. Research designs (operationalised similar to Flynn et al. 1990; Sageder et al. 2018, and Sageder and Feldbauer-Durstmüller 2019, i.e. surveys, single/multiple case studies, panel studies, focus groups, action researches, descriptive studies, and mathematical models)
2. Data analysis methods (i.e., statistics, optimisation, simulation, qualitative methods),
3. Descriptive study parameters (publication year, sample size, and position/function of respondents or interviewees),
4. Study context (operationalised through Donaldson's 2001 three types of contingencies: environment, size, and strategy of an organisation)
5. Theories applied in the studies (operationalised similar to Defee et al. 2010; Sageder et al. 2018, and Sageder and Feldbauer-Durstmüller 2019),
6. Key elements of Meredith's (1993) theory development cycle (i.e., models and frameworks).

The investigation of the study context based on Donaldson's (2001) three types of contingencies was operationalised through more granular contextual variables. Environment is represented by the geographical location (region/country) as well as the sector and industry of the analysed organisations. Size relates to the European Commission's (2015) factors (number of employees/revenue or turnover) to determine the company category (i.e., small: < 50 employees / ≤ €10 million; medium: > 50 to < 250 employees / > €10 million ≤ €50 million; and large ≥ 250 employees / > €50 million). Strategy is considered through manufacturing strategy, i.e., make-to-stock (MTS), make-to-order (MTO), and engineer-to-order (ETO). Similar to Thomé et al. (2012a), also the company's S&OP-related strategy is considered through the hierarchy of decision levels associated with the

planning horizon (strategic level with a long-term view; tactical level with a mid-term view; and operational level with a short-term view).

Data analysis, synthesis, and interpretation from steps 5 and 6 pertain to the evaluation of empirical evidence and theoretical foundations in the S&OP literature and were conducted with content analysis (Seuring and Gold 2012). The classifications of both were not always straightforward. When not directly reported in the original papers, an inference was required. This occurred through a careful check of each study in an interactive coding process among the reviewers, analogously to that conducted in Defee et al. (2010) for theory identification. The identification of the main S&OP research streams and their analysis towards developing a research agenda was conducted similar to Sageder et al. (2018). Corresponding to step 7, this paper presents the results in the next sections. An update of this SLR, step 8, remains as a suggestion for future research.

4 S&OP research findings

This section describes how S&OP evolved as a research domain. The first Sect. (4.1) presents the evolution of empirical evidence in S&OP. The second Sect. (4.2) discusses the scientific empirical studies, considering their methodology-related study parameters and contingencies. The third Sect. (4.3) offers the main research streams and theoretical foundations.

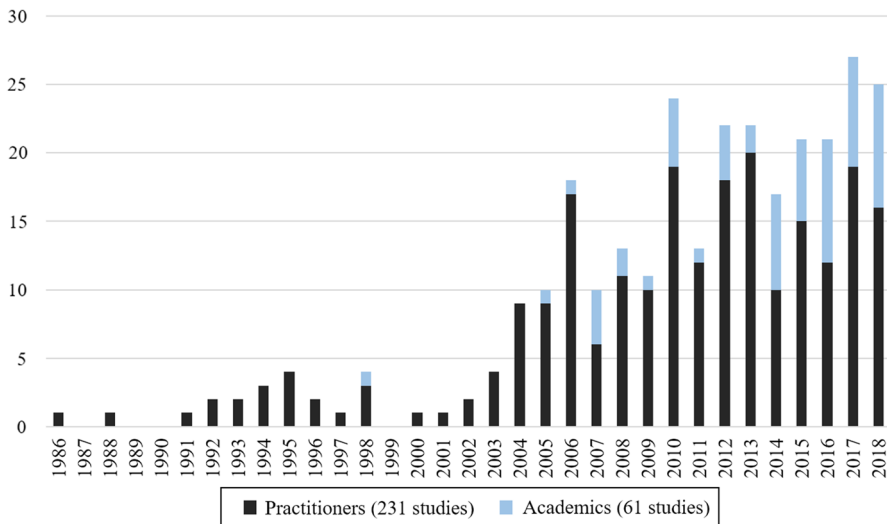


Fig. 2 Development of the S&OP empirical literature

4.1 Evolution of empirical evidence in S&OP

Figure 2 presents the evolution of empirical studies in S&OP along the years, grouping them into practitioner (grey) literature and academic publications. The first publications appeared in the late 1980s. Since then, an upward trend in the number of studies is observed. At first, the articles were only written by practitioners, and later, an increasing number of academics have started to publish in S&OP. This development confirms the growing interest in S&OP by both communities, which is reinforced by the finding that over 65% of the publications are concentrated in the last decade.

Around 79% of the total studies retrieved stem from grey literature. Therefore, practitioner studies produce a significant part of the available empirical evidence on S&OP, indicating that it is largely industry-driven. Practitioner articles are mainly written by business managers and consultants. Larry Lapide, Robert Stahl, and Thomas Wallace are examples with significant contributions, especially through practitioner-orientated magazines and journals (e.g., Lapide 2004) and handbooks (e.g., Wallace 2004). The grey literature is also composed of software vendors offering information technology insights (e.g., Demand Solutions 2008), as well as industry reports and surveys from market intelligence and research companies like Aberdeen Group (e.g., Viswanathan 2009) or Gartner (e.g., Barrett and Uskert 2010). The practitioner literature is based on authors' opinions and their personal experience, often using terms such as "experience tells us" and "our belief is that" (Keal and Hebert 2010, 2785). This is associated with a low strength of evidence (Reay et al. 2009). Although it does not indicate whether the presented findings are correct or incorrect, inferences from these studies should be drawn with caution, due to the lack of scientific rigour that may lead to potential subjectivity and bias of the works.

In total, 61 scientific empirical studies conducted by academics have been identified, which are mostly published in academic journals. Aside from one study (Gianesi 1998), the scientific literature has started to appear in 2005. In recent years, the number of academic studies has increased significantly, with over 60% ($n=39$) being published in the last five years (2014–2018). Except for the five SLRs identified (Thomé et al. 2012a, b; Tuomikangas and Kaipia 2014; Noroozi and Wikner 2017; Kristensen and Jonsson 2018), all empirical studies collect and analyse primary data from real-life settings. Due to the application of methodological approaches of higher scientific rigour, the findings of these studies are associated with a higher quality of evidence than those from practitioner works (Reay et al. 2009).

4.2 Scientific empirical studies in S&OP

In total, 56 scientific empirical studies analysing primary data were retrieved. These studies are presented in Table 1, organised by methodology-related study

Table 1 Empirical research in S&OP

Study	Methodology-related study parameters					Study context				
	Research design	Data Analysis	Sample size	Respondents or interviewees: position/function	Environment	Organisational size		Strategy		
						Region/country	Type of sector/industry		Category/turnover, revenue, employees	MFG-related
Gianesi (1998)	MCS	Qualitative methods	6	Managers/NA	Brazil	MFG/various	Different sizes	NA	NA	Tactical/mostly 4–5 months
McCormack and Lockamy (2005)	Survey	Statistics	55	Managers from multiple levels/different areas	NA	MFG/various	NA	NA	NA	NA
Sehgal et al. (2006)	SCS	Qualitative methods	1	NA	India	MFG/automotive paint	NA	NA	NA	NA
Grimson and Pyke (2007)	MCS	Qualitative methods	15	Managers/different areas	NA	MFG/various	Medium & large/revenue from US\$ 50 M to US\$ 5 B	MTO	NA	NA
Hadaya and Cassivi (2007)	Survey	Statistics	53	Managers/supply chain	Mostly USA & Canada	MFG/telco equipment	Mostly large/72% over 500 employees	NA	NA	NA
Olhager and Sellidin (2007a)	Survey	Statistics	128	Managers from multiple levels/different areas	Sweden	MFG/various	Mostly medium & large/75% over €15 M in revenue	NA	NA	NA

Table 1 (continued)

Study	Methodology-related study parameters				Study context				
	Research design	Data Analysis	Sample size	Respondents or interviewees: position/function	Environment		Strategy		
					Region/country	Type of sector/industry		Organisational size	MFGG-related S&OP-related
Olhager and Selldin (2007b)	Survey	Statistics	128	Managers from multiple levels/different areas	Sweden	MFG/Various	Mostly medium & large/75% over €15 M in revenue	MTS, M+TO	NA
Feng et al. (2008)	MM	Optimisation	1	NA	Canada	MFG/oriented strand board	Large/NA	MTO	Tactical/12 months
Song et al. (2008)	Survey	Statistics	119	Clients & MBA students/NA	China	MFG/pharmaceutical	Different sizes	NA	NA
Nakano (2009)	Survey	Statistics	65	Managers/supply chain & logistics	Japan	MFG/Various	NA	NA	NA
Chen-Ritzo et al. (2010)	MM	Optimisation	1	NA	USA	MFG/IT	Large/NA	MTO	Tactical/NA
Feng et al. (2010)	MM	Optimisation & simulation	1	NA	Canada	MFG/oriented strand board	Large/NA	MTO	Tactical/12 months
Godsell et al. (2010)	Descriptive study	Qualitative methods	1	Managers/NA	Europe	MFG/tobacco	Large/turnover £26 B, 53,907 employees	NA	NA/1 to 2 years

Table 1 (continued)

Study	Methodology-related study parameters				Study context					
	Research design	Data Analysis	Sample size	Respondents or interviewees: position/function	Environment		Strategy			
					Region/country	Type of sector/industry		Organisational size	Category/turnover, revenue, employees	MFG-related
Ivert and Jons-son (2010)	SCS & PS	Qualitative methods	1 (SCS); 15 (PS)	Multiple levels (CEO to site schedulers)/different areas (SCS); APS users & consultants (PS)	Europe	MFG/chemical (SCS); MFG/ various (PS)	Large/1100 employees (SCS); NA (PS)	NA	NA	Tactical—strategic/18 months (SCS); NA (PS)
Yurt et al. (2010)	SCS	Qualitative methods	1	Managers/NA	NA	MFG/food & beverage	Large/turnover over €6 B	NA	NA	Tactical—strategic/NA
Oliva and Wat-son (2011)	SCS	Qualitative methods	1	VPs, directors, managers, planners, & analysts/dif-ferent areas	USA	MFG/electron-ics	NA	NA	NA	NA
Rexhausen et al. (2012)	Survey	Statistics	116	CxOs, VPs, directors, head of dept./supply chain & logistics	Europe	MFG/various	Mostly large/over 80% over €100 M in revenue	NA	NA	NA
Wang et al. (2012)	MM & SCS	Optimisation & simulation	1	NA	Taiwan	MFG/electron-ics	NA	NA	NA	NA

Table 1 (continued)

Study	Methodology-related study parameters					Study context			
	Research design	Data Analysis	Sample size	Respondents or interviewees: position/function	Environment	Organisational size		Strategy	
						Region/country	Type of sector/industry		Category/turnover, revenue, employees
Adameczak et al. (2013)	Descriptive Study	Qualitative methods	10	Managers/NA	NA	MFG/Various	Small & medium/60% below 50 employees	NA	NA
Feng et al. (2013)	MM	Optimisation	1	NA	Canada	MFG/oriented strand board	Large/NA	MTO	Tactical/12 months
Davis et al. (2014)	MCS	Qualitative methods	2	Managers/new product development	Australia	MFG/food & beverage	Large/8000 employees	NA	NA
Ivert and Jons-son (2014)	MCS	Qualitative methods	2	CEO, managers, schedulers, vendors, APS team/different areas	Europe	MFG/chemical	Large/1100 employees	NA	Tactical/18 months
Lim et al. (2014)	AR & MM	Simulation	1	NA	France	MFG/automotive	Large/NA	MTO	NA
Thomé et al. (2014a)	Survey	Statistics	725	Senior managers/Operations	21 countries (Asia, Americas, Europe)	MFG/Various	Medium to large/Over 50 employees	NA	NA

Table 1 (continued)

Study	Methodology-related study parameters				Study context					
	Research design	Data Analysis	Sample size	Respondents or interviewees: position/function	Environment		Strategy			
					Region/country	Type of sector/industry		Organisational size	Category/turnover, revenue, employees	MFG-related
Thomé et al. (2014b)	Survey	Statistics	725	Senior managers/Operations	21 countries (Asia, Americas, Europe)	MFG/Various	Medium to large/Over 50 employees	NA	NA	NA
Wagner et al. (2014)	SCS, PS & Survey	Qualitative methods & statistics	1 (SCS); 88 (survey)	NA (SCS); supply chain & OM consultants/NA (PS); NA (survey)	Switzerland (SCS); Europe (survey)	MFG/pharmaceutical (SCS) & MFG/ various (survey)	Medium/NA (SCS); large/98% with revenue over €100 M (survey)	NA	NA	NA (survey)
Calia et al. (2015)	MM & SCS	Optimisation & Simulation	1	NA	NA	MFG/chemical	NA	NA	NA	Tactical/12 months
Goh and Eldridge (2015)	MCS & Survey	Qualitative methods & statistics	2 (MCS); 25 (survey)	Managers & planners (MCS); NA (survey)	Singapore (MCS); NA (survey)	MFG/fire protection & IT (MCS); NA (survey)	Large/NA (MCS); NA (survey)	MTS	MTS	NA
Ivert et al. (2015a)	MCS	Qualitative methods	8	Directors, managers, planners/ different areas	NA	MFG/food & beverage	Large/from 300 to 17,000 employees	MTS	MTS	Tactical/4 to 24 months

Table 1 (continued)

Study	Methodology-related study parameters					Study context			
	Research design	Data Analysis	Sample size	Respondents or interviewees: position/function	Environment	Organisational size		Strategy	
						Region/country	Type of sector/industry		Category/turnover, revenue, employees
Ivert et al. (2015b)	MCS	Qualitative methods	4	Directors, managers, planners/ different areas	Denmark, Finland, Norway, Sweden	NA	MFG/food & beverage	MTS, MTO	Tactical/4 to 15 months
Tanjajura et al. (2015)	Descriptive study	Qualitative methods	1	NA	Brazil	Large/NA	MFG/petro-chemical	NA	Tactical/NA
Taşkın et al. (2015)	MM & AR	Optimisation	1	NA	Turkey	Large/revenue US\$ 4.2 B	MFG/electronics	MTO	Tactical/at least 4 months
Akkermans et al. (2016)	MCS & MM	Simulation	3	NA	Europe	Medium/NA	Service/telco	NA	NA
Alvekrans et al. (2016)	SCS & Survey	Qualitative methods & statistics	1 (SCS); 30 (survey)	Managers/ different speciality departments	Sweden	Large/16,500 employees	Service/health care	NA	Tactical/12 months
Ambrose and Rutherford (2016)	Survey	Statistics	123	Mostly mid-level managers/different areas	NA	Large/revenues from US\$ \$125 M to \$80 B	MFG & service/ various	NA	NA
Hulthén et al. (2016)	MCS	Qualitative methods	5	VP, Directors, managers/different areas	NA	NA	MFG/IT, energy, telco, medical technology & cosmetics	NA	NA

Table 1 (continued)

Study	Methodology-related study parameters				Study context				
	Research design	Data Analysis	Sample size	Respondents or interviewees: position/function	Environment		Strategy		
					Region/country	Type of sector/industry		Organisational size	MFG-related
Jung and Chung (2016)	SCS	Qualitative methods	1	From executives to shop-floor workers/different areas	South Korea	MFG/electronics & various	Large/NA	NA	NA
Noroozi (2016)	MCS	Qualitative methods	2	NA/S&OP owners	Sweden	MFG/chemical & motion & control technologies	Large/1500 & 55,000 employees,	MTS	NA
Pedroso et al. (2016)	MCS	Qualitative methods	3	Director, managers, coordinator, supervisor/different areas	Brazil	MFG/mining, agricultural machinery & writing material	Large/2500, 3000 & 4500 employees	MTS	NA
Swaim et al. (2016)	Survey	Statistics	178	CEOs, managers, S&OP support/different areas	USA & Canada	MFG & Service/vice/industry	Mostly large/over 80% over US\$ 50 M in revenue	NA	NA/18 months
Wochner et al. (2016)	MM & SCS	Optimisation	1	NA	Europe	MFG/automotive	Large/NA	NA	Tactical/12 months

Table 1 (continued)

Study	Methodology-related study parameters				Study context					
	Research design	Data Analysis	Sample size	Respondents or interviewees: position/function	Environment		Strategy			
					Region/country	Type of sector/industry		Organisational size	Category/turnover, revenue, employees	MFG-related
Hulthén et al. (2017)	MCS	Qualitative methods	6	VP, Directors, managers/different areas	Sweden	MFG/Various	NA	NA	NA	NA
Kaipia et al. (2017)	MCS	Qualitative methods	2	Managers, planner/different areas	Europe	MFG/food & technical	NA	NA	NA	NA
Lim et al. (2017)	MM & AR	Simulation & optimisation	1	NA	France	MFG/automotive	Large/NA	MTO	NA	NA
Naslund and Williamson (2017)	MCS	Qualitative methods	6	NA	USA	MFG/paper	NA	NA	Operational—tactical/few months	NA
Nemati et al. (2017a)	MM & SCS	Optimisation	1	NA	Iran	MFG/dairy	Large/NA	MTS	MTS	NA
Nemati et al. (2017b)	MM & SCS	Optimisation	1	NA	Iran	MFG/plastic	Large/NA	MTS	MTS	NA
Pedroso et al. (2017)	MCS	Fuzzy	2	Managers/Sales & S&OP	Brazil & Germany	MFG/agricultural machinery & writing material	Large/NA	NA	NA	NA

Table 1 (continued)

Study	Methodology-related study parameters				Study context				
	Research design	Data Analysis	Sample size	Respondents or interviewees: position/function	Environment		Organisational size	Strategy	
					Region/country	Type of sector/industry			Category/turnover, revenue, employees
Ambrose et al. (2018)	Survey	Statistics	123	Mostly mid-level managers/different areas	NA	MFG & service/variou	Large/revenues from US\$ \$125 M to \$80 B	NA	NA
Ben Ali et al. (2018)	MM & SCS	Simulation	1	NA	Canada	MFG/lumber	NA	MTS	Tactical/NA
Danese et al. (2018)	MCS	Qualitative methods	3	CEO, directors, managers, planners/different areas	NA	MFG/food, construction, chemical	Medium & large/234, 1,200 & 1,400 employees	NA	NA/for one case 2 & 3 years
Dreyer et al. (2018)	MCS	Qualitative methods	4	Directors, managers, planners, analysts/different areas	Finland, Norway & UK	MFG/grocery retailing	Large/570, 3,000, 20,000 & 22,500 employees	NA	Tactical/up to 12 months
Garcia-Villarreal et al. (2018)	AR	Qualitative methods	1	NA	Germany	MFG/medical technology	Medium/180 employees	MTS, MTO	NA
Nemati and Alavidoost (2018)	MM & SCS	Optimisation	1	NA	Iran	MFG/dairy	NA	MTS	Tactical/NA

Table 1 (continued)

Study	Methodology-related study parameters				Study context			
	Research design	Data Analysis	Sample size	Respondents or interviewees: position/function	Environment		Strategy	
					Region/country	Type of sector/industry		Organisational size
Vereecke et al. (2018)	FG & Survey	Qualitative methods & statistics	12&30 (FG); 128 (survey)	Planners/demand (FG 1); NA/different areas (FG 2); NA (survey)	Europe	MFG & service/ various	NA (FG) NA (FG) Mostly medium & large (survey)	NA NA
Wery et al. (2018)	MM & SCS	Simulation & optimisation	1	NA	North America	MFG/lumber	NA	NA Tacti- cal/12 months

MCS Multiple case study; SCS Single case study; AR Action research; PS Panel study; FG Focus group; MM Mathematical Models; MFG Manufacturing; M Million; B Billion; NA not available

parameters (research designs, data analysis methods, and descriptive study parameters) and study context (contingencies), as explained in Sect. 3.

4.2.1 *Methodology-related study parameters*

Case studies and surveys are prominent research designs in the scientific S&OP studies, which is consistent with findings from other emerging OM topics (Chick-sand et al. 2012; Spina et al. 2016). Sixteen of the retrieved studies apply mathematical models. Just four studies adopt a purely descriptive research design or are solely based on action research.

The prevalence of case studies can be explained by the emerging nature of S&OP. Nearly 80% of the case studies (both single and multiple) are published in the last five years, which indicates that scholars are still aiming to explore and understand the S&OP phenomenon. To achieve this, the case studies, for instance, develop models (e.g., Grimson and Pyke 2007), identify success factors (e.g., Pedroso et al. 2016), or pose design propositions (Kaipia et al. 2017). Multiple case studies are the most used research design ($n=17$). They examine similar practices in different contexts with sample sizes from two (e.g., Pedroso et al. 2017) to 15 units (Grimson and Pyke 2007), which improves the potential to generalise their findings compared to single case studies (Reay et al. 2009). For the data analysis in these studies, different qualitative methods are applied, such as content analysis (e.g., Pedroso et al. 2016), field notes summarisation (Oliva and Watson 2011), process flows mapping and modelling (Goh and Eldridge 2015; Dreyer et al. 2018; Garcia-Villareal et al. 2018), coding structure and categorisation schemes (Hulthén et al. 2016 2017; Naslund and Williamson 2017), and expert panel and consensus ranking (Ivert and Jonsson 2010).

The identified quantitative studies are surveys and mathematical models. Surveys range from small sample sizes, collecting data from one single organisation (Alvekrans et al. 2016), to a large multi-site, multi-country sample of 725 manufacturing plants located in 21 countries (Thomé et al. 2014a, b). Consequently, the ability to generalise results from S&OP survey research varies. Ten surveys have large sample sizes above 100, allowing for statistical inferences and hypothesis tests (Hair et al. 2010). In these studies, data analysis is mainly conducted through statistical methods. Many papers use structural equation modelling (e.g., Hadaya and Cas-sivi 2007; Nakano 2009; Ambrose and Rutherford 2016). The objective of the studies that apply mathematical models vary from developing a decision support system for a single company (Wang et al. 2012; Taşkın et al. 2015), over problem-solving approaches for specific industry settings (Wochner et al. 2016; Ben Ali et al. 2018; Wery et al. 2018) to the development of general S&OP models (e.g., Feng et al. 2008 2010 2013). Mathematical models count with optimisation and simulation methods, with some combining both (e.g., Calfa et al. 2015; Lim et al. 2017).

Especially from 2014 onwards, most of the studies conduct multiple case studies and large sample surveys, which tend to have a higher external validity of their findings (Reay et al. 2009). Moreover, many studies combine different research designs. This tends to increase the quality of evidence of their findings as it can reduce potential risks of bias from single research method approaches and enable

“a more complete understanding of the phenomenon in question” (Muñoz-Pascual et al. 2019, p. 22). Single case studies are frequently combined with other research designs such as surveys (Wagner et al. 2014; Alvekrans et al. 2016) and mathematical modelling (e.g., Wochner et al. 2016; Wery et al. 2018; Ben Ali et al. 2018). With less frequency, multiple case studies are also combined with other research designs like surveys (Goh and Eldridge 2015) and simulations (Akkermans et al. 2016).

Despite the importance of practitioners for research in emerging topics, the adoption of action research is surprisingly low, with only four studies. Garcia-Villarreal et al. (2018) use action research for developing a technology-selection framework for S&OP, offering insights into practical challenges during its implementation. In the other three studies, the authors of this paper inferred the application of action research together with mathematical models (Lim et al. 2014 2017; Taşkın et al. 2015). Addressing the possibility to integrate practitioners with an active role into academic research, the design science approach has recently been introduced in S&OP research, offering a way to combine practical relevance with rigorous scientific approaches (Ivert et al. 2015a; Kaipia et al. 2017). Design science is combined with case studies to explore the application of advanced planning and scheduling systems for S&OP (Ivert and Jonsson 2014) and information sharing in collaborative S&OP settings (Kaipia et al. 2017). Besides these studies, practitioners are mainly included for data gathering purposes. Herein, most respondents or interviewees are managers from different business functions involved in the S&OP process, such as production, logistics, purchasing, sales, marketing, information technology, engineering, and finance. In cases where formal cross-functional S&OP teams were established, members of these teams are included as respondents (e.g., Ambrose and Rutherford 2016). Some studies also include top-level managers and executives (e.g., McCormack and Lockamy 2005; Olhager and Selldin 2007a, b; Danese et al. 2018). Only a few studies embrace interviewees positioned in all hierarchical organisational levels (e.g., Ivert and Jonsson 2010; Jung and Chung 2016).

4.2.2 Contingencies

S&OP has been studied in different contextual settings. Regarding the contingency of *environment*, S&OP applications are covered in different regions worldwide, especially in the European (spotlighting the Scandinavian countries) and American continents (especially USA, Canada, and Brazil). Studies from Asia are more seldom (e.g., Song et al. 2008; Goh and Eldridge 2015; Nemati and Alavidoost 2018). Also, the conduction of studies including different countries in the analysis is less frequent (e.g., Swaim et al. 2016; Pedroso et al. 2017). The vast majority of studies report findings from the manufacturing sector, especially in the chemical, pharmaceutical, food, beverage, and electronic industries. Only a few studies present S&OP applications in the service sector (Akkermans et al. 2016; Alvekrans et al. 2016).

Regarding the *size* of organisations, medium and especially large-sized companies in terms of revenue/turnover and number of employees are the main object of study. Different works study S&OP in multinational companies such as British American Tobacco (Godsell et al. 2010), IBM (Chen-Ritzo et al. 2010), Renault

(Lim et al. 2014, 2017); Samsung (Jung and Chung 2016), and Vestel Electronics (Taşkın et al. (2015)). Just two studies focus solely on small and medium-sized companies (Adamczak et al. 2013; Garcia-Villareal et al. 2018).

Regarding the contingency of *strategy*, most studies report S&OP applications in companies with MTS and MTO as their manufacturing strategy. Some works also observe a combination of both (e.g., Ivert et al. 2015a, b). No study reports S&OP applications in ETO settings. The S&OP-related strategy in most applications is to use S&OP for tactical planning. In some studies, S&OP is positioned in the tactical to strategic planning level (e.g., Yurt et al. 2010), while in others it is closer to the operational planning level (e.g., Naslund and Williamson 2017). S&OP is usually conducted within a medium-term planning horizon ranging from a few (e.g., Gianesi 1998; Taşkın et al. 2015; Naslund and Williamson 2017) to 12 months (e.g., Feng et al. 2008, 2010, 2013; Wochner et al. 2016; Wery et al. 2018). However, some studies report horizons that can reach from 18 months (Ivert and Jonsson 2010; 2014; Swaim et al. 2016), up to 24 months (Goldsell et al. 2010; Ivert et al. 2015a; Danese et al. 2018) and 36 months (Danese et al. 2018).

4.3 Empirical and theoretical research findings in S&OP

This section discusses the main research streams and theoretical foundations identified from the S&OP literature.

4.3.1 Main research streams of empirical studies

Despite the growth of the scientific literature on S&OP, empirical research findings remain highly fragmented. The content analysis conducted in this paper revealed three main research streams into which the empirical S&OP literature can be grouped. The allocation of the papers to these streams is not necessarily mutually exclusive, as some publications provide findings for different streams.

A first stream analyses the relation of S&OP and performance. Several empirical works investigate the impact of S&OP on the performance of the company, reporting a positive effect (Olhager and Selldin 2007a, b; Song et al. 2008; Feng et al. 2008 2010 2013; Rexhausen et al. 2012; Thomé et al. 2014a, b; Taşkın et al. 2015; Goh and Eldridge 2015; Hulthén et al. 2016; Swaim et al. 2016; Nemati et al. 2017a, b; Ambrose et al. 2018). Research in this stream is conducted from different perspectives and with different performance measures, such as finance-related (e.g., Nemati et al. 2017a, b), operations-related (e.g., Thomé et al. 2014a, b) and supply-chain-related (e.g., Rexhausen et al. 2012). Another set of studies allocated to this stream seeks to investigate the underlying causes for S&OP's potential to achieve its positive impact on performance. Herein, S&OP's ability to combine horizontal with vertical plan integration is emphasised as a distinct characteristic of S&OP (e.g., Wagner et al. 2014; Hulthén et al. 2016). The potential to achieve a balance between demand and supply through cross-functional horizontal plan integration is highlighted in several works (e.g., Oliva and Watson 2011; Goh and Eldridge 2015). Other studies investigate the vertical linkage of strategic to operational plans through

S&OP (e.g., Tanajura et al. 2015; Noroozi 2016). The resulting ability to enable plan integration within the company is found to positively impact firm performance (Thomé et al. 2014a, b; Feng et al. 2008, 2010, 2013; Noroozi 2016; Nemati et al. 2017a, b).

A second stream discusses the implementation of S&OP. Herein, scholars investigate challenges and barriers that need to be overcome, as well as enablers and success factors for S&OP implementations (e.g., Wagner et al. 2014; Pedroso et al. 2016; Swaim et al. 2016; Hulthén et al. 2017; Ambrose et al. 2018). For instance, Pedroso et al. (2016) find that when implementing S&OP, companies are facing barriers like siloed cultures, lack of stakeholder commitment, infrequent meeting attendance, or lack of participation in the S&OP process. The same study identifies that enablers to overcome these barriers are the creation of an S&OP department, a disciplined culture in the meetings, and the ability to conduct cultural changes and learn from mistakes. Studies in this stream also discuss necessary building blocks of S&OP designs, which are particularly presented in Thomé et al. (2012a) and synthesised into meetings and collaboration, organisation, information technology, and S&OP metrics. Also, the development of S&OP maturity models, as well as their application, play a key role in this stream (Grimson and Pyke 2007; Yurt et al. 2010; Wagner et al. 2014; Goh and Eldridge 2015; Pedroso et al. 2017; Hulthén et al. 2017; Danese et al. 2018; Vereecke et al. 2018). Examples for frequently discussed issues in the implementation stream are “soft” aspects and the role of people in S&OP (e.g., McCormack and Lockamy 2005; Ambrose and Rutherford 2016; Ambrose et al. 2018), top-management engagement (e.g., Pedroso et al. 2016; Swaim et al. 2016; Ambrose and Rutherford 2016; Ambrose et al. 2018), technology selection and the role of information systems (e.g., Ivert and Jonsson 2014; Taşkın et al. 2015; Garcia-Villareal et al. 2018), the definition of appropriate metrics and measurement systems (e.g., Noroozi 2016; Hulthén et al. 2016, 2017), and inclusion of supply chain partners in S&OP (e.g., Thomé et al. 2014a; Goh and Eldridge 2015; Kaipia et al. 2017).

The third stream focusses on the contextualisation of S&OP designs. Herein, the context-dependent nature of S&OP has been discussed recently in different studies, which highlight that S&OP should be designed and adjusted according to the given company context (e.g., Ivert et al. 2015a, b; Kaipia et al. 2017; Dreyer et al. 2018). This research stream is particularly reflected by the SLR of Kristensen and Jonsson (2018), which focuses on how the context can affect the design and performance of S&OP. As reported in this study, there is no universal recipe, according to which the same S&OP design leads to equal outcomes under all circumstances. Different types of contexts can affect the S&OP design, particularly the industry, supply chain complexity, and organisational characteristics like culture, orientation, and involvement (Kristensen and Jonsson 2018). The empirical studies in this stream found that these contexts are associated with a variety of S&OP adaptations. The context can, for instance, affect the participants in the meetings (e.g., Taşkın et al. 2015; Danese et al. 2018), the S&OP planning parameters (e.g., Ivert et al. 2015a, b), and the information system requirements. While S&OP can be run with the use of simple spreadsheets (Grimson and Pyke 2007; Yurt et al. 2010; Oliva and Watson 2011; Alvekrans et al. 2016), advanced software solutions are particularly necessary for

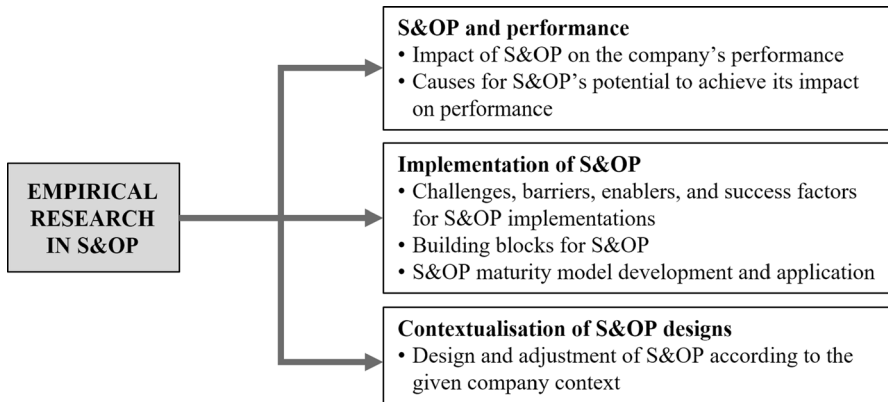


Fig. 3 Consolidation of empirical S&OP literature into three main research streams

complex planning contexts (e.g., Taşkin et al. 2015; Ivert and Jonsson 2014). Examples for concrete contextualised S&OP adaptations can be found in the works of Ivert et al. (2015a) and Yurt (2010), who emphasise that companies from the food industry should put specific attention on the purchasing and procurement within S&OP, and Dreyer et al. (2018), who suggest that grocery retailers should begin their S&OP process with a review of demand-stimulating events like promotions.

Figure 3 summarises the three research streams emerging from the empirical research in S&OP.

4.3.2 Theoretical foundations

The investigation of the theoretical foundations in S&OP revealed that twelve studies apply theory, which represents a rate of 19.7% of the scientific empirical S&OP studies. This percentage is lower than in the majority of other OM topics (Defee et al. 2010; Chicksand et al. 2012). However, the percentage of GT use in the scientific empirical S&OP studies has increased in recent years. While only 9.1% of the studies published until 2013 use theories, the number raises to 25.6% when focusing on the last five years (2014–2018). This increase in theory usage in S&OP corroborates the upward trend observed in other emerging OM topics (e.g., Chicksand et al. 2012; Walker et al. 2015; Spina et al. 2016).

In total, eleven distinct GTs were identified. Most of the theories have their origin in disciplines outside of OM, such as strategy research, economics, and organisational research. Contingency theory is the most applied one in S&OP empirical research. The frequent use of this theory goes in line with other OM studies (e.g., Defee et al. 2010; Walker et al. 2015; Spina et al. 2016). From a contingency theory perspective, the S&OP process should fit the organisations' structure and context to improve firm performance (Thomé et al. 2014b). Thomé et al. (2014b) build upon this theory to evaluate product and process complexity as contingencies in S&OP. Ivert et al. (2015a) study the relationship between the S&OP design and the planning environment from a contingency theory perspective, aiming to understand

how and why companies adjust S&OP. Even though Kaipia et al. (2017, 27) did not explicitly use the term contingency theory, its adoption is inferred, as the authors analyse the effect of information sharing on collaborative S&OP from a contingency perspective and corroborate Ivert et al. (2015a) regarding the “contingent nature of the S&OP process”. More recently, Kristensen and Jonsson (2018) propose a framework ingrained in contingency theory to guide the investigation of the context’s impact onto the S&OP design and performance.

Several other theories are only adopted once in the S&OP studies. Oliva and Watson (2011) analyse cross-functional integration using decision-making and information-processing theories. Ambrose and Rutherford (2016) apply group effectiveness theory in their analysis. Ambrose et al. (2018) build on the social identity theory to analyse team members’ attitudes. The antagonist goals and motivations of functional areas as sales and operations are also analysed in Akkermans et al. (2016), who apply a system dynamics perspective. These studies have in common that they analyse cross-functional teams’ integration as a driver for S&OP success through different theoretical lenses. With another study focus, Pedroso et al. (2017) use the fuzzy set theory to develop a decision-making model to evaluate S&OP maturity, Tanajura et al. (2015) propose an S&OP workbench based on the theory of constraints, Swaim et al. (2016) analyse the antecedents of effective S&OP by applying stewardship and agency theories, and Rexhausen et al. (2012) evaluate the impact of S&OP on demand management and supply chain performance based on RBV.

While different external GTs are applied in S&OP research, the analysis did not reveal a theory internal to S&OP. However, S&OP theory is learning to evolve. In line with Meredith’s (1993) theory development cycle (Fig. 1), empirical studies can improve the understanding within the S&OP domain and therefore can be significant contributors to internal theory development. A wide variety of S&OP models and frameworks is offered in the literature. These frameworks and models describe, explain, or test diverse aspects of the S&OP phenomena in different settings. Some of them also build upon other ones.

According to Meredith (1993), descriptions are the starting point of the theory-building process which in the case of S&OP, can be represented through the reports from practitioners. Building upon these reports, first models are developed. Grimson and Pyke (2007) developed an S&OP maturity model, using insights and descriptions from S&OP consultants and managers (e.g., Lapide 2004; Wallace 2004). Their maturity model served as a basis for further empirical studies. It was, for instance, adapted to new industrial settings and purposes (Goh and Eldridge 2015; Danese et al. 2018). Thomé et al. (2012a) used Grimson and Pyke’s (2007) model as a foundation to generate their S&OP framework, aiming to explain the S&OP process. In turn, other studies build upon this framework to develop new ones to explain different aspects of S&OP, such as coordination (Tuomikangas and Kaipia 2014), planning environment complexity (Ivert et al. 2015a, b), and performance measurement (Hulthén et al. 2016). Later, Noroozi and Wikner (2017) based their research upon two of these frameworks (Thomé et al. 2012a; Tuomikangas and Kaipia 2014) to build an S&OP framework considering supply chain integration. This example of studies building upon findings of previous ones can be seen as an example of going through

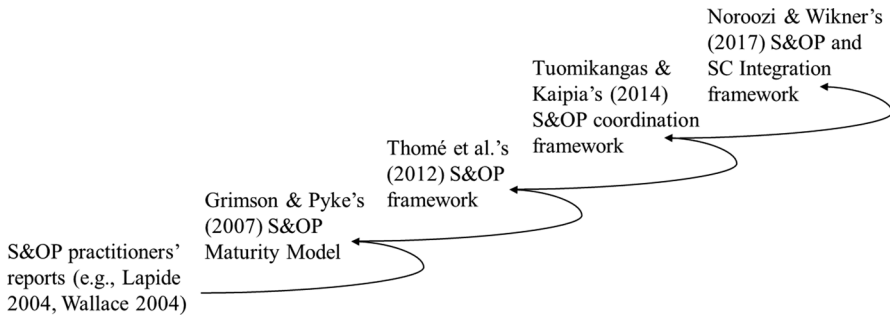


Fig. 4 Middle-range theorising in S&OP

the theory development cycle of Meredith (1993), using the strategy of MRT with frameworks and models bound to the specific domain of S&OP. Figure 4 depicts an example of this development of MRT for the S&OP.

Other examples of MRT development in S&OP can be found in mathematical models. The evolution in the sequence of Feng et al. (2008,2010,2013) mathematical models, compares a supply chain based S&OP with a sales-production S&OP and a fully decoupled planning model. Nemati et al. (2017a, b) and Nemati and Alavidooost (2018) offer a later replication of the findings in other settings, stressing the superiority of integrated planning in specific contexts.

Besides that, also examples of GT with MRT can be observed. For instance, Kristensen and Jonsson's (2018) S&OP contingency framework roots in the work of contingency theory in OM (Sousa and Voss 2008). The framework connects three variables of context, response, and performance. Examples of contextual variables, identified in the S&OP literature, are production processes (Noroozi and Wikner 2016) and complexity (Thomé et al. 2014b). Response variables are taken from Thomé et al. (2012a b) and Ivert et al. (2015b) frameworks describing S&OP structure and processes. Performance measurement variables are provided by Hulthén et al. (2016) S&OP efficiency and effectiveness framework.

5 Future directions and agenda for S&OP research

As presented in the previous section, empirical evidence in S&OP originates from both practitioners, who focus on practical relevance, and academics, who bring scientific rigour. Combining the insights from both drives empirical research, contributing to the evolution of the empirical evidence and theoretical foundations in S&OP. Based on the presented findings, this section provides an agenda and directions for future research with empirical and theoretical research implications, aiming towards the development of a common S&OP understanding. The framework displayed in Fig. 5 synthesises this view.

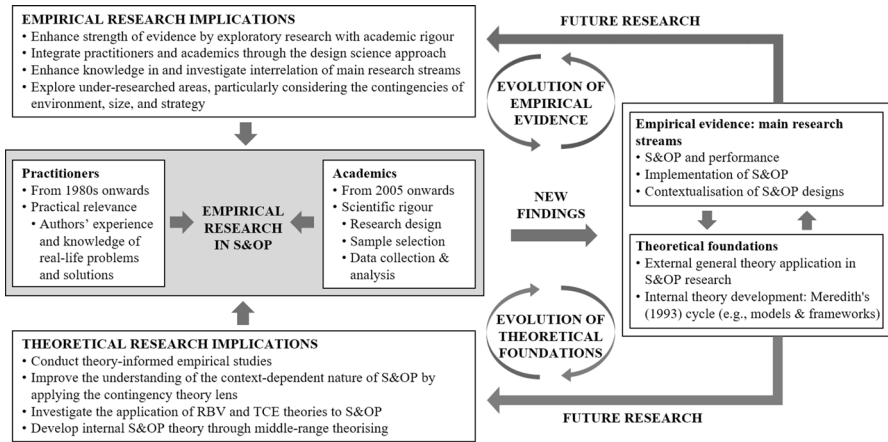


Fig. 5 Towards a common understanding of S&OP

5.1 Empirical research implications

The analysis of the empirical studies confirms that, although the S&OP literature has grown substantially, empirical evidence in S&OP is still dispersed and a common understanding is missing. These observations characterise S&OP as a topic that is still emerging (Burgess et al. 2006; Adams et al. 2017). This paper contributes to unifying the knowledge base by assessing the evolution and quality of the empirical evidence and consolidating S&OP research into three main streams, as revealed in Sect. 4.3.1. For future research, it is important to build up further knowledge in these streams and investigate their interrelation. As expected from an emerging research topic, the S&OP phenomenon is not yet explored comprehensively, under-researched areas are present, and incongruent findings are reported. This opens several directions for future research, as discussed next.

Particularly the context-dependent nature of S&OP and the necessity of design adjustments in different contingencies should be investigated further (i.e., research stream three: the contextualisation of S&OP designs). The findings focusing on S&OP contextualisation have appeared only recently in S&OP research and have direct relations with the other two research streams (implementation and performance). Future research should further explore the influence of Donaldson’s (2001) three types of contingencies onto the S&OP design, its implementation, and its impact on performance.

Regarding the *environment*, the differences between S&OP implementations in different geographical regions should be investigated. Herein, more cross-country studies are helpful, particularly embracing respondents from multiple continents. By this, intercultural perspectives could be incorporated into S&OP research. Also, the design and implementation of global S&OP processes to synchronise subsidiaries of multinational corporations remain to be examined in the future. As the present empirical studies are mainly from the manufacturing sector, it would be interesting to explore other sectors, such as recently conducted with service (e.g., Akkermans

et al. 2017). Herein, it has been found that for service companies, more loosely coupled processes with less formalisation and more flexibility could be beneficial (Akkermans et al. 2017), which contradicts findings from manufacturing environments highlighting the importance of formalised processes (e.g., Oliva and Watson 2011; Pedroso et al. 2016). This discrepancy should be investigated further to better understand the impact of the sector and industry on the S&OP process design.

Regarding *size*, more studies should contemplate S&OP implementations in smaller companies. One possible explanation for the focus on larger companies might be that small-sized companies do not have formal S&OP processes with multiple team members (Ambrose and Rutherford 2016). According to Adamczak et al. (2013), small companies do not apply S&OP due to the small scale of their operations (less complicated processes) and the centralisation of the decision-making process (the owner or general manager can be responsible for the entire process). These authors conclude that the interest in S&OP increases with firm size. Thomé et al. (2014b) present findings pointing in the same direction and indicating that S&OP gains increase with the growth of complexity. If small companies do not have enough complexity to require the need for integrative processes as S&OP and if S&OP in low complexity planning settings only obtains benefits that do not outweigh its implementation costs should be investigated in future research.

Regarding *strategy*, studies embracing ETO manufacturing strategies are needed, as up to now S&OP is mainly investigated in MTS and MTO settings. Following an ETO strategy is often associated with an increased planning complexity and requires flexibility in the production process. Particularly in these settings, cross-functional planning at a tactical level is necessary to better balance supply and demand. As S&OP is capable of achieving this, its application in ETO settings appears to be particularly suitable and should be investigated in the future. Moreover, the empirical studies show that companies mostly apply S&OP as a means for tactical planning. The integration of longer planning horizons into S&OP has been observed in some studies and associated with triggers like long production lead-times (Ivert et al. 2015a) and needs for aligning short-term with long-term company goals (Danese et al. 2018). Also, the difficulty of connecting operational-level plans with S&OP plans to cope with demand- and supply-related risks have been reported in the literature (Ivert et al. 2015b). Therefore, the integration of S&OP with operational and strategic planning processes as well as its connection to supply chain risk management should be studied in future research.

Other possible directions for future research are particularly related to the performance and implementation streams, again having intersections with the contextualisation of S&OP designs from stream three. Herein, mechanisms that have the potential to moderate or mediate the effect of S&OP on performance should be studied. For instance, it could be investigated, which contextual conditions can act as moderators and which implementation-related factors are mediators of the relationship between S&OP and performance. Also, S&OP's combination of vertical and horizontal plan integration as an antecedent for firm performance should be explored further, continuing Swaim et al. (2016) investigations in this direction. Even though a distinct characteristic of S&OP is its ability to combine both ways of plan integration, a majority of studies have investigated S&OP only from a horizontal integration

perspective, focussing on cross-functional integration between different business areas. Herein, the role of “non-traditional” stakeholders beyond the ones frequently observed (e.g., sales, marketing, production) is only investigated in a few studies and deserves future research. In particular, the role of research & development departments (e.g., Taşkın et al. 2015) and finance (e.g., Wagner et al. 2014) in S&OP are interesting aspects to be examined. Moreover, particularly the vertical integration perspective deserves future research. Herein, the role of top management in S&OP implementations requires further attention. While a strong top management participation has been identified as a key enabler in a variety of studies (e.g., Pedroso et al. 2016; Swaim et al. 2016), other studies highlight that it is important for lower-level S&OP managers to have a certain decision autonomy to enable collaborative cross-functional teamwork (Ambrose and Rutherford 2016) and the development of a superordinate team identity, which ultimately influences S&OP performance (Ambrose et al. 2018). Herein, future research should aim to identify the right balance between centralised and decentralised decision-making within S&OP.

The need to investigate these issues in future research reinforces and updates the call for more empirical studies on S&OP, especially those of an exploratory nature. On the one hand, studies with high academic rigour are required to enhance the quality of S&OP evidence. Overall, scientific empirical research in S&OP has applied increasingly rigorous approaches in recent years. To address the existing research gaps, further multiple case studies or multi-method approaches could increase the quality of evidence. On the other hand, to understand the emerging topic of S&OP and its current challenges, it is vital to embrace insights from practitioners, as they can guide scientific research by providing relevant problems, bringing first-hand knowledge, and asking the right questions (Pawson et al. 2005; Adams et al. 2017). Their knowledge should thus be used within rigorous academic research as a complementary information source and to assure the work’s relevance. Design science allows to combine academic rigour and practical relevance, providing practitioners with an active role within academic research. Combining traditional research designs with the design science approach, as recently introduced in S&OP research, appears particularly suitable to increase the scientific rigour of S&OP research and simultaneously ensure its practical relevance. Therefore, this is recommended to be pursued in future S&OP research.

5.2 Theoretical research implications

As revealed in this study, there is still a need for more consistent and integrative S&OP constructs and unifying theories, a familiar observation in emerging topics (Burgess et al. 2006; Adams et al. 2017). The increase in theory usage observed in S&OP research indicates the recent maturation of the topic. This trend should be reinforced by additional theory-informed empirical research to enhance the understanding of the S&OP phenomenon. Therefore, it is advisable to follow a two-pronged agenda that, on the one hand, borrows established theories from other fields and, on the other hand, develops internal theories that draw on observations from practice and are focused on the specific domain of S&OP.

The observed prominent use of contingency theory corresponds to the emerging nature of S&OP. The theory can assist in explaining contradictory findings from empirical research and in unifying domain-specific findings (Sousa and Voss 2008; Stank et al. 2017). Furthermore, this theory is suitable due to the S&OP design's context-dependency. Contingency theory can assist in identifying factors that influence the design (Sageder and Feldbauer-Durstmüller 2019). As it can help to understand the contextual nature of S&OP, it is particularly supportive for research in the third stream (contextualisation of S&OP designs). Consequently, the application of contingency theory in future S&OP empirical studies should be pursued.

Besides that, further GTs should be applied to understand the dynamics within S&OP, as successfully conducted in other OM topics. The finding that the TCE and RBV theories do not play a remarkable role in S&OP research is surprising, as these GTs are among the most applied theories in other OM topics and were successfully adopted to explain phenomena within them (e.g., Defee et al. 2010; Spina et al. 2016). Although the application of TCE could not be observed in any S&OP study and RBV is just observed once, both theories can be potentially promising theoretical lenses for future S&OP research. TCE could, for instance, be applied to understand S&OP transactions from a supply chain perspective, focusing on lowering the transaction costs or minimising the potential for opportunism in balancing demand and supply (Chicksand et al. 2012). RBV could be used to explore how S&OP, or one of its activities, could be seen as a valuable, rare, inimitable, and non-substitutable resource that can contribute to obtaining competitive advantage and superior performance (Kristensen and Jonsson 2018).

Besides applying more GTs to support S&OP research, future studies should continue to evolve towards developing internal theories for S&OP. This paper indicates first signs of internal theory development in S&OP embracing Meredith's (1993) view. These initial observations (presented in Sect. 4.3.2) allied with the emerging nature of S&OP indicate that the use of middle-range theorising appears suitable to enhance the S&OP understanding. MRT can produce actionable theoretical knowledge based on context-mechanism-outcome configurations (Stank et al. 2017). Thereby, MRT can facilitate the detection of mechanisms through which S&OP reaches plan integration and effects performance. By addressing the questions of "why?", "how?" and "when?" (Pawson et al. 2005; Stank et al. 2017), middle-range theorising could increase the knowledge on successful S&OP implementations and the need for contextualised design adjustments. Having the ability to enhance the understanding in all three identified research streams, expanding this paper's initial MRT investigations appears to be a promising research strategy for future studies.

6 Conclusion

This paper analyses the evolution of the empirical evidence and theoretical foundations in S&OP. Addressing the first RQ ("*How has S&OP evolved as a research domain?*"), the paper evaluates the development and conduction of empirical S&OP studies, embracing their methodology-related parameters and contingencies as well as their empirical and theoretical research findings. The analysis reveals that the

empirical evidence has been initially obtained by practitioners, who focus on practical relevance, and subsequently acquired by academics, who have demonstrated an increasing scientific rigour in their studies recently, seeking a higher generalisability of their findings. Three main research streams, not mutually exclusive, are identified: (i) S&OP and performance, (ii) implementation of S&OP, and (iii) contextualisation of S&OP designs. The investigation of theoretical foundations reveals an upward trend in external GT usage. Although most S&OP empirical research is not explicitly based on GT, the topic is not considered a-theoretical if perceived through the lens of Meredith's (1993) theory development cycle. Constitutive elements of theory building are reflected in the empirical studies, showing a cumulative knowledge acquired through the consistent development and use of S&OP models and frameworks. As a result, findings demonstrate the emerging nature of the S&OP research domain and reveal its growing maturity.

Answering the second RQ (*"What are promising directions for future developments in S&OP research?"*), the paper proposes an agenda for future research with empirical and theoretical research implications aiming towards the development of a common S&OP understanding. Empirical research implications embrace the need for more exploratory research with academic rigour to enhance the quality of evidence in S&OP studies. Herein, the design science approach is recommended to integrate practitioners into academic research in S&OP. Future research should enhance the knowledge in the identified research streams and explore the under-researched areas, particularly by embracing the contingencies of environment, size, and strategy. Theoretical research implications embrace more theory-informed empirical research in a two-prone agenda, including the application of GTs from other fields, like contingency theory, TCE, and RBV, and the development of internal theories focused on S&OP through middle-range theorising.

Academics and practitioners can benefit from the research findings presented in this paper to advance their understanding of the S&OP phenomenon. The awareness of the generalisability of study findings in the three research streams and the knowledge of the theory foundations in S&OP, combined with the empirical and theoretical research implications, can support the development of solutions to improve the S&OP effectiveness and evidence-based decisions in real-life settings. Especially, the proposed application of the design science approach can bring practitioners and academics closer together, which can be beneficial for both sides and is particularly needed in an emerging topic.

The findings of this paper should be analysed considering the research limitations. The SLR retrieved studies by applying specific keywords to limited databases and using several exclusion criteria. This restricts the sample for analysis and is a typical limitation for the SLR methodology. As the focus is on empirical studies, the paper does not embrace conceptual papers and their findings. Moreover, the paper explores an emerging topic with a growing but limited knowledge base, which confines the research findings. As S&OP has intersections with other topics that are already more mature, such as demand management and cross-functional integration, including S&OP-related findings from these topics could have enriched the analysis and research findings. Overcoming these limitations offer additional avenues for future research beyond the ones proposed in the research agenda section.

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