S&OP as Driver for Sustainability

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Abstract Both Sales and Operations Planning (S&OP) and sustainability are enjoying growing interest in the area of Operations Management. However, the association between them still lacks in academic research and industrial applications. This paper aims to develop a first analysis of the potential relationship between S&OP and sustainability and develops a comprehension of the possibility of managing sustainability through the lens of S&OP. The researchers conducted a systematic literature review to integrate the different and fragmented contents available in the literature associated with S&OP, especially to its tactical planning perspective, and sustainability. The absence of in-depth discussions on the feasibility of using tactical planning as a driver to improve sustainability can be understood as evidence that, in general, the academic literature already accepts this idea. The current discussion seems to be in the "How to do" level, which confirms the great opportunity to adapt S&OP to better achieve goals related to sustainability. Integrating S&OP and sustainability is crucial due to the essential role of S&OP as a tactical planning approach, in linking strategic and operational activities as well as its integrative nature among different functional areas within the firm and its supply chain. To reinforce the feasibility of managing these two subjects, three propositions are also presented within this research. Finally, the development of a framework for sustainable S&OP is suggested for future works.

Keywords Tactical planning · Supply chain · Triple bottom line

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A. M. Tavares Thomé et al. (eds.), *Industrial Engineering and Operations Management*, Springer Proceedings in Mathematics & Statistics 367,
https://doi.org/10.1007/978-3-030-78570-3_10

1 Introduction

Sales and Operations Planning (S&OP) is a topic of growing importance in the area of Operations Management (OM) that has been receiving considerable attention from academics and industry professionals [1, 2]. This is reflected in the increase of publications on the subject in the academic literature and the increase of implementations in industry [3–5]. S&OP is situated at the tactical level and seeks to balance demand and supply by integrating various business plans into one final set of plans [6]. In this sense, this practice seeks a vertical integration on the one hand, serving as a bridge between its strategic and operational levels. On the other hand, it strives for a horizontal integration, seeking a single and integrated plan aligned between the various functional areas of the company (e.g., sales, marketing, production, product development) within the company and throughout its supply chain [6–9]. The theme of S&OP is interdisciplinary but is predominantly associated with the traditional OM literature [6, 10].

Sustainability has emerged as another interdisciplinary concept of increasing interest in OM [11, 12]. It is associated with the vision of the "triple bottom line" (TBL), i.e., integrating economic, environmental, and social issues [13]. In the context of OM, sustainability can be related to generating competitive advantage through the operations of the various productive organisations [14, 15]. The sustainability approaches applied in OM require the expansion of its limits, the creation, and integration of new performance objectives, in addition to the adoption of new criteria to assist in decision-making [16].

According to Wallace and Stahl [17], integrating sustainability in S&OP is crucial due to the essential role of S&OP in linking strategic and operational activities as well as its integrative nature. Nevertheless, efforts to include sustainability in S&OP are still rare [18]. Broadly, S&OP has only been studied from the economic perspective, emphasising its impact on profit optimisation [6, 7, 19]. Despite the growing importance of both S&OP and sustainability within the OM literature, the association between them still lacks academic research and applications in the industry [18]. This scenario opens a promising future research opportunity for the area of OM, which is reinforced by the known existing association of the term "sustainability" to several OM concepts [20]. This goes from a broad concept perspective of sustainable OM [21] to more narrow ones as green supply chain management (GrSCM) [22]; sustainable supply chain management (SSCM) [23]; sustainable manufacturing practices [24], and sustainable lean production [25].

To address this research-practice gap, this paper aims to develop a first analysis of the potential relationship between S&OP and sustainability. It develops a comprehension of the possibility of managing sustainability through the lens of S&OP. Based on the premise that S&OP—similar to other OM practices—can benefit from the association to sustainability, the authors outline the following research question to guide this study: How can S&OP embrace the TBL view and be a driver for sustainability? To achieve this goal, the researchers have conducted a systematic literature review (SLR) to integrate the different and fragmented contents available in the

literature associated with S&OP, especially to its tactical planning perspective, and sustainability. Then, supported by the SLR, three research propositions are presented attesting the feasibility of using S&OP as a driver to sustainability.

2 Theoretical Background

This section first provides a background on sustainability from an OM perspective and second on S&OP from a tactical planning perspective. Finally, it offers a view from the missing link on S&OP and sustainability.

2.1 Sustainability and Operations Management

Sustainability is a multi-dimensional concept composed of three distinct dimensions: economic, environmental, and social, often referred to as the "triple bottom-line" [13]. Pojasek [26, p. 94] considers sustainability as "the capability of an organization to transparently manage its responsibilities for environmental stewardship, social wellbeing, and economic prosperity over the long-term while being held accountable to its stakeholders."

In OM, the term "sustainability" has been used in several different practices to express this complex combination of concepts [20]. In the beginning, sustainability initiatives have mainly focused on environmental issues [27]. GrSCM, for instance, has not directly incorporated the social pillar of the "triple bottom line", consisting in the action of integrating environmental concepts into Supply Chain Management, starting from the design phase to managing the product at the end of its lifecycle [22, 28]. However, there is an increase in the number of publications with a larger scope of sustainability research [29, 30], "moving from environmental concerns within the confines of the firm in the late 1990s to a more inclusive economic, social and environmental definition of sustainability, both internally to the firm and externally in the supply chain" [12, pp. 10–11]. Sustainable OM allows a company to obtain competitive returns on its capital assets, "without sacrificing the legitimate needs of internal and external stakeholders and with due regard for the impact of its operations on people and the environment" [21, p. 489]. SSCM has emerged with a broader definition when compared to GrSCM, including social aspects to embrace all three dimensions of the TBL [13], combining sustainability with efficient supply chain management, and being able to integrate the concept of GrSCM as a part of its field [23, 31, 32]. Sustainable manufacturing practices embrace the complete lifecycle of a product and encompass both internal and external organisational management, integrating economic, environmental, and social aspects into operational activities [12, 24]. Herein, one can also highlight sustainable lean production. It is another relevant topic, in which there is a consensus among different authors that its success involves more than the use of tools and methods [33]; as the efforts support the

development of a lean culture, where leaders and employees can achieve a truly continuous improvement [25] from the triple bottom-line lenses.

2.2 S&OP and Tactical Planning

Originally, the term 'sales and operations planning' has been used in the context of manufacturing resource planning (MRP II). Since then, it has been used synonymously with aggregated production planning (APP) [19]. According to the APICS definition, S&OP "brings together all the plans for the business (sales, marketing, development, manufacturing, sourcing, and financial) into one integrated set of plans" [34, p. 154]. S&OP seeks vertical and horizontal integration to balance supply and demand as well as strategic plans to operational plans [9, 10, 35]. Usually, it is conducted in a monthly cycle and has five steps as follows: (1) Data Gathering, in which data is updated; (2) Demand Planning, in which marketing and salespeople jointly generate the new consensus-based demand forecast; (3) Supply Planning, in which the operations department creates a supply plan, based on the forecast from step two; (4) Pre-Meeting, in which a cross-functional team discusses adjusts, and validates supply and demand plans; (5) Executive Meeting, in which executives meet to review all decisions from the pre-meeting, including those on which the pre-meeting team could not reach consensus, or which entail significant costs [17, 19, 36].

S&OP is a tactical planning process which planning horizon can vary between less than three to more than 18 months [2, 6]. Tactical or mid-term planning builds the bridge between strategic decisions and operational activities. As Fleischmann et al. [37, p. 72] state, it thereby focuses on "rough quantities and times for the flows and resources". Thus, it coordinates and organises the activities of operational units for a pre-defined time horizon [38]. Common activities of tactical planning include forecasting future demand as well as capacity, personnel, and material requirements planning [37].

2.3 Sustainability and S&OP: A Missing Link

The concept of sustainability has been deeply discussed in the academic community. However, it is still "far too abstract" among other stakeholders and decision-makers [39, p. 655]. Still, the OM perspective is being transformed to adjust organisations to the achievement of economic objectives not only from an environmentally but also socially responsible perspective [40]. Despite the tensions and conflicts that the inclusion of sustainability goals can bring to a given company, Magon et al. [12] attest the overall positive effects of sustainability on performance, such as lower costs, better delivery and product quality, enhanced volume and mix flexibility. To achieve a truly sustainable supply chain, it is of the utmost importance that all the stakeholders involved, find a joint vision of sustainability [41].

In the literature, S&OP is usually considered from the economic perspective, emphasising its impact on profit optimisation [6, 7, 19]. While many other areas in OM (e.g., SSCM; Sustainable and Lean Production) already address all three dimensions of the TBL in their practices, the S&OP literature does not yet recognise and embrace environmental and social aspects [18]. This research-practice gap is aimed to be addressed in this paper, aided by an SLR as described in the next section.

3 Research Methodology

The research methodology was based on the SLR approach to integrate the fragmented findings available in the literature towards developing a first and novel analysis of the potential relationship between sustainability and S&OP trough the perspective of tactical planning.

The SLR followed the methodology offered by Tranfield et al. [42], guided by the step-by-step approach of Thomé et al. [43] for conducting an SLR in OM, as done in Cotta Fonatinha et al. [44]. For the first step, the authors defined the research question, the scope of the review, the outcomes, and the research strategy, as described in the introduction section of this paper. In the second step, Scopus and Web of Science were selected as search engines and indexing systems, as both are well known as being good sources for extensive peer-reviewed literature and as being complementary [12]. Extensive discussions among the authors were carried out to select search keywords with different attempts using keywords and combinations as follows: (“Sales and Operations Planning” AND “Sustainab*”) OR (“S&OP” AND Sustainab*”) OR (“Sales and Operations Planning” AND “Green”) OR (“S&OP” AND “Green”). The search process yielded just three documents. As a new attempt, the authors considered the keywords (“tactical plan*” AND sustainab*”), due to the tactical nature of S&OP. This search resulted in 50 papers after eliminating the duplicates in both databases. The inclusion criteria for determining which studies need to be considered from the scientific literature were papers that considered tactical planning through the lens of sustainability over the TBL perspective as well as papers written in English. To improve the debate in the categorisation of studies, and facilitated the data analysis and interpretation process, the authors also classified all the abstracts according to the vision of sustainability brought in the abstracts. The content analysis approach was adopted herein [31, 45]. Three authors read all the abstracts individually to avoid a biased evaluation. In the first round, they agreed that nine papers attend to the inclusion criteria, 30 did not, and three needed a full-text analysis for a final decision. On nine papers, they did not achieve unanimity, so they held a round of discussion until a consensus was reached. After this step, four papers were added, which generated 13 papers that went to full-text analysis. After this step, one more paper was excluded, as it was out of the scope. As recommended in Thomé et al. [43] and Hollmann et al. [46], to go beyond the search keywords and database limitations, one more paper was added through a snowball search (backwards and forward search). The total number of studies retrieved was 13. The presentation of

the results and discussions, corresponding to step 7 of the SLR, are presented in Sect. 4.

4 Results and Discussion

This section presents the main results of the SLR. First, a discussion regarding the different views related to sustainability in the OM discipline is presented. Then, the studies related to tactical planning and TBL vision are briefly analysed. Finally, a discussion about the feasibility of using S&OP as a potential driver to reach goals related to sustainability is offered.

4.1 TBL Perspective as a Challenge

Of the 51 abstracts selected, the authors agree on the TBL vision in fourteen of them. Two abstracts present sustainability over the financial and social perspective, twelve over the financial perspective, and fifteen over the financial and environmental perspective. Additionally, in six articles the authors do not see any relation to sustainability. Many papers focus on logistical strategies for reducing greenhouse gas emissions (e.g., [47, 48]), which highlight a missing consensus on the terms green and sustainability [49]. For example, Sawadogo and Anciaux [50] present the TBL perspective in their abstract; however, the decision support system presented by them focuses on reducing the environmental impact for trip selection. This persistent confusion is probably one of the reasons for the view brought by Boukherroub et al. [51], which attest the existence of a lack in the literature regarding approaches considering the three dimensions of sustainability performance when planning the supply chain.

On the contrary, despite being one of the oldest studies analysed, Sheppard [52] already considers all three dimensions of sustainability. He introduces his work attesting that Sustainable forest management (SFM) involves balancing economic, environmental, and social values to meet society's objectives over the long term.

4.2 Tactical Planning as a Driver for Sustainability

Given the absence of papers specifically discussing S&OP and sustainability, the authors analysed papers that could answer the feasibility of using the implementation of tactical planning to improve sustainability. However, the majority of the studies focus on developing quantitative models to solve multi-objective and/or multi-criteria problems and do not deeply discuss tactical planning as a feasible strategy to improve sustainability goals (e.g., [49, 51, 53–55]).

Jensen et al. [53] describe how an Ecosystem Management Decision Support System could be successfully used in the development of logic models for integrated evaluations of economic, ecological, and social information to support strategic forest planning. Focusing on the tactical level, Boukherroub et al. [51] propose an integrated approach for the optimisation of the sustainable performance of a wood supply chain. The model presented has had to meet customer demand at the lowest cost while reducing greenhouse gas emissions and promoting local employment. They select twelve objectives to cover the TBL view: five objectives are related to the economic dimension, four to the environmental dimension, and three to the social dimension. However, after omitting the objective function related to social performance in the model test, they conclude that its analysis is one limitation of their work and should have more experiments. Fattahi et al. [54] take the uncertainty related to the renewable energy resources into account and present a novel cost-efficient multi-stage stochastic program in which strategic and tactical planning decisions are integrated. Besides the economic goal, the greenhouse gas emissions from transportation are mitigated, and the social impact of the supply chain is considered using a social life cycle assessment methodology. They conclude that the supply chain cost is sensitive to policies related to the supply chain sustainability and "*to separately reduce the network's environmental cost and improve its social impact by 5%, the expected of total [supply chain] cost increases about 2% and 1.8%, respectively"* [54, p. 12]. They also assume that the framework presented can help decision-makers to balance the economic goal, the environmental cost, and the social responsibility impact to the supply chain. Laguna-Salvadó et al. [49] present a multi-objective Master Planning Decision Support System for managing sustainable humanitarian supply chains. They attest that the tactical planning decision level is a lever to improve the performance of the sustainable supply chain, as it defines the gross operations that will take place according to the assessed needs. According to them, it enables the optimisation of the supply chain flows, and consequently, improves the operational performance. Their results show that "*managers can use the proposed model to prioritize the three sustainability dimensions and to fix a tolerance that would enable them to obtain an acceptable balance (trade-off) between the three sustainability performance objectives"* [49, p. 33]. This conclusion is aligned with Fattahi et al. [54] and deserves specific attention. Saravi et al. [55] propose a comprehensive Decision Support Tool (DST) integrating Artificial Neural Network (ANN), mathematical modelling, and solution approach to design and optimise the sustainable second-generation Bioethanol Supply Chain (BSC) while considering economic, environmental, and social aspects. Their results demonstrate that adapting an appropriate ethanol distribution policy could result in a 33% reduction in total costs. It is also suggested that a 10% increase in the total costs could be beneficial from environmental and social perspectives.

Bringing the risk management perspective, Mashaqbeh et al. [56] suggest a modified Failure Modes and Effect Analysis (FMEA) for understanding the non-technical risk comprehensively. Its main objectives are to improve awareness of risk management in power plants and to help top management having a better understanding of the organisation than lower-level managers who are close to day-to-day life.

Two documents play a more active role in demonstrating the feasibility of using tactical planning implementation to improve the sustainability of different supply chains. Reinforcing the need to better connect strategic goals with practical actions, Sizo et al. [57] present an analytical approach to support decision-making in the strategic environmental assessment, based on an application to the implementation of urban wetland conservation policies. Their focus is to strengthen the link between the strategic and the operational context. Using three sets of criteria to assess the different objectives of wetland conservation policy (economic well-being, environmental sustainability, and quality of life), they conclude that their approach is valuable for examining 'what if' strategic options and for guiding how to comply with high-level strategic policy targets. Loureiro et al. [58] bring the implementation of tactical plans as a strategy to improve the water-energy loss management. According to them, to ensure the sustainability of water supply systems, which has a direct impact on economic, environmental, and social issues, the problems should be addressed from a strategic to an operational point of view, including the tactical decision level. Their results show that the participating utilities which can define tactical measures are taken to a more efficient and sustainable service.

4.3 Discussion

The absence of in-depth discussions on the feasibility of using tactical planning as a driver to improve sustainability can be understood as evidence that, in general, the academic literature already accepts this idea. The current discussion seems to be in the "How to do" level with the majority of the studies focusing on developing quantitative models to solve multi-objective and/or multi-criteria problems (e.g., [49, 51, 53–55, 59]). Given that S&OP is a tactical planning process [6, 19, 34], this fact confirms Wallace and Stahl [17] who emphasize the need of integrating sustainability to S&OP. In this sense, there is a great opportunity to add the sustainability plan of the company to the S&OP methodology to better achieve goals related to sustainability. This scenario leads to the first proposition:

- As it is located at the tactical planning level, S&OP can be a key factor in improving sustainability goals because it can translate strategic plans into specific sustainability metrics, which are operationalised in practical activities.
  Even though many models reviewed in the literature have difficulties in embracing social performance (e.g., [51]), results show that they can already help decision-makers to balance the economic objective, the environmental cost, and the impact of social responsibility. It is important, however, to highlight that the order in which the three sustainability dimensions are prioritised has some impact on the performance measures [49, 54]. Consequently, each company needs to build a methodology that would enable to obtain an acceptable balance (trade-off) between the three sustainability objectives. Also, there is a need to align both short-term needs

and long-term responsibilities to achieve the principles of sustainable development [59]. This scenario opens a great opportunity to use the S&OP methodology as a driver to help decision-makers, and leads to the second proposition:

- Given its vertical integration dimension, the S&OP methodology can be used as an approach to help decision-makers better balancing the conflicting dimensions surrounding sustainability and translate the long-term vision to the short-term actions.

  The horizontal integration view offered by S&OP [6–9] is particularly important to ease the different functional areas of a given company to find its better balance regarding sustainability goals. For example, the marketing department must have a channel to explain the existence of an increasing demand related to more sustainable products and the need for the company to respond to that, even if it increases the production costs. These multiple connections and channels provided by the S&OP methodology are a great opportunity to increase the commitment of the employers and the agility of the company to respond to external pressures related to more sustainable practices and products. This leads to the third proposition:
- Given its horizontal integration dimension, the S&OP methodology can be used to standardise the sustainable goals of the company, enhancing the commitment of all functional areas and improving its agility to respond to different scenarios.

Lastly, the persistent misunderstanding relating to the vision of sustainability is indicative that authors must pay more attention to its correct use [49]. There is a clear need to standardise the speech and avoid the use of the terms "sustainability" or "sustainable" merely because it is a hotspot in the current days. It is important to highlight the TBL vision [28, 41], which attests that to be truly sustainable, the answer to a given problem needs to consider the economic, environmental, and social aspects [52, 54].

5 Conclusion

This paper offers a first analysis of the potential relationship between sustainability and S&OP. Considering tactical planning as an important tool to bring to the operational level the strategic plans of a given company, an SLR was conducted to integrate S&OP and tactical planning literature on the one hand, and sustainability literature on the other hand. Based on the findings, it can be concluded that the academic literature already accepts the idea of using tactical planning as a driver to improve sustainability. The current discussion seems to be in the "How to do" level, with the majority of the stud-ies focusing on developing quantitative models to solve multi-objective and/or multi-criteria problems. These findings confirm the great opportunity to adapt the S&OP methodology to better achieve sustainability-related goals. Integrating sustainability and S&OP is crucial due to the essential role of S&OP as a tactical plan, in linking strategic and operational activities as well as its integrative

nature among different functional areas within the firm and its supply chain. To reinforce the feasibility of managing these two subjects, three propositions describing the links between them are presented. Accordingly, including environmental and social plans into the S&OP methodology clearly offers potential benefits. This movement will help decision-makers to understand the holistic vision of sustainability without disconnecting from the need to translate a subjective concept into practical actions in the short and medium-term.

This paper addresses one major challenge of companies nowadays, i.e. facing the pressure of becoming more sustainable. Therefore, it offers interesting managerial implications. Findings indicate that S&OP could help organizations to provide a platform for discussing and integrating sustainability concerns into the business. Sustainability managers could attend S&OP meetings for aligning their specific plans and goals with the operational activities of the sales and production departments. As an example, the attendance at S&OP meetings could ensure that the production areas does not only consider the economic pilar, but also environmental and social issues. At the same time, production representatives can share their opinion and influence the process of defining sustainability goals in a way that they do not become too unrealistic. By considering all three dimensions of the triple bottom line in the S&OP meetings, executives are able to make better decisions and adjust the strategic direction so that the company becomes sustainable from an economic, environmental, and social point of view.

For future research, the development of a framework for sustainable S&OP is suggested towards guiding practitioners in the comprehension and implementation of sustainability in their operations from a tactical level perspective. Additionally, although the SLR was designed to minimise the risk of missing relevant papers, there is no guarantee that no such papers have been missed, as relevant keywords or databases may have been overlooked, that could have provided additional insights may have been excluded. A different choice of keywords and databases (e.g., specific ones for grey literature) might result in different papers retrieval.

Acknowledgements This work was supported by the following research agencies: German Academic Exchange Service – DAAD (PROBRAL Grant Number 57447177), Coordination for the Improvement of Higher Education Personnel (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brazil – CAPES) (Finance Code 001) & (Grant Number 88881.198822/2018-01), Brazilian National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq) (Grant Numbers 311757/2018-9).

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