Sales & Operations Planning Culture and Supply Chain Performance: The Mediating Effects of Five Coordination Mechanisms

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This paper investigates the role of culture as an antecedent of superior outcomes in Sales and Operations Planning (S&OP). By viewing S&OP coordination mechanisms as an S&OP team's internal means of coping collectively with challenges to be resolved in a supply chain, five S&OP coordination mechanisms were hypothesised to act as mediators between "S&OP Culture" and Supply Chain Performance in a multiple mediator model. Results from a global survey of S&OP practitioners suggest that while a strong S&OP culture leads to better overall coordination outcomes, the former's effects are primarily transmitted indirectly via the Strategic Alignment and Information Acquisition/Processing coordination mechanisms. However, S&OP Culture may simultaneously suppress Supply Chain Performance through the S&OP Procedure/Schedule mediator. Organisations implementing S&OP can therefore benefit from a culture of contextual ambidexterity by allowing S&OP teams to make their own judgments to strike a balance between alignment and adaptability during production planning.

Keywords: S&OP, culture, supply chain coordination, mediation, ambidexterity theory, cross-functional interfaces

1. Introduction

Supply chain management is a discipline that has evolved in recent decades to help firms achieve the aim of supplying goods and services to fulfil customers' needs. As the scale of production grows, complexity increases and product lifecycle shortens, the challenges for supply chains are exacerbated by the need to coordinate multiple constituents and production plans in an organisation to meet the requirements of the modern marketplace.

Sales and Operations Planning (S&OP), a form of organisational and supply chain coordination, is a set of processes that has shown promise in addressing the above challenges and is prevalent in industry (Affonso et al., 2008). Its deployment illustrates a form of internal

collaboration in which a consensus on sales forecasts, capacity and/or production plans are arrived at by a cross-functional team (Ivert and Jonsson, 2010), unlike aggregate planning which refers to mathematical programming methods to solve the production planning problem within S&OP (Olhager and Rudberg, 2002). Formal S&OP programmes can also help firms achieve a balance in supply and demand (Ivert et al., 2015; Dreyer et al., 2018). While some adopters of S&OP may initially intend it as a programme to improve intra-organisational production or logistics decisions at a local level, S&OP also often help coordinate supply chains amongst inter-connected firms. S&OP programmes thus have repercussions on suppliers and customers, which are reflected on supply chain performance measures such as lead time, back orders, inventory levels and responsiveness to changes to demand or supply.

S&OP is thus an important topic in organisational coordination and the wider context of supply chain integration (Affonso et al., 2008). It has been credited with improving various aspects of the supply chain and production process in the literature (e.g. Ivert and Jonsson, 2010; Thomé et al., 2012a; Tuomikangas and Kaipia, 2014; Goh and Eldridge, 2015; Kaipia et al., 2017). However, not all enterprises have benefited to the same extent by implementing S&OP. Some researchers attribute this to the presence of a "silo culture" (Mello, 2010; Pedroso et al., 2016; Danese et al., 2018) or a cross-functional "chasm" (Fawcett and Magnan, 2002) in those enterprises. This apparent divide can often be embedded in an organisation's structure and culture. This has prompted studies by strategy and organisation behavior researchers into the effect of organisational culture on firm performance but there are few examples in the field of operations management (McDermott and Stock, 1999; Nahm et al., 2004; Mello and Stank, 2005; Braunscheidel et al., 2010). Furthermore, there is a need for greater understanding of how cultural, strategic and implementation elements in a supply chain interrelate with each other (Barratt, 2004). In the context of S&OP, our understanding of the potentially conflicting influences of an organisation's culture on Supply Chain Performance and the pathways through

which cultural influences are exerted is relatively limited despite its relevance to the realisation of the benefits of S&OP.

S&OP Culture is just one of several S&OP coordinating mechanisms identified in earlier studies (e.g., Tuomikangas and Kaipia, 2014). S&OP Culture can be viewed as elements of an organisation's culture that coordinate an S&OP programme (Goh and Eldridge, 2019) or a subset of an organisation's overall culture. By considering the role of culture as an antecedent to effective S&OP implementations, our study aims to investigate how the other mechanisms of S&OP can mediate the relationship between a team or organisation's culture and its supply chain performance. Our research questions are thus:

- What are the pathways through which the effects of a "strong" S&OP Culture act on Supply Chain Performance?
- Why do some S&OP teams benefit from a strong culture but not others?

It is important to note that our focus in this study is not on "culture" across all contexts, but rather we are focused on cross-functional team culture as it pertains to S&OP and the supply chain.

2. Theoretical Background and Literature Review

Organisational culture is a fundamental trait or paradigm that differentiates organisations and determines how interconnected they are, both internally and externally. As such, we begin by providing some definitions and a typology of organisational culture prior to discussing the links between an organisation's culture and its performance. The role of culture in S&OP and in supply chain integration will then be explored.

2.1. Organisational culture and organisational ambidexterity

Organisational culture can be described as "a complex set of values, beliefs, assumptions, and symbols that define the way in which a firm conducts its business" (Barney, 1986, p.657). The strength of culture can then be explained in terms of the stability of group member and the intensity of shared experiences (Schein, 1984). Schein (1990, p.7) proposes six defining features of an organisational culture as "1) A pattern of basic assumptions, 2) invented, discovered, or developed by a given group, 3) as it learns to cope with its problems of external adaptation and internal integration, 4) that has worked well enough to be considered valid and, therefore 5) is to be taught to new members as the 6) correct way to perceive, think, and feel in relation to those problems". For example, when an organisation faces problems of external adaptation and survival, organisational culture helps determine how the group collectively copes internally with the situation in a problem-solving cycle, based on developing consensus on strategy, goals, means for accomplishing goals, measuring performance and correction (Schein, 1984). Furthermore, subcultures can coexist in an organisation (Schein, 1984; Saffold, 1988; Schein, 1990; Denison and Mishra, 1995), such as those related to occupations (e.g. a safety subculture for pilots and drivers) or work units (e.g. S&OP teams).

Organisational culture can also be characterised by an organisation's underlying traits and value dimensions (Denison and Mishra, 1995), which are widely shared and strongly held within the organisation (Braunscheidel et al., 2010). However, organisational cultural traits need not be mutually exclusive nor conform to idealised profiles or archetypes. Tushman and O'Reilly (1996)'s theory of organisational ambidexterity advocates the development of ambidextrous organisations that have cultures that have "simultaneously tight and loose" social controls, are adept at executing both evolutionary and revolutionary change, and are hence more likely to have superior performance. Wang and Rafiq (2014) similarly conceptualised organisational diversity and shared vision (traditionally seen to be incompatible) as

constituents of an ambidextrous organisational culture that can lead to better new product innovation outcomes.

2.2. Relationship between organisational culture and firm performance

Despite the difficulties in classifying organisational culture, numerous studies have linked the intensity of organisational culture to firm performance. Kotter and Heskett (1992) show that firms perceived to have a strong corporate culture generally have higher average levels of return on investment, net income growth and changes in share price. Similarly, Gordon and DiTomaso (1992) found that a strong culture, irrespective of content, that places a substantive value on adaptability is associated with better firm performance in the short-term. Denison and Mishra (1995) also uncovered that each of the cultural traits of involvement, consistency, adaptability, and mission have significantly positive links to multiple subjective and objective measures of organisational effectiveness.

Empirical evidence of the influence of organisational culture in the manufacturing context has been demonstrated in several cross-sectional surveys and case studies. For example, Bates et al. (1995) found that manufacturers with an effective strategy exhibit a collectivist organisational culture that is characterised by coordinated decision making, decentralised authority, and a loyal workforce. McDermott and Stock (1999) similarly found significant links between organisational culture and outcomes of advanced manufacturing technology implementation. Likewise, Nahm et al. (2004) conclude that those firms who adopt a customer-orientated culture have higher degrees of integrative beliefs and time-based manufacturing practices, and hence better performance. A study on innovation in production and operations management also shows that organisational culture has a significant influence on path dependent forces that shape the mechanisms and hence outcomes for innovation (Wagner et al., 2011).

In the supply chain, Mentzer et al. (2001) consider several aspects of organisational culture (i.e. trust, commitment, vision and top management support) as precursors to a firm's supply chain orientation. They describe supply chain orientation as the "recognition by an organisation of the systemic, strategic implications of the tactical activities involved in managing the various flows in a supply chain" (Mentzer et al., 2001, p.11). Furthermore, Eng (2006) found that organisational norms (particularly intra-organisational knowledge sharing and a participative culture) enhance cross-functional coordination and, consequently, supply chain responsiveness. Structural coordinating mechanisms may enable cross-functional coordination but the lack of management expectations and values for such coordination can reduce supply chain responsiveness (Eng, 2006).

However, Saffold (1988) highlights that the association between culture and performance is not inexorably monotonic, since a specific cultural trait or feature may not influence all organisational processes and performance in the same direction. Furthermore, resistance can develop if cultural controls increase excessively, leading to a decrease in performance. This explains why some organisations that have been initially successful in developing interlinked structures and systems may subsequently experience "cultural inertia" that eventually lead to failure (Tushman and O'Reilly, 1996).

An additional problem with attempting to link organisational culture to firm performance is that the former does not necessarily directly cause the latter and there may be other intervening factors involved. For example, Sørensen (2002) found that in relatively stable environments, firms exhibiting a strong culture have superior goal alignment, coordination and motivation levels. This leads to more reliable (i.e., less variable) performance. However, the benefits of a strong culture diminish in more volatile environments.

2.3. Linking organisational culture and supply chain integration

Schein (1984) observes that an organisation's survival depends on its ability to manage itself as a group and solve problems of internal integration (such as boundaries, intimacy and rewards/punishment), around which cultural solutions must be found. The role of organisational culture may extend beyond the individual firm by exerting influence in the firm's upstream and downstream supply chain. In its most advanced form, supply chain management can be regarded as a cultural orientation or philosophy that guides supply chain decision making and is enabled by supply chain integration (Fawcett and Magnan, 2002). Barratt (2004) presents the concept of a "collaborative culture" (defined by trust, mutuality, information exchange and openness/communication) that is a pre-requisite for effective process alignment, joint decision making and supply chain metrics. These descriptions explicitly highlight the influence of aspects of organisational culture on supply chains.

Following an analysis of studies of the marketing-operations interface and supported by interviews with companies across a range of industry sectors, Pagell (2004) proposes a model of internal supply chain integration in which organisational culture and organisational structure are important antecedents to internal supply chain integration. For example, companies with mechanised structures and cultures that are very functionally orientated tend to both discourage cross-functional communication and encourage measures reflecting the optimisation of local rather than global performance, which together lead to a lower level of internal integration and performance. Similarly, the supply chain cultural orientation framework of Mello and Stank (2005) proposes that shared values assumptions predicate shared values, which in turn govern the integrative behaviors of the firm and its partners, and ultimately drive effective supply chain management. Such shared values may take the form of an orientation towards working collectively among different functions (Eng, 2005) or a constructive organisational culture that promotes productive interpersonal relations among

people with different backgrounds (Ellinger et al., 2000). Some examples of specific notions of culture from the supply chain literature include a "culture that resolves supply chain issues holistically and proactively" in a performance-driven organisation (Lee and Amaral, 2002), a "performance culture" that impacts performance system design and implementation (Lakri et al, 2015) and a "willingness culture" to share information (Fawcett et al., 2007).

However, other studies warn that not all aspects of culture are beneficial to supply chain performance. In a survey study of 218 respondents using a competing values framework, Braunscheidel et al. (2010) investigated the effects of four dimensions of organisational culture (market, hierarchy, clan, and adhocracy) on internal and external supply chain integration. Their results indicate that a firm's adhocracy culture (characterised by adaptability and innovation) is positively associated with external integration, while a hierarchy culture (which stresses order, rules and regulations, clear lines of authority, uniformity and efficiency) is negatively linked to internal and external integration practices. These findings are also generally in agreement with those of Cao et al. (2015) who surveyed 317 manufacturers across ten countries and found that a firm profile with strong development, group and rational cultures but a weak hierarchical culture would achieve the greatest internal, customer and supplier integration.

The concept of ambidexterity was originally conceived to address the trade-off between efficiency and innovation or the simultaneous pursuit of exploration and exploitation in manufacturing/production (e.g. Kristal et al., 2010; Kortmann et al., 2014). Blome et al. (2013) extend ambidexterity to the supply chain domain and define ambidexterity generally as the concurrent quest for both relational and contractual governance objectives in buyer-supplier relationships. They found that, in accordance with complementarity theory, ambidextrous governance mechanisms complement each other. Moreover, demand uncertainty and product

complexity are important contextual variables in the moderating effects of organisational ambidexterity on cost and innovation performance.

The aspect of ambidexterity that is the most relevant to S&OP is perhaps the notion of a "supportive culture" that promotes both flexibility and control. In a study of 271 manufacturing plants, Khazanchi et al. (2007) found that plant performance increases when managers and operators have flexibility values that are congruent, and that this positive impact is greater when operator discretion is high. Hence, while controls can help with improving efficiency and execution, empowerment fosters creativity and innovation at the firms studied.

2.4. Culture as an antecedent in S&OP

In the context of S&OP, Tuomikangas and Kaipia (2014) identify several elements of an organisation's culture (which include commitment, trust, top management setting an example, collaboration and empowerment) that coordinate the S&OP process. Ivert and Jonsson (2014) also wrote of the importance of top management providing a strong mandate to the S&OP team and being continuously involved. Ambrose et al. (2018) similarly found that decision-making latitude, joint rewards, information quality and availability of resources can all help foster S&OP team social identity. Swaim et al. (2016), in a study of North American S&OP practitioners, conclude that organisational integration leads to increased standardisation in an S&OP process, which in turn increases organisational S&OP engagement and consequently S&OP effectiveness. Furthermore, Qi and Ellinger (2017) propose a framework of complementary organisational orientations that strengthen organisational culture and enable S&OP, while Danese et al. (2018)'s model on S&OP includes "planning culture" as an indicator of mature S&OP designs. Practitioners (e.g. Mello, 2010; Mello and Stahl, 2011; Van Hove, 2012) also emphasise the importance of company culture on S&OP effectiveness, whereby a successful implementation requires collaboration, trust, openness and

accountability. Kristensen and Jonsson (2018) similarly suggest that organisational culture (together with orientation and the degree of top management support) are important for S&OP outcomes and can either facilitate or hinder coordination. Hence, there appears to be a strong case for suggesting that a strong organisational culture (or at least a strong S&OP subculture) is a prerequisite or antecedent for a successful S&OP implementation.

Table 1 summarises the key attributes of an organisation's culture that many researchers and practitioners of S&OP have highlighted as being important in an S&OP context. These are also remarkably consistent with Mentzer et al. (2001)'s definition of aspects of an organisation's "culture" in a supply chain setting.

Table 1: Attributes of Culture in the S&OP Context

Attribute	Selected Supporting Literature
There is trust among employees or departments within the company	Hadaya & Cassivi (2007); Mello (2010); Oliva & Watson (2011); Thomé et al. (2012); Tuomikangas & Kaipia (2014)
Employees are empowered to contribute actively to the company's plans at various levels	Dreyer et al. (2018); Oliva & Watson (2011); Thomé et al. (2012); Tuomikangas & Kaipia (2014)
There is effective communications of business objectives and vision within the company	Dreyer et al. (2018); Godsell et al. (2010); Van Hove (2012); Tuomikangas & Kaipia (2014)
Top management is supportive of S&OP	Dreyer et al. (2018); Grimson & Pyke (2007); Ivert & Jonsson (2014); Kristensen & Jonsson (2018); Thomé et al. (2012); Van Hove (2012); Tuomikangas & Kaipia (2014)

Based on Goh and Eldridge (2019)

The literature examines in some detail the various components of "mature" S&OP implementations (e.g., Grimson and Pyke, 2007), yet does not study the mediating effects between these individual components. It would be most peculiar if variables in S&OP designs are mutually exclusive or are completely unrelated to each other. An associated observation from the S&OP literature is that the use of mediation techniques is rather uncommon. A notable study by Oliva and Watson (2011) qualitatively explored the mediating role of "process specifications" (comprising information quality, procedural quality, and alignment quality) between incentives and firm performance, and found evidence of mediation. More recently, Ambrose and Rutherford (2016) investigated the effect of collaboration as a single mediator

between several antecedents (social cohesion, centralisation, information quality, procedural quality and rewards & incentives) and S&OP effectiveness. Using 123 survey samples, they found evidence of mediation but at modest levels. Ambrose et al. (2018) further suggest that team social (or superordinate) identity not only positive impacts S&OP performance, but also fully mediates the relationship between decentralised team structures and S&OP performance, as well as that between the availability of resources/time and S&OP performance.

2.5. Coordination mechanisms of S&OP

S&OP implementations require intra-organisational coordination and several coordination mechanisms have been identified as enablers for S&OP teams to accomplish their goals. Several mechanism frameworks and maturity models have been developed by researchers such as Grimson and Pyke (2007) and Thomé et al. (2014a & 2014b). More notably, a more comprehensive framework proposed by Tuomikangas and Kaipia (2014) employs six constructs to represent S&OP coordination mechanisms, as defined in Table .

Table 2: S&OP Coordinating Mechanisms (Tuomikangas and Kaipia, 2014)

S&OP Coordination Mechanism	**Definition**
S&OP Organisation	Formal organizational S&OP Structure
S&OP Process	Formal and standardised process for conducting S&OP
S&OP Tools and Data	Processes and tools for capturing, sharing, storing and refining data needed for decision making
Performance Management	Measurement and optimisation of firm performance
Strategic Alignment	S&OP as a link between company strategy and operational planning, and reinforcing the reaching of strategic business targets
S&OP Culture and Leadership	Culture and leadership required to support and enhance S&OP

Goh and Eldridge (2019) refined and renamed these six S&OP coordination mechanisms and investigated their effects on Supply Chain Performance. Based on a global survey of S&OP practitioners, six independent variables (to represent the six coordination mechanisms) that act on one dependent variable (Supply Chain Performance) were included

within a single structural model. Supply Chain Performance was indicated by observed variables such as: fill rate; inventory levels; lead time; and a firm's ability to react to changes in demand or supply. Figure 1 shows these effects in terms of standardised coefficients. That study found that a formal templatised S&OP Procedure/Schedule (equivalent to "S&OP Process" in Tuomikangas and Kaipia (2014)) has a significant negative effect on Supply Chain Performance. This finding suggests that organisations that adopt a highly formalised S&OP Procedure/Schedule find it difficult to cope with fast-changing demand/supply conditions, which may be a specific manifestation of the more general findings of Sørensen (2002) described in Section 2.2. In particular, highly formalised S&OP procedures that have been designed to increase control and efficiency apparently do not provide S&OP teams with sufficient flexibility to adapt to dynamic conditions.

However, Goh and Eldridge (2019) found that the other five mechanisms generally have positive effects on Supply Chain Performance. Notably, the effect of S&OP Culture on Supply Chain Performance was found to be only marginally significant, with a standardised coefficient that is much lower than those for the Strategic Alignment and Information Acquisition/Processing (equivalent to "S&OP Tools and Data" in Tuomikangas and Kaipia (2014)) mechanisms. The effect of culture on performance among the sample of S&OP adopters studied is also clearly weaker than indicated in earlier studies (e.g. Eng, 2006; Grimson and Pyke, 2007; Mello, 2010; Swaim et al., 2016), which may suggest the presence of mediating effects between coordination mechanisms.

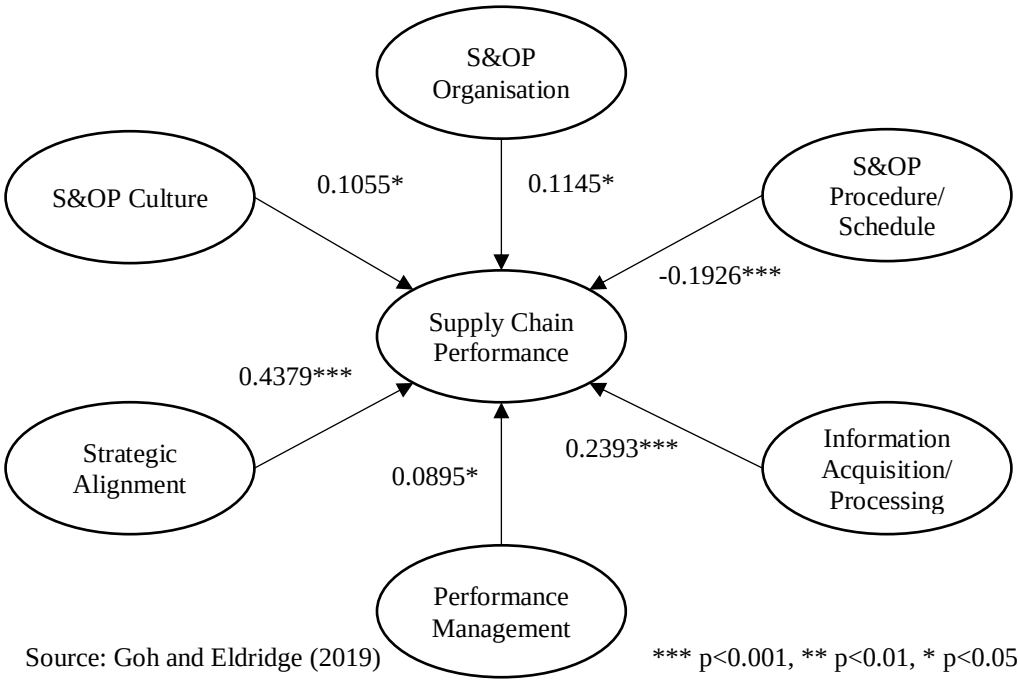

Figure 1: Structural Model on S&OP Coordinating Mechanisms

2.6. Research hypotheses

Overall, prior research strongly suggests that organisational culture can affect organisational performance. Ambidexterity theory also states that an organisation with a culture of adeptness in adjusting degrees of internal control in the appropriate context would have superior performance (Tushman and O'Reilly, 1996; Blome et al., 2013). However, even though organisational culture is linked to supply chain collaboration/integration outcomes (e.g. Barratt, 2004; Pagell, 2004; Mello and Stank, 2005; Eng, 2005), the effect of the culture on S&OP implementations and the intervening mechanisms involved has not been similarly demonstrated. Furthermore, Goh and Eldridge (2019) investigated several contingency factors that may show the circumstances that S&OP Culture may have a link to performance, but this did not reveal any satisfactory answers. The findings paint a rather tentative picture of the direct effect of S&OP Culture on Supply Chain Performance, which suggest that further analysis of the relationships between S&OP Culture and the other non-cultural mechanisms of S&OP would be valuable. Indeed, it is unclear why the four elements of S&OP Culture (top

management support, trust, communication and empowerment, as established in the literature) should have a direct effect on S&OP performance in the first place.

It is interesting that, as shown in Table 3, the non-cultural coordinating mechanisms of S&OP as defined in Tuomikangas and Kaipia (2014)'s framework correspond closely to the model of consensual coping mechanisms identified by Schein (1984) for problems in external adaption resulting from a strong organisational culture. Schein (1984)'s framework of coping mechanisms for the external adaptation and internal integration problems suggests that prior cultural experiences of members in an organisation pre-disposes them to perceive and to attempt to control the environment in a certain way. This collective culture shapes the design of tasks, division of labor, organisational structure, rewards and incentives, information systems and control systems that help an organisation to reach consensus on the core missions, goals, means to achieve goals, performance measurements and remedial actions. These thus closely parallel the set of cross functional mechanisms that S&OP teams use to coordinate themselves in addressing external supply chain problems. For example, at the organisational level, the corporate culture would determine the consensual corporate mission, while at the S&OP team level, the S&OP team culture would influence the alignment of the consensus plan in a sales and production cycle. Importantly, such a perspective also implies a temporal (and hence primarily mediative) relationship between an organisation's culture, the mechanisms it adopts to cope with an external environment to solve internal problems with integration and its performance.

Table 3: Corresponding Mechanisms for Collective External Adaption versus S&OP Coordination

Coping mechanisms for external adaption determined by a collective culture (adapted from Schein, 1984)	**Coordination mechanisms for S&OP (adapted from Tuomikangas and Kaipia, 2014; Goh and Eldridge, 2019)**
Strategy, Goals (consensus on primary task and core missions)	Strategic Alignment
Means for accomplishing goals (e.g. division of labor and organisational structure)	S&OP Organisation, S&OP Procedure/Schedule
Measuring performance (measurement criteria, information and control systems)	Performance Management, Information Acquisition/ Processing
Correction (remedial actions when the group is not achieving its goals)	S&OP Procedure/Schedule

Consequently, using Schein (1984)'s consensual coping mechanisms framework as the theoretical basis, it is possible to reframe the *non-cultural coordinating mechanisms of S&OP as an organisation's internal means of coping collectively with external challenges in the supply chain*. Furthermore, given the role of organisational culture as an antecedent in the supply chain coordination/integration literature, we re-examine the mechanisms studied in Goh and Eldridge (2019) from a mediation perspective with S&OP Culture viewed as an antecedent of successful S&OP implementations.

In the context of S&OP, authors such as Grimson and Pyke (2007), Tuomikangas and Kaipia (2014) and Pedroso et al. (2016) have suggested that moving away from a culture of "functional silos" aids companies in the development of a mature S&OP organisation. This may take the form of the active participation of functional representatives at S&OP meetings, designating the owners of the S&OP process and defining roles and responsibilities of each participant in S&OP, which may then in turn improve supply chain performance measures (Grimson and Pyke , 2007; Swaim et al., 2016). For example, we would expect that a strong S&OP Culture supports the creation of highly motivated S&OP teams that are pro-active in

responding to supply-demand imbalances before they escalate further, thereby reducing the incidences of stock-outs or excess inventories. Therefore, we hypothesise:

H1: S&OP Organisation mediates the effect of S&OP Culture on Supply Chain Performance

Similarly, the concept of a team culture may also facilitate the adoption of standardisation procedures or schedules (Swaim et al., 2016), which in S&OP may take the form of common S&OP calendars, standardised meeting formats and regular meetings/calls. These procedures or schedules may then conceivably improve performance (Grimson and Pyke, 2007; Ivert and Jonsson, 2010; Oliva and Watson, 2011). For example, a strong S&OP Culture could inculcate a system in which S&OP teams can rely on well-defined avenues to highlight impending disruptions at suppliers, thus mitigating the impact of missed delivery deadlines and long lead times to customers. Therefore, we hypothesise:

H2: S&OP Procedure/Schedule mediates the effect of S&OP Culture on Supply Chain Performance

From the perspective of S&OP teams, a strong culture that is conducive to sharing information would also lead to a greater willingness by managers to share information (Mello and Stank, 2005; Fawcett et al, 2007), especially information that is clear-specified and of a high quality, via informational sharing tools, for the mutual benefits of team members. Ease of sharing high quality information would then in turn improve the ability of the firm in improving its performance as well as that of its supply chain (Grimson and Pyke, 2007; Tuomikangas and Kaipia, 2014; Kaipia et al., 2017; Goh and Eldridge, 2019). For example, an organisation with a strong S&OP Culture would likely be more willing to invest in IT systems that facilitate collaborative forecasting and so reduce the incidences of backorders resulting from under-forecasts. Therefore, we hypothesise:

H3: Information Acquisition/Processing mediates the effect of S&OP Culture on Supply Chain Performance

Strong cultures are likewise often associated with performance-driven organisations (Lee and Amaral, 2002) and performance system designs (Lakri et al, 2015). In S&OP teams, strong cultures may be manifested through a shared motivation of tracking performance in multiple balanced dimensions from the financial, operations or process perspectives. Such an ethos towards performance would make it more conducive for performance issues and bottlenecks to be effectively addressed and followed-up upon after S&OP meetings, thereby improving performance (Grimson and Pyke, 2007; Thomé et al., 2012; Tuomikangas and Kaipia, 2014). For example, a strong S&OP Culture would instill in a firm a greater emphasis on monitoring inventory levels and taking active steps to draw down any excess inventories (such as via increased sales efforts initiated by the S&OP team). Therefore, we hypothesise:

H4: Performance Management mediates the effect of S&OP Culture on Supply Chain Performance

Shared vision associated with strong cultures (Wang and Rafiq, 2014) can also be postulated to foster stronger two-way feedback between strategic plans and S&OP plans, such as in the entering of new markets, winning of new customers or introducing new products. Achieving strategic alignment therefore helps in improving supply chain coordination outcomes (Tuomikangas and Kaipia, 2014; Goh and Eldridge, 2019). For example, an S&OP team that is built upon a strong S&OP culture would be more likely to have well-aligned goals and regular communications when formulating a cohesive plan to respond to demand or supply shocks, hence leading to better supply chain outcomes. Therefore, we hypothesise:

H5: Strategic Alignment mediates the effect of S&OP Culture on Supply Chain Performance

3. Methodology

3.1. Data sampling

The data for this study was derived from the survey conducted by Goh and Eldridge (2019) between 2016 and early 2017. A total of 3,600 supply chain professionals experienced in S&OP were individually invited to participate in a self-administered questionnaire in Qualtrics. Respondents were asked to state on a 7-point Likert scale the extent to which they agreed with a series of statements on S&OP coordination mechanisms and Supply Chain Performance at their organisations. Measurement items as developed in Goh and Eldridge (2019) and the respective descriptive statistics can be found in Appendix A.

The response rate was about 19% with 683 complete responses received. The sample set was then screened for usable responses that represent organisations that practiced formal S&OP. Of the responses that were disregarded, 64 respondents practiced only an informal form of S&OP at their organisations while the other respondents were disengaged in the course of the survey. The eventual set of 568 responses comprised a diverse set of respondents from a wide range of S&OP roles, industries and geographical locations (87 countries).

3.2. Analysis

In our study, SPSS 23 was used to check for factor loading and exploratory factor analysis (EFA), while AMOS 22 was adopted for Structural Equation Modeling and confirmatory factor analysis (CFA). The data set was tested under several criteria (e.g. model fit, discriminant

validity, convergent validity, cross validity, reliability, configural invariance, metric invariance, common method variance, endogeneity and selection/self-selection bias) and found to be satisfactory. These and other details (on survey design, constructs, factor loadings, etc) can be found in Goh and Eldridge (2019).

Mediation is the primary technique though which our data was analysed. The effect of S&OP Culture is hypothesised to act not just directly on Supply Chain Performance, but also through the former's impact on the other S&OP coordinating mechanisms (i.e. the mediators). Supply Chain Performance was controlled for size of firm, S&OP experience, order volume, SKU variety and product lifecycle, although these were each found to have insignificant effects on performance in Goh and Eldridge (2019). To investigate relative variations in the sizes of specific indirect effects through different pathways, unstandardised regression coefficients are presented in our study.

One particular challenge of asymmetric distributions (as is the case in our study) is that large sample sizes of approximately 500 are necessary to detect small effects in the path coefficients (Fritz and MacKinnon, 2007), a condition fulfilled by the initial data set in Goh and Eldridge (2019). Furthermore, in our study, resampling was conducted using 5,000 bootstrap samples and a 95% bootstrap confidence bias-corrected (to adjust for skewness in the bootstrap distribution) percentile method (MacKinnon et. al. 2004).

To report the presence and extent of mediation, Baron and Kenny (1986) propose the "full", "partial" and "no" mediation scale. This has been challenged (Zhao et al., 2010; Rucker et al., 2011) and Zhao et al. (2010) recommend an alternative scale with three mediation and two non-mediation classifications:

- Complementary mediation: Both mediated effect ($a \times b$) and direct effect (c') exist and act in the same direction (where a and b are the regression coefficients for $X \rightarrow M$ and $M \rightarrow Y$ respectively).
- Competitive mediation: Both mediated effect ($a \times b$) and direct effect (c') exist and act in opposite directions.
- Indirect-only mediation: Mediated effect ($a \times b$) is present, but not direct effect.
- Direct-only non-mediation: Direct effect (c') is present, but not indirect effect.
- No-effect non-mediation: Neither direct effect nor indirect effect exists.

In our analysis, we have adopted both classification approaches by Baron and Kenny (1986) and Zhao et al. (2010). Generally, mediation can be concluded only if mediated, direct and total effects are all present.

In the development of our research, moderation was also considered as the basis for our analysis, but this was found to be inappropriate. The most important reason for this is that the establishment of common purpose or shared values (even at a weak level) at an organisation generally precedes or influences the development of an organisation's ability to develop effective mechanisms to cope with external challenges (Schein, 1984) or innovate (Wagner et al., 2011). Path dependence thus suggests that the effect of culture on performance is mediated (rather than moderated) by coping mechanisms within a team or organisation. This is also aligned with how S&OP programmes typically evolve and mature (e.g. Grimson and Pyke, 2007; Danese et al., 2018). In contrast, there is little theoretical support from the operations management or organisational science literature that suggests culture is a contextual factor or moderator in studies on the performance of cross-functional teams or organisations.

4. Findings

Figure 2 shows our multiple mediator model with unstandardised path coefficients, as well as the significance of the mediating paths (but control variables are not shown). In this path model, each arrow between any two variables (the independent *X*, dependent *Y* or mediator *M*) represents a causal effect, whether positive or negative, that acts between them.

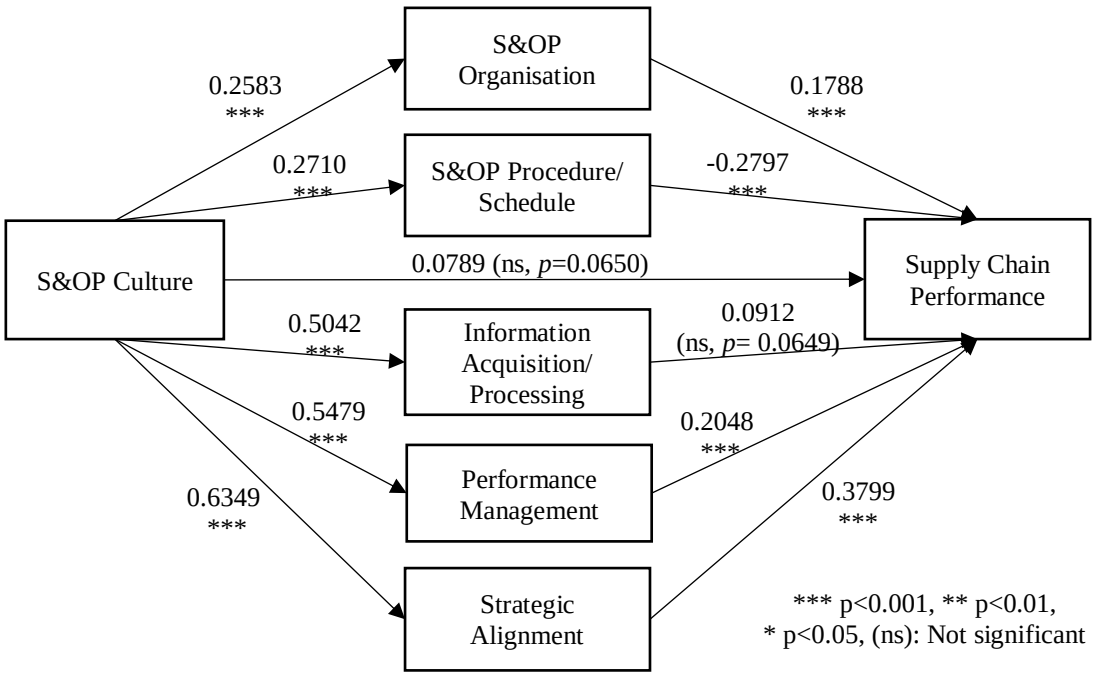

Figure 2: Results of Multiple Mediator Model for Effects of S&OP Culture on Supply Chain Performance

Table 4 shows the results of the five hypotheses tested using the model in Figure 2. It can be observed that S&OP Culture only has a marginally insignificant (p=0.0650) direct effect (c'=0.0789) on Supply Chain Performance, were it not for the mediating roles played by the S&OP Organisation, Information Acquisition/ Processing and Strategic Alignment mechanisms. In other words, without those mediators, a strong S&OP Culture would not have made a significant impact on Supply Chain Performance.

Table 4: Results of Mediation Analysis and Hypotheses Testing

Unstandardised effects and two-tail significance (bias corrected)	**Mediator**				
	S&OP Organisation	**S&OP Procedure/ Schedule**	**Information Acquisition/ Processing**	**Performance Management**	**Strategic Alignment**
Hypothesis	H1	H2	H3	H4	H5
Total effect (*c*)	0.4487 ***				
Direct effect (*c'*)	0.0789 (ns, p=0.0650)				
Indirect effect ($a_i \times b_i$)	0.0462 *	-0.0758 ***	0.1122 ***	0.0460 (ns)	0.2412 ***
Mediation type based on Baron and Kenny (1986)	Full mediation	Full mediation	Full mediation	No mediation	Full mediation
Mediation type based on Zhao et al. (2010)	Complementary mediation	Competitive mediation	Complementary mediation	Direct-only, no mediation	Complementary mediation

**** $p<0.001$, ** $p<0.01$, * $p<0.05$, (ns): Not significant*

Based on Baron and Kenny (1986)'s mediation scale, "full mediation" can be concluded for Hypotheses *H1*, *H2*, *H3* and *H5*. However, given the lack of clarity of the term "full mediation" (Zhao et al., 2010) and given that the direct effect (*c'*) exists but is only borderline insignificant at the 5% level, we also adopt Zhao et al. (2010)'s terminology in our classification for mediation type.

We find that the link between S&OP Culture and Supply Chain Performance is most strongly mediated *complementarily* by the Strategic Alignment as well as Information Acquisition/Processing coordinating mechanisms, while the mediating role of S&OP Organisation is relatively weak. Conversely, S&OP Procedure/Schedule acts as a *competitive mediator* between S&OP Culture and Supply Chain Performance (i.e. the direct and indirect effects have opposite signs). Lastly, Performance Management does not have a significant mediating role in the model, even though the former is strongly linked (a=0.5042, p<0.001) to

S&OP Culture. Overall, net indirect effects (including the negative and hence dilutive effect of S&OP Procedure/Schedule) account for more than 82% of the total effect. Figure 3, which is the graphical representation of Table 4, illustrates the relative magnitudes of these effects.

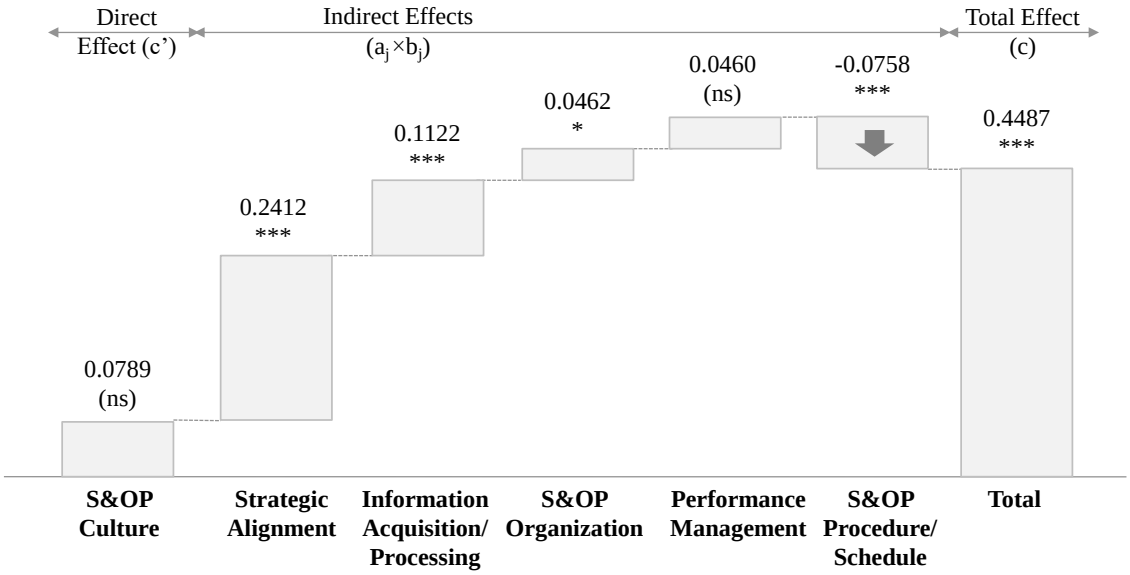

Figure 3: Magnitudes of Direct, Indirect and Total Effects of S&OP Culture

It may be observed that the significance of the total effect of S&OP Culture on Supply Chain Performance in Figure 3 is much higher than that in the unmediated model in Figure 1, but this is partly due to interactions between variables in the unmediated model, as well as partly due to implementation of bootstrapping in this study to detect small mediation effects in this paper. With bootstrapping, small but meaningful effects tend to become amplified and appear to be more significant.

5. Discussion and Conclusion

The correlation between organisational culture and firm performance is well-researched in the literature (e.g. Gordon and DiTomaso, 1992; Kotter and Heskett, 1992; Eng, 2006), as are the ingredients of "mature" S&OP practices (e.g. Grimson and Pyke, 2007; Thomé et al., 2014a &

2014b; Tuomikangas and Kaipia, 2014) in production and manufacturing. Studies on the means through which superior organisational cultures act towards better coordination outcomes in the context of S&OP are far less common, although Ambrose et al. (2018) suggest that superordinate identity is achievable in an S&OP context as well as other cross-functional team settings that share similar characteristics.

This study builds upon the above past research and extends the results in Goh and Eldridge (2019). While that paper fulfilled its intended purpose of informing on the efficacy of individual mechanisms identified by Tuomikangas and Kaipia (2014) under various contingency factors, it was unable to fully explain the weaker than expected effect of S&OP Culture on Supply Chain Performance experienced by S&OP adopters generally. It also did not consider the interaction of S&OP Culture with other mechanisms. To investigate these issues, we refine the theory of the effect of an S&OP team's culture on Supply Chain Performance, based on Schein (1984)'s model of the influence of a firm' culture on its coping mechanisms for external adaption and internal integration problems. Specifically, we investigate S&OP Culture as a precursor to S&OP coordination mechanisms by reframing the latter as an S&OP team's internal means of coping collectively with challenges to be resolved in a supply chain. We then derive a mediation model and test it on the original empirical data.

5.1. Implications

Our results reveal that S&OP Culture has a weak *direct* effect on Supply Chain Performance. While a strong S&OP Culture mechanism does ultimately lead to better coordination outcomes, the former's effects are most amplified when transmitted *indirectly* via the Strategic Alignment pathway. This transmission mechanism has been hinted at by Oliva and Watson (2011) who found that an *alignment* in plans can be more important than the quality of information and procedures.

Our results also show that the Information Acquisition/ Processing mechanism is another important conduit through which a strong S&OP Culture exerts indirect effects on Supply Chain Performance. As Mello (2010, p. 47) aptly explains, albeit in a negative reinforcement manner, "game playing by functional units degrades the accuracy of the data S&OP requires to set plans and operations for the future. A corporate culture that tolerates game playing will fail to adequately support the data accuracy critical to S&OP."

The lack of a significant mediating effect by the Performance Management mechanism between S&OP Culture and Supply Chain Performance resonates with the findings of Pagell (2004), who indicates that firms that are more concerned with measuring individual outcomes (rather than team-based outcomes) may use these measures to "place blame" rather than to find solutions. Resultantly, a seemingly "strong" S&OP Culture may foster strong Performance Management capabilities but not necessarily better Supply Chain Performance, as shown in our analysis. Yet, it is important to point out that the results in Goh and Eldridge (2019) show a significant direct effect (at the 5% level) between the Performance Management mechanism and Supply Chain Performance (Figure 1). However, our current results suggest that such a link is less predicated upon a strong S&OP Culture, though there is a clear need for further research in this area.

Although various S&OP coordination mechanisms have been identified in the literature, they tend to be viewed as standalone mechanisms that are distinct from one another (e.g. Grimson and Pyke, 2007; Tuomikangas and Kaipia, 2014). Instead, our results suggest that coordinating mechanisms should not be viewed in isolation, but rather they could be mediated by each other. S&OP Culture is a particularly complex and multifaceted coordination mechanism. It may not be easily discernible, but it nonetheless plays an important role in organisations implementing S&OP, via its indirect effects on Supply Chain Performance.

An important managerial implication of our study is that due to competitive mediation, a strong S&OP Culture could concurrently promote strong processes that hinder change and partially suppress Supply Chain Performance, particularly during periods of uncertainties when the benefits of strong cultures dissipates (Sørensen, 2002). While strong organisational culture can promote good performances and shape members' perceptions of the value of their work, those cultures can also be afflicted by arrogance, inward focus, and bureaucracy, which weaken an organisation's learning and adaptive capacities (Saffold, 1988; Kotter and Heskett, 1992). A strong culture may similarly have the effect of fostering "procedural and mandatory rather than expeditious and voluntary" exchanges within the organisation (Ellinger et al, 2000). Our finding is also in line with the negative links between the organisational culture and the degree of internal integration in some supply chains (Braunscheidel et al., 2010; Cao et al., 2015).

Therefore, from a duality perspective or alternatively through the lens of ambidexterity, a strong S&OP Culture can simultaneously exhibit both reinforcing and suppressing mediated effects on Supply Chain Performance, due to the non-monotonic effect of culture (Saffold, 1988). In manufacturing firms, an ambidextrous culture has been shown to promote a balance between flexibility and control (Khazanchi et al., 2007). In the case of S&OP teams, our results similarly suggest that a stronger S&OP Culture leads to better strategic alignment, better information sharing and more formal procedures. The former two traits then lead to better outcomes from S&OP, but the latter leads to poorer outcomes. Not only should S&OP programmes be adapted to the unique planning environment of each company (Ivert el al., 2015), firms should strike a delicate balance between having a strong culture that effectively guides internal alignment and the sharing of accurate data, and one that institutionalises agile processes that are receptive to feedback.

From a more practical perspective, a strong S&OP Culture should be cultivated delicately with "two hands". On the one hand, managers of S&OP programmes ought to

promote a strong culture as a means of control to foster the alignment of S&OP goals and priorities, as well as to raise the team's capacity to acquire and share information. On the other hand, managers must ensure that such a culture does not promote formal procedures to the point of inhibiting flexibility and fomenting rigidity.

If the cultural balance is upset, a paradoxical "*strong-culture conundrum*" may arise such that in an extreme dichotomous case, the positive effects of S&OP become completely suppressed, even though a nominally "strong" S&OP Culture is seemingly in place. This "strong-culture conundrum" would help explain why the effect of S&OP Culture on Supply Chain Performance is weaker than expected in the study by Goh and Eldridge (2019). Our finding thus supports the conclusion of Gordon and DiTomaso (1992) who suggest that firms need to find a combination of not just strong culture (in terms of consistency), but also appropriate culture (in terms of adaptability). These results also affirm the theory of organisational ambidexterity advocated by researchers such as Tushman and O'Reilly (1996), Gibson and Birkinshaw (2004), Kristal et al. (2010); Blome et al. (2013), Kortmann et al. (2014) and Wang and Rafiq (2014), in which organisations simultaneously achieve alignment and adaptability by allowing individuals to exercise their individual judgments in reconciling conflicting demands and supply chain ambiguities, for example during the production planning process.

5.2. Limitations

This current study is not without its limitations. Firstly, our focus is on S&OP Culture as an antecedent (or independent variable) in the mediation model. Other coordinating mechanisms have not been modelled as antecedents owing to a lack of theoretical grounding from the extant literature.

Secondly, *moderated-mediation*, in which mediating effects are conditional on the strength of a moderator, is beyond the scope of our study. For example, firm size and product variety had previously been found to moderate the effect of S&OP Culture on Supply Chain Performance in Goh and Eldridge (2019). While our results show that the effect of S&OP Culture on Supply Chain Performance is mediated by several other S&OP coordinating mechanisms, we could in turn further hypothesise that this mediating effect may be diluted in smaller firms or those with high product variety. However, such moderated-mediation effects have not been explored in this paper.

Thirdly, this study is concerned with coordination in the context of Sales and Operations Planning and an S&OP Culture may be just one of several connected subcultures within a wider organisation. Hence, these results cannot be generalised to other non-S&OP forms of cross-functional integration or to other dimensions of organisational culture, which may extend beyond those in the supply chain context (i.e. as defined by Mentzer et al., 2001). One potentially interesting area for future research would be how S&OP Culture interacts with the other subcultures that are often present in the rest of the organisation.

5.3. Contributions to literature

Notwithstanding these limitations, our research has contributed to the theoretical literature in several ways. This is the first study that has investigated potential mediation effects between selected coordination mechanisms of S&OP and developed a multiple mediator model via a large-scale global survey, in accordance with current best practices for the theorising of and testing for mediation effects. Our study has successfully distilled the individual mediators and quantified their strengths in translating a strong S&OP Culture to improved Supply Chain Performance. Moreover, we have uncovered evidence for an S&OP Procedure/Schedule mediating pathway through which a strong culture may inadvertently suppress Supply Chain Performance.

Our study is supportive of Schein (1984)'s model of organisational culture, such that S&OP coordinating mechanisms to address imbalances in the supply chain are but a microcosm of the coping mechanisms that evolve within organisations to adapt collectively to external factors. More generally, our research suggests that strong collective cultures should not be viewed as an unequivocal paradigm. Rather, as a firm's culture strengthens, performance trade-offs may be involved in certain settings. Indeed, the theory of organisational ambidexterity would suggest that coordinating mechanisms premeditated by a strong organisational culture are not necessarily always mutually reinforcing of superior supply chain outcomes. This study therefore contributes to the production planning and industrial management literature by extending the theory of organisational ambidexterity to the case of S&OP, which would help explain the apparently conflicting effects of organisational or team culture in a cross-functional setting. Our findings will therefore enable S&OP practitioners and leaders to better understand how their own organisations' S&OP Culture can be molded to achieve superior Supply Chain Performance.

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Appendix A: Constructs, Measurement Items and Descriptive Statistics

Construct	Measurement Item	Mean	Standard Deviation	Standard-ised Loading	Critical Ratio #
Supply Chain Performance	S&OP has brought about reduced lead time to customers at your business unit	2.18	1.12	0.75	a
	S&OP has brought about reduced stock-outs or back-orders at your business unit	2.27	1.15	0.77	14.76
	S&OP has brought about reduced inventory at your business unit	2.31	1.17	0.66	11.86
	S&OP has brought about increased responsiveness to changes in demand at your business unit	2.22	1.10	0.68	11.49
	S&OP has brought about increased responsiveness to disruptions in supply at your business unit	2.72	1.27	0.68	10.11
S&OP Organisation	There is a formal team involved in S&OP meetings	1.46	0.80	0.65	a
	There is a designated owner(s) for the S&OP process	1.42	0.80	0.77	11.86
	Each participant in S&OP meetings has clear roles and responsibilities	1.99	1.03	0.83	12.44
S&OP Procedure/ Schedule ("Procedure")	There is a defined common S&OP calendar within the company, as part of the S&OP process	1.40	0.76	0.78	a
	S&OP meetings or conference calls follow a standard process/format	1.62	0.85	0.81	14.43
	S&OP meetings or conference calls are conducted at least once a month	1.38	0.84	0.53	10.16
Information Acquisition/ Processing ("Information")	It is easy to share, retrieve or update S&OP-related data within the organisation	2.86	1.44	0.68	a
	S&OP is enabled by IT tools that are used in creating operational plans	2.90	1.53	0.55	14.16
	S&OP data collected is of a high standard	2.45	1.19	0.82	15.23
	S&OP data requirements are well-defined	2.07	1.04	0.81	15.70
Performance Management	S&OP performance metrics have multiple dimensions from the financial, operations or process perspectives	2.24	1.20	0.66	a
	Targets derived using the S&OP process is tracked against actual performance	1.90	1.02	0.71	13.93
	S&OP performance metrics balance between the interests of various parties in the organisation	2.40	1.19	0.84	14.38
	Performance issues and bottlenecks are effectively addressed and followed-up upon after S&OP meetings	2.17	1.01	0.80	15.02
Strategic Alignment	S&OP supports the entering of new markets or on-boarding of new customers	2.79	1.44	0.69	a
	S&OP supports the coordination of new product introductions	2.41	1.27	0.68	16.84
	There is two-way feedback between strategic plans and S&OP plans	2.60	1.26	0.79	14.20
S&OP Culture	There is trust among employees or departments within the company	2.63	1.27	0.84	a
	Employees are empowered to contribute actively to the company's plans at various levels	2.46	1.24	0.79	18.46
	There is effective communications of business objectives and vision within the company	2.41	1.24	0.88	21.02
	Top management is supportive of S&OP	1.84	1.17	0.78	14.51

Source: Based on Goh and Eldridge (2019); # Note: ‘‘a’’ means that the regression weight was fixed at 1.00.

Tables List

Figures List