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Drivers of supply chain adaptability: insights into mobilizing supply chain processes. A multi-country and multi-sector empirical research

Michiya Morita[1] · **Jose A. D. Machuca**[2] · **Juan A. Marin-Garcia**[3] · **Rafaela Alfalla-Luque**[2]

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Abstract
Supply chain (SC) adaptability (SC-Ad) implies that SC processes should change and adapt to anticipated structural and market changes. However, when these changes are related to shifts from exploitative to explorative focuses, companies face an inflexibility problem because of involved uncertainties, creating a barrier to obtaining SC-Ad. This research proposes to overcome this barrier by integrating new combinations of the product/market strategy and SC processes and securing their fit over time. To get it, this study proposes two SC-Ad drivers (related to the SC process (ASCOS) and new product development competences (PDC)), which secure the aforementioned fit by reducing its uncertainties and thus ensuring a SC-Ad that responds to emerging competitive changes. Measurement and structural models were assessed following PLS-SEM. ASCOS and PDC' relative importance was analyzed using the importance/performance/analysis procedure. PLS, PLS-predict, and CVPAT were used to analyze model's in-sample and out-of-sample predictive capacity. ANOVA was used to compare SC-Ad, ASCOS and PDC in different plant groups. Results suggest that ASCOS and PDC are SC-Ad's drivers, and that the plants with highest SC-Ad values are those with the higher ASCOS and PDC' values. This expand knowledge about SC-Ad drivers, which represents an important literature gap. In an indirect way, some new light is also added to the topic of ambidextrous management. The adequate generalizability of these results is supported by a) a wide multi-country, multi-informant, and multi-sector sample of 268 plants, b) a good out-of-sample model predictive capacity c) no heterogeneity issues.

Keywords Supply chain adaptability · Supply chain processes' inflexibility · Product development · Product/market strategy · Ambidextrous management · High performance manufacturing · PLS

1 Introduction

Supply chain adaptability (SC-Ad) is defined as the capability of directing and enabling supply chains (SC) to adapt its strategies, products, processes and/or technologies to structural changes in the market (Fisher 1997; Lee 2002, 2004; Ivanov et al. 2010; Arana-Solares et al. 2011; Marin-Garcia et al. 2018). The adaptability capability facilitates companies' reaction to structural changes, such as those in supply, demand and business environment (Eckstein et al. 2015; Christopher and Holweg 2017; Feizabadi et al. 2019). Accordingly, *SC-Ad consists of two competences regarding SC processes*: a) identifying the goals and necessary changes in SC processes to respond to structural changes in the markets; and b) implementing these changes (Alfalla-Luque et al. 2018).

Consequently, SC-Ad is considered crucial for SC's performance in a complex and turbulent global environment

✉ Jose A. D. Machuca
jmachuca@us.es

Michiya Morita
michiya.morita@gakushuin.ac.jp

Juan A. Marin-Garcia
jamarin@omp.upv.es

Rafaela Alfalla-Luque
alfalla@us.es

[1] Gakushuin University, Tokyo, Japan

[2] GIDEAO-DEFDO, Universidad de Sevilla, Sevilla, Spain

[3] ROGLE-DOE, Universitat Politècnica de València, Valencia, Spain

(Tuominen et al. 2004; Ivanov et al. 2010; Garrido-Vega et al. 2023), in which SC must continually adapt strategies and structures (Gibbons et al. 2003; Ivanov et al. 2010), while considering technology and market focuses (Tuominen et al. 2004; Ivanov et al. 2010; Arana-Solares et al. 2011). The importance of SC-Ad is increasing in the current context as it facilitates the reconfiguration of companies' SC design to respond to structural changes in the markets (Yang et al. 2022). Although the importance and positive effects of SC-Ad on company's performances have been acknowledged by the literature (e.g.: Lee 2004; Ivanov et al. 2010; Eckstein et al. 2015; Rojo et al. 2016; Yang et al. 2022; Iranmanesh et al. 2023; Daneshvar Kakhki et al. 2023; Marin-Garcia et al. 2023), the research about how to acquire SC-Ad is still limited (Whitten et al. 2012; Eckstein et al. 2015; Alfalla-Luque et al. 2018; Yang et al. 2022).

Regarding SC processes above mentioned, they consist of physical process network structures (from procurement to final delivery to customers) and administrative processes (for designing and managing operations such as physical processes) (Sterman 2000; Ivanov et al. 2010; Abassi and Varga 2022). One significant managerial issue as to SC processes is that companies must adapt those structures and processes to emerging new threats or opportunities timely and appropriately (Skinner 1969; Fisher 1997; Lee 2002, 2004; Ivanov et al. 2010). Although this adaptation is necessary to meet new competitive requirements such as quality, cost and delivery (Lee 2002), such changes have been sometimes considered as a serious managerial challenge because of the inflexibility of SC processes including manufacturing processes, which comes from the consideration of an enormous sunk cost and an immediate loss of efficiency under situations involving the shift (Skinner 1969; Hayes et al. 1988; De Meyer et al. 1989). This inflexibility of existing SC processes sometimes causes a companies' bias towards exploitative focuses (for current performance), and it is important to prevent companies from having such short-term focus because it could interfere the explorative activities (explorative focus for future performances) such as those related to the adaptation to the aforementioned structural market and competitive changes (Brenner and Tushman 2003).

This is important for companies that wish long time prosperity, but the inflexibility of SC processes (Skinner 1969; Hayes et al. 1988; De Meyer et al. 1989), which gives constraints on timely strategic changes could be a significant barrier for the appropriate balance between these two focuses, which is not yet operationally defined. Those factors such as the cost limitations (Boumgarden et al. 2012; Parida et al. 2016), the tensions between explorative and explorative focuses (He and Wong 2004; Van Looy et al. 2005; Hu and Chen 2016) and the dominant competitive focuses in markets like the topmost importance of innovativeness (Luger et al. 2018; Clauss et al. 2021) make the balancing complex and difficult. Successfully facilitating the steering of switchbacks between the mentioned exploitative and explorative activities (Levinthal 1997), we assume, requires the sufficient competence of mobilizing SC processes in terms of timing and scale with clear sense of future directions.

Despite the strategic importance of enhancing SC-Ad by resolving this inflexibility issue of SC processes (Skinner 1969; Hayes et al. 1988; De Meyer et al. 1989; Fisher 1997; Lee 2002, 2004; Ivanov et al. 2010), and the mentioned positive effects on performance measures (Skinner 1969; Fisher 1997; Lee 2002, 2004; Ivanov et al. 2010; Martínez Sánchez and Pérez Pérez 2005; Eckstein et al. 2015; Rojo et al. 2016; Wamba et al. 2020; Yang et al. 2022; Iranmanesh et al. 2023; Khan et al. 2023; Daneshvar Kakhki et al. 2023), how to drive SC-Ad has not still been well studied and this study seeks to fill this gap. In this sense, this paper aims to expand knowledge about SC-Ad drivers, because addressing the theoretical foundations of dynamic SC capabilities such as SC-Ad, and especially its antecedents, is still in its infancy. This is an important gap as it indicates that managers do not have guidelines to develop a SC-Ad that would make it easier for them to take advantage of new market opportunities (Aslam et al. 2020).

At this point, it is worth remembering that, in practice, *leading companies have often shown appropriate examples of mobilization of SC processes by integrating the characteristics* of *product/market strategy* and *SC processes* to create competitive advantages in specific phases of market competitions, as some cases in the automobile industry indicate. Some examples that can be cited are Ford (T-model and efficient SC process characterized by lot-size economy and assembly lines) (Tedlow 1988; Bednarek and Parkes 2021), General Motors (Class-based variety of models and SC processes under multi-divisional structures) (Chandler Jr. 1962; Sloan 1990; Tedlow 1988), and Toyota (a wide range of small fuel-efficient cars and the lean SC process) (Ohno 1988; Womack et al. 1990), all of which have been acknowledged as "winners" during specific phases of automobile market development when prestigious leaders supported these mobilizations. These cases also suggest that seeking a fit between the product/market strategy aims such as low price, variety and quality and the working properties of SC processes lead companies to successful SC-Ad with competitive advantage. Therefore, it is hoped that investigating how to develop this fit will provide us with important clues to obtain a higher SC-Ad.

Based on the above, this study seeks to propose drivers for the mobilization of SC processes to implement an effective SC-Ad through securing the competitive fit between the product/market strategy focus and the working properties of SC processes, which is a contribution to the existing literature. It is also important to consider that a successfully established effective fit may turn out to be not effective as competitive situations change, making it necessary to change to a new fit as the cases in the automobile industry previously mentioned which focused on the shift from the lot-size economy focused to (the Ford case), then to the variety focused (the General Motors case) and to the lean focused (the Toyota case) exemplified. *Consequently, the objective of this study is to find and propose appropriate drivers of SC-Ad that secure the fit between the product/market strategy focuses and the SC processes over time (embracing the mobilization of the strategic aims and SC processes).*

To solve this issue, it is important to recall again that SC processes consist of physical process network structures and administrative processes (Sterman 2000; Ivanov et al. 2010; Abassi and Varga 2022), and that to mobilize SC processes, that is, to design, construct, and operate such a network, it is necessary to have the knowledge required to understand what determines the network's performance given anticipated or planned demand patterns. Without these knowledge drivers, the barriers that generate the inflexibility of SC processes would remain and prevent companies from getting a higher SC-Ad. Regarding this matter, research by Morita et al. (2015, 2018) provides an interesting reference framework for this knowledge. Said authors introduce the concept of *absolute SC orientation strategy* (*ASCOS*) and analyzes it in conjunction with the *new product development competence (PDC)*. *PDC* is related to the SC-Ad competency of determining the goals and requirements of SC processes, and ASCOS is related to the SC-Ad competency of implementing these changes, that is, of configuring and operating the necessary SC processes. Morita et al.'s (2015, 2018) research results show that high levels of ASCOS and PDC lead to high competencies in both existing and new product strength. Therefore, they can be considered potential drivers of SC-Ad in the abovementioned sense. We assume that this approach is expected to contribute to improving company competitiveness overtime by reducing the uncertainty around the feasibility of steering the company's explorative and exploitative activities by means of *ASCOS* and *PDC*, which secure the fit between the product/market strategy and the SC processes over time, so as to get the necessary SC-Ad to adapt to anticipated changes.

The present section is followed by the theoretical background of this research and the hypotheses development. Next, we set out the analytical framework, the measurement of the factors involved, and the analysis of the results. The final section of this study offers the discussion and conclusions.

2 Theoretical background and research hypotheses

Thus far, we have showed that the *inflexibility of SC processes* makes it difficult to get *SC-Ad* and then to implement strategic changes of companies, but that this can be overcome by *securing a fit that integrates the competences of product/market strategy (strategic focus)* and *SC processes (SC competence) over time*. It was then proposed that the above issue should be addressed by *securing this fit* through appropriate *drivers of SC-Ad* in order to enable the successful response to environmental changes, and that *absolute SC orientation strategy (ASCOS)* in conjunction with the *new product development competence (PDC)* (Morita et al.'s (2015, 2018)) can be considered potential drivers of *SC-Ad* in the abovementioned sense. The present section develops the theoretical framework related to these issues and ends with the proposal of the corresponding hypotheses.

The issue of SC process inflexibility, i.e., the issue as to how to improve the flexibility of SC processes including manufacturing is an important problem for many companies seeking satisfactory long-term performance as it impedes timely adaptation to new competitive situations (Skinner 1969; Hayes and Wheelwright 1984; De Meyer et al. 1989; Brenner and Tushman 2003; Winkler 2009). The need for flexible SC processes stems from the view that companies' strategic focuses need to adapt the firms' SC processes to new competitive requirements such as quality, on-time delivery, and competitive cost (Fisher 1997; Lee 2002, 2004; Defee and Stank 2005; Selldin and Olhager. 2007; Flynn et al. 2010; Wagner et al. 2012; Prajogo et al. 2018; Sabri 2019) depending on their strategic focuses, as the concepts of generic strategies (Porter 1981) and product/market strategies exemplify (Ansoff 1957). This research assumes that due to SC process inflexibility, many companies struggling to develop a high SC-Ad capability find it difficult to change existing SC process configurations to adapt to new competitive situations.

On the other hand, *the fit between competitive requirements* (such as the above mentioned) *in companies' markets and their supply process competences to meet these competitive requirements* (even in changing environment) is considered to be one of the essential conditions that must be met to sustain high performance (Fisher 1997; Lee 2002, 2004; Defee and Stank 2005; Selldin and Olhager 2007; Flynn et al. 2010; Wagner et al. 2012; Prajogo et al. 2018; Sabri 2019). In this sense, this study assumes that *securing this fit* (under any changing competitive circumstances) *between designed new values that are desirably innovative* (e.g., new business or product introductions or new markets through expanded globalization) *and the necessary SC process competences* presupposes the competence of SC processes to be flexible to adjust to the new requirements, which is necessary for achieving a high SC-Ad.

In this line, this paper focuses on *enablers which secure the above-mentioned competitive fit over time to ensure a SC-Ad that responds to emerging competitive changes.* Regarding the mentioned issues, if the competences of *SC-Ad* previously defined in this study (i.e.: *specifying the new goals and requirements* to be met by SC processes to respond to structural changes in the markets and *to implement these changes* (Alfalla-Luque et al. 2018)) are strong, they will reduce the inflexibility of SC processes and improve SC-Ad by redefining the fit between designed values and SC processes. Therefore, SC-Ad would give directions and would show desirable changes for a new fit between the company's strategic focuses and its SC processes while focusing on strengthening this fit competency. *Therefore, this research focuses on proposing drivers that strengthen the two aforementioned SC-Ad's competencies and hypothesizes that companies should be competitive in both.*

Morita et al. (2015, 2018)' works provide a reference framework for these drivers. On the one hand, the above-described first SC-Ad competence ("specifying the goals and requirements to be met by SC processes to respond to structural changes in the markets") could be considered to be driven by the *product development competence* (*PDC*) proposed by the authors, defined as the integration of wisdom for designing and developing new products or services, which involves suppliers, customers, and functional departments such as manufacturing and marketing (Morita et al. 2018). In this sense, *PDC* is used in this paper to stand for the most representative explorative competence of new value design and development as well as improvements to existing products, and it is conceptualized as the integration of multifunctional explorative competencies. These include the following 4 dimensions, validated in the different rounds of the survey of the High Performance Manufacturing Project (HPM) (about HPM, see Schroeder and Flynn 2001) and used in (Morita et al. 2018): Customer involvement in new product development (NPD), manufacturing involvement in NPD, supplier involvement in NPD and front-end loading in NPD.

On the other hand, Morita et al (2015, 2018)' proposed the *absolute SC orientation strategy* (*ASCOS*), which is related to the second SC-Ad competence ("to implement the required changes") by the design and operation of SC structures and processes to respond to demand patterns. *ASCOS* is defined as a measure that contains strengths in four aspects: lead time, just-in-time control, quality conformance, and demand stability, which, together, are all functionally important for any SC process to deliver designed values to markets in terms of efficiency (cost and time) and effectiveness (for customers) (Morita et al. 2015, 2018). Therefore, when a company is *ASCOS*-oriented, it consistently focuses on these operating process factors and makes constant efforts to improve all four. The four mentioned components of *ASCOS* are fundamental factors that determine the potential performance of SC processes, which consist of linkages between activities in a network structure whose maneuvering competences are effectively and appropriately exploited in any set of products/markets (Morita et al. 2018). In other words, the capability to maneuver in these *ASCOS*'s four aspects is expected to be transferable and applied to the design, construction, and operation of SC processes to meet the anticipated competitive requirements of newly targeted products or markets detected thanks to an appropriate *PDC* competence. In this sense, *ASCOS* is regarded here as the capability to design and implement any necessary operational activities to meet new competitive requirements. Therefore, if sufficiently high, this capability is expected to reduce the tension associated with the proposed necessary explorative initiatives. To a certain extent, this competence has functional meanings similar to those of the operational absorptive capacity (Patel et al. 2012; Rojo et al. 2018) and organizational nurturing of organizational learning (García-Morales et al. 2008; Rojo et al. 2018) but its construct is more specifically defined as the four mentioned operational focuses that, technically, determine potentially flexible SC process competences.

Summarizing, when designing and developing product and service values, PDC's superiority is expected to correctly evaluate the existing strengths and weaknesses of current products and configure future products with a high probability of success. On the other hand, ASCOS competence diminishes SC processes' inflexibility because it facilitates to design and operate SC structures and processes to respond to demand patterns. For example, a desired reduction in time delays could be improved by ASCOS' lead time reduction focus. Securing information availability such as on-hand inventory level and reliable demand estimation is supported by ASCOS' just-in-time control, quality conformance, and demand stability focuses. Therefore, PDC and ASCOS are expected to underlie the necessary dynamic adaptation process competence. Thus, due to the above, PDC and ASCOS are hypothesized to act as drivers of SC-Ad, and Hypothesis 1 is formulated as:

Hypothesis 1: ASCOS and PDC are drivers of the SC-Ad.

As noted by Morita et al. (2018), in general, companies tend to be more aggressive towards new product development activities than to SC activities, and this generates a conflict between the long- and short-term visions. An attempt at improvement of the *PDC* type is explorative focused while the ASCOS type is considered to be exploitative-focused. Regarding this matter, it is important to stress that when a company focuses mainly on exploration it risks building tomorrow's business at the cost of today's, while focusing on exploitation it risks losing its long-term vision (Birkinshaw and Gibson 2004). It is, therefore, essential to find an appropriate balance of focuses between the two (Birkinshaw and Gibson 2004; Kristal et al. 2010; Feizabadi and Alibakhshi 2022), and easing the tension between these two focuses is a key strategic challenge (He and Wong 2004; Nieto-Rodriguez 2016). Regarding this matter, it is assumed here that, when ASCOS capability is nurtured in companies, it increases SC processes' flexibility as it lowers organizational barriers to renewing or rebuilding processes, and also contributes to carrying out an appropriate evaluation of new products or markets in terms of resource requirements and new SC process design. Two focuses, explorative and exploitative, can coexist (Adler et al. 2009; Kortmann et al. 2014; Alcaide-Muñoz and Gutiérrez-Gutiérrez 2017; Gutierrez-Gutierrez and Antony 2020). This can overcome the conflict between exploitative and explorative focuses by a balance in which *ASCOS* and *PDC* have both high values, which would lead to SC-Ad's higher values than other possible combinations of values of these variables (e.g.: high value-low value and low value-high value would be prioritizing one of the focuses, leading to the mentioned conflict between long term and short-term goals. And low value-low value will be against the obtention of an adequate SC-Ad).

Therefore, ASCOS and PDC can (and should) work together in the long-term as adaptations generally must be made due to changes in product/market, SC structures, processes, and ways of operating as a set or package (Morita et al. 2018). In this sense, as previously said, to maintain high performance over time, companies have to secure two types of fit: a) the fit of companies' strategic goals/aims to actual market and competitive situations (through PDC in this paper), and b) the fit of companies' SC processes' competencies to actual competitive requirements (through ASCOS in this research) (Venkatraman and Camillus 1984). Moreover, effective fits are required consecutively over time between their strategic goals and SC processes (Fisher 1997; Lee 2002, 2004; Ivanov et al. 2010; Arana-Solares et al. 2011; Marin-Garcia et al. 2018).

In line with the above comments, this study hypothesizes that the contribution of ASCOS and PDC to the creation of a more reliable and feasible configuration of SC-Ad is higher when both competences are present and are high in value than would otherwise be the case, and that the trade-off between these two competencies would harm the obtention of a high SC-Ad. This would avoid the conflict between the exploitative and explorative focuses, making it easier for companies to be competent in both kind of activities and, thus, be able to sustain the mentioned fits and companies' competitiveness in changing competitive situations. As mentioned before, ASCOS and PDC should work in partnership to determine a better SC-Ad, overcoming the conflict of exploitation vs exploration under certain managerial cultures that are capable of generalizing the effectiveness and logic of practices involved in the process management above mentioned (Adler et al. 2009; Kortmann et al. 2014; Alcaide-Muñoz and Gutiérrez-Gutiérrez 2017; Gutierrez-Gutierrez and Antony 2020).

Considering the above comments, we can hypothesize that:

Hypothesis 2: Plants with higher SC-Ad values are characterized by higher values of the ASCOS and PDC competences.

Higher PDC and ASCOS lead to more reliable insights into the feasibility and prospects of proposed changes. Therefore, a competitive set of high ASCOS and high PDC is expected to drive a high SC-Ad. To perform these practices well, companies should be equipped with the above-described constituent competencies of ASCOS and PDC.

Figure 1 summarizes the conceptual research framework.

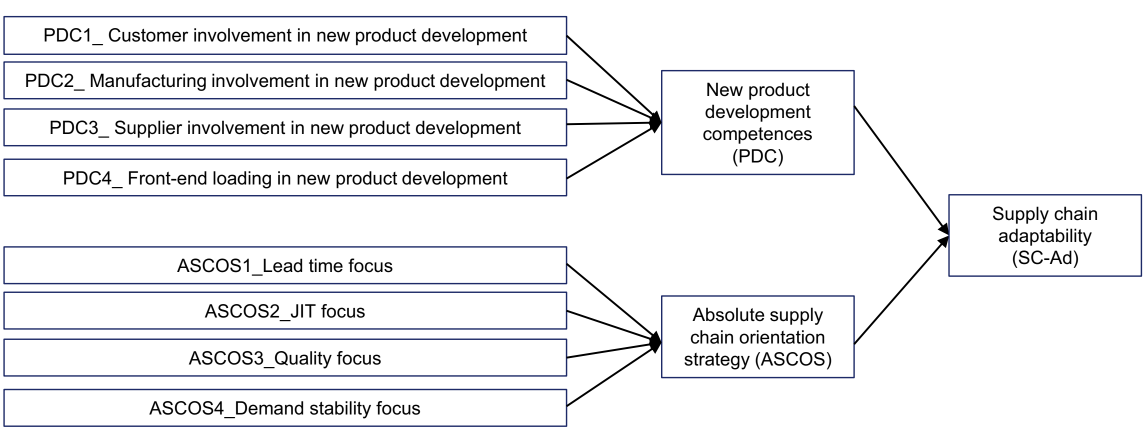

Fig. 1 Conceptual research framework

3 Methods

3.1 Sample

A wide multi-country, multi-informant, and multi-sector sample was used to provide highly reliable results. The sample was based on the database of the latest round of the international High-Performance Manufacturing (HPM) Project, which surveyed manufacturing plants (with ≥ 100 employees) in Europe, America, and Asia. Cases with missing values in over 15% of the items included in our study were deleted (Hair et al. 2022). The final sample consisted of 268 plants from 16 developed and emerging countries (Austria, Brazil, China Finland, Germany, Italy, Israel, Japan, South Korea, Spain, Sweden, Switzerland, Taiwan, UK, USA, Vietnam) in three sectors (electronics, machinery, and automotive components), chosen as they are in hotly-contested global competition and desirable managerial practice effects are expected to be identified in such industries. The 268 valid cases had missing values completely at random (MCAR) (little test, sig 0.097). At this point, all the variables with under 5% values missing per item (mean replacement option) (Hair et al. 2021, 2019) were selected in Smart PLS 4.0.8.9 (Ringle et al. 2022). To identify possible sources of heterogeneity in the sample, some control variables have been introduced into the model (country context, industry as dummy and log plant size), allowing the SC-Ad results to be adjusted for possible differences due to the sample. Furthermore, unobserved heterogeneity has been analyzed to verify whether the weights of the measurement model or the paths of the structural model have different values in the data subsamples (Becker et al. 2013; Marin-Garcia and Alfalla-Luque 2019).

3.2 Measures

Our constructs have been adapted from measures defined and validated in previous research. ASCOS and PDC were validated in Morita et al. (2018) and in Morita et al. (2015). All the lower-order composite constructs for ASCOS and PDC (see Table 1) have been measured with reflective indicators. Higher-order composite constructs (ASCOS2_JIT focus, ASCOS3_Quality focus, ASCOS, and PDC, see Table A2 in annex) have been modeled using lower-order construct latent variable scores as formative indicators. SC-Ad was validated in Marin-Garcia et al. (2018) and all the first-order and second-order constructs have been considered formative composite constructs (Table A2 in annex). ASCOS represents the competent culture of SC processes, which is consistently seeking lead time reduction, JIT implementation, demand stability, and quality conformance (Morita et al. 2018). PDC represents the competence of wisdom integration within and beyond organizations for new value development (e.g., product development) (Morita et al. 2018). SC-Ad embraces abilities for changes such as changing SC processes and structures in line with market changes, introducing new technologies (e.g., information technologies), and predicting changes such as those in markets (Marin-Garcia et al. 2018).

The control variables used in this research are in line with those used in previous research (e.g., Dubey et al. 2019; Machuca et al. 2021; Alfalla-Luque et al. 2023): a) plant size (log10), b) industry (dummy variable; reference category = electronics), and c) country context.

Several steps were taken to reduce the risk of common method bias (CMB) (Podsakoff et al. 2003; Schwarz et al. 2017). Different scale anchors were selected for use in the

Table 1 Psychometric properties for reflective scales

	Cronbach's Alpha	Rho_A	Composite Reliability (Rho_c)	Average Variance Extracted (AVE)
ASCOS1_Lead time focus	0.711	0.711	0.839	0.635
ASCOS2_JIT1_JIT delivery by suppliers	0.735	0.743	0.813	0.605
ASCOS2_JIT2_JIT link with customers	0.792	0.821	0.858	0.602
ASCOS2_JIT3_Setup time reduction	0.701	0.723	0.827	0.616
ASCOS3_Q1_Feedback To Employees on Quality	0.829	0.855	0.877	0.589
ASCOS3_Q2_Top Leadership on quality	0.875	0.878	0.907	0.619
ASCOS3_Q3_Process Control	0.805	0.808	0.911	0.836
ASCOS3_Q4_Quality Training	0.852	0.876	0.893	0.627
ASCOS4_Demand stability focus	0.626	0.621	0.801	0.574
PDC1_ Customer involvement in new product development	0.823	0.841	0.882	0.652
PDC2_ Manufacturing involvement in new product development	0.826	0.855	0.876	0.588
PDC3_ Supplier involvement in new product development	0.846	0.851	0.896	0.682
PDC4_ Front-end loading in new product development	0.847	0.854	0.884	0.523

same scale and in different parts of the questionnaire to prevent any priming effects; items were randomly listed in scales to prevent item proximity from generating any response patterns (Marin-Garcia et al. 2018); the questionnaires were responded by two people in each function who had not been informed about what the items were intended to measure (Danese et al. 2019). Informant confidentiality was prioritized during the data collection phase. In addition, Harman's Single-Factor test (Chin et al. 2013; Schwarz et al. 2017) was applied after collecting the data. The correlation matrix was analyzed using principal component with varimax rotation. The obtained results were robust and valid and indicated that several different factors were present with eigenvalues above 1, which indicated the absence of CMB issues (the presence of a single factor would have indicated CMB).

Using G-Power 3.1, a post hoc power check with 268 plants and $R2 = 0.184$ (the lowest value in our analysis, corresponding to Ad3 in the 1st-order model) gives a result of 0.99 power with Alpha 5% and 17 predictors. This power value is higher than the recommended cutoff value of 0.8 (Marin-Garcia and Alfalla-Luque 2019).

3.3 Analysis procedure

Measurement and structural models were assessed following the current guidelines for PLS-SEM (Marin-Garcia and Alfalla-Luque 2019; Becker et al. 2023; Sarstedt et al. 2022; Ringle et al. 2023). Mode A was used to calculate the weights of composites with reflective indicators (ASCOS and PDC low-order constructs (LOC)) and Mode B was used for formative indicators (SC-Ad lower order composites, and all 2nd and 3rd higher-order composites) (Hair et al. 2019; Sarstedt et al. 2019). The relative importance of the antecedents to SC-Ad was analyzed using the importance and performance analysis procedure (IPMA) (Hair et al. 2019). An analysis using PLS and PLS-predict was carried out of model in-sample and out-of-sample predictive capacity to show direct relationships of ASCOS and PDC with SC-Ad, respectively (Shmueli et al. 2016; Sharma et al. 2022). This predictive analysis enhances the retrospective character of classic explanatory models and helps to build theories for both explanation and prediction (Liengaard et al. 2021). ANOVA was used to compare ASCOS and PDC in plant groups with different SC-Ad values.

4 Results

The figures that represent 1st LOC (Fig. S1), 2nd HOC (Fig. S2) models and the full research model (Fig. S3) and some tables that complement the analyses can be accessed in the online supplementary material (https://doi.org/10.5281/zenodo.7813833). The items used in the questionnaire and their descriptive statistics are given in Table A1 in the annex.

4.1 Measurement model

The constructs in this research clearly meet the established criteria of internal reliability. Regarding *reflective LOCs* (see Table 1), the established cut-off values for *composite reliability* ($CR > 0.7$) and *average variance extracted* ($AVE > 0.5$) are met (Marin-Garcia and Alfalla-Luque 2019; Sarstedt et al. 2022). Regarding Cronbach's alpha, only one construct has a value below the cut-off value (0.626) but it is, nonetheless, very close to 0.7. It also shows high composite reliability (0.801) and AVE (0.574), which are the most relevant parameters. In addition, it belongs to a formative construct (*ASCOS*) and this dimension (1st-order construct-demand stability) is a basic part of *ASCOS*'s conceptual composition (as demonstrated in Morita et al. (2015, 2018). Therefore, it should be left in the model (Hair et al. 2019).

Fornell-Larcker and Heterotrait-Monotrait Ratio (HTMT) have been used to test the *Discriminant Validity of reflective constructs* (Marin-Garcia and Alfalla-Luque 2019; Sarstedt et al. 2022). Both criteria show global satisfactory results (see Table S1 in online supplementary material). Although "Feedback to employees on quality" and "Quality training" do not meet discriminant validity individually (0.777, higher than the diagonal value (0.767)), they should be considered sub-dimensions of a formative HOC with a VIF value lower than the established cut-off value of 3 (see Table S2 in online supplementary material). In addition, their significance means that they are an essential part of their construct and, so, should be left in the model (Hair et al. 2019). In addition, when the HOC order-2 constructs are evaluated (Table A2 in annex), the corresponding loadings and weights show that this is not a problem and does not negatively affect the proposed model.

Regarding the *formative constructs*, all *outer VIF values* (see Table S2 in online supplementary material) are lower than the established cut-off value of 3 (Marin-Garcia and Alfalla-Luque 2019; Sarstedt et al. 2022). Also, all *weights* are significant except two (see Table A2 in annex). However, both have loadings above 0.5 and represent relevant aspects of their construct, so should be retained in the model (Marin-Garcia and Alfalla-Luque 2019; Sarstedt et al. 2022).

4.2 Structural model

The results of the structural model analysis for the third-order composites are presented in Table 2 and Fig. 2. They show that the *ASCOS* and *PDC* paths on *SC-Ad* are both

Table 2 3rd-order structural model results (reference categories: developing for country context and electronics for industry)

	Value	Standard Deviation	T Statistics	P Values	5.0%	95.0%
Path ASCOS—> SC-Ad	0.589	0.057	10.363	0.000	0.489	0.678
Path PDC—> SC-Ad	0.085	0.053	1.612	0.054	0.020	0.190
Developed—> SC-Ad	0.006	0.121	0.050	0.480	-0.192	0.203
Automotive—> SC-Ad	-0.401	0.117	3.418	0.000	-0.584	-0.201
Machinery—> SC-Ad	0.027	0.122	0.226	0.411	-0.177	0.223
Logplantsize—> SC-Ad	0.011	0.051	0.223	0.412	-0.075	0.093
R2 SC-Ad	0.406	0.050	8.141	0.000	0.350	0.514

significant, with no overlap between the confidence intervals (0.499 to 0.674 for *ASCOS*; 0.017 to 0.185 for *PDC*). In addition, the mean value of the coefficient of determination (R^2) is 0.406, i.e., between the 0.344 and 0.509 confidence intervals. This indicates that the two variables (*ASCOS* and *PDC*) jointly explain a moderately high percentage of the variance, which is a sign of the model's adequate *predictive power (in-sample prediction)*. Therefore, *Hypothesis 1* is confirmed.

Further, as a set, the control variables can be considered not to exert any significant influence. The only significant control variable is the automotive sector in the industry control variable, which has a negative path (indicating that automotive sector firms present less SC-Ad (mean = 3.7) than electronics sector firms (mean = 3.9)). Despite being significant, this difference is almost certainly not relevant given that SC-Ad is in the mid-to-high part of the scale used in both sectors. Furthermore, the existence of a possible unobserved heterogeneity has been analyzed through solutions of 1 to 5 groups with finite mixture partial least squares (FIMIX) (Becker et al. 2013; Marin-Garcia and Alfalla-Luque 2019). The results seem to reinforce that a heterogeneity problem is not a real issue in the sample since they support that the solution of a single group can be considered to represent the results obtained.

The results show that *ASCOS* has a greater influence on SC-Ad than PDC (see Table 2 and Fig. 2). As Table 3 shows,

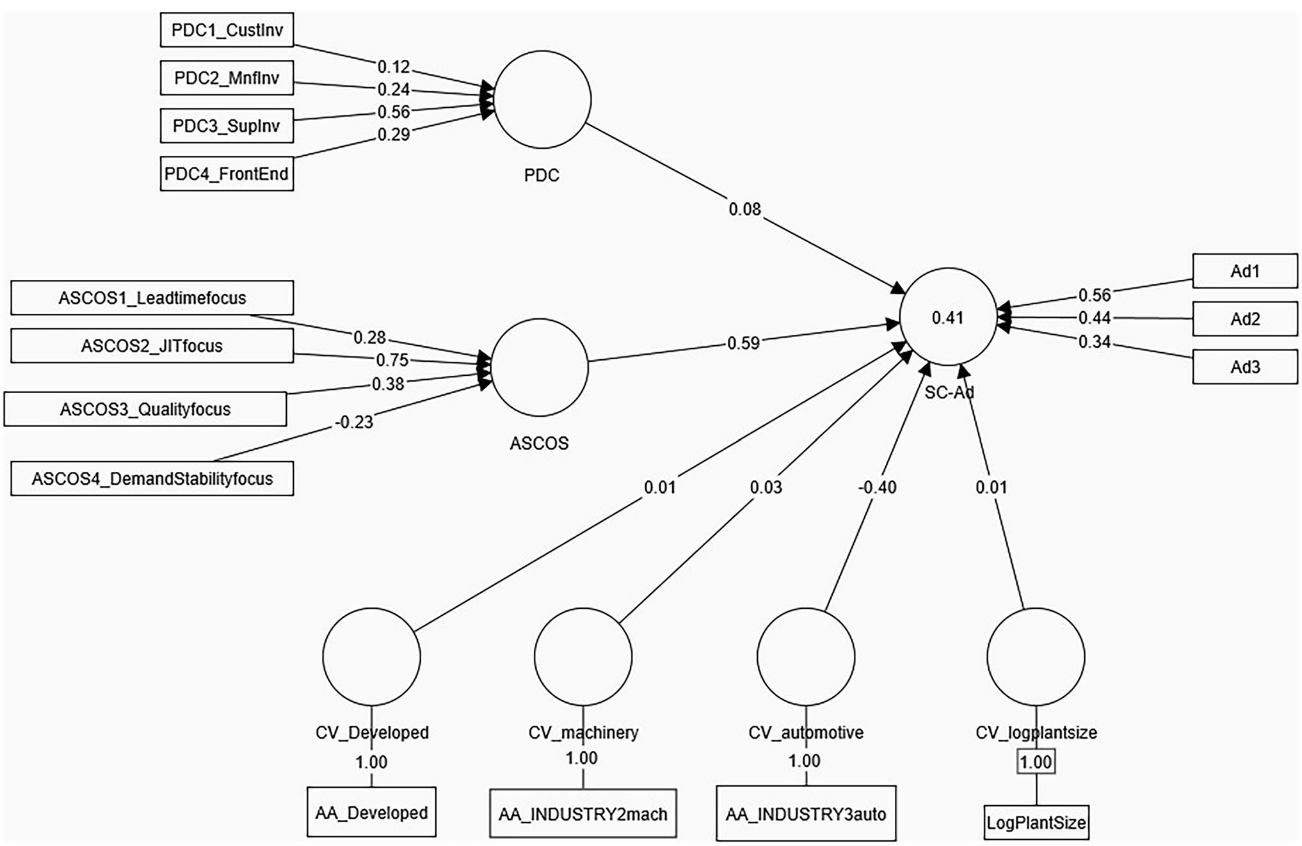

Fig. 2 3rd Higher-order composites

Table 3 Total effects of ASCOS and PDC components on SC-Ad and degree of deployment (performance)

	Standardized	Non-standardized	Deployment (performance)%
ASCOS	0.589	0.573	68.568
ASCOS1_Lead time focus	0.166	0.138	66.994
ASCOS2_JIT focus	0.444	0.335	63.776
ASCOS3_Quality focus	0.224	0.195	71.412
ASCOS4_Demand stability focus	-0.135	-0.095	55.219
PDC	0.085	0.084	69.939
PDC1_CustInv (Customer involvement)	0.010	0.009	73.333
PDC2_MnfInv (Manufacturing involvement)	0.020	0.017	70.015
PDC3_SupInv (Supplier involvement)	0.047	0.036	68.039
PDC4_Front End Loading	0.025	0.023	71.603
SC-Ad	–	–	69.506

this is mainly due to the significantly more intense relationship of the ASCOS JIT focus with SC-Ad (0.444). Nonetheless, two of the other *ASCOS* dimensions (ASCOS3_Quality focus, and ASCOS1_Lead time focus) also contribute to this higher influence (0.224 and 0.166, respectively).

The IPMA analysis (Hair et al. 2019) based on Table 3 (second and third columns) and presented in Fig. 3, also indicates that the influence of ASCOS on SC-Ad is, as already stated, is greater than that of PDC. This is, therefore, the construct that contains the most important levers of SC-Ad. It can also be stated that almost all the ASCOS levers are deployed between 63%-71% of the maximum deployment level, so there is still room for improvement. In this case, ASCOS4_Demand stability focus (the least deployed lever (55% of maximum capacity)) is the lever that least affects the development of SC-Ad. That said, the second least-deployed lever, ASCOS2_JIT focus (63.77%), is the LOC with the highest effect on SC-Ad, which indicates that it is the best candidate to use for leveraging SC-Ad in the plants of our sample.

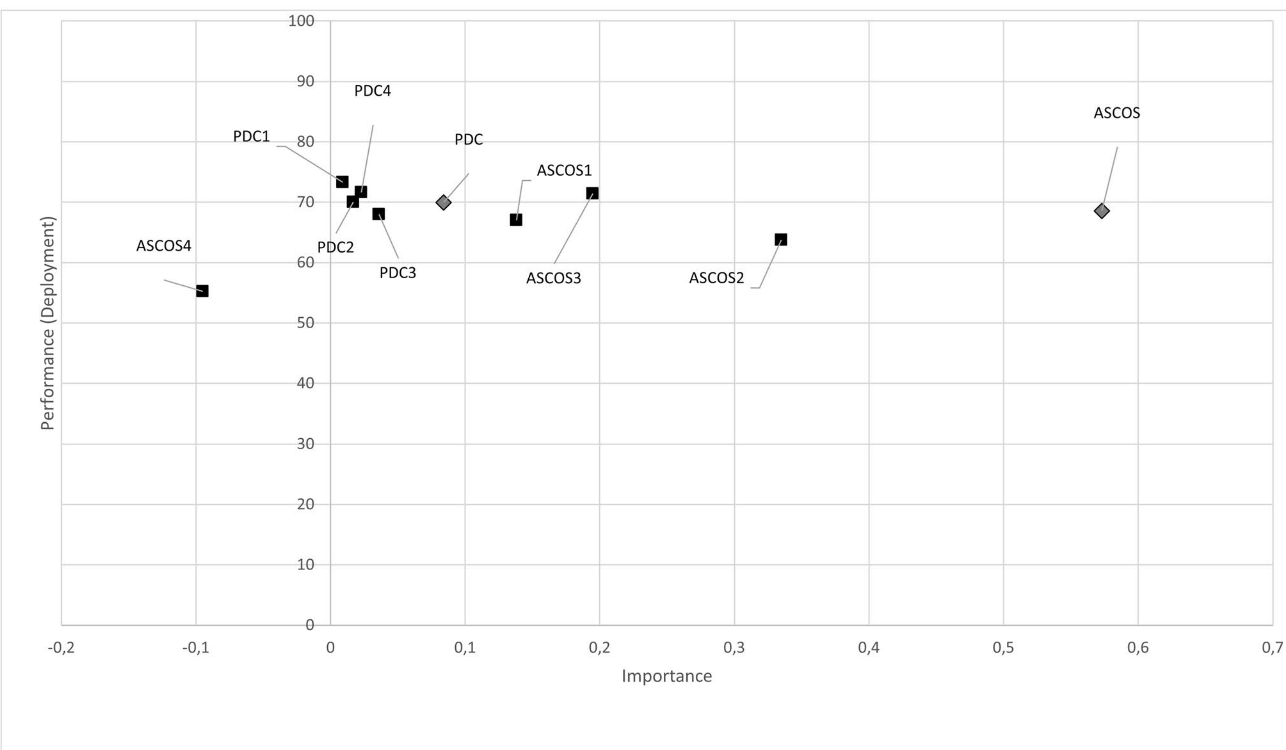

Fig. 3 IPMA analysis

Table 4 PLS-Predict results

	PLS			LM		PLS-LM		CVPAT Linear model	
	RMSE	MAE	Q^2_predict	RMSE	MAE	RMSE	MAE	Average loss	P-Value
Adapt11	0.83	0.63	0.10	0.86	0.65	-0.03	-0.02	Not available	Not available
Adapt12	0.81	0.59	0.07	0.91	0.69	-0.1	-0.1	Not available	Not available
Adapt21	0.85	0.67	0.05	0.91	0.71	-0.06	-0.04	Not available	Not available
Adapt22	0.91	0.72	0.10	0.92	0.75	-0.01	-0.03	Not available	Not available
Adapt31	0.94	0.74	-0.08	0.99	0.75	-0.05	-0.01	Not available	Not available
Adapt32	0.79	0.57	-0.04	0.88	0.67	-0.09	-0.1	Not available	Not available
Ad1	0.619	0.467	0.227	0.627	0.472	-0.0074	-0.0044	-0.12	0.00
Ad2	0.738	0.585	0.195	0.736	0.584	0.0014	0.0013	-0.06	0.16
Ad3	0.835	0.625	0.085	0.850	0.643	-0.0155	-0.0183	-0.12	0.01
SC-Ad	0.471	0.364	0.354	0.476	0.368	-0.005	-0.004	-0.0.08	0.00

Finally, it is important to comment that the negative sign in the weight of ASCOS 4 (Table 4) should not be interpreted as an issue as it is due to a "negative or net suppression" effect. This is common when several correlated variables are used in the same model, as is the case here. The tricky issue, in this case, is that although all the variables are positively related to SC-Ad (see latent variable correlations in the 2nd-order HOC model in Table S3 in online supplementary material), a negative value can be observed in the path. The reason for this is well-documented in mediation analysis (Ato and Vallejo 2011; Conger 2016; Krus and Wilkinson 1986) and it is explained by the relative "impact" of the predictors on the dependent variable. The predictor that is least correlated with the dependent variable (ASCOS 4, in this case) is used to "compensate" the "inflated" paths of the other predictors.

The *model's out-of-sample predictive validity* was measured using PLS-predict (see Table 4), which allows to empirically compare out-of-sample predictive power (Shmueli et al. 2019; Hair et al. 2022). RMSE is the root mean square error, MAE is the mean absolute error, that is, the average absolute difference between the predictions and the actual observations, with all individual differences having equal weight. RMSE results show that all the indicators and two of the SC-Ad latent variable scores (Ad1 and Ad3) are better predicted with PLS than with simple linear regression (the difference between PLS-LM results is negative). Moreover, taking *SC-Ad* globally, the PLS model outperforms the linear regression model. In addition, the CVPAT average loss value is lower for PLS-SEM than for the linear model. This indicates that the model possesses good *out-of-sample predictive capability*, which reinforces the generalization of the results, i.e., the results can be extrapolated to different samples of the same population.

Table 5 shows the ANOVA comparison of the ASCOS and PDC levels of three groups of plants delimited by two SC-Ad cut-off values (μ + 0.5σ) and (μ—0.5σ). The results show that the top SC-Ad group of plants have ASCOS and PDC values significantly higher than those of the other two groups. This suggests that higher SC-Ad plants are characterized by higher ASCOS and PDC competences than those of the other SC-Ad groups as previously hypothesized. Besides, ANOVA has been used to compare the SC-Ad levels of two groups of plants delimited by ASCOS or PDC two cut-off values for high (μ + 0.5σ) and low (μ—0.5σ). The results show (see Table 6) that the mean of SC-Ad is significantly higher in the group of plants with high ASCOS and high PDC than in the in the plants with Low ASCOS and Low PDC. Besides, although the size of the samples of the groups of High ASCOS-Low PDC (11 plants) and Low ASCOS- High PDC (9 plants) are too little to allow comparison tests with the other groups with a robust significance, it should be indicated that the

Table 5 ANOVA comparison of ASCOS and PDC of three groups of SC-Ad

	Top group (n = 79) (SC-Ad > μ + 0.5σ)	**Middle group (n = 114) (μ + 0.5σ > = SC-Ad > = μ—0.5σ)**	**Low group (n = 75) (SC-Ad < μ—0.5σ)**
ASCOS	4.075	3.837 (P = 0.004)	3.281 (P < 0.000)
PDC	4.025	3.815 (P = 0.012)	3.538 (P < 0.000)

p-value is for comparison of ASCOS or PDC against the top group

Table 6 ANOVA comparison of SC-Ad of four groups based on ASCOS and PDC

	High ASCOS-High PDC group (44 plants) ASCOS and PDC > (μ + 0.5σ)	**Low ASCOS- Low PDC group (32 plants) ASCOS and PDC < (μ—0.5σ)**
SC-Ad	4.197658	3.311186 (P < 0.000)

p-value is for comparison of *SC-Ad* against the high group means show a decreasing tendence between the 4 groups when we move from the top group to the lowest one (High-High (4.197658) – High-Low (4.077086)- Low–High (3.616623)- Low-Low (3.311186).

Therefore, the ANOVA results suggest that plants reach their SC-Ad highest values when ASCOS and PDC are working together with high values. Overall, it can be said that Hypothesis 2 seems to be supported. However, it would be advisable to reinforce this conclusion by using larger samples of the high-low and low–high groups, which would allow a complete comparison of the four groups considered.

5 Discussion, implications, and concluding remarks

This study responds to the call for more empirical research focusing on how to build SC-Ad (Whitten et al. 2012; Eckstein et al. 2015; Alfalla-Luque et al. 2018; Aslam et al. 2020; Yang et al. 2022; Garrido-Vega et al. 2023; Marin-Garcia et al 2023). It is an urgent need to facilitate SCs the way to address in a more proactive way the new challenges coming from the increasing turbulence and rapid changes of the current companies' global context. For this it is necessary that SC could be easily redesigned and reconfigured to successfully address structural changes (Feizabadi and Alibakhshi 2022). As stated by Aslam et al. (2020, p. 436), "the literature on the theoretical underpinnings of dynamic SC capabilities, in particular its antecedents, is still in the nascent stages", and this is the case of SC-Ad. In this sense, this study contributes to the knowledge about key antecedents of the SC-Ad capability that facilitate companies' adaptation of strategies, technologies and products to the structural market changes. This is done by providing evidences about effective new drivers that have not been analyzed to date (ASCOS and PDC) as it is shown in a literature review (Feizabadi et al. 2019), which shows that previous research has mainly focused on other kind of antecedents (e.g.: visibility, relationships, process integration…).

By proposing ASCOS and PDC as drivers of SC-Ad this research contributes to literature on the topic in a triple perspective. First, it develops/complements the framework established by Morita et al. (2015, 2018). Second, it contributes to SC-Ad research analyzing ASCOS and PDC as SC-Ad antecedents, which has not been done until now. The results suggest that ASCOS and PDC are drivers of SC-Ad, and that the plants with highest SC-Ad values are those with the higher competence levels of ASCOS and PDC. Finally, in an indirect way, this research also adds some new light on the topic of ambidextrous management (AM) as the SC-Ad's drivers ASCOS and PDC also appear to facilitate AM. These contributions are commented below.

Higher SC-Ad means higher readiness to adapt SC processes to achieve new strategic goals and aims. This requires an organizational design allowing to change SC processes and structure in line with market changes as well as to introduce new technologies in processes, products and information systems based on the detection of technological cycles. Also, a medium and long-term market knowledge to detect trends and possible medium and long-term changes (Alfalla-Luque et al. 2018).

In this sense, ASCOS facilitates an organizational design like the one mentioned through its 4 dimensions. The inflexibility of operational processes, pointed as a significant barrier for strategic behaviors of many companies (Skinner 1969; Hayes and Wheelwright 1984; De Meyer et al. 1989; Brenner and Tushman 2003), implies that their drivers of SC-Ad are not adequate. This study's results contribute to solve this issue by suggesting that ASCOS can be considered an effective driver of SC-Ad through the constant improvement of its four key facets (lead time, just-in-time control, quality conformance, and demand stability) to design, upgrade, and adjust SC processes for coming competition over time. Therefore, a high ASCOS value means greater power to fight against the mentioned inflexibility barrier. Moreover, low SC process competence (due to low ASCOS) induces greater adherence to existing processes and stronger resistance to the changes in processes, which are needed for more innovative product introduction or new product/market strategies such as large-scale globalization than would otherwise be the case. So, in the mentioned case, low ASCOS competence triggers attitudes averse to changing existing processes, which makes it difficult to enact SC-Ad. The reason may be that such strategic innovative changes tend to require significant structural changes in SC processes and that the new levels required will be difficult for companies with low ASCOS competence levels to accomplish.

On the other hand, designing appropriate new specifications for next SC processes requires good information feedback on markets, customers, competitors, etc., and thus PDC's competence level should be on a par with that of ASCOS. PDC helps to detect trends and possible medium and long-term market changes through the involvement of customers, suppliers, manufacturing, and front-end loading in new product development. This has been confirmed by the ANOVA results, which show that the highest values of SC-Ad are attained by plants with the highest values of both ASCOS and PDC, which jointly contribute to SC-Ad. These results seem to show that although PDC's effect on SC-Ad is weaker than that of ASCOS', this should not be taken as a suggestion that PDC should not be considered as it allows to explain a higher deployment of the SC-Ad capability. In this sense, high SC-Ad requires high values of ASCOS and PDC competences together to secure fits of satisfactory performances between strategic goals/aims and properties of SC processes over time. Finally, the reduction in the uncertainty around the expected performance of explorative initiatives is enabled by refining the estimation of expected performance. Our analyses suggest that the estimation based on the best combination of new values (related to PDC) and SC processes (related to ASCOS) is possibly associated with the enhancement of the quality of the estimates and leads to better decision-making whatever the final decision, be it affirmative or negative.

The bottom line of this study is to show the importance of strengthening physical value delivery processes. The satisfactory performance of explorative activities such as new product developments is reaped together with competent physical value delivery processes, i.e., SC processes, over product life cycles (Morita et al. 2018). The inflexibility that slows down or sometimes even prevents the achievement of *SC-Ad* is alleviated by the SC process competence, which is organizationally shared and improved based on the normative *ASCOS* principles of SC processes and successfully adapts itself to changing competitive situations over time.

One important factor that should be stressed in this section is that our results support the idea that, to progress toward high SC-Ad, which sustains long-run adaptation of companies with satisfactory performances, companies should be "normatively envisioned" and focused on maintaining high levels of both the ASCOS and PDC competences. However, this would require a change in the mentality of many organizations that are not normatively envisioned, as can be observed in our results, which show that approximately 28% of the plants in the sample present low ASCOS and PDC values, with approximately 43% presenting a low value in at least one of the two. This leads to a lower value of SC-Ad that most likely slows down or even prevents the achievement of SC-Ad. In turn, no or little SC-Ad coming from low values of ASCOS and PDC implies that it is almost impossible for these plants to completely eliminate the uncertainties attached to any explorative initiatives if there is no change in their managerial mentality that might result in a new focus with a rational approach to this issue and an increase in both the potentiality and the feasibility of the initiatives. This fact can be considered an important managerial implication.

Continuing with practical implications, this research is valuable for managers because SC-Ad capability is difficult to develop in practice as it needs to continuously assess customer needs, to identify new markets and be able to generate flexible designs (Whitten et al. 2012). Moreover, it needs to reconfigure processes with SC partners, which is difficult and risky because any reconfiguration implies new operational uncertainties (Chan and Chan 2010; Bode et al. 2011). This study helps to overcome this problem by identifying how to build SC-Ad through effective drivers, which help managers to allocate resources in order to facilitate the adjustment of SC partners to match new markets requirements in the long term (Aslam et al. 2020).

Obtaining further implications for managers requires digging deeper into the analysis of ASCOS as it is the most influential SC-Ad driver; it should be recalled that the effectiveness of the JIT focus on SC-Ad is the largest one (total effect of 0.444). Therefore, it is the most powerful sub-lever that must be increased in our sample of companies to improve SC-Ad, especially if it is considered that its deployment level only stands at 63.776% of its maximum capacity (see Table 3 and Fig. 3). The measure of JIT is important in the sense that ASCOS assumes the adoption of JIT as a rule of controlling flows through SC processes. In other words, the degree of understanding JIT determines the degree of understanding of meaningfulness of ASCOS. Furthermore, it is important to consider that the JIT competence is generally supported by the other three ASCOS's focuses (short lead time, high-quality conformance, smoothed production volume (stable demand)) and even by other resources, including trained human resources (Ohno 1988; Sakakibara et al. 2001; Singh and Singh 2013). Thus, the other three sub-competences should not be neglected because, as pointed above, in practice, they contribute to the performance level of JIT and therefore companies should focus on the improvement of all ASCOS components. In our sample, the relevance of the JIT focus is followed by Quality focus (0.224) and Lead time focus (0.166) and, although lower, both can be considered major SC-Ad sub-levers with room for improvement (71.442% and 66.994% deployment levels, respectively). This information about the most influential levers deployed by the plants in our sample is important for managers seeking to enhance the competence of initiating SC-Ad. As these comments refer to the aggregate sample, this analysis should be nuanced for company actions with due consideration of the conditions and circumstances of individual plants. In other respects, as mentioned above, although PDC's effect on SC-Ad is weaker than that of ASCOS', it should not be neglected as when having a high value together with ASCOS it allows a better balance of exploitative and explorative activities and facilitates a higher deployment of the SC-Ad capability.

At this point it is maybe worth highlighting another contribution of this research, which comes from the connection of this investigation with that of ambidextrous management (AM), which aims to secure companies' "survival and prosperity" (March 1991) by keeping an appropriate balance of resource commitments between future-focused explorative and present-focused exploitative activities. In the same sense, many authors state that AM seeks to find an appropriate balance between *exploitation* (leveraging of competence of daily operations) and *exploration* (*leveraging of* competence of innovative and adaptive response to environmental structural changes) focuses (Levinthal and March 1993; Birkinshaw and Gibson 2004; He and Wong 2004; Junni et al. 2013; Nieto-Rodriguez 2014; Karrer and Fleck 2015), and that easing the tension between these two focuses is at the heart of company survival and prosperity (March 1991) as well as the *sine qua non* of organizational ambidexterity (O'Reilly and Tushman 2004). Although AM has become one of the most important focuses in the field of management research and practice as many authors suggested as above, some key questions have still not been sufficiently addressed (O'Reilly and Tushman 2004; Ogrean and Herciu 2019; Binci et al. 2020; Pertusa-Ortega et al. 2021; Kafetzopoulos 2021). For example, questions continue around how to successfully implement AM and, despite its mentioned relevance, this remains an important research gap since, as the above studies point out, it is not still clear how to best achieve AM. One of the main barriers is the inflexibility of SC processes stemming from huge sunk cost and risks or difficulties attached to the change of existing SC processes (March 1991; Duarte et al. 2017), which makes difficult to initiate the necessary shifts between exploitative and explorative activities to find a balance allowing an AM to sustain competitiveness under changing competitive situations (He and Wong 2004; Van Looy et al. 2005; Boumgarden et al. 2012; Hu and Chen 2016; Parida et al. 2016; Luger et al. 2018; Clauss et al. 2021).

Related to this gap in the AM literature, we could say that our results and findings give some new light to the mentioned issue, as the SC-Ad's drivers ASCOS and PDC, which enable a higher SC-Ad by reducing the inflexibility of SC processes, facilitate the appropriate shifts between exploitative and explorative activities over time and then also AM. In this sense, we could say that although in an indirect way, this research also provides some new insight on this topic, where there is a lack of research (O'Reilly and Tushman 2004; Asif 2017; Ogrean and Herciu 2019; Pertusa-Ortega et al. 2021; Kafetzopoulos 2021).

Regarding the reliability of the results, it is important to note that reliability of this research's results is improved by the use of a wide multi-country, multi-informant, and multi-sector sample (in which we have not found a problem of heterogeneity), in contrast with studies that use a sample at the national or regional level, and/or of a single sector, and/or with single respondents. This is beneficial as it improves the generalizability of the results. This has been reinforced by the use of PLSPredict, which has confirmed that the model has a good *out-of-sample predictive capability* that enables the results to be extrapolated to other samples of the same population. On the managerial side, where it is important to find generalizable models that can be useful for business or produce predictive power (Ruddock 2017), this enables managerial decisions that will be more likely to work in other settings (Chin et al. 2020). Besides, the effects of the control variables (plant size, country, and industry) are seen to be non-significant, which strengthens the obtained results.

6 Limitations and further research

This research is not free of limitations. However, these can indicate some lines of possible future research. First, the database only comprises three industries in a limited number of countries. Despite the above-mentioned adequate generalizability of the results, these must be interpreted in the context of these sectors and countries. Nonetheless, the control variables did not have any significant influence on the results and the complementary heterogeneity test did not show any issue on this matter, which is a sign of robustness. In any case, it would be advisable to extend this research to other samples from different sectors and countries. Another limitation is the use of cross-sectional analysis, which is commonly used in many studies but does not allow to observe change/reactions to change in practice. The concept of "adaptation" requires us to look at companies' behaviors including data over time. Further research would be improved by using longitudinal analyses desirably based on time series data of more than a few product life cycles, which would enable to observe the evolution of the variables and their relationships. Hopefully, the next round of the HPM project will allow such research to be done.

A last important factor to be considered in further research is the role of managerial leadership, especially, top leadership as a facilitator or initiator. There are many studies on the positive role played by this factor regarding leaning toward explorative initiatives (Jansen et al. 2009; Kafetzopoulos 2021). In this sense, Section 1 referred to the three cases of Ford, GM, and Toyota (quoted as examples of a successful fit between product values and SC processes (PDC and ASCOS)), mentioning their three prodigious top leaders, Henry Ford, Alfred P. Sloan Jr., and Kiichiro Toyoda. It is highly likely that these leaders triggered and drove these successful watershed shifts in mentality with little certainty but with great belief in the theoretical insights that this study seeks to emphasize. For example, Mr. Toyoda said that the best way to make a car is by having a required part arrive at the very moment that a worker needs to assemble it (Ohno 1988). This was the birth of the JIT system and Toyota's worldwide success. It would, therefore, not seem to be by chance that this work has revealed a focus on JIT to be the most important ASCOS lever for obtaining higher SC-Ad, which re-confirms Mr. Toyoda's vision many years later. Moreover, Skinner (1969) observed that most inflexibility issues came from senior managers' indifference to anything related to processes. The reliability and quality of this assessment are expected to depend onASCOS and PDC competence levels of the companies' managers, which reflect the maneuverability of the critical factors that determine the performance of their processes. So, to associate the leadership issue with this research implication, we close this paper with two real examples that are provided as supplementary material in line with our results that spark further research (see https://zenodo.org/doi/10.5281/zenodo.7813833).

ANNEX

Table A1 Descriptive statistics for items (Itemcode, LOC, Mean, Std, max,min, skewness & kurtosis)

Id	Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Adapt11	Our production system is designed to accommodate changes in demand volume	267	1	5	3.777	0.8682	-0.817	0.743
Adapt12	Our production system is designed to accommodate changes in production mix	267	1	5	3.897	0.8383	-0.881	1.084
Adapt21	We have a good understanding of where our production technology stands, in terms of technology life cycles	267	1	5	3.743	0.8729	-0.649	-0.012
Adapt22	Our plant stays on the leading edge of new technology in our industry	267	1	5	3.61	0.961	-0.587	-0.159
Adapt31	In order to find potential new markets, we monitor economies around the world	260	1	5	3.85	0.9188	-0.868	0.595
Adapt32	We are concerned about the needs of both our immediate customers and our ultimate consumers	260	1	5	4.127	0.7855	-1.203	2.526
CINVLN01	We consult customers early in the design of new products	267	1	5	4.028	0.825	-1.026	1.592
CINVLN02	We partner with customers for new product design	267	1	5	3.833	0.8678	-0.933	0.852
CINVLN03	Customers are frequently consulted about the design of new products	267	1	5	3.822	0.8976	-0.657	-0.055
CINVLN05	Customers are an integral part of new product design efforts	267	1	5	4.039	0.8222	-0.837	0.692
CNTRLN02	A large percent of the processes on the shop floor are currently under statistical quality control	260	1	5	3.819	1.2334	-0.967	-0.158

Id	Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
CNTRLN05	We monitor our processes using statistical process control	260	1	5	4.254	1.2251	-1.608	1.3
FBACKN01	Charts showing defect rates are posted on the shop floor	268	1	5	3.795	1.1599	-0.799	-0.281
FBACKN02	Charts showing schedule compliance are posted on the shop floor	268	1	5	3.722	1.1202	-0.664	-0.528
FBACKN03	Charts plotting the frequency of machine breakdowns are posted on the shop floor	268	1	5	3.119	1.2003	-0.114	-1.026
FBACKN04	Information on quality performance is readily available to employees	268	1	5	3.78	0.9332	-0.854	0.493
FBACKN05	Information on productivity is readily available to employees	268	1	5	3.621	0.975	-0.638	-0.219
FRONTN01	We draw upon many sources and methods in identifying new product development opportunities	265	2	5	3.85	0.8087	-0.615	-0.131
FRONTN02	We obtain additional information to help in translating new product development opportunities into specific business, market	265	1	5	3.82	0.8761	-0.772	0.59
FRONTN03	We use processes such as direct contact with customers/users, linkages with cross-functional teams and collaboration with other companies and institutions to translate product development opportunities into concrete ideas	266	1.5	5	3.89	0.7989	-0.52	-0.019

Id	Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
FRONTN04	Our new product development selection process is designed to evaluate ideas based on market and technology risk, investment	266	1.5	5	4.088	0.8451	-0.823	0.102
FRONTN05	Our new product development process is well supported by high-level executive leadership	266	1	5	3.976	0.8749	-0.82	0.487
FRONTN06	We have a clear vision of product lines and platforms for specific markets	266	1	5	3.856	0.8318	-0.666	0.118
FRONTN08	In our company we have a map that shows the evolution of critical dimensions in the market, technology and the manufacturing	267	1	5	3.322	1.1663	-0.362	-0.843
JITDELN01	Our suppliers deliver to us on a just-in-time basis	266	1	5	3.513	1.1171	-0.563	-0.422
JITDELN02	We receive daily shipments from most suppliers	266	1	5	3.391	1.2137	-0.432	-0.763
JITDELN03	Our suppliers are linked with us by a pull system	267	1	5	3.354	1.2129	-0.515	-0.613
LINKCN01	Our customers receive just-in-time deliveries from us	261	1	5	3.612	1.0327	-0.669	0.041
LINKCN03	We can adapt our production schedule to sudden production stoppages by our customers	261	1	5	3.811	0.8566	-0.644	0.628
LINKCN04	Our customers have a pull type link with us	261	1	5	3.104	1.2279	-0.242	-0.939
LINKCN05	Our customers are linked with us via JIT systems	261	1	5	2.823	1.2093	-0.011	-0.979
MFDESN02	Manufacturing engineers are involved to a great extent before the introduction of new products	267	1	5	3.836	0.8994	-0.804	0.653

Id	Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
MFDESN04	New product design teams have frequent interaction with the manufacturing function	267	1	5	4.011	0.8157	-0.764	0.474
MFDESN05	Manufacturing is involved at the early stages of new product development	268	1	5	3.908	0.9145	-0.824	0.239
MFDESN06	The manufacturing function is key in improving new product concepts	267	1	5	3.755	0.9393	-0.525	-0.174
MFDESN07	Manufacturing is given challenging tasks in the development of new product concepts	267	1	5	3.439	0.9727	-0.423	-0.121
REPMASN01	Our master schedule repeats the same mix of products, from hour to hour and day to day	261	1	5	2.551	1.267	0.311	-1.098
REPMASN02	The master schedule is level-loaded in our plant, from day to day	261	1	5	3.217	1.1416	-0.33	-0.756
REPMASN03	Within our schedule, the mix of items is designed to be similar to the forecasted demand mix	260	1	5	3.737	0.9856	-0.862	0.507
SETUPN01	We are aggressively working to lower setup times in our plant	267	1	5	3.821	0.9683	-0.663	-0.202
SETUPN02	We have low setup times of equipment in our plant	267	1	5	3.494	0.9323	-0.29	-0.38
SETUPN03	Our workers practice setups, in order to reduce the time required	267	1	5	3.238	1.1812	-0.201	-0.935
SINVLN01	Suppliers are involved early in product design efforts	268	1	5	3.58	0.9382	-0.718	-0.064
SINVLN02	We partner with suppliers for the design of new products	268	1	5	3.75	0.8989	-0.807	0.474

Id	Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
SINVLN03	Suppliers are frequently consulted during the design of new products	268	1	5	3.666	0.9527	-0.49	-0.45
SINVLN04	Suppliers are an integral part of new product design efforts	268	1	5	3.854	0.9368	-0.766	0.165
SPEEDN01	Fast delivery is the most important criterion used by our customers in selecting us as a supplier	260	1	5	3.454	0.9534	-0.591	0.161
SPEEDN03	Our customers can rely on us for fast delivery	260	2	5	4.069	0.8342	-0.669	-0.212
SPEEDN04	We are selected by our customers because of our reputation for fast delivery	260	1	5	3.446	0.902	-0.398	0.058
TPLEADN01	All major department heads within the plant accept their responsibility for quality	268	1	5	3.994	0.8926	-0.894	0.409
TPLEADN02	Plant management provides personal leadership for quality products and quality improvement	268	2	5	3.875	0.8796	-0.679	-0.054
TPLEADN03	The top priority in evaluating plant management is quality performance	268	1	5	3.618	1.0196	-0.367	-0.826
TPLEADN04	Our top management strongly encourages employee involvement in the production process	268	1	5	4.062	0.7771	-0.834	1.041
TPLEADN05	Our plant management creates and communicates a vision focused on quality improvement	268	2	5	4.03	0.7844	-0.709	0.428
TPLEADN06	Our plant management is personally involved in quality improvement projects	268	1	5	4.052	0.8352	-0.953	0.917

Id	Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
TRAINN01	Specific work-skills training (technical and vocational) is given to hourly employees throughout the organization	268	1	5	3.838	0.8648	-0.671	0.176
TRAINN02	Quality-related training is given to hourly employees throughout the organization	268	1	5	3.507	1.0679	-0.529	-0.429
TRAINN03	Quality-related training is given to managers and supervisors throughout the organization	268	1	5	3.744	0.9346	-0.695	0.043
TRAINN04	Training in basic statistical techniques is given to employees	268	1	5	3.207	1.2144	-0.163	-1.121
TRAINN05	Training in problem-solving techniques is given to employees	268	1	5	3.61	1.0827	-0.648	-0.365

Table A2 Loadings and Weights

3rd order HOC	2nd-order HOC	LOC composing 2nd-order HOCs	Items of LOC	Loading	Standard Deviation	T Statistics	P Value	5.0%	95.0%	Weight	Standard Deviation	T Statistics	P Value	5.0%	95.0%
–	SC-Adaptability	SC organizational design:	Adapt11—> Ad1	0.897	0.073	12.307	**0.000**	0.752	0.981	0.748	0.118	6.316	**0.000**	0.530	0.914
–	SC-Adaptability	SC organizational design:	Adapt12—> Ad1	0.706	0.115	6.126	**0.000**	0.503	0.869	0.466	0.148	3.158	**0.001**	0.209	0.695
–	SC-Adaptability	Use of technology	Adapt21—> Ad2	0.717	0.117	6.116	**0.000**	0.500	0.880	0.343	0.172	1.992	**0.023**	0.062	0.617
–	Adaptability	Use of technology	Adapt22—> Ad2	0.953	0.062	15.425	**0.000**	0.839	0.998	0.791	0.137	5.766	**0.000**	0.543	0.970
–	SC-Adaptability	Medium- and long-term market knowledge	Adapt31-> Ad3	0.999	0.077	12.968	**0.000**	0.867	1.000	0.973	0.166	5.867	**0.000**	0.676	1.127
–	SC-Adaptability	Medium- and long-term market knowledge	Adapt32—> Ad3	0.504	0.222	2.273	**0.012**	0.076	0.800	0.056	0.284	0.198	**0.421**	-0.421	0.493
–	PDC	PDC1_Customer involvement in new product development	CINVLN01 <—PDC1_CustInv	0.845	0.043	19.568	**0.000**	0.775	0.894	0.370	0.077	4.785	**0.000**	0.260	0.497
–	PDC	PDC1_Customer involvement in new product development	CINVLN02 <—PDC1_CustInv	0.753	0.065	11.554	**0.000**	0.644	0.833	0.273	0.095	2.880	**0.002**	0.132	0.415
–	PDC	PDC1_Customer involvement in new product development	CINVLN03 <—PDC1_CustInv	0.822	0.051	16.164	**0.000**	0.728	0.875	0.345	0.090	3.840	**0.000**	0.200	0.465
–	PDC	PDC1_Customer involvement in new product development	CINVLN05 <—PDC1_CustInv	0.808	0.060	13.571	**0.000**	0.706	0.870	0.246	0.088	2.789	**0.003**	0.104	0.370
–	PDC	PDC2_Manufacturing involvement in new product development	MFDESN02 <—PDC2_MnfInv	0.818	0.037	22.203	**0.000**	0.754	0.863	0.347	0.060	5.742	**0.000**	0.257	0.447
–	PDC	PDC2_Manufacturing involvement in new product development	MFDESN04 <—PDC2_MnfInv	0.790	0.044	17.881	**0.000**	0.710	0.845	0.223	0.066	3.379	**0.000**	0.117	0.319

3rd order HOC	2nd-order HOC	LOC composing 2nd-order HOCs	Items of LOC	Loading	Standard Deviation	T Statistics	P Value	5.0%	95.0%	Weight	Standard Deviation	T Statistics	P Value	5.0%	95.0%
–	PDC	PDC2_ Manufacturing involvement in new product development	MFDESN05 <—PDC2_ MnfInv	0.825	0.043	19.149	**0.000**	0.747	0.876	0.303	0.068	4.430	**0.000**	0.202	0.410
–	PDC	PDC2_ Manufacturing involvement in new product development	MFDESN06 <—PDC2_ MnfInv	0.655	0.078	8.369	**0.000**	0.515	0.754	0.143	0.080	1.782	**0.037**	0.007	0.251
–	PDC	PDC2_ Manufacturing involvement in new product development	MFDESN07 <—PDC2_ MnfInv	0.729	0.057	12.734	**0.000**	0.629	0.799	0.268	0.078	3.463	**0.000**	0.151	0.391
–	PDC	PDC3_ Supplier involvement in new product development	SINVLN01 <—PDC3_ SupInv	0.848	0.030	27.942	**0.000**	0.792	0.885	0.234	0.053	4.407	**0.000**	0.143	0.307
–	PDC	PDC3_ Supplier involvement in new product development	SINVLN02 <—PDC3_ SupInv	0.826	0.035	23.398	**0.000**	0.763	0.876	0.323	0.058	5.562	**0.000**	0.238	0.422
–	PDC	PDC3_ Supplier involvement in new product development	SINVLN03 <—PDC3_ SupInv	0.836	0.037	22.678	**0.000**	0.764	0.882	0.339	0.051	6.628	**0.000**	0.255	0.417
–	PDC	PDC3_ Supplier involvement in new product development	SINVLN04 <—PDC3_ SupInv	0.793	0.042	19.050	**0.000**	0.719	0.851	0.316	0.058	5.422	**0.000**	0.230	0.411
–	PDC	PDC4_Front-end loading in new product development	FRONTN01 <—PDC4_ FrontEnd	0.698	0.053	13.232	**0.000**	0.605	0.773	0.199	0.048	4.149	**0.000**	0.122	0.276
–	PDC	PDC4_Front-end loading in new product development	FRONTN02 <—PDC4_ FrontEnd	0.763	0.048	16.034	**0.000**	0.678	0.822	0.205	0.046	4.461	**0.000**	0.130	0.275
–	PDC	PDC4_Front-end loading in new product development	FRONTN03 <—PDC4_ FrontEnd	0.728	0.050	14.512	**0.000**	0.637	0.792	0.178	0.056	3.191	**0.001**	0.093	0.263

3rd order HOC	2nd-order HOC	LOC composing 2nd-order HOCs	Items of LOC	Loading	Standard Deviation	T Statistics	P Value	5.0%	95.0%	Weight	Standard Deviation	T Statistics	P Value	5.0%	95.0%
–	PDC	PDC4_Front-end loading in new product development	FRONTN04 <—PDC4_FrontEnd	0.731	0.048	15.307	**0.000**	0.645	0.797	0.210	0.055	3.829	**0.000**	0.127	0.299
–	PDC	PDC4_Front-end loading in new product development	FRONTN05 <—PDC4_FrontEnd	0.753	0.047	15.853	**0.000**	0.671	0.811	0.209	0.052	4.037	**0.000**	0.129	0.284
–	PDC	PDC4_Front-end loading in new product development	FRONTN06 <—PDC4_FrontEnd	0.760	0.044	17.190	**0.000**	0.685	0.814	0.221	0.044	5.023	**0.000**	0.153	0.288
–	PDC	PDC4_Front-end loading in new product development	FRONTN08 <—PDC4_FrontEnd	0.619	0.073	8.527	**0.000**	0.487	0.716	0.156	0.065	2.414	**0.008**	0.045	0.251
ASCOS	–	ASCOS1_Lead Time Focus	SPEEDN01 <—ASCOS1_leadtime	0.775	0.063	12.268	**0.000**	0.659	0.859	0.403	0.084	4.823	**0.000**	0.267	0.536
ASCOS	–	ASCOS1_Lead Time Focus	SPEEDN03 <—ASCOS1_leadtime	0.755	0.070	10.806	**0.000**	0.628	0.853	0.436	0.091	4.788	**0.000**	0.282	0.583
ASCOS	–	ASCOS1_Lead Time Focus	SPEEDN04 <—ASCOS1_leadtime	0.859	0.046	18.746	**0.000**	0.763	0.909	0.417	0.073	5.704	**0.000**	0.288	0.524
ASCOS	ASCOS2_JIT FOCUS	JIT1_JIT delivery by suppliers	JITDELN01 <—JIT1_suppliers	0.870	0.056	15.561	**0.000**	0.776	0.916	0.526	0.086	6.097	**0.000**	0.389	0.659
ASCOS	ASCOS2_JIT FOCUS	JIT1_JIT delivery by suppliers	JITDELN02 <—JIT1_suppliers	0.504	0.140	3.587	**0.000**	0.234	0.680	0.014	0.149	0.095	**0.462**	-0.261	0.220
ASCOS	ASCOS2_JIT FOCUS	JIT1_JIT delivery by suppliers	JITDELN03 <—JIT1_suppliers	0.899	0.051	17.505	**0.000**	0.819	0.941	0.595	0.092	6.442	**0.000**	0.450	0.743
ASCOS	ASCOS2_JIT FOCUS	JIT2_JIT link with customers	LINKCN01 <—JIT2_Customers	0.746	0.105	7.095	**0.000**	0.579	0.837	0.333	0.114	2.908	**0.002**	0.163	0.493
ASCOS	ASCOS2_JIT FOCUS	JIT2_JIT link with customers	LINKCN03 <—JIT2_Customers	0.787	0.100	7.904	**0.000**	0.670	0.889	0.465	0.136	3.429	**0.000**	0.297	0.678
ASCOS	ASCOS2_JIT FOCUS	JIT2_JIT link with customers	LINKCN04 <—JIT2_Customers	0.773	0.111	6.988	**0.000**	0.595	0.853	0.276	0.102	2.700	**0.003**	0.112	0.407
ASCOS	ASCOS2_JIT FOCUS	JIT2_JIT link with customers	LINKCN05 <—JIT2_Customers	0.797	0.117	6.806	**0.000**	0.606	0.876	0.216	0.122	1.768	**0.039**	0.014	0.344
ASCOS	ASCOS2_JIT FOCUS	JIT3_Setup time reduction	SETUPN01 <—JIT3_SetupTime	0.844	0.022	38.616	**0.000**	0.804	0.876	0.463	0.038	12.335	**0.000**	0.403	0.526
ASCOS	ASCOS2_JIT FOCUS	JIT3_Setup time reduction	SETUPN02 <—JIT3_SetupTime	0.801	0.038	20.840	**0.000**	0.730	0.854	0.500	0.045	11.078	**0.000**	0.428	0.575
ASCOS	ASCOS2_JIT FOCUS	JIT3_Setup time reduction	SETUPN03 <—JIT3_SetupTime	0.703	0.058	12.082	**0.000**	0.598	0.787	0.296	0.044	6.655	**0.000**	0.222	0.365

3rd order HOC	2nd-order HOC	LOC composing 2nd-order HOCs	Items of LOC	Loading	Standard Deviation	T Statistics	P Value	5.0%	95.0%	Weight	Standard Deviation	T Statistics	P Value	5.0%	95.0%
ASCOS	ASCOS3_Quality focus	Q1_Feedback to employees on quality	FBACKN01 <—Q1_ FeedbackToEmployees	0.766	0.043	17.903	**0.000**	0.686	0.825	0.223	0.036	6.209	**0.000**	0.164	0.279
ASCOS	ASCOS3_Quality focus	Q1_Feedback to employees on quality	FBACKN02 <—Q1_ FeedbackToEmployees	0.771	0.041	18.925	**0.000**	0.695	0.828	0.289	0.044	6.641	**0.000**	0.220	0.360
ASCOS	ASCOS3_Quality focus	Q1_Feedback to employees on quality	FBACKN03 <—Q1_ FeedbackToEmployees	0.691	0.061	11.322	**0.000**	0.579	0.773	0.172	0.050	3.421	**0.000**	0.084	0.246
ASCOS	ASCOS3_Quality focus	Q1_Feedback to employees on quality	FBACKN04 <—Q1_ FeedbackToEmployees	0.828	0.029	28.336	**0.000**	0.776	0.871	0.347	0.041	8.387	**0.000**	0.286	0.417
ASCOS	ASCOS3_Quality focus	Q1_Feedback to employees on quality	FBACKN05 <—Q1_ FeedbackToEmployees	0.776	0.036	21.752	**0.000**	0.712	0.826	0.258	0.040	6.378	**0.000**	0.192	0.324
ASCOS	ASCOS3_Quality focus	Q2_Top leadership on quality	TPLEADN01 <—Q2_ TopLeadership	0.755	0.043	17.588	**0.000**	0.676	0.816	0.194	0.034	5.764	**0.000**	0.140	0.252
ASCOS	ASCOS3_Quality focus	Q2_Top leadership on quality	TPLEADN02 <—Q2_ TopLeadership	0.846	0.027	31.652	**0.000**	0.795	0.882	0.217	0.022	10.008	**0.000**	0.179	0.249
ASCOS	ASCOS3_Quality focus	Q2_Top leadership on quality	TPLEADN03 <—Q2_ TopLeadership	0.697	0.041	16.919	**0.000**	0.623	0.758	0.210	0.031	6.767	**0.000**	0.161	0.262
ASCOS	ASCOS3_Quality focus	Q2_Top leadership on quality	TPLEADN04 <—Q2_ TopLeadership	0.761	0.031	24.532	**0.000**	0.706	0.807	0.222	0.029	7.725	**0.000**	0.178	0.272
ASCOS	ASCOS3_Quality focus	Q2_Top leadership on quality	TPLEADN05 <—Q2_ TopLeadership	0.851	0.023	37.519	**0.000**	0.811	0.883	0.232	0.024	9.826	**0.000**	0.194	0.271
ASCOS	ASCOS3_Quality focus	Q2_Top leadership on quality	TPLEADN06 <—Q2_ TopLeadership	0.799	0.028	28.482	**0.000**	0.749	0.841	0.196	0.026	7.667	**0.000**	0.155	0.237
ASCOS	ASCOS3_Quality focus	Q3_Process control	CNTRLN02 <—Q3_ ProcessControl	0.904	0.175	5.155	**0.000**	0.708	0.986	0.515	0.279	1.846	**0.032**	0.119	0.889
ASCOS	ASCOS3_Quality focus	Q3_Process control	CNTRLN05 <—Q3_ ProcessControl	0.925	0.188	4.924	**0.000**	0.708	0.988	0.578	0.292	1.979	**0.024**	0.139	0.904
ASCOS	ASCOS3_Quality focus	Q4_Quality training	TRAINN01 <—Q4_ Training	0.709	0.050	14.139	**0.000**	0.613	0.778	0.211	0.045	4.711	**0.000**	0.134	0.279
ASCOS	ASCOS3_Quality focus	Q4_Quality training	TRAINN02 <—Q4_ Training	0.810	0.029	27.514	**0.000**	0.754	0.849	0.227	0.036	6.336	**0.000**	0.163	0.279

3rd order HOC	2nd-order HOC	LOC composing 2nd-order HOCs	Items of LOC	Loading	Standard Deviation	T Statistics	P Value	5.0%	95.0%	Weight	Standard Deviation	T Statistics	P Value	5.0%	95.0%
ASCOS	ASCOS3_Quality focus	Q4_Quality training	TRAINN03 <—Q4_Training	0.745	0.041	18.067	**0.000**	0.669	0.803	0.209	0.041	5.118	**0.000**	0.143	0.276
ASCOS	ASCOS3_Quality focus	Q4_Quality training	TRAINN04 <—Q4_Training	0.832	0.027	31.060	**0.000**	0.783	0.871	0.279	0.037	7.614	**0.000**	0.222	0.342
ASCOS	ASCOS3_Quality focus	Q4_Quality training	TRAINN05 <—Q4_Training	0.855	0.021	40.268	**0.000**	0.818	0.887	0.326	0.040	8.164	**0.000**	0.268	0.397
ASCOS	–	ASCOS4_Demand Stability Focus	REPMASN01 <— ASCOS4_Demand	0.773	0.099	7.840	**0.000**	0.613	0.895	0.482	0.120	4.029	**0.000**	0.302	0.670
ASCOS	–	ASCOS4_Demand Stability Focus	REPMASN02 <— ASCOS4_Demand	0.815	0.073	11.108	**0.000**	0.683	0.885	0.385	0.095	4.065	**0.000**	0.216	0.515
ASCOS	–	ASCOS4_Demand Stability Focus	REPMASN03 <— ASCOS4_Demand	0.679	0.129	5.282	**0.000**	0.433	0.831	0.462	0.139	3.318	**0.000**	0.222	0.657

LOC Low-order construct, *HOC* High-order construct

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