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Sustainability pressures and willingness to integrate multi-sided platforms: unpacking the demand-side dynamics in manufacturing firms☆

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ABSTRACT

This study examines manufacturing firms' willingness to integrate multi-sided retail platforms (MSPs) in response to sustainability-driven demands. Grounded in Diffusion of Innovation (DOI) and Institutional theory, the analysis focuses on how consumer-driven factors (*green customer pressure, product quality, and consumer involvement*) interact with an organizational capability (*internal green supply chain management*) to shape firms' willingness to integrate MSPs. Using survey data from 316 managers and applying fuzzy set qualitative comparative analysis (fsQCA) together with necessary condition analysis (NCA), the analysis yielded four distinct configurations. Results indicate that firms are most inclined to integrate MSPs when green customer pressure and product quality co-occur with internal green supply chain management. These findings reveal the joint role of external sustainability expectations and internal readiness in shaping firms' strategic engagement with digital retail platforms. They also extend research on platform-based innovation by outlining multiple demand-oriented pathways to digital engagement under sustainability pressures.

1. Introduction

Digital platforms are reshaping how manufacturing firms access and operate in retail markets. Multi-sided platforms (MSPs), defined as digital intermediaries connecting manufacturers, retailers, and consumers (Hagiu & Wright, 2015; Marzi et al., 2023), expand market access while reducing distribution layers and generating network effects (Hänninen et al., 2019; Trabucchi & Buganza, 2020). They also enhance product traceability and information transparency, making product attributes more visible and comparable. This, in turn, enables consumers to access, compare, and evaluate firms' environmental performance, linking sustainability more directly to reputation and market outcomes (Ghose & Ipeirotis, 2010; Hänninen et al., 2019). Despite these developments, research on MSPs has primarily examined how platforms alter competitive dynamics, restructure interfirm relationships, and shape consumer purchasing behavior (Khelladi et al., 2022; Loux et al., 2020; Muzellec et al., 2015), while offering limited insight into how firms evaluate participation under sustainability-related expectations. This gap becomes more pronounced as consumer concern for environmental responsibility increases (Guandalini, 2022; Tang & Gekara, 2020) and sustainability information becomes more visible and comparable across firms (White et al., 2025).

At the same time, concerns over misleading environmental claims raise demands for credible signals (Baldassarre & Campo, 2016). In this context, MSPs function as key environments in which sustainability information is organized and displayed, exposing firms' environmental performance to greater market scrutiny. Participation in MSPs, however, is not automatic. Firms evaluate the alignment between external sustainable expectations and internal capabilities, as well as the feasibility of operating under increased transparency (Marzi et al., 2023). These considerations shape their willingness to integrate MSPs, representing a pre-adoption stage in which firms interpret external pressures, assess their relevance and feasibility, and decide whether to respond. Yet current research offers limited insight into how this willingness forms

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and what drives firms' decision to participate in MSPs. Focusing on this stage matters because it is precisely where the decision takes shape. This process also bears on how platform providers design features and governance mechanisms to better align with the conditions shaping firms' participation. Accordingly, we examine how sustainability-related demands influence manufacturing firms' willingness to integrate MSPs.

Two theoretical frameworks guide the analysis. Institutional theory (DiMaggio & Powell, 1983) highlights the influence of social norms and external pressures on organizational behavior (Scott, 2013), while Diffusion of Innovation (DOI) theory (Rogers, 2010) explains how the perceived attributes of a given innovation shape its adoption across organizations. Combining these frameworks is warranted because institutional pressures and innovation attributes shape technology adoption decisions (Marzi et al., 2023). Mimetic, coercive, and normative pressures shape firms' predisposition toward digital technologies, while attributes such as relative advantage and compatibility influence how firms assess the feasibility of adoption (Delmas & Toffel, 2008; DiMaggio & Powell, 1983; Rogers, 2010). Research shows that digital technology integration is shaped by both external institutional forces and the perceived alignment of innovations with organizational practices (Kwon et al., 2021), and that platform adoption follows multiple pathways influenced by external pressures and firm-level characteristics (Marzi et al., 2023). Together, these contributions indicate that integrating DOI and Institutional theory yields a more complete account of how external legitimacy demands interact with innovation evaluation processes (Scott, 2013; Soewarno et al., 2019). Although prior studies primarily examine realized adoption, the same institutional pressures and perceived innovation attributes influence the earlier evaluative stages in which firms develop willingness to integrate a given technology. These frameworks therefore provide a suitable foundation for our analysis. The central research question is: *How do combinations of external sustainability pressures and internal readiness, as expressed through green consumer pressure, perceived product quality, customer involvement, and internal green supply chain management, shape the willingness to integrate MSPs among manufacturing firms?*

Drawing on survey data from 316 manufacturing firms and employing a configurational analysis approach, we identify four distinct configurations associated with willingness to integrate MSPs among SMEs and large firms. Fuzzy set qualitative comparative analysis (fsQCA) reveals that willingness to integrate is mainly driven by consumer-based triggers, particularly product quality and green customer pressure (Leonidou et al., 2013; Jansson et al., 2010), with stronger effects when these triggers co-occur with internal readiness in the form of green supply chain management (Laari et al., 2018). Necessary Condition Analysis (NCA) further demonstrates that green customer pressure acts as a baseline threshold: without a minimum level of consumer-driven sustainability demand, high willingness to integrate is unlikely to materialize, regardless of other favorable conditions (Kitsis & Chen, 2021).

This study contributes to research on platform-based innovation in three ways. First, it highlights the role of demand-side pressures, showing how consumer expectations for sustainability shape firms' willingness to engage with MSPs. By focusing on willingness rather than realized adoption, it captures an earlier stage of decision-making that has received limited attention. Second, it combines institutional theory and diffusion of innovation (DOI) to explain how external pressures and firms' evaluation of innovation characteristics jointly shape willingness to integrate MSPs, offering a more detailed account of how legitimacy concerns and innovation evaluation interact in digital platform contexts. Third, by adopting a configurational approach, the study identifies multiple pathways to MSP engagement under sustainability pressures and shows that willingness arises from different combinations of consumer-driven triggers and internal capabilities. In addition, the use of necessary condition analysis (NCA) reveals that green customer pressure acts as a threshold condition for high willingness to integrate.

The paper proceeds as follows. Section 2 presents the theoretical foundation. Section 3 describes the method. Section 4 reports the results. Section 5 discusses the implications, and Section 6 offers concluding remarks.

2. Theoretical foundations

Consumer demands for sustainability are prompting manufacturing firms to re-evaluate their practices across the value chain (White et al., 2025). This pressure is especially visible in retail, where customers seek transparency about the origin, traceability, and environmental impact of products. In response to these expectations, firms have begun adopting digital solutions that facilitate data exchange between stakeholders and improve the accessibility of external communication (White et al., 2025). MSPs have emerged as effective tools for improving information transparency (Trabucchi & Buganza, 2020), supporting open and collaborative interactions (Marzi et al., 2023), and aligning sustainable production practices with consumer purchasing decisions (Vakeel et al., 2021).

Through their interactive structure and ability to integrate information from multiple sources, MSPs strengthen communication along the supply chain and offer firms new retail channels to engage consumers in value creation and decision-making (Hagiu & Wright, 2015). Yet a firm's engagement with such platforms also depends on the technological relevance of the solution and the organization's internal capabilities to support its effective implementation (Trabucchi & Buganza, 2020). To capture this relationship, we integrate Institutional theory (DiMaggio & Powell, 1983) and DOI theory (Rogers, 2010), arguing that neither framework alone suffices to explain a firm's willingness to integrate MSPs under intensifying sustainability demands. Institutional theory posits that organizations conform to expectations from their external environment to maintain legitimacy (DiMaggio & Powell, 1983; Scott, 2013).

In the context of growing sustainability demands, firms encounter strong normative pressures from customers and society to "go green" and adopt responsible practices (Delmas & Toffel, 2008; Henriques & Sadorsky, 1996). Such pressures include consumer demand for eco-friendly products, industry standards for sustainable product quality, and expectations for stakeholder involvement in environmental initiatives. Firms can respond by aligning their strategies and innovations with these societal demands, thereby seeking legitimacy and gaining competitive advantage (Sharma & Henriques, 2005). While external pressures and concerns about legitimacy shape the broader context for willingness to integrate, they represent only one dimension of the decision-making process. DOI theory (Rogers, 2010) complements this institutional perspective by emphasizing that willingness to integrate also depends on how organizations perceive specific attributes of the innovation, including relative advantage, compatibility with existing practices, and complexity. In the MSP context, relative advantage may reside in the platform's capacity to support sustainability objectives, while compatibility reflects alignment with existing environmental commitments and operational routines.

Two limitations arise when applying the DOI model to platforms. First, the compatibility and observability of a platform's benefits can be uncertain when its value depends on network participation (Marzi et al., 2023). A firm might find an MSP appealing but hesitate if key customers are not committed. Second, DOI theory often assumes that favorable perceptions will translate into actual integration, but a firm may lack the internal capacity to follow through (Marzi et al., 2023). A key factor could be the internal green supply chain management competence, defined as a firm's capability to implement sustainable supply chain practices (Zhu et al., 2013). Firms with stronger internal competence are better prepared to absorb and deploy new digital tools in service of their sustainability efforts, which illustrates how institutional demands and resource-based readiness interact. Institutional pressures thus create the "*why*" for platform willingness to integrate, whereas DOI considerations

clarify the "*how*" by delineating the conditions under which this intention is feasible.

By integrating these theories, we assume that external sustainability pressures influence a firm's willingness to integrate an MSP, while the internal capability shapes its ability and intention to respond through this innovation. Consistent with this view, our framework identifies three key external sustainability pressures and one key internal capability likely to drive a manufacturing firm's intention to integrate an MSP. Green consumer pressure (Huang et al., 2016), product quality (Chavez et al., 2016), and customer involvement in sustainability (Feng et al., 2010), constitute rising market and societal demands that may push firms to innovate. Internal green supply chain management operates as an enabling condition that makes the firm more capable of implementing such innovations (Laari et al., 2018). Each of these factors is assumed to influence the firm's willingness to integrate an MSP as a strategic response to sustainability challenges. Before describing how these factors may combine, we note that while firm size can influence innovation adoption, its effect in MSP retail appears limited. Both SMEs and large firms face similar institutional pressures from environmentally conscious consumers to increase transparency and meet sustainable standards (DiMaggio & Powell, 1983; Leonidou et al., 2013). These external demands often overcome internal structural differences in decisions to adopt MSPs. Moreover, MSPs lower barriers to entry by providing ready-made infrastructure that equalizes market access, ensuring SMEs visibility and credibility once exclusive to large firms (Evans, 2013; Vakeel et al., 2021). Therefore, firm size is treated as a contextual factor rather than a central determinant.

2.1. Consumer-based triggers

2.1.1. Green customers' pressure

The growth of online commerce has reshaped consumer approaches to identifying and assessing sustainable products, leading firms to adopt more structured methods for communicating their environmental practices (Baldassarre & Campo, 2016). Research indicates that environmental knowledge, concern, and personal values influence ethical consumption (Davies & Gutsche, 2016; Jansson et al., 2010), while specific product characteristics, including recyclability and durability, support preferences for sustainable goods (Young et al., 2010). This evolving consumer orientation constitutes a form of normative institutional pressure, wherein socially embedded expectations shape what is perceived as appropriate corporate behavior (DiMaggio & Powell, 1983). Such pressures lead firms to pursue sustainability certifications and adopt environmental standards as a way of signaling conformity to external expectations and strengthening organizational legitimacy (Notaro & Paletto, 2021; Singh et al., 2022).

Conforming to these demands, however, requires more than internal operational changes; it also necessitates the deployment of effective mechanisms for communicating sustainability commitments to stakeholders. As consumers increasingly rely on online platforms for purchasing decisions, firms need to position their products in marketplaces that emphasize sustainability attributes (Ren et al., 2021). MSPs act as intermediaries between firms and consumers and present opportunities for cost savings, revenue growth, and expansion into new markets (Muzellec et al., 2015). Unlike stand-alone websites, MSPs offer greater transparency and interaction, allowing firms to display certifications, manage their profiles, and directly engage with consumers (Hänninen et al., 2019). Some platforms, such as Amazon Seller, further support sustainability communication through programs like Climate Pledge Friendly, which help customers identify sustainable products while promoting a seller's green credentials. MSPs therefore provide a context in which firms can manage brand visibility and communicate sustainability commitments to consumers (Hänninen et al., 2019; Ren et al., 2021).

This communication potential can be further understood through the lens of DOI theory, which posits that innovations are more widely integrated when perceived as compatible with prevailing values and when they are seen as enhancing the firm's capacity to respond to external demands (Rogers, 2010). Together, these frameworks offer a complementary perspective: Institutional theory explains the rise of sustainability as a central logic that organizations are required to follow, while DOI clarifies how innovations gain value when aligned with both a firm's objectives and the broader values embedded in its context. Green consumer pressure thus functions as a source of legitimacy-driven conformity and as a catalyst for the willingness to integrate technological solutions that support institutional alignment.

Proposition 1: *Green consumer pressure influences firms' willingness to integrate MSPs, which in turn enhance transparency around sustainability-related information.*

2.1.2. Product quality

Pressure from green consumers is pushing firms to improve product quality, defined by both functional performance and environmental and social characteristics. This requires firms to strengthen the sustainability of their products and communicate these efforts through credible channels (Aakko & Niinimäki, 2021). Although quality is often connected to features and performance (Bloch, 1995), it is best conceptualized as a relative concept, depending on comparison with predetermined standards or competing offerings (Chavez et al., 2016). Product quality includes multiple dimensions, such as performance, reliability, and compliance (Sebastianelli & Tamimi, 2002). Some definitions also emphasize environmental impact, suggesting that a high-quality product should have an ecological footprint (Kianpour et al., 2014). In online retail environments, this broader view of quality has become even more relevant. Consumers rely on detailed product information, specifications, and reviews to assess quality before making purchase decisions (Ghose & Ipeirotis, 2010; Hu et al., 2006).

Beyond technical specifications, consumers also seek confirmation from peer feedback, using reviews and shared experiences to assess whether a product offers reliability and sustainability (Rausch et al., 2021). Consumers have consequently developed preferences for products that combine performance with ethical and environmental value. MSPs aggregate detailed information about product quality, including descriptions, images, and customer ratings, allowing producers to communicate product quality and helping consumers make informed, value-aligned choices (Hänninen et al., 2019). At the same time, this transparency exerts considerable pressure on firms to maintain high standards (Reichheld, et al., 2023), as shortcomings are quickly surfaced through customer feedback. Manufacturing firms may be inclined to integrate MSPs when they recognize that their target customers place significant weight on product quality and rely on online platforms to evaluate it (Singh, 2013).

DOI theory predicts that platform integration becomes more likely when the innovation provides a relative advantage in communicating product benefits (Rogers, 2010). Firms with a reputation for durable or high-performance products may find these platforms particularly attractive, as features such as customer reviews and ratings can strengthen their brand image and consumer trust. Drawing on the MSP, review system can amplify word of mouth, leading to increased sales and a strong incentive for adoption (Babić Rosario et al., 2016). Institutional theory (DiMaggio & Powell, 1983) further explains how evolving consumer preferences around product quality exert normative pressure on firms, and quality becomes both a performance metric and a signal of legitimacy. Given consumers' renewed focus on products with high quality performance, firms may decide to integrate MSPs as a sales channel since online platforms allow immediate visualization of a product's sustainable characteristics and qualities (Mancha & Gordon, 2021). The presence of comments and feedback creates an immediate accountability mechanism, favoring the digital consumer in the purchasing process (Ghose & Ipeirotis, 2010).

Proposition 2: *Consumer attention to Product Quality exerts an influence on firms' willingness to integrate MSPs which, among other functions,*

contribute to enhancing product attributes toward ethical and environmental values.

2.1.3. Consumers' involvement

Alongside growing demands for sustainability and quality, consumers seek opportunities to influence the design and delivery of the goods they purchase. This expectation for active involvement has made participatory engagement a relevant dimension of market behavior, prompting manufacturing firms to consider MSPs as a strategic retail channel that enables closer interaction with customers (Prahalad & Ramaswamy, 2000).

Existing literature emphasizes that consumers can contribute to product and service development by acting as sources of innovation and feedback. Such involvement may take multiple forms, from suggesting new ideas to evaluating and refining existing offerings (Agrawal & Rahman, 2015). Facilitating these interactions helps firms better respond to evolving needs and supports the continuous adaptation of their offerings (Filieri, 2013). Further research indicates that involvement is often driven by consumers' interest in co-creating value, affirming identity, and aligning consumption with ethical and environmental commitments (Fernandes & Remelhe, 2016; Zhang et al., 2015). This trend is especially evident among younger consumers, who view participation as a channel for expressing personal values and holding firms accountable for sustainability-related concerns (Bedard & Tolmie, 2018). As a result, involvement becomes a way for consumers to shape corporate behavior in line with broader societal expectations (Palakshappa, et al., 2024). Firms that understand the value of such interaction tend to adopt pathways that enable two-way dialogue and collaboration (Wichmann et al., 2022).

Integrating MSPs may therefore become a strategic move to strengthen customer involvement by offering an additional touchpoint for interaction and real-time feedback (Veile et al., 2022). Beyond functional benefits, MSPs can also build brand communities and deepen customer loyalty (Anderski et al., 2023; Chan et al., 2022). Both DOI and Institutional theories emphasize customer involvement, and they clarify why interactive platforms gain relevance. DOI theory suggests that new technologies are more integrated when they align with users' existing needs and social tendencies. In this case, MSPs fulfill consumers' desire for interaction and connectivity by providing a space where customers and firms jointly co-create value. This ongoing dialogue leads to more customer-centric solutions but also ensures that the innovation is perceived as compatible with what users want (Rogers, 2010). Moreover, according to Institutional theory, rising consumer expectations for openness and empowerment can create a type of normative pressure to involve customers in the product experience (Dellaert, 2019).

Proposition 3: *The consumer's desire to be involved in improving a product, as well as voicing their creativity and green expectations supports the willingness to integrate MSP among firms.*

2.2. Firm facilitator: internal green supply chain management

While consumers' green expectations, willingness to buy high-quality products, and desire to be involved in product improvement are consumer-based triggers which may influence the intention of manufacturing firms to integrate MSPs as a retail channel, this integration also requires an internal facilitator (Laari et al., 2018). Prior research suggests that firms deciding to integrate this sales channel should be aware of environmental issues and need to have an internal sustainable culture (Fernández et al., 2003). Therefore, only those firms that consider sustainability as a core organizational value will be well positioned to benefit from MSP integration. Firms with an established commitment to environmental sustainability may consider MSPs as a strategic channel for increasing market share and communicating their sustainability efforts (Dai et al., 2018). This effort is most evident in supply chain management, where firms align procurement, production, and distribution practices with environmental and ethical standards (Laari et al., 2018). Organizations with a green culture tend to select suppliers based on sustainable criteria, prioritizing ethically sourced raw materials and environmentally responsible practices (Alexander, 2020). For instance, many firms are turning to suppliers that meet high sustainability standards, helping to create more competitive and responsible supply networks (Laari et al., 2018).

The development of internal green supply chain management competence has been associated with multiple benefits, including reduced environmental impact, improved organizational learning, and strengthened corporate image (Kitsis & Chen, 2021). Green approaches to sourcing and logistics also support consumer expectations and help build reputation and financial performance (Coskun et al., 2016). MSPs accordingly represent an opportunity to communicate firms' environmental achievements, whether through eco-labels, certified sourcing or low-carbon logistics. This alignment between internal values and external communication is central to maintaining authenticity and ensuring the reputational benefits of a green strategy (Baldassarre & Campo, 2016).

From an institutional standpoint, firms that have invested in sustainability initiatives also face pressures to demonstrate their alignment with societal expectations. In industries where environmental norms and regulations are tightening, these firms are often expected to lead by adopting visible innovations that demonstrate compliance and best practices (Soewarno et al., 2019). MSPs can, in this sense, function as a tool for symbolic conformity (Kitsis & Chen, 2021), while also lowering the barriers to implementing new digital technologies and making platform adoption more feasible. Internal green supply chain management could thus provide both the cultural motivation and the operational capability to engage with MSPs. We therefore posit that a firm's green culture can facilitate the willingness to integrate MSP.

Proposition 4: *A firm's green culture, reflected in its internal green supply chain management, influences the willingness to integrate MSPs by supporting sustainability goals and strengthening firms' capacity to communicate their environmental commitments.*

Consistent with our propositions and the configurational perspective, we examine how consumer-based triggers and the firm-level facilitator combine to generate different pathways toward firms' willingness to integrate MSPs (see Fig. 1).

3. Methodology

3.1. Data collection

This study used a survey to collect data from European SMEs and Large manufacturing firms that do not currently use MSPs to sell their products. The manufacturing sector offers a contextually relevant setting for examining the willingness to integrate the MSPs, given its reliance on traditional offline distribution structures and the distinctive strategic and operational challenges of digital transition (Gong & Ribiere, 2021). Manufacturers frequently contend with potential channel conflicts with incumbent distribution partners and must develop digital competencies to engage directly with end-consumers through MSPs (Reinartz et al., 2019). Concurrently, MSP integration may grant access to broader market segments and allow firms to communicate product-related attributes more effectively, strengthening their presence and consumer interaction (Guandalini, 2022).

In line with established principles of survey design (Groves et al., 2011), a structured questionnaire was developed through an iterative, multi-stage process. An initial draft was constructed based on theoretical constructs identified in prior literature. This version underwent pretesting with a panel of experienced managers from manufacturing firms to evaluate content validity and item clarity. A restricted group of managers assessed the instrument regarding linguistic precision, contextual relevance, and the adequacy of construct representation. Based on their feedback, minor revisions were introduced to improve clarity and alignment with industry-specific terminology. This stage

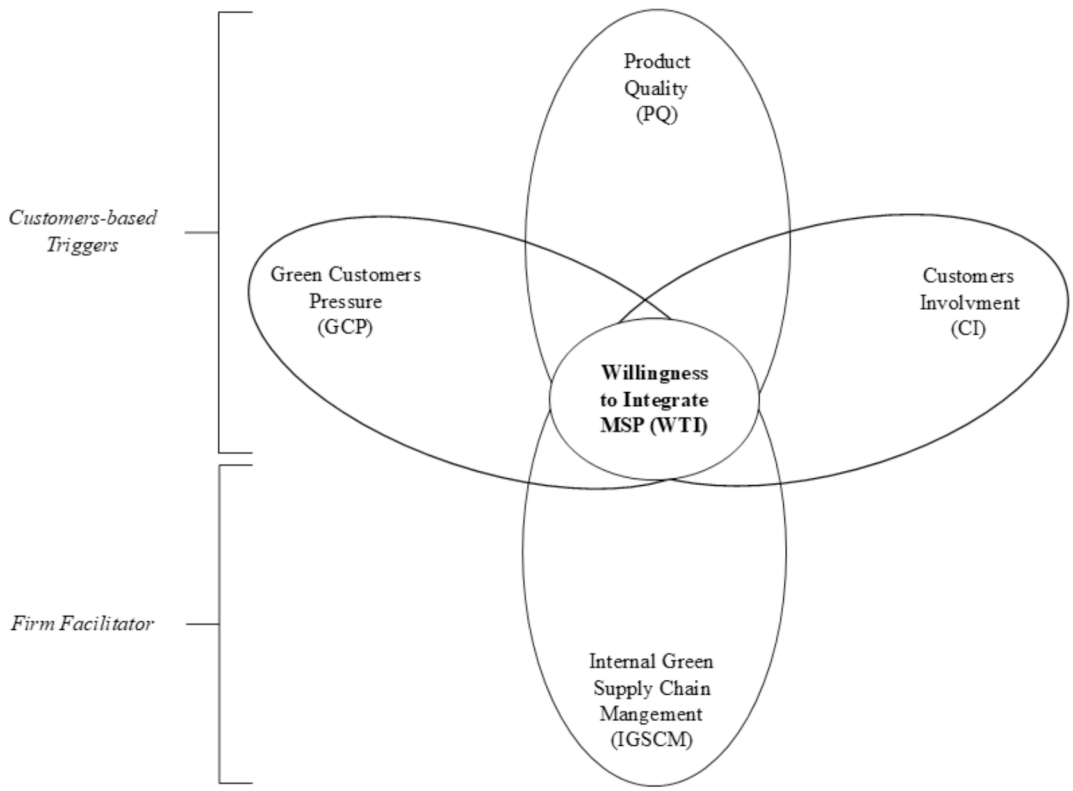

Fig. 1. Theoretical model.

strengthened the face validity of the instrument before broader administration (Groves et al., 2011). The finalized version was subsequently disseminated to a sample of decision-makers within manufacturing firms, with particular emphasis on management roles, given their responsibility for strategic decisions regarding adopting new sales channels such as MSPs. In particular, our sample was mainly composed of middle managers since they are often the actors responsible for assessing compatibility with internal processes, engaging with cross-functional teams, managing interdependencies between platform use and legacy systems, and coordinating with external stakeholders (Ellis et al., 2025). These responsibilities position them as key mediators in the actual adoption and routinization of digital platforms.

We received 325 responses, of which 316 passed the manipulation checks included in the sample. Table 1 represents the sample characteristics.

As a result, we obtained a diverse and experienced sample of managers and entrepreneurs, avoiding single-source bias (Groves et al., 2011).

When using self-administered surveys, respondents may give directional responses (Groves et al., 2011). To address potential common method bias and strengthen data quality, both procedural and post-hoc measures were employed. The survey was administered anonymously and incorporated attention-check and manipulation-check items to identify inattentive or disengaged respondents; all 316 responses met the inclusion criteria. Following data collection, wave analysis and statistical tests for common method variance were conducted with Harman's single factor test (31.11%). A comparison of early and late respondents revealed no statistically significant differences across key constructs, suggesting that non-response bias was absent (Podsakoff et al., 2003). Additionally, a random-split sample analysis yielded no systematic variation between groups based on control variables. Finally, we assessed common method variance using the marker variable technique (Miller and Simmering, 2023). The marker variable showed negligible correlations with all substantive constructs, indicating that common method variance does not significantly affect our results.

Table 1
Sample characteristics.

Respondents' characteristics					
Age			*Gender*		
18–30	22	6.96%	Male	227	71.84%
31–45	170	53.80%	Female	84	26.58%
46–60	104	32.91%	Other	5	1.58%
> 60	20	6.33%			
Industry expertise			*Seniority Level*		
1–5 years	44	13.92%	Junior Manager	37	11.71%
6–10 years	66	20.89%	Middle Manager	204	64.56%
> 10 years	206	65.19%	Senior Manager	75	23.73%
Firms' characteristics					
Size (employee number)			*Manufacturing Sector (NACE)*		
5–20	22	6.96%	Chemicals	36	11.39%
21–50	34	10.76%	Computer and Electronics	72	22.78%
51–250	63	19.94%	Electrical and Machinery	44	13.92%
251–500	47	14.87%	Metallic	44	13.92%
> 500	150	47.47%	Motor vehicles and transports	28	8.86%
			Food	39	12.34%
Total SMEs (≤250 employees)	119	37.66%	Pharmaceutical	27	8.54%
Total Large Firms (>250)	197	62.34%	Plastics and non-metallic	26	8.23%

3.2. Measures

All measurement items in the survey were adapted from prior studies to ensure content validity. Table 2 summarizes the constructs and sources, and their reliability. Each construct was measured with multiple items on a seven-point Likert scale (1 = "strongly disagree" to 7 =

Table 2
Constructs and reliability checks.

Constructs and Items		α	ω	AVE
GCP1	Among our customers there is an increased awareness of environmental issues	0.831	0.837	0.597
GCP2	Our customers prefer environmentally friendly products			
GCP3	Our customers have a continuous attention to our firm' environmental behavior			
GCP4	Our customers are pay attention to green supply chain management			
PQ1	Our customers expect high performance products	0.865	0.854	0.582
PQ2	Our customers expect products of consistent quality with few defects			
PQ3	Our customers desire highly reliable products			
CI1	Our customers often put forward improving proposes for our products	0.756	0.762	0.531
CI2	We often hear customers' opinions on product prototypes when developing new products			
CI3	We wish to involve customers in the product design and development stage			
CI4	Our customers have a major influence on the design of new products			
CI5	There is a strong consensus in our firm that customer involvement is needed in product design/development			
CI6	We have continuous improvement programs that include our customers			
IGSCM1	Being environmentally conscious is an integral part of our corporate culture	0.811	0.832	0.526
IGSCM2	We plan the deliveries of the firm to minimize environmental impacts			
IGSCM3	We utilize green marketing for our products and/or services			
IGSCM4	We do cross-functional cooperation for mitigating environmental impacts			
WTI1	Given the chance we intend to use multi-sided platform in our firm	0.856	0.849	0.591
WTI2	We are willing to use multi-sided platform in the near future in our firm			
WTI3	We plan to use multi-sided platform in our firm			
WTI4	We will recommend multi-sided platform to other firms			
WTI5	We predict that we should use multi-sided platform in our firm			

"strongly agree"). Below, we detail each construct and the source of its scale, noting any adaptations and their implications for reliability and validity (Groves et al., 2011).

We measured external Green Customer Pressure (GCP) using a four-item scale from Huang et al. (2016). The scale gauges the extent to which customers' environmental expectations and demands influence the firm. We assessed Product Quality (PQ) using a three-item scale from Chavez et al. (2016). This scale focuses on the firm's emphasis on delivering high-quality products, including objective and subjective quality aspects. We measured Customers' Involvement (CI) in the firm's processes using a six-item scale from Feng et al. (2010). This construct captures the extent of customer engagement or participation in product development and feedback loops. We used a four-item scale from Laari et al. (2018) to measure the firm's Internal Green Supply Chain Management (IGSCM). These items reflect the degree to which a firm emphasizes sustainable practices in its operations (e.g., selecting eco-friendly suppliers and reducing waste in production). The dependent variable, Willingness to Integrate MSP (WTI), was measured with a five-item scale adapted from Pappas et al. (2021). These items measure a firm's intention and readiness to integrate an MSP, reflecting the perceived benefits and strategic importance of joining such a platform. We ensured that the items reflected the different dimensions of willingness (such as intent to allocate resources to MSP onboarding, the belief that MSP integration would be advantageous, and the likelihood of adopting in the near future). The adapted WTI scale showed satisfactory reliability.

Discriminant validity was assessed using the Fornell-Larcker criterion (Fornell and Larcker, 1981), requiring the square root of each construct's AVE to exceed its correlations with all other constructs. This condition is satisfied across all construct pairs, with AVE square roots ranging from 0.725 (IGSCM) to 0.772 (GCP). The only borderline case is the correlation between GCP and IGSCM ($r = 0.759$), which approaches but does not exceed GCP's AVE square root (0.772). This result is theoretically consistent given that GCP may drive and reinforce IGSCM. Overall, the results support the discriminant validity of the measurement model.

3.3. Analytical approach

First, to estimate the latent constructs underlying the survey items, the analysis followed a congeneric measurement approach, which improves the accuracy and representativeness of latent construct estimation (McNeish & Wolf, 2020). The CLC Estimator software was used to implement this approach (Marzi et al., 2023b), with weights imputed using the maximum likelihood method.

Next, given the exploratory nature of our research, we employed a combination of fsQCA and NCA to analyze the data. Using both methods allows us to uncover complementary insights: fsQCA identifies configurations of conditions sufficient for high willingness to integrate MSPs (Woodside, 2013), while NCA assesses to what extent each condition is necessary (to some degree) for the outcome (Dul, 2016). This mixed-method analytical strategy is motivated by recent methodological developments advocating a shift from purely symmetric, net-effects thinking (as in regression) to asymmetric, configurational reasoning in business research (Woodside, 2013).

fsQCA is a set-theoretic method that examines how combinations of causal conditions relate to an outcome regarding set memberships. It is particularly suitable for studying multifaceted phenomena characterized by causal asymmetry and equifinality, where multiple paths can lead to the same outcome (Ragin, 2000; Woodside, 2013). Rather than assuming linear, additive effects of independent variables, fsQCA explores how attributes work in combination, aligning with the idea that organizational outcomes often arise from configurations of factors (Ragin, 2000). In our context, a firm's decision to integrate an MSP may not be driven by any single factor in isolation, but by certain bundles of external triggers and internal facilitators acting together.

While fsQCA focuses on sufficiency (identifying how an outcome can occur via different paths), NCA provides a complementary lens by examining necessity more nuancedly. A condition is necessary if the outcome cannot be achieved without it, even if the condition alone does not guarantee the outcome (Dul, 2016). NCA is particularly valuable because it can quantify necessity in degree, determining how much of a condition is required for a certain outcome level. Traditional techniques like regression and SEM are ill-equipped to detect such constraints, as they focus on average effects and assume all else can compensate for a lacking factor. In contrast, NCA identifies "bottleneck" conditions that act as binding thresholds: if a necessary condition is below a certain level, the desired outcome level is unattainable, no matter how favorable other factors are (Dul, 2016; 2019).

NCA computes a ceiling line for each independent variable in a scatter plot of the condition (X-axis) against the outcome (Y-axis). The ceiling line marks the upper boundary of data points; in other words, it shows the highest outcome level observed for a given condition level. Points above this line are theoretically difficult given the data; thus, the line represents X's limitation on Y. The ceiling envelopment–free disposal hull (CE-FDH) method to draw the ceiling line is recommended for monotonic necessity analysis (Dul, 2016). CE-FDH creates a stepwise function connecting the top-left points in the data cloud, ensuring that all observations lie at or below the line.

NCA provides two key statistics: the effect size (d) of each condition's necessity and a significance test (p-value) for that effect (Dul, 2016). The effect size represents the proportion of the outcome space constrained by the ceiling (the "empty space" where no observations appear above the ceiling). We followed the conventional benchmarks for interpreting d: <0.1 indicates a small necessity effect, 0.10–0.30 a medium effect, 0.30–0.50 a large effect, and > 0.50 a very large effect (Dul, 2016; 2019).

Additionally, we generated a bottleneck table for each necessary condition (Dul, 2016; 2019). The bottleneck table translates the ceiling analysis into actionable thresholds by listing, for various desired levels of the outcome, the minimum level of the condition required to reach that outcome level.

Using fsQCA and NCA in combination allows us to draw on the complementary strengths of each method while offsetting their respective limitations. FsQCA excels at identifying multiple sufficient paths (configurations) to an outcome, a property that aligns with the principle of equifinality in multilayered systems (Fiss, 2011; Pappas et al., 2016). However, fsQCA's analysis of necessity is typically limited to binary "in-kind" statements (a condition is either necessary or not, based on a consistency threshold) and may overlook nuanced degrees of necessity (Dul, 2016). Moreover, the configurational analysis often focuses on sufficient configurations and may report a condition as peripheral or absent in some solutions, which could understate its significance as a universal prerequisite. On the other hand, NCA is explicitly designed to detect necessary conditions and quantify the degree of necessity. It can reveal if a factor sets a fundamental limit on the outcome (for instance, no high willingness to integrate occurs unless a minimum level of customer pressure is present) even if that factor does not appear in every causal combination. Indeed, prior comparisons have found that NCA can identify more necessary conditions (and required levels) than fsQCA's built-in necessity analysis, providing a more complete picture of constraint relationships. By combining these methods, our analysis addresses both configuration-focused questions ("What combinations of factors can lead to the willingness to integrate the MSP?") and constraint-focused questions ("What factors must reach a certain level for the willingness to integrate the MSP?").

4. Results

4.1. fsQCA procedures

We followed established procedures for fsQCA (Ragin, 2009; Pappas & Woodside, 2021) using the software fsQCA 4.1 (Ragin, 2009). The first step was calibrating all our Likert-scale measures into fuzzy-set membership scores. Calibration transforms raw scores (ranging 1–7) into values between 0 and 1, where 0 indicates full non-membership in a set (e.g., "low product quality"), 1 indicates full membership ("high product quality"), and 0.50 is the crossover point of maximum ambiguity (neither in nor out of the set). Because our constructs do not have natural or theoretical breakpoints (no a priori crisp thresholds define what constitutes "high" versus "low" for these perceptions), we used a percentile-based calibration approach. In line with Ragin's (2009), we set three cut-off points for each variable: the 95th percentile of the raw score distribution as the threshold for full membership (fuzzy score = 0.95), the 50th percentile (median) as the crossover point (fuzzy score = 0.50), and the 5th percentile as the threshold for full non-membership (fuzzy score = 0.05). This approach is commonly adopted when theoretical calibration thresholds are unavailable. It ensures that the calibration is sensitive to the data distribution while imposing meaningful qualitative distinctions (high vs. medium vs. low levels of a condition). Table 3 reports the calibrated values for each variable and confirms that the calibration produced substantial variation in membership scores across cases.

After calibration, we performed necessity analysis within fsQCA and then the sufficiency analysis to derive combination solutions for high willingness to integrate MSP (outcome set = WTI). None of the individual conditions exceeded the conventional consistency threshold of 0.90 for necessity on their own, which indicates that no single factor was a trivial necessary condition for the outcome across all cases, a finding we revisit with NCA below. We then used the truth table algorithm to identify sufficient configurations. Each case (firm) was assessed for membership in combinations of conditions, and we applied a frequency threshold of 2 to consider a configuration empirically relevant. We also set a minimum consistency threshold of 0.80, ensuring that the cases subscribing to a given combination consistently exhibit high WTI (Ragin, 2009; Schneider & Wagemann, 2012).

We obtained four distinct combinations (solutions) of conditions that met the consistency and coverage criteria. Following Fiss's (2011) and Ragin's (2009) approaches, we distinguished core and peripheral conditions in each solution to facilitate interpretation. Core conditions appear in the intermediate and parsimonious solutions, indicating a strong, robust causal role; peripheral conditions appear only in the intermediate solution, suggesting a contributing but less central role. This differentiation is useful for identifying the most influential factors within each configuration (Pappas et al., 2016). We summarize the fsQCA results in Table 4, which lists the configurations, consistency, and coverage scores. All reported solutions have consistency well above 0.80, indicating they are empirically reliable patterns. Coverage values (raw and unique) show the proportion of outcome cases each combination explains.

The raw coverage for individual solutions ranges from approximately 0.38 to 0.56, and the solutions have some overlap (as indicated by unique coverages slightly lower than raw coverages), which is expected in configurational analyses where different paths can share certain cases or elements. The overall solution consistency is 0.753, slightly below the commonly cited 0.80 threshold. However, prior

Table 3
fsQCA calibration.

Constructs	**Mean**	**SD**	**Calibration (Fuzzy Score)**		
			Non-Member (0.05)	**Cross-Over (0.50)**	**Full Member (0.95)**
GCP	4.885	1.324	2.500	5.000	6.750
PQ	4.907	1.257	2.333	5.000	7.000
CI	4.884	1.362	2.158	5.333	6.500
IGSCM	4.546	1.471	2.000	4.750	6.500
WTI	4.389	1.456	1.400	4.400	7.000

Table 4
Results of the fsQCA analysis.

Solution Configuration	S1	S2	S3	S4
GCP	●		⊗	●
PQ	●	●	●	⊗
CI		⊗		●
IGSCM	●		⊗	
Consistency	0.844	0.820	0.834	0.826
Raw Coverage	0.564	0.469	0.405	0.378
Unique Coverage	0.146	0.029	0.043	0.046
Overall solution consistency	*0.753*			
Overall solution coverage	*0.776*			

Note: Black circles (●) indicate the presence of a condition, and circles with "x" (⊗) indicate its absence. Large circle; core condition, Small circle; peripheral condition; Blank space; "don't care" condition

fsQCA research indicates that overall consistency can vary depending on the structure and number of configurations included in the solution. Since all individual configurations exceed the 0.80 threshold and display satisfactory coverage, the overall solution can be considered robust and theoretically coherent (Stroe et al., 2018).

Moreover, we assessed the robustness of our findings through a sensitivity analysis by varying the consistency threshold. The results remain stable across alternative threshold specifications, indicating that the identified configurations persist under different analytical conditions. To further ensure that our findings are not artifacts of specific calibration choices, we re-calibrated all conditions using alternative anchors: (1) the 10th, 50th, and 90th percentiles, and (2) the median as the crossover point with full-in/full-out cutoffs at median ± 1 standard deviation (Schneider and Wagemann, 2010; 2012). The fsQCA analysis was re-run under these calibration schemes. Results remained stable, with the same core configurations emerging as sufficient for the outcome. Consistency and coverage scores varied minimally across calibration methods, and necessity conditions were preserved. These tests confirm that our configurational solutions are robust to alternative calibration approaches.

For interpretive clarity, we label the four solutions as follows: S1 (Alignment), S2 and S3 (Quality-centric), S4 (Consumer-centric). These labels are used consistently in both the results and discussion sections. Fig. 2 offers a graphical representation of fsQCA Solution.

4.2. fsQCA solution

As reported in Table 4 and Fig. 2, in S1, PQ appears as the core condition, while GCP and IGSCM appear as peripheral contributing conditions; CI has a do not care condition. This combination suggests that firms offering high product quality and experiencing green customer pressure are willing to integrate MSPs, particularly when they can draw on an internal green culture to support those efforts. The presence of both GCP and IGSCM, even as peripheral conditions, indicates an alignment of internal values with external expectations. S1 is consistent with the argument that external drivers prevail when customer sustainability expectations are high and product quality is strong; under these conditions, firms perceive MSP integration as an opportunity to signal and draw on these strengths.

S2 and S3 are both quality-centric configurations, as they are characterized by high PQ as the core condition shaping willingness to integrate MSPs. In S2, high PQ is combined with absent CI. In this pathway, firms express willingness primarily on the basis of PQ, even without active customer involvement. PQ operates as a sufficient demand-side evaluative signal, suggesting that firms perceive MSPs as effective channels to communicate established product standards independently of participatory engagement. S3 similarly centers on high PQ but is distinguished by the absence of both GCP and IGSCM. In this configuration, firms display willingness despite lacking green customer pressure and an embedded internal sustainability approach. While PQ continues to function as the central signal through which firms interpret consumer expectations in digital marketplaces, the absence of IGSCM indicates that sustainability routines are not structurally integrated into organizational processes, and the absence of GCP suggests that willingness can emerge even without active external sustainability demands. These configurations indicate that strong PQ can generate willingness under different surrounding conditions. S3 further indicates that a robust internal green capability is *not* necessary in every adoption scenario. Some firms may pursue MSP integration purely for market and performance gains, setting aside sustainability values. In S4 (Consumer-centric) GCP and CI are core conditions, while PQ is absent and IGSCM plays no role. In S4, firms facing high external green pressure and having actively involved customers drive the willingness to integrate MSP, even if the firm's PQ is not top-tier and the internal sustainability culture is weak. This pathway can be interpreted as a customer-driven innovation path: strong signals from customers, in terms of pressure for green practices and direct involvement in the firm's activities, push the firm to integrate the platform to respond to customer expectations and engagement.

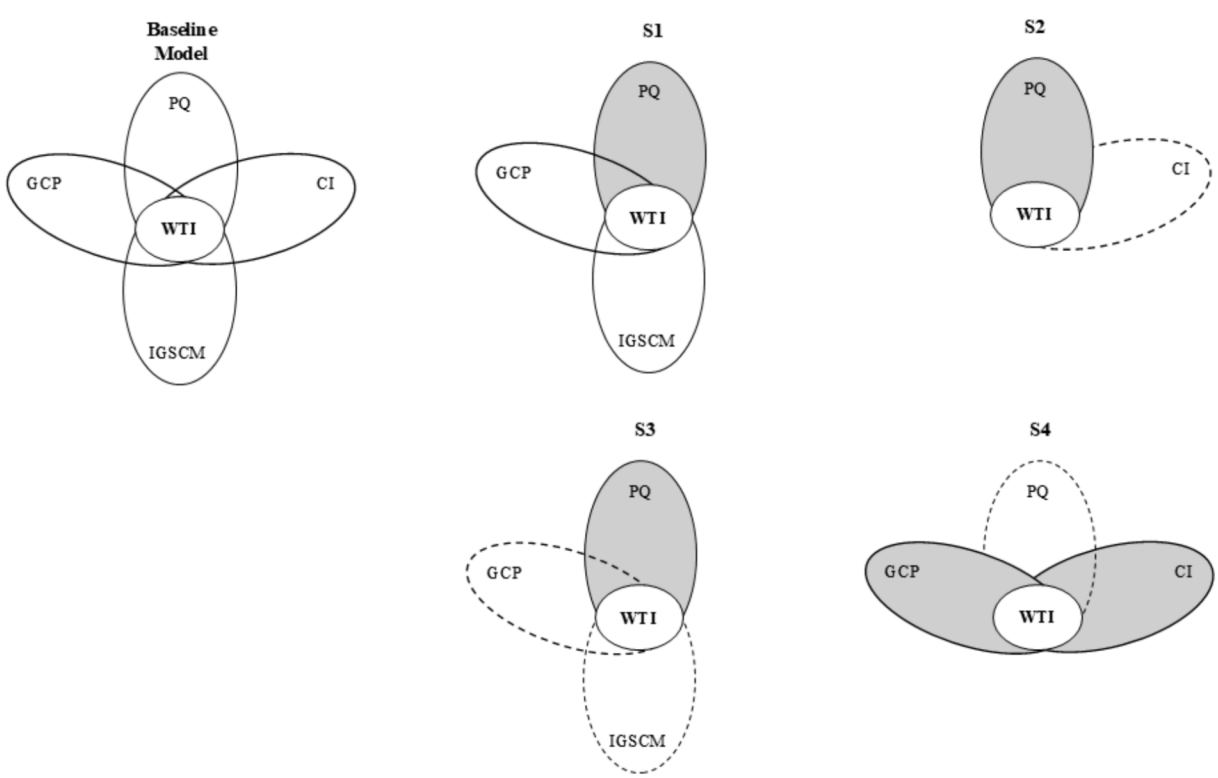

Fig. 2. Graphical representation of fsQCA solution. **Note:** Bold lines indicate the presence of a condition; dashed lines indicate its absence. Solid-filled circles indicate the presence of a core condition; dashed-filled circles indicate the absence of a core condition. The absence of circles indicates a "don't care" condition.

4.3. NCA procedures

We conducted NCA using the statistical package provided by Dul (2022) in R. For each independent variable (GCP, PQ, CI, IGSCM), NCA computes a ceiling line in a scatter plot of the condition (X-axis) against the outcome (Y-axis) that we reported in Fig. 3. As recommended for monotonic necessity analysis, we chose the CE-FDH method to draw the ceiling line (Dul, 2016).

Additionally, we generated a bottleneck table for each necessary condition (Dul, 2016) in Table 5. The bottleneck table translates the ceiling analysis into actionable thresholds by listing, for various desired levels of the outcome (WTI), the minimum condition level required to reach that outcome level. For example, it might show that to achieve a 75% level of WTI, a firm must have at least a certain score in GCP; to achieve 90% WTI, an even higher GCP is required, etc. This clearly articulates managerial implications: it tells decision-makers how much they must improve or maintain a certain factor if they aim for a particular target in the outcome.

Table 5
Necessary condition analysis (NCA).

Effect of condition X on Y	GCP	PQ	CI	IGSCM
CE-FDH	0.118	0.006	0.095	0.076
p-value	0.004	Not significant	0.003	0.002
Effect size	Medium	Not Significant	Small	Small
Bottlenecks CE-FDH X on Y				
WTI (Y)	GCP	PQ	CI	IGSCM
0%	–	–	–	–
10%	–	–	–	–
20%	–	–	–	–
30%	–	–	–	–
40%	–	–	–	–
50%	–	–	–	–
60%	–	–	–	–
70%	16.70%	–	14.70%	20.80%
80%	16.70%	–	14.70%	20.80%
90%	54.20%	–	41.20%	20.80%
100%	54.20%	–	47.10%	41.70%

4.4. NCA results

In Fig. 3, GCP emerged as the most influential necessary condition among the four conditions. GCP had an effect size of d = 0.118, which falls in the medium necessity effect range, and this effect was statistically significant (p = 0.004). In practical terms, d = 0.118 means that 11.80% of the outcome space is constrained by GCP: there is a non-trivial empty area in the top-left corner of the GCP vs. WTI plot where higher WTI scores are not observed unless GCP is also high. Thus, while GCP alone does not guarantee high WTI, insufficient GCP will limit how high WTI can go. This finding supports the notion that if no green pressure from customers exists, it is highly unlikely for a manufacturing firm to be fully willing to integrate MSP; some external push appears to be a necessary catalyst.

CI and IGSCM both showed small but statistically significant necessity effects. CI had d = 0.095 (p = 0.003) and IGSCM had d = 0.076 (p = 0.002). These small effect sizes suggest that each factor imposes a modest ceiling on WTI. There is a slight limitation such that without at least minimal customer involvement or some level of internal green practices, a very high willingness to adopt MSP might not occur. However, the relatively low d values indicate that these are not strong constraints; many firms can still achieve moderately high WTI with low CI or IGSCM, but for the absolute highest levels of WTI, some presence of these conditions is needed.

PQ had an effect size of d = 0.006 and is statistically non-significant. This means PQ was not found to be a necessary condition for the willingness to integrate MSPs – there is no evidence of a ceiling effect for PQ. In other words, across our sample, we do not see that WTI is inherently limited by PQ; firms with relatively lower product quality (as perceived internally) could still be willing to integrate MSPs if other conditions align. This result dovetails with the fsQCA finding that PQ is absent in one of the pathways (S4). It suggests that, from a necessity standpoint, PQ is more of a sufficient driver (when high, it helps, as seen in three configurations) but not a required baseline. A likely explanation is that quality is a hygiene factor in this context: most manufacturing firms in our sample may already meet a minimum quality standard necessary to operate in the market. Thus, variation above this threshold does not restrict firms' willingness to integrate MSPs. Firms offering products of moderate quality may still choose to integrate MSPs in response to

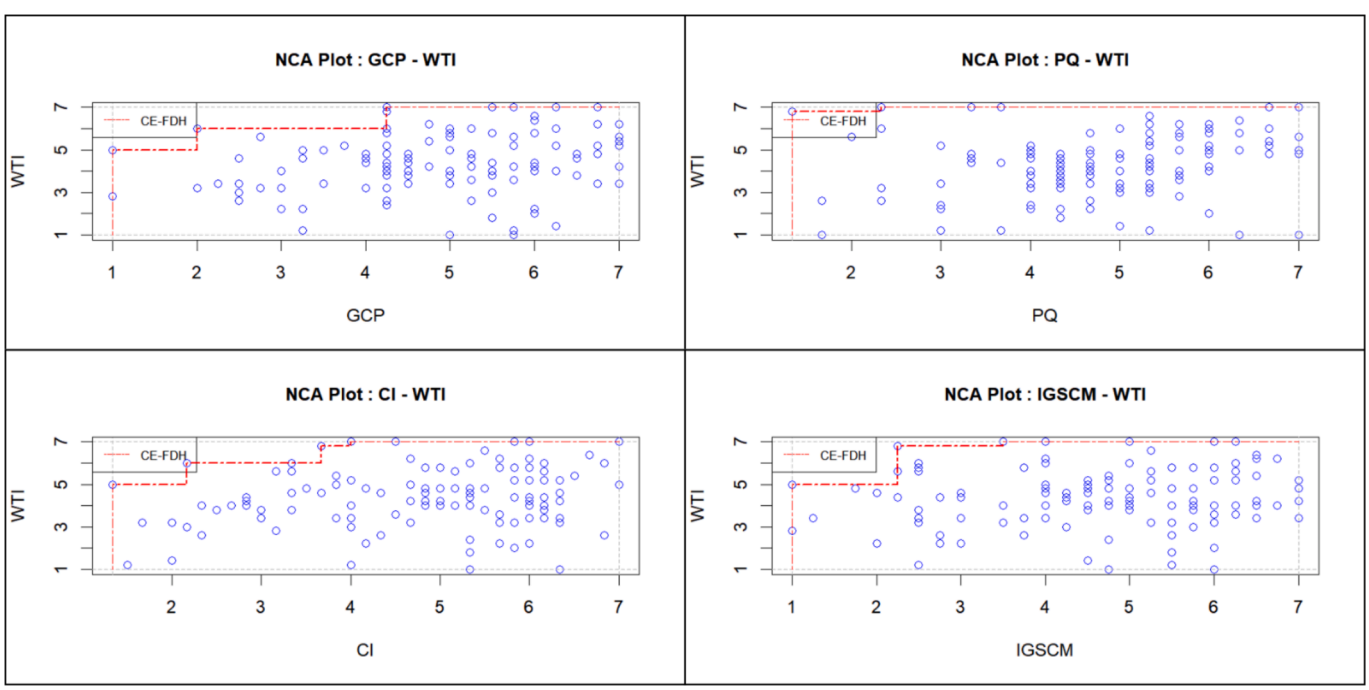

Fig. 3. NCA plots.

external pressures or stakeholder involvement, provided that product quality does not fall below a minimum acceptable level.

The bottleneck table (Table 5) provides concrete thresholds of necessity. For illustration, consider the levels of WTI at 70%, 80%, 90%, and 100% of the full range (with 100% representing maximum willingness). According to our bottleneck findings, to achieve around 70% of the maximum WTI, a firm needs to have at least roughly 15–20% of the range of each necessary predictor in place: specifically, GCP about 0.17 (17% of full GCP scale), CI about 0.15, and IGSCM about 0.21 (values here are normalized percentages of the condition scales for ease of interpretation). These figures indicate minimum conditions: e.g., for a fairly high level of WTI (around 70%), a minimal presence of green pressure (17%) is required, along with a minimal level of CI and IGSCM (around 15–20% of their scales). Notably, PQ has no entry in this range, reinforcing that even to reach moderately high WTI, there isn't a binding PQ requirement.

As we push to 90% and above WTI levels, the necessary conditions increase. GCP becomes more demanding: to attain ~90% WTI, the firm's GCP needs to be more than half of its full possible value (in our calibration, this corresponds to a firm needing a very strong green push from customers, approximately 54% on the normalized scale). For 100% WTI (the absolute highest willingness), our analysis suggests GCP must be around 0.54 (54% of the GCP scale), and similarly high levels are needed for CI (~47%) and IGSCM (~42%) at that extreme.

Finally, to test for any possible divergent patterns among SME and large-firm subsamples, we also conducted a set of separate fsQCA and NCA analyses (Fiss, 2011). No substantial differences were observed in the results. Thus, neither fsQCA nor NCA identified firm size as a relevant differentiating factor in the configurational pathways leading to willingness to integrate MSPs, nor as a necessary condition for this outcome.

5. Discussion

The fsQCA yielded four causal configurations, Alignment (S1), Quality-centric (S2-S3), and Consumer-centric (S4), indicating that willingness to integrate MSPs emerges from alternative combinations of consumer-based triggers and internal organizational conditions rather than from any single determinant. Each pathway reflects a distinct way in which sustainability pressures and firm-level characteristics shape how MSPs are evaluated as strategic retail channels.

The Alignment configuration (S1) is the broadest pathway in which strong green consumer pressure coexists with high perceived product quality and is reinforced by internal green supply chain management. External sustainability expectations activate legitimacy concerns that orient firms toward retail channels capable of making environmental commitments visible (Dhir et al., 2021; Leonidou et al., 2013). In parallel, MSPs are evaluated as advantageous because they increase transparency through certifications, eco-labels, and traceability mechanisms (Mancha & Gordon, 2021; Principato et al., 2023; Veile et al., 2022). These features increase observability and strengthen perceived relative advantage (Kwon et al., 2021; Rogers, 2010), as transparency in sustainability practices has been associated with consumer trust and positive purchasing behavior (Dhir et al., 2021; Jin & Tsujimoto, 2025; Smith & Brower, 2012). Internal green supply chain management consolidates this alignment by ensuring that externally communicated sustainability practices are grounded in operational routines (Laari et al., 2018). MSP integration in S1 thus reflects coherence between external expectations and internal readiness rather than symbolic compliance (DiMaggio & Powell, 1983), with the platform serving as an infrastructure through which firms connect sustainability commitments with retail visibility.

The Quality-based configurations (S2 and S3) show that product quality can act as a central condition shaping willingness to integrate MSPs, though in combination with different surrounding elements. In both pathways, high product quality increases the attractiveness of MSPs because platforms enhance the visibility and comparability of product attributes through reviews, ratings, and detailed information (Ghose & Ipeirotis, 2010; Rodriguez & Piccoli, 2024). Relative advantage and observability (Rogers, 2010) are particularly salient, as firms recognize that product quality can be communicated effectively in digital retail environments (Hänninen et al., 2019). However, the two configurations diverge in how institutional and organizational conditions interact with product quality. In S2, customer involvement is absent. This suggests that firms may perceive lower direct pressure from participatory or engagement-based sustainability expectations (Agrawal & Rahman, 2015; Prahalad & Ramaswamy, 2000). Willingness in S2 appears driven primarily by DOI-related considerations: firms evaluate MSPs as suitable channels to communicate existing product quality, rather than as mechanisms to respond to active stakeholder engagement. The logic is evaluation-driven, with compatibility interpreted as fit between platform functionalities and established product standards (Chavez et al., 2016; Peltier et al., 2020). In S3, internal green supply chain management is absent, and willingness develops despite the lack of embedded sustainability capability. Product quality remains the central signal through which consumers assess value in online marketplaces (Smith & Brower, 2012). In this configuration, willingness to integrate MSPs is linked to the perception that consumers demand visible and comparable quality standards, and that platforms provide an effective infrastructure for meeting those expectations (Fraj-Andrés et al., 2009; Miles & Covin, 2000). The absence of internal green supply chain management suggests that sustainability routines are not structurally embedded in organizational processes, yet firms may still perceive MSP integration as necessary to remain aligned with market expectations. This pattern reflects institutional arguments about decoupling (DiMaggio & Powell, 1983), whereby external responsiveness may precede full internal integration.

In the Consumer-Centric Path (S4), green consumer pressure and customer involvement are the core conditions for willingness to integrate MSPs, even in the absence of high product quality or internal competencies. Despite the S4 path demonstrating the lowest level of empirical relevance amongst the four possible paths, it is adopted with a high degree of consistency. Firms may turn to MSPs when external demand-side pressures are present, regardless of internal readiness or product attributes. Firms that adopt this approach are compelled to respond to the imperatives of institutional legitimacy (Pache & Santos, 2010; Zhu et al., 2013). This, in turn, reframes how firms interpret innovation attributes. Compatibility is interpreted as adherence to societal and environmental expectations (Humphreys, 2010), particularly the normative demands of environmentally conscientious consumers. Taken together, the Consumer-Centric path suggests that external pressures and customer involvement shape the intention to integrate MSPs, while product quality and internal supply chain management appear to be deemed not required.

5.1. Implications

This study investigates how external, consumer-based factors and internal organizational enablers interact to shape a firm's willingness to integrate MSPs. Anchored in the DOI theory and Institutional Theory, the analysis employs a configurational approach, namely fsQCA and NCA, to identify pathways reflecting different adoption logics across firms.

The findings contribute to theory in several ways. The primary contribution is the enrichment of DOI with an institutional dimension and the extension of Institutional Theory to digital platform strategies. The traditional perspective of DOI theory, which emphasizes innovation attributes such as relative advantage and compatibility (Rogers, 2010), is expanded by incorporating external institutional pressures into the innovation willingness to integrate processes. We find that sustainability-oriented consumers enhance firms' perceived value of MSPs by conceptualizing them as innovations that confer legitimacy by

aligning with prevailing environmental norms. This finding supports recent calls for context-sensitive DOI frameworks (Kwon et al., 2021) by illustrating that innovation benefits are shaped by societal expectations. The implementation of fsQCA enriches DOI theory by emphasizing equifinality. Firms can follow distinct strategic logics, such as combining consumer pressure with internal readiness or with active consumer engagement (Cervelló-Royo et al., 2020). Therefore, the willingness to integrate the platform is shaped by diverse motivational factors that are contingent on context.

Concurrently, the NCA results align with the DOI premise that specific conditions may be necessary but insufficient for willingness to integrate (Dul, 2016). The results indicate that a baseline level of consumer pressure is necessary for the consideration of MSP integration.

The contribution to Institutional theory is twofold. First, by positioning consumers as institutional agents of change (Huang et al., 2016; Kong et al., 2021), we show that market-driven expectations are central forces in shaping legitimacy imperatives. Consumer engagement constitutes a salient normative driver, creating strategic pressure for firms to align digital innovation efforts with environmentally responsible practices (Odou & Schill, 2020; Mostaghel & Koteshwar, 2021). In this context, MSP integration can function as a symbolic gesture that signals transparency and environmental responsibility, aligning firms with societal norms and reinforcing consumer trust (Kong et al., 2021). Second, the findings demonstrate the impact of internal green supply chain management on firms' responses to external normative pressures. Although not sufficient per se, internal sustainability orientation strengthens a firm's capacity to respond to external normative pressures. When aligned with external expectations, it reinforces legitimacy. Conversely, firms lacking such alignment may intend to integrate MSPs in a symbolic manner, reflecting decoupling dynamics (Baldassarre & Campo, 2016).

From a managerial perspective, the findings point to several actionable decisions for manufacturing firms. MSP integration is not a one-size-fits-all move; managers should align their platform strategy with the specific configuration of external pressures and internal capabilities they face.

First, green consumer pressure should be treated as a strategic signal. Monitoring shifts in customer expectations can inform the timing of platform entry and help managers anticipate when MSP participation becomes necessary to maintain market relevance. Firms operating in markets where green pressure has not yet reached a meaningful threshold may benefit from investing in demand-side awareness or eco-labeling initiatives before committing resources to MSP onboarding.

Second, MSPs function as a channel for signaling product quality and sustainability commitments. High-quality standards and environmental certifications act as legitimacy signals in digital marketplaces (Ghose & Ipeirotis, 2010; Li & Simcoe, 2021), and the transparency features of MSPs reinforce firms' ability to communicate these attributes. Managers should ensure that quality and sustainability claims are clearly documented and verifiable within platform environments, since the review mechanisms built into MSPs will surface any gap between claims and reality.

Third, MSPs facilitate customer engagement through interactive tools such as feedback loops, ratings, and feature voting. These mechanisms provide continuous signals about customer expectations and perceived performance. Firms can use this feedback to refine their offerings and align sustainability initiatives with market demands over time.

Taken together, these insights suggest that platform integration is a contingent decision shaped by how firms interpret external pressures and draw on their internal strengths.

These findings also inform platform providers. As firms' willingness to integrate is shaped by demand-side sustainability pressures, platforms can encourage participation by embedding these pressures into their design and governance. Features that increase the visibility of sustainability attributes and enable customer feedback can strengthen firms' incentives to participate, thereby facilitating actual platform integration.

6. Conclusion and limitations

This study extends research on platform strategy by showing how external demands and internal conditions jointly shape willingness to integrate decisions. For managers, the findings stress the need to align market awareness with internal preparation. Firms that respond to environmental expectations while developing sustainable practices are better positioned to integrate MSPs as a source of competitive advantage. For platform providers specifically, the configurational evidence suggests that governance features emphasizing sustainability transparency may lower participation barriers for firms already facing strong green customer pressure.

Several limitations should be noted. First, the cross-sectional design limits causal inference and calls for longitudinal studies that can trace the evolution of MSP adoption dynamics over time (Podsakoff et al., 2003). From a methodological perspective, fsQCA and NCA provide limited understanding on the causal mechanisms or temporal dynamics underlying these relationships (Woodside, 2013; Dul, 2016). Although all constructs meet the recommended threshold for convergent validity (AVE $>$ 0.50), the AVE values are relatively close to the cutoff, suggesting that future research could further refine and strengthen the measurement scales. Although firm size exhibited minimal influence, other organizational characteristics, including industry-specific regulatory contexts, corporate governance structures, or leadership styles, may moderate MSP adoption decisions and warrant examination in further studies. Future research could examine firms' willingness to integrate MSPs across different contexts, such as B2B versus B2C environments and developed versus emerging markets, to assess whether distinct institutional and technological factors shape this orientation (Shree et al., 2021). In addition, longitudinal studies could explore how willingness to integrate evolves into actual adoption over time and whether sustained external pressures lead to changes in firms' internal sustainability orientations. Research could further investigate post-integration outcomes to distinguish between symbolic and substantive forms of adoption. Finally, applying a configurational approach to other sustainability-driven digital innovations, such as blockchain-based traceability systems, would test the generalizability of the framework and advance theory on willingness to integrate digital sustainability tools.

CRediT authorship contribution statement

Anna Marrucci: Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Giacomo Marzi:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Yuliia Kyrdoda:** Writing – review & editing. **Donata Vianelli:** Funding acquisition.

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