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Virtual Integration in SMEs: The Digitalization Circuitry of Dynamic Strategic Planning for SMEs

Abstract

Though digital technology adoption among SMEs is widely studied, a manifestation of digitalization – virtual integration, particularly its strategic benefits to SMEs remains largely understudied. Virtual integration connects and coalesces the interfaces of digitalization in SMEs. Though the need for externally oriented digitalization in SMEs is widely desired and espoused, virtual integration and the ensuing effect on Dynamic Strategic Planning (DSP) could be key factors in realizing higher performance. Using the information theory lens and knowledge-based view and a two-study empirical setup based on data from manufacturing and services firms, we draw on Competence-Capability-Performance (CCP) framework. Specifically, we test a model of digitalization circuitry operational through mediating effects of virtual integration and dynamic strategic planning (DSP) through the ensuing interweaving effects of digitalization from virtual integration manifest into DSP through fluid partnering, business continuity planning, and market acuity. We find that digitalization manifested in the form of virtual integration cascades through DSP to improve financial performance.

Keywords: Virtual integration, Dynamic capabilities, Competencies, DSP.

1. INTRODUCTION

Dynamic strategic planning (DSP) involves continuously reviewing and adapting a company's strategic plans to changing market conditions, customer needs, and other external factors, allowing small and medium-sized enterprises (SMEs) to be more agile and responsive to market changes, and to take advantage of new opportunities. Virtual integration, on the other hand, refers to the use of technology to connect different parts of a business, including employees, suppliers, customers, and partners, allowing for better collaboration, more efficient processes, and faster decision-making. Combining these two concepts can be particularly beneficial for SMBs, as it allows them to be more nimble and adaptable in their strategic planning while also leveraging technology to improve their operations.

In this research we address the question--though the gains from virtual integration facilitated by digitalization could help manage a dynamic environment (Hoek et al., 2001), how does virtual integration manifest into SMEs' ability to respond to the dynamic environment? The

impetus to address the research question is rooted in the calls in numerous studies in recent IS (information systems) literature. Sadreddin and Chan (2022) show how digitalization can help firms capture new business opportunities. Similarly, other studies (e.g. Rozak et al, 2021; Schlagwein & Hu, 2017) have indicated that digitalization can improve a firm's ability to respond to environmental changes but highlight the "limited understanding of how specific digital technologies support firm capabilities." Consistent with this point of view the research problem addressed through this research is how virtual integration can improve a firm's ability to their dynamic strategic planning. Also, pertinent to this research problem is the explication of the intervening variables that enable a firm to develop the capability of dynamic strategic planning. We address the aforementioned research problem by extending research on digitalization and inter-organizational interfaces in SMEs (E.g. Li et al, 2018; Rozak et al., 2021).

To address the proposed research question, we draw on the theoretical framework of Competence-capability-performance (CCP) (e.g. Roth and Miller, 1990) and blend it with the dynamic capabilities framework (e.g. Teece et al., 1997) to propose the antecedents of DSP (Ojha, Patel, Sridharan 2020). As proposed by Liu et al. (2018), flexibility and integration improve DSP to strengthen SME adaptability through greater virtual integration. The antecedents to DSP operate at lower- higher levels of the capabilities-architecture. Virtual integration is the competency operational at the lower level. Collating and coalescing from lower-level, DSP as a meta-competency manifest through fluid partnering, business continuity planning, and market acuity.

Through the undergirding benefits of virtual integration through digitalization, our proposed theoretical framework aims to make the following contributions. First, DSP is at the core of organizational adaptation, yet, the undergirding factors that drive DSP are less explored. Our proposed framework takes a digitalization-driven infrastructural perspective for SMEs—virtual

integration—and external adaptation—fluid partnering, business continuity planning, and market acuity—as the drivers of DSP. This internal and external perspective attempts to explain the dual-order core competencies driving DSP. highlight the value of resilience following disruption, Chen et al. (2019) discuss a form of DSP, through knowledge flow in the information technology channels. In a similar vein, we project that DSP, through the inter-organizational knowledge exchange lens forms the undergird for responding to changing environment and also for the growing need to improve sustainability (de Camargo Fiorini & Jabbour, 2017).

Second, despite the broader prevalence of and widespread acknowledgment of the need for digitalization in SMEs, there remains a paucity of frameworks explaining why some firms are more responsive to the environment than others. We proposed and found support for the interwoven frameworks of dynamic capability and the role of virtual integration, a second-order outcome of digitalization. The notion of the value of ties is rooted in the increasing need for supply chain collaboration, wherein the commitment to network resources and the fairness of network resource distribution influence how an organization shares (Wu & Chiu, 2018). Knowledge ties among supply chain members are an additional consideration for improving DSP.

Third, the proposed elements of CCP through the digitalization-virtual integration-DSP performance represent important facets of the modern competitive landscape for SMEs. The depth of coordination-related knowledge resulting from virtual integration with lower coordination and communication costs forms the basis of virtual and physical elements driving fluid partnering, business continuity planning, and market acuity. Absent these elements, fluid partnering and business continuity planning may not flow efficaciously with the changing environment, and market acuity would not be sharp and adaptive. The antecedents to DSP embedded in virtual integration in SMEs improve the “adequacy, accuracy, accessibility, and timeliness” of market

sensing and coordination actions (DeGroote & Marx, 2013, page 909). The relational view explored in this work through the CCP framework facilitates complementary knowledge structures and exchanges (Lee et al., 2014).

The remainder of the paper follows the following sequence of sections. First, we provide the literature review followed by theoretical background and hypotheses. Next, we provide, the details of the methodology followed by the results. Finally, we provide a discussion of the results, limitations, future research, and conclusion.

2. LITERATURE REVIEW

A linchpin to dynamic capabilities is DSP (Neufville, 2000; Dibrell et al., 2007; Ojha et al., 2020; see Table 1). Though related conceptualizations of planning flexibility refer to "a firm's strategic plan to change as environmental opportunities/threats emerge" (Barringer & Bluedorn, 1999, page 424), DSP pivots to the capacity to change the nature of planning. The conceptualizations of emergent strategy by Mintzberg and Waters (1985), flexible planning from Ansoff (1991), and planned emergence from Grant (2003) explore the ability to change plans to respond to emerging environmental opportunities. Deviating from these past notions of how the previous plans must change, DSP focuses on what plans to leverage. In other words, flexible planning focuses on the notion of improvisation of plans whereas DSP focuses on a repertoire of potential plans a firm implements to adapt to emerging opportunities. Conceptualized earlier by Long (2000) and developed further by Ojha (2008), DSP aims to meld a deep understanding of recombination loci of core capabilities, select strategic goals in the current environment, and use planning strategies to execute capabilities recombinations, selection, and leveraging at multiple levels of the firm. The underlying tenets of proactive, less routinized, and realignment of resource and capabilities linkages are to allow for processes that are dynamic in that they enable changes to take place when

the strategy needs to be adjusted to a changing environment, as well as purposeful in that they give the organization a clear, unified direction. DSP allows for increased responsiveness to emerging opportunities, reduced inertia, and the necessary hysteresis necessary to allow a firm to adapt to newer strategic realities (Dibrell et al., 2007).

Table 1. Digitalization Enabled Virtual Integration and DSP

Source	**Type of Study**	**Key Findings**
Sadreddin and Chan, 2023	Qualitative Comparative Study	Provides pathways for developing IT-enabled organizational capabilities in new ventures
Xie et al., 2022	Empirical	Digitalization helps capability configurations for business model innovation
Rozak et al., 2021	Empirical	Digitalization can increase social media engagement and organizational agility
Schreieck et al., 2021	Case Study	IT-enabled organizational capabilities help enable value creation and capture
Jean et al., 2020	Empirical	Virtual integration provides safeguards against opportunistic behaviors and complements contracts
Ojha et al., 2020	Empirical/Survey	Develop the DSP scale
Li et al., 2018	Qualitative Research	Digitalization helps build organizational capability by improving managerial cognition development, social capital development, and team building
Schlagwein and Hu, 2017	Interviews	Digitalization helps firms use social media for improved performance
Dibrell et al., 2007	Conceptual	Develops the theory of DSP

Tai et al., 2007	Conceptual	Virtual integration provides an effective coordination mechanism in the manufacturing environment
Wang and Wei, 2007	Empirical	Virtual integration improves flexible responses by the organization through information visibility
Wang et al., 2006	Empirical	Virtual integration helps firms develop flexible strategies under environmental uncertainties
Carr et al., 2004	Empirical	Virtual integration helps gain opportunities offered by networks and alliances
Grant, 2003	Empirical/Case Study	Proposes the concept of planned emergence with decentralized decision making
Stafford, 2002	Conceptual	Virtual integration provides the necessary structure for planning flexibility
Neufville, 2000	Conceptual	Provides the conceptualization of DSP and details methods to support DSP
Long, 2000	Conceptual	Provides conceptualization of strategic planning in uncertain environments
Barringer and Bluedorn, 1999	Empirical	Planning flexibility positively influences entrepreneurship intensity
Van Hoek, 1998	Empirical/Survey/Case Study	Virtual integration helps in developing customer relationships and enables the management of cross-company interfaces
Zaheer and Venkataraman, 1994	Empirical	Virtual integration is integral to communicating and coordinating with external stakeholders
Ansoff, 1991	Conceptual	The emergent strategy helps firms in uncertain environments
Mintzberg and Waters, 1985	Conceptual	Provides the constituent elements of the umbrella construct of emergent strategies

An important, yet less explored complement to DSP is virtual integration (Jean et al., 2020; Magretta, 1998; Wang et al., 2006). Firms pursuing DSP are more adaptive when virtual integration, a quasi-integration governance approach that uses information systems to communicate and coordinate with external stakeholders (Zaheer & Venkatraman, 1994). Constituting forward (with customers) and backward (with suppliers), the multifaceted and multi-contextual information governed through virtual integration provides the circuitry required to collate, process, and leverage information and resources available through stakeholder networks (Carr et al., 2004). Virtual integration lowers transaction costs in joint decision-making and collaborations through improved coordination costs and reduced transaction risks (Wang et al., 2006). Virtual integration provides the necessary inter-organizational system such as electronic data interchange, blockchains, IoT connectivities, or Extensible Markup Language (XML) to improve governance, reduce frictions in information exchanges, and facilitate a smoother flow of resources and information (Patel & Sambasivan, 2021; Stafford, 2002; Tai et al., 2007; Van Hoek, 1998; Wang & Wei, 2007).

A framework explaining how virtual integration, along with internal knowledge processes and structures, could drive DSP is important in understanding its effect on DSP, a meta-competency. Connecting the DSP literature with virtual integration is absent in the literature on how virtual integration can be an enabler of DSP. To close this gap in the literature, we propose a conceptual framework that explains the role virtual integration can play in explaining how firms leverage internal mechanisms to realize improved DSP.

3. THEORETICAL BACKGROUND AND HYPOTHESES

3.1. Digitalization in SMEs and Competence-Capability-Performance framework (CCP)

Digitalization is an enabler of dynamic capabilities, or "the ability to integrate, build, and reconfigure internal and external competencies to address rapidly-changing environments" (Teece et al., 1997). Virtual integration improves response to environmental turbulence (Sambamurthy et al., 2003; Xie et al., 2022), and hones DSP by leveraging 'economies of knowledge at multiple levels of the firm (Roth, 1996). Virtual integration improves learning, coordination, and integration necessary to integrate and recombine knowledge bases to manage environmental response (Chi et al., 2005; Huotari, 1995).

Virtual integration helps manage, the relatively novel information provided by weak ties as compared to strong ties (Granovetter, 1973, 1983, and 2005). By helping bridge the 'structural holes' through internal and external networks (Burt, 1992) virtual integration helps us bridge knowledge islands in the knowledge ecosystem of the firm (Ruef, 2002). By connecting knowledge and skills across multiple levels of the firm, virtual integration forms the undergird of DSP in a firm. Through virtual integration, digitalization increases recombinant uncertainty (Fleming 1999), more fluid dispersion of ideas, and increased knowledge recombination discourses (Ruef, 2002). Table 2 presents the three CCP domains and their antecedents. We now turn to the hypotheses of our proposed model.

Table 2. CCP Framework

	Dynamic Capability Generating Processes		
First order competencies	Virtual Integration (VI)		
Second order competencies	Fluid Partnering (FP)	Business Continuity Planning (BCP)	Market Acuity (MA)
Capability	DSP (DSP)		
Performance	Firm Competitive Financial Performance (FINP)		

3.2. Digitalization as the undergird of virtual integration in SMEs

Virtual integration refers to information systems established by a focal firm's dependable and quick movement of data, related to its supply chain, inside and outside its boundaries. (Rai et al., 2006). DSP improves integration, redesign, network, and process reconfiguration through automation, CAD/CAM, and agile manufacturing (Burgess, 1994). Virtual integration through improved DSP improves renewed interpretation of the environment and designing novel strategic responses (Kumar and Motwani, 1995; Gehani, 1995; Pant, 1994). A loosely coupled system is especially conducive to improving the efficacy of virtual integration. Structuring competence and dynamic adjustment competence through fluid partnering allows organization of inter-organizational information flows and associated activities to minimize the work needed to adapt to a changing business environment by swiftly and efficiently adapting firms' inter-organizational processes to a new business context. (Gosain et al., 2004).

In this paper, we take the view of Holmström et al. (2019) that supply chain digitalization is comprised of three key dimensions – independence, redistribution, and interactivity. These dimensions of supply chain digitalization are reflected in the eight dimensions of virtual integration (Gosain et al., 2004). Independence which implies that the parts of the digital artifact are unique and can be acted upon independently is reflected in the virtual integration dimensions (see Table 3) - standardized processes and content interfaces, structured data connectivity, and modular interconnected processes. These three virtual integration dimensions help the various parts of a digitalization-based system to exist independently as standardization and modularity of interfaces create a loosely coupled system where constituent parts can exist independently while being able to work together (Sanchez and Mahoney, 1996; Cabigiosu et al., 2013). The redistribution aspect of digitalization is reflected in the three virtual integration dimensions - organizational memory of

past change episodes, knowledge of partner competencies, processes, and content, and understanding of the causal linkages - which together reflect the understanding of one's supply chain needs (Malhotra et al., 2005). Redistribution is enabled through the ability provided by these aspects of an organization's capabilities in helping with the correct assessment of supply chains' informational needs (Oloruntoba and Gray, 2006; Kovács and Falagara Sigala, 2021). The knowledge of partner competencies, processes, and content, and understanding of the causal linkages together allows firms to accurately determine where and what kind of information is needed in a supply chain which results in an effective information distribution system where pertinent information can be transferred to the right place in a supply chain. Finally pertaining to the interactivity in a supply chain the breadth of information and the quality directly capture the level of mutual information sharing that exists in a supply chain (Malhotra et al., 2005; Malhotra et al., 2005).

Table 3. Supply Chain Digitalization and Virtual Integration

Supply Chain Digitalization Dimension	Virtual Integration	Reason for Correspondence
Independence	1. Standardized processes and content interfaces (SPCI) 2. Modular interconnected processes 3. Structured data connectivity	Structure, standardization, and modularity provide the necessary mechanisms for the subpart of a system to exist independently while enabling the ease of connection
Redistribution	1. Organizational memory for past change episodes 2. Understanding the causal linkages 3. Knowledge of partner competencies, processes, and content	Knowledge about the partner's relationships, processes, and competencies allows effective distribution of information as it can quickly and accurately be ascertained where information is

		needed and the kind of information needed
Interactivity	1. Information breadth 2. Information quality	Information breadth and information quality capture the amount of valuable interaction taking place between supply chain partners in terms of information exchange

3.3. Virtual integration and Fluid partnering

Fluid partnership refers to a company's capacity to switch value chain partners swiftly and easily to respond to environmental changes (Rosenzweig and Roth, 2007; Gosain et al., 2004; Greis and Kasarda, 1997; El Sawy et al., 1999). We draw on the three main structuring competencies of the virtual integration competence — modular interconnected process, standardization of process and content interfaces, and structured data connectivity. Standardization of processes and content interfaces allows partners to incorporate and make partnership-specific investments and leverage modular interconnected processes to mix and match necessary knowledge components to improve sensemaking and sense-giving in supply chains (Weick, 1976) and to improve responsiveness to the environment. Through "electronic brokerage" modularity enhances the mixing and matching of interface aspects that enable communication of change along with the switching of supply chain partners resulting in greater flexibility in partnering (Gosain et al., 2004). The quality and breadth of information exchanges that allow diverse yet cohesive interpretation frames necessary for environmental responsiveness are improved by dynamic adjustment competence. Virtual integration provides avenues for improved resource reinterpretation frames and resource recombination loci to strengthen fluid partnering.

H1: Virtual integration has a positive association with fluid partnering.

3.4. Virtual integration and Business Continuity Planning

The business continuity planning process helps identify a firm's exposure to internal and external risks and enables the combining of the firm's hard and soft assets to enable effective threat prevention and recovery from disruptions while preserving its competitive edge and the integrity of its value system (Elliot, 1999). Business Continuity Planning aims to mitigate risk under business disruption through improved operational agility. Business continuity planning aims to lower risk by adding capacity, buffer inventory, building supply chain redundancies, and increasing resilience and flexibility, and stress (Chopra and Sodhi, 2004).

Development and implementation of business continuity plans are done through (Chapman et al., 2002; Gilbert and Gips, 2000; Morton 2002; Zsidisin et al., 2005) threat analysis and threat severity assessment to help develop recovery scenarios. The learning process associated with business continuity planning helps iterate fill and knowledge gaps through proactive and timely recognition of operational gaps. Virtual integration provides the necessary knowledge foundation that helps build the circuitry necessary to strengthen business continuity routines.

H2: Virtual integration is positively associated with Business continuity planning.

3.5. Virtual integration and Market acuity

A company's market acuity is its capacity to perceive the competitive landscape clearly and foresee client wants (Rosenzweig and Roth, 2007; Roth and Jackson, 1995; Menor and Roth, 2006). Market acuity strengthens the sensemaking and sense giving necessary to keep the pulse of the market by responding to external market forces including competitors, the overall company environment, and regulations" (Rosenzweig & Roth, 2007:1316; Kohli and Jaworski, 1990; Roth and Jackson, 1995).

Virtual integration hierarchically coalesces compositions of multilevel loosely coupled subsystems within and across the firm (Wang et al., 2006). Virtual integration improves within and between organization assessment of market intelligence, design of newer market needs, and co-development of marketing and operational needs to improve market responsiveness. Virtual integration improves access to shared knowledge among internal and external members to improve articulation, interpretation, and synthesis of the information to improve the internal and joint problem-solving capability of a firm. Virtual integration as a medium improves real-time knowledge assessment and combination activity to develop within and between organizational marketing and operational solutions (McGrath and Iansiti, 1998). Consequently, we hypothesize that,

H3: Virtual integration is positively associated with market acuity.

3.6. Business Continuity Planning and Market Acuity

Business Continuity Planning strengthens learning routines necessary to mitigate risks through scenario planning, lowering risks, and building flexibility and redundancies. With increased awareness of customer preferences, competitor actions, and environmental factors, market acuity helps improve the decision-making process necessary to develop "operational hedges" at multiple levels of the organizational process. Market acuity provides the necessary radars co-developed internally and through external cooperation to provide scenario planning and risk mitigation designs and processes to improve responsiveness, strengthen adaptation, and build resilience. Therefore, we hypothesize that,

H4: Market acuity is positively associated with Business Continuity Planning.

3.7. Business Continuity Planning and Fluid Partnering

The flexibility, adaptation, and responsiveness enabled by business continuity planning help improve the strategic and organizational fit necessary to manage relationality within and outside the firm (Douma et al., 2000). Strategic fit refers to the alignment of and dependence among partners through greater flexibility, streamlined relationships, joint control, and the development of shared resolution mechanisms necessary to improve joint strategic objectives.

Business continuity planning involves three key aspects of managing risks (Ojha et al., 2009): identification of risks and their criticality to a firm; creating risk management strategies, and learning from failures. Together these aspects of the business continuity process help a firm become more aware of its strategic and organizational needs that have to be met to mitigate risks. This strategic awareness of one's needs and the corresponding motivation emanating out of the criticality of these needs enables a firm to find firms that have a close strategic and organizational fit. Therefore, the business continuity process has a positive influence on the fluid partnering process. Consequently, we hypothesize that,

H5: Business Continuity Planning is positively associated with Fluid Partnering.

3.8. DSP

Ojha et al., (2020) conceptualize DSP as the need to adapt capabilities in the face of dynamic environments, dynamics strategic planning is salient to unpredictable environments. DSP could be an important precursor to how firms sense, interpret, and respond to opportunities and threats, but more importantly, it may lay the groundwork for dynamic capabilities that help build and reconfigure capabilities. Beyond the implied iterative nature of the dynamic planning process, DSP is a capability as it helps embedded multilevel and multi-contextual processes necessary to plan in the face of environmental challenges. The elements of DSP discussed by Ojha et al., (2020), are

the absorptive capacity necessary to sense and internalize opportunities and the adaptive capability necessary to respond to opportunities. DSP acts as a linchpin between a volatile environment and dynamic capabilities.

As an overarching process of the dynamics of the system involved in strategic planning, DSP allows for a less routinized, more proactive, and flexible approach to devising strategic goals. Dibrell et al. (2007) argue that a routinized approach to strategic planning that keeps an eye on the outside world for preserving strategic flexibility may be necessary. Such a strategy enables processes that are dynamic enough to accommodate adjustments when the strategy needs to be modified in response to a changing environment while also being purposeful in providing a clear and unified direction for the business. (Dibrell et al., 2007; page 30).

Planning flexibility, or the ability of a company's strategic plan to alter as environmental possibilities or challenges develop, is necessary for DSP. (Kukalis, 1989; Barringer and Bluedorn, 1999). Flexible planning combines both traditional planning (Ansoff, 1991) with emergent strategy (Mintzberg, 1991; 1994). The emergent planning element allows for the necessary framework to inform adaptive planning. The adaptive planning capacity facilitated by DSP is an essential element to improve performance.

Allowing for planned emergence, a strategic planning process that combines elements of formal strategic planning (from the design school) and ad-hoc or flexible planning (suggested by the process school), supports the deliberate and emergent creation of knowledge and information loops that require multilevel and multimodal exchanges essential to the information management bulwark of the firm. (Ansoff, 1991; Dibrell etal., 2014). As firms attempt to enhance sensemaking

and develop dynamic strategic plans, informational infrastructure, both hardware and people based, is intricately connected with the success of DSP.

The DSP scale is based on Mumford et al., (2001), Mumford et al., (2002), and Long (2000). The dynamic and relational elements of information exchange processes support DSP (Hayes-Roth and Hayes-Roth, 1979, Anzai, 1984). Based on Ojha et al., (2020) and Long (2000) the dimensions of DSP are Understanding Core Capabilities, Clarity of Vision, Shared Responsibility, Selecting Strategic Targets, and Taking Action. DSP helps align vision and resources to manage challenges and opportunities through improving vision, developing an organization-wide understanding of core capabilities, enhancing shared responsibility, selecting strategic targets to improve, and facilitating actions aimed at strengthening organizational strategy.

3.9. Fluid partnering and DSP

Fluid partnering is feasible under high trust, joint commitment, shared conflict resolution strategies, and information (Ellram, 1990; Heide and John, 1990). Fluid partnering improves both vertical and horizontal ownership while strengthening strategic flexibility (Spekman, 1988). Fluid partnering improves operational responsiveness, strengthens joint design capabilities, and improved supply chain responsiveness (Narasimhan and Das, 1999), by increasing discretization of the supply chain through loose coupling, higher autonomy, and increased modularity among the value-chain members. Increased autonomy and modularity improve responsiveness and decision-making through increased reliance on interfaced, localized knowledge. Modularity afforded by fluid partnering allows for resilience in other parts of the network and allows firms to rapidly fill knowledge competence gaps to improve responsiveness. By flexibly and resiliently mobilizing resources through fluidity in knowledge and connectivity among partners, firms may better undertake DSP. So we hypothesize that,

H6: Fluid Partnering is positively associated with DSP.

3.10. Business continuity planning, market acuity, and DSP

Business continuity planning enables firms to improve their awareness of knowledge and competence gaps (Ojha and Gokhale, 2009). Improved awareness, cognizance, and responsiveness to such gaps help improve DSP by informing the firm on collating resources, assembling human capital, and developing relational capital in supply chains (Archer-Brown and Kietzmann, 2018; Iles and Yolles, 2002; Singh and Rao, 2016; Nyamrunda, and Freeman, 2021). A robust, clearly defined business continuity planning provides the necessary undergird for developing a dynamic capabilities framework at operational and at strategic levels (Ojha et al., 2013). Business continuity planning provides the necessary tracking, completion, and assessment necessary to prime behavioral, tactical, and operational changes necessary to improve DSP (Gracey, 2020). Therefore, we hypothesize that,

H7: Business Continuity Planning is positively associated with Dynamic Strategic Planning.

Relatedly, market acuity acts as a feeder for DSP to improve understanding of customer needs and market changes (Powell, 1995). Allowing for improved scanning, assessment, tracking, and understanding of the severity and acuity of market changes allows firms to proactively devise a variety of dynamic capabilities through DSP (Nyamrunda, and Freeman, 2021). Market acuity acts as a zeitgeber that tunes market changes with a range of internal firm elements and supply chain components to strengthen DSP (Clemons et al., 2003). This leads us to the hypothesis that,

H8: Market acuity is positively associated with DSP.

3.11. DSP and financial performance

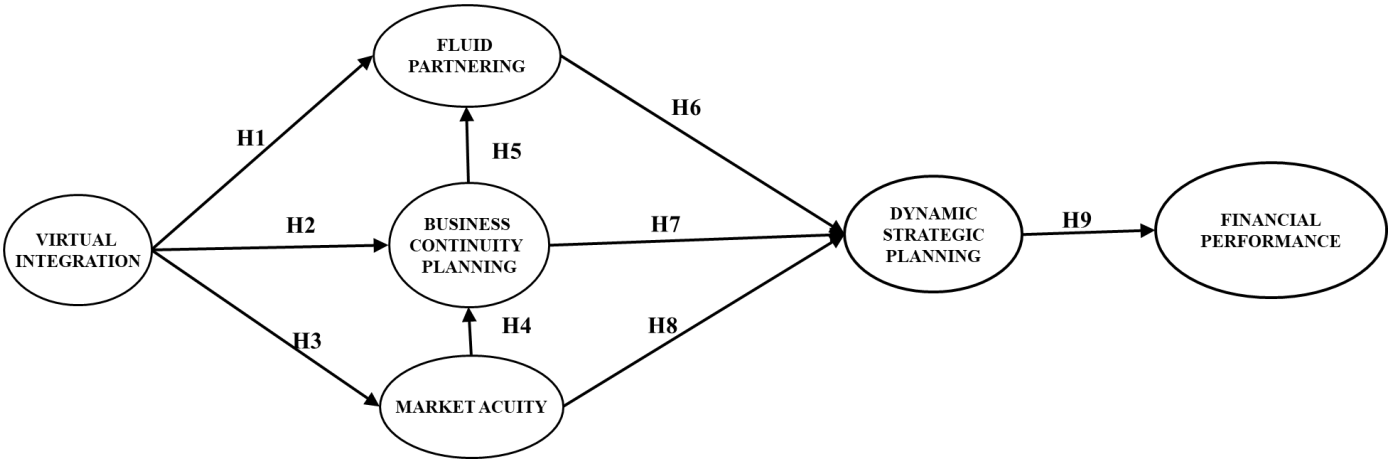
Based on Ojha et al. (2020), as the last hypothesis in the nomological chain, we propose DSP is expected to improve financial performance. DSP allows for flexibility in responding to a more dynamic, complex environment (Doz and Kosonen, 2008), allowing SMEs to strategically focus on value-creation activities and stakeholder engagement. The digitalization-related capabilities that drive the SME knowledge circuitry through fluid partnering, business continuity, and market activity through the undergird of virtual integration facilitate, learning and adaptations necessary to achieve improved financial performance (Nyamrunda, and Freeman, 2021). Therefore, we posit that,

H9: DSP is positively related to financial performance.

4. METHODOLOGY

In this we paper we conduct two separate studies to test our research model encompassing the nine hypotheses (see Figure 1). Study 1 used a sample of manufacturing firms. Study 2 used a sample of service firms. The second study was conducted to triangulate the results of Study 1. Support for the hypotheses is consistent across the two studies would provide greater confidence in the results and improve generalizability. Moreover, contrasting results from Study 1 and Study 2 should help to explain differences in the effects of the antecedents to DSP across manufacturing versus service environments.

Figure 1. Research Model



4.1.Study 1 – Manufacturing Sample

4.1.1. Study 1 - Data Collection Process

Pretesting was done using 12 MBA students who performed Q-sorting. The MBA students were full-time employees directly participating in the strategic planning process in manufacturing organizations. The overall placement ratios for all the constructs were above 70% indicating sufficient convergent and discriminant validity. The pilot testing was done with 55 high-level managers. The Cronbach's alpha for all the measures was over 0.70. At the end of the pilot testing, only the strongest 3 items for each construct were used for the final data collection.

For Study 1, we use Dunn and Bradstreet's Million Dollar Database as our sampling frame. The database allows screening samples based on industry type, size of the firm, location, manufacturing versus services, etc. We only chose single-location manufacturing firms classified as SMEs. The target respondent was high-level managers such as the VP of supply chain, VP of operations, materials manager, supply chain manager, among others. Our initial sample was 1,260 of which we received 255 usable responses for the final analysis for SMEs (see Table 4). Missing data were replaced with EM imputation. The final response rate for the final sample was 20.23%.

Non-response bias comparing early and late respondents on sales, employees, and financial performance showed non-significant differences between early and late respondents.

Table 4. Sample Details Manufacturing Firms (*n = frequency*)

INDUSTRY	***n***	**Number of Employees**	***n***
Chemical Manufacturing	19	100-200	212
Computer and Electronic Product Manufacturing	17	201-300	24
Fabricated Metal Product Manufacturing	17	301-400	12
Transportation Equipment Manufacturing	17	401-500	7
Machinery Manufacturing	16	**Total**	**255**
Miscellaneous Manufacturing	16	**Sales in Million US Dollars**	***n***
Plastics and Rubber Products Manufacturing	15	>= 0 AND <= 1	1
Primary Metal Manufacturing	15	> 1 AND <= 5	15
Printing and Related Support Activities	15	> 5 AND <= 10	53
Food Manufacturing	11	> 10 AND <= 50	165
Electrical Equipment, Appliance and Component Manufacturing	10	> 50 AND <= 100	17
Furniture and Related Product Manufacturing	10	> 100 AND <= 200	1
Wood Product Manufacturing	10	> 200 AND <= 300	1
Apparel Manufacturing	9	> 300	2
Nonmetallic Mineral Product Manufacturing	9	**Total**	**255**
Petroleum and Coal Products Manufacturing	9		
Textile Product Mills	9		
Beverage and Tobacco Product Manufacturing	8		
Paper Manufacturing	8		
Textile Mills	8		
Leather and Allied Product Manufacturing	7		
Total	**255**		

4.1.2. Measures

We next detail the measures used in Study 1 (see ONLINE APPENDIX provided as a supplementary file for the items of the constructs). We also provide the details of the psychometric properties of each of the measures. Table 5 provides the composite reliabilities, average variance explained, and inter-construct correlations.

Table 5. Composite Reliability, Average Variance Explained, and Correlations

	CR	AVE	BCP	DSP	FINP	FP	MA	VI
BCP	0.958	0.721	0.849					
DSP	0.960	0.826	0.780	0.909				
FINP	0.948	0.858	0.412	0.471	0.926			
FP	0.940	0.838	0.685	0.712	0.347	0.916		
MA	0.933	0.822	0.713	0.785	0.488	0.633	0.907	
VI	0.862	0.521	0.739	0.673	0.447	0.670	0.686	0.722

CR = Composite Reliability, AVE = Average Variance Explained, BCP = Business Continuity Planning, DSP = DSP, FINP = Financial Performance, FP = Fluid Partnering, MA = Market Acuity, VI = Virtual Integration

4.1.3. Virtual Integration

The virtual integration construct was adopted from Gosain et al. (2004). Virtual integration comprises eight dimensions: standardization of process and content interface, modular interconnected processes, organizational memory of past change episodes, structured data connectivity, understanding of causal linkages, knowledge of partner competencies, processes, and content, inter-organizational information sharing breadth; and inter-organizational information sharing quality. The item loadings were highly significant ($p \geq 0.001$), and the differences in chi-square between constrained and unconstrained models were highly significant.

4.1.4. Fluid Partnering

The ability of a company to switch value chain partners rapidly and easily is known as fluid partnering (FP). (Rosenzweig and Roth, 2007). All the item loadings were highly significant ($p < 0.001$) and the AVE for the fluid partnering construct was 0.838.

4.1.5. Business Continuity Planning

Business continuity planning consists of nine dimensions: roles and responsibilities, contact points, continuity and recovery service levels, risk levels, business continuity processes, business continuity reviews, failure reporting, and documentation, testing, and training. The item loadings were significant and the AVE was 0.838.

4.1.6. Market Acuity

A company's market acuity is its capacity to perceive the competitive landscape clearly and foresee client wants. (Rosenzweig and Roth, 2007). The item loadings were significant and the AVE for the market acuity construct was 0.822.

4.1.7. DSP

DSP includes five dimensions: understanding core capabilities, clarity of vision, shared responsibility, selecting strategic targets, and, taking action. The items loadings were significant and the AVE was 0.838.

4.1.8. Financial Performance

The measure included three self-reported performance measures: return on investments, pre-tax return on assets, and return on sales (Chen et al., 2004). All the item loadings were highly significant ($p < 0.001$), and the AVE was 0.822.

4.2. Study 2 – Service Sample

4.2.1. Study 2 - Data Collection Processes

The sampling frame for Study 2 is the US service SMEs. The sample was collected using an online survey of B2B panel data using Zoomerang, an online market research company. Zoomerang has been used for papers published in top information systems and management journals like MIS Quarterly, Organizational Behavior and Human Decision Process, Journal of Operations Management, and Journal of Academy of Marketing Science (Ayyagari et al., 2011; Mayer et al., 2012; Thau et al., 2009; Rogers and Bezerman, 2008; Autry et al., 2010; Richey et al, 2010). Our respondents consisted of mid- and high-level managers who knew the strategic service issues of their firm. The survey was initially sent out to 1,500 firms and we received 264 completed responses. We then screened the data to include only SMEs (less than 500 employees) which resulted in a final sample of 179. We have provided the demographic data for the final sample in

Table 6. The measures for the service sample were the same as the manufacturing sample except for the changes made to item wordings to cater to the service context.

Table 6. Sample Details Services Firms (*n = frequency*)

Number of Employees	*n*	**Industry**	*n*
19 - 20	82	Accommodation & Food services	7
20 - 49	28	Aerospace/Aviation/Automotive Services	5
50 - 99	17	Agriculture, Forestry, Fishing & Hunting Services	3
100 - 149	24	Arts, Entertainment & Recreation	8
150 - 499	28	Biotech Services	1
Total	**179**	Construction Services	17
		Finance, Banking & Insurance	29
Sales	n	Health Care & Social Assistance	44
<$1 million	77	Information Services	3
$1 million-$ 10 million	63	Retail Trade	34
$10 million-$ 100 million	32	Telecommunication services	4
$100 million-$ 1 billion	4	Transportation & Warehousing	16
>1 billion	3	Wholesale Trade	8
Total	**179**	**Total**	**179**

5. RESULTS

5.1. Hypotheses Testing – Manufacturing Sample

We use structural equation modeling (SEM) techniques in AMOS software (see Figure 2). The fit indices were above or below the recommended cutoffs, χ^2 (df)= 839.386 (425); CFI = 0.939; RMSEA = 0.062; SRMR = 0.0435. We evaluated common method bias using the marker variable approach. The marker variable was borrowed from the leisure literature (see Appendix). The chi-square difference between the model with and without the marker variable ($\Delta\chi^2$ [Δdf] = 1.343 [1]; p = 0.753) was not significant. We further investigated the impact of two control variables firm size (number of employees) and industry on the research model. While the type of industry did not have any effect on financial performance, firm size was positively related to financial performance.

Regardless, all of the results related to the hypothesized relationships remained consistent across the model with controls and one without control variables.

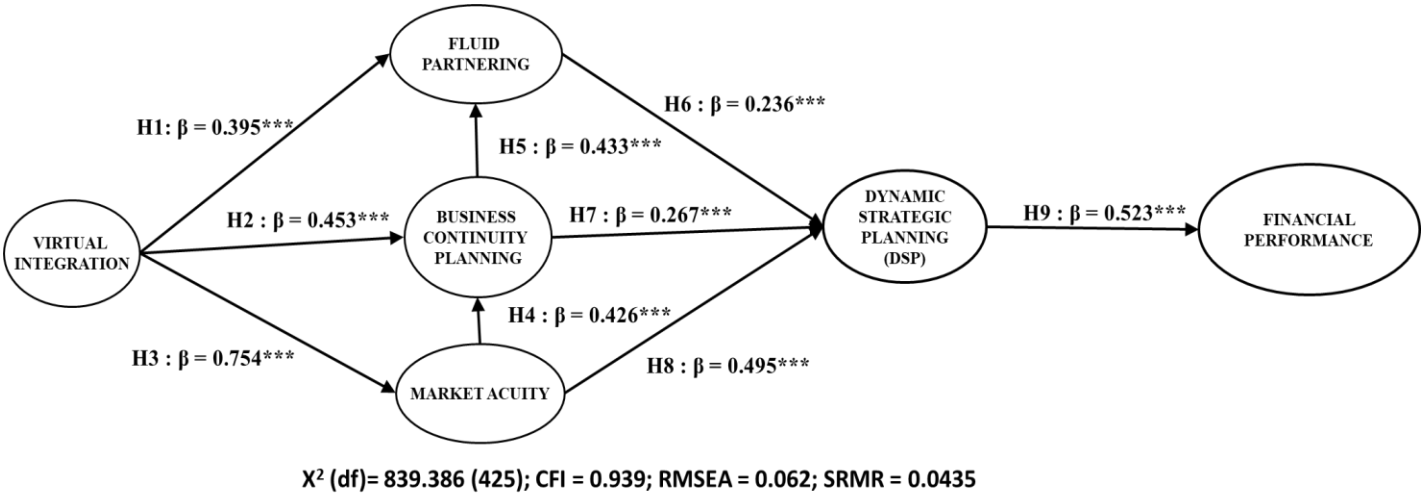
Hypothesis 1 proposed that virtual integration is positively related to fluid partnering ($\beta = 0.395$, $p \leq 0.001$). Hypothesis 2 proposed that virtual integration is positively related to business continuity planning ($\beta = 0.453$, $p \leq 0.001$). Hypothesis 3 on virtual integration with a positive relationship to market acuity was supported ($\beta = 0.754$, $p \leq 0.001$). Hypothesis 4 on the positive relationship between market acuity and business continuity planning was also supported ($\beta = 0.426$, $p \leq 0.001$). Hypothesis 5 on business continuity planning as positively related to fluid partnering ($\beta = 0.433$, $p \leq 0.001$), and Hypothesis 6 on fluid partnering as positively related to DSP ($\beta = 0.236$, $p \leq 0.001$) were both supported. Hypothesis 7 which states that business continuity planning is positively related to DSP was supported ($\beta = 0.267$, $p \leq 0.001$). Hypothesis 8 which states that market acuity is positively related to DSP was supported ($\beta = 0.495$, $p \leq 0.001$). Finally, Hypothesis 9 states that DSP is positively associated with financial performance was also supported ($\beta = 0.523$, $p \leq 0.001$).

We evaluated the indirect effects implied in the research using bootstrapping and bias-corrected percentile method. All the indirect effects were also significant (see Table 7).

Table 7. Indirect Effects, β (p-value)

	VI	MA	BCP	FP
BCP	0.321 (0.003)			
FP	0.335 (0.004)	0.184 (0.003)		
DSP	0.752 (0.004)	0.157 (0.002)	0.102 (0.011)	
FINP	0.393 (0.003)	0.341 (0.004)	0.193 (0.002)	0.123 (0.016)

Figure 2. Research Model with Path Loadings



5.2. Multiple Group Analysis - Service vs. Manufacturing

Table 8 provides the comparative results of hypotheses testing for service versus manufacturing samples. We used AMOS to run the multiple-group analysis. The multiple-group analysis was conducted for the overall research model. Also, we conducted nine separate multiple-group analyses for each of the nine hypotheses. The results for the overall research model comparison across services and manufacturing firms indicate that taken together, regression coefficients of the hypothesized research model are significantly different ($\Delta\chi^2$[df] = 123.031[9], p≤0.001).

To compare individual hypotheses across manufacturing and service samples we constrained the regression coefficient relating to each hypothesis for the two samples as equal. Table 6 provides the details of the analysis. As evident from the results, the regression coefficients relating to H1, H2, H3, and H4 were not significantly different across the two samples. On the other hand, the regression coefficients across the two samples were different for H5, H6, H7, H8, and H9. Also, while all of the hypotheses for the manufacturing sample were supported, the service sample results did not support hypothesis 8 which states that market acuity is positively related to DSP.

Table 8. Comparison of Hypotheses - Service vs. Manufacturing

Hypothesis	Relationship	Service Sample (β)	Manufacturing Sample (β)	Are regression coefficients different?
H1	VI→FP	0.231*	0.395***	NO
H2	VI→BCP	0.427***	0.453***	NO
H3	VI→MA	0.566***	0.754***	NO
H4	MA→BCP	0.258**	0.426***	YES
H5	BCP→FP	0.306**	0.433***	NO
H6	FP→DSP	0.300***	0.236***	YES
H7	BCP→DSP	0.660***	0.267***	YES
H8	MA→DSP	-0.060^{NS}	0.495***	YES
H9	DSP→FINP	0.625***	0.523***	YES

***p≤0.001, **p≤0.01, *p≤0.05, NS – not significant

6. DISCUSSION

DSP represents an important intangible capability a firm can leverage (Barney 1991). As a knowledge-based competency, DSP represents a higher-order competency that has been seldom connected to operations management research, and even more so in the context of SMEs. Extant SME and information system research can be further informed on the enabling role of DSP. Complementing research on manufacturing agility and related concepts in the nomological net focus on capabilities ensuing DSP, however, understanding the antecedents of DSP is important to understand the value of digitalization in SMEs.

Extending much of the research focused on the conceptual elements of DSP, insights into the nomological net of its antecedents remain less understood. Consistent with the resource-based view of the firm (Priem and Butler, 2001), supra-normal rents are less feasible from functional abilities (e.g., marketing agility or operational agility). Virtualization provides a source of developing non-imitable reconfigurations driving DSP.

The core premise of our model in the SME context, who face liabilities of smallness stems from the undergird that developing adaptive planning and partnering are important contributors to

improving financial performance. Faced with more market challenges and fewer resource buffers, DSP is even more important for SMEs. By conceptualizing and testing the antecedents to the DSP construct, our work not only conceptualizes an important knowledge-based competency but also provides SMEs with an important set of antecedents necessary to build DSP capabilities.

The nomological network for the impact of virtual integration on dynamic strategic agility and performance has stronger support for manufacturing as compared to service firms. While there were differences in the level of support of the nomological network across differed for manufacturing and service firms the majority of the model was supported for the two samples. In particular the relationship of virtual integration with the three mediating variables - market acuity, business continuity planning, and fluid partnering - was statistically the same across the two samples. This result was consistent with most previous research relating to the strategic planning process across service and manufacturing sectors (e.g. Robinson and Pierce, 1984; Glaister and Falshaw, 1999; Stonehouse and Pemberton, 2002). The primary difference arose in the latter part of the research model as the service sample had weaker support for the effect of mediating variables on DSP.

The relationship of market acuity on DSP was not supported for service firms indicating market knowledge does not directly influence DSP but influences DSP indirectly through improvement in a firm's ability to conduct BCP and the ability to readily change partners. Such a result could be attributed to the relatively higher volatility associated with service firms. High volatility renders market knowledge irrelevant in the planning process as the information becomes quickly outdated. It seems services become much more reliant on contingency planning and developing the right partners to deal with the contingencies as they occur. This result is consistent with Elbanna (2007) who found that market intelligence was less emphasized by service firms as

compared to manufacturing firms. Similarly, Robinson (1980) found that the use of outside partners (fluid partnering) was more prevalent for service firms than the use of a formal planning approach. This may be the case as service firms have lower confidence in the ability of a comprehensive planning process to help them achieve a better fit between the external environment and internal capabilities (Glaister and Falshaw, 1999).

Another difference of note was that the effect of DSP on performance was stronger for service firms as compared to manufacturing firms. Given our measure or performance is comparative this result indicates that the ability of DSP to create differentiated performance is stronger for service firms than manufacturing firms. DSP is a planning process that is especially useful in a volatile environment that generally characterizes the service industry as compared to the manufacturing industry (Dibrell et al., 2007). Service firms generally face higher demand volatility as compared to manufacturing firms (Brignall and Ballantine, 1996) and thus should be expected to have a stronger effect on comparative performance.

6.1. Theoretical Contribution

Using the fluid partnering conceptualization rooted in the dynamic capabilities framework, the strength of weak ties perspective, and the knowledge-based view of the firm we hypothesized the critical role of virtual integration and provide an important step forward for the literature in both entrepreneurship and information systems. The study proposed the value of interweaving threads of market acuity, fluid partnering, and business continuity planning. Though the adoption of digitalization in SMEs is widely called for how digitalization is leveraged and how the related capabilities emerge is an important consideration.

Our theoretical premise highlights the broader value of digitalization. The scalability and elasticity of digital assets provide a multilevel capabilities framework that helps SMEs improve.

Noteworthy is the fact that competencies can exist at the lower level (first order) or higher level (second order). Digitalization that enables virtual integration promotes lower-level functional competencies that combine and coalesce into higher-order competencies, also known as meta-competencies. The multi-level and multi-contextual role of virtual integration is primed through increased market acuity and fluid partnering. The proposed combination of lower-order combined with the three meta-competencies forms an undergirds of DSP. Our results based on respondents active in the industry supported this nomological net of antecedents.

Overall, the framework provides an important consideration for SMEs who instead of previously considered as low-growth firms, and at times as living dead, can adopt a DSP approach to garner greater legitimacy by demonstrating a willingness to change, pursuing internal adaptation to the environment, leveraging physical and virtual knowledge channels, and improving market sensing through sensemaking and sense giving with partners. Understanding that smaller firms do not have a larger resource base, our results show among the higher-order competencies, market acuity seems to provide the highest 'bang for the buck.' SMEs who are more market-dependent due to their smaller customer base may find market acuity as an important mechanism to help leapfrog the competition and be more responsive to change. Our results are consistent with the emerging view that effective humans-computer interaction can result in competitive advantage (Krakowski et al., 2022)

The findings also provide an important extension to information systems literature by highlighting the critical roles of digitalization and virtualization (e.g. Dwivedi et al., 2022). The study explains how DSP capability antecedents shape or deform knowledge bases driven by business continuity, market acuity, and fluid partnering that may provide the necessary isolating

mechanisms to lower imitability. Our study provides a key theoretical insight for SMEs in leveraging virtualization to improve the acquisition, management, and enhancement of DSP.

Our research has implications for the weak ties research in the supply chain (Hitt, 2011). Our contention in this research is that economies of knowledge are the primary driver of DSP. Such a view supports that the capacity for creative action is important for effective DSP. Prior research has provided some key structural antecedents of organizational innovation (Ruef, 2002). Using social network theory Ruef (2002) argues that the creative action capacity rests on three key capabilities 1) the ability of a firm to use its social network to obtain non-redundant information, 2) the ability to resist conformity pressures, and 3) maintaining trust in creating innovative, potentially lucrative innovations. Cultural and structural elements affect a firm's ability to creative action (Ruef, 2002; Mikalef and Gupta, 2021). The key structural elements are diversity, network strength, size, and orientation. The key cultural elements are team experience and diversity. Our study contributes to this discussion of structural elements that are key to creative action by suggesting the structural antecedents of DSP.

Modularity in product design has been suggested to be important for effective DSP (Jørgensen and Messner, 2009; Chen et al., 2021). The construct of virtual integration in our research model does include the concept of modularity in the dimension of modular interconnected processes but any discussion of modular products is missing. Prior research has argued that product design modularity positively influences the probability of both radical innovation as well as incremental innovation, and innovation reliability (Xiao and Zhang, 2021; Pils and Cohen, 2006). Therefore, both explorative and exploitative behaviors that lead to the generation of useful knowledge are facilitated by modularity leading to competitive advantage. In addition, modularity together with product heterogeneity acts as a safeguard against innovation and has a positive

influence on performance. DSP can thus be positive influences by modularity. Our research provides some indirect evidence of such phenomena. Our research thus provides the direction for future discussion and explication of the processes through which modularity influences DSP. Also, users will be the discussion of the mix of product heterogeneity and modularity that optimizes DSP.

6.2. Implications for practitioners

This research aids in the discovery of a distinct and useful set of antecedents that can be applied both conceptually and theoretically grounded and implementable in practice. The practical usefulness of research is dependent on operational validity – the ability of theoretical insights to be converted to implementable guidelines in practice – not on how theoretically valid and interesting is the research (Thomas and Tymon, 1982). Through this research, we provide direction to practice managers on "where to look" and effectively compete in environments characterized by high turbulence. Also, we have provided operationally valid antecedents of DSP that can be manipulated by practicing managers. For example, practicing managers can assess the level of virtual integration, business continuity planning, market acuity, and fluid partnering and ascertain if they need to put resources to enhance them for an adequate level of DSP effectiveness.

Based on the results the three lower-order competencies of fluid partnering, market acuity, and knowledge channels, serve as the basis for firms to acquire the capability of DSP through virtual integration. The findings have important implications for SME owners. The main implications are as follows. We guide antecedents rooted in digitalization practices that explain how SMEs could orient their virtualization efforts to improve dynamic responses to the environment. Based on Thomas and Tymon (1982) who highlight the importance of theoretical guidance to professional managers, our study measures provide important theoretical coordinates

for managers to consider. With SMEs competing increasingly in turbulent environments, SME owners prefer to understand "where to make" capabilities-related investments. We propose that managers consider virtualization at lower and second-order capabilities levels.

Our research focuses on a collaborative path to achieving knowledge-based advantages to achieve effective DSP. Practicing managers, though, have the option of taking the predatory route to gain knowledge and competence through the process of business acquisitions (Eisenhardt and Martin, 2000). This is a particularly attractive option if a firm operates in an industry on the decline as it allows firms to diversify and escape such an industry (Anand and Singh, 1997). Business acquisitions thus provide another option for improving a firm's ability to improve its DSP.

This research should also be useful for entrepreneurs as it provides a pathway to becoming adaptive to the external environment. Our research suggests that practicing managers should focus on developing a dynamic strategic planning system to achieve a fit with the external environment. Our research suggests that the key to creating the capability to plan dynamically is primarily dependent upon the ability to organize virtually using digitalization. So, the effective use of a digitalization tool to enable virtually integrated organizational efforts for planning activities is salient to creating effective dynamic strategic plans. Such a structure of virtually integrated collaborative efforts creates the necessary information-rich environment for improving the ability to create effective dynamic plans.

Practicing managers should also be cognizant of the fact that a firm's ability to organize virtually for collaboration enables a firm's ability to partner effectively with other firms for joint efforts toward gaining new knowledge and skills. Such knowledge can be key to improved performance. Another positive of effective virtual collaboration is the ability to plan for disruption. Managers should also focus on the efforts of disruption management as it not only helps the

survival of the business but also helps the business thrive through the effective creation of business continuity plans.

6.3. Limitations and Directions for Future Research

The findings of this study are subject to limitations, and also provide directions for future research. Though our study uses self-report data the common method of bias analysis shows that this is less of a concern. More importantly, we further lower such concerns by finding similar effects in a second study. Furthermore, it is challenging to consider a wide range of antecedents to DSP. Though our hypotheses are theoretically informed related supply chain literature and human capital literature could provide an important consideration set for future studies. Related to fluid partnering and market acuity, future studies could explore how firms leverage modular design to improve dynamic capabilities ecosystems within the firm and their supply chains.

Future studies could also focus on network-level analysis by further understanding how firms, from a social-network-theory perspective (Ruef 2002) create resilient and redundant information networks, balance pressures for conformity, and sustain trust. These factors are important complements to virtual integration and its ensuing strategic benefits.

The interaction of task and knowledge boundaries of the firm with modularity, as well as its consequences for the firm's DSP, is another area of study. Modularity establishes a clear connection between a system's activities at any given point and its final result. This suggests that a modular system's control mechanism may be more advanced, resulting in better coordination of the modular system. Additionally, a firm's efficient knowledge boundaries could not be the same as its efficient task boundaries. It is unclear how the modularity and knowledge boundaries of firms interact. While modularity on one hand hampers a firm’s ability to provide systemic solutions to supply chain issues, it provides clarification of the functional context of capabilities enabling the

development of useful competencies (Pil and Cohen, 2006). Thus, modularity may impact a firm's DSP in both a good and bad way. To gain a more insightful understanding of the relationship between modularity-DSP, this paradox needs to be studied in greater detail.

Trust plays a mediating function in the production of relevant information through weak links (Levin and Cross, 2004). According to their research, having strong relationships in one's network is preferable to having weak ones if one wants to obtain important information. Additionally, the utilization of weak ties to gather relevant information requires the presence of expertise and benevolence-based trust. The ability to put new ideas into practice is what makes something useful, as opposed to the ability to come up with new ideas. It appears that our research model lacks a construct that captures the capacity of implementing new ideas which is a necessary component of attaining DSP. Thus, it would seem that achieving the ideal level of DSP requires achieving the proper ratio of weak and strong ties and trust. This multifaceted viewpoint on the creation of valuable knowledge through diverse ties might illuminate several crucial mechanisms for attaining DSP.

Cultural preferences influence social networks, which in turn influence a firm's ability for innovation (Lizardo, 2006). Cultural preferences have a significant impact on both the network's construction and maintenance. Future studies should therefore focus on the role played by an organization’s culture in creating the essential and reliable framework that enables innovation and the DSP of the organization.

7. CONCLUSIONS

In conclusion, this paper draws on virtual integration as the interface of digitalization in SMEs that explains the design and development of workflows with external entities and how the elements of fluid partnering, business continuity planning, and market acuity combined to drive DSP. The

mediators are essential to explaining knowledge representation and reasoning with the virtual integration-related digital platforms of SMEs (eg. Song et al., 202; Xie et al., 2022). We theorized and tested enhancements of re-representation using the information theory lens and knowledge-based view, this paper draws on Competence-Capability (CC) framework to develop and test a model of mediators between virtual integration and DSP. The interweaving effects of digitalization from virtual integration manifest into DSP necessary to manifest through.

REFERENCES

Ansoff, H. I. (1991). Critique of Henry Mintzberg's 'The design school: reconsidering the basic premises of strategic management'. *Strategic management journal*, *12*(6), 449-461.

Asamoah, D., Agyei-Owusu, B., Andoh-Baidoo, F. K., & Ayaburi, E. (2021). Inter-organizational systems use and supply chain performance: Mediating role of supply chain management capabilities. *International Journal of Information Management*, 58, 102195. https://doi.org/https://doi.org/10.1016/j.ijinfomgt.2020.102195

Autry, C. W., Grawe, S. J., Daugherty, P. J., & Richey, R. G. (2010). The effects of technological turbulence and breadth on supply chain technology acceptance and adoption. *Journal of Operations Management*, 28(6), 522-536.

Anzai, Y., & Yokoyama, T. (1984). Internal models in physics problem solving. *Cognition and Instruction*, *1*(4), 397-450.

Asamoah, D., Agyei-Owusu, B., Andoh-Baidoo, F. K., & Ayaburi, E. (2021). Inter-Organizational Systems Use and Supply Chain Performance: Mediating Role of Supply Chain Management Capabilities. *International Journal of Information Management, 58*, 102195. doi:https://doi.org/10.1016/j.ijinfomgt.2020.102195

Ayyagari, R., Grover, V., & Purvis, R. (2011). Technostress: technological antecedents and implications. *MIS Quarterly*, 35(4), 831-858.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of management*, *17*(1), 99-120.

Barringer, B. R., & Bluedorn, A. C. (1999). The relationship between corporate entrepreneurship and strategic management. *Strategic management journal*, *20*(5), 421-444.

Bharadwaj, A. S. 2000. A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation. *MIS Quarterly*, 24 (1), 169-196

Burgess, T. F., 1994. Making the leap to agility: defining and achieving agile manufacturing through business process redesign and business network redesign. *International Journal of Operations & Production Management*. 14 (11), 23-34.

Burt, Ronald. 1992. Structural Holes: The Social Structure of Competition. Cambridge, Mass.: *Harvard University Press*.

Chapman, P., Christopher, M., Juttner, U., Peck, H. and Wilding, R., 2002. Identifying and managing supply chain vulnerability. *Logistics and Transport Focus.* 4(4), 59–64.

Chen, H. Y., Das, A., & Ivanov, D. (2019). Building Resilience and Managing Post-Disruption Supply Chain Recovery: Lessons from the Information and Communication Technology Industry. *International Journal of Information Management, 49*, 330-342. doi:https://doi.org/10.1016/j.ijinfomgt.2019.06.002

Chen, L., Wang, M., Cui, L., & Li, S. (2021). Experience base, strategy-by-doing and new product performance. *Strategic Management Journal*, 42(7), 1379-1398.

Chi, L., Jones, K. G., Lederer, A. L., Li, P., Newkirk, H. E., & Sethi, V. (2005). Environmental Assessment in Strategic Information Systems Planning. *International Journal of Information Management, 25*(3), 253-269. doi:https://doi.org/10.1016/j.ijinfomgt.2004.12.004

Chi, M., Huang, R., & George, J. F. (2020). Collaboration in Demand-Driven Supply Chain: Based on a Perspective of Governance and It-Business Strategic Alignment. *International Journal of Information Management, 52*, 102062. doi:https://doi.org/10.1016/j.ijinfomgt.2019.102062

Chopra, S. & Sodhi, M. S., 2004. Managing risk to avoid supply chain breakdown. *MIT Sloan management review*. October, 53-61.

Clemons, E. K., Gu, B. & Spitler, R., 2003. Hyper-Differentiation Strategies: Delivering Value, Retaining Profits. *Proceedings of the 36th Hawaii International Conference on System Sciences*. Track-8.

de Camargo Fiorini, P., & Jabbour, C. J. C. (2017). Information Systems and Sustainable Supply Chain Management Towards a More Sustainable Society: Where We Are and Where We Are Going. *International Journal of Information Management, 37*(4), 241-249. doi:https://doi.org/10.1016/j.ijinfomgt.2016.12.004

DeGroote, S. E., & Marx, T. G. (2013). The Impact of It on Supply Chain Agility and Firm Performance: An Empirical Investigation. *International Journal of Information Management, 33*(6), 909-916. doi:https://doi.org/10.1016/j.ijinfomgt.2013.09.001

De Long, D. W., & Fahey, L. (2000). Diagnosing cultural barriers to knowledge management. *Academy of Management Perspectives*, *14*(4), 113-127.

Dibrell, C., Craig, J. B., & Neubaum, D. O. (2014). Linking the formal strategic planning process, planning flexibility, and innovativeness to firm performance. *Journal of Business Research*, *67*(9), 2000-2007.

Dibrell, C., Down, J., & Bull, L. (2007). DSP: Achieving strategic flexibility through formalization. *Journal of Business & Management*, *13*(1).

Douma, M. U., Bilderbeek, J., Idenburg, P. J., & Looise, J. K. (2000). Strategic alliances: managing the dynamics of fit. *Long range planning*, *33*(4), 579-598.

Doz, Y., & Kosonen, M. (2008). The dynamics of strategic agility: Nokia's rollercoaster experience. *California Management Review*, *50*(3), 95-118.

Dwivedi, Y. K., Hughes, L., Kar, A. K., Baabdullah, A. M., Grover, P., Abbas, R., ... & Wade, M. (2022). Climate change and COP26: Are digital technologies and information management part of the problem or the solution? An editorial reflection and call to action. *International Journal of Information Management*, 63, 102456.

El Sawy, O., Gosain, A. S., Malhotra, A. & Young, K. M., 1999. IT-intensive value innovation in the electronic economy: Insights from Marshall Industries. *MIS Quarterly* 23 (3), 305-335.

Elliott, D., Swartz, E. and Herbane, B., 1999. Just waiting for the next big bang: business continuity planning in the UK finance sector. *Journal Applied Management Studies* 8(1), 43–60.

Ellram, L., 1990. The supplier selection decision in strategic partnerships. *Journal of Purchasing and Materials Management* 26 (4), 8–14.

Gehani, R. R., 1995. Time based management of technology: A taxonomic integration of tactical strategic roles. *International Journal of Operations & Production Management*. 15 (2), 19-35.

Gilbert, G.A. and Gips, M.A., 2000. Supply side contingency planning. *Security Management*, 44(3), 70–73.

Gosain, S., Malhotra, A. & El Sawy, O., 2004. Coordinating for flexibility in e-business supply chains. *Journal of Management Information Systems* 21 (3), 7-45.

Granovetter, M., 1973. The Strength of Weak Ties. *American Journal of Sociology*. 78:6, pp. 1360-380.

Granovetter, M., 1983. The Strength of Weak Ties: A Network Theory Revisited. *Sociological Theory*. 1, pp. 201-33.

Granovetter, M., 2005. The Impact of Social Structure on Economic Outcomes. *Journal of Economic Perspectives*, 19(1).

Greis, N. P. & Kasarda, J. D., 1997. Enterprise logistics in the information era. *California Management Review* 39 (3), 55-78.

Hamel, G., 1994. The Concept of Core Competence, in Hamel, G and Heene, A (eds.), Competence-Based Competition, *The Strategic Management Society, Sussex: John Wiley and Sons*, 11-33.

Hayes-Roth, B., & Hayes-Roth, F. (1979). A cognitive model of planning. *Cognitive science*, *3*(4), 275-310.

Heide, J. & John, J., 1990. Alliances in industrial purchasing: the determinants of joint action in buyer–supplier relationships. *Journal of Marketing Research* 27 (1), 24–36.

Hoek, Remko I. van, Harrison, A. & Christopher, M., 2001. Measuring agile capabilities in the supply chain. *International Journal of Operations & Production Management*. 21 (1/2), 126-147.

Huotari, M. L. (1995). Strategic Information Management: A Pilot Study in a Finnish Pharmaceutical Company. *International Journal of Information Management, 15*(4), 295-302. doi:https://doi.org/10.1016/0268-4012(95)00025-3

Kohli, A. K. & Jaworski, B. J., 1990. Market orientation: The construct, research propositions, and managerial implications. *Journal of Marketing* 54, 1-18.

Krakowski, S., Luger, J., & Raisch, S. 2022. Artificial intelligence and the changing sources of competitive advantage. *Strategic Management Journal*. https://doi.org/10.1002/smj.3387.

Kukalis, S. (1989). The relationship among firm characteristics and design of strategic planning systems in large organizations. *Journal of Management*, *15*(4), 565-579.

Kumar, A. & Motwani, J. A., 1995. Methodology of assessing time-based competitive advantage of manufacturing firms. *International Journal of Operations & Production Management*. 15 (2), 33-43.

Kwahk, K.-Y., Ahn, H., & Ryu, Y. U. (2018). Understanding Mandatory Is Use Behavior: How Outcome Expectations Affect Conative Is Use. *International Journal of Information Management, 38*(1), 64-76. doi:https://doi.org/10.1016/j.ijinfomgt.2017.07.001

Lee, H., Kim, M. S., & Kim, K. K. (2014). Interorganizational Information Systems Visibility and Supply Chain Performance. *International Journal of Information Management, 34*(2), 285-295. doi:https://doi.org/10.1016/j.ijinfomgt.2013.10.003

Liu, S., Chan, F. T. S., Yang, J., & Niu, B. (2018). Understanding the Effect of Cloud Computing on Organizational Agility: An Empirical Examination. *International Journal of Information Management, 43*, 98-111.

Li, L., Su, F., Zhang, W., & Mao, J.-Y. (2018). Digital transformation by SME entrepreneurs: A capability perspective. *Information Systems Jo*urnal, 28(6), 1129–1157. https://doi.org/10.1111/isj.12153

Mata, F. J., Fuerst, W. L. and Barney, J. B. 1995. Information Technology and Sustained Competitive Advantage: A Resource-Based Analysis. MIS Quarterly, 19(4), 487-505.

Mayer, D. M., Thau, S., Workman, K. M., Van Dijke, M., & De Cremer, D. (2012). Leader mistreatment, employee hostility, and deviant behaviors: Integrating self-uncertainty and thwarted needs perspectives on deviance. *Organizational Behavior and Human Decision Processes*, 117(1), 24-40.

McGrath, J. & M. Iansiti. 1998. Envisioning IT-enabled innovation. *Insight Magazine* 1(1) 2–10.

Melville, N., Kraemer, K., Gurbaxani, V. 2004. Information Technology and Organizational Performance: An Integrative Model of It Business Value. *MIS Quarterly*. 28(2), 283-322.

Menor, L. J., & Roth, A. V. (2007). New service development competence in retail banking: Construct development and measurement validation. *Journal of operations management*, 25(4), 825-846.

Mikalef, P., & Gupta, M. (2021). Artificial intelligence capability: Conceptualization, measurement calibration, and empirical study on its impact on organizational creativity and firm performance. *Information & Managem*ent, 58(3), 103434.

Mintzberg, H. (1991). The effective organization: forces and forms. *MIT Sloan Management Review*, *32*(2), 54.

Mintzberg, H. (1994). Rethinking strategic planning part I: Pitfalls and fallacies. *Long range planning*, *27*(3), 12-21.

Morton, R., Hope for the best, plan for the worst. *Transportation & Distribution*, 2002, 43(4), 51–54.

Mumford, M. D., Scott, G. M., Gaddis, B., & Strange, J. M. (2002). Leading creative people: Orchestrating expertise and relationships. *The leadership quarterly*, *13*(6), 705-750.

Narasimhan, R., Das, A., 1999. An empirical investigation of the contribution of strategic sourcing to manufacturing flexibilities and performance. *Decision Sciences* 30 (3), 683–718.

Neufville, R. D. (2000). Dynamic strategic planning for technology policy. *International Journal of Technology Management*, 19(3-5), 225-245.

Ojha, D., & Gokhale, R. A. (2009). Logistical business continuity planning-scale development and validation. *The International Journal of Logistics Management*.

Ojha, D., Patel, P. C., & Sridharan, S. V. (2020). DSP and firm competitive performance: A conceptualization and an empirical test. *International Journal of Production Economics*, *222*, 107509.

Pant, S., Rattner, L. & Hsu, C., 1994. Manufacturing information integration using a reference model. *International Journal of Operations & Production Management*. 14 (11), 52-72.

Pil, F., & Cohen, S., 2006. Modularity: Implications for Imitation, Innovation, And Sustained Advantage. *Academy of Management Review*, 31(4), 995-1011.

Powell, T.C., 1995. Total quality management as competitive advantage: a review and empirical study. *Strategic Management Journal* 16 (1), 15–37.

Prahalad, C. K. and Hamel, G. 1990. The Core Competence of the Corporation. *Harvard Business Review*. 68(3), 79-91.

Priem, R. L. and Butler, J. E. 2001. Is the Resource-Based "View" a Useful Perspective for Strategic Management Research? *Academy of Management Review*. 26(1), 22-40.

Qiao, T., Shan, W., Zhang, M., & Liu, C. (2019). How to Facilitate Knowledge Diffusion in Complex Networks: The Roles of Network Structure, Knowledge Role Distribution and Selection Rule. *International Journal of Information Management, 47*, 152-167. doi:https://doi.org/10.1016/j.ijinfomgt.2019.01.016

Rai, A., Patnayakuni, R. & Seth,N. 2006. Firm performance impacts of digitally-enabled supply chain integration capabilities. *MIS Quarterly* 30, (2), 225-246.

Rivkin, J. 2000. Imitation of complex strategies. *Management Science*, 46: 824–845.

Rosenzweig, E.D. & Roth, A.V., 2007. B2B seller competence: construct development and measurement using a supply chain strategy lens. *Journal of operations management*.

Roth, A. V. & J. G. Miller,1990. Manufacturing Strategy, Manufacturing Strength, Managerial Success and Economic Outcomes, in *Manufacturing Strategy, (J. Ettlie, M. Burstein, and A. Fiegenbaum, Eds.), Boston, MA: Kluwer Academic Pub*., 97-108

Roth, A. V. & Jackson, W., 1995. Strategic determinants of service quality and performance: Evidence from the banking industry. *Management Science* 41 (11), 1720-1733.

Roth, A. V., 1996. Achieving Strategic Agility through Economies of Knowledge, Strategy and *Leadership Strategy and Leadership (formerly Planning Review Planning Review)*, 24(2), 30-37.

Rozak, H. A., Adhiatma, A., Fachrunnisa, O., & Rahayu, T. (2021). Social media engagement, organizational agility and digitalization strategic plan to improve SMEs' performance. *IEEE Transactions on Engineering Management*, doi: 10.1109/TEM.2021.3085977.

Ruef, M., 2002. Strong ties, weak ties and islands: structural and cultural predictors of organizational innovation. *Industrial & Corporate Change*, 11(3), 427-449.

Sadreddin, A., & Chan, Y. E. (2023). Pathways to developing information technology-enabled capabilities in born-digital new ventures. *International Journal of Information Management*, 68, 102572.

Sambamurthy, V., Bharadwaj, A. & Grover, V., 2003. Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly* 27 (2), 237-263.

Schlagwein, D., & Hu, M. (2017). How and why organisations use social media: Five use types and their relation to absorptive capacity. *Journal of Information Technology*, 32 (2), 194–209.

Schreieck, M., Wiesche, M., & Krcmar, H. (2021). Capabilities for value co-creation and value capture in emergent platform ecosystems: A longitudinal case study of SAP's cloud platform. *Journal of Information Technology*, 36(4), 365– 390. https://doi.org/10.1177/02683962211023780

Song, H., M. Li, and K. Yu. 2021. "Big Data Analytics in Digital Platforms: How Do Financial Service Providers Customise Supply Chain Finance?" *International Journal of Operations & Production Management* 41 (4): 410–435.

Spekman, R., 1988. Strategic supplier selection: understanding long-term buyer relationships. *Business Horizons* 31 (4), 75–81.

Teece, D., Pisano, G. & Shuen, A., 1997. Dynamic capabilities and strategic management. *Strategic Management Journal* 18 (7), 509-533.

Thomas, K. W. and Tymon, W. G. 1982. Necessary Properties of Relevant Research: Lessons from Recent Criticisms of the Organizational Sciences. *Academy of Management Review*. 7(3), 345-352.

Thau, S., Bennett, R. J., Mitchell, M. S., & Marrs, M. B. (2009). How management style moderates the relationship between abusive supervision and workplace deviance: An uncertainty management theory perspective. *Organizational Behavior and Human Decision Processes*, 108(1), 79-92.

Richey, R. G., Tokman, M., & Dalela, V. (2010). Examining collaborative supply chain service technologies: a study of intensity, relationships, and resources. *Journal of the Academy of Marketing Science*, 38(1), 71-89.

Rogers, T. and Bazerman, M. H. (2008). 'Future lock-in: future implementation increases selection of 'should'choices'. *Organizational Behavior and Human Decision Processes*, 106, 1-20.

Venkitachalam, K., & Willmott, H. (2017). Strategic Knowledge Management—Insights and Pitfalls. *International Journal of Information Management, 37*(4), 313-316. doi:https://doi.org/10.1016/j.ijinfomgt.2017.02.002

Vukšić, V. B., Bach, M. P., & Popovič, A. (2013). Supporting Performance Management with Business Process Management and Business Intelligence: A Case Analysis of Integration and Orchestration. *International Journal of Information Management, 33*(4), 613-619. doi:https://doi.org/10.1016/j.ijinfomgt.2013.03.008

Wang, E., Tai, J., & Wei, H., 2006. A Virtual Integration Theory of Improved Supply-Chain Performance. *Journal of Management Information Systems*, 23(2), 41-64.

Weick, K.,1976. Educational Organizations as Loosely Coupled Systems. *Administrative Science Quarterly*, 21(1), 1.

Wu, I.-L., & Chiu, M.-L. (2018). Examining Supply Chain Collaboration with Determinants and Performance Impact: Social Capital, Justice, and Technology Use Perspectives. *International Journal of Information Management, 39*, 5-19. doi:https://doi.org/10.1016/j.ijinfomgt.2017.11.004

Xiao, Y., & Zhang, H. (2021). New product advantage infused by modularity: Do resources make a difference? *Journal of Product Innovation Manag*ement, 38(4), 473-493.

Xie, X., Han, Y., Anderson, A., & Ribeiro-Navarrete, S. (2022). Digital platforms and SMEs' business model innovation: Exploring the mediating mechanisms of capability reconfiguration. *International Journal of Information Management*, 65, 102513.

Zsidisin, G.A., Melnyk, S. A. and Ragatz, G. L., 2005. An institutional theory perspective of business continuity planning for purchasing and supply management. *International Journal of Production Research*, Vol. 43, No. 16, 3401–342.