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Cross-Functional Integration in the Supply Chain: Construct Development and the Impact of Workplace Behaviors

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Cross-Functional Integration in the Supply Chain: Construct Development and the Impact of Workplace Behaviors

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DEDICATION

This dissertation is dedicated with love to my wife, Lee.

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ABSTRACT

Cross-functional integration (CFI) is central to supply chain theory and practice. However, researchers have yet to settled on a consistent definition or measure of CFI, creating confusion over its conceptual content and making it difficult to validate given operationalizations. In addition, researchers have only recently begun to explore the impact of workplace behaviors on CFI and supply chain performance. The two studies in this dissertation seek to contribute to the supply chain literature in both of these areas. Study 1 develops a comprehensive definition and valid measure of CFI based on a systematic process of construct development. Study 2 employs the newly developed construct to investigate the relationships among organizational design, workplace behaviors, CFI, and supply chain performance. Overall, this dissertation seeks to enhance the rigor and relevance of CFI research by (1) offering a precise definition and measure of the CFI phenomenon and (2) establishing its relationship to variables, such as workplace behaviors, that are within the control of most supply chain managers.

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INTRODUCTION: ENHANCING THE RIGOR AND RELEVANCE OF RESEARCH ON CROSS-FUNCTIONAL INTEGRATION

The concept of cross-functional integration (CFI) is central to supply chain theory and practice (Frankel et al. 2008). Many of the basic theoretical claims of supply chain scholarship rely on some notion of CFI (Cooper et al. 1997; Mentzer et al. 2001; Frohlich and Westbrook 2001; Chen and Paulraj 2004). Likewise, practitioners continue to view CFI as an important driver of supply chain performance (Jin et al. 2013; Deloitte 2014). Indeed, the importance of integration to supply chain management has led both scholars (Pagell 2004) and practitioners (CSCMP 2013) to suggest it as the field's defining concept.

The CFI concept is rooted in one of the earliest insights of business scholarship: that maximizing organizational outcomes requires comprehensive management of the interdependent processes that define a business (Shaw 1920). Historically, organizations have assigned different functional areas operational control over different business processes (Child and Mansfield 1972). This segmenting of business processes into functional areas is called diversification (Lawrence and Lorsch 1967). The counterpart to diversification is integration. Through integration, an organization seeks to achieve unity of effort among different functional areas so as to maximize organizational outcomes (Lawrence and Lorsch 1967).

Early management researchers primarily focused on understanding how organizations could achieve integration through bureaucratic controls that would strictly define functional interactions (Child 1972; Ouchi 1979). Later scholars, particularly in the emerging field of supply chain management, began to challenge this top-down approach to integration (Oliver and Webber 1982; La Londe and Powers 1993). Supply chain scholars argued that, in the context of a dynamic

competitive environment, unity of effort is more effectively achieved through lateral or horizontal engagement across functions (Song et al. 1997; Christopher 2000). Subsequent research has supported this original theoretical claim (Leuschner et al. 2013). And indeed today, the basic idea of lateral engagement across functions, generally referred to in the literature as cross-functional integration, lies at the heart of much supply chain scholarship and practice (Frankel et al. 2008).

Limitations in Current Research

Despite the importance of CFI to the supply chain discipline, research on the topic is inhibited in two fundamental respects. First, supply chain researchers have not settled on a consistent definition or measure of the CFI concept (Frankel and Mollenkopf 2015). Scholars have used a wide range of terms – including coordination, collaboration, cooperation, working together, interaction, and information exchange – to characterize CFI. However, a lack of attention to similarities and differences across these terms has led researchers to define CFI in ways that are not always compatible and measure CFI in ways that are not always complete. Thus, while most scholars have an intuitive sense of CFI as a complex, multidimensional concept, more work is needed to (1) provide a clear, theoretically based definition of the concept, (2) specify the concept's dimensions, and (3) validate a set of scale items that reliably measure its conceptual domain.

Second, supply chain researchers have largely focused on organizational structures related to information management systems and performance metrics as the primary operational antecedents to CFI (Stank et al. 2001a; Vickery et al. 2003; Hausman 2004; Rodrigues et al. 2004; Flynn et al. 2010). Yet CFI remains a persistent challenge even for companies operating under organizational conditions that would theoretically lead to greater cross-functional engagement

(Gartner 2013; Jin et al. 2014). This situation suggests the need for research on additional factors that might impact CFI (Pagell 2004). An emerging stream of research points to supply chain professionals' workplace behaviors as representing a set of important, but under-researched, factors in this regard (Daugherty et al. 2009; Oliva and Watson 2011; Fawcett et al. 2012; Enz and Lambert 2014). As Ellinger et al. (2006, 2) argued, the on-going struggle firms have with integrating across functional boundaries creates a "compelling need to develop a more comprehensive understanding of the behavioral factors that facilitate (or inhibit) inter-functional collaboration." Thus, additional research is needed to (1) identify specific types of workplace behaviors that supply chain professionals may exhibit, (2) relate these behaviors theoretically and empirically to CFI, and (3) relate behavioral variables to organizational antecedents of CFI that have already been established in the literature.

Current limitations with regard to defining, measuring, and predicting CFI have implications for both research and practice. First, the lack of a consistent definition that clearly articulates CFI's essential features limits the ability of supply chain scholars to engage in research that resonates with a broad academic audience (Kaplan 1964). Multiple definitions narrow the common ground on which researchers can build as they seek to consolidate previously established knowledge on CFI and push research in new directions (Mackelprang et al. 2014). Moreover, definitional disparities constrain the ability of scholars to clearly articulate the central "problem" of CFI for practitioners in a way that helps them improve their supply chain organizations (Spradlin 2012).

Second, the lack of a single valid and reliable measure for CFI undermines confidence in research results. Without a common measure, studies run the risk of reflecting the characteristics

of specific measures rather than underlying theoretical relationships (Peter 1981; Hinkin 1998). To the extent that measures (rather than underlying relationships) drive results, supply chain scholars lose credibility in their efforts to establish the antecedents and consequences of CFI (Swink and Schoenherr 2015). More generally, the use of multiple measures limits the extent to which studies can be consolidated into a common body of knowledge on CFI (Mackelprang et al. 2014). Although beneficial, meta-analyses do not necessarily overcome these limitations, as the interpretation of meta-analytic results also depends on the compatibility of the underlying conceptualizations and measures on which they are based (Sharpe 1997; Hunter and Schmidt 2004).

Finally, a lack of research on antecedents such as workplace behaviors limits the ability of supply chain scholars to deliver actionable advice to practitioners seeking to enhance CFI in their organizations. Organizations have invested heavily in collaborative business strategies and organizational re-designs aimed at creating a more connected work place (Lechner 2012; Morgan 2013). Nevertheless, practitioners report that their ability to integrate across supply chain functions has not significantly improved (Jin et al. 2013). Current CFI research provides limited guidance to managers on additional steps they can take to improve this situation.

Research Proposal

This research seeks to contribute to the supply chain literature on CFI by attempting to address the limitations outlined above. First, it seeks to advance scholarship on CFI by (1) developing a comprehensive definition that synthesizes previous supply chain research on the concept and (2) developing a valid and reliable set of scale items that measure the conceptual

domain outlined by this definition. Consistent with a middle-range approach to construct development, this work is limited to defining CFI within a supply chain context in order to enhance theory development and testing within the domain of supply chain management (Merton 1968; Stank et al. 2016).

Second, this research seeks to advance understanding of the impact of workplace behaviors on CFI by drawing on well-established research in the area of organizational psychology. Researchers in organizational psychology have identified three distinct sets of behaviors that characterize how employees engage in their work: task behaviors (TBs), organizational citizenship behaviors (OCBs), and counterproductive work behaviors (CWBs) (Motowidlo and Van Scotter 1994; Dalal 2005). These behaviors have been measured at both the individual and group levels, and shown to have distinct performance outcomes (Rotundo & Sackett, 2002; Podsakoff et al. 2009; Choi and Sy 2010). The aim here is to test how such behaviors, measured at the group level, influence CFI in the supply chain. Third, this research seeks to understand how workplace behaviors relate to previously established organizational antecedents to CFI. Constructs representing organizational design will therefore be included in this study. The goal is to provide a more detailed understanding of how different factors interact to create SC performance.

The research is organized into two studies. Study 1 is focused on construct development, following procedures outlined in the literature (Churchill 1979; Hinkin 1998; MacKenzie et al. 2011a). Study 2 is focused on understanding the impact of workplace behaviors on CFI and employs cross-sectional survey data for hypothesis testing (Dillman 1991; Malhotra and Grover 1998). The overarching goal is to provide a clearer understanding of CFI and what steps managers can take to improve the performance of their supply chain organizations.

Study 1 – Cross-Functional Integration: Concept Clarification and Scale Development

Supply chain management research on CFI is characterized by three broad perspectives: the integration of goals through cross-functional collaboration (Ellinger 2000; Stank et al. 2001b); the integration of activities through cross-functional coordination (Germain and Iyer 2006; Lambert and Cooper 2000); and the integration of knowledge through cross-functional communication (Narasimhan and Kim 2002; Flynn et al. 2010). Building on the theoretical and empirical literature in supply chain management, this paper incorporates elements of each perspective in developing the following definition of CFI in the supply chain:

> Cross-functional integration in the supply chain is an on-going process in which different functional areas of the supply chain collaborate, coordinate, and communicate in an effort to maximize outcomes for their organization.

Precise conceptual definitions of CFI's three main dimensions – cross-functional collaboration, coordination, and communication – are likewise developed.

The definitions developed in this study are grounded in the supply chain literature. In particular, definitional work undertaken here builds on previous research by Kahn (1996), which has been widely cited in supply chain scholarship on CFI (e.g. Kahn and McDonough 1997; Stank et al. 1999; Verma et al. 2001; Daugherty et al. 2009). An assessment of whether these definitions offer an appropriate basis for scale development is undertaken according to the framework provided by MacKenzie et al. (2011a). Scale development and testing is then conducted following procedures proposed by Churchill (1979) and later refined by Hinkin (1998) and MacKenzie et al. (2011a). The following steps provide a general sense of the how this research will progress:

- Items will be generated to represent the CFI construct
- Content and face validity of items will be assessed empirically through a survey of supply chain scholars and practitioners

- Items with strong content and face validity will be used in specifying a hypothesized measurement model
- Data from a large-scale survey of 300 supply chain managers and executives will be used to pre-test the specified model
- Scale purification and refinement will occur based on the pre-test data
- Data from a second large-scale survey of 300 additional supply chain managers and executives will be used to reexamine and validate scale properties

Hinkin (1998) provides a succinct statement of the value of this research: "Because researchers studying organizational behavior rely most heavily on the use of questionnaires as the primary means of data collection, it is crucial that the measures on these survey instruments represent the constructs under examination" (104-105). The goal of this study is to overcome the limitations that the lack of a coherent definition and valid measure of CFI has placed on supply chain researchers, and to establish a firm foundation on which future scholars can build.

Study 2 – The Impact of Cross-Functional Integration and Workplace Behaviors on Supply Chain Performance

Supply chain researchers have largely focused on information management systems (Flynn et al. 2010) and cross-functional performance metrics (Lambert and Knemeyer 2007) as the primary mechanisms through which organizations can integrate their supply chain functions. However, the presence of these organizational structures does not fully explain the impact of CFI on performance (Pagell 2004). An emerging stream of literature points to supply chain professionals' workplace behaviors as representing an additional set of factors that may impact CFI in an organization (Ellinger et al. 2006; Daugherty et al. 2009; Oliva and Watson 2011; Enz and Lambert 2014). This research stream suggests that both structural and behavioral related to CFI play an important role in determining supply chain performance (Oliva and Watson 2011).

This study adopts a socio-technical systems (STS) perspective to analyze the effects of structural and behavioral factors on CFI. From an STS perspective, integrated information systems and cross-functional KPIs represent CFI's technical core, i.e. the primary structures that organizations put in place to drive employee behaviors toward executing the task of integration (Pasmore et al. 1982). However, STS recognizes that although the technical core is intended to produce certain task-oriented behaviors, it may also produce other unintended behaviors based on how employees respond its requirements (Ash et al. 2007; Harrison et al. 2007). Thus, "optimizing" the technical core alone does not guarantee performance results. Organizations must also take care to ensure that the behaviors elicited by the technical core align with desired outcomes (Emery and Trist 1960; Trist 1981; Pasmore et al. 1982). STS therefore argues that organizations must optimize both the structural and behavioral aspects of a task to maximize outcomes (Appelbaum 1997).

Research in organizational psychology suggests that supply chain professionals' can potentially exhibit three general types of workplace behaviors: task, citizenship, and counterproductive behaviors (Motowidlo and Van Scotter 1994; Dalal 2005). Building on the supply chain literature, this study predicts that task and citizenship behaviors positively impact CFI, while counterproductive behaviors negatively impact CFI (Mollenkopf et al. 2000; Pagell 2004; Ellinger et al. 2006; Ellegaard and Koch 2014). Consistent with the STS perspective outlined above, this study also considers the impact of the technical core on driving these workplace behaviors. The study predicts that highly integrated information management systems and performance metrics will be associated with high levels of task behaviors. At the same time, however, this study also predicts that highly integrated information management systems and

performance metrics will be associated with *low* levels of citizenship behaviors and *high* levels of counterproductive behaviors. Overall, therefore, this study suggests a competitive mediation model (Zhao et al. 2010). The study hypothesizes that the technical core associated with CFI produces task behaviors that increase integration, but that these positive effects are offset by a reduction in citizenship behaviors and an increase in counterproductive behaviors. The level of CFI therefore remains below what might be expected if the technical core produced only task-oriented behaviors as intended, and far below what potentially could be achieved if citizenship and counterproductive behaviors were directly addressed by management.

A survey of supply chain professionals is used to test these hypotheses following procedures outlined in the literature (Groves et al. 2009). Survey methodology is appropriate for "explanatory research" that seeks to empirically test theoretical explanations of how and why variables should be related (Malhotra and Grover 1998). Moreover, survey data coupled with structural equation modeling provides a powerful empirical basis for establishing the interrelationship among organizational variables, behavioral variables, and CFI (Ullman 2006).

Conclusion

The impact of supply chain research rests on the ability of scholars to (1) precisely define and measure phenomena of interest and (2) credibly establish their relationship to managerially relevant outcomes (Mentzer 2008). This research seeks to advance scholarship in the area of CFI on both fronts. By offering a comprehensive definition and validated measurement instrument for the CFI concept, this study seeks to build a common foundation for extending theoretical understanding of integration's antecedents and consequences. In addition, construct development

undertaken here aims to improve scholars' ability to communicate the insights gained from CFI research to a broader practitioner community still struggling to achieve integration in their organizations.

This research also seeks to enhance the relevance of CFI research to supply chain managers by focusing on concrete behaviors that enhance (or inhibit) integration in the context of day-to-day operations. Despite high-level attention to collaborative business strategies as a driver of performance (Morgan 2013) and massive investments in information technology aimed at creating a more connected work place (Hardy 2012), researchers and practitioners continue to report that companies find integration difficult to achieve (Jin et al. 2013; Lash 2012). The implication seems to be that while strategy and organizational design may play a part in driving integration, additional factors are needed fully realize its performance benefits.

Anecdotal evidence from practitioners supports initial findings in the literature that behavioral antecedents offer a fruitful avenue of research in this regard (Merrill 2007; Van Bodegraven and Ackerman 2013). As one SVP of Global Operations for a Fortune 500 company recently put it, "[Our biggest challenge is] overcoming the cultural silo mentality that we have had in the past. Expectations have been set. We are now training the organization on how they can work together." Research undertaken here seeks to improve understanding of how to achieve this goal.

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STUDY 1:
CROSS-FUNCTIONAL INTEGRATION IN THE SUPPLY CHAIN: CONCEPT CLARIFICATION AND SCALE DEVELOPMENT

This study represents original research undertaken by the author with the help of his dissertation committee members, Drs. Theodore Stank, Diane Mollenkopf, Chad Autry, and Timothy Munyon.

Abstract

Practitioners and scholars have suggested cross-functional integration (CFI) as a defining concept in the field of supply chain management. Moreover, a substantial body of literature has developed around demonstrating CFI's impact on key supply chain outcomes. Yet the field has no consistent definition or measure of the CFI concept, undermining the theoretical and empirical implications that can be drawn from research on this important topic. This study advances research in the area of CFI by developing (1) a comprehensive definition that synthesizes previous supply chain research to clearly specify CFI's conceptual domain and underlying dimensions and (2) a valid set of scale items that measure the conceptual domain outlined by this definition. A systematic process of construct development is employed to achieve these goals. The result is a comprehensive definition and valid measure for CFI that provides a common foundation for extending theoretical understanding of integration's antecedents and consequences within supply chain management.

> "Cross-functional integration (CFI) seems to be one of those notions that we all 'know it when we see it,' but there does not appear to be a consensus about what integration really is…[T]he construct must be clearly defined in order for research results to be meaningfully interpreted across the many streams of literature that include notions of CFI…[A]lthough the concept of CFI has been around for decades, scholars are still in the early stages of genuine construct development." (Frankel and Mollenkopf 2015, 1)

Practitioners and scholars have suggested cross-functional integration (CFI) as a defining concept in the field of supply chain management (Frankel et al. 2008). Moreover, a substantial body of literature has developed around demonstrating CFI's impact on key supply chain outcomes, including operational efficiency (Rodrigues et al. 2004; Germain and Iyer 2006; Schoenherr and Swink 2012), customer service (Stank et al. 2001; Vickery et al. 2003; Troy et al. 2008; Springinklee and Wallenburg 2012), and financial performance (Droge et al. 2004; Flynn et al. 2010; Swink and Schoenherr 2015). Yet the field has no consistent definition or measure of the CFI concept, undermining the theoretical and empirical implications that can be drawn from research on this important topic.

The use of multiple definitions and measures impairs CFI research in at least three ways. First, the lack of a common definition creates confusion over CFI's conceptual content, making it difficult to establish the validity of a given operationalization (Peter 1981; MacKenzie 2003). Individual studies therefore run the risk of reflecting the characteristics of specific measures rather than underlying theoretical relationships (Peter 1981; Hinkin 1998). Second, divergent definitions and measures limit the ability of researchers to consolidate findings across studies into an established body of knowledge on CFI (Kaplan 1964; MacKenzie 2003). Although beneficial, meta-analyses do not necessarily overcome this problem, as the interpretation of meta-analytic results also depends on the compatibility of underlying conceptualizations and measures (Sharpe 1997; Hunter and Schmidt 2004; Mackelprang et al. 2014). Third, lack of consistency in CFI

research constrains scholars' ability to clearly articulate the central "problem" of integration for supply chain professionals and distill current knowledge into a set of actionable, evidence-based management principles that can guide practice.

This study seeks to advance research in the area of CFI by developing (1) a comprehensive definition that synthesizes previous supply chain research to clearly specify CFI's conceptual domain and underlying dimensions and (2) a valid set of scale items that measure the conceptual domain outlined by this definition. A systematic process of construct development is employed to achieve these goals (Churchill 1979; Hinkin 1998; MacKenzie et al. 2011a). Consistent with a middle-range approach to construct development, the research is limited to defining CFI within a supply chain context in order to enhance theory development and testing within the domain of supply chain management (Stank et al. 2016). The result is a complete, yet parsimonious, definition and measure for CFI in the supply chain. Figure 1 provides a detailed illustration of the steps undertaken to achieve these goals. All figures and tables are located in Appendix A.

[Insert FIGURE 1 here]

The purpose of this research is to offer a comprehensive definition and valid measure for CFI so as to build a common foundation for extending theoretical understanding of integration's antecedents and consequences within supply chain management. In addition, construct development undertaken here aims to improve supply chain scholars' ability to communicate the insights gained from CFI research to a broader practitioner community still struggling to achieve integration in their supply chain organizations.

Foundations of the CFI Concept

Research on CFI in the supply chain is rooted in foundational scholarship on the effective management of complex organizations (Shaw 1920; Nordsieck 1934; Follet 1942; Forrester 1958; March and Simon 1958; Cyert and March 1963; Alderson and Martin 1965; Lawrence and Lorsch 1967; Galbraith 1974; Mintzberg 1980). This early literature pointed to a crucial tension within organizations: the need to specialize within functional areas to gain efficiencies, on the one hand, and the need to manage across interdependent functions to maximize performance on the other. Thus, Lawrence and Lorsch (1967) provided an early definition of integration as overcoming differentiation (specialization) to achieve "unity of effort" among different areas of an organization. However, this literature offered divergent perspectives on what exactly needs to be integrated in order to maximize organizational performance. In particular, earlier scholars variously viewed the central "problem" of integration as overcoming the diversity of goals (Cyert and March 1963), activities (Thompson 1967), and knowledge (Galbraith 1974) in complex organizations.

Integration as Overcoming Diversity of Goals

The management literature has long identified integration with overcoming the diversity of goals in complex organizations (Cyert and March 1963; Simon 1964; Lawrence and Lorsch 1967; Mintzberg 1979; Tjosvold 1988). From this perspective, an organization is composed of various stakeholders (persons or groups) seeking satisfactory solutions to problems within their local area of operation and in the face of local constraints. As a result, stakeholders' goals and objectives are widely varied (March and Simon 1958). Integration is primarily concerned with aligning these local goals and objectives with more comprehensive organizational goals (Lawrence

and Lorsch 1967). Resolving conflicts among stakeholders whose goals and objectives may be incompatible is a primary concern from this perspective (Cyert and March 1963; Simon 1964). Collaboration among stakeholders based on norms of mutual commitment and trust therefore becomes an important means for achieving integration (Appley and Winder 1977; Lawrence and Lorsch 1986; Tjosvold 1988; McAllister 1995; Mintzberg et al. 1996).

Integration as Overcoming Diversity of Activities

Another stream of thought has viewed integration primarily in terms of coordinating activities across functional areas (Nordsieck 1934; Forrester 1958; Thompson 1967; McCann and Galbraith 1981; Barki and Pinsonneault 2005). From this perspective, an organization is seen as a system of interdependent functions, each carrying out a specified set of activities, such that the outputs from some functional activities represent inputs for other functional activities (Forrester 1958; Thompson 1967; Anderson 1999). The central "problem" of integration becomes managing interdependencies across functional activities so as to optimize the overall flow of inputs and outputs along an entire "activity series" or process (Malone and Crowston 1994). Emphasis is therefore placed on coordination mechanisms – such as rules, plans, schedules, periodic reviews – that regulate and synchronize functional operations (Thompson 1967; Van de Ven et al. 1976; McCann and Galbraith 1981). Business process design and improvement likewise emerge as important themes from this perspective (Davenport and Short 1990), insofar as integration aims at maximizing overall process performance (Crowston 1997).

Integration as Overcoming Diversity of Knowledge

Finally, a third stream of literature has focused primarily on the integration of knowledge across organizational units (Galbraith 1974; Tushman and Nadler 1978; Hitt et al. 1993; Nonaka

1994; Alavi and Leidner 2001). This perspective argues that knowledge represents the most basic organizational resource, in that it allows organizations to overcome operational problems associated with value creation. However, the knowledge needed to address specific problems is oftentimes lacking or dispersed across specialized groups and individuals (Grant 1996b). Thus, creating, sharing, and combining knowledge through the exchange of relevant and timely information becomes the core task of any organization (Tushman and Nadler 1978; Nonaka 1994). Integration here is understood primarily as a process of reciprocal information flows between different parts of the organization (Hitt et al. 1993; Grant 1996a; Hansen 1999), with technology acting as an important, although imperfect, mechanism for enhancing intra-organizational communication (Orlikowski and Robey 1991; Swan et al. 1999; Alavi and Leidner 2001).

Defining CFI in the Supply Chain

The three main perspectives on integration in the foundational literature have informed researchers' conceptualizations of CFI in the supply chain. Thus, supply chain researchers have variously understood CFI in terms of integrating goals through cross-functional collaboration (Stank et al. 1999; Ellinger 2000), integrating activities through cross-functional coordination (Germain and Iyer 2006; Swink and Song 2007), and integrating knowledge and information through cross-functional communication (Calantone et al. 2002; Sherman et al. 2005; Flynn et al. 2010). Although some scholars have combined elements across perspectives (e.g., Kahn and Mentzer 1998; O'Leary-Kelly and Flores 2002; Pagell 2004; Swink and Schoenherr 2015), there nevertheless remains a compelling need for additional research that systematically develops a comprehensive understanding of CFI in the supply chain (Frankel and Mollenkopf 2015).

The current research views each of the three main perspectives found in the literature as informing different dimensions of the overall CFI concept. This approach is consistent with prior research, particularly work by Kahn and Mentzer (1996, 1998), who defined CFI as a process of interdepartmental interaction and collaboration. It therefore allows for a reconceptualization of CFI that nevertheless remains rooted in the in literature (MacKenzie 2003; MacKenzie et al. 2011a). Thus, the current research defines CFI in the supply chain as follows:

> Cross-functional integration in the supply chain is an on-going process in which different functional areas of the supply chain collaborate, coordinate, and communicate in an effort to maximize outcomes for their organization.

This definition views CFI as a multi-dimensional concept that entails elements of collaboration, coordination, and communication. This definition implies that CFI occurs in organizations where goals, activities, and knowledge have been differentiated across different areas of the supply chain. Diversification is therefore viewed as antecedent to CFI rather than a dimension of the concept (Lawrence and Lorsch 1967; Malone and Crowston 1994; Grant 1996). Likewise, the phrase "maximize outcomes for their organization" refers to the outcomes of CFI rather than a dimension of the concept (Kahn and Mentzer 1998; O'Leary-Kelly and Flores 2002; Pagell 2004). The definition therefore specifies the domain of the CFI concept in terms of its three sub-dimensions: cross-functional collaboration, coordination, and communication. Defining and measuring these three sub-dimensions should therefore fully capture the CFI concept (MacKenzie et al. 2011a). The follow sections describe and define these sub-dimensions.

Cross-Functional Collaboration

A number of supply chain scholars have emphasized an understanding of CFI as a collaborative process aimed at managing divergent functional goals (Kahn 1996; Jassawallat and

Sashittal 1998; Stank et al. 1999; Ellinger 2000; Stank et al. 2001b; Vickery et al. 2003; Sabath and Whipple 2004; Ellinger et al. 2006; De Luca and Atuahene-Gima 2007; Springinklee and Wallenburg 2012). These researchers have focused attention on the need for functions to develop a common vision that recognizes the strategic interdependence of different parts of the supply chain (Sabath and Whipple 2004; De Luca and Atuahene-Gima 2007). Through the collaborative process, functions seek to arrive at a mutual understanding of functional goals and objectives and their contribution to collective outcomes (Kahn and Mentzer 1998; Stank et al. 2001b).

The supply chain literature on CFI suggests that cross-functional collaboration has two main features: establishing common goals and working together to achieve those goals. Establishing common goals requires supply chain functions to negotiate a mutual understanding of group objectives and the role each function plays in achieving those objectives (Stank et al. 2001b; Ellinger et al. 2006). It also implies an on-going process of evaluating and adjusting common goals to ensure mutual alignment is maintained (Ellinger 2000; De Luca and Atuahene-Gima 2007). Thus, an open process that allows for constructive debate on defining and refining joint supply chain goals is a critical element of collaboration (Oliva and Watson 2011). In addition to establishing common goals, collaboration also entails working together to achieve those goals (Hausman et al. 2002; Pagell 2004). Working together requires that functions consider the unique constraints faced by different areas of the supply chain and share resources when necessary to overcome such constraints (Kahn 1996; Barrat 2004).

Cross-functional collaboration represents an oftentimes difficult process of reconciling conflicting interests into a joint plan of action with few enforcement mechanisms beyond voluntary agreement (Oliva and Watson 2011). Therefore, meaningful relationships based on trust,

commitment, and mutual respect among different groups and individuals act as key enablers of collaboration (Morgan and Hunt 1994; Stank et al. 1999). In terms of outcomes, collaboration has the potential to improve performance in a number of areas, including innovation (Lovelace et al. 2001; Brettel et al. 2011), new product development (Gerwin and Barrowman 2002; Sherman et al. 2005), and customer service (Vickery et al. 2003; Springinklee and Wallenburg 2012). More generally, collaboration "facilitates an assessment of the state of the supply chain, of the needs of the organization, and the determination of an approach for creating and sustaining value based on that collaborative assessment" (Oliva and Watson 2011, 434). It therefore improves the ability of the supply chain to effectively meet the demands of dynamic market environments (Kahn 2001; Hausman et al. 2002).

Collaboration encompasses the more basic concept of *cooperation*, which researchers have also used to characterize CFI in the supply chain (e.g. Song et al. 1997; Lievens and Moenaert 2000; Calantone et al. 2002; O'Leary-Kelly and Flores 2002; Wong and Boon-itt 2008). Cooperation primarily describes how stakeholders prioritize their actions with reference to individual and joint goals. Given a common goal that no one stakeholder can achieve in isolation, cooperative stakeholders act to achieve both their own goals as well as the common goal (Doran et al. 1997). Cooperation therefore implies a willingness to take actions that may temporarily sub-optimize individual goals in furtherance of a joint goal on the understanding that others will behave likewise (Weber 2008). The concept of collaboration includes these attributes, but moves beyond simply prioritizing actions to include jointly establishing goals and proactively supporting others in achieving those goals (Wood and Gray 1991; Thomson et al. 2009). Importantly, however, collaboration/cooperation does not imply *coordination* (discussed below), insofar as stakeholders

can work toward common goals without any explicit sequencing of actions aimed at achieving those goals (Doran et al. 1997; Davis et al. 2010). Yan and Dooley (2013, 523) make this distinction in arguing that "integration encompasses coordination (alignment of actions) and cooperation (alignment of interests)."

Based on this discussion, the following definition of cross-functional collaboration in the supply chain is proposed:

> *Cross-functional collaboration* in the supply chain is an on-going process in which different functional areas of the supply chain establish common goals and objectives and work together to achieve them.

Cross-Functional Coordination

A second stream of literature has placed greater emphasis on the coordination aspects of CFI in the supply chain (Lambert and Cooper 2000; Sahin and Robinson 2002; Stadtler 2005). From this perspective, CFI is understood primarily in terms of linking internally performed work into a seamless process to support customer requirements (Stank et al. 2001a). The emphasis is on holistically managing the entire sequence of supply chain activities, from purchasing (Moses and Ahlström 2008), through value-added operations (Thomas and Griffin 1996), to transportation and distribution (Chen and Vairaktarakis 2005). Researchers have also looked at the coordination of supply chain functions with related areas, such as marketing (Bregman 1995; Lee et al. 1997; Gimenez and Ventura 2005) and R&D (Carlsson 1991; Brettel et al. 2011). Related concepts such as "synchronization" (Lambert and Cooper 2000), "seamless supply chain operations" (Rodrigues et al. 2004), and "unified control of processes" (Germain and Iyer 2006) are encompassed by the notion of coordination, which has deep roots in the supply chain literature (Bowersox 1969; Heskett 1969).

The supply chain literature suggests that coordination requires functions to view their activities in the context of larger supply chain processes (Lambert and Cooper 2000; Chen et al. 2009). This "process perspective" focuses functional efforts on optimizing the overall flow of supply chain activities, rather than simply the execution of activities within individual functional areas (Forrester 1958; Bowersox 1969; Stadtler 2005). Coordination entails resolving conflicts in decision-making to ensure that the sequencing and timing of activities (i.e. process inputs and outputs) are matched with maximal efficiency (Morash and Clinton 1998; O'Leary-Kelly and Flores 2002; Brettel et al. 2011; Williams et al. 2013). Managing operational lead times is therefore seen as an important component of cross-functional coordination (Simatupang et al. 2002). More generally, coordination entails jointly managing interdependencies across functional areas in an effort to create more streamlined and consistent supply chain operations (Germain and Iyer 2006; Chen et al. 2009; Springinklee and Wallenburg 2012).

Supply chain researchers emphasizing a coordination view of CFI have focused on organizational design, process controls, and decision-making tools as key enablers of coordination (Germain et al. 1994; Simatupang et al. 2002; Stadtler 2005). Such enablers include, for example, the use of advanced planning systems that employ optimization and meta-heuristic approaches to find system-wide solutions (Stadtler 2005) or liaison personnel whose specific job it is to coordinate the efforts of several departments (Germain and Iyer 2006). Broadly speaking, the outcome of high levels of coordination is greater efficiency in matching supply with demand (Germain et al. 2008). Coordination results in more streamlined operations with decreased process buffers, redundancies, and non-value added activities/materials (e.g. excess inventory) (Bregman 1995; Gustin et al. 1995; Rodrigues et al. 2004; Statler 2005; Germain and Iyer 2006). These

efficiency gains from cross-functional coordination have been shown to reduce overall operating costs and positively impact return on assets (Stank et al. 2001a; Chen et al. 2007; Schoenherr and Swink 2012).

Based on this discussion, the following definition of cross-functional coordination in the supply chain is proposed:

> *Cross-functional coordination* in the supply chain is an on-going process in which different functional areas of the supply chain focus on optimizing overall supply chain processes by jointly managing the flow of operational activities.

Cross-Functional Communication

Finally, a third stream of supply chain management research has emphasized an understanding of CFI as a process of cross-functional communication (Hitt et al. 1993; Huang and Newell 2003; Hult et al. 2004; Barratt and Barratt 2011; Schoenherr and Swink 2012). The focus here has been on the exchange of information across functional areas needed to support supply chain operations and strategies (Calantone et al. 2002; Sanders and Premus 2002; Oh et al. 2012; Williams et al. 2013). Research within this stream has conceptualized cross-functional communication terms of information exchange (Narasimhan and Kim 2002; Flynn et al. 2010; Brettel et al. 2011), information sharing (Song and Montoya-Weiss 2001), information dissemination (Mollenkopf et al. 2000), information processing (Hult et al. 2004; Schoenherr and Swink 2012), and interaction (Kahn and Mentzer 1998; Kahn and McDonough 1997). The central theme in this literature has been the critical role that information and knowledge play in collective decision-making and action within the supply chain (Swink and Schoenherr 2015).

Cross-functional communication in the supply chain implies a process of both conveying and interpreting information (Oliva and Watson 2011). The communication process can

incorporate both formal information exchange (Flynn et al. 2010) as well as informal interactions (Andrea et al. 2011). The focus in either case is on sharing information that is housed in one functional area but is relevant to the operations of other functions or the supply chain as a whole (Mollenkopf et al. 2000; Sanders and Premus 2002; Sherman et al. 2005; Flynn et al. 2010). Communication therefore implies that functions are clear on the information needs of other supply chain members (Calantone et al. 2002). Communication also requires that the receiver understands the sender's intention (what the information is meant to communicate) (Dougherty 1992; Lovelace et al. 2001). More generally, cross-functional communication entails different parts of the supply chain working together to maintain a reciprocal flow of information that supports a collective response to the business environment (Ellinger et al. 2006; Fugate et al. 2009; Ellegaard and Koch 2012).

Supply chain research on CFI suggests various enablers of cross-functional communication related to people, processes, and technology. For instance, on-going interpersonal interactions that break down the interpretive barriers created by different functional "thought worlds" is seen a key people-related enabler of communication (Dougherty 1992; Hitt et al. 1993; Ellinger et al. 2006; Hirunyawipada et al. 2010; Andrea et al. 2011), particularly when the supply chain incorporates a wide range of functional areas (Lievens and Moenaert 2000; Lovelace et al. 2001). How and when information is collected, evaluated, shared, and interpreted also impact communication (Ellinger et al. 2006; Fugate et al. 2011; Oliva and Watson 2011). Finally, researchers in this stream have strongly emphasized the dependence of cross-functional communication on information systems that facilitate access to and transmission of high quality data across the supply chain (Narasimhan and Kim 2002; Sahin and Robinson 2002; Vickery et al. 2003; Gunasekaran and Ngai 2004; Rai

et al. 2006; Speier et al. 2008; Flynn et al. 2010). Outcomes of cross-functional communication are similarly diverse, ranging from greater operational efficiency (Swink and Schoenherr 2015) to improved market effectiveness (Gustin et al. 1995; Lee et al. 1997; Hult et al. 2004) and product innovation (Griffin and Hauser 1992; Gerwin and Barrowman 2002; Koufteros et al. 2005; Yan and Dooley 2013).

Based on this discussion, the following definition of cross-functional communication is proposed:

> *Cross-functional communication* in the supply chain is an on-going process in which different functional areas of the supply chain work together to maintain a reciprocal flow of information that supports collective decision-making and action.

Assessing the Definition of CFI and Its Sub-dimensions

Strong conceptual definitions have four main characteristics: (1) they are clearly related to previous theoretical and empirical research on the construct, (2) they identify the nature of the conceptual domain of the construct in terms of the general property to which it refers and entity to which it applies, (3) they specify the conceptual theme of the construct in terms of necessary and sufficient attributes, dimensionality, and stability, and (4) they define the construct in unambiguous terms (MacKenzie et al. 2011a). An assessment of the definitions developed in the previous sections is offered in Table 1 and suggests that they meet these requirements.

[Insert TABLE 1 here]

Scale Development and Testing

Scale development was carried out following procedures outlined in the literature (Churchill 1979; Hinkin 1998; MacKenzie et al. 2011a). An initial pool of survey items was developed to cover the domain of the CFI concept as defined by its sub-dimensions. Through a

structured process of scale refinement, including tests for content and face validity, a subset of items was arrived at for CFI's three underlying dimensions (MacKenzie et al. 2011a). The psychometric properties of the scale, including convergent, discriminant, and nomological validity, were then tested used two rounds of survey data collection (Churchill 1979). The result is a complete yet parsimonious measure of CFI in the supply chain. The following sections provide additional detail on this process.

Generating Items to Measure CFI

Numerous scales have been used to measure CFI in the supply chain. In order to ensure that scale development remained consistent with previous operationalizations, and to minimize scale proliferation, scales from the literature were collected and reviewed for items that potentially reflected the attributes of CFI's underlying dimensions as defined above (Bruner 2003). In the absence of established items, new items were generated to ensure that the overall conceptual domain of CFI was adequately captured by the measures (Churchill 1979). This process led to an initial pool of 183 potential items. Through an iterative review process, the research team eventually narrowed this initial pool to 40 items that were seen as potentially representing each of the CFI sub-dimensions (Hinkin 1998).

Assessing the Face and Content Validity of the Items

An online survey was developed to assess the face and content validity of the items following procedures developed by Hinkin and Tracey (1999). Respondents were provided with definitions of the CFI sub-dimensions, and presented with a matrix that listed sub-dimensions as column headers, with individual measurement items listed along the left-hand side in rows. Respondents were then asked to rate the extent to which each item represented each sub-

dimension, using 1 (not representative), 2 (somewhat representative), and 3 (strongly representative). In this way, respondents provided data for each cell in the matrix, allowing for cross-dimension comparisons on items. The survey was administered to 25 supply chain content and theory experts, representing a balanced mix of practitioners and scholars.

Analysis proceeded in three steps. First, items were assigned to dimensions based on the highest item mean score for each dimension. Next, one-way repeated measures ANOVA testing was used to determine whether mean item scores were significantly different ($p < 0.1$) across any of the three dimensions. If a significant difference occurred, a post hoc test using the Bonferroni correction was used to find significant differences ($p < 0.1$) across pairwise comparisons (Mackenzie et al. 2011a). Finally, items where the mean score was over 2.5 and statistically different from means scores on other dimensions were accepted as strongly representative of the dimension to which they were assigned. Three additional items were included in the measure for cross-functional coordination, as these were seen as important to ensuring the conceptual domain of the dimension was adequately measured (Churchill 1979). The wording of some items was also clarified based on comments from respondents (Schwartz 1999). This process yielded a total of 19 items, seven for collaboration, six for coordination, and six for communication. These items were used in subsequent data collection. Table 2 presents the measurement items, mean scores and standard deviations for the dimension to which they were assigned, and variable labels.

[Insert TABLE 2 here]

Formally Specifying the Measurement Model

A formal measurement model was then specified, relating items to the sub-dimensions they were intended to represent. As an initial starting point, the measurement model was constructed such that scale items and dimensions combined to create a reflective second order construct. Construct dimensionality was subsequently assessed empirically using survey data (Gerbing and Anderson 1988; Bagozzi and Edwards 1998). The results of this assessment are presented below. Figure 2 provides an illustration of the *a priori* model.

[Insert FIGURE 2 here]

The reflective nature of the CFI construct is a matter of conceptualization and therefore was established based on theoretical considerations (Javis et al. 2003). There were two main reasons for operationalizing CFI as a reflective rather than formative construct. First, the activities measured by the scale items are not understood as causing the dimensions with which they are associated (Bagozzi 2007). For example, "jointly establishing overarching goals" and "supporting other functions in achieving common goals" do not *create* cross-functional collaboration. Rather, these activities are manifestations (reflections) of an underlying process in which functions work together to forge a common approach to creating value in the supply chain. Likewise, cross-functional collaboration, coordination, and communication do not *create* integration. Rather they reflect underlying processes in which functions attempt to overcome the diversification of goals, activities, and information across the supply chain. Indeed, causality runs in the reverse: integration compels functions to engage in various activities related to collaboration, coordination, and communication. Thus, the extent to which functions engage in these activities can be said to reflect the extent to which they are integrated. Items and dimensions are therefore most

appropriately modeled as reflecting rather than forming the constructs in the model (Diamantopoulos and Siguaw 2006).

Second, the indicators associated with a given dimension clearly share a common theme and are theoretically expected to covary substantially (Jarvis et al. 2003). Likewise, conceptual overlap across the collaboration, coordination, and communication dimensions seems appropriate. Both from both a theoretical and practical perspective, these processes occur in tandem and are mutually supportive. Thus, they do not reflect strictly discriminant elements that combine to form an index of the CFI construct (Diamantopoulos and Winklhofer 2001). Perspectives in the literature on CFI support this understanding (O'Leary-Kelly and Flores 2002; Pagell 2004; Swink and Schoenherr 2015).

Pretest Data Collection and Analysis

Survey data from supply chain professionals currently holding managerial positions in US companies were collected to pretest the psychometric properties of the scale. Table 3 provides sample summary data. The 19 newly developed items for CFI were included in the survey instrument. In addition, a three item scale was adopted from the literature to measure supply chain IT integration (Rai et al. 2006). Supply chain performance measures were also developed from the literature (Stock and Lambert 2001; Fugate et al. 2010). IT integration and supply chain performance constructs were used to test discriminant and nomological validity.

[Insert TABLE 3 here]

Data collection was carried out using a third party data collection service over a three-week period, yielding a total of 1,824 responses. Partial responses were eliminated, leaving 303 full

responses. Full responses were further cleansed based on (1) screening questions to ensure respondents were appropriately positioned to provide valid answers, (2) filter questions to eliminate spurious responses, and (3) consistency on two reverse coded questions (Schoenherr et al. 2015). This procedure yielded a final set of 182 full, valid responses. Three response rates can be calculated based on these procedures: a completed response rate of 16.61% (303/1,824), a usable response rate of 9.98% (182/1,824), and a usable-to-completed response rate of 60.01% (182/303). The ratio of completed useable responses to construct items was 182:19 (greater than 9:1), exceeding recommended minimums for scale testing (Anderson and Gerbing 1988; MacKenzie et al. 2011a).

Data analysis was conducted using SPSS and AMOS. Exploratory factor analysis (EFA) was first conducted as an initial "blind" test of the data structure. Three alternative confirmatory models were then considered: first, that indicators converged onto a single latent construct; second, that indicators converged onto three discriminate latent constructs; third, that indicators converged onto three closely correlated first order constructs that reflected a second order construct. The three alternatives, depicted in Figure 3, represented increasingly aggregated models of the CFI construct (Koufteros et al. 2009). Omnibus and reduced models were developed under each alternative and tested against a performance criterion variable. Tables 4 provide results from the EFA. Table 5 provides regression weights for omnibus and reduced models under each alternative. Table 6 provides information on model fit, average variance extracted (AVE), and reliability (Cronbach's alpha) for each alternative. Table 7 provides the results of the criterion tests.

[Insert FIGURE 3, TABLE 4, TABLE 5, TABLE 6, TABLE 7 here]

Exploratory Factor Analysis (EFA). Prior to considering each alternative, EFA with all 19 items was conducted using maximum likelihood extraction with varimax rotation. EFA yielded three components, with the first component explaining 56% of the variance. The rotated factor matrix indicated that items for collaboration, coordination, and communication loaded most strongly onto three separate factors (see Table 4). Similar patterns were observed when EFA was conducted using any combination of two sets of construct items.

Alternative 1: Single Construct. All items were loaded onto a single construct in AMOS. Factor loadings ranged from .673 to .766. AVE for the omnibus single construct was .537. The construct had a strong positive correlation with the criterion variable (CFI‹--›PERF = .594). However, when criterion variable was regressed onto CFI, factor loadings for the omnibus construct became negative and produced a negative regression weight. An iterative process of removing items based on factor loadings and correlations among items representing collaboration, communication, and coordination was then undertaken. The goal was to find a reduced model that improved convergent validity and model fit, while at the same time maintained theoretical coverage of the CFI construct. A reduced model that retained six items, two items reflecting each dimension, improved fit and achieved an AVE of .562. Regressing the performance criterion onto this reduced construct yielded a positive regression weight of CFI--›PERF = .577.

Alternative 2: Three Constructs. Collaboration, coordination, and communication were modeled as three separate constructs. Factor loadings ranged from .716 to .825, with AVE for each construct indicating strong convergent validity. Overall model fit suggested that loading items onto separate constructs represented an improvement over loading all items onto a single construct. However, high correlations across the three constructs indicated a lack of discriminant validity

(COLLAB‹--›COORD = .852, COLLAB‹--›COMM = .834, COORD‹--›COMM = .810). Dropping items to improve the convergent validity of each construct did not resolve these discriminant validity issues. A reduced model that improved the convergent validity of each construct resulted in similarly high correlations among constructs (COLLAB‹--›COORD = .819, COLLAB‹--›COMM = .823, COORD‹--›COMM = .744). Moreover, suppression effects due to multicollinearity were in evidence when the three constructs were modeled as predicting the performance criterion variable. Omnibus collaboration, coordination, and communication constructs correlated with the criterion variable at .644, .564, and .459 respectively. Regressing performance on all the three constructs separately, however, yielded the following regression weights: COLLAB--›PERF = .760, COORD--›PERF = .168, and COMM--›PERF = -.311. Similar effects were also evident using the reduced model.

Alternative 3: Second Order Construct. Collaboration, coordination, and communication were modeled as three first order constructs predicted by a second order construct. Factor loadings for each construct were above .710. AVE for first order factors were COLLAB = .580, COORD = .618, and COMM = .630. An AVE of .833 for the second order construct was calculated using the standardized regression weights predicting the first order constructs (MacKenzie et al. 2011a). Regression weights across the three constructs were roughly balanced (CFI--›COLLAB = .937, CFI--›COORD = .910, and CFI--›COMM = .890), suggesting that each of the first order constructs contributed relatively equally to the second order construct. A reduced model was achieved that improved overall model fit while maintaining roughly balanced regression weights. Criterion testing indicated a strong positive correlation with the omnibus model that improved slightly with the reduced model.

Reexamining Scale Properties with New Data

Pre-test data did not present any problematic indicators (i.e. indicators with low validity, low reliability, or high measurement error covariance), therefore all 19 items were retained moving forward into a second round of data collection. A different third party data collection service was used to collect a second sample of responses from supply chain professionals currently holding managerial positions in US companies. For the second sample, the vendor provided only full responses. The full data set included 204 responses. These responses were further cleansed based on the criteria above to arrive at a final set of 182 full, valid responses implying a usable-to-completed response rate of 89.22% (182/204). The analysis conducted on the pre-test data was repeated with this new sample. Table 8 through Table 11 present the results of this analysis, which were consistent with the results of the pre-test data analysis. An additional test was conducted with the new sample as described below.

[Insert TABLE 8, TABLE 9, TABLE 10, TABLE 11 here]

Alternative 2a: Two Constructs. EFA using items representing collaboration and coordination extracted two components but nevertheless indicated strong correlations across measures. Moreover, the omnibus constructs for collaboration and coordination were more closely correlated to each other than either with communication (COLLAB‹--›COORD = .811, COLLAB‹--›COMM = .704, COORD‹--›COMM = .736). Analysis was therefore undertaken to determine whether the data supported a two-construct model (COLLAB+COORD and COMM). Construct model fit, validity, and reliability assessments are presented in Table 12. Criterion variable tests are presented in Table 13. Omnibus and reduced models were developed for a single

COLLAB+COORD construct. COLLAB+COORD and COMM were then alternatively represented as separate constructs and first order indicators.

[Insert TABLE 12 and TABLE 13 here]

Suppression effects were in evidence when representing the constructs separately. Modeling the omnibus and reduced constructs as first order indicators yielded a standardized regression coefficient of 1.346 for COMM, suggesting that regression estimates based on the second order construct were likely unstable. Model fit statistics for the second order omnibus and reduced models were reasonable but worse than fit statistics for three first order constructs (Alternative 3 in Table 9). This analysis suggested Alternative 3, which modeled collaboration, coordination, and communication as separate first order indicators, most accurately represented the data.

Discriminant and Nomological Validity Tests

In order to further validate the second order construct model, tests for discriminant and nomological validity were undertaken (MacKenzie et al. 2011a). An established three-item scale for supply chain IT integration was used to test discriminant validity (Rai et al. 2006). Supply chain IT integration has been well established in the literature as being closely related, but distinct from, CFI (Stank et al. 2001a; Vickery et al. 2003; Rodrigues et al. 2004; Rai et al. 2006; Speier et al. 2008). A high correlation between supply chain IT integration and the second order construct would therefore be expected. In order to demonstrate that the second order construct tapped unique variance associated with CFI, however, these two variables would have to discriminate. Discriminant validity was tested with reduced models using the Data Set 1 and Data Set 2

separately. Data sets were then combined and tested again on an omnibus model. Results are presented in Table 14. Comparing AVE with the square correlations suggested discriminant validity with the second order construct as well as with first order constructs.

[Insert TABLE 14 here]

Nomological validity was tested using both the IT variable and a performance variable. Evidence suggests that an integrated supply chain IT system is an important organizational design feature that leads to greater CFI (Stank et al. 2001a; Rodrigues et al. 2004; Prajogo and Olhager 2012; Foerstl et al. 2013). At the same time, CFI has been linked to improved supply chain performance (Leuschner et al. 2013; Mackelprang et al. 2014). A mediating effect from supply chain IT through CFI to performance would therefore provide a strong test of nomological validity. The SPSS process macro (Hayes 2013) was used to test the indirect effect with weighted factor scores imputed using AMOS. Indirect effects were tested with reduced models using the Data Set 1 and Data Set 2 separately. An omnibus model was then tested using the combined data. Results are provided in Table 15. The analysis indicates that the second order construct clearly mediates the relationship between integrated supply chain IT and performance across different samples.

[Insert TABLE 15 here]

Discussion of Results

Overall the analysis indicated that the data represented three distinct yet highly correlated constructs. EFA across the two samples indicated three separate components when all 19 items were included. EFA with paired sets of items provided additional evidence of significant

distinctions across construct measures. Although items were able to converge on a single construct, a loss of theoretical coverage was required to achieve reasonable model fit. Continued elimination of items to improve fit would have severely limited the face and content validity of the overall CFI measure. Model fit statistics for the single construct were consistently worse than the fit achieved when modeling constructs separately.

Modeling constructs separately under Alternative 2 substantially improved fit while maintaining broad theoretical coverage. Across both samples, AVE for each of the three omnibus constructs under Alternative 2 was higher than the AVE of the reduced model under Alternative 1, indicating items converged more strongly onto their respective constructs than a single construct. However, suppressions effects due to high correlations across the three constructs suggested that it would be inappropriate to model them separately. Additional analysis that combined the COLLAB and COORD constructs using Data Set 2 produced similar results.

Alternative 3 overcame both the convergent and discriminant validity issues raised by Alternatives 1 and 2. Across both samples, AVE for the first and second order constructs (omnibus and reduced) exceeded AVE for Alternative 1 models. Alternative 3 models were also able to produce strong and consistent regression weights across the three constructs, suggesting Alternative 3 models allowed all first order constructs to contribute substantially to the second order construct without suppression effects. Fit statistics for Alternative 3 models were likewise strong. The literature suggests that second order construct models cannot achieve better fit than models specifying correlated first order constructs (Koufteros et al. 2009). Researchers must therefore accept a penalty in terms of fit when modeling second order constructs. Across both samples, Alternative 3 displayed minor differences compared to Alternative 2 models, while also

exceeding minimum acceptable limits. These results suggested a minimal penalty for modeling constructs as first order indicators. Alternative 3 models strongly predicted the criterion variable, with implied correlations for first order sub-dimensions similar to correlations found under Alternative 2. Discriminant validity was achieved across first and second order constructs with a theoretically related IT variable. Finally, nomological validity across samples was demonstrated by a clear mediating effect from the IT variable through CFI to performance.

Taken as a whole, the analysis supports modeling collaboration, coordination, and communication as first order indicators that covary substantially yet nevertheless tap separate dimensions of an overall CFI construct. This conclusion is consistent with the theoretical discussion above. However, future researchers should not be doctrinaire in modeling CFI as a second order construct. Rather they should be driven by the data they have in an effort to best represent their sample. Thus, it is recommended that the dimensionality of the construct be tested for all samples to ensure the most accurate representation of reality. Doing so would in no way diminish the validity of the scale items as reflective measures of the CFI construct, as long as theoretical coverage is maintained (Bagozzi and Edwards 1998). Future researchers may also wish to use a subset of items for each construct. Appendix B provides an inter-item correlation matrix using the combined sample (N=364) to aid in this effort. It also provides regression weights for an omnibus second order construct and a suggested reduced second order construct. This information is intended to help future researchers decide on which items to use in their research, with an eye toward limiting the length of their survey.

Conclusion and Future Research Applications

The purpose of this research was to offer a comprehensive definition and valid measure for CFI so as to build a common foundation for extending theoretical understanding of integration's antecedents and consequences within supply chain management. Construct development undertaken here accomplishes both of these goals. First, this research provides precise definitions of CFI and its underlying dimensions that are deeply rooted in the supply chain research. Defining CFI as on-going process in which different functional areas of the supply chain collaborate, coordinate, and communicate to maximize outcomes for their organization synthesizes dominant perspectives in the literature and provides for a comprehensive understanding of the concept. Second, this research employs a rigorous process for developing and validating a measure of CFI that can be used by future researchers. The study provides a valid set of 19 scale items that capture the conceptual domain of the CFI concept as defined by its sub-dimensions. Based on the samples used in this study, it is suggested that CFI is most appropriately modeled as a second order construct with collaboration, coordination, and communication constructs acting as first order indicators. Future researchers are encouraged to test scale validity and structure in additional samples. Consistent with a middle-range approach to construct development, definitions and measures are clearly contextualized in a supply chain context, maximizing their relevance for theory development and testing within the domain of supply chain management (Stank et al. 2016).

In addition, this research aims to improve supply chain scholars' ability to communicate the insights gained from CFI research to a broader practitioner community still struggling to achieve integration in their supply chain organizations. Viewing CFI in terms of a set of interrelated processes focused on goals, activities, and information sharing can provide a useful

conceptual framework for articulating the central “problems” of integration for industry partners. The measures developed here can also be used with practitioners as a tool to assess the level of integration in their supply chain organizations. Ultimately, the value of supply chain research is measured by its impact on practice. Researchers are therefore encouraged to use the concepts and measures developed here both in their research and in more direct engagement with practitioners.

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Appendix A: Tables and Figures

Table 1.1 Assessment of Conceptual Definitions

	Cross-functional Integration	Collaboration	Coordination	Communication
Definition	On-going process in which different functional areas of the supply chain collaborate, coordinate, and communicate in an effort to maximize outcomes for their organization	On-going process in which different functional areas of the supply chain establish common goals and objectives and work together to achieve them	On-going process in which different functional areas of the supply chain focus on optimizing overall supply chain processes by jointly managing the flow of operational activities	On-going process in which different functional areas of the supply chain work together to maintain a reciprocal flow of information that supports collective decision-making and action
Dimensions & Attributes	• Collaboration • Coordination • Communication	• Establishing common goals • Working together to achieve common goals	• Adopting "process perspective" • Managing interdependences across SC activities • Focusing on processes perf.	• Maintaining reciprocal flows of information • Sharing relevant information • Ensuring clarity of intent
Entity & Property	**Property** = Collaboration, coordination, communication across functional areas of a SC **Entity** = Functional areas of a SC	**Property** = Establishing and working together toward common SC goals **Entity** = Functional areas of a SC	**Property** = Optimizing SC processes by jointly managing operational activities **Entity** = Functional areas of a SC	**Property** = Maintaining a reciprocal flow of relevant SC information **Entity** = Functional areas of a SC
Stability & Terminology	**Stability** • Definitions assumed to be stable over time and across supply chain contexts		**Terminology** • Dimensions have precise operational definitions • Attributes can be clearly stated • Definitions are not overly technical • Definitions are phrased positively, not negatively • Definitions are not tautological or self-referential	

Table 1.1 Continued

		Cross-functional Integration	Collaboration	Coordination	Communication
Literature	**SCM Research**	• Bowersox (1969) • Heskett (1969) • Oliver and Webber (1982) • La Londe & Powers (1993) • Kahn (1996) • Kahn & Mentzer (1996) • Cooper et al. (1997) • Song et al. (1997) • Kahn & Mentzer (1998) • Pagell (2004)	• Kahn & Mentzer (1996) • Jassawallat & Sashittal (1998) • Stank et al. (1999, 2001b) • Ellinger (2000), et al. (2006) • Hausman et al. (2002) • Vickery et al. (2003) • Sabath & Whipple (2004) • DeLuca & Atuahene-Gima (2007) • Oliva & Watson (2011)	• Bowersox (1969) • Lambert & Cooper (2000) • Stank et al. (2001a) • Sahin and Robinson (2002) • Rodrigues et al. (2004) • Stadtler (2005) • Chen et al. (2009) • Germain and Iyer (2006) • Germain et al. (2008) • Schoenherr & Swink (2012)	• Kahn (1996) • Mollenkopf et al. (2000) • Song & Montoya-Weiss (2001) • Calantone et al. (2002) • Oh et al. (2012) • Narasimhan & Kim (2002) • Flynn et al. (2010) • Andrea et al. (2011) • Fugate et al. (2011) • Swink & Schoenherr (2015)
	Conceptual Foundations	• Forrester (1958) • March & Simon (1958) • Alderson and Martin (1965) • Lawrence & Lorsch (1967) • Thompson (1967) • Galbraith (1974) • Grant (1996a)	• Cyert and March (1963) • Simon (1964) • Lawrence & Lorsch (1986) • Appley and Winder (1977) • Mintzberg (1979), et al. (1996) • Tjosvold (1988) • McAllister (1995)	• Nordsieck (1934) • Van de Ven et al. (1976) • McCann & Galbraith (1981) • Malone & Crowston (1994) • Crowston (1997) • Anderson (1999)	• Galbraith (1974) • Tushman & Nadler (1978) • Hitt et al. (1993) • Nonaka (1994) • Alavi & Leidner (2001) • Grant (1996b) • Hansen (1999)

**Based on MacKenzie et al. (2011)*

Table 1.2. Face and Content Valid Measurement Items for CFI

PROMPT: In my firm, different areas of the supply chain work across functional boundaries to …	LABEL	MEAN†	STD DEV†
Jointly establish the overarching goals that direct our individual functional activities	Collab_1	2.842	0.375
Make sure there is joint agreement on supply chain goals	Collab_2	2.632	0.684
Engage constructively in debates about the goals of the supply chain	Collab_3	2.600	0.598
Ensure an open and transparent process for establishing common goals	Collab_4	2.556	0.616
Establish a regular process for reviewing joint supply chain goals	Collab_5	2.500	0.607
Support other functions in achieving common goals	Collab_6	2.500	0.761
Adjust goals and objectives to reflect constraints faced by different functions	Collab_7	2.600	0.503
Actively manage lead-times across functions	Coord_1	2.750	0.550
Ensure that functional activities are synchronized across the supply chain	Coord_2	2.700	0.571
Jointly manage interdependencies across supply chain functions	Coord_3	2.600	0.503
Make sure everyone is focused on process optimization rather than achieving separate functional goals*	Coord_4	2.474	0.697
Make sure functional decisions do not conflict with each other*	Coord_5	2.400	0.681
Make sure functional areas see themselves as part of a larger overall process*	Coord_6	2.000	0.745
Make sure relevant information gets to the right people in different areas of the supply chain	Comm_1	2.789	0.535
Keep key players in different functions informed about what's going on	Comm_2	2.700	0.470
Make sure everyone understands what information needs to be communicated out to different functional areas	Comm_3	2.500	0.761
Make sure information that is being communicated is useful to those on the receiving end	Comm_4	2.650	0.587
Make sure everyone understands how information is used in different areas of the supply chain	Comm_5	2.600	0.681
Make sure those on the receiving end understand why they are getting the information that they are getting	Comm_6	2.550	0.686

** Items included to ensure adequate theoretical coverage*
†Mean scores and standard deviations for dimension to which item was assigned. Scale: 1 (low) to 3(high) & N=25

Table 1.3. Sample Demographic Information

Respondent Information	Sample 1	Sample 2
Level in the Organization		
Reports directly to the CEO	11%	30%
Boss reports directly to the CEO	8%	25%
Two levels of reporting to CEO	14%	16%
Three levels of reporting to CEO	16%	15%
Four levels of reporting to CEO	16%	6%
Five levels of reporting to CEO	15%	3%
More than five levels	19%	5%
Years with Current Organization		
Less than 1 year	3%	2%
1 - 10 years	52%	63%
10 - 20 years	29%	26%
20 or more years	16%	10%
Time Spent on Cross-Functional Activities		
0 - 19% of my time	11%	4%
20 - 39% of my time	32%	23%
40 - 59% of my time	28%	38%
60 - 79% of my time	18%	25%
80 - 100% of my time	11%	9%

Organization Information	Sample 1	Sample 2
Industry		
Mfg & Construction	17%	11%
Chemicals & Plastics	3%	3%
Oil & Gas	3%	2%
Food & Beverage	7%	7%
Consumer Goods	20%	10%
Transportation	13%	7%
Business Services	9%	27%
IT & Info Systems	8%	16%
Biotech & Medical	7%	5%
Govt & Nonprofit	0%	5%
Other	13%	6%
Sales		
Under $1 billion	7%	52%
$1 - $9.9 billion	23%	35%
$10 - $19.9 billion	12%	12%
$20 billion or more	37%	2%
N/A	21%	0%

Table 1.3. Continued

Respondent Information				Organization Information		
Scope of Responsibility*				**Number of Employees**		
Supply Chain Strategy	30%	21%		Under 2,000	5%	51%
Supply Chain Planning/MRP	24%	20%		2,000 - 10,000	13%	40%
Research & Development	15%	20%		10,000 - 100,000	34%	9%
Sourcing & Procurement	24%	19%		100,000 or more	26%	0%
Manufacturing & Operations	43%	33%		N/A	21%	0%
Logistics & Transportation	33%	22%				
Warehousing & Materials Hdlg	22%	21%				
Customer Service	19%	39%				
Returns Management	12%	10%				
Demand Planning & Mgmt	14%	19%				
Marketing	8%	21%				
Supply Chain IT	19%	25%				
SC Center of Excellence	4%	5%				
Other	0%	7%				
Career Number of Managerial Roles in Different SC Areas						
Manager in only one SC area	27%	25%				
Manager in two SC areas	33%	29%				
Manager in three SC areas	23%	23%				
Manager in four SC areas	8%	9%				
Manager in five SC areas	3%	4%				
Manager in more than five SC areas	7%	10%				

**Respondents could choose more than one area, percentages do not add to 100*

Table 1.4. Sample 1 Exploratory Factor Analysis (Rotated Factor Matrix)

	1	2	3
Collab_1			.604
Collab_2			.706
Collab_3			.571
Collab_4			.599
Collab_5			.591
Collab_6			.623
Collab_7			.519
Coord_1	.654		
Coord_2	.740		
Coord_3	.649		
Coord_4	.573		
Coord_5	.648		
Coord_6	.632		
Comm_1		.625	
Comm_2		.574	
Comm_3		.756	
Comm_4		.561	
Comm_5		.643	
Comm_6		.756	

KMO Measure of Sampling Adequacy .952

Bartlett's Test of Sphericity

Chi-Square = 2440.323, df=171, Sig. = .000

Table 1.5. Sample 1 Item Regression Weights Under Each Alternative

	Alt 1		Alt 2		Alt 3	
	Single Construct		Separate Constructs		First Order Indicators	
	Omnibus	Reduced	Omnibus	Reduced	Omnibus	Reduced
Collab_1	.744		.783		.783	
Collab_2	.695		.761	.718	.761	.718
Collab_3	.718		.745		.745	
Collab_4	.757	.729	.793		.793	
Collab_5	.753	.755	.784	.807	.784	.807
Collab_6	.673		.716	.741	.716	.741
Collab_7	.717		.745		.745	
Coord_1	.685		.747		.747	
Coord_2	.732		.790	.770	.790	.770
Coord_3	.753		.810	.822	.810	.830
Coord_4	.755	.740	.784		.784	
Coord_5	.728		.776		.776	
Coord_6	.766	.763	.808	.830	.808	.822
Comm_1	.752	.752	.800	.806	.800	.806
Comm_2	.751	.757	.780		.780	
Comm_3	.744		.825	.846	.825	.846
Comm_4	.751		.782		.782	
Comm_5	.720		.770	.791	.770	.791
Comm_6	.719		.805	.803	.805	.803
COLLAB					.937	.952
COORD					.910	.861
COMM					.890	.865

All reported weights are standardized and significant at .001

Table 1.6. Sample 1 Construct Model Fit, Validity, and Reliability

	Alt 1		Alt 2		Alt 3	
	Single Construct		Separate Constructs		First Order Indicators	
	Omnibus	Reduced	Omnibus	Reduced	Omnibus	Reduced
Model Fit						
Chi-Square	452.928	20.172	259.313	48.350	259.313	48.350
P (Chi-Square)	.000	.017	.000	.032	.000	.032
DF	152	9	149	32	149	32
CFI	.873	.978	.953	.984	.953	.984
RMSEA	.105	.083	.064	.053	.064	.053
PCLOSE	.000	.118	.042	.405	.042	.405
Validity & Reliability: AVE [CA]*						
COLLAB			.580[.906]	.572[.801]	.580[.906]	.572[.801]
COORD			.618[.906]	.652[.849]	.618[.906]	.652[.849]
COMM			.630[.910]	.659[.885]	.630[.910]	.659[.885]
CFI	.537[.956]	.562[.884]			.833[.902]	.799[.857]

** AVE = Average of squared factor loadings, CA = Cronbach's alpha*

Table 1.7. Sample 1 Criterion Variable Tests

	Alt 1		Alt 2		Alt 3	
	Single Construct		Separate Constructs		First Order Indicators	
	Omnibus	Reduced	Omnibus	Reduced	Omnibus	Reduced
Model Fit						
Chi-Square	638.229	99.851	432.358	163.059	441.671	171.839
P (Chi-Square)	.000	.000	.000	.000	.000	.000
DF	274	53	269	98	271	100
CFI	.875	.953	.944	.959	.941	.954
RMSEA	.086	.070	.058	.061	.059	.063
PCLOSE	.000	.062	.099	.143	.071	.091
Correlation						
COLLAB			.644	.662	.598*	.618*
COORD			.564	.544	.564*	.533*
COMM			.459	.426	.545*	.520*
CFI	.594	.577				
Regression Weight						
COLLAB			.760	.904	.598*	.618*
COORD			.168	.092	.564*	.533*
COMM			-.311	-.386	.545*	.520*
CFI	-.594	.577			.625	0.626

**Implied correlations with criterion through the second order construct*

Table 1.8. Sample 2 Exploratory Factor Analysis (Rotated Factor Matrix)

	1	2	3
Collab_1			.651
Collab_2			.709
Collab_3			.500
Collab_4			.628
Collab_5			.635
Collab_6			.660
Collab_7			.600
Coord_1	.459		
Coord_2	.566		
Coord_3	.608		
Coord_4	.668		
Coord_5	.687		
Coord_6	.491		
Comm_1		.741	
Comm_2		.620	
Comm_3		.709	
Comm_4		.761	
Comm_5		.614	
Comm_6		.725	

KMO Measure of Sampling Adequacy .942

Bartlett's Test of Sphericity

Chi-Square = 1963.619, df=171, Sig. = .000

Table 1.9. Sample 2 Item Regression Weights Under Each Alterative

	Alt 1		Alt 2		Alt 3	
	Single Construct		Separate Constructs		First Order Indicators	
	Omnibus	Reduced	Omnibus	Reduced	Omnibus	Reduced
Collab_1	.728	.689	.779	.768	.779	.768
Collab_2	.644		.734		.734	
Collab_3	.566		.619		.619	
Collab_4	.741	.739	.793	.794	.793	.794
Collab_5	.661		.712		.712	
Collab_6	.700		.774	.778	.774	.778
Collab_7	.642		.693		.693	
Coord_1	.665		.693		.693	
Coord_2	.671	.662	.731	.714	.731	.714
Coord_3	.694	.731	.754	.789	.754	.789
Coord_4	.581		.666		.666	
Coord_5	.622		.706	.703	.706	.703
Coord_6	.630		.686		.686	
Comm_1	.738	.684	.826	.803	.826	.803
Comm_2	.671		.729		.729	
Comm_3	.725	.736	.813	.820	.813	.820
Comm_4	.704		.817	.826	.817	.826
Comm_5	.678		.730		.730	
Comm_6	.659		.762		.762	
COLLAB					.881	.912
COORD					.921	.912
COMM					.799	.789

All reported weights are standardized and significant at .001

Table 1.10. Sample 2 Construct Model Fit, Validity, and Reliability

	Alt 1		Alt 2		Alt 3	
	Single Construct		Separate Constructs		First Order Indicators	
	Omnibus	Reduced	Omnibus	Reduced	Omnibus	Reduced
Model Fit						
Chi-Square	4.75.770	36.387	210.857	29.568	210.857	29.568
P (Chi-Square)	.000	.000	.001	.200	.001	.200
DF	152	9	149	24	149	24
CFI	.827	.936	.967	.993	.967	.993
RMSEA	.108	.130	.048	.036	.048	.036
PCLOSE	.000	.002	.580	.689	.580	.689
Validity & Reliability: AVE [CA]*						
COLLAB			.535[.889]	.609[.824]	.535[.889]	.609[.824]
COORD			.499[.856]	.542[.778]	.499[.856]	.542[.778]
COMM			.609[.902]	.666[.857]	.609[.902]	.666[.857]
CFI	.450[.939]	.497[.857]			.754[.853]	.762[.830]

** AVE = Average of squared factor loadings, CA = Cronbach's alpha*

Table 1.11. Sample 2 Criterion Variable Tests

	Alt 1		Alt 2		Alt 3	
	Single Construct		Separate Constructs		First Order Indicators	
	Omnibus	Reduced	Omnibus	Reduced	Omnibus	Reduced
Model Fit						
Chi-Square	670.636	128.286	402.277	131.151	404.083	136.439
P (Chi-Square)	.000	.000	.000	.001	.000	.000
DF	274	53	269	84	271	86
CFI	.832	.915	.944	.962	.944	.960
RMSEA	.089	.089	.052	.056	.052	.057
PCLOSE	.000	.001	.351	.293	.364	.253
Correlation						
COLLAB			.425	.376	.467*	.451*
COORD			.530	.534	.504*	.483*
COMM			.441	.428	.431*	.406*
CFI	.506	.482			.539	.513
Regression Weight						
COLLAB			-.052	-.284	.467*	.451*
COORD			.480	.653	.504*	.483*
COMM			.124	.163	.431*	.406*
CFI	.506	.482			.539	0.513

**Implied correlations with criterion through the second order construct*

Table 1.12. Alt 2a and Alt 3a Construct Model Fit, Validity, and Reliability

	Alt 2a		Alt 3a	
	Two Constructs		First Order Indicators	
	Omnibus	Reduced	Omnibus	Reduced
Model Fit				
Chi-Square	285.418	80.428	258.418	80.428
P (Chi-Square)	.000	.000	.000	.000
DF	151	43	151	43
CFI	.928	.966	.928	.966
RMSEA	.070	.069	.070	.069
PCLOSE	.005	.087	.005	.087
Validity & Reliability: AVE [CA]*				
COLLAB+COORD	.466[.918]	.537[.850]	.466[.918]	.537[.850]
COMM	.609[.902]	.609[.902]	.609[.902]	.609[.902]
CFI			.880[.815]†	.881[.799]†

** AVE = Average of squared factor loadings, CA = Cronbach's alpha*

†Standardized regression weight for COMM > 1, suggesting unstable estimate

Table 1.13. Alt 2a and Alt 3a Criterion Variable Tests

	Alt 2a		Alt 3a	
	Two Constructs		First Order Indicators	
	Omnibus	Reduced	Omnibus	Reduced
Model Fit				
Chi-Square	480.715	206.699	491.556	213.717
P (Chi-Square)	.000	.000	.000	.000
DF	272	116	273	117
CFI	.912	.941	.908	.938
RMSEA	.065	.066	.067	.068
PCLOSE	.006	.041	.003	.025
Correlation				
COLLAB+COORD	.490	.436	.466*	.469*†
COMM	.440	.438	.519*	.352*†
CFI			.549	.462†
Regression Weight				
COLLAB+COORD	.367	.245	.466*	.469*†
COMM	.163	.254	.519*	.352*†
CFI			.549	.462†

**Implied correlations with criterion through the second order construct*

†Standardized regression weight for COMM > 1, suggesting unstable estimate

Table 1.14. Discriminant Validity Tests

	Sample 1			Sample 2			Combined Sample		
	AVE	Corr (IT)	Corr(IT)^2	AVE	Corr(IT)	Corr(IT)^2	AVE	Corr(IT)	Corr(IT)^2
IT	.660			.630			.645		
CFI	.798	.682	.465	.761	.767	.588	.796	.707	.500
COLLAB	.572	.592*	.350*	.585	.599*	.359*	.558	.650*	.422*
COORD	.653	.577*	.333*	.542	.730*	.533*	.576	.639*	.408*
COMM	.659	.655*	.430*	.667	.672*	.451*	.623	.603*	.364*

** Implied correlations through the second order construct*

Table 1.15. Nomological Validity Tests

	Sample 1		Sample 2		Combined Sample	
	CFI	PERF	CFI	PERF	CFI	PERF
Independent Variables						
IT	.658***	.292***	.605***	.336***	.631***	.318***
CFI		.332***		.319***		.312***
Indirect Effect						
IT-->CFI--PERF		.219***		.193***		.197***
R-Squared	.555***	.546***	.720***	.412***	.612***	.486***

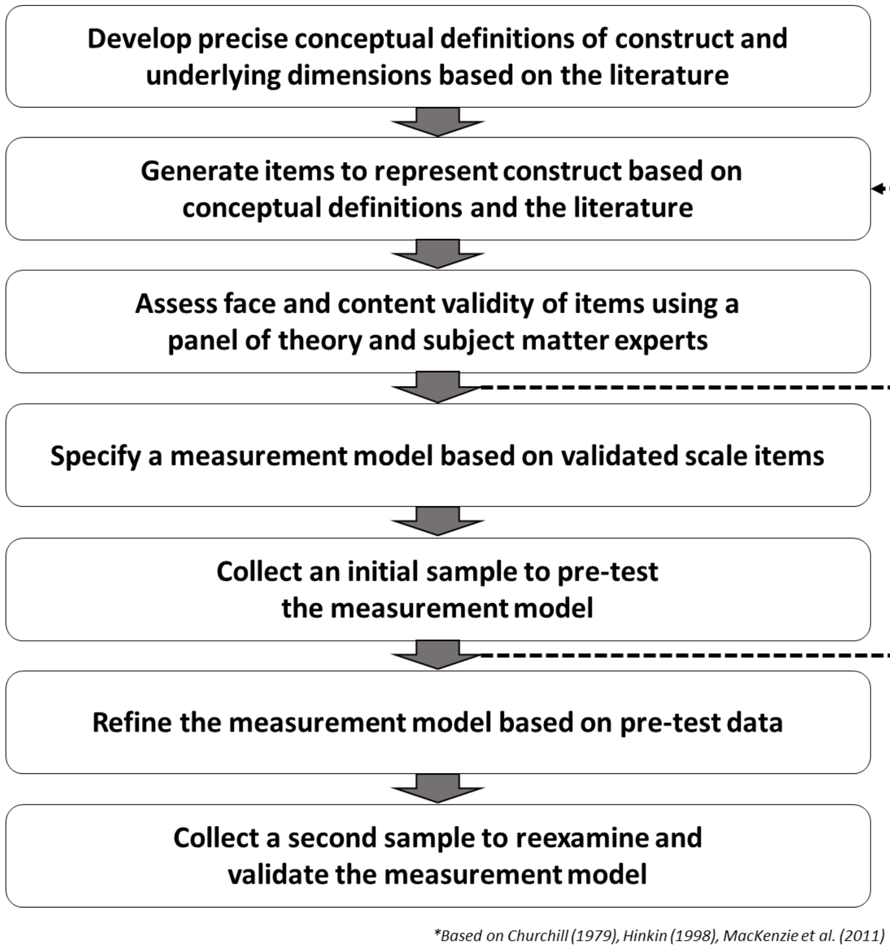

Figure 1.1. Construct Development Process

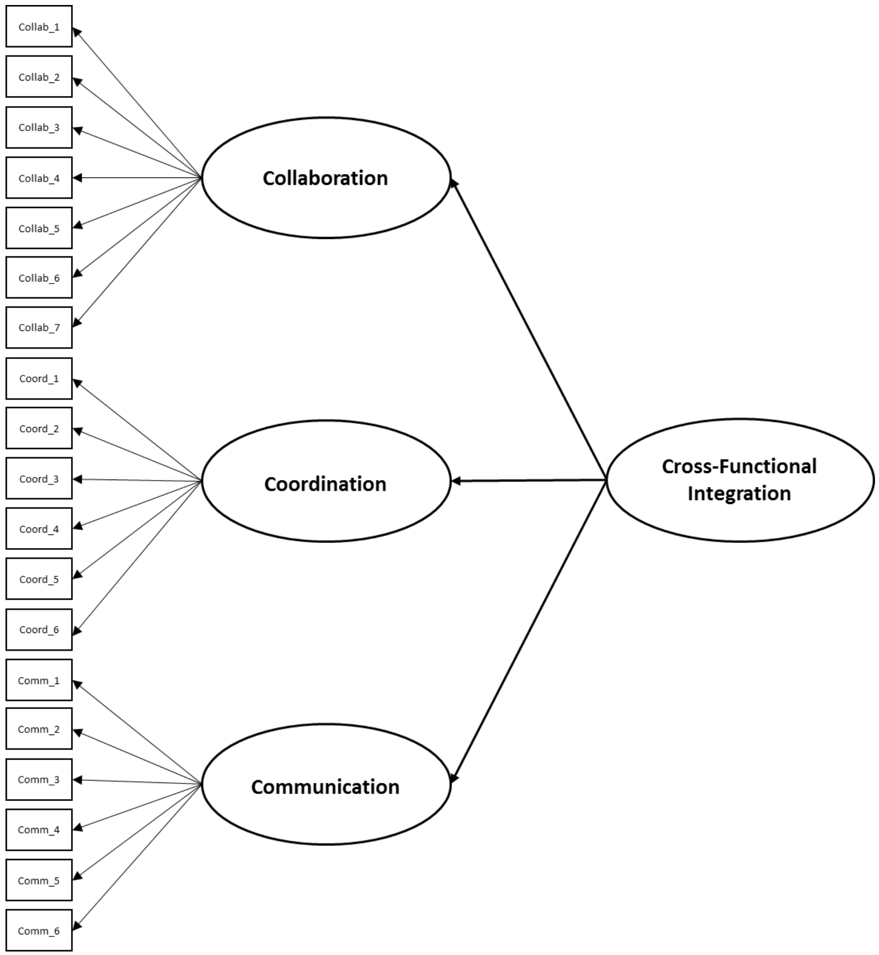

Figure 1.2. A Priori Theoretical Model

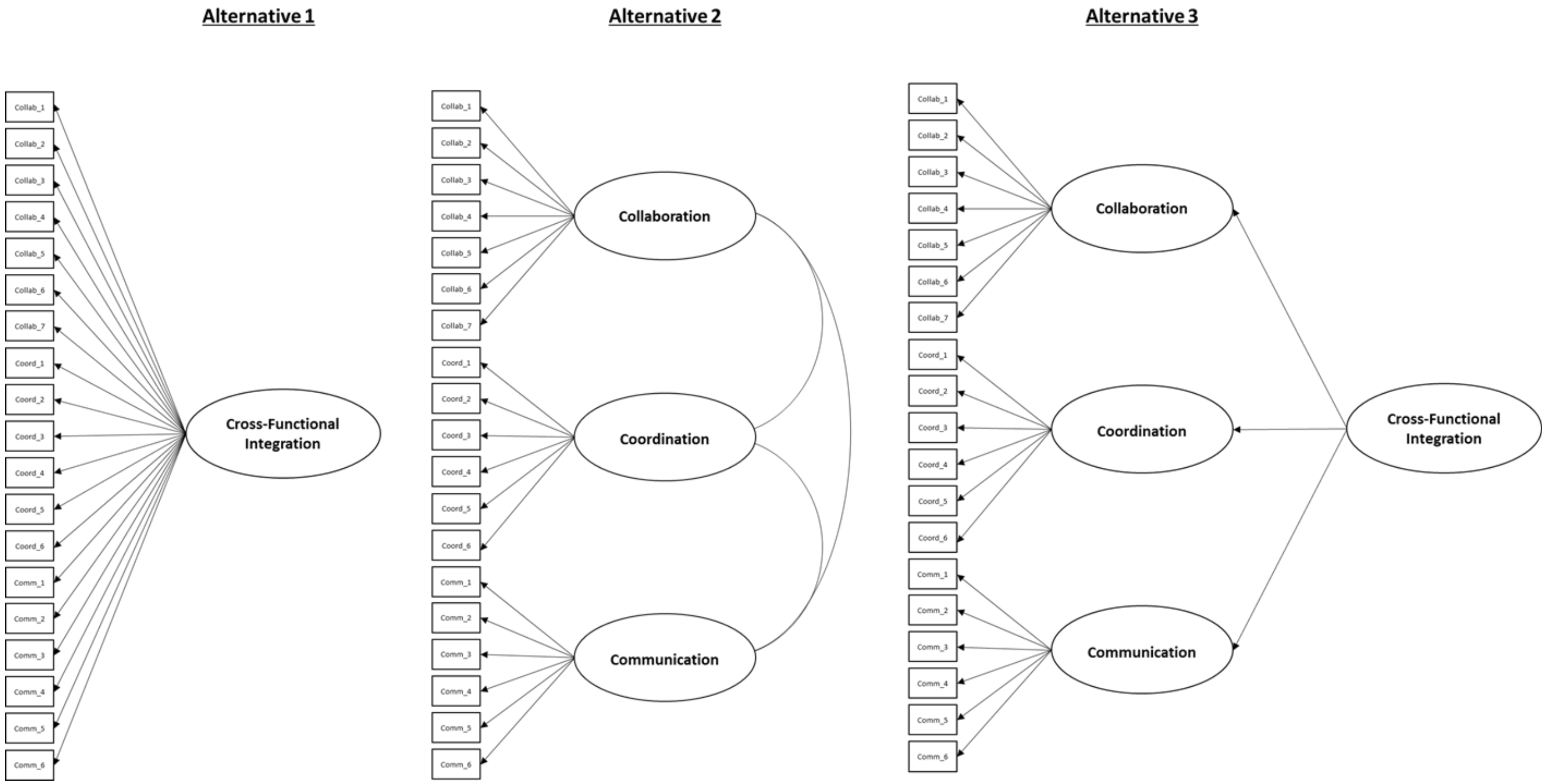

Figure 1.3. Alternative Confirmatory Models

Appendix B: Additional Analysis Using Combined Samples

Table 1.16. Item Regression Weights (First Order Indicators)

	Omnibus	Reduced
Collab_1	0.781	
Collab_2	0.747	.745
Collab_3	0.692	
Collab_4	0.793	.857
Collab_5	0.752	
Collab_6	0.739	.725
Collab_7	0.723	
Coord_1	0.731	
Coord_2	0.773	.771
Coord_3	0.784	.787
Coord_4	0.744	
Coord_5	0.756	
Coord_6	0.763	.772
Comm_1	0.811	.819
Comm_2	0.761	
Comm_3	0.822	.831
Comm_4	0.797	
Comm_5	0.754	
Comm_6	0.789	.782
COLLAB	0.905	.892
COORD	0.913	.923
COMM	0.858	.804

Table 1.16. Continued

	Omnibus	Reduced
Validity & Reliability: AVE [CA]*		
COLLAB	.559[.886]	.605[.820]
COORD	.576[.890]	.603[.819]
COMM	.623[.908]	.658[.853]
CFI	.796[.820]	.765[.836]

** AVE = Average of squared factor loadings, CA = Cronbach's alpha*

All reported weights are standardized and significant at .001

Table 1.17. Interitem Correlation Matrix Using Combined Samples (N=364)

	Collab_1	Collab_2	Collab_3	Collab_4	Collab_5	Collab_6	Collab_7	Coord_1	Coord_2	Coord_3	Coord_4	Coord_5	Coord_6	Comm_1	Comm_2	Comm_3	Comm_4	Comm_5	Comm_6
Collab_1	1																		
Collab_2	.601**	1																	
Collab_3	.527**	.550**	1																
Collab_4	.596**	.652**	.525**	1															
Collab_5	.572**	.571**	.535**	.554**	1														
Collab_6	.582**	.557**	.500**	.598**	.559**	1													
Collab_7	.591**	.478**	.482**	.550**	.597**	.532**	1												
Coord_1	.497**	.445**	.425**	.478**	.411**	.437**	.442**	1											
Coord_2	.491**	.431**	.427**	.552**	.438**	.427**	.454**	.540**	1										
Coord_3	.506**	.458**	.508**	.566**	.475**	.506**	.454**	.580**	.614**	1									
Coord_4	.453**	.405**	.473**	.502**	.449**	.452**	.464**	.523**	.570**	.571**	1								
Coord_5	.510**	.432**	.466**	.517**	.428**	.434**	.432**	.562**	.607**	.585**	.605**	1							
Coord_6	.517**	.470**	.454**	.550**	.487**	.478**	.436**	.586**	.600**	.595**	.563**	.531**	1						
Comm_1	.487**	.409**	.420**	.503**	.558**	.509**	.471**	.514**	.490**	.494**	.450**	.491**	.492**	1					
Comm_2	.475**	.376**	.473**	.455**	.486**	.404**	.459**	.498**	.530**	.484**	.523**	.495**	.492**	.613**	1				
Comm_3	.494**	.411**	.389**	.530**	.501**	.424**	.516**	.416**	.471**	.524**	.455**	.471**	.473**	.665**	.591**	1			
Comm_4	.510**	.402**	.447**	.498**	.455**	.413**	.460**	.452**	.542**	.505**	.472**	.480**	.479**	.632**	.645**	.657**	1		
Comm_5	.471**	.456**	.427**	.479**	.533**	.469**	.457**	.395**	.454**	.503**	.447**	.363**	.474**	.618**	.528**	.658**	.570**	1	
Comm_6	.470**	.392**	.368**	.453**	.436**	.434**	.500**	.487**	.423**	.376**	.474**	.429**	.436**	.646**	.608**	.664**	.630**	.598**	1

STUDY 2:
THE IMPACT OF WORKPLACE BEHAVIORS ON CROSS-FUNCTIONAL INTEGRATION AND SUPPLY CHAIN PERFORMANCE

This study represents original research undertaken by the author with the help of his dissertation committee members, Drs. Theodore Stank, Diane Mollenkopf, Chad Autry, and Timothy Munyon.

Abstract

This research develops a model that includes both structural and behavioral factors related to CFI to clarify the relationships among those factors and better understand their impact on supply chain performance. Hypotheses are developed based on a socio-technical systems (STS) framework and tested using survey data from 364 respondents. Analysis found that the STS framework, which suggested a linear causal relationship from technical core to workplace behaviors to CFI to supply chain performance, was a poor fit for the data. Post hoc analysis revealed a more nuanced relationship among these variables based on an extension of the strategy-structure-performance paradigm. Findings align with recent research suggesting that workplace behaviors play an important role in influencing supply chain outcomes. Particularly with regard to CFI, this research finds that the impact of integration on supply chain performance is contingent on the presence or absence of particular types of workplace behaviors. Managerial implications and future research opportunities are discussed.

Cross-functional integration (CFI) is a central concept in supply chain management (Frankel et al. 2008) and has been shown to improve supply chain performance (Leuschner et al. 2013). Research on CFI has identified key elements of organizational design that comprise the primary mechanisms for driving internal supply chain functions toward greater integration, including reporting structures, information systems, metrics, and processes (Pagell 2004). But although investments in these areas have yielded positive results, practitioners continue to find integration a major challenge and struggle to realize its full performance benefits (Jin et al. 2013).

An emerging stream of literature identifies supply chain professionals' workplace behaviors as an additional mechanism that may influence CFI within the supply chain (Ellinger et al. 2006; Daugherty et al. 2009; Oliva and Watson 2011; Enz and Lambert 2014). Workplace behaviors reflect the impact of interpersonal interactions on the difficult task of actually achieving CFI in the context of day-to-day business operations (Ellinger et al. 2006). However, research in this area is still developing, with few studies considering both structural *and* behavioral factors related to CFI (Oliva and Watson 2011). Thus, additional research is needed to identify specific workplace behaviors that supply chain professionals exhibit and better understand how these behaviors influence the integration process (Fawcett et al. 2011).

This study adopts a socio-technical systems (STS) framework to explore the interrelationships between structural and behavioral mechanisms related to CFI (Emory and Trist 1965). From an STS perspective, CFI's technical core consists of the primary organizational design elements put in place to drive employee behaviors toward executing the task of integration (Pasmore et al. 1982). However, STS recognizes that although the technical core is intended to produce task-oriented behaviors, it may also produce other, unintended, behaviors based on how

employees respond to its requirements (Ash et al. 2007; Harrison et al. 2007). Thus, “optimizing” the technical core alone does not guarantee optimal task performance. Organizations must also take care to ensure that other behaviors elicited by the technical core align with desired outcomes (Emery and Trist 1960; Trist 1981; Pasmore et al. 1982). STS therefore suggests that organizations must focus on both the structural and behavioral factors related to CFI in order to ultimately improve supply chain performance (Appelbaum 1997).

The purpose of this research is to develop a model that includes both structural and behavioral factors related to CFI to clarify the relationships among those factors and better understand their impact on supply chain performance. The following sections provide a review of relevant research, outline details of the research design and analysis, and present key theoretical and managerial implications based on the results.

Review of Theoretical Foundations of Socio-technical Systems Framework

The socio-technical systems (STS) framework was developed out of research on coal mining operations in post-war England (Jaques 1951). These studies described how the implementation of new mining equipment meant to boost operational efficiency ultimately led to a decline in productivity. The central cause of this decline was found to be a range of negative behavioral responses on the part of miners, who felt the new technologies impeded the close interpersonal interactions needed to successfully navigate hazardous mining conditions (Trist 1978). The STS framework emerged from these findings as a way to shift thinking away from a “scientific management” paradigm, in which technologies were seen as strictly determining task performance, to one in which individuals’ engagement with and reaction to technologies mediated

the relationship between technologies and task performance (Emery and Trist 1960; Emery and Trist 1965; Trist 1978).

The STS framework includes four main categories of variables: technologies, workplace behaviors, tasks, and organizational outcomes (Majchrzak and Borys 2001). At the broadest level, technologies represent all those elements of organizational design – such as reporting structures, information systems, metrics, and technical equipment – that organizations put in place to structure how inputs are acquired from the environment and transformed into outputs (Pasmore 1988). The technical core with respect to a given task includes those elements of organizational design most closely associated with the execution of that task (Thompson 1967; Pasmore 1988). Workplace behaviors, on the other hand, reflect the elements of the social system – such as beliefs, attitudes, and social relationships – that shape the reactions and interactions of organizational members (Pasmore et al. 1982). Tasks are those activities that organizational members must carry out in order to achieve organizational outcomes. Organizational outcomes vary therefore depending on how successfully tasks are executed (Rousseau 1977; Pasmore et al. 1982).

For any task, the technical core restricts the personal and interpersonal engagement of organizational members with the aim of driving their behaviors toward the execution of that task (Katz and Kahn 1978; Rousseau 1977). However, the response by organizational members to these restrictions imposed on them by the technical core is not at all predetermined (Trist and Bamforth 1951; Rice, 1958). Organizational members may respond by exhibiting behaviors specifically associated with the execution of the task, but may also respond by exhibiting any number of negative or positive behaviors that impact task performance (Rice 1958; Katz and Kahn 1978). Such unintended behavioral responses occur when the technical core unexpectedly conflicts with

or supports the personal and interpersonal dimensions of the task (Ash et al. 2007; Harrison et al. 2007). In the case of the English coal miners, new mining equipment created a situation where miners were dependent on each other but simultaneously restricted in their ability to engage in the close interpersonal interactions needed to effectively manage those interdependencies, leading to unintended negative behaviors (Trist and Bamforth 1951). Overall, the STS framework suggests that the influence of the technical core on the execution of a given task is mediated by the behavioral responses to those technologies. Figure 1 depicts the basic conceptual model suggested by the STS framework. All figures and tables are located in Appendix A.

[*Insert Figure 1 here]*

The STS framework provides a useful lens for understanding the relationship between technical and behavioral factors impacting CFI in the supply chain (Glaser 2008; Fawcett et al. 2011). CFI is defined as an on-going process in which different functional areas of the supply chain collaborate, coordinate, and communicate in an effort to maximize outcomes for their organization (Kahn and Mentzer 1998; O'Leary-Kelly and Flores 2002; Pagell 2004; De Luca and Atuahene-Gima 2007; Swink and Schoenherr 2015). The need for CFI typically arises in response to dynamic market environments that call for ongoing adjustments to functional objectives and operations (Hausman et al. 2002; Stonebraker and Liao 2004; Xu et al. 2010; Williams et al. 2013). As such, executing the task of integration requires intensive interaction among individuals representing the various parts of the supply chain (Hitt et al. 1993; Kahn and Mentzer 1998; Stank et al. 1999; Ellinger et al. 2006; Oliva and Watson 2011).

Research in supply chain management has identified integrated information systems (IIS) and cross-functional performance indicators (KPIs) as the primary organizational design elements most closely associated with the task of integration (Gunasekaran and Ngai 2004; Hausman 2004; Lambert and Knemeyer 2007; Flynn et al. 2010). Thus, from an STS perspective IIS and KPIs represent CFI's technical core. Implicit in this research, is that IIS and KPIs produce workplace behaviors that increase integration. However, the link between these organizational design elements, workplace behaviors, and CFI has not been explored. Indeed, the STS framework suggests organizational members may exhibit a range of positive or negative workplace behaviors in response to the requirements placed on them by IIS and KPIs. Building on research in organizational psychology (Motowidlo and Van Scotter 1994; Organ 1997; Fox et al. 2001; Podsakoff et al. 2014), this paper hypothesizes IIS and KPIs may produce unintended behavioral responses that offset some of the benefits of these systems. These unintended behavioral responses may help to explain the ongoing struggle practitioners face in realizing the full performance benefits of integration.

The Task and Its Outcomes: Cross-Functional Integration and Supply Chain Performance

CFI represents a central task for supply chain organizations (Omar et al. 2012). Effective execution of CFI requires engagement across functional boundaries in a joint effort to align functional goals, activities, and information with changing market demands (Kahn & Mentzer 1998; Stank et al. 2001b; Pagell 2004; Fugate et al. 2009; Oliva & Watson 2011). CFI therefore requires supply chain professionals to undertake a complex set of activities related to cross-functional collaboration, coordination, and communication (Kahn and Mentzer 1998; Lambert and Cooper 2000; Calantone et al. 2002; Germain and Iyer 2006).

Cross-functional collaboration refers to different functional areas of the supply chain establishing common goals and objectives and working together to achieve them (Kahn 1996; Kahn and Mentzer 1998; Stank et al. 2001b). Collaboration represents an oftentimes-difficult process of reconciling conflicting interests into a joint plan of action with few enforcement mechanisms beyond voluntary agreement (Oliva and Watson 2011). Meaningful relationships based on trust, commitment, and mutual respect among different groups and individuals are therefore critical to the success of the collaborative process (Morgan and Hunt 1994; Stank et al. 1999).

Cross-functional coordination refers to a separate but related set of activities focused on optimizing overall supply chain processes by jointly manage operational flows (Morash and Clinton 1998; Lambert and Cooper 2000; Stadtler 2005; Swink and Song 2007; Sahin and Robinson 2002). Coordination requires supply chain professionals to jointly manage the timing and sequencing of supply chain activities while resolving conflicting functional decisions in these areas (Morash and Clinton 1998; O'Leary-Kelly and Flores 2002; Brettel et al. 2011; Williams et al. 2013).

Finally, cross-functional communication requires supply chain professionals to work together to maintain a reciprocal flow of information that supports collective decision-making and action (Hitt et al. 1993; Calantone et al. 2002; Ellinger et al. 2006; Fugate et al. 2009). Cross-functional communication implies both conveying and interpreting information (Oliva and Watson 2011). The process therefore relies on both formal and information interpersonal interactions that break down the interpretive barriers created by different functional "thought worlds" (Dougherty 1992; Hitt et al. 1993; Ellinger et al. 2006; Hirunyawipada et al. 2010; Andrea et al. 2011).

Successful execution of the CFI task improves supply chain organizational outcomes. Overall, CFI allows for flexible and innovative responses to market changes, while reducing the costs associated with executing supply chain activities. CFI is therefore associated with improvements in supply chain operational effectiveness, such as product quality and delivery performance, as well as operational efficiency (Mackelprang et al. 2014).

Workplace Behaviors: Task, Citizenship, and Counterproductive

Research suggesting that supply chain professionals' workplace behaviors play an important role in influencing CFI remains largely qualitative in nature (Ellinger et al. 2006; Oliva and Watson 2011; Enz and Lambert 2014). This research stream is in the early stages of defining and categorizing workplace behaviors specifically within a supply chain context (Thornton et al. 2013). Researchers in organizational psychology, however, have produced a rich stream of literature on more broadly defined workplace behaviors (Brief and Weiss 2002). This research has identified three basic sets of behaviors that characterize how employees engage in their work: task behaviors (TBs), organizational citizenship behaviors (OCBs), and counterproductive work behaviors (CWBs) (Organ 1997; Podsakoff et al. 2014). Supply chain scholars have begun applying these general behavioral categories to better understand the influence that workplace behaviors have on supply chain phenomena (Autry et al. 2013; Thornton et al. 2013; Esper et al. 2015). In keeping with this trend, the current research views TBs, OCBs, and CWBs as representing the range of potential behaviors that supply chain professionals may exhibit as they seek to carry out the task of CFI.

TBs (sometimes referred to as "in-role" behaviors) "bear a direct relation to the organization's technical core, either by executing its technical processes or by maintaining and

servicing its technical requirements" (Motowidlo and Van Scotter 1994, 476). TBs are distinguishable from OCBs and CWBs (sometimes referred to "extra-role" or "contextual" behaviors) (Motowidlo and Van Scotter 1994; Borman and Motowidlo 1997; Conway 1999; Whiting et al. 2008). Whereas TBs represent the intended behavioral consequences of the technical core (Katz and Kahn 1978), OCBs and CWBs represent unintended positive and negative behavioral consequences, respectively (Ash et al. 2007).

OCBs are individual behaviors that enhance the social and psychological environment in which more technically oriented tasks are performed (Organ 1997). They represent pro-social gestures that support positive social interactions among co-workers and constructive engagement with organizational structures (Smith et al. 1983; LePine et al. 2002). OCBs may be accommodating, cooperative, and generally aimed at strengthening interpersonal ties (Brief and Motowidlo 1986) or they may express a needed challenge to the status quo that promotes positive changes in the organization (LePine and Van Dyne 1998; Graham and Van Dyne 2006). Their overall effect is to enhance individual and aggregate workplace performance (Podsakoff et al. 2009).

CWBs are behaviors that are harmful to the legitimate interests of others or the organization (Fox et al. 2001). CWBs are not simply the opposite of OCBs, rather they represent a distinct set of behaviors that supply chain professionals might engage in alongside OCBs (Dalal 2005). CWBs negatively affect interpersonal relationships and have a generally detrimental effect on the overall work environment (Robinson and Bennett 1995; Fox and Spector 1999). Research suggests that CWBs negatively impact both individual task performance and, more generally, operational effectiveness (Dunlop and Lee 2004).

TBs should improve execution of the CFI task insofar as they directly relate to carrying out the activities necessary for integration. Likewise, OCBs should improve supply chain professionals' ability to manage the various challenges associated with aligning functional goals, managing complex interdependent processes, and forging a shared interpretation of specialized information. OCBs "lubricate the social machinery of the organization, …[providing] the flexibility needed to work through many unforeseen contingencies…[and enabling] participants to cope with the otherwise awesome condition of interdependence on each other" (Smith et al. 1983, 654). Conversely, CWBs reflect individuals' resistance to such workplace engagement, while at the same time contributing to a negative interactive base within an organization, and should therefore impair efforts at integration (Dunlop and Lee 2004).

The Technical Core and Its Impact on Workplace Behaviors

The supply chain literature suggests that integrated information systems (IIS) and cross-functional KPIs are the primary organizational design elements most closely associate with the task of integration, and therefore represent CFI's technical core (Gunasekaran et al. 2001; Gunasekaran and Ngai 2004). IIS aim to facilitate access to and transmission of information across functional boundaries and ensure the quality of information underlying supply chain decisions (Barua et al. 1995; Bourland et al. 1996; Gunasekaran and Ngai 2004; Arun et al. 2006; Fawcett et al. 2007; Speier et al. 2008; Gorla et al. 2010). Cross-functional KPIs aim to measure and reward achievement of cross-functional objectives with the intention of stimulating continuous improvement of overall supply chain processes (Bond 1999; Neely et al. 2000; Brewer and Speh 2000; Hausman 2002; Neely et al. 2005; Lambert and Knemeyer 2007). Empirical evidence

supports the idea that implementing these technologies positively influences integration outcomes (Stank et al. 2001a; Rodrigues et al. 2004; Prajogo and Olhager 2012; Foerstl et al. 2013).

From an STS perspective, the impact of IIS and cross-functional KPIs should be mediated by the behavioral responses that these technologies elicit (Emery and Trist 1960; Emery and Trist 1965; Trist 1978). Implementing these technologies should enhance task behaviors by structuring cross-functional activities around objective metrics and consistent information that cut across functional domains (Gunasekaran et al. 2001; Zhou and Benton 2007). However, the extent to which these technologies place pressure on supply chain professionals to integrate while simultaneously creating barriers to personal and interpersonal engagement in the CFI process, these technologies may inhibit OCBs and elicit CWBs (Spector and Fox 2010).

OCBs and CWBs arise out individuals' reaction to their work environment (Miles et al. 2002; Spector and Fox 2010). OCBs tend to be exhibited when individuals are assigned tasks they view as important and stimulating, are given latitude to use their judgment in completing such tasks, and are fairly evaluated and rewarded for their efforts (Podsakoff et al. 2000). CWBs tend to be exhibited in response to circumstances that are seen as blocking individuals from achieving valued work goals or limiting their control over ambiguous or stressful environments (Bennett 1988; Fox et al. 2001). Although individual psychological factors come into play, research suggests that in general when organizational structures constrain individuals' opportunities to act on their best impulses or solve problems creatively with others, employees are less likely to exhibit OCBs and more likely to exhibit CWBs (Spector and Fox 2002; Dalal 2005). Likewise, when employees find it difficult to see their contribution to overall performance or are overly distanced

from the fruits of their labor, they are less likely to engage positively and more likely to revert to negative, counterproductive behaviors (Podsakoff et al. 2000; Martinko et al. 2002).

Research suggests that critically evaluating supply chain information and establishing a common understanding of the relevance of that information is central to CFI (Fugate et al. 2009; Oliva and Watson 2011). IIS, however, may reduce the perceived need for supply chain professionals to actively engage in collecting, validating, and evaluating the relevance of information, while also limiting opportunities for them to voice and defend their interpretations of this information (Carlile 2004; Seo and La Paz 2008). Supply chain professionals may also feel restricted in their ability to express and act upon their own tacit knowledge, particularly when it conflicts with the more regulated forms of explicit knowledge disseminated through information systems (Harper and Utley 2001; Johannessen et al. 2001; Davison et al. 2013). Thus, IIS may serve to frustrate supply chain professionals' earnest attempts to contribute to the CFI process while limiting the extent to which their voice is reflected in the information used to drive supply chain decisions (Hislop 2002; Willem and Buelens 2009).

Cross-functional KPIs might reduce perceptions of organizational justice and fairness, particularly if functional areas are perceived as making unequal contributions to group objectives (Moorman 1991; Moorman et al. 1993). Broad performance indicators might also reward or punish supply chain professionals based on metrics that are seen to be out of their individual control, thereby reducing the perceived value of their individual efforts (Spreitzer 1995; Bititci et al. 1997). Moreover, given that CFI arises out of a need to respond to dynamic market forces, adherence to established performance indicators could frustrate attempts at achieving alternative goals based on changing circumstances (Ramdas and Spekman 2000). Cross-functional KPIs might therefore lead

supply chain professionals to view their efforts as simply an exercise of "hitting the numbers," reducing the likelihood of positive workplace engagement (Godsell and Van Hoek 2009). Indeed, research suggests that in general external performance metrics reduce individuals' intrinsic motivation to engage in complex and challenging work (Deci et al. 1999).

Control Variable: Organizational Reporting Structure

In addition to integrated IIS and cross-functional KPIs, there may be more general features of organizational design that tend to drive supply chain professionals toward CFI. In particular, research suggests that integration should improve when organizations require cross-functional interaction through formal reporting structures (e.g. matrix structures) (Ford and Randolph 1992). Controlling for reporting structures should therefore enable a more focused analysis of the unique effects of the technical core related to CFI.

Hypotheses Based on the STS Framework

Theoretical development based on the STS framework suggested a causal relationship from technical core to workplace behaviors to CFI to supply chain performance. The technical core is predicted to increase TBs, but also have the unintended consequence of reducing OCBs and increasing CWBs. Overall, therefore, a competitive mediation model is suggested (Zhao et al. 2010). Table 1 provides formal hypotheses and Figure 2 depicts the tested theoretical model.

[Insert Table 1 and Figure 2 here]

Data Collection and Model Development

Sampling and data collection procedures

Two separate data collections were carried out using two different third party data collection services. The sample frame for both collections was supply chain professionals currently holding managerial positions in US companies. Collecting separate samples from different vendors helped to reduce sampling bias and allowed for cross-sample comparisons to validate the trustworthiness of responses. Sample demographics are provided in Table 2.

[Insert Table 2 here]

For the first sample, data collected over a three-week period yielded a total of 1,824 responses. Partial responses were eliminated, leaving 303 full responses. Full responses were further cleansed based on (1) screening questions to ensure respondents were appropriately positioned to provide valid answers, (2) filter questions to eliminate spurious responses, and (3) consistency on two reverse coded questions (Schoenherr et al. 2015). This process yielded a final set of 182 full, valid responses. Three response rates can be calculated based on these procedures: a completed response rate of 16.61% (303/1,824), a usable response rate of 9.98% (182/1,824), and a usable-to-completed response rate of 60.01% (182/303). For the second sample, the vendor provided only full responses. The full data set included 204 responses. These responses were further cleansed based on the criteria above to arrive at a final set of 182 full, valid responses implying a usable-to-completed response rate of 89.22% (182/204). In total therefore these procedures yielded a combined data set of 364 responses.

Construct measures

The IIS construct was measured using a three-item scale adopted from the literature (Rai et al. 2006). Scale items covering both metrics (Neely et al. 2000) and incentives (Ahmad and Schroeder 2003) were adapted from the literature to measure cross-functional KPIs. A six-item scale was developed for organizational reporting structure based on the literature (Ford and Randolph 1992). Measures for TBs (Williams and Anderson 1991), OCBs (Munyon et al. 2010), and CWBs (Bennett and Robinson 2000) were adopted from the literature. Supply chain performance measures were also developed from the literature (Stock and Lambert 2001; Fugate et al. 2010). Finally, a 19 item scale was developed to measure CFI in the supply chain as defined by its subdimensions (collaboration, coordination, communication). CFI was modeled as a second order construct with first order constructs acting as reflective indicators, consistent with prior conceptualizations in the literature (Kahn and Mentzer 1996; Rodrigues et al. 2004). Survey items are provided in Appendix B.

Nonresponse and common method bias

Nonresponse bias was tested in each sample by comparing the responses of early versus late respondents (Armstrong and Overton 1977; Lambert and Harrington 1990). No statistically significant differences were found between the groups. Moreover, t-tests for constructs across the two samples indicated there was no statistical difference between the samples. Given that each sample was drawn from the same population, i.e. supply chain professionals currently holding managerial positions in US companies, it was concluded that nonresponse bias was not a serious concern in the samples.

Consistent with the recommendations of Craighead et al. (2011), survey design and statistical approaches were employed to control and assess common method bias (CMB). With

regard to survey design, predictor and criterion variable items were separated over a lengthy survey instrument. Survey design also sought to reduce method biases by ensuring questions were highly relevant to participants and that answers would be kept anonymous. Subheadings, pagination, and different scale anchors were also used to break up the survey (MacKenzie and Podsakoff 2012).

Two post hoc statistical tests were employed to test for CMB. First, a Harman's single-factor test of all of the measurement items was conducted (Harman, 1976). The test suggests CMB is present if all measurement items load on a single exploratory factor or one factor explains more that 50 percent of the variance (Podsakoff and Organ, 1986). Exploratory factor analysis (EFA) identified the largest factor as accounting for only 34 percent of the variance. A second test of CMB was completed using Lindell and Whitney's (2001) marker variable technique. In this analysis, the smallest correlation between constructs was used as a post hoc proxy to represent CMB. This marker variable correlation was partialled out from the remaining constructs to see whether the remaining relationships between constructs were still significant. All remaining correlations remained significant ($p < .01$), indicating CMB did not play a significant role in our findings.

Construct reliability and validity

Scale purification was carried out using the combined data sets (Anderson and Gerbing 1988). This process revealed that the construct for organizational reporting structure had poor internal validity and did not discriminate across other constructs. Dropping items to improve the convergent validity of scale did not alleviate these issues. Moreover, it was found that including the organizational reporting structure construct did not appreciably alter model fit. It was therefore judged that the construct added noise to the model without improving overall predictive ability,

and was excluded from subsequent analysis. Remaining constructs were examined for reliability, and convergent and discriminant validity. Composite reliability for each construct was greater than 0.8 and average variance extracted was greater than 0.55 indicating strong convergent validity. The square root of the average variance extracted for each construct was greater than its correlation with other constructs, indicating discriminant validity. Table 3 displays these results.

[Insert Table 3 here]

Discriminant validity was further investigated using multi-trait/multi-method (MTMM) correlations (Henseler et al. 2015). This approach argues that discriminant validity is achieved when the average within-construct item correlations are greater than average across-construct item correlations. The MTMM approach has been shown to be a more reliable and powerful test of discriminant validity than traditional methods, such as the Fornell-Larcker criterion and examination of cross-loadings (Henseler et al. 2015). The results of the MTMM analysis for the principal constructs in this study revealed no discriminate validity issues. Results are displayed in Table 4 and the full inter-item correlation matrix displayed in Appendix C.

[Insert Table 4 here]

Measurement Model

Based on this analysis a final measurement model was derived that reflected the principal constructs. Table 5 displays model fit statistics. Measurement model fit statistics met or exceeded recommended criteria, suggesting that hypothesis testing was appropriate (Hooper et al. 2008).

[Insert Table 5 here]

Hypotheses Testing Based on the STS Framework

A structural model was developed to test hypotheses based on the STS framework. Figure 2 depicts the relationships tested and Table 6 displays model fit statistics. Model fit was poor (Chi-Square = 452.396, CFI = .714, RMSEA = .349) despite the strong measurement fit demonstrated earlier. This lack of model fit made it inappropriate to interpret the parameter estimates (Anderson and Gerbing 1988). Overall, the result indicated that the theoretical relationships suggested by the STS framework did not adequately describe the underlying data. However, a strong measurement model with clear correlations among constructs suggested that relationships existed and perhaps could be explained using an alternative theoretical frame. Post hoc analysis was therefore undertaken to determine whether an alternative model could be developed.

[Insert Table 6 here]

Post Hoc Analysis: A Structure-Process-Performance Extension of the SSP Framework

The strategy-structure-performance (SSP) framework has a long history of application in the supply chain literature (Murphy and Poist 1992; Cooper and Ellram 1993; Stock et al. 1998; Bowersox et al. 1999; Chow et al. 1995; Defee and Stank 2005; Stank et al. 2005; Esper et al. 2010; Daugherty et al. 2011). In particular, the SSP paradigm has been used to successfully predict structural antecedents of CFI as well as performance consequences (Rodrigues et al. 2004; Stank et al. 2005). Thus, it was considered a strong candidate as an alternative theoretical framework.

Research on the relationship between firm strategy and structure developed out of Chandler's (1962) study of American manufacturing companies, in which he concluded that the

choice of strategy impacts the development of organizational structures with significant implications for performance. Rumelt (1974) later elaborated this relationship into what has become known as the strategy-structure-performance (SSP) framework. The SSP framework has spawned a wide-ranging stream of literature looking at the performance implications of “fit” between strategy and structure (Venkatraman and Camillus 1984; Fry and Smith 1987; Venkatraman 1989). Most studies have adopted a contingency approach when assessing fit, typically modeling it as the interaction between strategic and structural variables (Galunic and Eisenhardt, 1994; Xu et al. 2006). An extension of the framework includes management processes, creating a strategy-structure-process triad (Miles and Snow 1978; Galbraith and Nathanson 1979; Galbraith and Kazanjian 1986; Miller 1987; Bartlett and Ghoshal 1991; Xu et al. 2006). This strategy-structure-process-performance model remains a powerful framework still used by researchers in a number of fields to understand the interplay among organizational elements (Galunic and Eisenhardt 1994; Amitabh and Gupta 2010).

A structural contingency model based on the SSP framework suggests that structural elements (IIS and KPIs) should be aligned with internal processes (CFI) to maximize performance (Flynn et al. 2010). This reconceptualization is in keeping with the definition of CFI as an on-going process entailing elements of collaboration, coordination, and communication across functional boundaries. Incorporating TBs, OCBs, and CWBs is likewise in keeping with recent research in supply chain management that views supply chain professionals’ workplace behaviors as necessary supports for organizational structures and processes (Overstreet et al. 2014). Following the dominant approach in SSP literature, the fit between structure, process, and

behaviors were modeled as a series of interactions (Galunic and Eisenhardt, 1994; Venkatraman 1989; Xu et al. 2006). Figure 3 presents the conceptual model based on SSP framework.

[Insert Figure 3 here]

Hierarchical regression analysis was used to test the contingent effects of IIS and KPIs across levels of CFI and workplace behaviors. The first step assessed the direct effect of IIS and KPIs, respectively, on supply chain performance (Model 1). The second step assessed the moderating effect of CFI on structural variables (Model 2). In the third step, two-way interactions among structural variables, CFI, workplace behaviors were assessed (Models 3-5). In the final step, a three-way interaction was added to determine the additional effect of structural variables on performance across levels of both CFI and workplace behaviors (Models 6-8). Each structural variable was tested separately to prevent overfitting the models (Babyak 2004). The results of the analysis for IIS are displayed in Table 7 and for KPIs in Table 8. Table 9 displays point estimates of the impact of the structural variables on performance across levels of CFI and workplace behaviors. Figure 4 presents a graphical representation of conditional main effects compared with effects over levels of CFI and workplace behaviors based on the point estimates in Table 9.

[Insert Table 7, Table 8, Table 9, Figure 4 here]

Effect of IIS and KPIs Across Levels of CFI

Model 1 indicated that IIS and KPIs had significant direct effects on supply chain performance. Adding the interaction term with CFI in Model 2 improved these relationships and

the overall R^2 of the model. The positive moderating effect of CFI on IIS and KPIs remained consistent in the presence of both two-way and three-way interactions with behaviors.

Two-way Interactions with Behaviors

Models 3 through 5 considered two-way interactions with workplace behaviors. TBs were shown to have a positive moderating effect on the relationship between structural variables and performance. OCBs were also shown to have a positive moderating effect on IIS and KPIs as well as a positive direct effect. CWBs, conversely, were shown to weaken the effect of IIS on performance and have no moderating effect on KPIs.

Two-way interactions between CFI and behavioral variables were also significant. For both CFI x TBs and CFI x OCBs the interaction terms were negative. This result suggests a substitution effect, such that the importance of CFI is greatest under conditions where TBs and OCBs are not the norm, but diminishes as these behaviors are more frequently exhibited. Conversely, the interaction between CFI and CWBs was positive, suggesting that CFI becomes more important the more frequently negative behaviors are exhibited. Overall, the two-way interactions between CFI and behaviors indicated that CFI has an impact on performance, independent of IIS and KPIs; however, the level of CFI's impact is conditioned on the presence or absence of particular behaviors.

Three-way Interactions with CFI and Behaviors

Considering the effect of IIS across levels of both CFI and behaviors indicated significant positive effects with TBs and OCBs, but no significant interaction with CWBs. Three-way interactions with KPIs indicated a significant positive effect with TBs, a non-significant effect with OCBs, and a significant negative effect with CWBs. Table 9 compares point estimates of the

conditional effects of IIS and KPIs on performance at (1) at high and low levels of CFI, holding behaviors at zero, and (2) high and low levels of both CFI and behaviors. In all but two cases, these estimates indicated that significant changes occurred when behaviors are considered. Figure 4 presents a graphical representation of these point estimates. To provide a baseline of comparison, Figure 4 also includes the conditional effects of IIS and KPIs on performance holding both CFI and behaviors at zero.

Overall, Table 9 and Figure 4 suggested a consistent pattern in the data. At low levels of IIS and KPIs, having even low levels of CFI increased the impact of these variables on performance. As the level of IIS and KPIs increased, the additional improvement garnered from CFI was less, but still significant. Under conditions where CFI and TBs were both low, there was still an improvement over the baseline effects, but that improvement was diminished. However, as CFI and TBs both moved to high levels, the overall impact on performance was significantly improved relative to the baseline and CFI only. A similar pattern occurred across levels of both CFI and OCBs. While low levels of OCBs appeared to diminish the potential improvement due to CFI, high levels of OCBs enhanced its effect on IIS and KPIs. Finally, the moderating effect of CFI on IIS and KPIs was clearly stronger when CWBs were low, but these gains from CFI appeared to be erased as CWBs increased.

Implications and Conclusion

The purpose of this research was to clarify the relationships among structural and behavioral factors related to CFI and investigate the impact of these relationships on supply chain performance. Analysis suggested that the impact of IIS and KPIs on performance was substantially

enhanced as CFI processes were put into place. Additional benefits were also seen as workplace behaviors related to task execution and improving the overall social environment increased. However, the benefits of CFI were reduced or eliminated by negative behaviors that harm interpersonal relationships and have a generally detrimental effect on the overall work environment.

Theoretical Implications

This research suggests a number of theoretical implications. First, it provides generalizable evidence in support qualitative studies that had previously investigated the impact of workplace behaviors on CFI. Moreover, it extends these earlier studies by identifying clear categories behaviors (TBs, OCBs, and CWBs) that impact supply chain structures, processes, and performance in different ways. Demonstrating the relevance of these categories provides a basis for future research aimed at defining types of workplace behaviors that apply more specifically to a supply context. More broadly, the findings contribute to an understanding of the impact of behaviors on supply chain phenomena as part of a growing interest in the micro-foundations of supply chain and operations management (Croson et al. 2013; Esper and Crook 2014).

Second, the research suggests that the strategy-structure-process framework continues to be a useful theoretical lens for understanding the general relationships among various factors related to CFI and supply chain performance. Extensions of the SSP framework that consider supply chain processes and workplace behaviors may provide additional insights in this regard. The research does not, however, necessarily demonstrate a rejection of socio-technical systems perspective. STS provides a strong theoretical basis for investigating the impact of workplace behaviors that other perspectives lack (including more traditional readings of SSP). The STS

framework might therefore be usefully applied to drive other types of research that seeks to relate workplace behaviors to supply chain phenomena.

Finally, this research suggests the need for middle-range theorizing in order to provide a clearer understanding of how, why, and when structural and behavioral factors related to CFI drive performance (Stank et al. 2016). The research here adopted a general theoretical framework to explore the impact of general categories of behaviors on phenomena specially related to supply chain management. Such an approach was warranted, given that research on workplace behaviors in supply chain management is still emerging. However, the generality of the research means that the results, although suggestive, are best viewed as an initial outline of some of the basic relationships among these factors. A middle-range approach that contextualizes the variables and relationships within the domain of supply chain management would greatly enhance understanding of conditions under which these phenomena impact outcomes as well as the specific mechanisms through which such outcomes are generated.

Managerial Implications

Overall, this research suggests that managers have a range of options as they seek to improve the performance of their supply chain organizations. Implementing integrated information systems and cross-functional performance metrics have long been recommendations in the literature. This research supports the idea that undertaking such initiatives improves supply chain performance. However, implementing these systems requires substantial investment of resources and on-going commitment from top management. Moreover, research indicates that efforts aimed at implementing integrated information systems, such as ERP systems, face failure rates of

between 40 and 50 percent (Chen et al. 2009). Limited available evidence on efforts aimed at implementing cross-functional performance metrics points to even worse results, with failure rates potentially reaching 70 percent (Shepherd and Hannes 2010). In the face of such daunting challenges, supply chain managers might enhance the performance impact of existing systems by focusing on developing robust CFI processes. This research indicates that doing so would be particularly helpful in organizations where existing cross-functional structures are relatively underdeveloped. CFI might also be a cost effective option for SMEs, which may lack the resources needed to invest in integrated systems (Archer et al. 2009; Thakkar et al. 2009). Focusing on CFI has the additional benefit of placing the necessary organizational changes more clearly within the locus of control of most supply chain managers. Improving cross-functional processes may also serve to set the stage for more substantial changes to organizational structures, perhaps even improving the chances for success in these initiatives.

The research further suggests that workplace behaviors also have a role to play. By encouraging task oriented behaviors and proactive contributions to the work environment, managers may improve the ability of their supply chain organizations to overcome the limits of existing systems through positive interpersonal interactions. The greatest gains were seen when task and citizenship behaviors complemented strong cross-functional processes. However, the analysis suggests that, although task and citizenship behaviors might not fully substitute for CFI, these behaviors can to some degree make up for a lack of such processes. Limiting negative behaviors seems to be equally important. Time and effort spent in creating strong cross-functional processes seems to be almost completely wasted if negative behaviors are allowed to destroy the interpersonal relationships on which these processes are based. Finally, as with CFI, workplace

behaviors fall more clearly within the scope of managerial control. Therefore, focusing on behaviors might well be the first step that managers undertake when seeking to improve the performance of their supply chain organizations.

Limitations and Future Research

The results of the current study must be interpreted within its limitations. First, the lack of an established scale for organizational reporting structures required the development of a new measure that was ultimately excluded. Thus, organizational reporting structure was not included as a control variable, despite theoretical arguments for its inclusion found in the literature (Ford and Randolph 1992). Second, cross-sectional survey research only provides a "snapshot" of current supply chain practices. Thus, novel results, such as the contingent effect of CFI on performance across levels of different workplace behaviors, must be validated by subsequent research. Finally, generalized constructs such as TBs, OCBs, and CWBs do not capture specific behaviors that supply chain managers exhibit in the context of day-to-day supply chain operations. Such constructs may therefore miss important aspects of supply chain managers' workplace behaviors that impact CFI and performance.

Each of these limitations suggest that future research in the area of workplace behaviors and CFI is needed. In particular, researchers interested in the impact of supply chain professionals' workplaces behaviors should look to develop definitions and measures of such behaviors that are clearly contextualized within supply chain management, so as to maximize their relevance for theory development and testing within the supply chain domain (Stank et al. 2016). Initial efforts in this regard have been undertaken (Thornton et al. 2013), but more work is needed. Overall, the results of this study align with recent research suggesting that workplace behaviors play an

important role in influencing supply chain outcomes (Eckerd et al. 2013; Overstreet et al. 2014; Esper et al. 2015). Thus, focusing on the impact of behavioral factors on supply chain phenomena appears to be a fruitful avenue of investigation for future researchers.

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Appendix A: Tables and Figures

Table 2.1. Hypothesis Development Based on the STS Framework

Label	Hypothesis
H1a	Integrated information systems are positively related to task behaviors
H1b	Integrated information systems are negatively related to organizational citizenship behaviors
H1c	Integrated information systems are positively related to counterproductive work behaviors
H2a	Cross-functional performance indicators are positively related to task behaviors
H2b	Cross-functional performance indicators are negatively related to organizational citizenship behaviors
H2c	Cross-functional performance indicators are positively related to counterproductive work behaviors
H3	Task behaviors are positively related to cross-functional integration
H4	Organizational citizenship behaviors are positively related to cross-functional integration
H5	Counterproductive work behaviors are negatively related to cross-functional integration
H6	Cross-functional integration is positively related to supply chain performance
H7	Organizational reporting structure is positively related to cross-functional integration (control)

Table 2.2. Sample Demographic Information

Respondent Information	Sample 1	Sample 2	Organization Information	Sample 1	Sample 2
Level in the Organization			**Industry**		
Reports directly to the CEO	11%	30%	Mfg & Construction	17%	11%
Boss reports directly to the CEO	8%	25%	Chemicals & Plastics	3%	3%
Two levels of reporting to CEO	14%	16%	Oil & Gas	3%	2%
Three levels of reporting to CEO	16%	15%	Food & Beverage	7%	7%
Four levels of reporting to CEO	16%	6%	Consumer Goods	20%	10%
Five levels of reporting to CEO	15%	3%	Transportation	13%	7%
More than five levels	19%	5%	Business Services	9%	27%
			IT & Info Systems	8%	16%
Years with Current Organization			Biotech & Medical	7%	5%
Less than 1 year	3%	2%	Govt & Nonprofit	0%	5%
1 - 10 years	52%	63%	Other	13%	6%
10 - 20 years	29%	26%			
20 or more years	16%	10%	**Sales**		
			Under $1 billion	7%	52%
Time Spent on Cross-Functional Activities			$1 - $9.9 billion	23%	35%
0 - 19% of my time	11%	4%	$10 - $19.9 billion	12%	12%
20 - 39% of my time	32%	23%	$20 billion or more	37%	2%
40 - 59% of my time	28%	38%	N/A	21%	0%
60 - 79% of my time	18%	25%			
80 - 100% of my time	11%	9%			

Table 2.2. Continued

Respondent Information			Organization Information		
Scope of Responsibility*			**Number of Employees**		
Supply Chain Strategy	30%	21%	Under 2,000	5%	51%
Supply Chain Planning/MRP	24%	20%	2,000 - 10,000	13%	40%
Research & Development	15%	20%	10,000 - 100,000	34%	9%
Sourcing & Procurement	24%	19%	100,000 or more	26%	0%
Manufacturing & Operations	43%	33%	N/A	21%	0%
Logistics & Transportation	33%	22%			
Warehousing & Materials Hdlg	22%	21%			
Customer Service	19%	39%			
Returns Management	12%	10%			
Demand Planning & Mgmt	14%	19%			
Marketing	8%	21%			
Supply Chain IT	19%	25%			
SC Center of Excellence	4%	5%			
Other	0%	7%			
Career Number of Managerial Roles in Different SC Areas					
Manager in only one SC area	27%	25%			
Manager in two SC areas	33%	29%			
Manager in three SC areas	23%	23%			
Manager in four SC areas	8%	9%			
Manager in five SC areas	3%	4%			
Manager in more than five SC areas	7%	10%			

**Respondents could choose more than one area, percentages do not add to 100*

Table 2.3. Descriptive Statistics, Convergent, and Discriminant Validity for Principal Constructs

	AVE	CR (CA)	MEAN (SD)	CFI	TBs	OCBs	CWBs	KPIs	ITS	PERF
CFI	.794	.920 (.881)	5.64 (.866)	**.891**						
TBs	.599	.882 (.882)	5.82 (.815)	.599	**.774**					
OCBs	.585	.894 (.893)	5.11 (1.11)	.500	.632	**.765**				
CWBs	.729	.942 (.941)	2.77 (1.53)	-.191	-.333	-.158	**.854**			
IIS	.644	.844 (.842)	5.41 (1.16)	.710	.599	.542	-.188	**.803**		
KPIs	.561	.884 (.881)	5.24 (1.12)	.698	.578	.526	.689	-.168	**.749**	
PERF	.555	.897 (.897)	4.97 (.914)	.510	.462	.486	-.131	.624	.562	**.745**

Notes: *Items on the diagonal (in bold) represent the square root of the average variance extracted (AVE) scores*
CR = Composite Reliability, CA = Cronbach's alpha

Table 2.4. MTMM Test of Discriminant Validity

	CFI	TBs	OCBs	CWBs	ITS	KPIs	PERF
CFI	**.793**						
TBs	.413	**.599**					
OCBs	.341	.374	**.584**				
CWBs	-.145	-.220	-.103	**.727**			
IIS	.507	.372	.332	-.129	**.642**		
KPIs	.463	.300	.300	-.107	.412	**.556**	
PERF	.338	.266	.277	-.083	.335	.352	**0.496**

Notes: Numbers in bold represent average within-construct item correlations

Table 2.5. Measurement Model Fit Statistics

Index	Statistic
Chi-Square	2121.596
P (Chi-Square)	.000
Degrees of Freedom	1200
CFI	.925
RMSEA	.046
PCLOSE	.981

Table 2.6. Structural Model Fit Statistics Based on the STS Framework

Index	Statistic
Chi-Square	452.396
P (Chi-Square)	.000
Degrees of Freedom	10
CFI	.714
RMSEA	.349
PCLOSE	0.000

Table 2.7. Impact of IIS on SC Performance Across Levels of CFI & Workplace Behaviors

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Main Effect								
IIS	.254***	.327***	.350***	.312***	.327***	.326***	.290***	.326***
Across Levels of CFI								
CFI		.015	-.074	-.056	.002	-.113	-.079	-.014
IISxCFI		.183***	.165***	.157***	.207***	.171***	.191***	.215***
Across Levels of CFI & TBs								
TBs			.065			.023		
IISxTBs			.214***			.269***		
CFIxTBs			-.184**			-.162**		
IISxCFIxTBs						.162**		
Across Levels of CFI & OCBs								
OCBs				.169***			.130***	
IISxOCBs				.170**			.211***	
CFIxOCBs				-.135**			-.145**	
IISxCFIxOCBs							.127**	
Across Levels of CFI & CWBs								
CWBs					.008			.043
IISxCWBs					-.127**			-.149**
CFIxCWBs					.175***			.171***
IISxCFIxCWBs								-.070
Control=KPIs	.487***	.472***	.491***	.448***	.486***	.493***	.459***	.490***
R-Squared	.490***	.518***	.530***	.541***	.528***	.537***	.547***	.531***

Note: p<.01 (***), p<.05 (**), p<.1 (*)

DV = SC Performance

Table 2.8. Impact of KPIs on SC Performance Across Levels of CFI & Workplace Behaviors

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Main Effect								
KPIs	.487***	.526***	.556***	.556***	.557***	.527***	.559***	.567***
Across Levels of CFI								
CFI		.048	-.047	-.054	.030	-.077	-.050	.008
KPIsxCFI		.186***	.139**	.139***	.214***	.170***	.134***	.229***
Across Levels of CFI & TBs								
TBs			.077			.039		
KPIsxTBs			.188***			.202***		
CFIxTBs			-.127*			-.091		
KPIsxCFIxTBs						.156**		
Across Levels of CFI & OCBs								
OCBs				.157***			.167***	
KPIsxOCBs				.179***			.178***	
CFIxOCBs				-.113*			-.118*	
KPIsxCFIxOCBs							-.027	
Across Levels of CFI & CWBs								
CWBs					.014			.057
KPIsxCWBs					-.088			-.084
CFIxCWBs					.134**			.105
KPIsxCFIxCWBs								-.089*
Control=IIS	.254***	.237***	.246***	.201***	.231***	.243***	.204***	.232***
R-Squared	.490***	.519***	.531***	.543***	.526***	.537***	.543***	.530***

Note: p<.01 (***), p<.05 (**), p<.1 (*)

DV = SC Performance

Table 2.9. Point Estimates of Conditional Effects of IIS and KPIs Across Levels of CFI & Workplace Behaviors

	CFI†	CFI & TB	Diff. Test††	CFI†	CFI & OCB	Diff. Test††	CFI†	CFI & CWB	Diff. Test††
<u>IIS</u>									
μ - σ	.1977*	.0424	-.1553**	.1448*	.0243	-.1205**	.1628**	.2730**	11.03*
μ	.3310*	.3310***		.2940***	.2940***		.3305***	.3305***	
μ + σ	.4643*	.7452***	.2809***	.4431***	.6672	.2241***	.4983***	.3102***	-.1181**
<u>KPIs</u>									
μ - σ	.3978*	.2948***	-.1029	.4563***	.2850***	-.1713***	.3932***	.4259***	.0327
μ	.5260*	.5260***		.5574***	.5574***		.5657***	.5657***	
μ + σ	.6542*	.8828***	.2286***	.6585***	.8024***	.1439**	.7383***	.6023***	-.1360**

† Conditional effect across levels of CFI when Behavior=0

†† Test of difference between point estimates across CFI and CFI&Behaviors

Note: p<.01 (***), p<.05 (**), p<.1 (*)

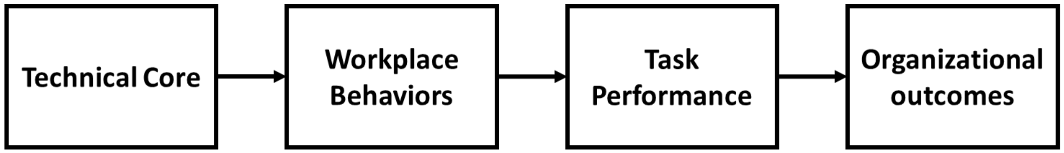

Figure 2.1. Conceptual Model Based on the STS Framework

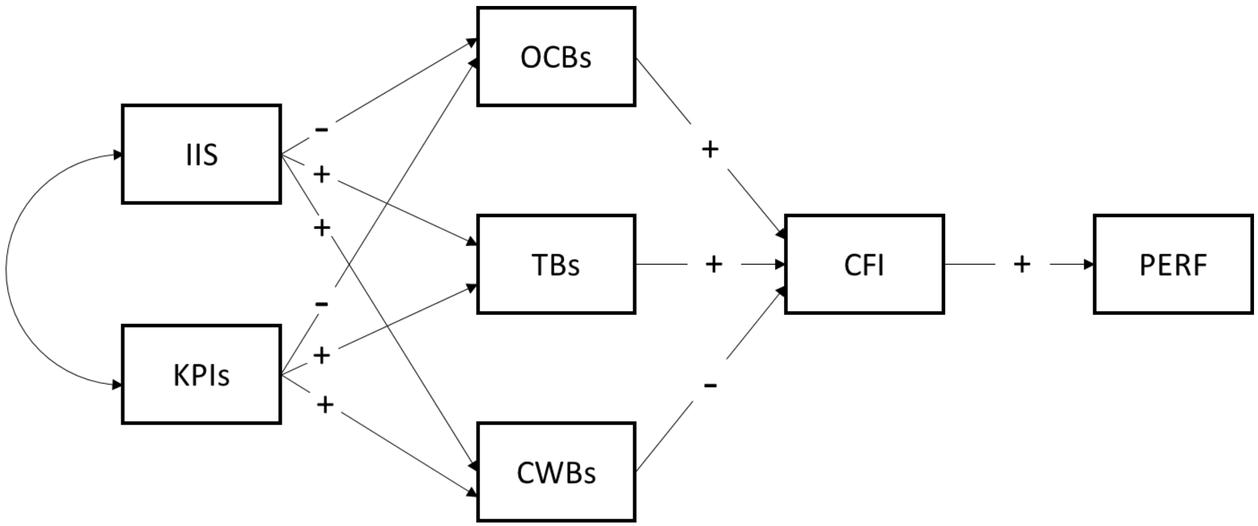

Figure 2.2. Theoretical Model Based on the STS Framework

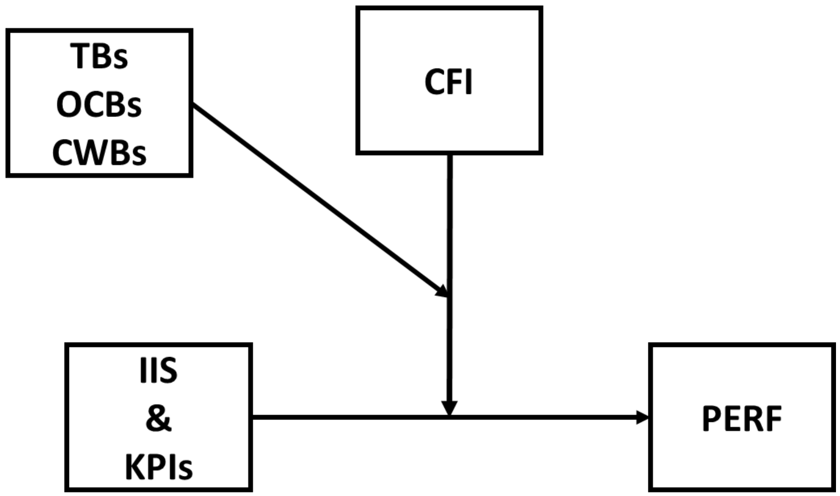

Figure 2.3. Post Hoc Model Based on the SSP Framework

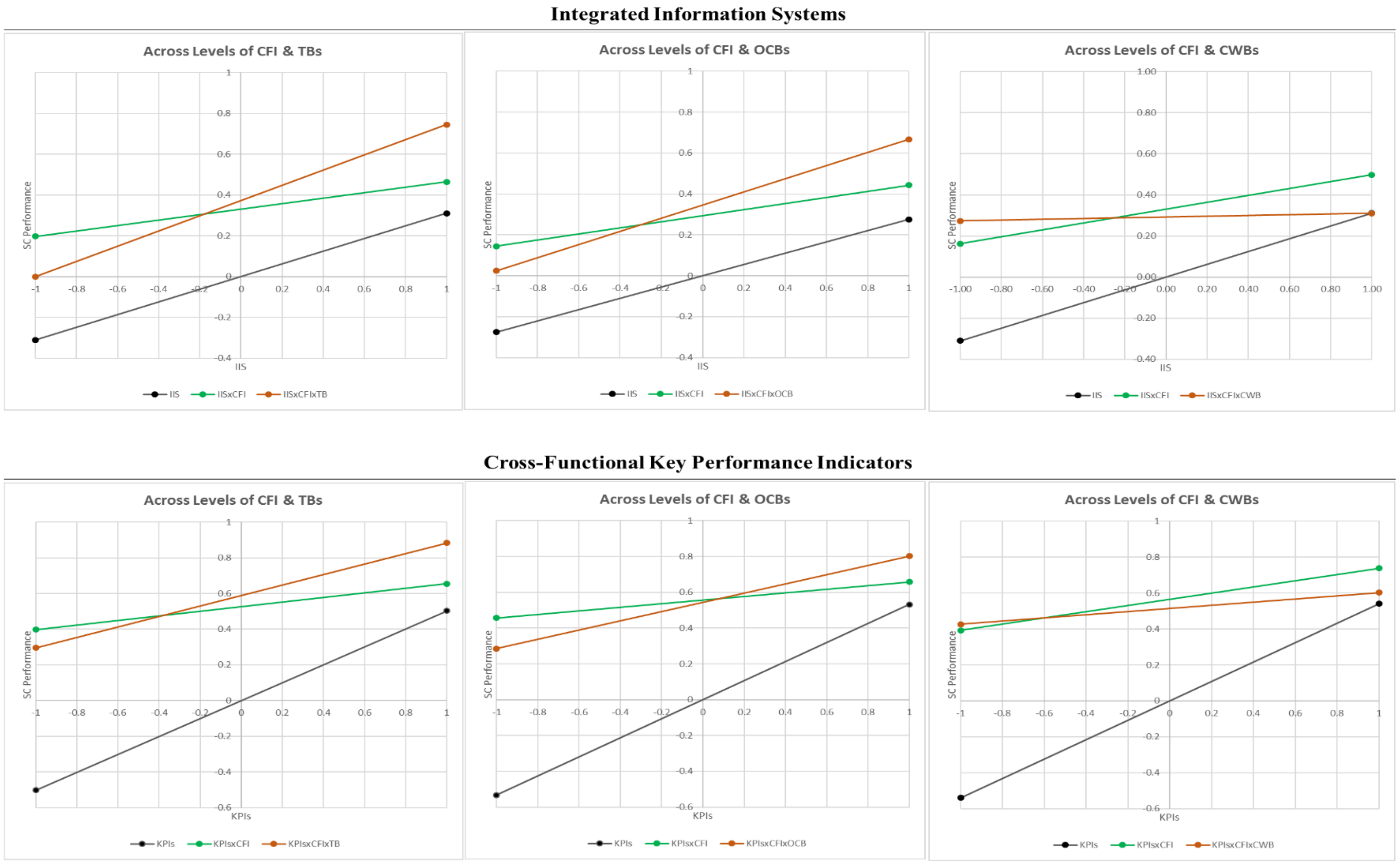

Figure 2.4. Conditional Effects of IIS and KPIs on SC Performance

Appendix B: Survey Questions

Integrated Information Systems

IT_Int_1 … Ensure data stored in different databases are consistent
IT_Int_2 … Ensure key data elements (e.g. customer information, order information, part numbers) are common across our organization
IT_Int_3 … Allow users to search across different data sources

Cross-Functional Key Performance Indicators

Incentives_1 … Encourage people to vigorously pursue cross-functional objectives
Incentives_2 … Reward individuals or groups who accomplish cross-functional objectives
Incentives_3 … Reward performance based on how well we meet cross-functional goals
Incentives_4 … Are based on end-to-end process performance
Metrics_1 … Focus on the flexibility of supply chain processes
Metrics_2 … Stimulate continuous improvement of supply chain processes (rather than just monitoring)

Task Behaviors

TB_1 … Conscientiously perform the tasks that are expected of them
TB_2 … Consistently meet the formal performance requirements of their job
TB_3 … Clearly fulfill the responsibilities specified in their job description
TB_4 … Adequately complete all of their assigned duties
TB_5 … Perform the essential duties of their job

Organizational Citizenship Behaviors

OCB_1 … Make innovative suggestions to improve their department
OCB_2 … Assist their supervisor with his or her work
OCB_3 … Orient others although it is not required at work
OCB_4 … Help others when they have a heavy workload
OCB_5 … Volunteer for things at work that are not required
OCB_6 … Help others who have been absent

Counterproductive Work Behaviors

CWB_1 … Publicly embarrass someone at work
CWB_2 … Say something hurtful to someone at work
CWB_3 … Make an ethnic, religious, or racial remark at work
CWB_4 … Make fun of someone at work
CWB_5 … Act rudely toward someone at work
CWB_6 … Curse at someone at work

Cross-Functional Integration

Collab_1 … Jointly establish the overarching goals that direct our individual functional activities
Collab_2 … Make sure there is joint agreement on supply chain goals
Collab_3 … Engage constructively in debates about the goals of the supply chain (dropped)
Collab_4 … Ensure an open and transparent process for establishing common goals
Collab_5 … Establish a regular process for reviewing joint supply chain goals
Collab_6 … Support other functions in achieving common goals
Collab_7 … Adjust goals and objectives to reflect constraints faced by different functions

Coord_1 … Actively manage lead-times across functions
Coord_2 … Ensure that functional activities are synchronized across the supply chain
Coord_3 … Jointly manage interdependencies across supply chain functions
Coord_4 … Make sure everyone is focused on process optimization rather than achieving separate functional goals
Coord_5 … Make sure functional decisions do not conflict with each other
Coord_6 … Make sure functional areas see themselves as part of a larger overall process

Comm_1 … Make sure relevant information gets to the right people in different areas of the supply chain
Comm_2 … Keep key players in different functions informed about what's going on
Comm_3 … Make sure everyone understands what information needs to be communicated out to different functional areas
Comm_4 … Make sure information that is being communicated is useful to those on the receiving end
Comm_5 … Make sure everyone understands how information is used in different areas of the supply chain
Comm_6 … Make sure those on the receiving end understand why they are getting the information that they are getting

Supply Chain Performance

Perf_1 … Inventory costs
Perf_2 … Total supply chain costs
Perf_3 … Unit cost of manufacturing
Perf_4 … Inventory turns per year
Perf_5 … Finished goods inventory
Perf_6 … Forecasting accuracy
Perf_7 … Total inventory turns

Organizational Reporting Structure

Org_1 … Creates formal lines of authority that cross functional boundaries
Org_2 … Requires people to interact across functional boundaries
Org_3 … Officially designates people as members of both functional and cross-functional teams
Org_4 … Organizes reporting relationships around products, lines of business, or processes
Org_5 … Creates what could be best described as a matrix organizational structure
Org_6 … Creates both vertical and horizontal lines of authority

Appendix C: Inter-item Correlation Matrix

		CFI			TBs					OCBs						CWBs						ITS			KPIs						PERF						
		COLLAB	COORD	COMM	TB_1	TB_2	TB_3	TB_4	TB_5	OCB_1	OCB_2	OCB_3	OCB_4	OCB_5	OCB_6	CWB_1	CWB_2	CWB_3	CWB_4	CWB_5	CWB_6	IT_Int_1	IT_Int_2	IT_Int_3	Incent_1	Incent_2	Incent_3	Incent_4	Metrics_1	Metrics_2	Perf_1	Perf_2	Perf_3	Perf_4	Perf_5	Perf_6	Perf_7
	COLLAB	1																																			
CFI	COORD	0.767	1																																		
	COMM	0.778	0.833	1																																	
	TB_1	0.404	0.433	0.439	1																																
	TB_2	0.386	0.413	0.419	0.608	1																															
TBs	TB_3	0.399	0.427	0.433	0.628	0.599	1																														
	TB_4	0.399	0.427	0.433	0.628	0.6	0.62	1																													
	TB_5	0.373	0.399	0.405	0.587	0.561	0.579	0.58	1																												
	OCB_1	0.332	0.356	0.361	0.396	0.377	0.39	0.39	0.365	1																											
	OCB_2	0.304	0.326	0.331	0.362	0.346	0.358	0.358	0.334	0.564	1																										
OCBs	OCB_3	0.32	0.343	0.347	0.381	0.364	0.376	0.376	0.351	0.593	0.543	1																									
	OCB_4	0.329	0.352	0.357	0.391	0.373	0.386	0.386	0.361	0.609	0.558	0.587	1																								
	OCB_5	0.333	0.356	0.361	0.396	0.378	0.391	0.391	0.366	0.617	0.565	0.594	0.61	1																							
	OCB_6	0.324	0.347	0.352	0.386	0.368	0.381	0.381	0.356	0.6	0.55	0.578	0.594	0.601	1																						
	CWB_1	-0.144	-0.154	-0.156	-0.236	-0.225	-0.233	-0.233	-0.22	-0.11	-0.101	-0.106	-0.109	-0.111	-0.108	1																					
	CWB_2	-0.146	-0.157	-0.159	-0.24	-0.229	-0.237	-0.237	-0.22	-0.11	-0.103	-0.108	-0.111	-0.113	-0.11	0.803	1																				
CWBs	CWB_3	-0.128	-0.137	-0.139	-0.21	-0.201	-0.207	-0.207	-0.19	-0.1	-0.09	-0.095	-0.097	-0.098	-0.096	0.702	0.714	1																			
	CWB_4	-0.139	-0.149	-0.151	-0.228	-0.217	-0.225	-0.225	-0.21	-0.11	-0.098	-0.103	-0.105	-0.107	-0.104	0.761	0.775	0.677	1																		
	CWB_5	-0.142	-0.152	-0.155	-0.234	-0.223	-0.231	-0.231	-0.22	-0.11	-0.1	-0.105	-0.108	-0.109	-0.107	0.781	0.794	0.694	0.753	1																	
	CWB_6	-0.129	-0.138	-0.14	-0.213	-0.203	-0.21	-0.21	-0.2	-0.1	-0.091	-0.096	-0.098	-0.099	-0.097	0.71	0.722	0.631	0.684	0.702	1																
	IT_Int_1	0.516	0.552	0.56	0.41	0.391	0.405	0.405	0.378	0.365	0.334	0.351	0.361	0.365	0.356	-0.143	-0.146	-0.128	-0.138	-0.142	-0.129	1															
ITS	IT_Int_2	0.475	0.508	0.516	0.378	0.36	0.372	0.373	0.348	0.336	0.308	0.323	0.332	0.336	0.327	-0.132	-0.134	-0.117	-0.127	-0.131	-0.119	0.678	1														
	IT_Int_3	0.455	0.488	0.495	0.362	0.345	0.357	0.357	0.334	0.322	0.295	0.31	0.319	0.323	0.314	-0.127	-0.129	-0.113	-0.122	-0.125	-0.114	0.65	0.598	1													
	Incent_1	0.503	0.538	0.546	0.393	0.375	0.388	0.388	0.363	0.351	0.322	0.339	0.348	0.352	0.343	-0.127	-0.129	-0.113	-0.122	-0.125	-0.114	0.503	0.463	0.444	1												
	Incent_2	0.451	0.483	0.49	0.352	0.336	0.348	0.348	0.325	0.315	0.289	0.303	0.312	0.316	0.307	-0.114	-0.116	-0.101	-0.11	-0.112	-0.102	0.451	0.415	0.398	0.651	1											
KPIs	Incent_3	0.468	0.501	0.508	0.366	0.349	0.361	0.361	0.337	0.327	0.3	0.315	0.324	0.328	0.319	-0.118	-0.12	-0.105	-0.114	-0.117	-0.106	0.468	0.431	0.414	0.675	0.605	1										
	Incent_4	0.431	0.462	0.469	0.337	0.322	0.333	0.333	0.311	0.302	0.276	0.29	0.298	0.302	0.294	-0.109	-0.111	-0.097	-0.105	-0.108	-0.098	0.432	0.398	0.381	0.623	0.558	0.579	1									
	Metrics_1	0.381	0.408	0.414	0.298	0.284	0.294	0.294	0.275	0.266	0.244	0.256	0.264	0.267	0.26	-0.096	-0.098	-0.085	-0.093	-0.095	-0.086	0.381	0.351	0.337	0.55	0.493	0.512	0.472	1								
	Metrics_2	0.408	0.437	0.443	0.319	0.304	0.314	0.315	0.294	0.285	0.261	0.275	0.282	0.286	0.278	-0.103	-0.105	-0.091	-0.099	-0.102	-0.092	0.408	0.376	0.36	0.589	0.528	0.548	0.505	0.446	1							
	Perf_1	0.332	0.355	0.36	0.283	0.27	0.279	0.279	0.261	0.293	0.268	0.282	0.29	0.293	0.286	-0.089	-0.091	-0.079	-0.086	-0.088	-0.08	0.37	0.341	0.327	0.408	0.366	0.38	0.35	0.309	0.331	1						
	Perf_2	0.336	0.36	0.365	0.287	0.274	0.283	0.283	0.265	0.297	0.272	0.286	0.294	0.297	0.289	-0.09	-0.092	-0.08	-0.087	-0.089	-0.081	0.375	0.345	0.331	0.413	0.37	0.385	0.355	0.313	0.335	0.597	1					
	Perf_3	0.321	0.344	0.348	0.274	0.261	0.27	0.27	0.253	0.283	0.26	0.273	0.28	0.284	0.276	-0.086	-0.088	-0.077	-0.083	-0.085	-0.078	0.358	0.33	0.316	0.395	0.354	0.367	0.339	0.299	0.32	0.57	0.578	1				
PERF	Perf_4	0.327	0.35	0.355	0.279	0.266	0.275	0.275	0.257	0.289	0.265	0.278	0.286	0.289	0.282	-0.088	-0.09	-0.078	-0.085	-0.087	-0.079	0.365	0.336	0.322	0.402	0.36	0.374	0.345	0.305	0.326	0.581	0.589	0.562	1			
	Perf_5	0.304	0.326	0.331	0.26	0.248	0.256	0.257	0.24	0.269	0.246	0.259	0.266	0.269	0.262	-0.082	-0.083	-0.073	-0.079	-0.081	-0.074	0.34	0.313	0.3	0.375	0.336	0.349	0.321	0.284	0.304	0.541	0.548	0.524	0.534	1		
	Perf_6	0.312	0.334	0.339	0.266	0.254	0.263	0.263	0.246	0.275	0.252	0.265	0.273	0.276	0.269	-0.084	-0.085	-0.075	-0.081	-0.083	-0.075	0.348	0.32	0.307	0.384	0.344	0.357	0.329	0.291	0.311	0.554	0.562	0.536	0.546	0.509	1	
	Perf_7	0.32	0.342	0.347	0.273	0.26	0.269	0.269	0.252	0.282	0.259	0.272	0.279	0.283	0.275	-0.086	-0.088	-0.076	-0.083	-0.085	-0.077	0.357	0.328	0.315	0.393	0.352	0.366	0.337	0.298	0.319	0.568	0.576	0.55	0.56	0.522	0.534	1

CONCLUSION

The impact of supply chain research rests on the ability of scholars to (1) precisely define and measure phenomena of interest and (2) credibly establish their relationship to managerially relevant outcomes. This research sought to advance scholarship in the area of CFI on both fronts.

Study 1 provided precise definitions of CFI and its underlying dimensions that are deeply rooted in the supply chain research. By defining CFI as on-going process in which different functional areas of the supply chain collaborate, coordinate, and communicate to maximize outcomes for their organization, Study 1 synthesized dominant perspectives in the literature and provided for a comprehensive understanding of the concept. Study 1 then employed a rigorous process for developing and validating a measure of CFI that can be used by future researchers. This process yielded a valid set of 19 scale items that capture the conceptual domain of the CFI concept as defined by its sub-dimensions. Based on the samples used in the study, it was suggested that CFI is most appropriately modeled as a second order construct with collaboration, coordination, and communication constructs acting as first order indicators. Definitions and measures were clearly embedded in a supply chain context, maximizing their relevance for theory development and testing within the domain of supply chain management (Stank et al. 2016).

Study 2 focused on clarifying the relationships among structural and behavioral factors related to CFI and investigated the impact of these relationships on supply chain performance. Analysis suggested that the impact of IIS and KPIs on performance was substantially enhanced as CFI processes were put into place. Additional benefits were also seen as workplace behaviors related to task execution and improving the overall social environment increased. Conversely, the benefits of CFI were reduced or eliminated by negative behaviors that harm interpersonal

relationships. In demonstrating these relationships, Study 2 provided generalizable evidence in support qualitative studies that had previously investigated the impact of workplace behaviors on CFI. Moreover, it extended these earlier studies by identifying clear categories behaviors (TBs, OCBs, and CWBs) that impact supply chain structures, processes, and performance in different ways. Finally, Study 2 laid the groundwork for middle-range theorizing aimed at contextualizing the variables and relationships within the domain of supply chain management in order to enhance understanding of conditions under which these phenomena impact outcomes as well as the specific mechanisms through which such outcomes are generated.

In addition to the contributions noted above, this research suggested several implications for supply chain managers. Viewing CFI as a set of interrelated processes focused on goals, activities, and information sharing can provide practitioners with a useful conceptual framework for articulating the central "problems" of integration for themselves and their organizations. Moreover, the measures developed in Study 1 can be used as a tool to assess the level of integration in supply chain organizations. Results from Study 2 suggested that understanding the role of CFI and workplace behaviors provides managers with options as they attempt to improve the performance of their supply chain organizations. Given the challenges associated with implementing new IIS and KPIs, supply chain managers might choose to enhance the performance impact of existing systems by developing robust CFI processes. In addition, managers may seek to improve the ability of their supply chain organizations to overcome the limits of existing systems by encouraging positive interpersonal interactions and limiting negative workplace behaviors. Focusing on CFI and workplace behaviors places necessary organizational changes more clearly within the locus of control of most supply chain managers and may serve to set the stage for more

substantial changes to organizational structures, perhaps even improving the chances for success in these initiatives.

Finally, both studies suggested that additional research in the area of workplace behaviors and CFI is needed. In particular, researchers interested in the impact of supply chain professionals' workplaces behaviors should look to develop definitions and measures of such behaviors that are clearly contextualized within supply chain management, so as to maximize their relevance for theory development and testing within the supply chain domain. Initial efforts in this regard have been undertaken, but more work is needed. Overall, the results of this research suggested that CFI remains an important factor in successful supply chain management and that workplace behaviors play an important role in influencing supply chain outcomes. Thus, CFI and workplace behaviors appear to be a fruitful areas of investigation for future researchers.

VITA

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