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# Micro-Foundations of Supply Chain Integration: An Activity-Based Analysis

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**Abstract:** A large body of literature has studied supply chain integration (SCI) at the macro (firm or dyad) level. However, the micro-foundations of SCI that highlight the range of different activities and choices firms have in implementing integration have not been studied. This paper identifies and analyzes integrative activities or practices that form the micro-units of firm-level SCI. Qualitative analysis yields nine elements of integration that emerge from the large number of integrative practices. In doing so, the paper maps out the structure of the broad SCI construct and discusses the theoretical repercussions of this new approach. New theoretical insights and research directions are identified based on this new micro-level activity-based view of SCI. This paper shifts the focus from where integration is done (customer vs. supplier integration) to what integration entails. SCI has become a very broad construct over time. This paper is a significant and systematic step in unraveling the structure of this broad conceptual domain. It improves nascent ideas about the multiple dimensions of integration by identifying elements based on a comprehensive list of different integrative activities that firms undertake.

**Keywords:** supply chain integration; supply chain relationship management; theory development

## 1. Introduction

Firms are increasingly relying on collaboration with their supply chain partners to be competitive [1]. Supply-chain integration (SCI) research has shown that firms can create superior value by partnering with key suppliers and customers rather than using purely transactional or auction based mechanisms [2–4]. SCI is so fundamental to the study of supply chains that several authors have defined supply chain management (SCM) in terms of integration [5,6]. Over time firms have started to establish a large number of collaborative activities with their supply chain partners [7] which has increased the breath of the SCI concept manifold. This has necessitated looking at the micro-foundations of integration that are comprised of the detailed processes and practices that constitute day-to-day activities in supply chain management [8,9]. Analyzing micro practices and activities that make up integration can enable greater insight into why, when, and how integration enables greater performance. In the strategy literature, focusing on low level routines and processes rather than higher level capabilities has yield new insights [10]. Ray et al. [11] acknowledge that "Activities, routines, and business processes are the mechanisms through which resources and capabilities get exposed to market processes where their ultimate value and ability to generate

competitive advantage are realized." In the same spirit, we focus on integrative practices to shed grater light on how integration works in supply-chain relationships. An integrative practice, in the supply chain context, is a shared activity or process that involves personnel, data, or resources in both the buyer and supplier firms. Integrative practices are the micro-units of SCI that we examine in this paper, in contrast to traditional SCI studies that focus on the high level constructs of customer and suppler integration [12,13].

To address the increased breath of the SCI concept, some authors have taken a multi-dimensional view of SCI [14–16]. However, there have been no attempts to systematically map out the entire conceptual domain of SCI using more micro units such as integrative practices. Without a systematic study of what constitutes SCI, researchers will either be left with an outdated unidimensional view or a multi-dimensional view used in a specific study that may not be sufficient for other studies. A thorough exploration of what SCI entails at the micro activity level is much needed to understand the various ways firms can implement and benefit from SCI.

Increasingly, researchers are pointing out limitations of the macro SCI construct, due to ambiguity in what it represents [8,9,17–19]. These studies call for a review of the SCI concept and identification of its important micro-components [8,9]. This paper seeks to bring greater clarity to the SCI literature by studying the following fundamental questions: What are the micro-units, integrative practices, that comprise SCI? Does a structure of the macro SCI construct emerge from an analysis of these micro-practices? What are the theoretical implications of this new approach to SCI? We find that 140 integrative practices comprise SCI and form its micro-foundations. This large number of practices is part of the reason why SCI can mean very different things to different researchers and practitioners [1]. Since managers work at the micro-level, they need make decisions about integrative practices in particular supply-chain relationships [20]. Thus, understanding the complementarities and differences between these practices is of great practical importance.

In addition to identifying 140 integrative practices, qualitative analysis is used to identify the groupings of these practices that may reflect sub-constructs of SCI. These groupings are termed elements of integration, and they lead to a more fine-grained understanding of how SCI operates in supply-chain relationships. The discussion section focuses on the theoretical implications of analyzing the micro-foundations of SCI and how it can resolve some of the limitations of existing literature. The approach of this study is similar to that of Shah and Ward [21] who used a large body of existing literature to clarify and improve the micro-constructs that comprise lean production.

The contribution of this paper is of three types: (1) we map out the SCI conceptual space by identifying a comprehensive list of integrative practices, (2) we identify groupings of integrative practices (elements of integration) at the relationship level that capture different aspects of SCI; and (3) we show how our analyzing the micro-units of SCI ameliorates limitations of existing work and contributes to SCI theory. Our work is timely and relevant because several reviews of SCM literature have called for efforts to synthesize research findings that are based on different conceptualizations of SCI [8,9,22]. Our analysis of inter-firm integrative practices, that form the micro-foundations of SCI, provides such a synthesis as it lays out a structure that maps out the SCI conceptual domain and shows how studies that use different operationalizations of SCI fit together. In addition, we improve the relevance of SCI research to practitioners by identifying a comprehensive yet parsimonious "menu" of nine elements of integration. Managers can make combinations of these elements to have a different form of integration in each supply-chain relationship. Such an approach towards selective SCI is promising as some studies have indicated that selective integration can outperform broad-based integration [20].

The paper is structured as follows: In Section 2 we provide a review existing literature to identify a comprehensive list of integrative practices that comprise SCI. The qualitative analysis process used to identify and define the new elements of integration is explained in Section 3. In Section 4 we show how our elements of integration view advances our understanding of inter-firm integration. Section 5 concludes with the limitations of this study.

## 2. Identifying Integrative Practices

In order to determine what integrative practices constitute SCI, we needed to create a comprehensive list of such practices that firms implement in their SC relationships. An important source of these integrative practices is the operationalizations of integration constructs by empirical papers. In empirical studies, authors devise a list of questions that measure the level of integration of a firm on a list of integrative practices. The list of integrative practices is identified by relying on past literature, as well as interviews with groups of practitioners and researchers who are knowledgeable about the subject [23]. Each empirical paper provides a small sample of all possible integrative practices. By combining these smaller samples used in individual studies a comprehensive list of integrative practices can be created.

A literature review is a useful method to summarize the conceptual space and operationalization of a construct, when a significant body of research exists [21]. Our methodological approach in selecting articles for review is similar to that of Parmigiani and Rivera-Santos [24] because we focus on existing literature reviews and papers from top journals. Bibliographies of existing literature reviews are an important source of relevant papers as chosen by other authors. Using bibliographies chosen by others reduces any researcher specific bias. Secondly, to complement those bibliographies, we select articles from top empirical journals in the field, as we believe the strict review process at such journals ensures quality. The literature review process is illustrated in Figure 1.

We started by examining the bibliographies of 11 relevant literature reviews published since 2000. These literature reviews were identified by searching for literature reviews on buyer-supplier relationships (BSRs), SCI, or supply chain management. We found 684 references in the bibliographies of the 11 literature review papers listed in Table S2 in Supplement A [7–9,12,17,22,25–29].

We then selected the Journal of Operations Management and the Journal of Supply Chain Management to search for papers on SCI and BSRs. These journals have the highest impact factors amongst journals that publish empirical papers on the topics relevant to our research and are broadly recognized for publishing high quality empirical work [28]. We searched for papers that had the terms "supply chain integration" or "buyer supplier relationship" in the paper and that were published between 2000 and 2018 in the selected journals. This led to a list of 321 papers. The search engine ABI/Inform was used to search for papers, and the search results were verified using Google Scholar.

We examined each of the 1005 papers (684 + 321) to select empirical papers that provided a list of integrative practices. For all articles in the search result the abstract was examined to determine if the paper related to integration, collaboration or buyer-supplier relationships. For all papers on relevant topics the entire paper was downloaded and checked for measurement of any integration related construct using a list of integrative practices. This led to a list of 127 relevant papers. The integrative practices found in these papers were copy pasted into an Excel sheet. Duplicate practices were removed as new practices were added. We found 140 different integrative practices in these 123 papers. As a check to ensure our list was comprehensive and representative, we picked an additional journal and repeated the process to see if we would discover additional integrative practices. We did the same search with the International Journal of Production Economics and found 103 papers in the search results. From these we identified 28 empirical papers out of which two were already part of our review and 26 were new. We did not find any new integrative practices in these 17 papers. This check provides credence that we have identified the commonly used integrative practices in supply chains. Table 1 shows the journal representation of our total sample of (127 + 26) 153 articles used to build the list of integrative practices.

Table S1 in Supplement A lists the empirical papers used to make the list of integrative practices. The complete list of 140 integrative practices is given in Table S3 in Supplement A.

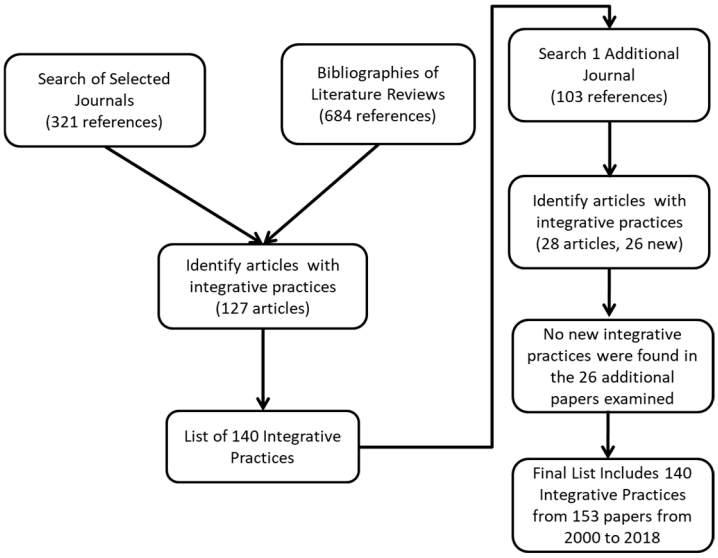


**Figure 1.** Process to create a comprehensive list of integrative practices.

**Table 1.** Journal sources of the articles in the literature review.

| Journal Name | Count |
|---|---|
| Journal of Operations Management | 49 |
| International Journal of Production Economics | 31 |
| Journal of Supply Chain Management | 16 |
| International Journal of Operations & Production Management | 11 |
| Decision Sciences | 7 |
| Industrial Marketing Management | 7 |
| Journal of Business Logistics | 6 |
| International Journal of Production Research | 3 |
| Journal of Business Research | 3 |
| Others | 20 |
| Total | 153 |

The long list of 140 integrative practices agrees with Terpend et al.'s [7] finding who showed that from 1986 to 2005 the number and variety of integrative practices studied in the literature increased. Recent studies have added new practices to the same constructs resulting in the constructs getting broader in scope. Figure 2 shows a word cloud of these integrative practices, with the size of each word proportional to its frequency of occurrence.

Existing studies have not measured integration consistently. Studies pick and choose their own unique combinations of integrative practices to measure integration, making comparing research findings difficult [8]. The numerous integrative practices studied as SCI are qualitatively different. For example, information sharing has very different requirements in terms of costs and requisite trust as well as very different objectives and benefits than joint new product development [30]. Bundling such different practices in the same construct reduces precision, interpretability of results, generalizability and practical application. Fabbe-Costes and Jahre also highlight this issue and state that "it is [...] difficult to provide managers with normative advice over how and what to integrate, the cost of integration, and its possible negative consequences" [26].


**Figure 2.** World cloud of the 140 integrative practices.

## 3. Theoretical Development

In this section a systematic process is followed to identify the structure of SCI. The list of integrative practices identified from the previous step are used as an empirical dataset that represents the micro-units of the broad SCI concept.

### *3.1. Defining Inter-Firm Supply Chain Integration*

Analysis of the integrative practices collected from different papers must be guided be a clear definition of what inter-firm integration is. A review of the literature reveals several definitions of integration in the supply chain context focusing on collaboration and integration of processes [2,12,31]. Past critiques of the integration literature have been vocal to suggest that different types and levels of integration may be practiced in different buyer-supplier relationships [8,18,32]. To capture this notion, we define inter-firm integration in the context of two supply chain partners. Examination of the operationalizations of the SCI construct in existing studies makes it clear that the term SCI is generally used in the literature to describe various supply-chain integrative practices. An example of an integrative practice is joint forecasting, in which personnel from both firms come together to create forecasts that drive production plans. Thus, based on the analysis of the existing literature, we define inter-firm integration in terms of supply-chain integrative practices as follows:

1. A supply-chain integrative practice is a shared activity between a buyer firm and a supplier firm, with the aim of creating greater value for both firms than what could be achieved without such joint action.
2. A shared activity is one in which each supply chain partner has to do some share of the tasks. A recurring activity is also called a process.
3. A buyer-supplier dyad's level of integration can be determined based on the use of supply-chain integrative practices.

We use value in the same way it is used in strategy literature and in the resource-based theory (RBT), that is value is the difference between what the end customer of the buyer-supplier dyad is willing to pay and the total economic cost of the good or service produced [33].

This definition distinguishes the SCI concept from unilateral supply management decisions of the focal firm, such as deciding to source each component from two suppliers or top management focus on supplier integration. It distinguishes SCI from some aspects of purchasing; for example, having a strategic orientation to purchasing does not necessarily mean integrated buyer-supplier dyads. A firm with a strategic orientation to purchasing may still have many transactional relationships. It defines the scope of the construct to be between two firms, a buyer and a supplier, (i.e. inter-firm SCI is a dyad level construct) so the confusion regarding integration being the average of a group of supply-chain relationships is resolved. The distinction between supplier and customer integration is removed by defining inter-firm SCI to be a dyadic construct.

### *3.2. Qualitative Analysis for the Integrative Practices*

We used the 140 supply chain practices identified in the literature review as an empirical data set. Qualitative analysis was used to discover the underlying constructs. We followed the guidelines of Miles and Huberman [34] in analyzing textual data. The steps followed are illustrated in Figure 3 below.

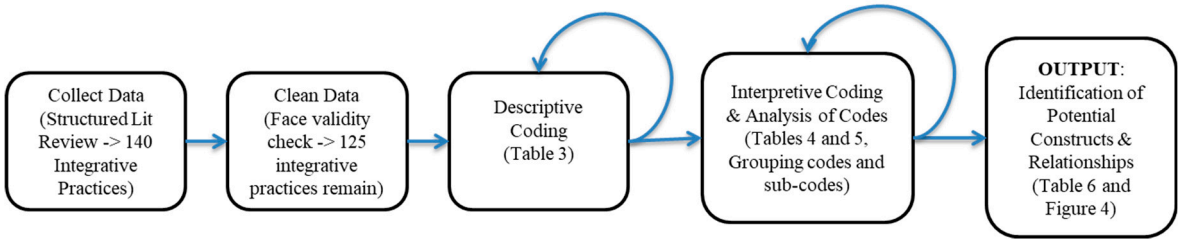


**Figure 3.** Qualitative analysis steps.

After the data had been collected in the structure literature review phase, the data was cleaned by checking all the integrative practices for face validity. The face validity check compared the integrative practices with our definition of inter-firm integration. Practices that were unilateral decisions of one firm were discarded, as they do not represent integration between two firms. For example, a firm's decision to select suppliers based on quality rather than price would not be integration as it is a unilateral policy decision of the buyer. This initial cleanup based on face-validity of the practices reduced the list to 125 practices.

Miles and Huberman [34] recommend that after collecting and cleaning the data, the next step is to code the data using descriptive codes. This coding summarizes the data; and using an inductive approach to develop the codes lets the data speak for itself. The next step is more interpretive in which pattern codes are found. Pattern codes capture "sets, themes, or constructs" in the data [34]. We generated descriptive codes using a grounded or inductive approach [34,35]. The advantage of this approach is that it does not bias the researcher to existing views and expectations about the data. It also lets the data speak on its own terms as otherwise data can often be forced to fit a preconceived set of codes.

Each practice was examined by considering (1) what activities were being done and (2) what were the objectives of doing those activities. This allowed us to group together similar practices. Table 2 shows the codes that emerged from the first pass of coding and the number of practices coded with each code. If a practice seemed applicable to more than one code it was assigned multiple codes, which is why the total in column 3 of Table 2 exceeds 125. As we describe next, these first pass codes were subjected to several rounds of refinement and validation. Two researchers did the coding. After each round of coding results were compared and any discrepancies resolved through discussion and mutual agreement.

**Table 2.** Codes that emerge from first pass of descriptive coding.

| Codes (High Level) | Description | Number of Practices Coded |
|---|---|---|
| COMM-HOW | Communication How: Communication is broad term that captures sharing intangible resources. How refers to modes of communication, for example EDI, and face to face meetings. | 25 |
| COMM-WHAT | Communication What: Communication is broad term that captures sharing intangible resources. What refers to what type of information and knowledge is shared. | 65 |
| RES-SHARE | Sharing Tangible Resources: Captures sharing and pooling together physical resources. | 12 |
| BUS-PRATICES | Business Practices: Various business practices that involve of buyer and supplier firms working together. | 68 |
| LT-ORIENT | Long-Term Orientation: Long-term collaborative arrangements or types of collaboration that suggest long-time horizon | 15 |

A second pass of descriptive coding was done by examining each group from Table 2 and coding the practices in that group using more descriptive codes. Again, the same method was followed where the practices were examined and codes generated to reflect similar practices with similar business objectives. The results of the second round of descriptive coding are shown in Table 3.

Examination of the data after the second pass of descriptive coding revealed no new descriptive codes. This indicated that we had described the data on its own terms. Before proceeding to the next more interpretive stage of finding pattern codes we reviewed and revised the codes to check for redundancy and duplication [34]. We examined all the codes and the practices in them and found two instances where codes were duplicating what had already been captured in other codes. The first instance was the COMM-HOW code as all the practices under COMM-HOW were also assigned other more appropriate codes as well. Each integrative practice requires an appropriate communication mechanism that is suitable for it. In that sense the communication medium employed is an attribute of the integrative practice and not another type of integrative practice by itself. Conceptually COMM-HOW should be treated as an attribute of integrative practices and not a separate integrative practice by itself. Thus, we removed COMM-HOW from further analysis. This did not result in any of the practices being dropped as all practices coded as COMM-HOW also had other codes assigned to them. The second instance was that of the Teams codes under Business Practices. Just like COMM-HOW, teams are a communication and collaboration mechanism that is often employed by many types of integrative practices [36]. It is an attribute of some integrative practices that require close collaboration with face-to-face communication. Thus, all of the Teams codes (Teams-P and C, TeamsNPD, TeamsOpsImp) were removed for reasons similar to the instance of COMM-HOW. Removing these codes resulted in only eight practices out of 125 getting dropped as these eight practices were not assigned to any other code. These dropped practices were only measuring the communication mechanism being used without providing any information about the type of collaborative activity being done.

We then proceeded to the next stage of finding patterns or leitmotivs. Pattern codes are "explanatory or inferential codes, ones that identify an emergent theme, configuration or explanation" [34]. This stage is more interpretive where the researcher must move from the descriptive codes to the underlying constructs [34]. We make use of data displays to map the descriptive codes along various dimensions related to integration to identify the inter-relationships between the codes. An important part of this stage is "unfreeze and reconfigure" [34] codes as constructs and relationships between them emerge. We examined the descriptive codes by creating data displays using tables to see if they exhibited any patterns.

**Table 3.** Codes from further descriptive coding.

| Code | Description | Number of Practices |
|---|---|---|
| COMM-HOW | Communication How | |
| F2F | High Level Face to Face Communication, such meetings, facility visits | 13 |
| CompMed | Computer Mediated Communication: use of emails, IT systems, EDI, and electronic information sharing | 9 |
| CommFreq | Communication Frequency: ensuring frequent and timely communication | 6 |
| Teams | Using Inter-organizational Teams | 9 |
| COMM-WHAT | Communication What | |
| PerfFeedback | Sharing performance assessments and providing feedback | 24 |
| OpsComm | Operational (day-to-day) communication to coordinate material flows and manage production and logistics related processes | 34 |
| KnowComm | Sharing knowledge | 11 |
| NPDComm | Communication related to new product development (NPD) | 2 |
| StratComm | Long-term sensitive and strategic communication | 26 |
| RES-SHARE | Sharing tangible resources | |
| Fin&Tech | Providing financial and technological support | 6 |
| LogRes | Sharing logistics related resources, such as shipping containers. | 6 |
| BUS-PRACTICES | Business practices | |
| P and C | Planning and control of logistics, material flows, and manufacturing related activities | 26 |
| JIT-Lean | JIT and lean related practices that involve supply-chain partners | 6 |
| Quality-CI | Quality and continuous improvement activities that involve supply-chain partners | 22 |
| NPD | Jointly conducting new product development (NPD) | 8 |
| Teams-P and C | Use of teams for planning and control | 7 |
| Teams-NPD | Use of Teams for new product development | 5 |
| Teams-OpsImp | Use of Teams for operational improvement | 11 |
| LT-ORIENT | Long-term orientation | |
| CollabOrient | Maintaining and strengthening collaborative orientation and a long-term relationship perspective | 9 |
| StratPlan | Strategic planning with supply-chain partners | 8 |

As a first cut at identifying pattern codes, we wanted to see which theoretical perspectives were represented by the codes. The theoretical perspectives regularly used in the SCI literature are: system dynamics, the extended resource based view (eRBV) [12,37,38] along with the relational view [39], transaction cost economics (TCE) [40], and the knowledge-based view (KBV) [41,42]. We briefly discuss how these theoretical perspectives underscore the need for shared processes to improve supply chains. A more detailed discussion of how these theoretical perspectives apply to our work is presented in Supplement B to avoid digressing from the qualitative analysis here.

In a supply chain the company closest to the end consumer caters to the fundamental demand for the product or service. Upstream firms face derived demand that comes from the inputs required by downstream firms. The system dynamics view shows that if firms that comprise a supply chain work independently using only market-based transactions then they will perform sub-optimally. According to system dynamics, supply chain partners must implement inter-organizational (shared) processes to effectively manage end-customer orders. Processes related to production planning, inventory management, and logistics of all supply chain partners are linked by their goal of serving the end-customer demand. If these processes are not managed in a shared manner then the outcomes will be sub-optimal [43,44].

The extended RBV shows that firms can improve performance and achieve better outcomes by accessing resources and capabilities of inter-linked firms [39]. In a supply-chain context this theory implies that developing shared processes that allow firms to access the information, knowledge, capabilities, and resources (such as logistics resources) of supply chain partners will lead to superior outcomes [45]. Thus, supply-chain partners should implement processes that identify and exploit synergies from sharing of resources and capabilities. Examples of such processes include supplier involvement in new product development and developing shared forecasts by pooling all of the information available to different supply chain partners.

Transaction cost economics is fundamentally about explaining the choice between make (hierarchy) and buy (market) decisions, based on governance costs. In the supply chain context it leads to processes that create shared resources, or specialized resources for the relationship as such resources reduce the threat of opportunism, build trust, and reduce transaction costs [40]. It also leads to a long-term orientation and joint strategic planning processes that tie the firms together with mutual dependence and reduce the threat of opportunism.

The knowledge-based view (KBV) treats the firm as an institution for acquiring, integrating and exploiting knowledge [46]. In the supply chain context KBV leads to processes for the sharing and creation of knowledge collaboratively by the buyer and supplier [41,47]. Processes that incorporate suppliers early in the new product development efforts lead to sharing and utilizing the knowledge of both parties [48].

We examined the practices in each code to determine if the code reflected one or more of the theoretical perspectives. Table 4 shows the results of mapping the codes to the appropriate theoretical perspectives. In Table 4 we have combined the relational view and the extended resource-based view as they are similar in their approach. Both rely on leveraging resources and capabilities outside of firm boundaries (i.e., those with partner firms). For a code to be reflective of a theoretical perspective the integrative practices coded by it must address the theoretical rationale for integration provide by that perspective. For example, resource sharing reduces chances of opportunism as both sides have a cost for behaving opportunistically, i.e., loss of access to shared resources. Some codes capture more than one theoretical perspective and are illustrated off the diagonal of Table 4. The location of the codes in terms of which column and row they lie in shows which theoretical perspectives they relate to. These four perspectives underlie the motivations and reasons for supply chain integration and also explain why integration is beneficial for firms.

**Table 4.** Theoretical perspectives and integrative practices.

| Theoretical Perspective | Integrative Practices | Explanation |
|---|---|---|
| **System Dynamics** | COMM-WHAT: OpsComm<br>BUS-PRACTICES: P and C<br>BUS-PRACTICES: JIT-Lean, Quality-CI | Integrative practices that reduce oscillations in flow of materials and inventory in the supply chain, and create efficient flows |
| **Relational/Extended RBV** | COMM-WHAT: PerfFeedback<br>RES-SHARE: Fin&Tech, LogRes<br>BUS-PRACTICES: JIT-Lean, Quality-CI | Integrative practices that allow greater value to be produced from the configuration, coordination and use of resources and capabilities in the buyer and supplier firms |
| **TCE** | RES-SHARE: Fin&Tech, LogRes<br>LT-ORIENT: CollabOrient, StratPlan<br>COMM-WHAT: PerfFeedback | Integrative practices that reduce opportunism in various ways, such as through generating goodwill, developing shared strategies and creating shared resources that increase the cost of opportunism |
| **KBV** | COMM-WHAT: KnowComm, NPDComm<br>BUS-PRACTICES: JIT-Lean, Quality-CI<br>BUS-PRACTICES: NPD | Integrative practices that lead to sharing and development of knowledge, such as by generating new products and developing better processes |

To understand the relationships and differences between these codes, which represent groups of related integrative practices, we compared them on their requirements for the mode of communication, contractual trust, and goodwill trust. Integrative practices can have very different relational requirements. If these relational requirements are not met, the benefits of these integrative practices will not be realized. Table 5 shows a 2 × 2 matrix that shows which codes require what type of trust and communication medium. We take the idea of contractual verses goodwill trust from the existing literature [49]. Contractual trust is based on the idea of control where contracts are used to govern the relationship and contract enforceability though not perfect is sufficient to provide confidence in the behavior of the partner. On the other hand, goodwill trust is required for more intimate forms of collaboration where the outcomes are uncertain and hard to quantify up front. Contracts cannot

be written or are too costly to write and implement. In such situations trust stems from knowledge of the partner's intentions, past history, behavioral disposition, and shared fate. The literature on trust shows that firms can build goodwill trust by frequent interactions that can be governed by contractual trust [50,51]. Table 5 highlights that for new relationships, or relationships where trust has been damaged and needs repair, firms can start with integrative practices in the first row that can be governed using contractual trust alone. This will result in frequent interaction that will slowly develop or repair goodwill trust. In time, the practices in the second row of Table 5 can be implemented to realize the full potential of the supply chain relationship.

**Table 5.** Comparison of the codes on communication medium and trust.

| | **Electronic (IT Mediated) Communication** | **Face to Face Communication** |
|---|---|---|
| Contractual Trust: confidence in partner behavior due to control (governance through contracts and contract enforceability) | COMM-WHAT: PerfFeedback, OpsComm<br>BUS-PRACTICES: P and C | RES-SHARE: Fin&Tech<br>COMM-WHAT: PerfFeedback |
| Goodwill Trust: confidence based on knowledge of partner's intentions, relationship strength, and past history | RES-SHARE: LogRes | COMM-WHAT: KnowComm, NPDComm, StratComm<br>BUS-PRACTICES: JIT-Lean, Quality-CI, NPD<br>LT-ORIENT: CollabOrient, StratPlan |

#### 3.2.1. Identifying Constructs from Codes

At this stage the codes, their descriptions and the integrative practices they represent, were analyzed to get to a set of distinct and comprehensive integration constructs. The goal is to keep the constructs as close to the codes as possible so that the contructs reflect the underlying activity-based micro-structure of SCI. The following steps were taken to process and update the codes to identify constructs: (i) codes that represented a particular means of collaboration, such as use of a communications technology or forming teams, were removed when this was being captured by other codes that focused on specific joint activities, (ii) codes that represented similar activities with similar objectives were merged together, and (iii) codes that represented two stages or levels of a broader activity, such as making a joint resource investment and sharing resources, were merged. Details of how the basic communication construct emerged are given below. In the interest of space, such details are not provided for the remaining constructs. The final constructs are then shown in Table 6.

#### 3.2.2. Detailed Steps for Basic Communication

Tables 4 and 5 show that some of the codes under the COMM-WHAT category are very different from each other. For example PerfFeedback and OpsComm do not require face-to-face communication or goodwill trust, whereas KnowComm and StratComm require both. This means that the COMM-WHAT code is capturing more than one construct.

We identified "basic communication" as the most important construct captured by COMM-WHAT. Basic communication comprises of those aspects of communication that can exist (or be implemented) without any of the other higher-level integrative practices taking place. Essentially *basic communication* consists of those elements of communication that are required from the system dynamics perspective to manage material flows more efficiently. The other types of communication are all already part of various other codes. For example COMM-WHAT/StratComm is captured by LT-ORIENT/StratPlan. To make a collaborative strategic plan by definition involves some level of strategic communication.

Since basic communication does not capture some of the codes in COMM-WHAT, those codes were moved. The practices coded as KnowComm and NPDComm were moved from COMM-WHAT to a new code called *Knowledge Generation*. Similarly COMM-WHAT/StratComm was moved to StratPlan under LT-ORIENT.

Thus, the construct basic communication captures the codes PerfFeedback and OpsComm only. These changes reduce the scope of COMM-WHAT and allow for greater precision and uniqueness in the emerging constructs.

Similar analysis was done to transform the codes in to the nine constructs shown in Table 6.

**Table 6.** Results of qualitative analysis: elements of integration and their definitions.

| Construct | Definition |
| --- | --- |
| Operational Communication | Operational communication refers to sharing routine data between the buyer and supplier firms that is used in day to day decision making, like inventory levels, sales forecasts, delivery and order information, logistics data, capacity and production related data. |
| Performance Related Communication | Performance Related communication refers to sharing of performance metrics, performance score-cards and similar feedback between the supply chain dyad members. |
| Operational Planning and Control | Operational planning and control refers to buyer and supplier firms jointly planning and synchronizing recurring tasks and activities and systematically reacting to environmental signals related to production and flow of goods and services. |
| Collaborative Improvement | Collaborative improvement refers to the buyer-supplier dyad jointly establishing continuous improvement programs and quality practices. |
| Sharing Logistics Resources | Sharing logistics resources refers to combining transportation, storage and distribution resources to improve efficiency of logistics operations. |
| New Product Development | New product development refers to collaboration by the buyer and supplier firms to research, design and commercialize products that are new for the supply chain dyad. |
| General Knowledge Generation | General knowledge generation refers to collaboration by buyer and supplier firms to generate new relevant knowledge outside of new product development efforts such as acquiring or developing new capabilities and technologies. |
| Financial and Technological Support | Providing financial and technological support refers to combining financial assets and/or technological capabilities usually for strategic and long-term gains. |
| Strategic Partnership | Strategic partnership refers to a buyer and supplier dyad developing and implementing business strategy together such that their fate (success or failure) is intimately tied. |

### *3.3. Constructs Identified through Qualitative Analysis*

The qualitative analysis suggests nine constructs. These nine constructs are termed *elements of integration* because a given supply chain relationship may have one or more of these elements. In this manner these elements represent the building blocks of supply chain relationships. The practices that are part of each code can be considered a representative sample of the theoretical domain of the newly identified construct, as our literature review was representative of the empirical work done in SCI. Thus, the qualitative analysis has allowed us to identify new constructs that form the building blocks of the broad inter-firm SCI construct.

We now define these new elements of integration. Our coding of the integrative practices provides a useful map of the theoretical domain of each construct, which guides our definitions. The definitions are listed in Table 6.

## 4. Theoretical Contributions

This study makes several substantial contributions to the existing view of supply chain integration. Firstly, a comprehensive list of integrative practices is identified that allows future research to take an inter-organizational activity-based perspective in modeling supply chain relationships. We also show that given the number of integrative practices that have been used to measure SCI, it cannot be a singular, or one dimensional, construct. Several influential papers have also pointed out the need

to synthesize a view of SCI that captures the diversity of integrative practices found in the literature. For example, van der Vaart and van Donk [9] state "if we looked at all the surveys on integration, a large list of seemingly different constructs and measurements could be drawn up." Ho et al. [8] comment that "it is important to note the fact that there is little consistency about the basic definition and content of the SCM construct among these studies." Finally, Fabbe-Costes and Jahre [26] conclude that "a differentiated approach of SCI is of interest and can help companies to identify and focus on a limited number of key integration elements." Supply chain integration is conceptually multi-faceted and is rooted in several theoretical perspectives (see Supplement B). We make this multi-faceted nature explicit in this paper by systematically mapping out the constructs that make up supply chain integration. Figure 4 graphically shows how the elements of integration view that comes from our analysis of the literature updates the popular conceptualization of SCI.

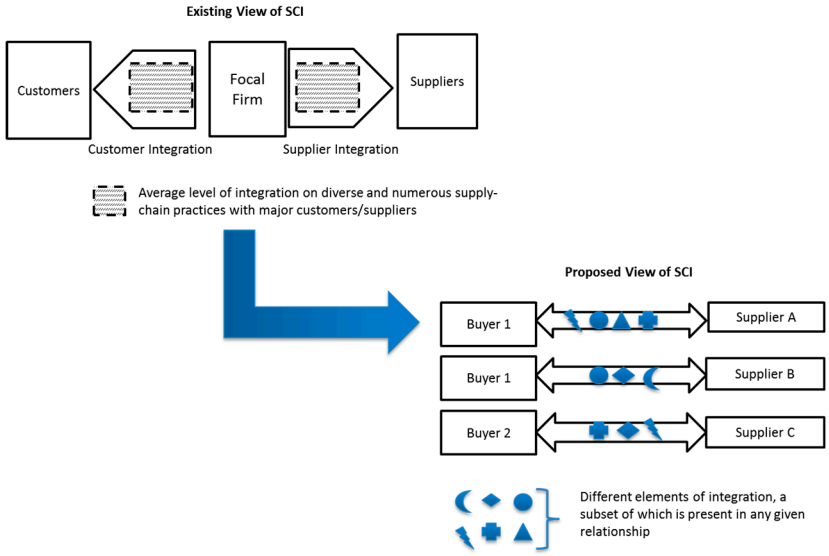


**Figure 4.** Overview of proposed conceptualization of SCI.

One of the main contributions of our work is the identification of the micro-structure of SCI. We show that the conceptual space of supply chain integration is comprised of *elements of integration*. The elements of integration are bundles of related integrative practices that buyer-supplier dyads might implement. The elements selected for implementation are likely to vary between relationships [20]. Since these elements have different relational requirements and have different objectives, the set of elements selected have important implications for the relationship. The elements influence what inputs are required from each partner to make the relationship work, what outcomes to expect and whether the relationship will build goodwill trust for future time periods or not. The analogy of elemental atoms combining to make molecules in chemistry applies here. Just like changing the selection of atoms that comprise a molecule changes its properties, changing the *elements* used to construct a supply-chain relationship will change how that relationship functions. Additionally, since the *elements* require different levels of effort, firms will make conscious decisions about which elements (i.e. which integrative practices) to implement. Thus, we expect a diversity of relationships where each relationship is some combination of the nine elements defined in Table 6. The relationship between Amazon and its suppliers that produce goods sold on Amazon was initially entirely focused on operational performance. As such, operational communication and operational planning and control would have been the cornerstones of the integration between Amazon and its key suppliers. Over time Amazon started to leverage its knowledge of consumer preferences to develop its own line of products that were branded as Amazon Basics. To develop these products, Amazon needed to know the capabilities of the suppliers that would produce them, and work with the suppliers to design the specifications of the products, develop and test prototypes and revise the design in response to

user feedback. For such relationships Amazon would most likely have implemented new product development, collaborative improvement, and general knowledge generation elements of integration. As the goals of the relationship change, different elements of integration can be combined to gain appropriate benefits [52].

The proposed view of SCI can help explain the mixed empirical findings on the relationship between SCI and the different dimensions of performance [26]. With the micro-foundations view of SCI, the relationship between different elements of integration and different performance dimensions can be delineated with greater detail. For example, operational planning and control and collaborative improvement will impact operational performance dimensions. On the other hand, general knowledge generation and new product development will increase innovation performance of the supply chain. Sharing logistics resources will improve cost performance, and financial and technical support will primarily help suppliers improve quality. The elements of integration allow a more nuanced understanding of how different aspects of integrative activities increase different areas of performance. Firms can benchmark their performance on multiple dimensions with competitors, and then focus on implementing elements of integration that are relevant for their weak areas. This allows resource-constrained managers to conduct selective integration to obtain a greater return on investment from integration efforts.

Studying relationships in this manner will allow supply chain integration research to be directly applicable to practice where managers must take relationship level decisions. Our work contends that we should expect diversity in supply chain relationships between any firm of interest and its supply chain partners. All relationships are not created equal because firms make conscious decisions regarding which of the nine elements of integration to implement and these decisions would subsequently lead to salient differences in relationship management. For example, the expected outcomes from a relationship with new product development practices are very different from the expected outcomes from a relationship focusing on operational planning and control. Additionally, the investment in terms of commitment, resources, and time would be different. Our work highlights that firms need to manage their various buyer-supplier relationships differently, taking into account the elements of integration that make up each relationship.

There is support in the existing literature about the role of SCM in supporting various competitive priorities. For example, a cost based strategy requires an efficient supply chain while a flexibility based strategy requires a response supply chain [53]. In the existing view of SCI, we cannot determine how integration impacts the various competitive priorities. This paper provides a more rigorous foundation to study the impact of the supply chain integration on competitive priorities. For example, firms following a cost advantage strategy are likely to be more successful by implementing the operational communication and operational planning and control elements with numerous low-cost suppliers. This is because these elements can be implemented in a large number of relationships at relatively low cost, with the relationship being governed by contracts. Thus, firms can work with the lowest-cost suppliers and even change suppliers frequently to get the best prices while benefiting from operational efficiencies obtained through these elements. On the other hand, firms following a flexibility strategy are likely to be more successful by implementing performance-related communication and collaborative improvement in addition to the operational communication and operational planning and control elements. Collaborative improvement requires goodwill trust and long-term orientation. It is difficult to establish collaborative improvement with a large number of suppliers or with suppliers that get changed every so often. Its benefits are best realized when a company has a long-term orientation and works closely with a small number of suppliers to achieve time-based advantages like flexibility and quick response. Our elements of integration view enables this type of more nuanced prescription for implementing integration based on the competitive priorities of the firm.

This paper also contributes towards a process perspective of supply chain integration [20,54]. In the prevailing view of SCI firms should integrate for better performance, and they must implement

a large number of integrative practices. However, there is no discussion of how to go from a non-integrated state to achieving supply chain integration. The elements-of-integration view developed in this paper suggests that there can be staged strategies, or an incremental process for achieving supply chain integration. For a completely new relationship where the supply chain partners have no history of working with each other, the relationship may start with implementing basic communication elements only and contracts may be used to govern the relationship. As trust develops, and both partners learn more about each other's operations, they may implement operational planning and control to achieve operational efficiencies. When an appropriate level of goodwill trust has developed and both partners know the capabilities and resource each one has, then they may introduce collaborative improvement and the knowledge-based elements of integration. This allows practitioners to analyze and plan their integration efforts and systematically introduce new elements of integration in promising relationships.

To appreciate the significance of elements of integration view of SCI we need to consider what the natural extensions of this work enable us to accomplish. Empirical research based on the elements of integration view, will lead us to an understanding of the performance effects of the elements and their individual responses to various environmental conditions. When this is combined with research on how the elements of integration interact with constructs like trust and relational governance then we can build frameworks that help design supply chain relationships. Such frameworks can enable firms to determine the optimal configuration of the elements of integration to employ in a given relationship based on buyer and supplier characteristics, the present levels of trust, and the desired outcomes from the endeavor. Designing supply chain relationships by considering the elements that will be used to build them has the promise to resolve the "apparent contradiction in the literature between promised benefits and still limited evidence of extensive implementation" [55].

## 5. Limitations

Our paper has several limitations. First, we made a conscious choice not to study sustainability and social issues. Supply chain collaboration happens on sustainability and social issues as well and future work on that may reveal more elements of integration centered on the triple bottom line.

Additionally, due to the vast body of published papers under various disciplines it was impossible to study and synthesize all articles related to supply chain management. This means that our conceptualization of SCI needs to be updated as new research is published. We hope future work can build on this paper to address this concern.

Like every research endeavor we had to draw certain boundaries around the scope of this paper. We explicitly chose to limit ourselves to the relationship level of analysis. This is because we feel there is much room for improvement in building normative models that allow practitioners to make decisions at the relationship level. However, a body of work exists that studies supply chains as networks of many inter-linked firms. This network perspective allows conceptualizing properties of networks and their effects on the performance of network members. There is need for future work to link our relationship level perspective with the network view of supply chains.

The focus of this paper is restricted to inter-firm (external) integration because internal integration concepts have been well developed by multiple research traditions over several decades while the same cannot be said for inter-firm supply-chain integration [38,56,57]. Future work should investigate whether internal integration is unidimensional as is currently assumed. Furthermore, the relationships between internal integration and the constructs we have identified need to be investigated.

As we indicate in the paper there are likely to be relationships between the elements of integration. We have not dealt into such relationships in this paper and future research should explore them. For example, it is possible for some elements to be implemented with just contractual trust. These elements would lead to a build-up of goodwill trust over time and subsequently allow other elements of integration to be implemented.

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