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WHY SUPPLIER DEVELOPMENT WORKS? A KNOWLEDGE-MANAGEMENT PERSPECTIVE

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WHY SUPPLIER DEVELOPMENT WORKS? A KNOWLEDGE-MANAGEMENT PERSPECTIVE

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
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at the University of Kentucky

By

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Lexington, Kentucky

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ABSTRACT OF DISSERTATION

WHY SUPPLIER DEVELOPMENT WORKS? A KNOWLEDGE-MANAGEMENT PERSPECTIVE

Supplier development (SD) has been intensively and increasingly used in practice and studied in academia. Many studies find that SD can generate operational, capability-based, attitudinal, and financial performance measures for both the supplying firm (supplier) and the buying firm (buyer), but very few studies systematically explain why SD yields supplier's performance improvements and, in turn, buyer's performance improvements. Using a meta-analysis approach, this dissertation finds that SD does lead to positive outcomes, but SD is found to have very weak or even negative relationship with performance improvements in some cases. Such findings further support the importance of examining the main research question: why SD works.

In order to answer the main research question, this dissertation adopts a multiphase triangulation approach: theoretical construction, conceptual examination, and empirical examination. Doing so, this dissertation constructs and validates a knowledge management (KM) view of SD.

The purpose of theoretical construction (Chapter 3) is to develop a KM view of supplier development via a systematic view of previous studies. Presented in Chapter 4, conceptual examination reveals that all SD activities can be subsumed into KM activities, and further conceptually supports the feasibility of the KM view in SD. Empirical examination, including a survey of 39 SD scholars and a survey of 295 SD practitioners (156 complete responses), is presented in Chapters 5 and 6. Most hypotheses are strongly supported, demonstrating the importance of the knowledge-management view of SD.

Overall, this dissertation has both theoretical contributions for KM and SD sides, and practical contributions for researchers, practitioners, and educators/students. First, it contributes by supporting the addition of KM variables to other theories when explaining why SD works, confirming the role of KM in SD, providing a complete KM view of SD, and revealing why SD works. Second, it contributes by implementing mixed research methods, integrating multiple disciplines, and exemplifying collecting data on LinkedIn.

Third, it contributes by offering a catalog of SD activities and guidance for designing, implementation, and evaluation of SD initiatives. Fourth, it contributes by advancing a mental model to understand SD literature. Conclusions, limitations, and future research directions are also discussed.

KEYWORDS: Knowledge Chain, Knowledge Management, Knowledge Sharing, Supplier Development, Supply Chain Management

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To my wife Ling and two children Joy and Andrew

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CHAPTER 1 INTRODUCTION

1.1 General Definitions and Research Scope

An industrial market includes at least two critical roles: buyer and supplier. Broadly speaking, *buyer* (i.e., buying organization) refers to an entity purchasing resources for value-added purpose from the market; whereas, *supplier* (i.e., supplying organization) refers to an entity selling its product in the market for value-realization purpose. Buyer-supplier dyads represent fundamental unit of a typical *supply chain*, which refers to "all those activities associated with the transformation and flow of goods and services, including their attendant information flows, from the sources of raw materials to end users" (Ballou et al., 2000, p. 9). Within a supply chain, buyer-supplier dyads involve buyer-supplier relationships supporting information flow and business transactions. Therefore, in nature, "supply chain management is about relationship management" (Lambert, 2008, p. 6).

Although supply chains could be examined from both buyer's perspective and supplier's perspective, for the sake of research convenience, the buyer is typically chosen as the focal company in the discipline of supply chain management. Accordingly, its upstream parties include tier 1 suppliers, tier 2 suppliers, and tier 3 to initial suppliers and its downstream parties include tier 1 customers, tier 2 customers, and tier 3 to end users. For the buyer (focal company), it is overwhelming to manage all suppliers. This study focuses on the tier 1 suppliers of a buyer because of their important and close relationship with the buyer. Additionally, a buyer purchases both direct martials (i.e., core materials used to manufacture finished products) and indirect materials (i.e., materials used to support the production, including maintenance, repair, and operations materials), which

may be provided by different suppliers. This dissertation focuses on suppliers of direct materials. In summary, *supplier* in this study is defined as the organization which directly (i.e., tier 1) provides the focal organization (i.e., *buyer*) with direct materials.

In order to make its supply chain work, a buyer has to create and maintain a network of competent suppliers (Watts & Hahn, 1993)[1]. A "competent" supplier must demonstrate both performance and capability to meet the buyer's supply needs. *Supplier performance* refers to a supplier's demonstrated ability to meet the buyer's supply requirements, and *supplier capability* denotes a supplier's potential that can be leveraged to the buyer's advantage in the long run (Sarkar and Mohapatra, 2006; Prajogo et al., 2012). If a supplier cannot meet the buyer's supply needs, a buyer might either switch to another supplier or develop this incompetent supplier. This study focuses on the second approach, that is, supplier development. Broadly speaking, *supplier development* in this study refers to any organizational efforts initiated by the buyer to improve an existing supplier's performance and/or capability to meet the buyer's supply needs.

This dissertation aims at providing a convincing framework to answer why supplier development (SD) leads to buyer/supplier performance improvements through modeling SD as a knowledge management system. Knowledge has been identified as the most strategically-significant resource of an organization (Grant, 1996a, b). One important purpose of an organization is to managing its knowledge resources to create or add value to the organization and its environment. Knowledge management represents organizational efforts to expand, cultivate, and apply available knowledge resources by knowledge processors via knowledge processes (Holsapple and Joshi, 2004).

[1] Watts & Hahn (1993) generally define supplier development as an organization's efforts to create and maintain a network of competent suppliers.

1.2 The Importance of Supplier Development

In the supply chain management (SCM) area, SD has been identified as an important topic. After summarizing more than 774 articles published in Journal of Supply Chain Management during its first 35 years (from 1965 to 2000), Carter and Ellram (2003) find that SD is one of the fifteen important topics in SCM research. More recently, Giunipero et al. (2008) review 405 articles published in nine leading academic journals from 1997 to 2006 and demonstrate that SD is one of the thirteen key SCM research topics.

Extant research has identified many activities that fall under the umbrella of SD ranging from low-risk initiatives such as supplier evaluation, to high-risk initiatives like supplier-specific investments (Krause and Scannell 2002). SD has broad implications, involving many functional areas in addition to purchasing and significantly affecting overall organizational performance (Hahn et al., 1990).

Scannell et al. (2000) refer to SD as one of the three important improvement programs associated with supply chain management and argue that SD can "improve a firm's competitive positions through lowering costs, increasing quality, and flexibility, improving technology, and reducing cycle times" (p. 26). Accordingly, SD has been intensively initiated in many notable companies, including Toyota (Dyer & Hatch, 2006; Dyer & Nobeoka, 2000; Sako, 1999; Langfield-Smith & Greenwood, 1998; Marksberry, 2012), Italtel (Colombo & Mariotti, 1998), Honda (MacDuffie & Helper, 1997), and Kodak (Ellram & Edis, 1996).

In addition, empirical studies have supported that SD activities improve the performance of both buyer and supplier, including the following dimensions: productivity (e.g. Carr et al., 2008; Kaynak, 2005), agility (e.g. Humphreys et al., 2004; Li et al.,

2007), innovation (e.g. McGovern & Hicks, 2006; Wagner, 2006a), reputation (e.g. Chen & Paulraj, 2004; Dyer and Hatch, 2006), satisfaction (e.g. De Clercq & Rangarajan, 2008; Ghijsen et al.; 2010), and financial improvement (e.g. Kim, 2006; Sanchez-Rodriguez & Hemsworth, 2005). These results underscore the value of supplier development activities, which occur at every stage in the supply chain.

However, little research systematically explains why SD leads to supplier's performance improvement and, in turn, buyer's performance improvement. Therefore, the value-creation process of SD is still a black box. Without a good understanding of this process, I cannot provide a convincing explanation of why SD activities generate various performance measures, and thus offer a feasible guidance on matching SD activities with performance measures.

1.3 Research Questions and Methods

The main research question in this dissertation is:

Why does supplier development lead to positive outcomes in terms of buyer and supplier performance improvements?

This research question can be called *why SD works* for short. Positive outcomes of SD can be influenced by two groups of factors: environmental factors which measure the external environment in which SD is implemented, such as company resources, firm size, asset specificity, and industry, and component factors which describe elements or activities involved in a SD program, such as knowledge sharing and supplier evaluation. However, the first group of factors varies greatly across firms, and cannot be controlled by individual firms. Therefore, this study focuses on the second group of factors which

make SD lead to positive outcomes. Before answering the main question, one prerequisite question should be answered:

Does supplier development lead to positive outcomes in terms of buyer and supplier performance improvements?

In order to answer the prerequisite research question, this dissertation first comprehensively reviews existing studies and then synthetizes those studies using a meta-analysis approach. The main reason is that many existing studies have examined the relationship between SD and buyer/supplier performance improvements. The meta-analysis results demonstrate that SD has a medium weighted effect size on buyer/supplier performance improvements, even though correlations between SD and buyer/supplier performance improvements range from -0.365 to 0.900. These results further highlight the importance of answering the main research question.

Existing studies have identified a list of variables to explain why SD works, but they do not uncover the inside (i.e., elements) of SD. This dissertation leverages a knowledge-management perspective and introduces knowledge management (KM) factors, which adopted from Knowledge Chain Theory (Holsapple & Singh, 2001). As a value-creation process theory, KCT can capture what occur in a SD program (the inside of SD), and thus can be combined with other theories to explain why SD works. Consideration of these KM factors can increase the chance to explain why SD works if they are considered as useful indigents of an SD program. The main research question can be divided into the following two sub-questions

- Can SD be modeled as a knowledge management system?
- If so, can SD performance be better explained?

In order to answer the two sub-questions above, this dissertation adopts a multiphase triangulation approach, which includes three steps: theoretical construction, conceptual examination, and empirical examination. Each of the three steps is described as below:

1) Theoretical Construction

   The purpose of theoretical construction is to develop a knowledge-management view of supplier development. Chapter 3 reviews how previous studies explain this question and summarizes two research paradigms. Such a review not only facilitates opening the black box of why SD works, but also sheds light on the use of knowledge management (in particular, knowledge chain theory) in supplier development. In order to develop a KM perspective of supplier development, this dissertation then reviews knowledge, knowledge management, knowledge chain theory, and the relationship between knowledge management and supplier development. These reviews provide a theoretical foundation for developing testable hypotheses of this study.

2) Conceptual Examination

   Presented in Chapter 4, the purpose of conceptual examination is to investigate whether SD can be modeled as a knowledge management system. First, various SD activities are identified and collected from previous empirical studies focusing on supplier development and then further condensed into 30 distinct SD types, generating an extensive catalog of SD activities. Second, each SD type is examined to see whether it is matched with any KM activity identified from the knowledge chain theory. It is found that all SD activities can be subsumed into

knowledge management activities. Such a finding conceptually supports the ***feasibility*** of knowledge-management view in supplier development.

3) Empirical Examination

The purpose of empirical examination is to examine whether SD performance is better explained when SD is modeled as a knowledge management system. Empirical examination includes a survey of SD scholars, structured interviews with SD practitioners, and a survey of SD practitioners, all of which are presented in Chapters 5 and 6. First, a pre-survey structure interview is conducted to examine whether the KM perspective can applied to the actual SD implementation, which further check the ***feasibility*** of knowledge-management view in supplier development. Then, a survey about the role of knowledge management and knowledge sharing in supplier development is sent to SD scholars. Their responses further support ***feasibility*** of knowledge-management view in supplier development and validate the instrument of the knowledge management constructs. Finally, a survey of SD practitioners is used to test hypotheses which are raised during the theoretical construction process. Those results can demonstrate the utility of knowledge-management view of supplier development.

Doing so, this dissertation constructs and validates a knowledge-management view of SD and provides a useful framework to answer the question of why SD works

1.4 Contributions

The answer to the research question is very valuable for researchers, practitioners, and educators. First of all, it contributes by opening the black box and revealing the value-

creation process of SD. Even though many environmental factors such as company resources, firm size, asset specificity, and industry may contribute to predicting positive outcomes of supplier development, they are out of the "box". Some other elements such as knowledge sharing may be considered as one value-creation process, but this study argues and finds that knowledge management is at least one of the key elements which can explain why SD works.

By opening the black box, this study serves as a trigger for future research avenues and subsequent research programs. First, armed with a better understanding of value-creation process of SD, researchers can solve contradictory observations from existing studies. For instance, extant studies fail to explain why the combination of different types of SDAs generates lower performance than implementing each individually. Using a survey-approach, Wagner (2010) finds that the combined effect of indirect and direct SDAs results in lower levels of supply chain performance such as supplier's product and delivery performance and capabilities. However, some case studies find that some well-known firms such as Toyota can achieve superior performance through combing both types of supplier development (Dyer & Hatch, 2006; Dyer & Nobeoka, 2000; Sako, 1999; Langfield-Smith & Greenwood, 1998).

Moreover, this study contributes to managerial practice by showing why SD works and providing practitioners with a realistic framework for conducting SD activities effectively. Managers cannot mistakenly assume that SD outcomes are guaranteed as long as they initiate it. Currently, many firms do not realize the expected benefits from SD initiatives (Mohanty et al., 2014). One of the main reasons is that they lack a comprehensive understanding of why SD works. In addition, with a comprehensive

review of SD and framework, it is of value to them concerned with organizing coverage of SD in course plans.

1.5 Structure of This Dissertation

In order to provide an extensive background of SD, the next chapter first reviews the history, definition, classification and measurement of SD and then examines the prerequisite question using a meta-analysis approach and reviews the paradigms which are used to build the link between SD and its outcomes. Following, Chapter 3 states research question, describes research roadmap, and develop hypotheses. The next three chapters report results. Chapter 4 develops an extensive catalog of SD activities based on a systematic review and classification of SD activities identified from previous studies and establishes a conceptual link between SD and knowledge management activities. Chapter 5 reports findings derived from a survey of scholars and presents survey instruments for SD practitioners and sample profiles. Chapter 6 reports results from a survey of SD practitioners. Chapter 7 triangulates all these findings and makes final conclusions, and then discusses limitations, future research directions, and contributions.

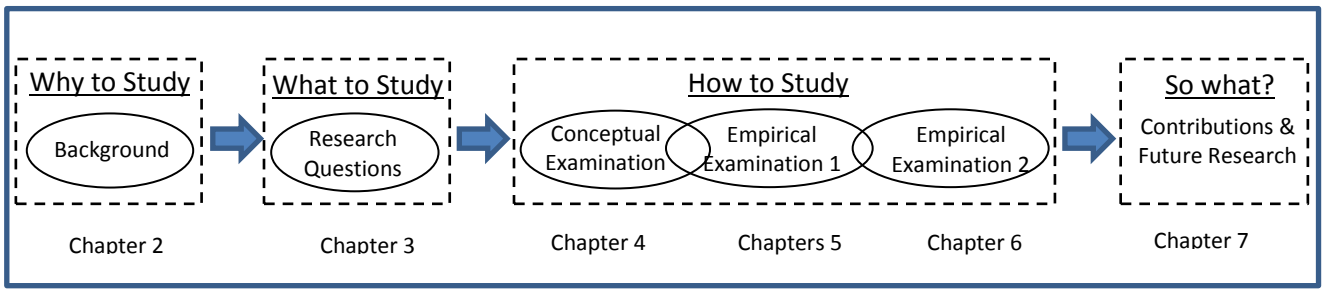


Figure 1-1: Structure of Remaining Chapters

Table 1-1: Key Findings/Contributions for Each Remaining Chapter

Chapter	Purposes	Key Findings/Contributions
2	To provide background information about supplier development by conducting a comparative examination of supplier development research	2.1 SD research has undergone three waves, from quality management (the first wave), through buyer-supplier relationship (the second wave), and to multi-theoretical application (the third wave) 2.2 SD is defined in different ways and perspectives and various definitions include some key elements. 2.3 SD includes three implementation approaches: performance, capability, and mixed approaches, each of which has its representative SD definitions 2.4 SD activities have been classified in different ways, but there are confusions across different taxonomies 2.5 SD is measured as one factor of multiple items, multiple factors, and a second-order factor. All of them take a cumulative view, rather than an episodic view. 2.6 An episodic view of SD is raised to help explain why SD works. 2.7 A meta-analysis study is conducted to reveal that SD does bring positive outcomes for both buyer and supplier (*SD works*). 2.8 SD research extensively uses the direct-impact paradigm. However, a knowledge-sharing or KM paradigm is emerging, which can help us understand *why SD works*.
3	To develop research hypotheses	3.1 Review how existing studies explain why SD works and provides a theoretical background for KM&SD 3.2 Identify key variables from existing studies 3.3 Raise research hypotheses
4	To conduct an examination through an extensive literature review and conceptual factor analysis	4.1 Generate a catalog of 30 types of SD activities based on an extensive review and condensation 4.2 All the 30 SD types involve first-order or second-order KM activities, indicating significant importance of KM in SD; however, buyer and supplier play different roles in KM. 4.3 Based on the knowledge-based view and knowledge chain theory, an integrated definition, taxonomy, and implementation approach of SD are generated. 4.4 All the evidence supports the application of knowledge chain theory in supplier development
5	Data collection & Instrument development	5.1 Data collection and results from SD scholars: All KM activities are very important for buyer and supplier 5.2 Data Collection from SD practitioners: survey instrument, survey distribution process 5.4 Profiles of respondents and their organizations: From a diversity of industries, with a diversity of size.
6	Test hypotheses and report findings	6.1 Data profile: no late-response bias, high reliability and validity, justification of regression assumptions 6.2 Test hypotheses using linear regression models: most hypotheses are strongly supported, indicating the magnitude of KM in SD and utility of adding KCT to other theories in explaining why SD works.
7	Conclusions & Discussions	7.1 Key conclusions and contributions are made 7.2 Six limitations are addressed 7.3 Future research directions are put forwarded to alleviate limitations and increase the value of this research.

CHAPTER 2 A COMPARATIVE EXAMINATION OF SUPPLIER DEVELOPMENT RESEARCH

2.1 The History of Supplier Development

Japanese automobile companies such as Toyota and Honda are pioneered the use of SD practice (Krause, 1999; Krause et al., 2007; Wagner & Johnson, 2004). However, the term ‘‘supplier development’’ was first used by Leenders (1965, 1966[2]) to describe efforts by manufacturers to increase the number of viable suppliers and improve suppliers’ performance. Leenders (1966) contends that the basic idea of supplier development could date back to the expeditions of the explorers of Spain, England, and Holland from 1400 to 1700 A.D. Leenders (1989) defines supplier development as “the creation of a new source of supply by the purchaser” (p. 52). Using a case study, Leenders illustrates the needs and decisions of SD. He argues that SD is necessary for assuring long-term future source of supply. His study mainly concentrates on creating new suppliers.

However, this term was not further examined until “business environments forced firms to pay more attention to quality management issues” in 1980s (Wagner, 2006b). At the end of 1980s, SD emerged as a prominent quality improvement approach. Wagner (2006b) treats this period (1987-1993) as the “first wave” of SD research, which was initiated by researchers in the quality management field. A few notable articles in this period include Bache et al. (1987), Lascelles & Dale (1988, 1989, 1990), Saraph et al. (1989), Hahn et al. (1990) and Galt & Dale (1991). All these studies contribute by

[2] It is noteworthy to mention that this article was selected to be republished in the journal’s 25th Anniversary Special Issue in 1989, which was selected as the future reference in this study. The republication also indicates the significance of this article.

developing conceptual frameworks of SD implementation and examining SD drivers and barriers. For instance, Lascelles & Dale (1990) summarize a few key steps involved in a supplier development program and point out that supplier development is an ongoing process aimed at building-up an effective business relationship. Hahn et al. (1990) create a framework for supplier development process and suggest that SD could be defined in both narrow and broad perspectives.

At the end of this period, two studies reported the SD adoption level: Galt & Dale (1991) reveal how SD has been used in ten British organizations and summarize eight important issues observed in the supplier development process and Watts & Hahn (1993) report the use of SD programs in the United States. Both studies indicate that, in practice, SD programs are more prevalent and less novel than as expected. In sum, the "first wave" SD studies are still practice-oriented: They have summarized relevant issues such as implementation process, observed problems from practice, and then create a framework to guide the SD implantation. Accordingly, most of these early studies focus on SD implementation process, barriers, and benefits.

The "second wave", which was mainly characterized by buyer-supplier relationship management, started at 1995 and continued until 2005 (Wagner, 2006b). At this period, many empirical studies (survey and case studies) were published. Krause (1995) finished his dissertation *Interorganizational cooperation in supplier development Influencing factors* in 1995 and then he and his colleagues published six empirical papers in the late 1990s. Krause & Ellram (1997a) test critical elements of supplier development, Krause & Ellram (1997b) present that high-performance firms involve more supplier development activities, and Krause (1997) demonstrates that supplier development include

heterogeneous activities. Later, Krause et al. (1998) summarize an evolutionary path to SD and improved supply base performance and identify two approaches to supplier development: strategic and reactive. Krause (1999) first empirically examines the antecedents of SD and Krause et al. (1999) first investigate SD from the minority suppliers' perspective.

The "third wave" started at 2006, and a large number of theories were employed to show the link between SD activities and their outcomes: the transaction cost theory (e.g. Ghijsen et al., 2010), the resource dependence theory (e.g. Cai &Yang, 2008), the resource-based view (e.g. Koufteros et al., 2012), the knowledge-based view (e.g. Modi & Mabert, 2007), the social exchange theory (e.g. De Clercq & Rangarajan, 2008), and the social capital theory (e.g. Krause et al., 2007).

2.2 Definitions of Supplier Development

Scholars have different views and various definitions for SD. Hahn et al. (1990) indicate that SD could be defined from general, narrow, and broad perspectives. In a general perspective, SD is defined as "any systematic organizational effort to create and maintain a network of competent suppliers" (p.3). Whereas the narrow perspective of SD involves "identifying new sources of supply where no adequate ones exist", the broad perspective of SD involves "a long-term cooperative effort between a buying firm and its suppliers to upgrade the suppliers' technical, quality, delivery, and cost capabilities and to foster ongoing improvements" (Watts and Hahn, 1993, p.12). The general perspective points out the ultimate goal of SD to buyers, while the other two describe two ways to achieve the ultimate goal, either identifying new suppliers or improving the existing suppliers.

SD was first defined, from a narrow perspective, as "the creation of a new source of supply by the purchaser" (Leenders, 1989, p.52). However, this perspective of SD was later called "reverse marketing" by Leenders & Blenkhorn (1988). In the past decades, intensifying global competition, increased outsourcing, more demanding just-in-time supply requirements, and enhanced focus on supply disruption management have served to favor the broad perspective. Accordingly, a majority of SD studies have been stimulated by the broad perspective.

Even in the broad perspective, SD is still defined in several ways. In order to better understand how SD is defined and what key elements should be included to define it, I review SD definitions identified from the previous research. Our review includes around 200 articles. However, I find that less than 20 percent of articles explicitly define this term. That finding is consistent with Wacker (2008), who finds that a majority of business articles do not formally define their concepts. In addition, I find that SD definitions vary greatly in the level of details (i.e., the number of words use in the definition). The shortest definition is given by Park et al., (2010) and includes only seven words: SD refers to "a process that improves the supplier's performance" (p.506). In contrast, the longest definition includes 49 words: SD refers to "a long-term cooperative strategy initiated by a buying organization to enhance a supplier's performance and/or capabilities so that a supplier is able to meet the buying organization's supply needs in more effective and reliable way which will give additional competitive advantage to buyer to become more competitive in market" (Chavhan et al., 2012, p. 38).

Fundamentally, what is supplier development? Is it an abstract theory, strategy, relationship, practical action, or something else? After reviewing 53 definitions (See

Figure 2-1), I find that SD could be defined either at the operational level (how to implement, e.g. process, practice, program, procedure, operation), or at the strategic level (how to plan, e.g. strategy, approach), or at the mixed level (e.g. activity, effort, initiative). At most cases, SD refers to particular efforts or activities, that is, a set of practical actions.

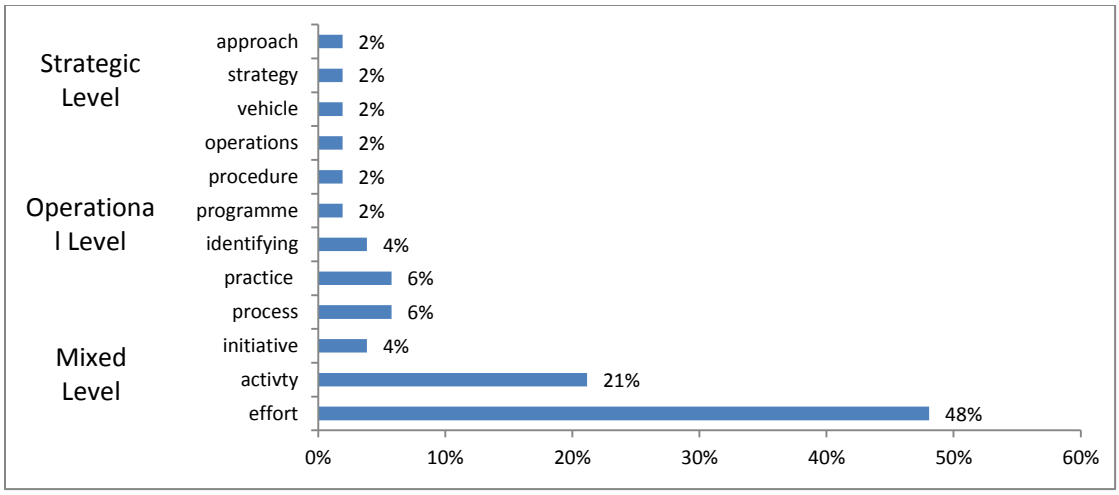


Figure 2-1: The "What" Dimension of SD Definition

In terms of how to describe SD, I find that a few key words are frequently used (see Figure 2-2): positive verbs (e.g. maintain, increase), supplier, buyer, performance, and capability. This indicates that both buyer and supplier are involved in supplier development, and the direct goal is to improve supplier performance and capability. For instance, the most highly-cited SD definition is given by Krause & Ellram (1997a) , who define SD as “any effort of a buying firm with its supplier (s) to increase the performance and/or capabilities of the supplier and meet the buying firm's short- and/or long-term supply needs” (p. 21). This definition indicates that SD includes a set of practical actions sponsored by the buyer and aims to meet the buyer’s supply needs through improving a supplier’s performance and/or capabilities. In addition, both suppliers and buyers benefit

from SD activities, indicating that SD is a win-win strategy rather than a zero-sum approach. This widely-used definition includes the key components of supplier development, and therefore, I also adopt this definition in our study.

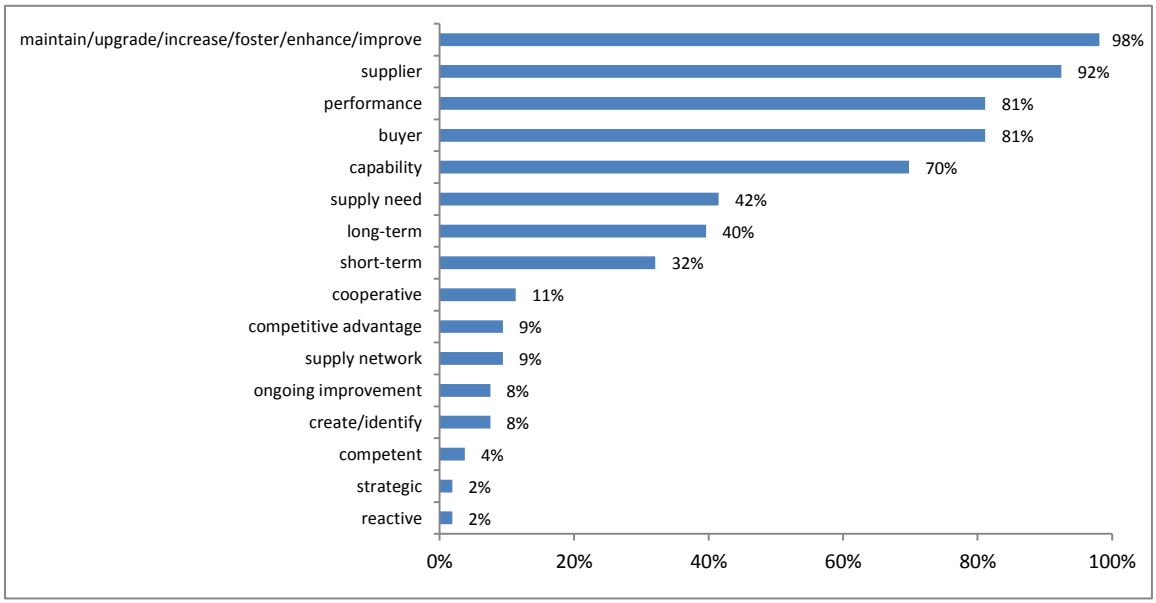


Figure 2-2: The Most Frequently-used Key Words in SD Definitions

2.3 Implementation Approaches of Supplier Development

As mentioned above, SD is concerned with establishing and sustaining a firm's competitive advantage through its supply side. In order to achieve this ultimate goal, SD involves systematic and bilateral efforts for improving the supplier's performance and/or capability (Hahn et al., 1990; Sako, 2004). Therefore, performance improvement and capability development are perceived as two intermediate goals. Programs geared toward the two goals represent distinct approaches to defining and performing SD. Table 2-1 shows sample definitions for each approach, as well as combinations.

Table 2-1: Selected Definitions of Supplier Development

Approach	Sample Definitions
Capability Approach	Watts and Hahn (1993, p. 12): "supplier development also involves a long-term cooperative effort between a buying firm and its suppliers to upgrade the suppliers' technical, quality, delivery, and cost capabilities and to foster ongoing improvements".
	Mahapatra et al. (2012, p.408): Supplier development "is defined as systematic efforts by the buyer firm to improve supplier capabilities through direct financial and technical assistance, and quality training".
Performance Approach	Krause et al. (1998, p. 40): "Supplier development was defined as any set of activities undertaken by a buying firm to identify, measure, and improve supplier performance and facilitate the continuous improvement of the overall value of goods and services supplied to the buying company's business unit".
	Carr and Pearson (1999, p.500): "Supplier development is any effort by the buying firm to increase its supplier's performance in order to meet the buying firm's objectives".
Capability/ Performance Approach	Krause (1997, p. 12): "Supplier development is defined as any effort of a firm to increase performance and/or capabilities to meet the firm's short- and/or long-term supply needs".
	Praxmarer-Carus et al. (2013, p. 202) : "Supplier development is defined here as any set of activities that a buyer expends on a supplier to improve the supplier's performance and/or capability in a manner that meets the buyer's supply needs and generates favorable results".

The performance approach focuses on solving specific production problems for suppliers and making immediate improvements in the supplier's operations (Hartley and Jones, 1997). When a supplier cannot meet the buyer's performance requirement, the buyer describes this problem to the supplier's top management and then works with the supplier's employees by collecting and analyzing production data. With hand-on assistance from the buyer's development team, supplier's problems are quickly identified and solved. Once the supplier's performance reaches the threshold of the buyer's performance requirement, the supplier development program ceases. Under such an approach, suppliers cannot continue an upward trend of continuous improvements on their own, because they lack adequate time and experience to learn the problem-solving techniques (Hartley and Jones, 1997).

In contrast, the capability approach emphasizes making continuous improvement through cultivating the supplier's technical, quality, delivery, and/or cost capabilities. In addition to identifying and solving the supplier's problems, the buyer's development team can further help the supplier locate what capabilities it needs to upgrade for continuous improvement. For instance, a high defect rate of incoming material could be traced to poor quality control capability. Then, the buyer's development teams can provide total quality management (TQM) training and share incoming material control techniques with the supplier. At the same time, the supplier is required to unlearn its old practices, learn new practices, and encode the new knowledge into its organization routines (Hartley and Jones, 1997). Sako (2004) interprets this approach as a buyer's attempt to transfer (or replicate) some aspects of its in-house organizational capability across firm boundaries.

The two foregoing approaches differ greatly in many aspects, such as the degree of buyer's investment and involvement. However, both of them reveal that SD involves knowledge sharing from the buyer to supplier. Even though both approaches help the buyer achieve its ultimate goal, they are not able to explain how the improvement of performance and/capability is achieved.

2.4 Taxonomies of Supplier Development Activities

As shown in Table 2-2, Previous studies have classified SD by various perspectives such as SD Objectives (e.g., Hartley & Jones, 1997), the degree of buyer's involvement (e.g., Krause et al., 2000), and transaction cost (e.g., Humphreys et al., 2004).

Table 2-2: A Review of Supplier Development Taxonomies

Studies	Classified by	Types and Description
Hahn et al. (1990)	Supplier performance problems	Supplier development activities matrix is classified by two dimensions: required supplier capabilities (technical, quality, delivery, and cost) and problem source (product-, process-, and systems-related).
Hartley & Jones (1997)	SD Objective	Result-oriented SD: activities which focus on solving specific production problems for suppliers. Process-oriented SD: activities which increase the supplier's capability for improvement.
Krause (1997)	Buyer's involvement	Enforced Competition: No firm commitment Incentives: Buying Firm Commitment Only If Supplier Improves. Direct involvement: Buying Firm Commits to Active Involvement in Supplier Development.
Krause et al. (1998)	SD Objective	Strategic SD: efforts to increase the capabilities of the supply base to enhance the buying firm's long-term competitive advantage. Reactive SD: efforts to increase the performance of laggard suppliers.
Krause et al. (2000)	Buyer's involvement	Internalized SD: activities which represent a direct investment of the buying firm's resources in the supplier. Externalized SD: activities which represent the use of the external market to instigate supplier performance improvements.
Humphreys et al. (2004)	Transaction cost	Transaction-specific SD: activities which represent buyer's direct involvement in developing suppliers (the core practice of SD) Infrastructure factors: the environment that supports effective use of transaction-specific activities
Sako (2004)	Organizational capability	Supplier development activities are classified along two dimensions: type of capability (three levels: maintenance, evolutionary, dynamic) and scope of activity (ranging from a specific component to the whole firm).
Sanchez-Rodriguez et al. (2005)	Implementation	Basic SD: activities that require the most limited firm involvement and minimum investment of the company's resources. Moderate SD: activities characterized by moderate levels of buyer involvement and implementation complexity, therefore requiring comparatively more company resources than basic SD. Advanced SD: activities characterized by high levels of implementation complexity and buyer involvement with suppliers, therefore, requiring more company resources than the other two.
Wagner (2006a, 2006b, 2010)	Buyer's involvement	Direct SD: activities which represent buyer's active role and human and/or capital resources dedicated to a specific supplier. Indirect SD: activities which represent no or only limited resources committed by the buyer to a specific supplier and no active involvement of the buyer in supplier's operation.
Blonska et al. (2013)	Development goal	Capability Development: activities which aim to enhance the efficiency of supplier operations through the achievement of performance-related benefits, such as reduced cost, greater quality and flexibility, and shorter product development cycle times. Supplier Governance: activities which increase supplier compliance with buyer needs and requests.

Hartley & Jones (1997) demonstrate that process-oriented SD activities help suppliers sustain and continue the change process, and therefore are more effective in building a supplier's capability for improvement. Compared to the reactive approach, the strategic approach requires significantly greater levels of resource commitment, but it can bring more benefits such as more responsive suppliers and higher levels of supplier input, all of which are more likely to yield a competitive advantage for the buyer (Krause et al., 1998). Sanchez-Rodriguez et al. (2005) think basic SD activities are first implemented because they require the minimum involvement and resources dedicated by the buyer.

Krause et al. (2000) categorize SD strategies as externalized or internalized activities. Externalized SD initiatives such as supplier incentives, supplier assessment, and competitive pressure represent the way that firms make use of the external market to instigate supplier performance improvements. Internalized activities, such as training and site visits, represent a direct investment of the buying firm's resources in the supplier. Correspondingly, Wagner (2006a, 2006b, 2010) puts forth the notions of indirect and direct SD activities, asserting that they are the same as externalized and internalized SD activities, respectively. In addition, Humphreys et al. (2004) point out that SD activities are classified into transaction-specific SD and infrastructure factors of SD. While transaction-specific SD represents direct involvement of the buying company in developing suppliers, infrastructure factors comprise the environment that supports effective use of transaction-specific SD activities.

All of these taxonomies contribute to our understanding of SD strategies, but there are confusions across different taxonomies, even for those based on the same theory. Using transaction cost economics, Krause (1999, p. 206) contends that "supplier development

represents a transaction-specific investment by a buying firm in a supplier" and uses the construct *transaction-specific supplier development activities* to cover all SD activities such as supplier evaluation, certification programs, training, and site visits. Later, however, Krause et al. (2000) indicate that only direct involvement activities, such as training and education of a supplier's personnel, represent transaction-specific investments (i.e., internalized SD); other SD strategies, such as supplier incentives, supplier assessment, and competitive pressure, are treated as externalized SD. In contrast, Humphreys et al. (2004, p. 132) contend that transaction-specific SD not only encompasses buyer's direct investments in a supplier, but also includes buyer's expectation for supplier performance improvement and joint action between both parties. More recently, Ghijsen et al. (2010) introduce the notion of relationship-specific SD activities. From their description and examples, I can see that relationship-specific SD activities are comparable to transaction-specific SD activities, even though their names are different.

In addition, same SD activities are categorized into different types within taxonomies. For example, Krause (1999) considers supplier evaluation as a transaction-specific SD activity, but Humphreys et al. (2004, 2011) view it as one of the infrastructure factors of transaction-specific SD activities. Furthermore, the relationships among multiple types of SD activities are unclear. Krause et al. (2000) find that externalized SD activities are key enablers of internalized SD activities, indicating that one type of SD precedes the other type. However, Humphreys et al. (2004) argue that the infrastructure factors of supplier development, such as supplier evaluation, support effective use of transaction-specific SD

activities, indicating the moderation effect of one type of SD on the influence of the other type.

2.5 Measurements of Supplier Development

SD consists of many activities. Therefore, in practice, how to measure this construct is a question. Through an extensive review of existing studies, I find this construct is measured by various approaches (see Table 2-3). Wen-li et al. (2003) identify seven key factors of supplier development and recognize them as supplier development elements. They further indicate that these elements are reliable and valid instruments for measuring supplier development practice. However, this measurement is problematic because it mixes up determinants (e.g., long-term strategic goals, top management support) with elements (e.g., supplier evaluation, direct supplier development).

Based on the data collected from respondents, who are asked to indicate the extent to which their firms engaged in various SD activities, Krause (1997) uses explanatory factor analysis to yield three factors: enforced competition (no commitment), incentives (commitment if supplier improves), and direct firm involvement (commitment to active involvement).

The review of SD measures yields several important conclusions. First, many studies consider all of a firm's supplier relationships in aggregate (e.g. Sanchez-Rodriguez et al., 2005). However, such a measurement approach ignores the diversity of supplier relationships within a buying firm's supply base. It is very important to consider individual supplier relationships when studying SD for avoiding compound effects of multiple relationships. For instance, Krause (1997) asks respondents (i.e., buying firms) to focus their responses on a single supplier with which their firms had made any efforts

to increase its performance or capabilities. Second, existing studies hold cumulative views of SD in which the SD construct is operationalized as a composite of disparate SD activities. However, such views cannot show why specific SD activities work. Therefore, I adopt the episodic view in this dissertation.

Table 2-3: A Review of Supplier Development Measurement

Measurement Methods	Example Studies (including measurement)
A factor with multiple items	• Scannell et al. (2000): supplier development • Carr & Kaynak (2007): supplier development support
A list of multiple factors with multiple items	• De Toni & Nassimbeni (2000): formalized vendor rating/ranking procedure, organizational integration devices, supplier assistance training, contractual incentives • Krause & Scannell (2002): supplier assessment, supplier incentives, direct involvement, competitive pressure • Wen-li et al. (2003): seven factors, including long-term strategic goals, effective communications, partnership strategy, top management support, supplier evaluation, direct supplier development and perception of supplier's strategic objective. • Sanchez-Rodriguez et al. (2005): three factors, including basic, moderate, and advanced supplier development • Wagner (2006a): two factors, indirect and direct supplier development • Kim (2006): effective communication and buyer's involvement • Li et al. (2007): five factors, including asset specificity, joint action, performance expectation, and trust • Modi & Mabert (2007): four factors, including competitive pressure, evaluation, incentives, and direct involvement (operational knowledge transfer activities) • Krause (1997): enforced competition (no commitment), incentives (commitment if supplier improves), and direct firm involvement (commitment to active involvement)
A hierarchy of factors with multiple items	• Krause et al. (2000): three externalized supplier development factors (competitive pressure, supplier assessment, and supplier incentives) and one internalized supplier development factor (direct involvement). • Wagner (2006b): four indirect supplier development factors (occasional supplier evaluation, regular, planned and proactive supplier evaluation, supplier evaluation system and process, and communication) and two direct supplier development factors (human resource and know-how commitment, transfer of capital resources to the supplier) • Humphreys et al. (2004): four transaction-specific supplier development factors (Performance expectation, Human-asset specificity, Physical-asset specificity, and Joint action) and seven Infrastructure factors of supplier development (Strategic goals, Top management support, Effective communication, Long-term commitment, Supplier evaluation, Supplier strategic objectives, and Trust)

2.6 Supplier Development Episode

In the communication literature, an episode has been defined as "rule-conforming sequence of symbolic acts generated by two or more actors who are collectively oriented toward emergent goals" (Frentz & Farrell, 1976, p. 336). When an actor is unable or unwilling to accomplish a goal without assistance of other actors, an episode may occur (Holsapple et al., 1996). Within an episode there can be multiple interactions or acts. Accordingly, Liljander and Strandvik (1995, p.78) define an episode as "an event of interaction which has clear starting point and an ending point". This concept has been examined in multiple research areas such as business marketing (e.g., Anderson, 1995), service marketing (e.g., Liljander and Strandvik, 1995), and knowledge management (e.g., Holsapple et al., 1996).

Here, I note that researchers have made an important distinction between relationships and interaction episodes. Relationships capture characteristics that are more generalized and longer-term than interaction episodes. An episode involves specific transactions or interactions, while relationships are (conceptually) higher-level manifestations of connected episodes. A relationship consists of a number of interaction episodes, and interaction episodes are comprised of actions associated with exchange and adaption between firms (Liljander and Strandvik, 1995; Schurr, 2007). Therefore, relationships and interaction episodes represent two different levels of analysis. This study will focus on the episode level, rather than relationship level. Supplier development episodes are one of many interaction episodes which can facilitate buyer supplier relationship development.

The definition of supplier development and previous literature indicate that supplier development can be studied in an episodic view. Arroyo-López et al. (2012) present that a supplier's participation in a supplier development program can be treated as one set of episodes among many other episodes in the relationship with the buyer. Therefore, I conceptualize the term of supplier development episode (SDE). Such an episodic view can help researchers understand specific details occurring in a SD program.

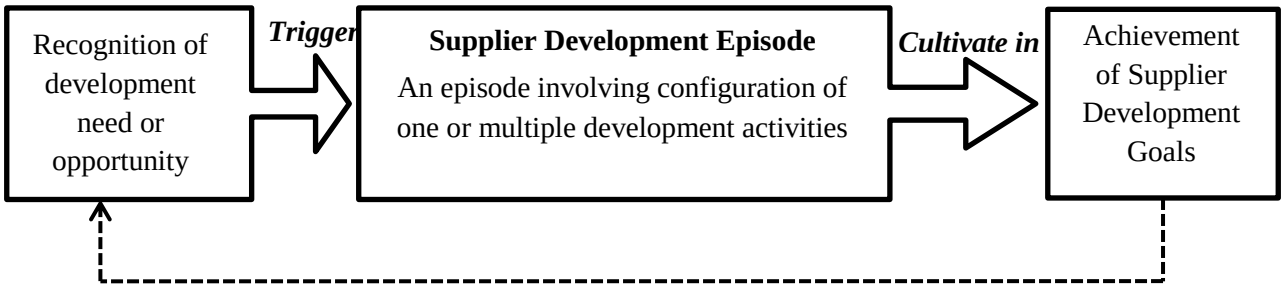


Figure 2-3: An episodic View of Supplier Development

Each SD episode is a short-term event, with a clear starting point and an ending point. In addition, each SD episode has specific goals, which are set up by both buyer and supplier before the episode commences. Each SD episode involves intensive interactions between buyer and supplier's employees and systems. For instance, when a buyer provides its supplier with a quality management training program, this program involves both buyer and supplier and aims to improve supplier's quality management skills. A SD episode may involve a single or multiple subsidiary activities. For instance, supplier evaluation covers developing measures, applying measures, and providing the evaluation feedback. This dissertation will collect all SD episodes from existing literature and examine whether/how knowledge management is involved in each SD episode. As shown in Figure 2-3, recognition of a development need between a buyer and supplier signals

the start of a SD episode, which will involve many subsidiary activities and end with achievement of SD goals.

2.7 Does Supplier Development Work: A Meta-Analysis

Despite many articles on this topic, there is no agreement on the relationship between SD activities and their outcomes. For instance, Modi and Mabert (2007) find that evaluation and certification do not significantly affect supplier performance improvements, while Humphreys et al. (2011) find a significant influence. Wagner (2010) find direct supplier development doesn't lead to product and delivery performance while Wagner and Krause (2009) find that, knowledge transfer, a type of direct supplier development, greatly enhances product and delivery performance improvement. Therefore, a synthesis of current studies is necessary to proffer an integrated view of the relationship between supplier development activities and their outcomes.

Based on how prior studies measure supplier development, this study codes the measurement of supplier development as knowledge sharing (KS) activity or KS enabler. Studies which use both KS activities and KS enablers to measure supplier development are coded as Mix. Some examples are presented in Table 2-4.

Table 2-4: Supplier Development Coding in Meta-Analysis

Type	Example
KS activity	Knowledge Transfer (Wagner & Krause, 2009) Employee Exchange(Wagner & Krause, 2009) Human-Specific Supplier Development (Ghijsen et al., 2010)
KS Enabler	Supplier Evaluation & Feedback (Wagner & Krause, 2009) Promises (Ghijsen et al., 2010)
Mix	Quality Management Practices in Purchasing (Sanchez-Rodriguez & Hemsworth, 2005) Asset specificity (Li et al., 2007)

Terpend et al. (2008) review 151 articles published in four prominent U.S.-based academic journals between 1986 and 2005. They identify four supply chain performance

measures: operational, integration-based, capability, and financial outcomes. In addition, many studies such as Hong & Hartley (2011), Humphreys et al. (2004), and Kim (2006) measure supplier development outcomes from both supplier and buyer perspective. Therefore, it is reasonable to consider this perspective in measuring supplier development performance.

2.7.1 Research Approach

Given the extensive treatment that SD has received within prior literature, meta-analysis is an appropriate methodology to investigate whether SD works. Meta-analysis refers to "the statistical analysis of a large collection of analysis results for the purpose of integrating the findings" (Glass, 1976, p.3). The basic purpose of meta-analysis is to provide the same methodological rigor to a literature review that I require from experimental research and survey research. Some good examples of meta-analysis published in Management Science include Capon et al. (1990), Sabherwal et al. (2006), and Vanderwerf & Mahon (1997).

DeCoster (2004) provides a clear procedure about how to conduct meta-analysis, so this study follows their procedure. The key step in meta-analysis is to collect, calculate, and test effect sizes. Effect size refers to a statistical measure that describes the strength degree of relationship between factors is present in a sample or a population (Field, 2001; Cohen, 2013). Effect size could be gained from mean difference or correlation coefficients. This study collects correlation coefficients between supplier development constructs and supply chain performance constructs provided in current studies.

This study collects journal articles, published between 2002 and 2011, using Google Scholar and other database such as ABI/Inform and EBSCOhost. In addition, some

review studies such as Chen et al. (2011), Mortensen & Arlbjørn (2012) and Terpend et al. (2008) are used to obtain a comprehensive pool of related research.

Table 2-5: Literature Search Procedure Meta-Analysis

Filtering Procedure	Count	Percentage
Total empirical studies	73	100%
- Theory Building	23	31.5%
- Only adoption research	3	4.1%
- Not based on correlation	8	11.0%
- Only measurement	2	2.7%
- Not highly related	4	5.5%
- Not providing correlation matrix	3	4.1%
- Total	43	58.9%
Remainder	30	41.1%

Two of 30 articles use a two-sample approach (i.e., Krause & Scannell, 2002; Kotabe et al., 2003), so according to DeCoster (2004), each of them is coded as two studies. Therefore, this study includes 32 sample studies from 30 articles. In total, 5,421 subjects and 237 correlation coefficients are extracted from the 30 articles. Among the 237 correlation coefficients, 136 involve the relationship between supplier development constructs and their outcomes, the other 101 involve the relationship between different supplier development constructs.

DeCoster (2004, p. 34) provides a clear guideline for evaluating effect size:

- *If other meta-analyses have been performed in related topic areas, you can report the mean size of those effects to provide context for the interpretation of your effect.*
- *If no other meta-analyses have been performed on related topics you can compare the observed effect size to Cohen's (1992) guidelines:*

Because no prior meta-analysis studies have been done in supplier development, this study adopts the second approach. According to DeCoster (2004), “Cohen established the medium effect size (r=0.3) to be one that was large enough so that people would naturally recognize it in everyday life, the small effect size (r=0.1) to be one that was noticeably

smaller but not trivial, and the large effect size (r=0.5) to be the same distance above the medium effect size as small was below it" (p.34).

2.7.2 Brief Findings

After summarizing 136 correlation coefficients from 30 empirical studies, this study finds that the overall association between supplier development and it outcomes is 0.301 (sample: 4443), indicating that, supplier development works in general. Specifically, the weighted effect size between SD and buyer's performance is 0.298 (total sample size: 3,012) and the weighted effect size between supplier development and supplier's performance is 0.307 (total sample size: 2,407). All the two effect sizes are close or above 0.3, indicating that overall, supplier development does positively associate with supplier's performance and buyer's performance.

Moreover, the associations are stable when I measure SD from either KSA or KSE only: the weighted effect size between knowledge sharing activity and supplier development performance is .316 (total sample size: 4049) and the weighted effect size between knowledge sharing enabler and supplier development performance is 0.309 (total sample size: 1,449). However, the association is small when I measure SD using both KSA and KSE together: the weighted effect size between mixing knowledge sharing enabler with knowledge sharing activity and supplier development performance is .236 (total sample size: 1,272) . This finding is consistent with the finding in Wagner (2010), which finds that the supplier development performance is lower when different types of supplier development activities are combined together.

In addition, this study finds that the supplier development outcomes are mainly measured from the dimension of operation. Therefore, it further examines of the

relationship between supplier development and its operational performance. Overall, among nine effect sizes, five are between 0.1 (small) and 0.3 (medium) and four greater than 0.3. Mixed measure generates the lowest relationship with operation performance in all three contexts, which is consistent with Wagner's (2010). In particular, the relationship between KSA and BOP is a little bit greater than that between KSE and BOP, although both of them are greater than 0.3. Mixed measures generate the lowest relationship between supplier development and operational performance. The relationship between KSA and SOP generates higher effect size, but varies more greatly than that between KSE and SOP. Mixed measures generate the lowest relationship between supplier development and operational performance. Only few studies focus on the relationship between supplier development and buyer-supplier operational performance. All the three effect sizes are close to 0.3, although KSE generates the highest relationship with BS operational performance.

Table 2-6: Weighted Effect Size between Supplier Development and Operational Performance

Independent Variables	Dependent Variables	Number of studies	Number of correlations	Range of correlations	Sample size	Mean correlation	Weighted effect size
KSA	BOP	10	20	.08 to .46	1962	.296	.313
KSE	BOP	6	17	.13 to .51	993	.360	.319
Mix	BOP	3	5	.12 to .35	590	.217	.177
KSA	SOP	11	24	-.36 to .58	1447	.298	.333
KSE	SOP	4	6	.02 to .44	327	.273	.288
Mix	SOP	2	4	.02 to .58	227	.278	.236
KSA	BSOP	2	2	.13 to .46	455	.299	.299
KSE	BSOP	1	1	-	142	.352	.352
Mix	BSOP	2	2	.11 to .39	455	.248	.248

KSA: Knowledge sharing activity; KSE: Knowledge sharing enablers; Mix: include both KSA and KSE in one construct; BOP: buyer's operational performance; SOP: supplier's operational performance; BSOP: buyer-supplier operational performance.

CHAPTER 3 HYPOTHESES DEVELOPMENT

3.1 "Black Box"

I summarize research paradigms used or represented in extant studies to develop the link between supplier development and its outcomes. I first review the direct-impact paradigm which argues that supplier development has direct effect on performance improvement, then the knowledge-sharing paradigm which argues that supplier development leads to performance through knowledge sharing. This section ends up with introducing knowledge-management paradigm in supplier development.

3.1.1 The Direct-Impact paradigm

The direct-impact paradigm, which is described in Figure 3-1, assumes that SD activities can lead to performance directly. Many extant studies have employed this paradigm to examine SD outcomes. For instance, Humphreys et al. (2004) use the transaction cost theory and classify SD practice into transaction-specific SD and infrastructure factors of SD. Then, they argue that both of them have direct effects on the performance in terms of supplier performance improvement, buyer's competitive advantage improvement and buyer–supplier relationship improvement. Using social capital theory, Krause et al. (2007) build direct relationships between several SD activities (information sharing, supplier evaluation, and direct involvement) and buyer's performance (cost savings, quality, flexibility, and delivery). Li et al. (2007) apply the transaction cost theory to formalize their hypotheses that SD activities (asset specificity, joint action, performance expectation, and trust) lead to market responsiveness and operational effectiveness directly. The list of studies using this paradigm could go on and on: Ghijsen et al. (2010),

Li et al. (2003), Narasimhan et al. (2008), Prahinski & Benton (2004), Sanchez-Rodriguez et al. (2005), Sanchez-Rodriguez (2009), and Wagner (2006, 2010). Most studies in Appendix I use this paradigm. In aggregate, all these studies above support that SD does generate positive performance, no matter how SD outcomes are measured.

This direct-impact paradigm contributes to supporting the value of SD and confirming that various SD activities lead to heterogeneous performance measures, indicating that SD activities and performance measures could be matched in a certain way to achieve an optimal allocation (e.g. Humphreys et al., 2004). Some theories such as transaction cost economics (e.g. Li et al., 2007), social capital theory (e.g. Krause et al., 2007) and resource dependence theory (Carr et al., 2008) are introduced to explain why SD activities generate performance and more details are discussed in Section 3.3. However, those theories do not capture the *inside* of a SD program. Thus, SD and its outcomes are analogous to input and output, respectively; however, the process (how/why SD activities create value) is still a black box, as depicted in Figure 3-1.

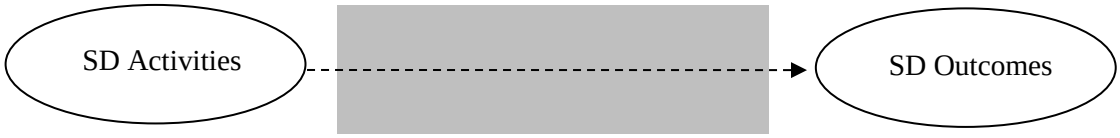


Figure 3-1: The Direct-impact Paradigm

Some studies use the direct-impact paradigm, but their arguments suggest that knowledge sharing could be the mediator between SD and its performance. For instance, when using social capital theory to explain why SD leads to performance improvement, Krause et al. (2007) present that "from a relational perspective, buying firms must determine what knowledge and resource investments are likely to yield benefits" (p. 530).

Therefore, the knowledge shared in SD helps buyer achieve its expected benefits. Similarly, when Ghijsen et al. (2010) discuss the relationship between SD and supplier satisfaction, they argue that "supplier often lack the know-how or resources to improve performance by themselves and appreciate help and support from the buyer" (p.20). Accordingly, their argument demonstrates that the knowledge shared between buyer and supplier promotes supplier satisfaction.

3.1.2 The Knowledge-Sharing Paradigm

The knowledge-sharing paradigm is based on the assumption that knowledge is critical for both supplier and buyer and therefore knowledge shared in SD lead to performance improvement. The knowledge-sharing paradigm, which is depicted in Figure 3-2, demonstrates that both supplier and buyer could not possess all the knowledge they need, and SD can facilitate knowledge sharing among supplier and buyer. Chen et al. (2011) summarize extant SD activities and find that they are strongly associated with knowledge sharing. Therefore, they classify SD activities as knowledge sharing activities and influencers. A knowledge sharing activity refers to a SD activity involving a direct knowledge transfer from one exchange partner to another, while the second refers to a SD activity which does not involve knowledge sharing directly, but influences (i.e., facilitates or hinders) knowledge sharing effectiveness. Relying on knowledge sharing between supplier and buyer, SD can lead to performance improvement.

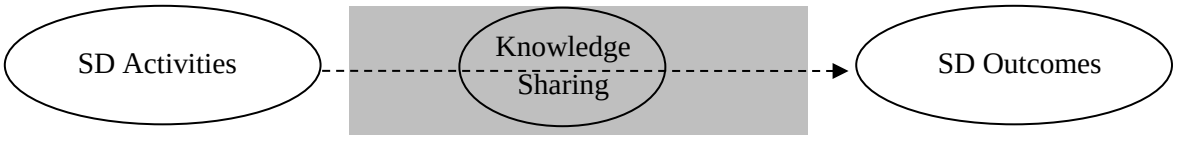


Figure 3-2: The Knowledge-sharing Paradigm

A review of over 100 studies, as shown in Appendix I, suggests that select studies draw from the knowledge sharing paradigm to formalize their research model or hypotheses, although they may not explicitly point it out. For instance, Krause et al. (2000) compare two models -- direct impact model and mediated impact model -- to examine the relationship between SD activities and performance improvement. Using survey data, they find that the mediated impact model, in which three SD activities lead to performance improvement through direct involvement, works much better than the direct impact model. In addition, Modi & Mabert (2007) use operational knowledge transfer activities as the mediator between three basic SD activities (i.e., knowledge sharing influencers) and supplier performance improvement. Some other studies directly examine the relationship between knowledge sharing constructs and SD performance. For instance, Kotabe et al. (2003) examine how technical exchange and technical transfer lead to supplier performance improvement. Similarly, Wagner & Krause (2009) examine the relationship between two knowledge-sharing constructs (knowledge transfer and employee exchange) and SD outcomes (product and delivery performance improvement and capability improvement).

The knowledge-sharing paradigm explains why SD activities yield positive performance. Nowadays, knowledge is recognized as an important resource for any organization, and therefore, both buyer and supplier benefit from knowledge sharing in SD. However, knowledge or knowledge sharing itself may not guarantee buyer or supplier performance improvements in SD. For instance, a buyer may acquire of valuable knowledge through SD, but if the knowledge could not be embedded or applied to the firm's business due to some reasons (e.g. causal ambiguity, lack of absorptive capacity),

the valuable knowledge does not exert its value and thus performance improvement may not be achieved in knowledge sharing. Accordingly, the value is generated by the application or implementation of the new knowledge to buyer's or supplier's business, including product, process, service, market, and administration. Therefore, a systematic management of knowledge in SD can further facilitate the understanding of why SD works.

3.2 Knowledge Management in Supplier Development[3]

3.2.1 Knowledge and Knowledge Management

The knowledge-based view of the firm has identified knowledge as the most strategically-significant resource of a firm and views a firm is as an institution for integrating knowledge (Grant, 1996a, b). Accordingly, the fundamental role of an organization is to integrate various knowledge resources. Holsapple and Joshi (2004a) point out that knowledge has a variety of attributes such as mode (tacit vs. explicit) and type (descriptive vs. procedural vs. reasoning). Their knowledge resource (KR) taxonomy describes the portfolio of an organization's knowledge resources and classifies them into two classes: schematic and content resources. Whereas schematic KRs such as culture and strategy depend on the organization for their existence, content KRs such as employees' knowledge and video training tapes exist independently of an organization to which they belong. Schematic KRs are the basis for attracting, organizing, and deploying content KRs, which in turn populate, instantiate, and enrich the frame of reference furnished by schematic KRs (Holsapple and Joshi, 2004b). Together, the two classes of KRs are available for internal knowledge integration. However, when its own KRs alone

[3] This subsection is adapted from Chen et al. (2015) at *Knowledge Process and Management*.

are not able to support development of organizational capabilities, an organization can augment and replenish its knowledge resources through interaction with its external environment. The environment's knowledge resources can facilitate external integration of knowledge.

The concept of knowledge integration can be subsumed in the knowledge management (KM) ontology in which knowledge management is defined as "*an entity's systematic and deliberate efforts to expand, cultivate, and apply available knowledge in ways that add value to the entity, in the sense of positive results in accomplishing its objectives or fulfilling its purpose*" (Holsapple and Joshi, 2004a, p. 596). Similarly, Bock et al. (2006, p.357) define knowledge management as "*structured activities aimed at improving an organization's capacity to acquire, share, and use knowledge in ways that enhance its survival and success*". Both definitions suggest that KM includes a set of specific goal-driven activities or efforts which create value via processing knowledge. Integration of specialized knowledge involves multiple knowledge processors and, therefore, when a knowledge processor cannot accomplish a particular KM activity, then a KM episode is triggered (Holsapple et al., 1996). A KM episode refers to a pattern of activities performed by multiple processors with the intent of satisfying a knowledge need or opportunity (Holsapple and Joshi, 2004a, b). A KM episode may be independent of, or interdependent with, other episodes at a given time within an organization.

3.2.2 Knowledge Chain Theory

In order to explain how KM activities occurring in KM episodes result in increased organizational competitiveness, Holsapple and Singh (2001) draw from the KM ontology and advance the Knowledge Chain Theory (KCT). Analogous to Porter's value chain

theory, KCT identifies and characterizes five classes of first-order activities that organizations perform. These involve manipulation of knowledge resources. There are also four classes of second-order activities that capture managerial factors influencing and governing the conduct of those manipulation activities (Holsapple and Singh, 2001; Holsapple and Jones, 2004, 2005). As presented in Table 3-1, the five classes of first-order activities are knowledge acquisition, selection, generation, assimilation, and emission and the four classes of second-order activities are knowledge measurement, control, coordination, and leadership. In total, the nine distinct, generic classes of activities are available for an organization to perform in the course of managing its knowledge resources in an effort to attain better performance or competitive advantage. Empirical study of the KCT has found that any of the nine KM activities can be performed in ways that enhance competitiveness (Holsapple & Wu, 2011; Holsapple et al., 2015).

The five first-order classes of KM activities represent distinct processes within a KM episode and, together, facilitate knowledge flows in an organization (Holsapple and Joshi, 2004). A knowledge acquisition activity receives knowledge from the external environment, which includes buyers and suppliers, and then delivers the acquired knowledge to assimilation, generation, and/or emission activities. Obtaining knowledge from an entity's knowledge resources, a knowledge selection activity delivers the selected knowledge to generation, assimilation, and/or emission activities. Upon receiving knowledge flows from knowledge selection or acquisition, a knowledge generation activity may deliver the knowledge it derives or discovers to assimilation and/or emission activities. A knowledge assimilation activity delivers knowledge to the

entity's knowledge resources, subject to considerations such as filtering, validity, and security, after it receives knowledge flows from the knowledge acquisition, selection, and/or generation activities. Knowledge emission receives knowledge flows from knowledge selection, acquisition, and/or generation activities and, then, delivers it to targets in the environment, such as suppliers.

Table 3-1: A Brief Description of First- and Second-order KM Activities

Activity Class		Description	Sample Activities
First-order Classes	Knowledge acquisition	Identifying and acquiring K from external environment for subsequent use	Receiving external training, hiring an employee, obtaining data sets
	Knowledge selection	Identifying and selecting needed K from internal sources for subsequent use	Participating in in-house training, recalling failed or successful efforts
	Knowledge generation	Producing K through discovery or derivation from existing K	Devising/developing a strategy, data mining, making decisions/choices.
	Knowledge assimilation	Altering an organization's K resources by internally distributing and storing acquired, selected, or generated K	In-house training, internal storytelling, posting an idea on an intranet, publishing a policy manual
	Knowledge emission	Applying an organization's K to produce organizational outputs for release into the environment	Providing technical support, creating the product/service packages, sharing knowledge with external partners
Second-order Classes	Knowledge measurement	Assessing values of K resources, processors, and their deployment	Measuring knowledge resources, benchmarking
	Knowledge control	Ensuring needed K processors and resources available in sufficient quality and quantity	Control financial resources available for KM, Protect knowledge access
	Knowledge coordination	Managing dependencies among KM activities to ensure that proper processes and resources are brought to bear appropriately.	Establish communication patterns, provide incentives, and motivate employees
	Knowledge leadership	Establishing conditions that enable and facilitate fruitful conduct of KM	Aligning KM with business strategies, establishing KM culture

Note: K denotes knowledge and KM denotes knowledge management.

Knowledge flows into a firm, for instance, when its employees attend a lean six sigma course (i.e., knowledge acquisition), and then those employees may choose appropriate quality control skills for future use (i.e., knowledge selection), or offer an in-house training (i.e., knowledge assimilation), or create new knowledge by shaping it to the firm's context (i.e., knowledge generation), or share knowledge with suppliers to facilitate inter-organizational collaboration (i.e., knowledge emission).

The four classes of second-order activities represent managerial influences in the KM ontology. "The objective of KM within and across organizations is to ensure the right knowledge is available in the right forms to the right processors at the right times for the right cost in order to secure the right level of organizational performance" (Holsapple & Jones, 2005, p. 4). This objective cannot be accomplished without appropriate execution of second-order KM activities because they enable an organization to successfully conduct KM manipulation activities through managing knowledge resources, knowledge processors, knowledge flow conditions, and dependencies among KM activities. Whereas knowledge leadership establishes enabling conditions for fruitful execution of various KM manipulation activities, the other three classes contribute to establishing these conditions. For instance, knowledge coordination activities ensure that proper resources are brought to bear at appropriate times and integrate knowledge processing with organization's operations.

In addition, Holsapple and Jones (2004, 2005) further develop the KCT by identifying, in the literature, particular activities for each primary class and secondary class. Specifically, they uncover 32 and 29 distinct activity types for the five primary and

four secondary activity classes, respectively. For instance, knowledge assimilation includes four types such as formal internal publishing and informal internal interaction.

Overall, KCT contributes to the KM literature by identifying nine classes of knowledge chain activities, developing a typology of activity types for each class, and illustrating how knowledge chain activities lead to organization competitiveness. Importantly, the KCT indicates that each activity class can increase an organization's competitiveness through improved productivity, agility, reputation, and innovation (Holsapple & Singh, 2001, 2005; Holsapple & Jones, 2007). KCT has been applied to various KM issues (e.g., Holsapple & Jones, 2007; Tsai, 2008; Holsapple & Wu, 2011; Ponis & Koronis, 2012). For instance, based on KCT, Ponis & Koronis (2012) elaborate a process-based approach of crisis management, which identifies and determines a set of primary knowledge activities to support crisis management for each phase of the crisis' life cycle. Tsai (2008) leverages KCT to construct the knowledge diffusion model that integrates intra-firm and inter-firm diffusion processes simultaneously.

Recently, the KCT has been used at inter-organizational levels. For instance, Tseng (2009) develops a framework for explaining how a firm gains and transforms external knowledge (i.e., customer, supplier, and competitor knowledge) through knowledge acquisition, selection, generation, assimilation, and emission. Using case studies, he finds that all five first-order activities of the knowledge chain enhance the firm's competitiveness. In a follow-up study, Tseng (2012) empirically discovers that the knowledge chain plays a critical role as a full mediator between external knowledge and service quality. When external knowledge flows into a firm's knowledge base, it first influences the knowledge chain, and then the firm's competitiveness via service quality

(enhanced reputation). These studies demonstrate that KCT can help us understand how a firm acquires and leverages its external knowledge to create a competitive edge.

3.2.3 Knowledge Management and Supplier Development

There is a growing interest in connections between knowledge management and supply chain management. On one hand, due to intensive and efficient knowledge flows and knowledge sharing across organizations (Tseng, 2009), the research scope of KM has been extended from the intra-organization level to the inter-organization level (esp. supply chains). For instance, Sambasivan et al. (2009) examine the effect of two KM processes (i.e., knowledge acquisition and knowledge application) within the context of supply chain management. On the other hand, SCM scholars, noticing the importance of knowledge as a strategic resource in supply chains, demonstrate an increasing interest in investigating knowledge flow in supply chains or applying a KM perspective (or along with some other perspectives) to SCM phenomenon. For instance, Hult et al. (2006) posit that eight knowledge elements (e.g., knowledge memory, use, quality) are critical to forming ideal performance-driving profiles in supply chains. In a supply chain, information or knowledge flow is perceived to have a higher priority than product flow (Cook et al., 1995). Therefore, the management of knowledge across inter-firm boundaries provides a primary significant source of competitive advantage in a supply chain (Dyer and Nobeoka, 2002; Sambasivan, 2009). The knowledge acquired through external relationships or networking is seen as more relevant to the development of new capabilities than internal knowledge interchanges (Arroyo-López et al., 2012).

As one of the key SCM strategies, supplier development depends heavily on knowledge management activities between buyer and supplier. Let us use Toyota's

supplier development as an example. Toyota's supplier development involves two parallel teams: its Operations Management Consulting Division enhances core suppliers' evolutionary capability (i.e., capability for capability building) and the Purchasing Department for short-term fixing of problems and long-term capability enhancement (Sako, 2004). The two teams implement capability approach and performance approach, respectively. Together, they help Toyota build a competitive supply network around the world through a set of knowledge-oriented activities. Therefore, both aforementioned SD implementation approaches could be illuminated from a KM perspective.

Under the KM perspective, in SD, both personnel and computing systems from the buyer and supplier are knowledge processors and they process knowledge resources from both buyer and supplier. Among many KM theories, KCT is selected for the following reasons. First, KCT is concerned with value creation processes and can be used at both intra- and inter-organizational levels. Second, KCT identifies specific categories of KM activities, which allow us to match specific SD activities with KM activities. Third, the literature on SD implicitly or explicitly suggests the use of KCT (Arroyo-López et al., 2012; Asare et al. 2013; Nagatia and Rebolledo, 2013).

Empirical studies show that the use of SD activities creates a context that favors knowledge exchanges between buyers and suppliers (Krause, 1999; Krause et al., 2007; Modi & Mabert, 2007). Therefore, both buyer and supplier should create an environment conducive to acquisition and application of knowledge (Sambasivan et al., 2009). The literature supports the two classes of KM activities in KCT. In addition, SD involves specific KM activities identified in KCT. For instance, Nagatia and Rebolledo (2013) suggest that by participating in SD activities, suppliers can acquire and assimilate

knowledge transferred by buyers. Arroyo-López et al. (2012, p. 687) point out that "suppliers with high learning intent would be more proactive to knowledge acquisition and put more effort to diffuse and internalize the knowledge transferred by customers". In conclusion, KCT can help us systematically examine SD from a KM perspective.

3.3 Key Variables from Existing Theories

Because the knowledge sharing paradigm was discussed in Section 3.1.2, this subsection identifies key variables from three commonly-used theories (transaction cost economics, resource dependence theory, and relational capital theory) and two emerging theories (motivational theory and goal setting theory), presents how they have been used to explain why SD works, and indicate that their combination with KCT variables can generate a better explanation for why SD works.

3.3.1 Asset Specificity

Transaction cost economics (TCE) explicitly views the organization as a governance structure. The central thesis of TCE is that transaction attributes – uncertainty, asset specificity, and frequency of exchange – are the primary determinants of governance (Rindfleisch & Heide, 1997). In the context of buyer-supplier exchange, TCE logic suggests that market relationships characterized by high levels of asset specificity, frequent exchange, and uncertainty necessitate forms of interfirm governance that proximate hierarchical coordination to stem risks associated with opportunistic behavior (Williamson, 1991). From the review table included in Rindfleisch & Heide (1997), asset specificity, which refers to "the transferability of the assets that support a given transaction" (p.41), is most frequently used by scholars among the three determinants.

SD efforts represent transaction specific investments in the supplier by the buying firm (Krause et al., 2000). TCE is appropriate to explain why a buying firm adopts a SD program; however, SD studies, such as Li et al. (2007, 2012) and Ghijsen et al. (2010), apply TCE to explain why SD works. Assets with a high level of specificity represent sunk costs that have little value outside of a particular exchange relationship (Rindfleisch & Heide, 1997; Joshi & Stump, 1999). Such a relationship-specific investment could make a supplier more willing to make customized items for its customer, and allow both parties more communicate efficiently (Humphreys et al, 2004). Thus, the supplier is able to reduce their cost and increase their quality. However, TCE has at least two major limitations when used to analyze interorganizational strategies: (i) a single-party, cost minimization emphasis that neglects the interdependence between exchange partners in the pursuit of joint value and (ii) an over-emphasis on the structural features of interorganizational exchange that neglects important process issues (Zajac and Olsen, 1993). As a process theory, KCT is helpful for understanding how buyer and supplier collectively perform KM activities in a SD program to pursue joint value. Using an episodic view, KCT describes specific KM processes in a SD program. Thus, the combination of KCT and TCE can yield a higher explanation power in predicting supplier performance improvements.

3.3.2 Supplier Dependence

Resource dependence theory (RDT), similar to TCE, considers the uncertainties and risks that stem from an organization's dependence on its environment for needed resources (Pfeffer and Salancik, 1978). Consistent with the prescriptions of RD theory, differences in resource dependence facilitate power differentials that may be exploited by exchange

partners (Emerson, 1962). Hence, RD theory is largely concerned with behaviors and formal and informal governance structures that enable firms to access needed external resources while minimizing uncertainty and risk (Smeltzer and Siferd, 1998). Dependence between two parties can motivate them to develop cooperative norms (Cai and Yang, 2008). Previous SD studies leverage RD theory to suggest that SD represents a potent means to establish relational governance structures that can attenuate the risks associated with resource dependence (Cai et al., 2009).

Like TCE, RDT can be used to explain why a buying firm adopts a SD program with a particular supplier (Carr et al., 2008). As a relationship magnitude, supplier dependence has been consistently found as a critical predictor of collaborative behaviors between buying and supplying firms (Thomas et al., 2011; Terpend et al. 2008). When examining the effect of SD on performance improvements, supplier dependence is usually treated as a control variable (e.g. Ghijsen et al., 2010; Blonska et al., 2013). KCT can describe what buyer and supplier really does during a SD program, and thus the model including both KCT variables and supplier dependence can generate a higher explanation power than that including only supplier dependence.

3.3.3 Relational Capital

Social capital has been recognized as a valuable asset made available through social relationships (Granovetter, 1992). It includes three dimensions: structural, cognitive, and relational. The effects of social capital on relationship performance are conveyed by relational capital (Tsai & Ghoshal, 1998; Carey et al., 2011; Kohtamäki et al., 2012; Blonska et al., 2013), and thus, this study focuses on relational capital. Relational capital, which refers to the strength of the relationship between organizations (Granovetter, 1992),

provides a profound sense of the partner's reliability and faithfulness in resource exchanges (Moran, 2005). It consists of three components: trust, reciprocity, and affective commitment (Blonska et al., 2013).

SD is a reciprocal program that requires mutual commitment and recognition from both buyer and supplier (Humphreys et al., 2004). As a soft "safeguard", relational capital can help overcome concerns about the potential risk resided in SD investments. Relational capital can facilitate shared understanding between the buyer and its supplier. With the existence of relational capital, suppliers likely reciprocate investments made by buyers and are more willing to cooperate and participate in knowledge sharing or joint problem solving, and thus the effectiveness of SD investments increases (Blonska et al., 2013). When KM efforts are added to predict supplier performance together with relational capital, the model will have a higher explanation power.

3.3.4 SD Motivation

Motivation is considered as one of the key factors determining individual performance (Davidoff, 1987). Motivation is "a process that starts with physiological or psychological deficiency or need that activates a behavior or a drive that is aimed to a goal of incentive" (Kaila, 2006, p.64). Put simply, motivation represents the desire to get the job done. There is an extensive body of knowledge on motivation (Latham, 2011). Siemsen et al. (2008) point out that "motivational theories provide a framework for predicting individual behaviors, but researchers rarely measure or model motivation as a distinct construct". There are many different types of motivation, but this study focuses task motivation, which refers to the degree to which an individual is engaged in a specific job or task.

Applying this concept to the SD field, SD motivation can be defined as buyer's or supplier's willingness to engage itself in a specific supplier development activity, whether or not this motivation is extrinsic or intrinsic. As a buyer or supplier is highly motivated in an SD program, it will be more willing to exert efforts or resources to perform the task and achieve SD goals. Even though some SD literature contends that supplier motivation plays an important role in facilitating supplier performance (Giunipero, 1990; Handfield et al., 2000; Mortensen & Arlbjørn, 2012; Mohanty et al., 2014), very rare studies have examined it empirically. Even though supplier motivation can drive supplier performance, it alone may not be insufficient to achieve the desired outcomes if appropriate process infrastructure or conformance to operational processes is absent (Joshi, 2009). KCT describes specific KM activities and processes which may occur in a SD program, and thus the introduction to the motivational model can better predict supplier performance improvements.

3.3.5 Goal Congruence

As an underlying motive, goals direct individuals to conduct intentional behavior. Goal congruence occurs when multiple players, with varying goals, are involved. Goal congruence refers to the extent to which different parties agree on their common objectives and values. The issue regarding goal congruence is not whether the goal is of higher or lower priority, but whether the goal is explicitly recognized by different parties or not (Witt, 1998). Goal congruence has been found to be positively associated with positive outcomes in the context of supply Chain Management (Jap & Anderson, 2003; Samaddar et al., 2006; Yan & Dooley, 2013).

In SD, buyers and suppliers may have different goals. If both buyers and suppliers can hold common values or objectives, they are intrinsically motivated to adopt cooperative behaviors, such as dynamic communication and mutual support (Jap & Anderson, 2003). When the buying firm's goals are aligned with it supplier's goal, the supplier is more likely to invest its resources and efforts in a SD program. In contrast, if they pursue different goals in a SD program, their resources cannot be appropriately allocated and it will be difficult to achieve desired SD outcomes. However, like SD motivation, goal congruence does not involve any activities or elements occurring in a SD program. When a model includes both KM variables and goal congruence, it can present mode details about why SD works. For instance, Samaddar et al. (2006) find that buyer-supplier goal congruence can lead to inter-organizational knowledge sharing.

3.4 Research Hypotheses

Based on previous discussions and literature review, this dissertation raises the following main hypotheses:

H1: *Buyer's knowledge sharing in SD is positively associated with supplier's performance improvements.*

H2: *Knowledge management in SD is positively associated with SD outcomes.*

- H2a: *Supplier's KM effort in SD is positively associated with supplier's performance improvements.*
- H2b: *Buyer's KM effort in SD is positively associated with supplier's performance improvements.*
- H2c: *Buyer's KM effort in SD is positively associated with buyer's performance improvements.*

H3: *When KCT is combined with traditional theories in predicting SD outcomes in terms of supplier's performance improvement, the prediction power will be higher.*

H3a: *When KM is combined with buyer asset specificity and supplier asset specificity (Transaction Cost Economics), the explanation power will be higher*

H3b: *When KM is combined with supplier dependence (Dependence Theory), the explanation power will be higher.*

H3c: *When KM is combined with relational capital (Social Capital Theory), the explanation power will be higher.*

H3d: *When KM is combined with supplier motivation (Motivation Theory), the explanation power will be higher*.

H3e: *When KM is combined with Goal congruence (Goal Setting Theory), the explanation power will be higher*.

H3f: *When KM is combined with knowledge sharing (Knowledge Sharing Perspective) the explanation power will be higher*.

H4: *When variables culled from alternative theories are controlled,*

H4*a: Supplier's KM effort is still positively associated with supplier's performance improvements.*

H4b: *Buyer's KM effort is still positively associated with supplier's performance improvements.*

CHAPTER 4 CONCEPTUAL EXAMINATION

In order to bring greater clarity to connections between supplier development and its consequences, this chapter[4] leverages the knowledge chain theory to capture buyer's and supplier's knowledge management activities in supplier development. Through an extensive review and systematic classification of supplier development activities in the literature, this chapter generates a reliable catalog of supplier development activities, supports the knowledge management perspective, and reveals the extent to which supplier development activities are knowledge-based activities. In addition, this chapter generates an integrated definition, a meaningful taxonomy, and a comprehensive implementation approach for supplier development and illuminate how positive performance and capability consequences of supplier development can be achieved by design and implementation of knowledge activities within the thirty SD types.

4.1 Five-step Research Method

In order to understand how supplier development is subsumed under the KM perspective, I use a five-step method. First, I conduct an extensive literature search for journal articles that study at least one supplier development activity. Second, I collect a large number of supplier development activities explicitly described in the search results. Third, the set of candidate activities is shortened by eliminating duplicates and consolidating items having the same emphasis, but explained with different phrasings. Fourth, consolidated candidate activities are further clustered into distinct activity types, each of which is given a brief description, yielding an extensive catalog of supplier development activities.

[4] This chapter is adapted from Chen et al. (2015) at *Knowledge Process and Management*.

Fifth, I investigate whether and how each activity type matches with one or multiple knowledge chain activities.

I begin by identifying SD articles that serve as the basis for our analysis. The intent of this phase is to assemble articles that collectively cover the wide variety of SD perspectives. To guide this identification of relevant research articles, I employ several search criteria. In particular, I consider only those articles that were recently published in refereed academic journals and that directly address at least one SD activity in a concrete fashion. To emphasize real-world relevance, I limit the analysis to include empirical studies only, because their data come from surveys or interviews of practitioners. Accordingly, I omit abstract, modeling, or conceptual SD studies from our analysis.

The article-identification phase yields 92 articles published between 1996 and 2010, for an average of six articles per year. The reason I use 1996 as a starting point is that the broad perspective of supplier development raised by Hahn et al. (1990) and Watts and Hahn (1993) has been generally used since that year. Another consideration is that the number of empirical SD studies has been increasing since 1996. I believe that a 15-year window is sufficient for collecting a set of diverse SD activities.

I find that both quantitative and qualitative research approaches have been used to study supplier development phenomena. Further, I find that supplier development research adopts a buyer's perspective, a supplier's perspective, or both. Moreover, relevant articles appear in a variety of journals. Unsurprisingly, most articles come from journals devoted to supply chain management, but they also come from many journals devoted to the reference discipline of operations management (most notably, the *Journal of Operations Management*). Relevant articles are also evident in journals of other

reference disciplines, such as strategy, and in multi-disciplinary journals (e.g., *Decision Sciences*). In addition, authors of the 92 articles represent diverse countries and their data (via survey or interview) cover various industries and countries. Together, these traits suggest that the sample of articles encompass a wide range of perspectives.

The intent of the collection phase is to assemble a relative comprehensive set of SD activities. For each sample article, the SD activities being studied are identified as follows. For survey-based studies, the activity candidates are drawn mainly from their respective questionnaire instruments. For other studies, SD activities are drawn mainly from the articles' finding and discussion sections. In any case, each article is carefully examined to ensure that all SD activities studied are identified. Most articles yield several SD activities. During this phase, I make each activity candidate as specific as possible. Most candidates drawn from sample articles referred to only one specific activity. In a few cases, which include multiple emphases in their descriptions, the candidate is divided into multiple activities. For instance, "evaluate suppliers' operation and provide feedback to help them to improve" (Carr and Kaynak, 2007) is coded as two activities: "evaluate suppliers' operation" and "provide feedback to help suppliers to improve." The collection phase yields a set of 565 SD activities, which were saved in an MS Excel worksheet, along with the sample article where they originate. On average, each article mentions 6.14 SD activities.

The intent of the consolidation phase is to make the set of SD activities as parsimonious as possible. I first eliminate duplicate activities. This greatly shortens the list of SD activities, indicating that many studies study the same SD activity, albeit in different settings. Among those remaining, activities with the same emphasis, but

different phrasing, are consolidated into a single activity reflecting that emphasis. For instance, "formal assessment of supplier's performance" and "formal, periodic written evaluation of suppliers' performance" are consolidated into a single SD activity "formal evaluation of supplier's performance." Upon completion of the consolidation phase, over 100 of candidate activities remain. In order to generate a more concise codebook, the set of activities is further consolidated by conducting a "conceptual factor analysis" that clusters remaining activities with similar purposes into a single activity type. For instance, the activities of formal evaluation of supplier's performance, informal supplier evaluation, evaluating supplier's capabilities, and supplier audit are not the same activity with different phrasings. However, because these activities are interpreted as having the same pattern or purpose, they are clustered into the activity type "supplier evaluation". Out of the over 100 consolidated activities, such clustering yields 30 distinct activity types.

I assign a brief name and description to each resultant activity type, yielding a complete taxonomy of SD activities. In order to check whether our consolidation and clustering are reliable, I recruit an MBA student to code the original list of activities into 30 activity types based on the codebook. The inter-coding agreement is extremely high, with the few disagreements being resolved by discussion. The intent of final phase is to bring order to the 30 activity types by determining whether and how each activity type fits into the knowledge chain theory. During this phase, I refer to typologies of first-order and second-order activities developed by Holsapple and Jones (2004, 2005) and the codebook. Interestingly, most SD activity types directly fit into KCT. Instances of disagreement are resolved by group discussion. It turns out that all activity types can be

mapped into at least one knowledge chain activity. The next section presents findings from the final two phases.

4.2 Research Results

4.2.1 An Overview of Supplier Development Activities

The 30 SD activity types derived from the SD literature are shown in Appendix II. Along with each, there are examples of how prior studies have defined or illustrated the SD activity.

Table 4-1 portrays the definitions that I advance for each of the activity types. Each is devised to subsume variations of the SD activity type, such as those exemplified in Appendix II. For example, the Co-Location (SD17) definition is designed to accommodate such variants as "assign support personnel to this supplier's facilities" (Krause et al., 2007; Humphreys, 2004; Li et al., 2003), "co-location of engineers to supplier facilities" (Krause et al., 1998), "co-located or 'guest' engineers" (Dyer, 1996), and "provide individual assistance to suppliers at their facilities" (Sako, 1999).

Table 4-2 categorizes SD activity types based on the attention they have received, from studies in the sample. The degree of attention is measured in terms of relative frequency, which I divide into the ranges shown in the table. Among the 30 SD types, supplier evaluation (SD1), supplier training (SD2), and information sharing (SD9) have received the highest degree of attention. Over 50% of the sample's articles use them to represent or capture a supplier development program. On average, each article mentions approximately 5.5 SD types, and all articles except one study at least two SD types, indicating that multiple SD types are usually studied at a same article.

Table 4-1: Catalog of Supplier Development Activity Types

No.	Brief Name	Brief Description
SD1	Supplier Evaluation	Evaluate supplier's performance in formal or informal process
SD2	Supplier Training	Provide training or education to supplier's personnel in any area
SD3	Direct Incentive	Recognize supplier's achievements/performance in the form of awards
SD4	Performance Expectation	Increase or set supplier performance goals
SD5	Financial Support	Provide capital for new investments or direct investment
SD6	Physical Asset Support	Provide equipment, tools or/and new production line
SD7	Technical Assistance	Provide technical support/assistance or solve technical problems
SD8	Managerial Assistance	Provide support/assistance in QM, inventory management, etc.
SD9	Information Sharing	Share/exchange all kinds of information (e.g. product, quality, product process, volumes, overall corporation direction, price development, and market conditions) to help suppliers
SD10	Supplier rating	Rank supplier's performance through a rating system
SD11	Supplier Involvement	Involve suppliers in some activities such as NPD,
SD12	Plant Visit	Visit regularly to supplier's plant/site
SD13	Invite Supplier to Visit	Invite suppliers' personnel to buyer's site
SD14	Dynamic Communication	Communication/interaction/contact with supplier's personnel, including two-way, face-to-face, open forms
SD15	Supplier Certification	Use certification program to certify supplier's quality
SD16	Competitive Pressure	Invent new suppliers or use multiple suppliers for purchased some items to create pressure
SD17	Co-Location	Assign support personnel to the supplier's facilities, or guest engineers
SD18	Supplier Council	Build supplier council for supplier's feedback on buyer's performance
SD19	Quality Emphasis in Supplier Selection	Select suppliers according to quality first
SD20	Supply base reduction	Reduce/narrow down the number of suppliers
SD21	Community of Suppliers	Facilitate learning/information sharing networks among suppliers
SD22	Promise of Business	Promise of current or future benefits/business, or extension of long-term contracts to suppliers
SD23	Supply base management	Supply base rationalization or integration to meet buyer's needs
SD24	Quality Assurance	Assurance of supplier quality or supplier auditing
SD25	Employee Exchange	Employee rotation/transfer/exchange between buyer and supplier
SD26	Clear Specification	Clarify buyer's specifications; provide product/technical specification
SD27	Trust Building	Build mutual trust/credibility; trust supplier
SD28	Evaluation Feedback	Provide feedback about evaluation results; point out supplier's problem
SD29	Joint Action	Collaboration/cooperation/work with suppliers in some areas
SD30	Buyer's Involvement	Buyer's involvement in supplier's business, e.g. process improvements, planning and goal-setting activities, etc.

Table 4-2: Attention Given to the Thirty SD Activity Types

Degree of attention	Criteria: relative frequency of occurrence	Specific SD activity types (frequency of occurrence)	Total #
Very High	At least 1/2 (46) of sample articles	Supplier training (47), supplier evaluation (46), information sharing (46)	3
High	At least 1/4 (23) of sample articles	Direct incentive (31), joint action (29), supplier involvement in NPD (28), technical assistance (28), dynamic communication (27)	5
Moderate	At least 1/8 (12) of sample articles	Managerial assistance (22), evaluation feedback (21), supplier certification (19), plant visit (18), performance expectation (15), financial support (14) , co-location (13)	7
Rare	At least 1/16 (6) of sample articles	Invite supplier to visit (10), supply base reduction (10), physical asset support (9), competitive pressure (8), promise of business (8), supplier rating (8), community of suppliers (7), quality assurance (7), trust building (6)	9
Very rare	Less than 1/16 (6) of sample articles	Clear specification (5), quality emphasis in supplier selection (5), employee exchange (4), buyer's involvement in supplier's business (4), supply base rationalization (3), supplier council (2)	6

An examination of the 30 SD activity types finds that all of them are initiated by the buyer. However, the supplier's role and efforts cannot be ignored in supplier development; otherwise, an SD program cannot achieve its goal effectively. For instance, a buyer provides its supplier with a training program to improve a supplier's cost management capability. However, this program cannot achieve its goal without the supplier's active participation and dedicated learning. Another example is supplier evaluation, in which the buyer develops and applies an assessment mechanism to measure the supplier's performance and capability, while the supplier is encouraged to provide precise information about its operations, attitudes, and expectation. Therefore, although buyer-initiated, supplier development involves bilateral efforts of both buyer and supplier (Krause & Handfield, 1999).

4.2.2 First-Order KM Activities in Supplier Development

Among the five first-order KM activities, there are two pairs of counterparts: knowledge acquisition vs. knowledge selection, and knowledge assimilation vs. knowledge emission.

The first pair of counterparts focuses on producing a knowledge flow for subsequent use by identifying, capturing, organizing, and transferring knowledge from either external environment (i.e., acquisition) or internal knowledge sources (i.e., selection). The second pair is aimed at producing a knowledge flow that impacts an organization, either by retaining the knowledge within the organization (i.e., assimilation) or by releasing the knowledge into the external environment (i.e., emission). In addition, knowledge generation produces new knowledge by processing existing knowledge, either internally selected or externally acquired. This new knowledge may be assimilated for future use (i.e., via selection)

Upon careful consideration of 30 the SD activity types, I find that knowledge acquisition, knowledge emission, and knowledge generation (external) are explicitly recognized as being involved in SD. However, knowledge selection, knowledge assimilation, and knowledge generation (internal) are almost ignored within the SD literature. This oversight is important, as KCT would predict that these types of knowledge activities have roles to play in efforts to implement strategies for enhancing competitiveness via supplier development. The implication is that SD researcher and practitioners may be well served to explicitly consider these overlooked aspects of knowledge management in the design and implementation of SD initiatives.

Knowledge Acquisition

Recall from Table 3-1, k*nowledge acquisition* refers to obtaining knowledge from external sources and making it suitable for subsequent use. It includes both direct and indirect acquisition activities (Holsapple and Jones, 2004). The examination of the 30 SD

activity types reveals that the supplier employs both types of knowledge acquisition, but the buyer depends mainly on indirect knowledge acquisition.

From the supplier's perspective, many SD activities such as supplier training (SD2), technical assistance (SD7), managerial advice (SD8), information sharing (SD9), and evaluation feedback (SD28) fit into KCT's sphere of direct knowledge acquisition. All of these activities involve a supplier's active participation in receiving knowledge that resides in the buyer's knowledge repositories. In addition, SD activities such as co-location (SD17) and employee exchange (SD25) are incorporated into indirect acquisition, because their main purpose may not be directed toward obtaining knowledge, but they help the supplier in acquiring new knowledge assets from the buyer's support personnel or exchanged employees.

In contrast, the buyer rarely acquires new knowledge in supplier development because the purpose is to develop the supplier's knowledge. In a few cases, the buyer indirectly acquires knowledge through co-location (SD17) and employee exchange (SD25). When sharing important information with the supplier, the buyer may also indirectly acquire knowledge through requesting an access to supplier's internal information (Hemsworth et al., 2005).

Knowledge acquisition in SD could be unidirectional (i.e., supplier acquires knowledge from buyer) or bidirectional (i.e., buyer and supplier acquire knowledge from each other). In some activities such as co-location (SD17) and employee exchange (SD25), both buyer and supplier may acquire knowledge from each other, while in other cases such as supplier training (SD2) and technical assistance (SD7), only the supplier acquires knowledge from the buyer.

Knowledge Emission

Recall that *knowledge emission* is defined as applying an organization's knowledge to produce organizational outputs for release into the environment. According to Holsapple and Jones (2004), knowledge emission activities can be partitioned into four distinct categories: formal external publishing, informal external publishing, formal external interaction, and informal external interaction. Here, publishing has unidirectional flow of knowledge while interaction involves multidirectional flow of knowledge. Formal denotes a well-defined, institutionalized approach, while informal denotes a more ad hoc and improvised approach. The examination of the 30 SD activity types demonstrates that in SD, the buyer is concerned with all the four categories of knowledge emission.

The buyer is heavily involved in knowledge emission, either through unidirectional publishing or multidirectional interaction. SD activities such as providing the supplier's personnel with a training program (SD2), offering technical assistance (SD7), and managerial assistance (SD8) emit buyer's knowledge to its supplier through formal external interactions with the supplier. Dynamic communication (SD14) and co-location (SD17) are examples of informal external interaction. The buyer can emit its knowledge to the supplier through either formal external publishing activities, such as providing product or technical specification (SD26) and producing feedback about evaluation results (SD28), or informal external publishing activities such as sharing production information (SD9). In sum, SD activities necessarily involve knowledge emission from the buyer to the supplier in various channels.

In contrast, the supplier emits knowledge to the buyer mainly in an informal channel. For instance, in dynamic communication (SD14) and co-location (SD17), the supplier

may emit its knowledge to the buyer via informal external interaction. In some cases, the supplier emits its cost information (SD9) upon the request of the buyer through informal external publishing.

Knowledge Generation

Knowledge generation is defined as producing knowledge from existing knowledge by either discovery or derivation. Knowledge discovery activities generate knowledge in less structured ways, via skills involving creativity, imagination, and synthesis, whereas knowledge derivation generates knowledge in an analytical, logical, and constructive manner (Holsapple and Jones, 2004). In supplier development, buyer and supplier can collectively generate new knowledge. For instance, buyer and supplier may develop a production strategy or quality control solution (i.e., knowledge discovery) or derive a market forecast (i.e., knowledge derivation) together. Such joint knowledge generation can help both buyer and supplier achieve shared understanding, strengthen their social bonds, and promote knowledge integration (Becker, 2001; Newell et al., 2004). In addition to joint knowledge generation, individual knowledge generation may be also involved. For instance, in order to train a particular supplier, the buyer may revise or create training materials based on the performance evaluation of this supplier. Likewise, a supplier may improve its production process through the evaluation feedback given by the buyer. However, in the SD literature, I find that the main concern is with generation of knowledge through collaboration between buyer and supplier.

In the case of joint action (SDA29), the buyer and the supplier solve a problem together (Li et al., 2005), mutually develop alternative plans (Giannakis, 2008), reduce products/services' cost collectively (Zsidisin et al., 2003), and collaborate in materials

improvement (Sanchez-Rodriguez, 2009). When the supplier is involved in the buyer's product development process (SD11), they together develop a new product through knowledge discovery. In a few cases, new knowledge is generated through a buyer's involvement (SD30) in the supplier's product development process (Forker et al., 1999), supplier's planning and goal-setting activities (Monczka, et al., 1998), development of logistics process (Groves and Valsamakis, 1998), and improvements of environmental management practice (Simpson and Power, 2005).

Knowledge Selection and Knowledge Assimilation

Knowledge selection refers to identifying and selecting needed knowledge within an organization's existing KRs for subsequent use (i.e., by an assimilating, generating, and emitting activity) and *knowledge assimilation* refers to altering the state of an organization's knowledge resources by internally distributing and storing acquired, selected, or generated knowledge. Both activities involve the internal operation on knowledge resources. Our review finds that none of the 92 articles' examinations of the 32 SD activity types explicitly encompasses knowledge selection or assimilation. However, I contend that this lack of recognition does *not* indicate that the two first-order KM activities should be excluded from an SD program. There are several reasons for this.

KCT suggests that knowledge selection can facilitate external operations of knowledge such as knowledge emission and generation. As the main knowledge provider in supplier development, a buyer must identify the right knowledge within its existing KRs and make it available in an appropriate representation *before* conducting knowledge emission and generation activities in such SD aspects as supplier training (SD2), technical assistance (SD7), information sharing (SD9), and joint action (SDA29). For

instance, Hahn et al. (1990) present an SD matrix to help the buyer identify appropriate knowledge, based on the cause of a supplier's problem and required supplier capabilities. I posit that appropriate identification and representation of buyer knowledge can facilitate a supplier's learning and improve the usability of knowledge (Holsapple and Joshi 2004a, b).

As a main knowledge recipient in supplier development, the supplier must assimilate the knowledge acquired from the buyer or generated together with the buyer. By examination, interpretation, and understanding, the knowledge that does not originally reside in a supplier's repository can be absorbed into the supplier's KRs. Accordingly, knowledge assimilation is critical for supplier knowledge development (Giannakis, 2008). For instance, after receiving education about quality control techniques (SD2), a supplier's personnel may assimilate the knowledge by conducting in-house training, sharing techniques across the enterprise, integrating practices into its manufacturing process, or publishing a quality control manual.

4.2.3 Second-order KM Activities in Supplier Development

The remaining 18 SD activity types mainly involve a buyer's efforts for administering the management of knowledge. Across the set of SD publications, all four second-order KM activities have been recognized within one or more of them. In the following, I briefly present and discuss each of the four.

Knowledge measurement refers to the valuation of knowledge resources, processors, and their deployment. In supplier evaluation (SD1), a buyer gauges the supplier's performance and/or capability through formal evaluation, using established guidelines and procedures (Krause and Scannell, 2002), or through informal evaluation in an ad hoc

manner with no set procedure (Krause, 1997). Such evaluation activities help the buyer measure supplier performance in terms of knowledge resources, processors, and processes. Based on evaluation results, the buyer can determine whether and how to deploy knowledge resources and knowledge processors to develop the supplier. Supplier ranking (SD10) may be used when multiple suppliers are evaluated.

Knowledge control is concerned with ensuring that needed knowledge resources and processors are available in sufficient quality and quantity, subject to required security (Holsapple and Joshi, 2000). Knowledge control includes KM resource control and process governance. Our investigation finds that providing a supplier with financial support (SD5) can ensure that the supplier to be developed possesses adequate financial resources for knowledge manipulation activities. In addition, the quality of the supplier (i.e., knowledge processor) and its KRs is ensured by SD activities such as supplier certification (SD15), quality emphasis in supplier selection (SD19), and quality assurance programs (SD24). Furthermore, supply base reduction (SD20) and supply base rationalization (SD23) facilitate the protection of organizational knowledge and reduce the risk of intellectual property leaking out to the buyer's competitors. In addition, the buyer's regular visits to a supplier's site (SD12) also contribute to knowledge control by ensuring that the supplier follows the buyer's protection policy.

Knowledge coordination refers to managing dependencies among KM activities to ensure that proper processes and resources are brought to bear appropriately. Holsapple & Jones (2005) discover that knowledge coordination activities can be categorized into two main groups: structuring efforts and securing efforts. Our examination reveals that SD activities such as direct incentive (SD3) and promise of future business (SD22) align

rewards and performance evaluation. That is, they secure supplier efforts. A supplier's management and employees become sufficiently motivated and have proper incentives for executing knowledge manipulation activities in supplier development. In addition, SD activities such as providing suppliers with necessary equipment or tools (SD6) and building a community of suppliers (SD21) create communications for knowledge sharing and establish a structure whereby knowledge manipulation activities can be implemented in supplier development. In sum, these SD activities involve knowledge coordination via either structuring or securing KM efforts in supplier development. The way in which knowledge coordination is performed within SD can, thus, affect the success of development in contributing to competitiveness.

Knowledge leadership creates favorable circumstances for KM. Knowledge leadership works as a catalyst through such practices as setting examples, engendering trust and respect, instilling a cohesive and creative culture, and establishing a vision (Holsapple and Joshi, 2000). SD activities such as building trust with a supplier (SD27) can promote knowledge sharing and joint action between the buyer and supplier (Humphreys et al., 2004; Li et al., 2007). In addition, the buyer undertakes performance expectation (SD4) by creating an expectation roadmap for the supplier (Handfield et al., 2000), setting supplier's improvement targets (Wagner and Krause, 2009), and increasing supplier performance goals (Li et al., 2007). Such efforts can establish a vision for the suppliers and inspire their conduct of KM activities. Through SD activities such as building a supplier council (SD18) and creating a community of suppliers (SD21), knowledge sharing and learning can be facilitated and accelerated. In some cases, the buyer invites the supplier's personnel to its site (SD13) to increase their awareness of

how their product is used (Krause and Ellram 1997b; Krause and Scannell, 2002), or invites them to company activities to develop a cohesive culture.

4.2.4 Co-occurrence Analysis

As mentioned above, multiple SD types are commonly studied at a single article. Therefore, it is very important for scholars to know the co-attention given to any two SD types. The co-attention degree helps scholars to identify what SD types have already been studied together or what SD types have never been studied together. Such identification can suggest future research directions (e.g., examining why two SD types have significantly positive or negative co-attention degree), as well as guide researchers in conducting SD research (e.g., SD type which have high co-attention degree may have to be studied together). Therefore, I generate a co-occurrence coefficient matrix for the fifteen most-studied SD activities in Table 4-3.

A co-occurrence coefficient is calculated using the frequency of each SD activity type and the co-occurrence (or joint) frequency of the two SD activity types in the same article (Jackson et al., 1989); therefore, it can measure the strength of likelihood that the two SD activities are studied together (Leydesdorff & Vaughan, 2006). A positive coefficient indicates that the two SD activities are more frequently studied together than studied separately in previous literature, and vice versa.

Most of co-occurrence coefficients are smaller than 0.3, indicating that previous studies consider disparate types of SD activities. The five greatest co-occurrence coefficients are: plant visit (SD12) and supplier certification (SD15), supplier evaluation (SD1) and evaluation feedback (SD28), supplier evaluation (SD1) and supplier certification (SD15), direct incentive (SD3) and supplier certification (SD15), and

information sharing (SD9) and joint action (SD29). Among the 105 co-occurrence coefficients in Table 10, 28 (26.7%) are significant at a 0.1 level. Of these, seven coefficients are negative and twenty-one are positive. Among them, supplier certification (SD15) is significantly associated with as many as eight other SD activities. Dynamic communication (SD14) is the only kind of SD activity that has no significant co-occurrence coefficient with any other SD activity type.

Table 4-3: Co-occurrence Coefficients of 15 Frequently-Studied SD Types

ID	First-Order SD Activity Types									Second-Order SD Activity Types				
	SD2	SD7	SD8	SD9	SD11	SD14	SD17	SD28	SD29	SD1	SD3	SD4	SD5	SD12
SD7	-.063													
SD8	-.170	-.110												
SD9	.022	.051	-.105											
SD11	-.011	-.039	**-.177***	.000										
SD14	.132	-.137	.123	-.024	-.011									
SD17	.147	-.081	.164	-.031	.003	.081								
SD28	.118	-.001	-.035	.078	.034	.104	.151							
SD29	-.038	-.051	.153	**.304*****	.009	.128	**-.208****	.077						
SD1	**.283*****	.056	-.147	-.044	.123	.007	.087	**.351*****	-.144					
SD3	**.284*****	-.022	**-.208****	-.023	.028	-.005	.107	.160	-.088	**.178***				
SD4	.138	-.040	.124	**-.206****	-.019	-.026	**.243****	**.181***	-.088	.071	.059			
SD5	**.172***	**.259****	-.003	-.061	.049	-.007	**.263****	.130	.038	.110	**.274*****	**.223****		
SD12	.154	-.148	-.061	**.219****	.031	-.077	.036	**.254****	.078	**.247****	.112	**.227****	.020	
SD15	**-.181***	-.097	**-.204***	**.242****	.013	-.034	-.053	**.234****	**-.231****	**.319*****	**.318*****	.066	.008	**.358*****

Note: * 0.1; ** 0.05; *** 0.01

In order to understand whether and how the first-order and second-order KM activities are used to characterize or capture supplier development phenomena, I group the fifteen SD types into two classes: nine depending on (or enabled by) first-order KM activities and six for second-order KM activities. In Table 4-3, SD activities in the first group are shaded, while those in the second group are not. Interestingly, the six SD types

involving second-order KM activities contribute at least five significant co-occurrence coefficients, whereas none of the nine SD types representing first-order KM activities contributes as many as five. In addition, each SD type involving second-order KM activities significantly co-occurs with at least four other SD types. For instance, financial support (SD5) significantly co-occurs with both first-order KM activities such as supplier training (SD2) and second-order KM activities such as direct incentive (SD3).

All fifteen co-occurrence coefficients between six second-order activities (the triangle at the right of the shaded area in Table 4-3) are positive, half of which are significant, indicating that SD types involving second-order activities have been frequently studied together. However, only one co-occurrence coefficient between nine SD activities associated with first-order KM activities (the triangle ending above the shaded area in Table 4-3) is significantly positive, indicating that SD types associated with first-order KM activities are frequently studied separately or independently.

Over half of the SD co-occurrence coefficients across first-order and second-order activities (the shaded rectangle area in Table 4-3) are positive. Of these, seventeen co-occurrence coefficients are significant at the 0.1 level: twelve being positive and five negative. Interestingly, evaluation feedback (SD28) is the only SD activity type that has positive co-occurrence coefficients with all SD types involving second-order KM activities, suggesting that evaluation feedback is usually studied with those SD activities that facilitate knowledge leadership (e.g. SD4), knowledge measurement (e.g., SD1), knowledge control (e.g., SD5), and knowledge coordination (e.g., SD3).

Together, the knowledge-based links reveal the extant pattern of empirical SD activity research. This pattern gives a knowledge-based view of what has, and has not,

been studied as far as connections among SD activity types go. It acts as an organizing mechanism for stimulating research, practice, and instruction.

4.3 Implications

This chapter extensively reviews empirical research on SD activities and generates a codebook of 30 types of SD activities. Even though many empirical studies have examined SD, none of them has provided a holistic view of all SD activities. Based on an extensive review of SD activities described in these studies, this research is the first study to advance a comprehensive codebook of major SD types, supplemented by relative frequency with which each type has been studied and a co-occurrence analysis for the fifteen most-frequently-studied SD types.

Applying KCT, this chapter finds that all the 30 SD types involve either first-order or second-order KM activities. For the first-order KM activities, buyers' and suppliers' heavy involvement in knowledge acquisition, knowledge emission, and joint knowledge generation has been recognized and studied by SD researchers. However, the same is not true for knowledge selection and knowledge assimilation. For the second-order KM activities, only buyer is involved in knowledge measurement, control, leadership, and coordination. In addition, the results reveal a knowledge-based co-occurrence pattern for the most-frequently studied SD activities. Whereas second-order KM activities in SD are more likely studied together, first-order KM activities in SD are more likely studied separately; first-order and second-order KM activities are moderately studied together.

4.3.1 Contributions

The extensive taxonomy and the frequent analysis (degree of attention and co-occurrence analysis) in this chapter contribute in multiple ways. First, such a codebook can help

supply chain managers detect what potential activities they can use to develop their suppliers. For instance, if a buyer wants to motivate its supplier, SD activities such as direct incentive (SD3) and promise of business (SD22) can be considered as candidates. Furthermore, with assistance of our codebook and degree of attention for 30 SD types, SD researchers can determine what SD activities they want to study. For instance, if a researcher takes a typical approach to study supplier development, s/he may consider those SD types with a high degree of attention such as supplier training (SD2) and supplier evaluation (SD1). After identifying target SD types, researchers can decide what relevant SD types are expected to be included, using the degree of co-attention for top fifteen SD types. Brief description of each SD type in our codebook can help researchers define and measure those SD types.

The application of KCT contributes to the SD literature by generating an integrated definition of SD, a new SD taxonomy, and a new SD approach, all from a KM perspective. Modi & Mabert (2007), Wagner & Krause (2009), and Thomas et al. (2011) highlight and examine the role of knowledge sharing in supplier development and their studies motivate further exploration of the knowledge-based view in supplier development. A careful examination of past SD definitions shows no explicit mention of knowledge, but a comprehensive review of SD activities indicates that SD essentially involves both first-order and second-order KM activities. SD can be seen as a part of buying and supplying organizations' conduct of KM. This chapter contends that both SD practitioners and SD researchers should be cognizant of and can benefit from a view that relates SD to the knowledge-driven economy. Thus, the findings in this chapter motivate a revised definition of SD:

Supplier development is a set of knowledge management (KM) activities that are conducted by both buying and supplying firms and aimed at meeting the buying firm's short- or long-term supply needs via expanding the supplying firm's knowledge resources and/or knowledge handling capabilities.

Supplier development may involve first-order KM activities (i.e., knowledge acquisition, selection, generation, assimilation, and emission) as well as second-order KM activities (i.e., knowledge measurement, leadership, coordination, and control).

The application of KCT also contributes a new taxonomy of SD activities. As described before, previous studies have classified SD by various perspectives, but these taxonomies are limited and tend to conflict with one another. Therefore, it is beneficial to bring all SD activities together into a parsimonious, unified, and well-organized classification. Furthermore, previous taxonomies do not highlight the significance of KM in SD, demonstrates the relationships among the diverse types of SD activities, or involves suppliers in their classifications. The knowledge-based taxonomy introduced here can overcome these drawbacks. In it, SD activities are categorized into first-order and second-order KM activities. The taxonomy is based on the integrated definition of SD and further highlights that SD is fundamentally a set of KM activities. Second, based on KCT, the taxonomy reveals the relationship between two groups of SD activities: whereas the first-order KM activities are performed to manipulate knowledge resources, the second-order KM activities support and guide the performance of the first-order activities. For instance, the performance of a training program (first-order KM activity) is influenced by creation of an active learning environment and establishment of an

evaluation system (second-order KM activities). Third, the knowledge-based taxonomy suggests that both buyer and supplier are involved in SD. SD is perceived as an inter-organizational strategy (Mortensen and Arlbjørn 2012), in contrast to previous taxonomies, which classify SD activities from the buyer's perspective.

The application of KCT facilitates the integration of SD activity types derived from SD literature with knowledge chain activities identified in the KCT to foster a better understanding of knowledge management in supplier development. The utility of KCT is evidenced when contrasted with studies of SD based on the performance approach and the capability approach. As described in Table 4-4, the knowledge approach gives a more comprehensive understanding of supplier development than the other two approaches.

Many studies have found significant positive relationships between supplier development activities and their consequences, but without telling how these consequences are achieved. Understanding the modus operandi of these relationships is important for beginning to understand why some SD initiatives succeed, while others fail. It is important for understanding the operative, controllable levers that can affect consequences of SD initiatives and practices. Appreciation of such levers puts management in a better position for experimenting with them and setting them in ways that amplify positive outcomes, such as improve performance and greater competitiveness. Here, I have shown a knowledge-intensive perspective on the nature of these levers.

Table 4-4: Comparisons of Three SD Approaches

	Performance Approach (Krause et al.,1998; Carr & Pearson, 1999)	Capability Approach (Watts & Hahn,1993; Mahapatra et al., 2012)	Knowledge Approach (this study)
Direct Goal	Performance development	Capability development Continuous performance improvement	Knowledge development Continuous capability development
Driver	Problem-driven	Process-driven	Competitiveness-driven
Duration	Short-term	Long-term	Long-term
Supplier's KM activities	Acquisition (push)	Acquisition (push), selection, and emission	Acquisition (push & pull), selection, assimilation, generation, and emission
Buyer's role in KCT	Mainly second-order KM Limited first-order KM	Both first-order and second-order	Both first-order and second-order
Supplier's role in KCT	Very limited first-order KM	First-order KM	Both first-order and second-order
Supplier's KM flow	Acquisition	Acquisition → Selection → Emission	Acquisition → Assimilation/generation → Selection → Emission
KR impacted	Limited content knowledge from buyer's KR	Buyer's content knowledge and limited supplier's content knowledge	Both content and schematic knowledge from buyer's and supplier's KR
KM Goal	Apply knowledge	Expand and Apply Knowledge	Expand, cultivate, and apply knowledge

Our application of the KCT helps illuminate how positive performance and capability consequences of supplier development can be achieved: by design and implementation of knowledge activities (first- and second-order) within the thirty SD types. KCT holds that there are nine fundamental kinds of knowledge management activities that can be performed in ways that heighten firm performance and/or competitiveness. Several empirical studies (e.g., Holsapple & Wu, 2008, 2011; Wu & Holsapple, 2013) offer evidence that this is indeed the case, in terms of both accounting and market measures of firm performance, as well as perceptions of KM experts (Holsapple & Singh, 2005).

Because I now characterize SD types in terms of KM practices, it follows that KM can be designed and executed within SD episodes (for any of the thirty types) in ways that heighten firm performance and/or competitiveness. That is, KM alternatives furnish levers that can be set and managed in ways that lead to positive SD outcomes. It must be noted that the KCT does not specify "the way" to perform the KM activities, as this is context dependent. Similarly, here I cannot prescribe "the way" to perform KM within any of the thirty SD types, as this, too, is likely context sensitive.

Building links between knowledge resources and competitiveness, via the nine kinds of KM activities, the KCT holds that heightened competitiveness/performance is due to gains in productivity, agility, innovation, and/or reputation – the so-called PAIR model of competitiveness. By applying KCT in the SD world, it follows that the nine KM activities can be engaged within SD in ways that lead to successful SD consequences along any of the PAIR dimensions. Interestingly, consistent with the KCT, empirical studies have found that SD can improve the performance of both buyer and supplier, including the following dimensions: productivity (e.g., Carr et al., 2008; Kaynak, 2005), agility (e.g., Humphreys et al., 2004; Li et al., 2007), innovation (e.g., McGovern & Hicks, 2006; Wagner, 2006a), and reputation (e.g., Chen & Paulraj, 2004; Dyer & Hatch, 2006). However, predominate theories used in SD literature, such as transaction cost economic and resource dependence, can predict only a part of these performance dimensions (mainly in productivity and agility) because they focus on leveraging transaction cost or relative power. In contrast, KCT predicts that SD, as a subset of buyer's and supplier's KM activities, can predict all four of dimensions of competitiveness.

4.3.2 Future Research

The application of KCT in SD suggests several future research directions. For instance, in the interest of achieving desired SD consequences, it would be very useful for researchers to devise guidance about how to set and adjust the KM levers within an SD episode. Even if such prescriptions cannot be made in a generalized fashion, knowing about the operative levers within one of the SD types being studied can give researchers a starting point for devising prescriptions for a particular context being studied (e.g., a perishable goods supply chain). That is, I now have a basis for study, confirmation, and creation of localized SD best practices.

Holsapple and Singh (2001) note that a combination of multiple KM activities, when performed in a superior fashion, lead to enhanced competitiveness. However, in the context of SD, Wagner (2010) finds a negative interaction effect between direct and indirect SD activities and suggests avoiding a combination of direct and indirect SD activities. Such a finding is counter to the prediction of KCT. Future research can examine alignment of KM activities within and across first-order and second-order SD groups.

In addition, future research can use KCT as a lens to examine the relationship between SD and knowledge-specific capability or performance. For example, absorptive capacity refers to firm's ability to value, assimilate, and utilize new external knowledge (Lane and Lubatkin, 1998). Dyer and Nobeoka (2000) propose that knowledge sharing in Toyota's supplier association builds supplier's absorptive capacity through enhancing its knowledge base. However, they briefly introduce the term "absorptive capacity" and do not offer further explanation; furthermore, they argue that inter-organizational routines

that are purposefully designed to facilitate knowledge transfer across organizational boundaries facilitate learning (i.e., absorptive capacity), but they do not describe specific routines. I assert that all nine KM activities are examples of those routines and KCT holds that these activities lead to organizational learning. Therefore, KCT suggests details about the fit between SD and absorptive capacity. Leveraging KCT, future research can use this connection to examine relationships between SD and absorptive capacity in greater detail. Furthermore, when applying KCT to inter-organizational issues such as SD, knowledge complementarity between the buyer and supplier should be considered and examined. KCT also suggests the importance of technology support in KM (Holsapple and Jones, 2007), so I believe technology support is also important in SD and deserving of investigation.

CHAPTER 5 DATA COLLECTION

This chapter first describes data collection from SD (supplier development) scholars and reports brief findings based on the data. Then, it presents how variables/constructs are measured in the survey of SD practitioners and distribution process. This chapter ends with describing the demographic variables of the participants.

5.1 Data Collection from SD Scholars

5.1.1 Data Collection Purpose

The previous chapter identified over 500 SD activities featured in about 100 empirical articles dealing with SD. These activities were condensed and classified into 30 types, which were named and defined based on the articles' characterizations. The result is a comprehensive catalog of SD activities. Further analysis of this catalog revealed that SD relies heavily on performance of KM (knowledge management) activities. As a follow-up investigation, this chapter collects perceptions from experienced SD scholars to 1) verify and improve the catalog of SD activities, and 2) examine the role of KM in SD.

5.1.2 Data Collection Process

First, 107 journal articles and four dissertations, which were published in the past 20 years with SD as their emphasis (either focus on SD or consider it as a key concept/factor), were identified. The 107 articles were published in 55 journals. The top three journals in terms of number of articles in the list are *Journal of Supply Chain Management* (12), *Journal of Operations Management* (7), and *International Journal of Production Economics* (7). Based on this list, 171 authors were further identified. Among them, six authors (Daniel R. Krause, 12; Stephan M. Wagner, 7; Paul Humphreys, 6;

Thomas V. Scannell, Wen-Li Li, 5; Cristobal Sanchez-Rodriguez, 4) have published more than three articles. In addition, 13 and 20 have published three and two articles, respectively, and the remaining 132 have published one article or dissertation.

The scholars' contact information (including email, affiliation, location, position, and source website, if available) was sought via the internet. However, 26 of them were dropped because their contact information was not available online. Accordingly, 145 researchers made it onto the final list of SD scholars. Among them, 49 are from the United States, 24 from the United Kingdom, 14 from the Greater China Region (6 from Hong Kong, 5 from Taiwan, and 3 from Mainland China), 9 from Germany, and 8 from Canada and Netherlands, respectively.

An invitation email, along with a survey link, an electronic copy of the scholar survey, and cover letter (See Appendix III), which were approved by the IRB office at the University of Kentucky, was sent to the scholars. The survey was hosted on uky.qualtrics.com. After three weeks, a follow-up email was sent to them, followed by a final reminder, two weeks later. Among 145 researchers, four were unreachable and eleven responded to indicate their unavailability. Among the remaining 130 potential respondents, 39 responded to the survey (response rate=30%), either via email or on uky.qualtrics.com.

This survey includes two sections: Section I, *Summary of Supplier Development Activities* and Section II, *Knowledge Sharing & Management in Supplier Development*. Among the 39 participants, 22 and 33 completed Section I and Section II, respectively.

5.1.3 Brief Findings

The SD scholars were invited to evaluate how precisely each statement described the activity listed in Table 4-1. Overall, the SD scholars thought the descriptions of all 30 SD activities are at least moderately precise. The mean values of 30 activities' descriptions range from 2.73 to 4.43, with an average of 3.86, and rank significantly (p=.000) higher than 3 (moderate). In addition, 24 of 30 descriptions were rated significantly higher than 3, indicating that this group of SD scholars regards a large majority of activities as being described precisely. Furthermore, 13 activities' descriptions were rated higher than 4, among which the description of *Financial Support* ranked significantly higher than 4 (p=.009). Furthermore, SD scholars showed a high interest in this catalog, and they commented on 28 of the 30 SD activities.

Across all 30 activities, the average of the degree to which each was regarded as being an SD activity is 3.71, significantly higher than 3, indicating that the activities in this catalog were, overall, regarded as SD activities. Interestingly, direct SD activities, such as *Supplier Training* and *Financial Support*, have higher SD inclusion degrees than indirect ones, such as *Supplier Evaluation* and *Competitive Pressure.*

Among the 30 activities, 19 were ranked significantly higher than 3 (moderate). *Supplier Training*, *Technical Assistance*, and *Managerial Assistance* were rated significantly higher than 4 (high). In addition, these three activities had the smallest standard deviations, indicating that most of the scholars surveyed *consistently* regarded them as being SD activities. Therefore, they will be examined in a following survey of SD practitioners.

Over 45% of the SD scholars demonstrated that knowledge sharing is *extremely important* for SD. An overwhelming majority of SD Scholars (over 95%) indicated that knowledge sharing is at least *very important* for supplier development. KM is very important for both buying and supplying firms to achieve desired SD outcomes. As shown in Table 5-1, all the nine KM activities were rated significantly higher than 3 (p=0.000) for both buyer and supplier, indicating that the SD scholars believed that both buyer and supplier should at least moderately conduct each KM activity in SD to achieve desired outcomes. For buyers, three (knowledge selection, assimilation, and coordination) and two (knowledge generation and leadership) KM activities were rated significantly higher than 4 at the significant levels of 5% and 10%, respectively. For suppliers, one (knowledge assimilation) and two (knowledge generation and measurement) KM activities were rated significantly higher than 4 at the significant levels of 5% and 10%, respectively. Knowledge assimilation and generation were highly rated for both buyers and suppliers.

Table 5-1: To What Degree to KM Activities Should Be Conducted in SD

KM Activities	Buyer		Supplier		Comparison (P-value)
	Mean	Std. D	Mean	Std. D	
Knowledge acquisition	4.21	0.781	4.00	0.866	0.109
Knowledge selection	4.30	0.728	4.03	1.045	0.141
Knowledge generation	4.27	0.839	4.27	0.876	1.000
Knowledge assimilation	4.45	0.754	4.47	0.761	0.745
Knowledge emission	4.13	0.942	3.94	1.014	0.280
Knowledge measurement	4.09	0.777	3.66	1.096	0.021
Knowledge control	4.22	0.751	3.91	0.856	0.010
Knowledge coordination	4.28	0.772	3.91	0.995	0.016
Knowledge leadership	4.28	0.813	3.88	1.070	0.005

As shown in Table 5-1, when comparing the nine KM activities across buyer and supplier, it is found that SD scholars thought all five first-order KM activities should be conducted by both buyers and suppliers to a similar degree (p values range from 0.109 to 1.000), but buyers should conduct second-order KM activities to a higher degree than suppliers (p values range from 0.000 to 0.021). This finding suggests that, in order to achieve desired outcomes of supplier development, both buyers and suppliers should play equally important roles in knowledge manipulation, but buyers should play a more important role in second-order knowledge management activities, because they are usually SD initiators and sponsors.

Table 5-2: Exploratory Factor Analysis of Responses from SD Scholars

Item	Factor 1	Factor 2
Knowledge acquisition	.813	.113
Knowledge selection	.674	.364
Knowledge generation	.847	.207
Knowledge assimilation	.830	.217
Knowledge emission	.468	.528
Knowledge measurement	.671	.210
Knowledge control	-.004	.948
Knowledge coordination	.413	.797
Knowledge leadership	.623	.620

Through explanatory factor analysis, two factors were extracted, indicating that the nine KM activities describe two distinct aspects of knowledge management (see Table 5-2). Four of the five first-order KM items were loaded into one factor, and three of the four second-order KM items were loaded into the other factor. Reasons for why a couple of items are not perfectly loaded include that: 1) participants were scholars, rather than practitioners, so their perceptions might not totally reflect the actual perceptions of SD

practitioners; 2) SD scholars were asked to provide a cumulative view, rather than an episodic view; 3) the survey statement read "each of the following knowledge management activities should be conducted", rather than "has been conducted". However, when items with high cross factor loadings were dropped, one factor was extracted to capture knowledge management activities in SD.

5.2 Data Collection from SD Practitioners

5.2.1 Survey Design

The survey from SD practitioners was used to test research hypotheses and includes three sections: 1) background information, 2) information about a specific SD, and 3) relational and demographic information. The first section aims to obtain the information about respondents and their organization's involvement in SD, the second section requests information about a specific SD which the respondent's organization has most extensively conducted with a particular supplier in the past year, and the final section is about the relational and demographic information about the respondent's organization and its supplier. Variables in Section II are considered as key variables in this study.

In order to examine why SD works, the unit of study should be a specific SD, and therefore, an episodic view, rather than a cumulative view, of SD was adopted. The use of the episodic view facilitates the understanding of buyer-supplier relationship. "Relationship theory is incomplete without a more complete understanding of interaction episodes" (Schurr, 2007, p162). Accordingly, the main purpose of this survey is to seek respondents' insight into a specific SD with a specific supplier. The previous findings reveal that there are many diverse SD activities. As a first study to apply KCT to the field of SD, a small number of specific SD activities should be identified. Comments given by

scholars in the previous survey suggest that direct SD activities such as supplier training should be emphasized in this study. Indeed, direct SD activities were more highly recognized by SD scholars than indirect ones.

Three direct SD activities (supplier training, technical assistance, and managerial assistance) were the three most highly recognized by SD scholars, and thus they were identified as target SD activities in this survey. Based on their description in the SD catalog, one question with four items was designed as a filtering question to identify target respondents. In the beginning of this survey, respondents were asked to what degree (1=not at all, 3=moderately, 5=extremely) their organization has ever used any of the following supplier training or assistance activities in the past year:

A. Providing training or education to your supplier's personnel
B. Providing your supplier with technical support/assistance
C. Providing your supplier with support/assistance in quality management, inventory management, etc.
D. Solving your supplier's technical problems

If respondents chose "not at all" for all the four questions above, they would skip Sections II and III; otherwise, they would go through the remaining two sections.

5.2.2 Survey Instrument

"Developing effective measurement scales for various dimensions can be challenging" (Modi & Mabert, 2007, p.48). To address this issue, both previous studies and pilot testing (SD scholars) were used to develop the instrument employed in this study. Whenever possible, existing scales were used to measure the constructs of interest.

Additionally, two structured interviews were conducted with purchasing executives in large manufacturing firms.

The dependent variables of this study are buyer and supplier performance improvement. Previous studies have identified that the effect of SD on the performance composites of product/service cost, total cost, product/service quality, delivery times and reliability, and production/service flexibility. Therefore, the dependent variables were measured by these six items, which were adopted from Krause et al. (2007). Two additional items, innovation and learning capability, were added. These measures cover all the four dimensions of competitiveness in KCT: productivity, agility, reputation, and innovation. In order to examine whether subjective measures could represent actual performance improvement, three objective performance measures were used in this survey. Participants were asked to indicate the average percentage that their supplier had improved since SD began in terms of unit cost, on-time delivery, and defect rate of purchase parts.

One purpose of the practitioner survey was to examine whether KCT can help existing theories explain why SD works. Therefore, ten independent variables were identified in this survey. The review table (see Appendix I) facilitated the variable identification process. One or two variables were identified from each of the six other commonly-used theories in SD literature (see Table 5-3). Most of those variables were measured by multiple items. Because the variable KM from KCT has not been measured in previous studies, its scales were developed from the description of each KM activity given by Holsapple & Jones (2004, 2005) and then tested and improved them using two structured interviews and a pilot study of SD scholars.

Table 5-3: Constructs/Variables: Theory and Their Source

Construct/Variable	Number of Items	Theory	Sources
Buyer/Supplier KM	9	Knowledge Chain Theory	Adopted from Holsapple & and then tested by SD Scholars
Knowledge Sharing	4	Knowledge sharing perspective	Krause & Wagner (2009), Modi & Mabert (2007)
Buyer/Supplier Asset Specificity	3	Transaction cost economics	Joshi & Stump (1999), Lee et al. (2009), Buvik (2000), Dyer (1996a); Nyaga et al. (2010)
Supplier Dependence	4	Resource Dependence Theory	Cai et al. (2009), Lusch and Brown (1996), Carr et al. (2009)
Relational Capital	3	Social Capital Theory	Blonska et al. (2013), De Clercq & Rangarajan (2008), Nyaga et al. (2010)
Goal Congruence	1	Goal Setting Theory	Yan & Dooley (2013)
Buyer/Supplier Motivation	1	Motivation Theory	Siemsen et al. (2008)

SD outcomes are influenced by the potential impact of buyer-supplier relationship, organization size, and industry. Therefore, four controlled variables were identified and added to the research models: the number of employees (at the buying and supplying organizations), the annual gross sales (at the buying and supplying organizations), relationship length, and the industry type (manufacturing or not). For more details about all the measures, please refer to Appendix IV.

5.2.3 Sample Identification

Completion of the survey required of those practitioners who have sufficient knowledge and experience in SD, and thus, it was very important to identify those potential participants. Because both buying and supplying firms are involved in SD, they can provide insight into a specific SD. That is why previous studies have collected data from either buying or supplying firms. The main target respondents in this study were from buying firms, but some respondents may participate in SD activities provided by their

customers and thus, can provide information from a supplier's perspective. Accordingly, a supplier survey, which is similar to the buyer survey, was also created and made available online. Respondents could choose the buyer or supplier survey based on their experience and knowledge. Because the supplier survey is supplementary in this study and its distribution process was the same as the buyer survey, the following sections will only refer the buyer survey, unless otherwise stated.

Respondents' typical positions included purchasing managers, supply chain managers, vice presidents of purchasing, purchasing directors, SD managers, purchasers[5], and senior purchasers. Previous studies find that SD practices differ across industries, and therefore this survey was sent to respondents from various industries to increase the generalizability of research findings.

Accordingly, respondents were obtained from two sources: 1) a contact database vendor, which provides the information of over 30 million business executives, including email addresses, social media links, and much more, and 2) LinkedIn, which operates the world's largest professional network on the Internet, with more than 364 million members in over 200 countries and territories as of June 2015[6]. Data was collected for two months, from the end of April to the end of June 2015.

5.2.4 Survey Distribution Process

For the data collection from the contact database, the first personalized email, which included a brief introduction of the survey questionnaire and link, was sent to initial

[5] Here, purchaser, as a title in an organization, refers a person who buys something for its organization. Some organization uses buyer to refer this title. Because the buying organization/firm is abbreviated as "buyer", here the title "buyer" is replaced with "purchaser".
[6] https://press.linkedin.com/about-linkedin

respondents. If they agreed to participate in this study, they could click the link to get access to the survey. However, hundreds of emails were undeliverable, and thus these email addresses were later dropped and would not be used for the data collection. Some respondents had questions about the survey, and therefore, a reminder email, including FAQ about this study and the progress of the data collection, was sent out after two or three weeks. Two or three weeks later, a final reminder along with an update progress report was sent out.

For the data collection on LinkedIn, a short invitation message was sent to potential respondents. Once they accepted the invite, a personalized LinkedIn message, which included a brief introduction of the survey questionnaire and link, was sent to them. At the same time, their names, current titles, email addresses and LinkedIn public profile URLs were collected and stored in an Excel worksheet. Through comparing the email addresses collected from LinkedIn with those purchased from the database vendor, only three records were duplicated across the two sources and they were only kept in one source. A second and then final reminders were sent out in the same manner as the previous process.

As a reward for their completion of the survey, they were offered a 12-page research report on SD based on the survey of SD scholars. In addition, all participants could indicate whether they would like to receive a copy of the executive report from this study at the end of the survey.

As of June 25, 2015, 347 had responded to the survey. Table 5-4 describes data collection and response rate for each source. Among the 2633 potential email

participants, 133 participated in this survey, yielding a response rate of 5.1%. Among 848 LinkedIn connections, 214 responded to the survey, yielding a response rate of 25.2%. The overall response rate is 10.0%. Among the 347 respondents, 311 and 36 chose the buyer and supplier survey, respectively.

Responses from the two sources were pooled into one dataset because no significant difference in key variables was found between respondents from the two sources (p-values range from 0.070 to 0.945). One of the reasons why respondents from two sources had similar opinions is that many purchasing executives have an online presence on LinkedIn. In the contact database, 74.1% of contacts had their LinkedIn account.

Table 5-4: Data Collection and Response Rate

Sample Source	Total sent out	Undeliverable /Not Fit	Remaining	Responses (as of June 25th, 2015)	Response Rate
Contact Database	3312	679	2633	133	5.1%
LinkedIn Connections	856	6	848	214	25.2%
Total	4186	685	3481	347	10.0%

Table 5-5: Survey Completion Progress

Survey progress							
	Start	Section I	Section II			Section III	Optional
		Background information	Before KCT	KCT variables	Performance Variables	Relational & Demographic variables	Open-end questions
Total	311	295	186	186	162	152	
Left	16	109+	0	24	10		
Skip							16

+ 16 of them skip to the open-end question because they indicated their organization had no supplier training or assistance in the past year.

As shown in Table 5-5, among the 311 respondents, 16 were dropped because they did not complete at least half of questions in section I. Among the remaining 295 respondents, 162 completed Section II, but six of them had missing values for at least one key variable (i.e., variables in Section II), and therefore their responses were considered as partial, rather than complete. In addition, 16 indicated that their organization had not conducted any of the three SD activities in the past year, and thus they skipped to the open-ended question. Even though they completed the survey, their responses were treated as partial as well. However, their comments would be used for future analysis. Accordingly, in total, there were 156 complete responses and 139 partial responses.

5.2.5 Respondents and Organization Background

The respondents were primary purchasing executives in solicited organizations. Table 5-6 presents the distribution of titles of the respondents. Among 295 respondents, 23.4% were Directors/VPs (of purchasing, operations, materials, supply chain), 55.3% were Managers (of purchasing, materials, supplier resources, supply chain), 10.8% were purchasers or senior purchasers, and 6.8% were SD managers/engineers. There is no significant difference in the position distribution across partial and complete responses (p-value=0.584).

On average, 295 respondents had 18.77 years of working experience in Purchasing Management, Supply Chain Management, or Operations Management, with a standard deviation of 9.96 years (see Table 5-6). No significant difference is found across partial and complete responses (p=0.923). In addition, each respondent was asked to rate their knowledge of their organizations' relationship and interaction with their suppliers on a scale ranging from 1 (very poor) to 5 (very accurate). For the total sample, the average

score of this knowledge is 3.89, with a standard deviation of 0.99, which is considered acceptable (Nagati & Rebolledo, 2013; Kumar et al., 1993). Interestingly, respondents submitting complete responses had significantly higher knowledge than those submitting partial responses. This indicates that a lack of sufficient knowledge to assess the nature of their organizations' relationship and interaction with their suppliers during a SD program may be one of the reasons why some respondents did not complete the survey. Overall, respondents had adequate knowledge to assess the interaction and relationship between their organizations and their suppliers in supplier training/assistance.

Table 5-6: Titles of Respondents

Titles	139 partial responses		156 complete responses	
	Frequency	Percent	Frequency	Percent
Director/VP (of purchasing, operations, materials, supply chain, procurement, etc.)	32	23.0%	37	23.7%
Manager (of purchasing, operations, materials, supply chain, procurement, etc.)	77	55.4%	86	55.1%
Sr. Purchaser or Purchaser	17	12.2%	15	9.6%
Analyst of (of purchasing, operations, materials, supply chain, procurement, etc.)	4	2.9%	2	1.3%
SD managers/engineers	6	4.3%	14	9.0%
Others	2	1.4%	2	1.3%
Missing	1	0.7%	0	0.0%

Table 5-7: Knowledge & Working Years of Respondents

	139 partial responses	156 complete responses	Total	Comparison btw partial and complete responses (p-value)
Knowledge Accuracy (5/1 very accurate/poor)	3.66 (1.12)	4.08 (0.85)	3.89 (0.99)	.000
Working Years in SCM (years)	18.71 (10.67)	18.83 (9.31)	18.77 (9.96)	.923

Table 5-8: Industries of Respondents' Organizations

Industry (SIC Codes)	139 partial responses		156 complete responses	
	Freq.	Percent	Freq.	Percent
Agriculture, Forestry, and Fishing (SIC: 01, 02, 07, 08, 09)	0	0.0%	2	1.3%
Mining (SIC: 10-14)	2	1.4%	1	0.6%
Construction (SIC: 15-17)	10	7.2%	3	1.9%
Manufacturing				
Industrial and commercial machinery and computer equipment (SIC: 35)	14	10.1%	13	8.3%
Electronic and other electrical equipment and components, except computer equipment (SIC: 36)	16	11.5%	13	8.3%
Transportation equipment (SIC: 37)	5	3.6%	24	15.4%
Other manufacturing (SIC: 20-34, 38-39)	28	20.1%	42	26.9%
Manufacturing in total	**63**	**45.3%**	**92**	**58.9%**
Service				
Retail Trade & Wholesale Trade (SIC: 50-59)	12	8.6%	15	9.6%
Finance, Insurance, and Real Estate (SIC: 60-67)	4	2.9%	6	3.8%
Transportation, communications, electric, gas, and sanitary services (SIC: 40-49)	1	0.7%	5	3.2%
Public Administration (SIC: 91-99)	4	2.9%	2	1.3%
Other services, including hotels, health, educational, amusement, etc. (SIC: 70-89)	20	14.4%	15	9.6%
Service in total	**41**	**29.5%**	**43**	**27.5%**
Others or unknown	17	12.2%	12	7.7%
Missing	6	4.3%	3	1.9%
Total	139	100%	156	100%

As shown in Table 5-8, 295 respondents came from diverse industries, with 52.5% and 28.5% from manufacturing and service sectors, respectively. Responses came from various industries, indicating that supplier training and assistance are being employed in

different industries, even though organizations in the manufacturing sector are still the main SD users. Complete responses included a higher percentage of manufacturing organizations and lower percentage of construction organizations than partial responses. This may indicate that supplier training and assistance were more commonly used in the manufacturing sector than in the construction industry.

By comparing these variables above, no significant difference was found in the two sets of responses, in terms of the distribution of respondents' titles, working experience, and industries. This could indicate that non-response bias may not be a threat to this study. A further non-response test will be done in the next chapter. Only complete responses are reported in the reminder of this chapter and the next chapter.

Table 5-9: Size of Respondents' Organizations

The Buying firm's Size	Frequency	Percentage
Annual sales/revenues ($)		
Less than $1 million	6	3.8
1 - $99 million	32	20.5
100 - $499 million	20	12.8
500 - $999 million	13	8.3
1,000 M & above	60	38.5
Unknown or not applicable	25	16.0
Total	156	100
Number of Full-time Employees		
Less than 100 people	17	10.9
101-200 people	13	8.3
201 -500 people	23	14.7
501 - 1,000 people	13	8.3
1,001 -5,000 people	17	10.9
Over 5,000 people	57	36.5
Unknown	16	10.3
Total	156	100

Note: Unknown or not applicable may refer to organizations such as charities, government, and universities.

The organizations' annual gross sales and number of full-time employees are reported Table 5-9. The results indicate that both larger and smaller organizations are implementing SD programs, such as supplier training and assistance.

CHAPTER 6 MAIN FINDINGS

This chapter contains a description of the data analysis, which includes testing for three potential sources of bias, exploratory factor analysis for the validity and reliability of scales, confirming the measurement of Knowledge Management by comparing the first- and second-order factor models, justifying the assumptions of linear regression, and testing the hypotheses using linear regression models.

6.1 Survey Bias Checking

Many efforts were made to minimize survey bias before and during the survey distribution process. After collecting sufficient responses, the existence of potential bias was further examined, including non-response bias, common method variance, and subjective data bias.

6.1.1 Non-response Bias

One approach used to test for non-response bias assumes that responses from later participants can be treated as representative of non-responders. This approach is meant to test whether there are significant differences between responses returned early and returned towards the end of data collection (Modi & Mabert, 2007; Armstrong & Overton, 1977). Accordingly, the 156 complete responses were split into three datasets, and the first and last 52 responses were used for testing for non-response bias.

A t-test was performed on the mean responses of all usable items in Sections II and III from these two datasets. The t-test found that 47 of the 50 usable items showed no significant difference between the early and late responders (the medium p-value is 0.467). The p-values of the other three items were very close to 0.05. Therefore, the

sample passed the non-response bias test. In addition, as presented in Section 5.2.4, there were no significant differences between partial and complete responders in terms of working experience, title, and industry. Even though these tests do not completely rule out the possibility of non-response bias, they suggest that non-response may not be a concern, given the assumption that the late responders and partial responders represent the opinions of non-responders.

6.1.2 Common Method Variance

One of the potential sources of bias in survey research is common method variance (Podsakoff et al., 2009). Harman Single Factor Technique (Harman, 1960; Podsakoff & Organ, 1986) was used here to determine to what degree any common method bias exists. An exploratory factor analysis (EFA) was performed on the variables of interest. If a single factor is obtained or if one factor accounts for a majority of the covariance in the independent and dependent variables, then the threat of common method bias is high. After an EFA was performed by combining the independent and dependent variables, multiple factors were obtained based on eigenvalues greater than one, indicating that the first situation was not the case. Furthermore, when this analysis was fixed to extract one factor, it explained only 34.34% of common variance, which does not exceed the commonly accepted threshold of 50%. The analysis did not observe a single factor that explained significant covariance. In addition, the common method bias was examined by building a common latent factor, which was fixed to have equal influence on all items. The common latent factor only account for about 30% of variances (common factor loading=.55), lower than the accepted threshold of 50%. Thus, both approaches suggest that common method bias may not be a cause for concern in the sample.

6.1.3 Subjective Data

Another source of potential bias is the use of subjective data. According to Miller et al. (1997), two situations where subjective data may be reliable and valid are: (a) if questions do not require recall from distant past, and/or (b) if informants are motivated to provide accurate information. When participants were invited to complete this survey, a cover letter and the first screen of the survey indicated confidentiality of data, highlighted the importance of this project, and promised that no identity information about the respondents themselves, their organization, or its supplier would be collected. Further, respondents would receive an executive report based on this study, so it was believed that they would try to respond to this survey as accurately as possible. In addition, the beginning of this survey asked respondents whether their organization had involved each of the four SD activities in the past year. Later, this survey asked respondents to provide their insight into a specific SD activity which their organization had used most extensively in the past year.

Furthermore, three objective measures of supplier performance improvements (cost, quality, and delivery reliability) were collected to check whether subjective responses were reliable. Through a correlational analysis, highly significant and positive correlations between objective measures and subjective measures of supplier performance indicated that subjective data represented the actual information of SD and its performance. Therefore, distortions in subjective data obtained from key informants were minimized.

6.2 Reliability & Validity of Scales

Nine variables (latent constructs) were measured by multiple items and three variables were measured by a single item. The survey question of each item, the item name, and its descriptive statistics (including mean and standard deviation) are presented in Appendix VI. An exploratory factor analysis (EFA) was used to generate loadings for the various factors. Because information about buying and supplying organizations was collected, the EFA was conducted for survey items regarding buying and supplying organizations separately. Factor loadings represent how much a factor explains an item variable in factor analysis. Loadings can range from -1 to 1. While loadings close to -1 or 1 indicate that the factor strongly affects the item variable, loadings close to zero indicate that the factor has a weak effect on the item variable. Typically, a factor loading higher than 0.6 is acceptable (Chin et al. 1997).

Table 6-2 present factor loadings generated by the EFA and Cronbach's alpha, composite reliability, and AVE (Average variance extracted). Tables 6-3 and 6-4, provide descriptive statistics and correlations of variables and factors. EFA resulted in clean loadings for the various factors. All item loadings on their own factors were higher than the recommended minimum value of .60, indicating a high convergent validity (Chin et al. 1997). Both Cronbach's alpha and the composite reliability of each factor are much higher than the recommended cutoff value (0.7), demonstrating high measurement reliability (Gefen, 2000). The square root of AVE for all nine factors is higher than the correlations between this factor and other variables or factors, demonstrating high discriminant validity (Barclay et al. 1995; Chin et al. 1997).

Table 6-1: EFA for Variables in Section II of the Survey

Survey Items	Buyer KM	Buyer Perform	Knowledge Sharing	Survey Items	Supplier KM	Supplier Perform
BuyerAcquire	.603	.111	.306	SupplierAcquire	.769	.219
BuyerSelect	.780	.059	.314	SupplierSelect	.784	.246
BuyerGenerate	.748	.173	.031	SupplierGenerate	.773	.227
BuyerAssimilate	.749	.341	.001	SupplierAssimilate	.740	.213
BuyerEmit	.714	.370	.040	SupplierEmit	.655	.288
BuyerMeasure	.649	.238	.316	SupplierMeasure	.731	.212
BuyerControl	.763	.128	.294	SupplierControl	.814	.170
BuyerCoordinate	.757	.059	.208	SupplierCoordinate	.778	.162
BuyerLead	.780	.192	.253	SupplierLead	.825	.210
BuyerPerform1	.337	.611	.197	SupplierPerform1	.432	.672
BuyerPerform2	.223	.534	.400	SupplierPerform2	.422	.613
BuyerPerform3	.301	.526	.289	SupplierPerform3	.266	.732
BuyerPerform4	.108	.842	.176	SupplierPerform4	.122	.809
BuyerPerform5	.118	.861	.167	SupplierPerform5	.190	.820
BuyerPerform6	.118	.638	.164	SupplierPerform6	.096	.672
KSharing1	.136	.278	.665			
KSharing2	.164	.191	.771			
KSharing3	.250	.179	.751			
KSharing4	.318	.309	.615			
Cronbach Alpha	.910	.846	.794		.923	.857
AVE	.532	.465	.495		.585	.524
Composite Reliability	.910	.834	.795		.927	.867

The numbers of above the blank row are factor loadings, also called component loadings, which represent how much a factor (the unobserved latent variable, which is measured by multiple observed variables) explains an item variable in factor analysis. Analogous to Pearson's r, the squared factor loading is the percent of variance in that indicator/item variable explained by the factor. For instance, factor loadings of the item BuyerMeasure on the three factors are .603, .173, and .306, respectively, indicating that 36%, 1%, and 9% of the variance of this item can be explained by the factors Buyer KM, Buyer Perform, and Knowledge Sharing, respectively. Because the factor Buyer KM can explain over 30% of variance, but the other factors only explain less than 10% of it variance, this item should be considered as an indicator of the factor Buyer KM. If an item is highly loaded on one factor, but very lowly loaded on other factors, this item can be used to measure the first factor.

Table 6-2: EFA for Variables in Section III of the Survey

Items	Supplier Depend	Relation Capital	Buyer Specificity
BuyerSpecificity1	.176	.163	.820
BuyerSpecficity2	.002	.119	.829
BuyerSpecficity3	.254	-.012	.852
SupplierDepend1	.831	.085	.196
SupplierDepend2	.855	.164	.074
SupplierDepend3	.773	.298	.073
SupplierDepend4	.665	.118	.132
Trust	.190	.885	.017
Reciprocity	.169	.872	.183
Commitment	.199	.906	.105
Cronbach Alpha	.823	.901	.810
AVE	.615	.788	.695
Composite Reliability	.864	.918	.872
Items	Supplier Depend	Relation Capital	Supplier Specificity
SupplierSpecificity1	.261	.376	.762
SupplierSpecificity2	.154	.261	.729
SupplierSpecificity3	.151	-.021	.851
SupplierDepend1	.834	.056	.227
SupplierDepend2	.850	.142	.130
SupplierDepend3	.665	.360	.189
SupplierDepend4	.687	.066	.091
Trust	.124	.880	.132
Reciprocity	.156	.875	.152
Commitment	.152	.906	.195
Cronbach Alpha	.823	.901	.768
AVE	.615	.788	.612
Composite Reliability	.864	.918	.825

Table 6-3: Correlations and Descriptive Statistics for the Model of Supplier Performance Improvement

Items	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Relation Length (years)	14.66	10.6													
2. Supplier Employee	3.25	1.78	-.07												
3. Supplier Sale	3.19	1.31	.08	.60**											
4. Sector (1= MFG, 0:others)	0.59	0.49	-.01	-.05	-.11										
5. Knowledge Sharing	3.21	1.00	-.04	.23*	.05	.28**									
6. Supplier Motivation	3.88	0.92	-.08	.08	.04	-.05	.35**								
7. Buyer KM	3.53	0.81	.03	.10	.05	-.02	.55**	.39**							
8. Supplier KM	3.48	0.85	-.04	.06	.03	.03	.44**	.49**	.70**						
9. Buyer Specificity	3.25	1.02	-.13	.12	-.11	.15	.48**	.31**	.57**	.45**					
10. Supplier Specificity	3.39	0.91	-.20*	.10	-.04	.10	.47**	.47**	.54**	.56**	.65**				
11. Goal Congruence	3.78	0.89	-.19*	-.05	-.16	-.01	.21*	.43**	.38**	.40**	.27**	.55**			
12. Supplier Dependence	3.2	0.83	.08	.15	.00	.10	.36**	.39**	.43**	.46**	.35**	.52**	.48**		
13. Relation Capital	3.84	0.82	-.15	-.08	-.10	.04	.17*	.31**	.36**	.46**	.25**	.45**	.63**	.51**	
14. Supplier Performance	3.55	0.84	-.06	.14	.02	.15	.56**	.36**	.48**	.52**	.38**	.58**	.42**	.41**	.44**

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed)

Table 6-4: Correlations and Descriptive Statistics for the Model of Buyer Performance Improvement

Variables	Mean	SD	1	2	3	4	5	6
1. Buyer Employee	4.22	1.83						
2. Buyer Sale	3.68	1.38	.71**					
3. Sector (1=MFG, 0:others)	0.59	0.49	.10	.16				
4. Buyer Motivation	3.88	0.98	.15	.03	.09	.41**		
5. Buyer KM	3.53	0.81	.11	.05	-.02	.55**	.55**	
6. Buyer Performance	3.62	0.84	.13	.08	.14	.61**	.37**	.54**

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed).

6.3 Measurement Models of Knowledge Management

All constructs except buyer and supplier knowledge management were adopted from previous studies. As a first study to measure KM using nine KM activities from KCT, it was recommended to further examine its measurement model in confirmatory factor analysis (CFA). Recall that KCT identifies and classifies nine KM activities into two groups: five activities directly manipulating knowledge resources and four more impacting the performance of those activities. Following this logic, the construct KM could be measured as a second-order factor. EFA using data from SD scholars did generate two factors from the nine KM items. However, the results might not be applicable to SD practitioners due to high cross-loadings and different statement of survey items. EFA for the SD practitioner data extracted only one factor (i.e., Buyer KM or Supplier KM) from the nine KM items. Therefore, CFA was conducted to compare first- and second-order measurement models of Buyer or Supplier KM. Based on goodness-of-fit indices and other criteria, a final decision on how to measure Buyer or Supplier KM would be made.

The first-order factor model was first created and tested for buyer and supplier KM separately (see Table 6-5). Standardized regression weights (i.e., factor loadings) for both Buyer and Supplier KM are similar to those in Table 6-1. More importantly, all goodness-of-fit indices are better than the recommended thresholds, indicating a reasonable fit of Buyer KM and Supplier KM measurement models to the data.

Then, the CFA further empirically examined the conceptualization of Buyer (Supplier) KM as a second-order factor model with two first-order factors ─ Knowledge

Manipulation (KM1) and Knowledge Influence (KM2) ─ as reflective indicators. The results, including factor loadings and goodness-of-fit indices, are reported in Table 6-6.

Table 6-5: Standardized Factor Loadings and Goodness-of-Fit Indices of First-order Factor Models

Path			Standardized Regression Weights	Goodness-of-Fit Indices	
First-order Factor Model of Buyer KM					
BuyerAcquire_1	<---	Buyer KM	.601	Chi-square	55.518
BuyerSelect_1	<---	Buyer KM	.799	DF	26
BuyerGenerate_1	<---	Buyer KM	.618	Chi-square/DF	2.135
BuyerAssimilate_1	<---	Buyer KM	.664	GFI	.923
BuyerEmit_1	<---	Buyer KM	.657	AGFI	.868
BuyerMeasure_1	<---	Buyer KM	.694	CFI	.963
BuyerControl_1	<---	Buyer KM	.814	NFI	.933
BuyerCoordinate_1	<---	Buyer KM	.801	TLI	.948
BuyerLeader_1	<---	Buyer KM	.842	RMSEA	.086
				SRMR	.047
First-order Factor Model of Supplier KM					
SupplierAcquire_1	<---	Supplier KM	.779	Chi-square	63.207
SupplierSelect_1	<---	Supplier KM	.765	DF	26
SupplierGenerate_1	<---	Supplier KM	.732	Chi-square/DF	2.431
SupplierAssimilate_1	<---	Supplier KM	.683	GFI	.918
SupplierEmit_1	<---	Supplier KM	.592	AGFI	.857
SupplierMeasure_1	<---	Supplier KM	.715	CFI	.954
SupplierControl_1	<---	Supplier KM	.786	NFI	.925
SupplierCoordinate_1	<---	Supplier KM	.746	TLI	.936
SupplierLeader_1	<---	Supplier KM	.835	RMSEA	.096
				SRMR	.042

Note: Recommended thresholds for these fit indices are as follows: below 1:3 (Gefen et al., 2000) for Chi-square/DF; below .05 (Gefen et al., 2000) or .08 (Hu & Bentler, 1999) for SRMR; below .06 (Hu & Bentler, 1999) or .08 (Byrne, 2013), or 0.10 (Chen et al., 2008) for RMSEA; above .90 for NFI (Gefen et al., 2000); above .95 (Hu & Bentler, 1999) or .90 (Bentler, 1992; Hoyle, 1995) for CFI; above .90 for GFI (Gefen et al., 2000); above .80 for AGFI (Gefen et al., 2000); and above .90 for TLI (Tucker & Lewis, 1973).

Table 6-6: Standardized Factor Loadings and Goodness-of-Fit Indices of Second-order Factor Models

Path			Standardized Regression Weights	Goodness-of-Fit Indices	
Second-order Factor Model of Buyer KM					
BuyerKM1	<---	Buyer KM	1.414	Chi-square	40.452
BuyerKM2	<---	Buyer KM	.636	DF	25
BuyerAcquire_1	<---	BuyerKM1	.638	Chi-square/DF	1.618
BuyerSelect_1	<---	BuyerKM1	.834		
BuyerGenerate_1	<---	BuyerKM1	.674	GFI	.948
BuyerAssimilate_1	<---	BuyerKM1	.688	AGFI	.906
BuyerEmit_1	<---	BuyerKM1	.665	CFI	.980
BuyerMeasure_1	<---	BuyerKM2	.689	NFI	.951
BuyerControl_1	<---	BuyerKM2	.823	TLI	.972
BuyerCoordinate_1	<---	BuyerKM2	.823	RMSEA	.063
BuyerLeader_1	<---	BuyerKM2	.859	SRMR	.042
Second-order Factor Model of Supplier KM					
SupplierKM1	<---	Supplier KM	1.133	Chi-square	48.904
SupplierKM2	<---	Supplier KM	.803	DF	25
SupplierAcquire_1	<---	SupplierKM1	.808	Chi-square/DF	1.956
SupplierSelect_1	<---	SupplierKM1	.770		
SupplierGenerate_1	<---	SupplierKM1	.762	GFI	.938
SupplierAssimilate_1	<---	SupplierKM1	.723	AGFI	.888
SupplierEmit_1	<---	SupplierKM1	.604	CFI	.970
SupplierMeasure_1	<---	SupplierKM2	.718	NFI	.942
SupplierControl_1	<---	SupplierKM2	.801	TLI	.957
SupplierCoordinate_1	<---	SupplierKM2	.769	RMSEA	.079
SupplierLeader_1	<---	SupplierKM2	.857	SRMR	.036

A comparison of the first- and second-order factor models revealed that even though fit indices of the second-order model were better than those of the first-order model for either Buyer or Supplier KM, the second-order model had a few problems. First, the second-order factor models had one negative residual variance (i.e., Buyer/Supplier KM1) and one standardized regression weight (from Buyer/Supplier KM1 to Buyer/Supplier) over 1, indicating the existence of a Heywood Case. A Heywood Case

occurs in factor analysis when the iterative maximum likelihood estimation method converges to specific variance values that are less than a prefixed lower bound value. Heywood cases occur frequently when too many factors are extracted or the sample size is too small.

In addition, the second-order factor models had a multicollinearity problem. The correlation coefficient between Buyer (Supplier) KM1 and KM2 was as high as .900 (.910), much higher than the square root of AVE for Buyer (Supplier) KM1 and KM2, demonstrating a low discriminant validity for Buyer (Supplier) KM1 and KM2. One approach to solve this multicollinearity problem is to combine the measures ad indicators of only one factor (Byrne, 2013).

In sum, the first-order factor models did not have these problems and had a good fit with the data, and thus, were used for further analysis. However, in the future, such a comparison could be done using a bigger sample size.

6.4 Justification of Linear Regression Assumptions

Because one main hypothesis (H_3) involves model comparison, it is recommended to use linear regression to test the significance of regression coefficients and model changes. However, four key assumptions should be tested before running linear regression models.

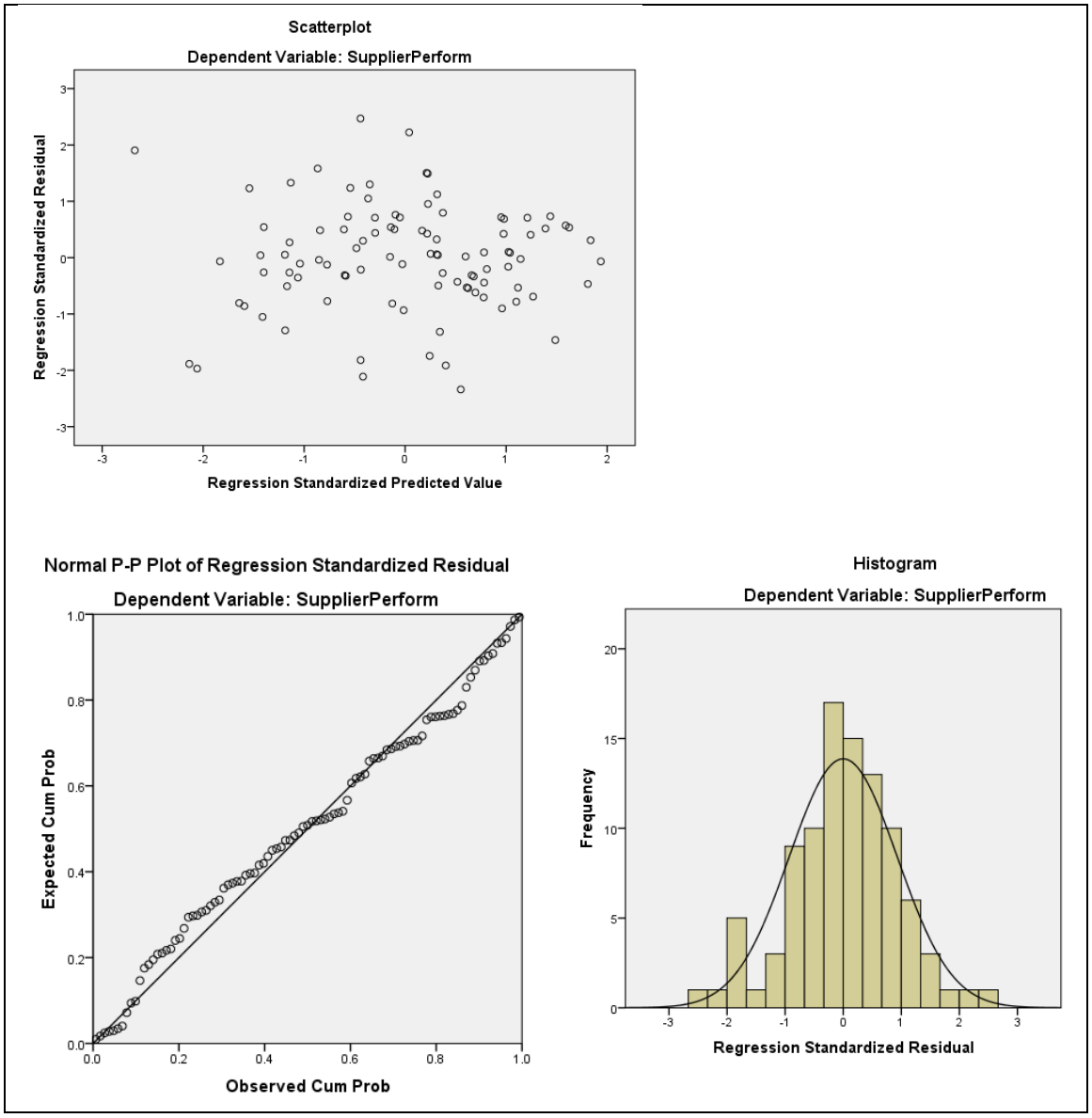
Assumption 1: There needs to be a linear relationship between the independent and dependent variables. After creating matrix scatterplots using SPSS Statistics to plot supplier performance (buyer performance) against independent variables, a visual inspection was conducted to check for linearity. All independent variables except relationship length were found to have different extents of linear relationship with

dependent variables. Later, relationship length was transformed using the logarithm function.

Assumption 2: Residuals are not correlated serially from one observation to the next (also called independence of observations). This means the size of the residual for one case has no impact on the size of the residual for the next case. This assumption could be checked using Durbin-Watson statistic, which is a simple test to run using SPSS Statistics. The value of the Durbin-Watson statistic ranges from 0 to 4. As a general rule of thumb, the residuals are uncorrelated is the Durbin-Watson statistic is approximately 2. A value close to 0 indicates strong positive correlation, while a value of 4 indicates strong negative correlation. For the data in this study, the values of Durbin-Watson for various models in this study were very close to 2, ranging from 2.0 to 2.2, and thus, there was no serial correlation for the data in this study.

Assumption 3 is that the data should show homoscedasticity, which means the error variance should be constant. When moving along the line, the variances along the line of best fit should remain similar in the scatterplot of the regression model. The final assumption is that residuals (errors) of the regression line should be approximately normally distributed. Two common methods to check this assumption include using either a histogram (with a superimposed normal curve) or a Normal P-P Plot. The following charts, shown in Figure 6-1, were generated from the model with supplier performance as the dependent variable, indicating that the data does meet the final two assumptions. In addition, VIF values for all variables are not greater than 3.15, with an average of 2.14, indicating there is no collinearity issue.

Figure 6-1: Charts for Checking Assumptions of Linear Regression



6.5 Hypotheses Testing

Similar to Krause et al. (2007), this study ran multiple linear regression models to test the research hypotheses power. Following the statistical procedure given by Warner (2012), this study ran models with Supplier and Buyer Performance as dependent variables separately as below.

6.5.1 Dependent Variable: Supplier Performance

Table 6-7 provides the results of the regression for the main effects of variables from different theories and controlled variables on supplier performance as measured in terms of quality, delivery, cost, and flexibility.

Table 6-7: Models with Single Theories (Supplier Performance)

Model Name	Model 1-1	Model 1-2	Model 1-3	Model 1-4	Model 1-5	Model 1-6	Model 1-7	Model 1-8
Theories [a]	-	TCE	RDT	SCT	GST	MT	KSP	KCT
Constant [bc]	3.34***	1.00*	1.75***	1.34**	1.61	2.18***	2.10***	.99*
Supplier-employee	.245*	.116	.110	.294*	.257*	.209	.072	.145
Supplier-annual sales	-.127	.011	-.030	-.114	-.066	-.108	-.047	-.063
Ln(Relationship length)	-.026	.127	-.033	.055	.059	.004	-.036	.038
Sector (1=MFG, 0=others)	.144	.157	.143	.152	.183*	.166	.026	.210
Buyer Specificity		-.051						
Supplier Specificity		.656***						
Supplier Dependence			.483***					
Relation Capital				.463***				
Goal Congruence					.399***			
Supplier Motivation						.307**		
Knowledge Sharing							.540***	
Buyer KM								.053
Supplier KM								.554***
Adjusted R Square	.025	.376	.248	.241	.177	.111	.285	.364
R Square Change from Model 1-1		.350	.222	.206	.146	.092	.257	.338
Sig. F-value change		.000	.000	.000	.000	.002	.000	.000

[a] Theory abbreviations: GST – Goal Setting Theory, MT – Motivation Theory, KCT – Knowledge Chain Theory, KSP – Knowledge Sharing Perspective, RDT – resource dependence theory, SCT – social capital theory, TCE – transaction cost economic theory.
[b] Coefficients of constant are unstandardized, but coefficients of all independent variables are standardized.
[c] ***significant at .001, **significant at .01, *significant at .05

Model 1-1 is the baseline model ─ this model was not significant and all controlled variables except supplier employee were not significant. Models 1-2 to 1-8 evaluated the impact of independent variable(s) from theories such as TCE, RDT, and KCT. These models were significant and adjusted R squares ranged from .111 to .376. R square

changes from the baseline model to other models were significant. Supplier Specificity, Supplier Dependence, Relational Capital, Goal Congruence, Knowledge Sharing, and Supplier KM were very highly significant ($p < .001$) and Supplier Motivation was highly significant ($p < .01$). These results indicate strong support for H1 and H2a. However, buyer KM was not significant in Model 1-8, indicating that H2b is not supported.

Models 2-2 to 2-7 examined the impact of Buyer and Supplier KM and variable(s) from each of other theories in addition to controlled variables. Knowledge Sharing was significant in Model 2-7, which provides additional support for H1. Supplier KM was very significant in all the models (Models 2-2 to 2-7), which provides additional support for H2a.

Table 6-8: Models with Combined Theories (Supplier Performance)

Model Name	Model 2-2	Model 2-3	Model 2-4	Model 2-5	Model 2-6	Model 2-7	Model 2-8
Theories [a]	TCE & KCT	RDT & KCT	SCT & KCT	GST & KCT	MT & KCT	KSP & KCT	All
Supplier-employee	.115	.094	.199*	.173	.145	.075	.093
Supplier-annual sales	-.022	-.024	-.075	-.050	-.063	-.033	-.018
Ln(Relationship length)	.105	.024	.075	.076	.037	.028	.082
Sector (1=MFG, 0=others)	.210**	.196*	.203**	.221**	.210	.122	.129
Buyer Specificity	-.193						-.198
Supplier Specificity	.461**						.315*
Supplier Dependence		.257**					.098
Relation Capital			.257***				.192
Goal Congruence				.189*			-.029
Supplier Motivation					-.003		-.126
Knowledge Sharing						.315**	.272*
Buyer KM	.030	.017	.018	.012	.053	-.091	-.100
Supplier KM	.398***	.459***	.462***	.504***	.556***	.493***	.384**
Adjusted R Square	.456	.409	.412	.386	.403	.411	.501
R Square Change from the model without KM	.086	.165	.175	.211	.247	.132	.049
Sig. F-value change	.001	.000	.000	.000	.000	.000	.011

[a] Theory abbreviations are same as those in Table 6-7 above.
All are Standardized Coefficients; ***0.001, **0.01, and *0.05.

Adjusted R Square of Model 2-*i* (*i* =2, 3 … 7) were higher than that of Model 1-*i* (*i* =2, 3 … 7) and the changes of R Square from Model 1-*i* (*i* =2, 3 … 7) to Model 1-*i* (*i* =2, 3 … 7) were very significant, indicating that the addition of KCT to each of other theories significantly increases the explanation power. Therefore, Hypotheses 3a-3f are strongly supported. Regression coefficients of key variables in each of other theories decrease from Model 1-*i* (*i* =2, 3 … 7) to Model 2-*i* (*i* =2, 3 … 7) due to addition of Buyer KM and Supplier KM to their models. However, the impact of all key variables except Supplier Motivation on Supplier Performance is still significant.

Model 2-8 examined the impact of all variables on supplier performance, yielding the highest R Square among all the models. Three variables (Supplier Specificity, Knowledge Sharing, and Supplier KM) were found to be significant, which provides additional support for H1 and H2a. Because variables culled from alternative theories were controlled, the significance of Supplier KM indicates support for H4a, but H4b is not supported.

6.5.2 Dependent Variable: Buyer Performance Improvements

Buyer performance improvement was measured by six items (i.e., product/service cost, total cost, product/service quality, delivery times and reliability, and production/service flexibility), adopted from Krause et al. (2007). Models with buyer performance as dependent variable included three independent variables (Supplier Performance, Buyer Motivation, and Buyer KM) and three controlled variables (Buyer employee, Buyer-annual sales, and Sector). Four models were run to show the changes of R Square when new variables were added. As shown in Table 6-9, Model 3-1, the baseline model, was not significant and only one controlled variable was significant. Supplier Performance is

very significant in all other models, but Buyer Motivation is not significant. In addition, Buyer KM is very significant, indicating great support for H2c.

Table 6-9: Regression Analysis for Buyer Performance

	Model 3-1	Model 3-2	Model 3-3	Model 3-4
Buyer-employee	.124	.039	.018	.018
Buyer-annual sales	-.019	-.078	-.047	-.049
Sector (1=MFG, 0=others)	.185*	.014	.025	.071
Supplier Performance		.795***	.765***	.686***
Buyer Motivation			.007	-.110
Buyer KM				.293***
Adjusted R Square	.028	.617	.614	.665
R Square Changes		.578	.000	.051
Sig. F value change		.000	.893	.000

All regression coefficients are standardized; *** 0.001, ** 0.01, and * 0.05.

Table 6-10 summarizes the results from the analysis represented in Tables 6-7, 6-8, and 6-9. All hypotheses except H2b and H4b are supported.

Table 6-10: A Summary of Hypotheses Testing

Hypotheses	Results
H1: Buyer's knowledge sharing in SD is positively associated with supplier's performance improvements.	Supported
H2a: Supplier's KM effort in SD is positively associated with supplier's performance improvements.	Supported
H2b: Buyer's KM effort in SD is positively associated with supplier's performance improvements.	Not Supported
H2c: Buyer's KM effort in SD is positively associated with buyer's performance improvements.	Supported
H3:The explanation power will be higher, when KM is combined with	
H3a: buyer and supplier asset specificity (Transaction Cost Economics)	Supported
H3b: supplier dependence (Dependence Theory)	Supported
H3c: relational capital (Social Capital Theory)	Supported
H3d: buyer and supplier motivation (Motivation Theory)	Supported
H3e: Goal congruence (Goal Setting Theory)	Supported
H3f: knowledge sharing (Knowledge Sharing Perspective)	Supported
H4: When variables culled from alternative theories are controlled,	
H4a: Supplier KM in SD is still positively associated with supplier's performance improvements.	Supported
H4b: Buyer KM is still positively associated with supplier's performance improvements.	Not Supported

CHAPTER 7 CONCLUSIONS & DISCUSSIONS

7.1 Conclusions

This dissertation focuses upon the buying firm's SD from a KM perspective and demonstrates that SD outcomes can be better explained when SD as a KM system. An extensive review of existing SD literature indicates that why SD can increase supplier and buyer performance is still unclear but very valuable for both researchers and practitioners. By triangulating theoretical construction, conceptual examination, and empirical examination, this dissertation finds that KM activities from KCT (knowledge chain theory) are very important for SD for the following reasons. First, unlike traditional theories such as TCE, KCT builds the link between KM efforts in SD and SD outcomes, which can theoretically explain why SD works. Second, all SD activities can be subsumed into KM activities from KCT. Third, SD scholars demonstrate that all nine KM activities should be at least moderately conducted by both buying and supplying organizations. Fourth, empirical data from SD practitioners further validates the importance of KM in promoting buyer and supplier performance. The introduction of KM can also increase the explanation power of traditional theories used in SD literature such as TCE. Overall, this research adds to the growing body of knowledge on supplier development and knowledge management and provides an impetus to increase our understanding of inter-organizational efforts for managing knowledge in buyer-supplier dyads, or evening complex supply networks.

In addition, this dissertation produces many "byproducts", which would be very helpful for researchers, practitioners, and educators. First, this dissertation provides an extensive review of SD literature, including SD history, definitions, implementation

approaches, measurements, and taxonomies, and conducts a meta-analysis of SD activities and their outcomes. All these results provide researchers and educators with a mental model to understand SD in a complete manner. Second, this dissertation generates an integrated definition, a meaningful taxonomy, and a comprehensive implementation approach for SD. Further, this study illuminates how positive performance and capability consequences of SD can be achieved through the design and execution of knowledge activities embedded within supplier development activities. This dissertation contributes to extant research by articulating the important role of knowledge and knowledge management in supplier development and advancing a comprehensive, unified, organized foundation for understanding SD and its link with performance.

Moreover, this dissertation examines the impact of variables from different theories on supplier performance improvements in an episodic view, rather than a cumulative view. Results demonstrate the utility of those traditional theories, even though the combination with TCE can generate higher explanation power. Among the independent variables, supplier asset specificity, buyer's knowledge sharing, and supplier knowledge management are critical to supplier performance improvements. This indicates that even though SD is typically sponsored and initiated by the buying firm, the main role for buyer is to effectively share appropriate knowledge with its supplier and the supplier has to undertake more responsibility to absorb the knowledge and commit resources to improve its performance.

7.2 Limitations

Like any other research, this dissertation has several limitations. First, even though about 300 responded to the survey, over forty percent of them did not complete the survey due

to unknown reasons, resulting in an acceptable but not desirable sample size. Especially, the response rate for the contact database was only 5%. The test demonstrates that non-response bias is not problematic for this study, but the survey itself and its online interface could be furthered improved to make respondents more willing to complete the survey.

Second, the key construct Knowledge Management was decided to be measured as a first-order factor, rather than a second-order factor, as conceptually suggested by KCT. Third, only three highly-recognized SD activities are selected for further examination in this survey, so this may pose some concern about the generalizability of the results in this dissertation. Fourth, measures of dependent variables in this dissertation were adapted from Krause et al. (2007), but those measures are more manufacturing-oriented, and thus, they may not be totally applicable to the service sector. A few comments from respondents indicate this limitation. In addition, those measures represent different dimensions of performance, but previous studies (e.g., Wagner & Krause, 2009; Kim et al., 2006) find that SD activities have a varying impact on different dimensions of performance improvement.

Fifth, practitioner data was only collected in North America, mainly in the United States, but some results may not be applied to other regions such as Asia or Europe. Sixth, the main data of this dissertation comes from the buyer's side. Even though the buying firm is more informative in SD, opinions from the supplying firm are also important for us to understand how and why KM works in SD. All these limitations could be further overcome or minimized by future research, which will be discussed in the next section. The final limitation is that the meta-analysis in Chapter 2 only includes published

journal articles. Some scholars (e.g., DeCoster, 2004) suggest that it is very important to find unpublished articles and conference proceedings for meta-analysis because they think published articles typically favor significant findings over non-significant ones. However, there are few unpublished articles in the field of Supply Chain Management field. In addition, the sample articles in the meta-analysis include many non-significant findings.

7.3 Future Research

In addition to those provided in Section 4.3.2, more future research directions, driven by both study limitations and findings, are discussed as below.

7.3.1 Future Research Driven by Study Limitations

Study limitations can be further alleviated by the following future research efforts. First, based on this research and comments given by respondents, both survey interface and questions could be further improved. For instance, one respondent commented that "the questions were phrased very differently than how I would have". In addition, through an analysis of respondents' behavior, this study finds that many respondents quit this survey at Question 4 or 5 in Section I. A friendly reminder can be added there to encourage respondents to move forward. Furthermore, in order to increase the response rate for those in the contact database, future research can fully implement Total Design Method (Dillman, 2000) or Tailored Design Method (Dillman et al., 2014). All these efforts could mitigate the first limitation above.

The second limitation could be addressed through further testing items used for measuring KM. As the first study to measure KM from the perspective of KCT, this dissertation provides a good starting point. According to Holsapple & Jones (2004,

2005), each of the nine KM activity (e.g. knowledge acquisition) includes multiple activities, and thus, each of them could be considered as a first-order factor with multiple survey items. Doing so, the construct KM could be better measured. In addition, the statement of each survey item could be further refined to make it applicable to the context of supplier development.

This dissertation focuses on specific direct SD activities, supplier training/assistance. However, future research could employ the same research method to study the role of KM in other SD activities. Due to high multiplicity of SD activities, it is recommended to examine a specific SD activity or a group of similar activities in each survey. The catalog of SD activities generated by this study and its verification from SD scholars can help researchers choose appropriate target SD activities. All these future research efforts can address the third limitation.

In order to circumvent the fourth limitation, future research can refine the measures of dependent variables to make them more applicable to the service sector or other industries. For instance, this study revised "product" in the statement of original survey items to "product or service". However, future research can borrow some items which are more specific to the service sector. In addition, future research can measure each of buyer/supplier performance dimensions as a multi-item factor so that the relationship between buyer/supplier KM and each performance dimension can be further examined.

The fifth limitation could be overcome by distributing the survey to informants from other regions such as Asia and Europe. Such efforts not only help to increase the generalizability of findings in this study, but also facilitate conducting comparative

analysis. For instance, national culture and economic development level could be used to explain potential difference between regions.

The sixth limitation could be addressed through data collection from either both buying and supplying firms, or buyer-supplier dyads because SD requires investments and involvements from both parties. For instance, Praxmarer-Carus et al. (2013) use dyadic data from buyers and suppliers and support the existence of gap between the suppliers' and the buyers' perceptions of their share of costs and earnings in SD. As indicated before, this dissertation also connected supplier's opinions, but the sample size was not big enough for factor analysis and regression analysis. More data are needed to collect from the supplier's side in the future. It is desirable but time-consuming to collect dyadic data, but future research can consider such an approach to test hypotheses in this study. The final limitation can be addressed by including conference papers or unpublished articles (DeCoster, 2004).

7.3.2 Future Research Driven by Study Results

There are several future research directions which are driven or triggered by this dissertation. The first is to introduce SD goals and examine how they influence KM efforts in SD, and in turn, the performance measures. As indicated by Wagner & Krause (2009), SD goals in general and their relationship with SD activities have received little research attention. Furthermore, Koufteros et al. (2012) find that resource domains for which the buyer selects the supplier (e.g. NPD capability, quality capability, and cost capability) match with output domains in which the buyer expects to see enhanced performance (e.g., product innovation, quality, and competitive pricing). Therefore, SD goals can influence how KM performs in SD. Future research can examine the

moderation effect of SD goals on KM efforts and matched effect of SD goals with SD outcomes.

Second, this research examines the impact of buyer KM and Supplier KM in SD separately and finds that Supplier KM increases supplier performance improvements, but Buyer KM does not. Future research can examine how a buyer-supplier dyad performs KM activities in SD. Such a dyadic view requires a better measurement of buyer-supplier KM, but such a research is very promising area to understand the role of KM in SD.

The third research avenue is to combine KCT with Knowledge Resource Theory (Holsapple & Joshi, 2004), which defines knowledge resource (KR) as "knowledge that an entity has available to manipulate in ways that yield value" (p. 598). This theory recognizes two classes of KRs: schematic and content knowledge. The first one is a KR whose existence depends on the existence of the organization, and the second one is a KR that exists independently of an organization to which it belongs. Future research can examine how different types of knowledge resources are performed in SD to achieve desirable outcomes.

Among the three critical variables determining supplier performance improvement, supplier asset specificity is the only non-knowledge factor. Supplier asset specificity involves supplier's commitment, willingness, and capability to invest their specific resources and to tailor its existing approach or system to meet the requirements of buyer's organization. Many comments given by the survey respondents indicate that this factor is important (see below). Thus, future research can introduce change management to SD and examine how to overcome supplier inertia in SD.

"*Most suppliers are stuck in their ways, and/or are too large to change*"
"*Knowledge enhances the capable, but does nothing for the incapable*"

"*I have found that supplier's work at their own pace and there is little I can do to change that*"
"*Suppliers are not willing to change their processes*"

The fifth research direction is to examine the mediation effect of KM in SD. For the same independent variables, their regression coefficients reduce from Table 6-7 to Table 6-8, indicating that the introduction of KM factors reduces the effect of other independent variables. This suggests that KM factors may play as a mediator in those models. Baron and Kenny (1986) recommend a four-step approach in which four regression analyses are conducted and the significance of the regression coefficients is examined at each step. The Sobel test (Sobel, 1982) provides a statistical method to assess the significance of the mediator in relation to the independent and dependent variables. Both results indicate significant mediation effects of supplier KM on the relationship between six independent variables (i.e., Supplier Motivation, Goal Congruence, Supplier Specificity, Supplier Dependence, Relational Capital, and Knowledge Sharing) and Supplier Performance Improvement. Future research can further provide theoretical evidence for the existence of the mediation effect and empirically test its significance in large samples.

7.4 Contributions

As the first study to examine SD from the perspective of KCT, this dissertation makes both theoretical and practical contributions, at different levels. Table 7-1 summarizes the specific contributions, each of which will be elucidated as below.

7.4.1 Theoretical Contributions

With a multidisciplinary topic, this dissertation contributes to both KM and SD literature. At the KM side, it empirically confirms the KM ontology and KCT. As presented in

Chapter 6, factor analysis of the nine KM items from both buyers and suppliers reveals that all the nine KM activities should be included to represent the construct Knowledge Management. This construct has a high reliability and validity, indicating the excellence of such a measurement of KM.

Table 7-1: Contributions of This Dissertation

Categories	Specific Contributions
Theoretical Contribution	Theoretical – KM Side • Confirming the KM ontology and KCT • Examining the role of Knowledge Sharing and KM in SD • Investigating combination of KCT with other theories in explaining why SD works
	Theoretical – SD Side • Revealing why/how SD works from a KM perspective • Providing an extensive list of SD activities • Offering an integrated definition, taxonomy, and implementation approach of SD from a KM perspective
Practical Contribution	Researchers • Illustrating how KCT is applied, esp. at the inter-organization level • Exemplifying the use of mixed research methods and integration of multiple disciplines. • Providing an example for collecting data on LinkedIn
	Practitioners • Developing a catalog of SD activities, from which practitioners can make their own SD initiatives • Emphasizing the importance of KM and KS in SD • Advancing guidance for the design, implementation, and evaluation of SD initiatives
	Educators & Students • Providing a mental model to understand SD literature • Articulating the body of knowledge on SD • Explaining to students what are involved in SD

In addition, buyer/supplier KM is positively associated with buyer/supplier performance improvements, which not further confirms the utility of KCT in the context of SD, but also reveals the important role of knowledge management in SD. Combining

KM with variables from existing theories, this dissertation contributes by empirically testing the explanation power of different models and indicating that KCT can be nicely aligned with other theories in explaining why SD works.

At the SD side, this dissertation contributes to SD literature by exploring and answering the question of why SD works. KM activities, along with other variables such as asset specificity and knowledge sharing, can be used to predict SD outcomes. KCT help SD researchers understand what occur in a SD program. This dissertation also generates an extensive list of SD activities and verifies their relevance (to what degree this activity is regarded as an SD activity) and preciseness (to what degree the description of this activity is precise) from the perspective of SD scholars. Such a list will be able to facilitate the systematic development of a cohesive SD theory. Furthermore, applying KCT, this dissertation contributes to the SD literature by generating an integrated definition of SD, a new SD taxonomy, and a new SD approach, from a KM perspective. An application of the KCT helps illuminate how positive performance and capability consequences of supplier development can be achieved: by design and implementation of knowledge activities (first- and second-order) within the thirty SD types. Section 4.3.1 provides more details about these contributions.

7.4.2 Practical Contributions

In addition to theoretical contributions, practical implications for researchers, practitioners, and educators/students, can be drawn from this dissertation. First, researchers can benefit from theoretical development and methodological innovation in this dissertation. As indicated before, KCT has been extensively used in the organizational level, but this study illustrates how it could be applied to the inter-

organizational phenomena. This dissertation suggests that KM activities in SD should be examined from buying and supplying organizations separately because they play different roles in implementing KM activities. A multidisciplinary perspective and mixed methods allow for a wide variety of supply chain research questions to be answered and provide strong, systematic, robust results (Johnson & Onwuegbuzie, 2004; Boyer & Swink, 2008; Davis et al., 2011). Golicic & Davis (2012) demonstrate that a very small percentage of published studies in the supply chain field have used mixed methods research design. This dissertation integrates multiple disciplines, including knowledge management, supply chain management, and work motivation, and research methods, including systematic literature reviews, conceptual examination, interviews, and surveys. As one of the first studies collecting data on LinkedIn, this dissertation suggests that LinkedIn is a very good source for identifying potential research subjects.

Second, this dissertation contributes to practitioners by developing a catalog of SD activities, illustrating KM activities which should be conducted in SD, and advancing guidance for designing, implementing, and evaluating SD initiatives. The catalog of SD activities, along with the comparison of SD implementation approaches, can help practitioners plan their own SD programs. For instance, if a buying firm wants to improve its supplier's short-term performance, it may choose the performance approach and use activities which mainly involve second-order KM activities such as supplier evaluation and supplier training. Furthermore, this dissertation uncovers the significance of KM factors in SD and illustrates how each KM activity is connected with SD. Practitioners should pay more attention to managing knowledge activities in SD, especially for those who adopt the knowledge approach. For instance, practitioners have to figure out how to

effectively select appropriate knowledge for suppliers or assimilate knowledge shared by their customers.

This dissertation also identifies three critical factors determining SD performance improvements in SD: Supplier Asset Specificity, Knowledge Sharing, and Supplier KM. This can provide can provide practitioners with a guideline to design, implement, and evaluate SD initiatives. For instance, before a buying firm determines which supplier and what areas will be developed, it must consider the transferability of supplier resources; once a particular supplier is selected and the development areas are identified, the buyer has to figure out what knowledge should be shared with this supplier to improve its performance or capability. When the SD program starts, the buyer should monitor and evaluate the supplier's KM efforts because they have a very significant impact on supplier performance improvements. Such a guideline can help practitioners capture and manage the key influencers in SD design, implementation, and evaluation.

The final practical contributions are for Supply Chain educators or students. As an important strategy, SD, however, has been rarely described at length in Supply Chain textbooks and knowledge about SD has been scattered on many articles. This study reviews hundreds of articles and articulates the body of knowledge on supplier development, including its history, definitions, taxonomies, implementation approaches, and measurements. Applying KCT, this dissertation explains to students what KM activities are involved in an SD program, and helps them comprehend the inside of KM. The KM-based definition of SD is rated by SD scholars at least moderately complete, accurate, clear, concise, and generally applicable, and thus it can help educators and students perceive SD in a new perspective. SD scholars also indicate that the adoption of

this definition is moderately important for understanding SD. The review table and the KM catalog can help educators and students understand SD literature.

APPENDICES

Appendix I: Large-Scale Survey-Based Supplier Development Studies

Study [a]	Theory/Discipline [b]	Focal Constructs [c]	Directly Related Constructs [d]
Agbejule & Burrowes (2007)	N/A	Supplier Development	Perceived Environmental Uncertainty, Use of Managerial Accounting Information
Ahire et al. (1996)	QM	Supplier Quality Mgt.	Product Quality
Arroyo-López et al. (2012)	KBV	SD Activities	Supplier's Absorptive Capacity, Financial Performance, Operational Performance, Development of Capabilities, Preconditions for Learning
Asare et al. (2013)	RBV, RV, Market-based Assets Framework	Knowledge Transfer Content, Knowledge Transfer Frequency, Buyer Involvement Intensity	Marketing Process Improvement
Black & Porter (1996)	QM	Supplier Partnerships	N/A
Blome et al. (2014)	Legitimacy theory	Green SD	Green Procurement, Supplier Performance, Top Management Commitment
Blonska et al. (2013)	SCT	Capability Development, Supplier Governance	Relational Capital, Buyer Benefits, Supplier Benefits
Bozarth et al. (1998)	N/A	Procurement Strategy	International Sourcing Practices, Supplier Market Characteristics
Buvik (2000)	TCE	Interfirm Coordination	Asset Specificity, Exchange Frequency, Uncertainty
Carr & Kaynak (2007)	CMT	SD Support	Information Sharing Within Firm, Information Sharing Between Firms, Firm Financial Performance, Product Quality Improvement
Carr & Pearson (1999)	TCE	Supplier Evaluation Systems, Buyer-Supplier Relationships	Strategic Purchasing, Firm Performance
Carr et al. (2008)	RDT	Supplier Dependence, Supplier Involvement, Supplier Training	Supplier's Operational Performance
Carter (2000)	ET	Perceived Gap in Buyer's Deceitful Practices	Supplier Satisfaction With Relationship
Carter (2005)	RBV	Purchasing Social Responsibility	Organizational Learning, Supplier Performance

Study [a]	Theory/Discipline [b]	Focal Constructs [c]	Directly Related Constructs [d]
Carter et al. (1998)	QM	Interaction With Suppliers, Competitive Focus	TQM Program Success
Chen & Paulraj (2004)	SMT, RV	Supply Network Structure, Supply Base Reduction, Cross Functional Teams	Buyer Performance
Chin et al. (2006)	QM	Potential Supplier Evaluation, Sourcing Strategies, Supplier Motivation, Technology & Information Sharing	N/A
Curkovic et al. (2000)	QM	SD	Quality Performance, Firm Performance
De Clercq & Rangarajan (2008)	Social Exchange Theory	Communication Intensity, Perceived Relational Support	Customer Reputation, Procedural Justice, Social Interaction, Commitment, Satisfaction
De Toni & Nassimbeni (2000)	Organization Theory, TCE	SD JIT-P Practices, Operational JIT-P Practices	Plant Performance
Dong et al. (2001)	N/A	JIT-P, SC Integration	Logistics Costs, Supplier JIT Manufacturing
Dyer & Chu (2000)	TT	Supplier Assistance	Trust
Dyer & Hatch (2006)	RBV, KBV	Time Spent on Knowledge Transfer, Quality Assistance, Inventory/Cost Assistance	Product Quality, Inventory Costs
Dyer (1996)	TCE	Information Sharing, Human Asset Specificity	Type of Relationship
Dyer et al. (1998)	IOR	Assistance, Relationship Specific Assets	Type of Relationship
Ellram & Hendrick (1995)	IOR	Perceived Gap in Futuristic Focus, Risk Sharing & Information Sharing	N/A
Forker & Stannack (2000)	TCE	Perceived Gap in SD Practices	N/A
Forker (1997)	QM	Supplier Quality Mgt.	Quality Performance, Implementation Efficiency
Forker et al. (1999)	QM	Perceived Gap in Supplier Mgt. Practices	N/A
Foster Jr. & Ogden (2008)	QM	N/A	N/A
Ghijsen et al. (2010)	RDT, TCE	Indirect Influence Strategies, Promises, Other Indirect Influence Strategies, Human-Specific SD, Capital-Specific SD	Supplier Satisfaction, Supplier Commitment
Groves & Valsamakis (1998)	IOR	Partnership Practices	Type of Relationship, Relationship Performance

Study [a]	Theory/Discipline [b]	Focal Constructs [c]	Directly Related Constructs [d]
Heide & John (1990)	TCE	Expectation of Continuity, Supplier Evaluation, Performance Ambiguity	Buyer's & Supplier's Specific Investment, Volume & Technological Uncertainty, Joint Action
Heide & Miner (1992)	Game Theory	Information Exchange, Extendedness of Relationship, Performance Ambiguity, Shared Problem Solving, Restrained Use of Power	Delivery Frequency
Hemsworth et al. (2005)	QM	Quality Mgt. Practices in Purchasing	Information System Practices, Purchase Performance
Humphreys et al. (2004)	TCE	Transaction Specific SD, Infrastructure Factors of SD	Supplier Performance, Buyer Competitive Advantage, Buyer-Supplier Performance
Humphreys et al. (2011)	TCE	Direct Supplier Involvement, Supplier Evaluation, Effective Communication	Long-term Strategic Goals, Partnership Strategy, Top Management Support, Supplier Strategic Objective, Trust, Buyer-supplier Performance Improvement
Janda & Seshadri (2001)	CLT	Interaction	Efficiency, Effectiveness of purchasing Performance
Joshi (2009)	CT, CMT	Output, Process, Capability Controls	Continuous Supplier Performance Improvement
Kaynak (2005)	QM	Supplier Quality Mgt.	Technical Complexity
Kim (2006)	IOR	Effective Communications, Buyers' Involvement, Financial Performance	Delivery Performance, Product & Service Quality Performance, Competitive Intensity
Kocabasoglu & Suresh (2006)	IOR	Status of purchasing, Internal coordination, Information sharing with suppliers, Development of key suppliers	Strategic Sourcing
Kocabasoglu et al. (2007)	Supply Chain Risk	Forward Supply Chain Investment	Business Uncertainty, Forward Supply Chain Risk Propensity, Reverse Supply Chain Risk Propensity, Reverse Supply Chain Investment
Kotabe et al. (2003)	RV, KBV	Technology Transfer, Supplier Performance Knowledge	Length of Relationship, Supplier Performance Improvement
Koufteros et al. (2012)	RBV	SD, Supplier Partnership	Supplier Selection Based on NPD Capability, Supplier Selection Based on Low Cost Capability, Supplier Selection Based on Low Quality Capability, Buyer Product Innovation Capability, Buyer Quality Capability, Buyer Competitive Pricing Capability
Krause & Ellram (1997a)	N/A	SD Involvement, Relationship Characteristics	N/A

Study [a]	Theory/Discipline [b]	Focal Constructs [c]	Directly Related Constructs [d]
Krause & Ellram (1997b)	N/A	Purchasing Philosophy, SD Activities, SD Success	N/A
Krause & Scannell (2002)	TCE	Supplier Assessment, Competitive Pressure, Supplier Incentives, Direct Involvement	Type of Business
Krause (1997)	TCE	Direct Involvement, Incentives, Enforced Competition, SD Effort Results	Supplier Relationships, Supplier Performance
Krause (1999)	TCE	SD Activities, Buyer's Expectation of Relationship Continuity	Interfirm Communication, Buyer's Perception of Supplier Commitment
Krause et al. (1998)	N/A	SD Activities, SD Identification Tools, SD Implementation Strategies, Continuous Improvement Activities, SD Effectiveness	Cross-Functional Involvement, Dedicated Supplier Resources, Performance Improvement, Supplier Metrics
Krause et al. (1999)	PDT	Minority SD Program Effectiveness, Barriers to Minority SD Effort	Supplier Size, Percent Sales To Customer, Length of Relationship
Krause et al. (2000)	RBT	Supplier Assessment, Competitive Pressure, Supplier Incentives, Direct Involvement	Performance Improvement
Krause et al. (2007)	SCT	Supplier Evaluation, SD Activities	Buyers' Cost Performance Improvement, Buyers' Quality, Delivery & Flexibility Performance Improvement
Lawson et al. (2014)	RV	SD Activities in NPD	Supplier Responsibility, Skill Similarity, Single Supplier, Supplier Task Performance
Lee & Humphreys (2007)	IOR	Supplier Development	Guanxi, Strategic Purchasing, Outsourcing
Lee et al. (2009)	TCE	Supplier Alliances (including Supplier Development, Joint Action, Information Technology Application)	Technology Change, Market Uncertainty, Specific Investments, Strategic Purchasing,
Li et al. (2005)	N/A	Strategic Supplier Partnership	Delivery Dependability, Time To Market
Li et al. (2007)	TCE	Asset Specificity, Performance Expectations, Trust, Joint Action	Market Responsiveness, Operational Effectiveness
Li et al. (2012)	TCE	Transaction-specific Supplier Involvement, Supplier Evaluation, Effective Communication	Long-term Commitment, Supplier Strategic Objectives, Trust, Supplier Performance Improvement, Strategic Goals, Buyer Competitive Advantage, Buyer-supplier Relationship Improvement, Top Management Support

Study [a]	Theory/Discipline [b]	Focal Constructs [c]	Directly Related Constructs [d]
Lo & Yeung (2006)	QM	Direct Involvement, Credibility, Purchasing Practice, Buyer-supplier Interaction	N/A
Lu et al. (2012)	Corporate Social Responsibility	SR(Socially Responsible)-Information Sharing, SR-Supplier Evaluation, SR-SD	Ethics Codes, Environment, Investors, Employees, Customers, Suppliers, Community
Mahapatra et al. (2012)	RBV, TCE	Supplier Development Investments	Competitive Intensity, Relational Orientation, Supplier Capability
Maloni & Benton (2000)	PDT	Power Bases	Relationship Strength
Modi & Mabert (2007)	KBV	Operational Knowledge Transfer Activities, Competitive Pressure, Evaluation & Certification, Future Business Incentives	Collaborative Communication, Supplier Performance Improvement
Monczka et al. (1995)	IOR, TCE, RDT	Quality Practices, Co-operation, Joint Programmes	Overall Relationship, Exchange Between Firms
Monczka et al. (1998)	Alliance	Attributes of Alliance	Alliance Success
Nagati & Rebolledo (2013)	TT, Customer Attractiveness	Participation in SD Activities	Supplier's Trust, Preferred Customer Status, Dynamism of the Environment, Performance Improvement
Narasimhan & Das (2001)	N/A	Purchasing Practices	Purchasing Integration, Manufacturing Performance
Narasimhan et al. (2001)	Competence-Performance	Purchasing Competence	Firm Performance
Narasimhan et al. (2008)	Relational Norm, TCE	SD Investments	Trust, Relational Norms, Supplier Performance
Noordewier et al. (1990)	TCE	Relational Syndrome	Inventory Turnover, On-Time Delivery, Part Quality
Oh & Rhee (2008)	CLT	Second-Tier Supplier Evaluation, Second-Tier SD, SD	Technological Uncertainty, Customer Proliferation Capability, Supplier’s Capability, Communication, New Car Development Collaboration, Collaborative Problem-Solving, Strategic Purchasing
Powell (1995)	QM	Closer to Suppliers	TQM Performance, Firm Performance
Prahinski & Benton (2004)	CMT	Supplier Evaluation Communication Strategy, Cooperation	Buyer-Supplier Relationship, Supplier’s Commitment, Supplier’s Performance

Study [a]	Theory/Discipline [b]	Focal Constructs [c]	Directly Related Constructs [d]
Ragatz et al. (1997)	N/A	Supplier Integration Practices	Supplier Integration Success
Sanchez-Rodriguez & Hemsworth (2005)	QM	Supplier Quality Mgt.	Purchasing Performance
Sancha et al. (2015)	Supply chain Sustainability	Sustainable S Practices	Coercive Pressures, Normative Pressures, Mimetic Pressures, Supplier Integration
Sanchez-Rodriguez (2009)	RV	SD	Strategic Purchasing, Purchasing Performance
Sanchez-Rodriguez et al. (2004)	QM	Supplier Quality Mgt.	Purchasing Performance, Internal Customer Satisfaction
Sanchez-Rodriguez et al. (2005)	N/A	Basic, Moderate & Advanced Supplier Development	Purchasing Performance
Scannell et al. (2000)	SMT	Supplier Development, SC Mgt. Strategy	Firm Performance
Shin et al. (2000)	SC Orientation	Supplier Mgt. Orientation	Supplier Performance, Buyer Performance
Spekman et al. (1999)	Strategy-structure-performance	Information Sharing, Trust, Commodity Team Approach	SC Performance
Stanley & Wisner (2001)	QM	Cooperative Buyer-Supplier Relationship	Internal Supplier's Service Quality & Purchasing's Service Quality Performance
Stuart (1993)	Strategic Alliance	Purchasing Philosophy, Problem Solving, Sharing of Benefits	Purchasing Capability, Degree of Partnership
Stump & Heide (1996)	TCE, CT	Monitoring, Performance Ambiguity	Purchase Importance, Buyer's & Supplier's Specific Investments, Technological Uncertainty, Supplier Qualification
Tan & Wisner (2003)	QM	Supplier Assessment Practices	JIT, Quality & NPD Practices
Tan (2001)	QM	Supplier Assessment Strategy	JIT, Quality & NPD Practices
Tan et al. (1998)	N/A	Supply Base Mgt., Supplier Evaluation	Firm Performance
Tan et al. (2002)	N/A	SCM Practices, Supplier Evaluation Practices	Firm Performance

Study [a]	Theory/Discipline [b]	Focal Constructs [c]	Directly Related Constructs [d]
Theodorakioglou et al. (2006)	QM	Supplier Policy, Joint action of supplier/buyer, Information Sharing/Communication, Supplier Support , Relationship-handling Issues, Relationship Quality	N/A
Trent & Monczka (1999)	N/A	Type of SD Activities	N/A
Wagner & Krause (2009)	KBV, Media Richness	Supplier Evaluation & Feedback, Knowledge Transfer, Employee Exchange	Product & Delivery Performance Improvement, Supplier Capability Improvement
Wagner (2006a)	RBV, TCE	Direct SD Activities, Indirect SD Activities	N/A
Wagner (2006b)	TCE	Direct SD Activities, Indirect SD Activities	Supplier Relationship, Product & Delivery Performance Improvement
Wagner (2010)	KBV, TCE, Goal-Setting Theory	Direct SD Activities, Indirect SD Activities	Product & Delivery Performance Improvement, Supplier Capabilities
Wagner (2011)	SCT	SD	Performance Improvement, Relationship Length
Watts & Hahn (1993)	N/A	Supplier Evaluation, SD Program Adoption	Firm Demographics
Wen-li et al. (2003)	N/A	Long-Term Strategic Goals, Effective Communication, Partnership Strategy, Supplier Evaluation, Direct Supplier Development	Buyer-Supplier Performance Improvement
Wu et al. (2011)	Organizational Learning Theory	Competitive Pressure, Supplier Assessment, Direct Involvement	Relationship Learning (including Joint Sense-making, Information Sharing, and Integrating Knowledge into Memory), Exploitation Competence, Exploration Competence
Zsidisin & Ellram (2001)	Total Cost of Ownership	Cost & Pricing Activities, Involvement in Supplier Alliances	Supplier Alliance Support Factors

[a] This table includes large-scale ($n \geq 30$) survey-based research publications in operations management, supply chain management, strategic management, and marketing disciplines published in peer-reviewed academic journals since 1990; dissertations, unpublished working papers, and conference papers were omitted from our review. I rationalized the number of studies by including only those studies in which at least one supplier development activity (i.e. an activity meeting the definition set forth in the

introduction) was specifically addressed within the focal research. Consequently, some tangential studies in which research exclusively focuses on supplier selection, supplier involvement, and supplier management, were omitted.

[b] Theory (as defined by original authors) abbreviations: CLT – collaboration theory, CMT – communication (media) theory, CT – control theory, ET – exchange theory, IOR – interorganizational relationship theory (B2B relationship management), KBV – knowledge-based view, PDT – power dependence theory, QM – quality management discipline, RBV – resource-based view, RDT – resource dependence theory, RV – relational view, SCT – social capital theory, SMT – strategic management theory, TCE – transaction cost economic theory, TT – trust theory.

[c] Constructs may be a statistically validated first-order construct, second-order construct, or a group of related items or factors.

[d] Related constructs include all tested relationships and include both significant and non-significant findings.

Appendix II: Examples of 30 Types of Supplier Development in Extant Studies

No.	Name	Example Definition or Illustration
SD1	Supplier Evaluation	Wagner & Krause (2009): Supplier evaluation and feedback efforts represent evaluations of a supplier's quality, delivery, cost, and service performance, and other facets of performance the buying firm may deem important.
SD2	Supplier Training	Carr et al. (2008): The buyer may send its employees to the supplier's facility to offer training or the buyer may invite the supplier to participate in training that is offered at its facilities; Lo & Yeung (2006): The buyer provides training and education for suppliers to improve their performance
SD3	Direct Incentive	Joshi (2009): The tools that are "designed to induce suppliers to improve their performance based on a desire for increased business with the firm" (Krause et al., 2000; p. 36)
SD4	Performance Expectation	Humphreys et al. (2004): buyer's expectation for supplier performance improvement; Increasing supplier performance goals is an efficient way of motivating suppliers since without the urging of buyers, suppliers are not likely to initiate programs designed to enhance performance Powell (1995): Requiring suppliers to meet stricter Quality specification
SD5	Financial Assistance	Abdullah et al. (2008): providing soft loans to start production, as well as commercial loans for other purposes including purchase of machinery, advances against payments and the like
SD6	Physical Asset Support	Li et al. (2007): provide this supplier with equipment or tools for process improvement (provide this supplier with capital for new investments at their facilities
SD7	Technical Assistance	Abdullah et al. (2008): Technical assistance in terms of automation and modernization of machinery, upgrading of tooling and equipment, facilitating technical agreements, and the like
SD8	Managerial Assistance	Abdullah et al. (2008): Provide Management related assistance Kim (2006): Provide managerial guidance/procedures to improve suppliers' performance
SD9	Information Sharing	Krause et al. (2007): The degree to which each party discloses information that may facilitate the other party's activities supplier evaluation and more ''direct involvement'' supplier development activities Li et al. (2007): The extent to which critical and proprietary information is communicated to one's supply chain partner
SD10	Supplier Rating	Wen-li et al. (2003): Evaluate suppliers through a supplier rating system
SD11	Supplier Involvement	Humphreys et al., (2004), Sanchez-Rodriguez (2009): involvement of the supplier in the buyer's new product design process
SD12	Plant Visit	Krause et al. (2007): Regular visits to the supplier by the buying firm's [engineering] personnel. Krause (1997): Site visits by your firm to supplier's premises to help supplier improve its performance
SD13	Invite Supplier to Visit	Lee & Humphreys (2007): inviting the personnel of the supplier to visit the buyer's own plant. Krause (1997): Inviting supplier's personnel to your site to increase their awareness of how their product is used
SD14	Dynamic Communication	Humphreys et al (2004): Open and frequent communication between buying firm's personnel and their suppliers was identified as a key approach in motivating suppliers
SD15	Supplier Certification	Modi & Mabert (2007): the use of [supplier certification program] to certify this supplier's quality; Krause & Scannell (2002): Use of a supplier certification program to certify supplier's quality, thus making incoming inspection unnecessary

SD16	Competitive Pressure	Modi & Mabert (2007): Use multiple suppliers for the purchased item to create competitive pressure Krause & Scannell (2002), Krause et al. (2000): Use of two or more suppliers for this purchased item to create competition among suppliers
SD17	Co-Location	Ragatz et al. (1997): Co-location of buyer/seller personnel Li et al. (2007), Humphreys et al. (2004), Wen-li et al. (2003): Assign support personnel to the supplier's facilities Krause et al. (2007): the allocation of personnel to improve the supplier's skill base
SD18	Supplier Council	Fawcett et al. (2006): The supplier council is composed of a dozen senior level company managers and 16 senior executives from highly valued suppliers
SD19	Quality-focused Supplier Selection	Shin et al. (2000): Quality focus' meaning that quality performance is the number one priority in selecting suppliers Forker & Stannack (2000): the importance of quality (versus price or schedule) is greatest in their supplier selection decisions Ahire et al. (1996): Quality is considered as a more important criterion than price in selecting supplier
SD20	Increase Supplier Intensity	Foster Jr & Ogden (2008): narrowing the numbers of suppliers Kaynak (2005): Reduce the number of suppliers Shin et al. (2000): Rely on a small number of high quality suppliers Forker & Stannack (2000): Reliance on a few dependable suppliers
SD21	Community of Suppliers	Sako (1999): A platform or network, set up by the buyer, for suppliers to facilitate supplier learning ongoing communication
SD22	Promise of Business	Modi & Mabert (2007): a promise consideration for improved business in the future Krause & Scannell (2002), Krause & Ellram (1997a), Krause (1997): a promise of future business or current benefits Forker & Stannack (2000), Forker et al. (1999), Forker (1997): a promise of extension of long-term contracts to suppliers
SD23	Supply Rationalization	Langfield-Smith & Greenwood (1998): Supply Rationalization program focuses on developing a core family of suppliers that are more competitive (usually using supplier base reduction).
SD24	Quality Assurance	Dong et al. (2001): Quality assurance programs help improve suppliers' product quality and facilitate JIT manufacturing Tan et al. (1999): the use of quality assurance programs for monitoring supplier's processes and products
SD25	Employee Exchange	Wagner & Krause (2009): Employee Exchange consists of various ways to co-locate either buying firm or supplier firm employees so that they are able to learn from each other and communicate face-to-face and share even more tacit information during their residence with the other firm
SD26	Clear Specification	Forker & Stannack (2000): Clarity of specifications provided to its suppliers by this customer Powell (1995): Requiring suppliers to meet stricter Quality specifications
SD27	Trust Building	Li et al. (2007): The buyer's trust in the information suppliers shared and suppliers' commitment. Ahire et al. (1996): Develop a long-term relationship with suppliers Lo & Yeung (2006): Credibility is the proactive attitude of a company towards supplier development. Ragatz et al. (1997): Formal trust development process/practices
SD28	Evaluation Feedback	Sanchez-Rodriguez et al. (2005): Report supplier evaluation results to suppliers Wagner & Krause (2009): Provide suppliers with the feedback about their performance Oh & Rhee (2008): Inform evaluation results after evaluating suppliers Modi & Mabert (2007) , Krause et al. (2007): Provide feedback about results of the evaluation

SD29	Joint Action	Lettice et al. (2010): Work with supplier to improve performance, solve problems and build up their business Ghijsen et al. (2010): Collaboration with suppliers in performance improvement McGovern & Hicks (2006): build/form collaborative relationship with suppliers Narasimhan et al. (2008): Joint problem solving with suppliers
SD30	Buyer's Involvement	Simpson & Power (2005): Buyer's involvement in the process of suppliers' performance improvement Forker et al. (1999): Involvement with supplier's product development process Monczka et al. (1998): Participate in supplier's planning and goal-setting activities

Appendix III: Cover Letter & Survey to SD Scholars

Dear Dr. XXX,

I cordially invite you to participate in this brief survey about supplier development (SD). This survey is an important part of my doctoral dissertation at the University of Kentucky. Your insight and perspective are of great importance to my research study, and more generally, the growing need for a cohesive SD theory. In addition, you may find the survey questions to be thought-provoking and helpful in your own research on supplier development. Your responses are treated as confidential.

My research has identified over 500 SD activities from a list of about 100 empirical articles. I have further condensed and classified these activities into 30 types, which are renamed and redefined based on previous studies. The intent of this study is to examine whether this catalog is complete and clear and to investigate the role of knowledge management in SD. I am requesting your help because you have published at least three articles in the list (**List all publications authored by this scholar here**).

Although you will not get personal benefit from taking part in this research study, your responses may help us understand more about supplier development. I hope to receive completed questionnaires from over 50 researchers, so your answers are important to us. Of course, you have a choice about whether or not to complete the survey, but if you do participate, you are free to skip any questions or discontinue at any time.

The survey will take about five minutes to complete. You can choose to respond to this survey in two ways: 1) complete the survey attached in this email and return it to me by email, or 2) click **this link** and complete/submit the survey online. I would appreciate receiving your responses **within two weeks**; however, if you need additional time, please let me know, as I am still interested in your responses.

There are no known risks to participating in this study. Your response to the survey is anonymous which means no names will appear or be used on research documents, or be used in presentations or publications. I assure you that the results of this survey will be reported only in summary form and you and your institution will not be identifiable. However, if you don't mind, I will list your name in the acknowledgement section of my dissertation and any future publications based on my dissertation.
If you have questions about the study, please feel free to ask; my contact information is given below. You can also contact my supervisors Dr. Scott Ellis at scott.ellis@uky.edu and Dr. Clyde Holsapple at cwhols@uky.edu. If you have complaints, suggestions, or questions about your rights as a research volunteer, contact the staff in the University of Kentucky Office of Research Integrity at 859-257-9428 or toll-free at 1-866-400-9428.
Please indicate if you would like a copy of the executive summary from this study at the end of this survey. I will be more than happy to forward it to you. Thank you very much for your great contribution to this study.

Sincerely,

Liang (Leon) Chen
Doctoral Candidate in Decision Science & Information Systems
Gatton College of Business and Economics
University of Kentucky, Lexington, KY

A Survey of Supplier Development Activities

Thank you very much for taking this brief survey. The purpose of the survey is to examine the role of knowledge sharing and knowledge management in supplier development (some typical activities may include supplier evaluation, supplier training, supplier assistance, etc.).

Q1: From your perspective, please indicate how ***important*** knowledge sharing is for supplier development.

1 (not at all) ⋯ 2 ⋯ 3 (moderately) ⋯ 4 ⋯ 5 (extremely)

Q2: More generally, I have identified and characterized nine knowledge management activities (see the Table below): five first-order activities that an organization performs in manipulating knowledge resources and four second-order activities that support/guide how the first-order activities perform. Supplier development (either direct or indirect) may involve both first-order knowledge management activities (e.g., selecting appropriate training materials to assist suppliers) and second-order knowledge management activities (e.g. measuring supplier's performance improvement).

Please write down the number (1, 2, 3, 4, 5) in the blank cells to indicate the degree to which you think each of the following knowledge management activities should be conducted by the buying firm(the supplying firm) **to achieve desired outcomes of supplier development**:

1 (not at all) ⋯ 2 ⋯ 3 (moderately) ⋯ 4 ⋯ 5 (extremely)

Classes	KM Activities	Description	Buying firm	Supplying firm
First-order Classes	Knowledge acquisition	A. Identifying and acquiring relevant knowledge (e.g., cost, market information or practice) from external environment for subsequent use.		
	Knowledge selection	B. Identifying and selecting appropriate knowledge which has already existed in the firm for subsequent use.		
	Knowledge generation	C. Generating new knowledge from existing knowledge, either individually or collaboratively		
	Knowledge assimilation	D. Incorporating the knowledge obtained in supplier development into the firm's own knowledge system or repository so that it can be later used.		
	Knowledge emission	E. Incorporating the knowledge obtained in supplier development into the firm's outputs (e.g., services, products, ads)		
Second-order Classes	Knowledge measurement	F. Measuring knowledge resources, processes, and/or outcomes that are involved in supplier development		
	Knowledge control	G. Controlling knowledge resources and/or processes that are involved in supplier development		
	Knowledge coordination	H. Coordinating knowledge management activities to ensure proper processes and resources are brought appropriately		
	Knowledge leadership	I. Establishing conditions that enable and facilitate knowledge handling or management in supplier development		

Q3: Do you have any comments on the description of each knowledge management activity mentioned above? How do you think the role of knowledge management in supplier development?

_____

Q4: The knowledge-based view of the firm has identified knowledge as a firm's most strategically-significant resource and views a firm as an institution for integrating knowledge. Applying this view, I define supplier development as below:

> *Supplier development is a set of knowledge management (KM) activities that are conducted by both buying and supplying firms and aimed at meeting the buying firm's short- or long-term supply needs via expanding the supplying firm's knowledge resources and/or knowledge handling capabilities. Supplier development may involve first-order KM activities (i.e., knowledge acquisition, selection, generation, assimilation, and emission) as well as second-order KM activities (i.e., knowledge measurement, leadership, coordination, and control).*

Please indicate the degree to which you think this definition is successful in the following criteria:

1 (not at all) ⋯ 2 ⋯ 3 (moderately) ⋯ 4 ⋯ 5 (extremely)

Criteria	Your Judgment				
1. This definition is complete	1	2	3	4	5
2. This definition is accurate	1	2	3	4	5
3. This definition is clear	1	2	3	4	5
4. This definition is concise	1	2	3	4	5
5. This definition is generally applicable	1	2	3	4	5

Q5: Please indicate the degree to which you think the adoption of this definition is important for understanding supplier development?

1 (not at all) ⋯ 2 ⋯ 3 (moderately) ⋯ 4 ⋯ 5 (extremely)

Q6: Do you have any comments about this definition?

_____

Thank you very much for participating in this survey!

If you need an executive summary of this study, please provide your email address: _____

Do you allow me to list your name in the acknowledgement section of my dissertation and any future publications from my dissertation? □ Yes □ No

Appendix IV Definition and Measurement of Multi-Item Variables

Construct	Definition	Measurement	Sources
SD outcomes-supplying firm performance	Supplier's organizational effectiveness in terms of its primary competitive priorities in its end-markets.	Subjective Measures: Please indicate the ***degree*** to which **this supplier** has increased each of following areas since the SD began. • Increasing the reliability of product/service delivery times • Improving production/service flexibility • Improving product/service quality • Reducing the cost of products/services • Providing innovative products, service or solutions • Increasing learning capability	Krause et al. (2007), Wagner (2010)
		Objective Measures: Please indicate the average percentage this supplier has improved since the SD began: • On average, the unit cost of purchased parts from this supplier has decreased by _____ • On average, the percentage of on time deliveries from this supplier has increased by___ • On average, the defect rate of purchased parts from this supplier has decreased by ____	Watts & Hahn(1993), Modi & Mabert (2007), Li et al. (2012)
SD outcomes-buying firm performance	Buyer's organizational effectiveness in terms of its primary competitive priorities in its end-markets.	Please indicate the ***degree*** to which **your organization** has increased each of following areas since the SD began. • Increasing the reliability of product/service delivery times • Improving production/service flexibility • Improving product/service quality • Reducing the cost of products/services • Providing innovative products, service or solutions • Increasing learning capability	Krause et al. (2007), Wagner (2010)
Knowledge Sharing Efforts in SD	The efforts a buyer puts into knowledge sharing during a supplier development program	Please indicate the degree to which your organization has extensively undertaken supplier development by: • Giving manufacturing related advice to suppliers (e.g. processes, machining process, machine set up) • Giving technological advice to suppliers (e.g. software, materials) • Giving product development related advice to suppliers (e.g. processes, project management) • Giving quality related advice to suppliers (e.g. use of inspection equipment, quality assurance procedures)	Wagner & Krause (2009)
KM Efforts in SD	The efforts a buyer puts into	Please indicate the ***degree*** to which your organization and this supplier were involved in each of the following knowledge management activities **during the SD:**	Holsapple & Singh (2001),

	knowledge handling during a supplier development program	• Acquiring relevant knowledge (e.g., information, insight, or practice) from external environment for this SD. • Selecting appropriate knowledge to satisfy each other's need in this SD. • Generating new knowledge such as solution or insight either individually or collaborating with each other during this SD. • Incorporating the knowledge obtained during this SD into the firm's own knowledge system or repository so that it can be later used. • Incorporating the knowledge obtained in this SD into the firm's outputs (e.g., services, products). • Measuring value of knowledge resources (e.g., practice, skills) and processors (e.g., employees or systems that deal with knowledge) during or after this SD. • Ensuring needed knowledge resources and/or processors are available in sufficient quality and quantity for this SD. • Ensuring that right stakeholders have the right knowledge at the right time during this SD. • Establishing conditions that enable and facilitate acquiring, using, generating or absorbing knowledge during this SD.	Holsapple & Jones (2004, 2005) Pre-survey interview, Survey of SD scholars
Asset Specificity	The transferability of assets that support a given transaction (Grover & Malhotra, 2003)	Please indicate your level of agreement with each of following statements (1 *strongly disagree*; 5 strongly agree). • I have made significant investments in resources dedicated to our relationship with this supplier. • Our operating process has been tailored to meet the requirements of dealing with this supplier. • Training and qualifying this supplier has involved substantial commitments of time and money.	Lee et al. (2009), Buvik (2000), Dyer (1996a); Nyaga et al. (2010)
Supplier Dependence	The extent that a supplier relies on a particular buyer to purchase its output (Krause & Scannell, 2002)	Please indicate your level of agreement with each of following statements (1 *strongly disagree*; 5 strongly agree). • This supplier is dependent on us. • This supplier would find it difficult to replace us. • This supplier would find it costly to lose us. • For this supplier, the overall costs of switching to another similar customer are very high	Cai et al. (2009),
Relational Capital	The strength of the ties between two organizations, including trust, reciprocity, commitment	Please indicate your level of agreement with each of following statements (1 *strongly disagree*; 5 strongly agree). • I trust that this supplier keeps our best interest in mind. • The relationship that I have with this supplier can be defined as "mutually beneficial." • This supplier is committed to us.	Blonska et al. (2013), Nyaga et al. (2010),

Appendix V: Cover Letter & Survey to SD Practitioners

Dear Mr. /Ms. XXXXX:

I am writing to ask for your help in a study on supplier development programs. The intent of this study is to investigate how both buyer and supplier's knowledge management (KM) activities affect performance outcomes in a supplier development program. This study aims at identifying factors that can give buyers insight into the circumstances in which they are likely to effectively and efficiently conduct KM activities with suppliers. Your experience and perspective are of great importance to my research study, and more generally, the growing need for a cohesive supplier development theory.

Although you will not get personal benefit from taking part in this research study, your responses may help us understand more about supplier development. I hope to receive completed questionnaires from about 200 people, so your answers are important to us. Of course, you have a choice about whether or not to complete the survey, but if you do participate, you are free to skip any questions or discontinue at any time.

The survey will take about 10 minutes to complete. There are no known risks to participating in this study. Your response to the survey is anonymous which means no names will appear or be used on research documents, or be used in presentations or publications. The research team will not know that any information you provided came from you, nor even whether you participated in the study. In addition, I assure you that the results of this survey will be reported only in summary form and you and your company will not be identifiable. Please indicate if you would like a copy of the executive summary from this study at the end of this survey.

Please be aware, while I make every effort to safeguard your data once received from Qualtrics, given the nature of online surveys, as with anything involving the Internet, I can never guarantee the confidentiality of the data while still on the survey hosting company's servers, or while en route to either them or us. It is also possible the raw data collected for research purposes may be used for marketing or reporting purposes by the survey hosting company after the research is concluded, depending on the company's Terms of Service and Privacy policies.

If you have questions about the study, please feel free to ask; my contact information is given below. You can also contact my supervisors Dr. Scott Ellis at scott.ellis@uky.edu and Dr. Clyde Holsapple at cwhols@uky.edu.If you have questions about the study, please feel free to ask; my contact information is given below. If you have complaints, suggestions, or questions about your rights as a research volunteer, contact the staff in the University of Kentucky Office of Research Integrity at 859-257-9428 or toll-free at 1-866-400-9428.

To ensure your responses will be included, please complete the questionnaires and submit your responses within two weeks. Thank you in advance for your assistance with this important project.

Sincerely,

Liang (Leon) Chen

Doctoral Candidate in Decision Science & Information Systems,
Gatton College of Business and Economics
University of Kentucky, Lexington, KY

A Survey of Supplier Development for SD Practitioners

Thanks very much for accepting my invitation to participate in this brief survey about supplier development (i.e., the practice of working with a supplier to increase its performance and/or capability). Your experience and perspective are of **GREAT** importance to my research study, and more generally, the growing need for a cohesive supplier development theory. All your responses are treated as **CONFIDENTIAL**.

Section I: Background Information

i. Please indicate the industry (numbers are SIC code) of your organization as below

□ Agriculture, Forestry, and Fishing (SIC: 01, 02, 07, 08, 09)	□ Mining (SIC: 10-14)	□ Construction (SIC: 15-17)
□ Manufacturing: industrial and commercial machinery and computer equipment (SIC: 35)		
□ Manufacturing: electronic and other electrical equipment and components, except computer equipment (SIC: 36)		
□ Manufacturing: Transportation Equipment (SIC: 37)	□ Manufacturing: others (SIC: 20-34, 38-39)	
□ Retail Trade & Wholesale Trade (SIC: 50-59)	□ Finance, Insurance, and Real Estate (SIC: 60-67)	
□ Transportation, communications, electric, gas, and sanitary services (SIC: 40-49)	□ Public Administration (SIC: 91-99)	
□ Other services, including hotels, health, educational, amusement, etc. (SIC: 70-89)	□ Others or unknown	

ii. Please describe your position (title) in your organization :_____

□ Director/VP (of purchasing, operations, procurement, materials, supply chain)	□ Sr. Buyer
□ Manager (of purchasing, materials, supplier resources, supply chain)	□ Buyer
□ Supplier Development Manager/Engineer	□ Others, please specify_____

iii. How many years of experience do you have in Supply Chain Management or Operations Management? _____

iv. Please indicate the degree to which your organization has ever involved each of the following supplier training or assistance activities to improve your supplier's performance or capability in the past year?

1 – Not at all **3 – Moderately** **5 – Extremely**

A. Providing training or education to your supplier's personnel	1	2	3	4	5
B. Providing your supplier with technical support/assistance	1	2	3	4	5
C. Providing your supplier with support/assistance in quality management, inventory management, etc.	1	2	3	4	5
D. Solving your supplier's technical problems	1	2	3	4	5

v. Please rate your knowledge of the relationship and interaction with your suppliers during a supplier training or assistance activity on a scale ranging from 1 (very poor) to 5 (very accurate).

1 Very poor	2	3	4	5 Very accurate

Section II: A Specific Supplier Development

Instruction: All questions in this section are to seek your insight into a **specific** supplier training or assistance activity which your organization has used most extensively in the past year. If multiple suppliers are involved, please choose one particular supplier in answering the following questions. Thank you very much.

1. Please indicate to what degree your organization and this supplier are motivated to participate in this training or assistance activity.

To what degree our organization is motivated					To what degree this supplier is motivated				
1	2	3	4	5	1	2	3	4	5

2. Please indicate the ***degree*** to which your organization had invested in or participated in (i.e., been involved with) each of the following practices **during this supplier training or assistance activity**.

1 – Not at all 3 – Moderately 5 – Extremely

A. Giving manufacturing related advice to this supplier (e.g. processes, machining process, machine set up)	1	2	3	4	5
B. Giving technological advice to this supplier (e.g. software, materials)	1	2	3	4	5
C. Giving product development related advice to this supplier (e.g. processes, project management)	1	2	3	4	5
D. Giving quality related advice to this supplier (e.g. use of inspection equipment, quality assurance procedures)	1	2	3	4	5

3. Please indicate the ***degree*** to which your organization and this supplier were involved in each of the following knowledge handling activities **during this supplier training or assistance** activity.

1 – Not at all 3 – Moderately 5 – Extremely NA – I do not know/unknown

	To what degree our organization was involved					To what degree our supplier was involved					
A. Acquiring relevant knowledge (e.g., information, insight, or practice) from external environment for this training or assistance activity.	1	2	3	4	5	1	2	3	4	5	NA
B. Selecting appropriate knowledge to satisfy each other's need in this training or assistance activity.	1	2	3	4	5	1	2	3	4	5	NA
C. Generating new knowledge such as solution or insight either individually or collaborating with each other during this training or assistance activity.	1	2	3	4	5	1	2	3	4	5	NA
D. Incorporating the knowledge obtained during this training or assistance into the organization's own knowledge system or repository so that it can be later used.	1	2	3	4	5	1	2	3	4	5	NA
E. Incorporating the knowledge obtained in this training or assistance into the organization's outputs (e.g., services, products).	1	2	3	4	5	1	2	3	4	5	NA
F. Measuring value of knowledge resources (e.g., practice, skills) and processors (e.g., employees or systems that deal with knowledge) during this during or after this training or assistance activity.	1	2	3	4	5	1	2	3	4	5	NA
G. Ensuring needed knowledge resources and/or processors are available in sufficient quality and	1	2	3	4	5	1	2	3	4	5	NA

quantity for this training or assistance activity.											
H. Ensuring that right stakeholders have the right knowledge at the right time during this training or assistance activity.	1	2	3	4	5	1	2	3	4	5	NA
I. Establishing conditions that enable and facilitate acquiring, using, generating or absorbing knowledge during this training or assistance activity.	1	2	3	4	5	1	2	3	4	5	NA

4. Overall, please indicate how capable your organization or your supplier is of conducting the knowledge activities mentioned above.

A. Our organization	1 (Not at all)	2 (Slightly)	3 (Moderately)	4 (Quite)	5 (Extremely)
B. Our supplier	1 (Not at all)	2 (Slightly)	3 (Moderately)	4 (Quite)	5 (Extremely)

5. Please indicate the ***degree*** to which this training/assistance activity with this supplier has helped **your organization** and **this supplier** achieve following outcomes.

1 – Not at all; 3 – Moderately; 5 – Extremely; NA –Not Applicable or Unknown

This training or assistance with this supplier has helped	Our Organization						Our Supplier					
A. Increasing the reliability of product delivery times	1	2	3	4	5	NA	1	2	3	4	5	NA
B. Improving production or manufacturing flexibility	1	2	3	4	5	NA	1	2	3	4	5	NA
C. Improving product quality	1	2	3	4	5	NA	1	2	3	4	5	NA
D. Reducing product cost	1	2	3	4	5	NA	1	2	3	4	5	NA
E. Lowering the total cost of products.	1	2	3	4	5	NA	1	2	3	4	5	NA
F. Shortening the delivery times of products	1	2	3	4	5	NA	1	2	3	4	5	NA
G. Providing innovative products, service or solutions	1	2	3	4	5	NA	1	2	3	4	5	NA
H. Increasing learning capability	1	2	3	4	5	NA	1	2	3	4	5	NA

6. Please indicate the average percentage your supplier has improved since this training/assistance activity began.

A. On average, the unit cost of purchased parts from **this supplier** has **decreased** by	_____%
B. On average, the percentage of on time deliveries from **this supplier** has **increased** by	_____%
C. On average, the defect rate of purchased parts from **this supplier** has **decreased** by	_____%

Section III: Relational & Demographic Information

7. Please indicate your level of agreement with each of following statements (1 *strongly disagree*; 5 strongly agree).

A. I have made significant investments in resources dedicated to our relationship with this supplier.	1	2	3	4	5
B. Our operating process has been tailored to meet the requirements of dealing with this supplier.	1	2	3	4	5
C. Training and qualifying this supplier has involved substantial commitments of time and money.	1	2	3	4	5
D. This supplier has made significant investments in resources dedicated to their relationship with us.	1	2	3	4	5

E. This supplier's operating process has been tailored to meet the requirements of our organization.	1	2	3	4	5
F. Training our people has involved substantial commitments of time and money from this supplier.	1	2	3	4	5
G. Our organization and this supplier hold common goals and values for supplier training and assistance	1	2	3	4	5
H. This supplier is dependent on us.	1	2	3	4	5
I. This supplier would find it difficult to replace us.	1	2	3	4	5
J. This supplier would find it costly to lose us.	1	2	3	4	5
K. For this supplier, the overall costs of switching to another similar customer are very high.	1	2	3	4	5
L. I trust that this supplier keeps our best interest in mind.	1	2	3	4	5
M. The relationship that I have with this supplier can be defined as "mutually beneficial."	1	2	3	4	5
N. This supplier is committed to us.	1	2	3	4	5

8. How many years has your company been buying materials from this supplier?
   _____ years

9. With respect to sales volume last year, how large is your organization relative to this supplier? (Format: 1 = much smaller to 5 = much larger)
   _____

10. a) Number of full-time employees at your organization: _____; b) Number of full-time employees at your supplier: _____
    [1] Less than 100 [2] 101-200 [3] 201 -500 [4] 501 - 1,000 [5] 1,001 -5,000 [6] Over 5,000 [7] unknown

11. a) Annual sales volume at your organization (In Millions):___; b) Annual sales volume at your supplier (In Millions): ___
    [1] Less than $1 [2] $1 - $99 [3] $100 - $499 [4] $500 - $999 [5] $1,000 & above [6] Unknown

12. Do you have any comments on this study or supplier development? _____

Thanks for Participating in this study!

If you would like an executive summary of this study, please list your email address as below:
_____

Appendix VI Descriptive Statistics of Items

Items/Statements	Mean	Std. D.
Please indicate the degree to which your organization has ever involved each of the following SD activities in the past year?		
DSD1: Providing training or education to your suppliers' personnel	2.62	1.36
DSD2: Providing your suppliers with technical support/assistance	3.07	1.28
DSD3: Providing your suppliers with support/assistance in quality management, inventory management, etc.	2.92	1.31
DSD4: Solving your suppliers' technical problems	2.56	1.29
Please indicate to what degree your firm and this supplier are motivated to participate in this SD activity		
Buyer motivation : To what degree our organization was motivated	3.82	1.02
Supplier motivation: To what degree this supplier was motivated	3.80	0.97
Please indicate the *degree* to which your firm had invested in or participated in (i.e., been involved with) each of the following practices during this SD activity.		
KS1: Giving manufacturing related advice to this supplier (e.g. processes, machining process, machine set up).	2.96	1.33
KS2: Giving technological advice to this supplier (e.g. software, materials).	2.91	1.23
KS3: Giving product development related advice to this supplier (e.g. processes, project management).	3.23	1.22
KS4: Giving quality related advice to this supplier (e.g. use of inspection equipment, quality assurance procedures).	3.45	1.26
Please indicate your level of agreement with each of following statements (1 strongly disagree; 5 strongly agree).		
BuyerSpecificity1: I have made significant investments in resources dedicated to our relationship with this supplier.	3.41	1.21
BuyerSpecificity2: Our operating process has been tailored to meet the requirements of dealing with this supplier.	2.95	1.22
BuyerSpecificity3: Training and qualifying this supplier has involved substantial commitments of time and money.	3.23	1.21
SupplierSpecificity1: This supplier has made significant investments in resources dedicated to their relationship with us.	3.49	1.03
SupplierSpecificity2: This supplier's operating process has been tailored to meet the requirements of our organization.	3.48	1.11
SupplierSpecificity3: Training our people has involved substantial commitments of time and money from this supplier.	3.10	1.16
Goal Congruence: Our firm and this supplier hold common goals and values for supplier development	3.75	0.92
SupplierDepend1: This supplier is dependent on us.	2.79	1.17
SupplierDepend2: This supplier would find it difficult to replace us.	2.98	1.16
SupplierDepend3: This supplier would find it costly to lose us.	3.55	1.14
SupplierDepend4: For this supplier, the overall costs of switching to another similar customer are very high.	3.07	1.19
Trust: I trust that this supplier keeps our best interest in mind.	3.77	0.89
Reciprocity: The relationship that I have with this supplier can be defined as "mutually beneficial."	3.90	0.92
Commitment: This supplier is committed to us.	3.82	0.90

Appendix VII Descriptive Statistics of Items (Cont.)

Items/Statements	Buying Org. [Buyer-]		Supply Org. [Supplier-]	
	Mean	Std. D.	Mean	Std. D.
Please indicate the degree to which your organization and this supplier were involved in each of the following knowledge handling activities in this SD.				
[-Acquire]: Acquiring relevant knowledge (e.g., information, insight, or practice) from external environment for this SD.	3.22	1.11	3.29	1.09
[-Select]: Selecting appropriate knowledge to satisfy each other's need in this SD.	3.56	1.07	3.51	1.04
[-Generate]: Generating new knowledge such as solution or insight either individually or collaborating with each other during this SD.	3.66	1.01	3.59	1.00
[-Assimilate]: Incorporating the knowledge obtained during this SD activity into the firm's own knowledge system or repository so that it can be later used.	3.56	1.07	3.51	1.14
[-Emit]: Incorporating the knowledge obtained in this SD into the firm's outputs (e.g., services, products).	3.49	1.09	3.58	1.03
[-Measure]: Measuring value of knowledge resources (e.g., practice, skills) and processors (e.g., employees or systems that deal with knowledge) during or after this SD.	3.11	1.22	3.08	1.14
[-Control]: Ensuring needed knowledge resources and/or processors are available in sufficient quality and quantity for this SD.	3.31	1.12	3.37	1.10
[-Coordinate]: Ensuring that right stakeholders have the right knowledge at the right time during this SD.	3.73	1.06	3.57	1.13
[-Lead]: Establishing conditions that enable and facilitate acquiring, using, generating or absorbing knowledge during this SD.	3.51	1.05	3.46	1.07
Please indicate the degree to which this SD activity with this supplier has helped your organization and this supplier achieve following outcomes.				
[-Perform1]: Increasing the reliability of product/service delivery times	3.89	0.87	3.84	0.92
[-Perform2]: Improving production or service flexibility	3.48	1.12	3.57	1.12
[-Perform3]: Improving product/service quality	3.77	1.06	3.77	1.06
[-Perform4]: Reducing product/service cost	3.43	1.26	3.32	1.24
[-Perform5]: Lowering the total cost of products/services.	3.47	1.26	3.37	1.17
[-Perform6]: Shortening the delivery times of products/services	3.55	1.16	3.46	1.12

Note: The abbreviation of each item composites of the abbreviation of organization (i.e., [buyer-] and [supplier-]) and that of each statement (e.g., [-Lead], [Perform]). For instance, BuyerPeform1 indicates the buying organization's performance (Increasing the reliability of product/service delivery times).

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PUBLICATIONS

Journal Articles

1. Accepted March 2015: Chen, L., Ellis, S., & Suresh, N. C. "A Supplier Development Adoption Framework Using Expectancy Theory", *International Journal of Operation & Production Management*.
2. Accepted May 2015: Chen, L., Ellis, S., & Holsapple, C.W. "Supplier Development: A Knowledge-Management Perspective", *Knowledge and Process Management*.
3. Xu, P., Chen, L., & Santhanam, R. (2015), "Will Video Be the Next Generation of E-Commerce Product Reviews? Presentation Format and the Role of Product Type", *Decision Support Systems*, Vol. 73, May 2015, pp. 85–96.
4. Chen, L. & Holsapple, C.W. (2013), "E-Business Adoption Research: State of the Art", *Journal of Electronic Commerce Research,* Vol. 14 No. 3, pp. 261-286.
5. Chen, L. & Holsapple, C.W. (2013), "Evaluating Journal Quality: Beyond "Expert" Journal Assessments in the IS Discipline", *Journal of Organizational Computing and Electronic Commerce*, Vol. 23, No. 4, pp. 392-412. Full Text

Proceedings (along with Conference Presentations)

1. **Chen, L.**, Xu, P., & Liu, D. (2015) Experts versus the Crowd: A Comparison of Selection Mechanisms in Crowdsourcing Contests, *the 9th China Summer Workshop on Information Management* (*CSWIM*), Hefei, China, June 2015, 6 pages.
2. **Chen, L.**, Xu, P., & Liu, D. (2014) Comparing Selection Mechanisms in Crowdsourcing Platforms, accepted at the Workshop on Information Systems Economics (WISE 2014), Auckland, New Zealand December 17-19, 2014, 34 pages.
3. **Chen, L.** & Holsapple, C. W. (2014) Teaching the Introductory MIS Course: An MIs Approach, *the Americas Conference on Information Systems* (*AMCIS*), Savannah GA, August 2014, 12 pages. [selected as a **finalist for the AMCIS Best Paper Award**]
4. **Chen, L.**, Xu, P., & Liu, D. (2014) Comparing Two Rating Mechanisms in Crowdsourcing Contests, *the 8th China Summer Workshop on Information Management* (*CSWIM*), Chengdu, China, June 2014, 6 pages.
5. **Chen. L.** (2013) Exploration and Exploitation in Supplier Development: Determinants, Outcomes, and Difference, *the 44th Annual Meeting of Decision Sciences Institute* (*DSI*), Baltimore, MD, November 2013, 17 pages.
6. **Chen, L.** & Holsapple, C. W. (2013) Impact Analysis in E-Business: A Case of Adoption Research, *the Americas Conference on Information Systems* (*AMCIS*), Chicago, IL, August 2013, 11 pages.
7. **Chen, L.** (2013) Motivation and Innovation in Online Collaborative Communities: An Application of Expectancy Theory, *the Americas Conference on Information Systems* (*AMCIS*), Chicago, IL, August 2013, 9 pages.

8. **Chen, L.**, Xu, P., & Liu, D. (2013) A Comparison of Rating Mechanisms in Crowdsourcing Contests: Preliminary Findings, *the 7th China Summer Workshop on Information Management* (*CSWIM*), Tianjin, China, June 2013, 6 pages.
9. **Chen, L.** & Holsapple, C. W. (2012) E-Business Adoption Research: Analysis and Structure, *Proceedings of the Americas Conference on Information Systems* (*AMCIS*), Seattle, WA, August 2012, 9 pages.
10. **Chen, L.** & Liu, D. (2012) Comparing Strategies for Winning Expert-rated and Crowd-rated Crowdsourcing Contests: First Findings, *the Americas Conference on Information Systems* (*AMCIS*), Seattle, WA, August 2012, 11 pages.
11. Xu, P., **Chen, L.,** Wu, L., & Santhanam, R. (2012) Visual Presentation Modes in Online Product Reviews and Their Effects on Consumer Responses, *the Americas Conference on Information Systems* (*AMCIS*), Seattle, WA, August 2012, 9 pages.
12. **Chen, L.**, Ellis, S., & Holsapple, C.W. (2011) A Knowledge-sharing Perspective on Supplier Development Activities, *the Americas Conference on Information Systems* (*AMCIS*), Detroit, MI, August 2011, 10 pages.
13. **Chen, L.** & Santhanam, R. (2011) The Influence of Usage Experience on Adoption of Successive ICT Products, *the Americas Conference on Information Systems* (*AMCIS*), Detroit, MI, August 2011, 8 pages.
14. **Chen, L.** & Jiang, L. (2006) Relationship Marketing in Virtual Community: Antecedents and Consequences, *IEEE International Conference on Service Operations and Logistics, and Informatics,* Shanghai, China, June 2006, 6 pages (pp.570-575).

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