

■ KENNETH E. KENDALL, Feature Editor, School of Business-Camden, Rutgers University

We have, for as long as I can remember, proudly claimed to be an interdisciplinary society. Most recently, at our very first DSI strategic planning retreat, the participants included in its “measures to monitor progress,” an increase in the number of cross disciplinary articles. This enlightening article by Clyde Holsapple and Haihao Jin is likely to become an exemplar of this type of research. These authors build a convincing case that collaborative decision making (CDM) research, identified as a major topic area in our *Decision Sciences* journal, can benefit from being linked with ecommerce research and supply chain management research. They provide data from Google Scholar searches on these fields, and then use preliminary results from case studies to further refine their arguments. I hope this is the first of many articles that look at interdisciplinary and cross-disciplinary work that encompasses ecommerce.

[Feature Editor Kenneth E. Kendall]



Clyde W. Holsapple

is a professor of decision science and information systems at the University of Kentucky, where he has held the Rosenthal Endowed Chair in Management Information Systems for twenty years. His research focuses on decision support systems, especially from a knowledge management perspective. He has authored over 100 research articles in such journals as *Decision Sciences*, *Decision Support Systems*, *Operations Research*, *Journal of Operations Management*, *Group Decision and Negotiation*, and *Communications of the ACM*. His books include *Foundations of Decision Support Systems*, *Handbook on Knowledge Management*, *Decision Support Systems: A Knowledge-Based Approach*, and the new 2-volume *Handbook on Decision Support Systems*. He is editor-in-chief for the *Journal of Organizational Computing and Electronic Commerce* and the foundations area editor for *Decision Support Systems*. Currently, he chairs the DSI Publications Committee.

research focuses on decision support systems, especially from a knowledge management perspective. He has authored over 100 research articles in such journals as *Decision Sciences*, *Decision Support Systems*, *Operations Research*, *Journal of Operations Management*, *Group Decision and Negotiation*, and *Communications of the ACM*. His books include *Foundations of Decision Support Systems*, *Handbook on Knowledge Management*, *Decision Support Systems: A Knowledge-Based Approach*, and the new 2-volume *Handbook on Decision Support Systems*. He is editor-in-chief for the *Journal of Organizational Computing and Electronic Commerce* and the foundations area editor for *Decision Support Systems*. Currently, he chairs the DSI Publications Committee.

cwhols@uky.edu



Haihao Jin

is a visiting assistant professor of supply chain management in the Fogelman College of Business and Economics at the University of Memphis, and is completing a Ph.D. in the Gatton College of Business and Economics at the University of Kentucky. His current research interests include IT-supported collaborative decision making in supply chains, technology-supported supply chain collaboration, global supply chain design, and e-commerce. His teaching activities include decision making analysis, supply chain management, and IT applications in business.

College of Business and Economics at the University of Kentucky. His current research interests include IT-supported collaborative decision making in supply chains, technology-supported supply chain collaboration, global supply chain design, and e-commerce. His teaching activities include decision making analysis, supply chain management, and IT applications in business.

hjin@memphis.edu

Connecting Some Dots: E-Commerce, Supply Chains, and Collaborative Decision Making

by Clyde W. Holsapple, University of Kentucky; and Haihao Jin, University of Memphis

Electronic commerce and supply chain management are two substantial dots in the ever-developing picture of decision sciences. Over the past three years (2004-2006), the annual rate of scholarly publications referring to electronic commerce has exceeded 15,000 per year—or, more than 300 per week. In the same three-year window, scholarly publications referring to supply chains have averaged 12,000 annually—over 230 each week. As Figure 1 shows, scholarly engagement in these two topic areas has risen dramatically since the mid-1990s. We can also see that there is a connection between the electronic commerce (EC) and supply chain (SC) dots, which has become more evident in recent years. In the most recent three-year window, over 1,900 scholarly publications per year have appeared referring to both EC and SC—up from an annual average of fewer than 30 between 1994-1996. The EC+SC connection is now being exhibited in over 35 new scholarly publications per week. The clear conclusions are that electronic commerce and supply chains

are heavily studied topics, and that there is considerable attention being given to building and/or understanding the connection between them.

The data for Figure 1 are obtained from Google Scholar (August 2007) via three keyword searches:

- “electronic commerce” OR “ecommerce” OR “e-commerce”
- “supply chain”
- (“electronic commerce” OR “ecommerce” OR “e-commerce”) AND “supply chain”

Although Google Scholar does not track all notable outlets for scholarly publications in the decision sciences, it is relatively comprehensive compared to other databases such as Thomson’s ISI Web of Knowledge. What is important about Figure 1 are the basic trends and relative magnitudes which are symptomatic of scholarly activity related to the two topic areas and their connection.

In studying this connection, Golcic et al. (2002) point out that e-commerce

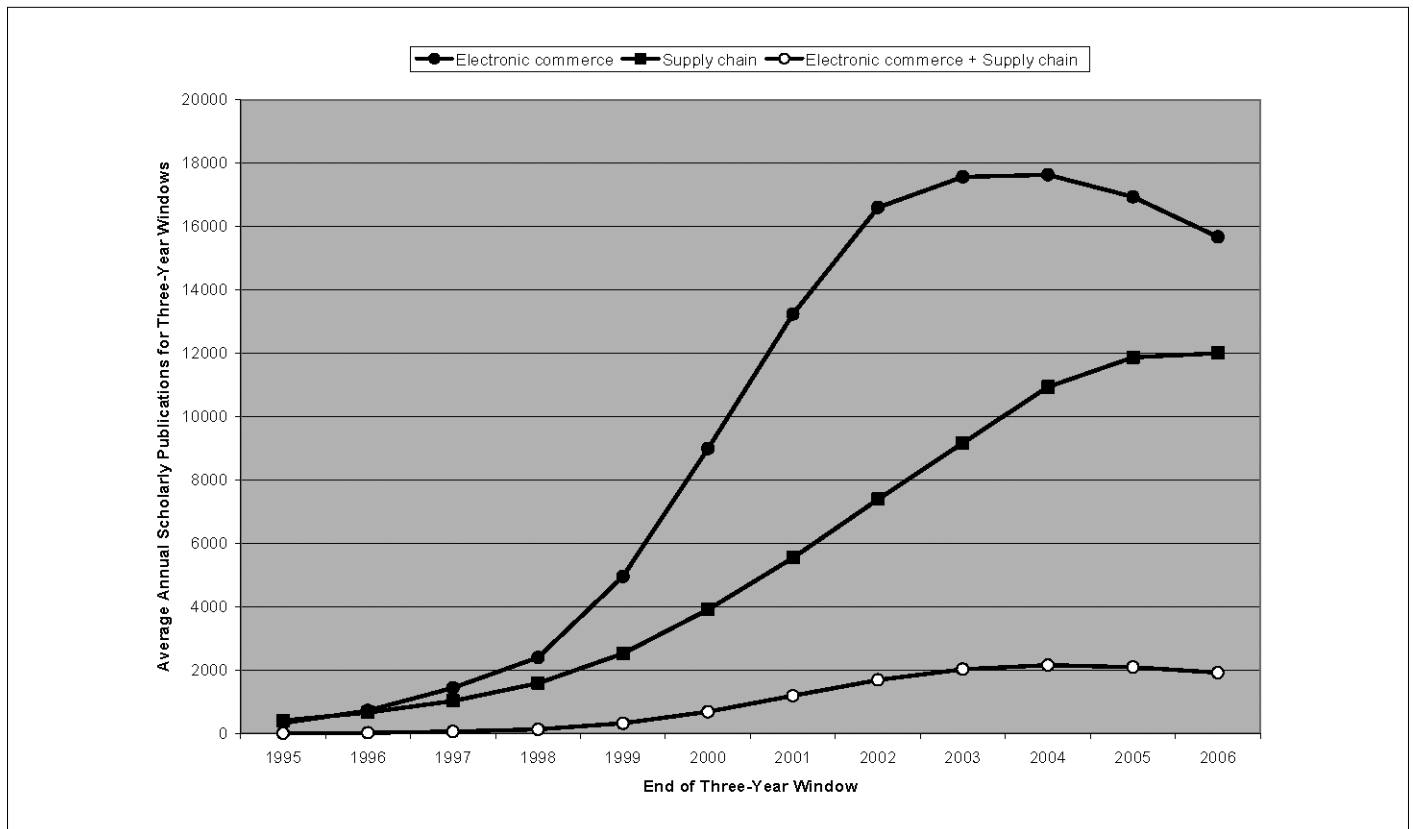


Figure 1. Trends in scholarly publications for the areas of electronic commerce and supply chains.

presents a new environment for managing dynamics of supply chain relationships. Analyzing results of interviews with SC executives, they identify two main factors that differentiate the EC environment from traditional business settings: the greater speed at which business activities occur and the greater scope of connectivity with suppliers and customers. They find that these two factors engender more visibility across a supply chain (in terms of knowledge about events and other players), new market structures (in terms of direct access to other players), and a greater sense of uncertainty about the dynamic, rapidly shifting environment that pressures firms into making rapid decisions without complete information or analysis. To increase their flexibility in dealing with such uncertainty, firms tend to rely more on externally available capabilities and resources than they would in relatively

stable environments, and EC facilitates the management of relationships formed to access these external capabilities and resources (Golicic et al, 2002).

Productive relationships and their management inherently involve collaboration. At a very basic level, pairs, chains, or networks of firms collaborate in the sense of engaging in transactions. At a higher level, collaboration in supply chains manifests as joint planning exercises involving forecasting, continuous planning, replenishment, and so forth, and can be supported by electronic marketplaces that act as process facilitators—furnishing specialized capabilities for collaboration among supply chain participants (Markus & Christiaanse, 2003). At another level, collaboration among multiple supply chain participants involves decision making. Supply chain collaboration goes beyond making joint operational

planning decisions to include product design decisions, work design decisions, marketing decisions, entrepreneurial decisions, incentive decisions, alliance decisions, strategic decisions, and so on. Like EC and SC, collaborative decision making (CDM) is a major topic area explicitly identified in the editorial scope of *Decision Sciences*.

Interestingly, when we compare scholarly activity referring to CDM with that pertaining to EC or SC, a very sharp (and perhaps surprising) contrast appears. As shown in Figure 2, the explicit study of CDM pales in comparison to EC and SC with respect to both the level of activity and the dramatic rise in activity. In the most recent three-year window, scholarly publications referring to collaborative decision making averaged slightly over 450 annually—or, about 9 per week. This is only about one-fourth as many as those publications involving an EC+SC connection (compare Figure 2

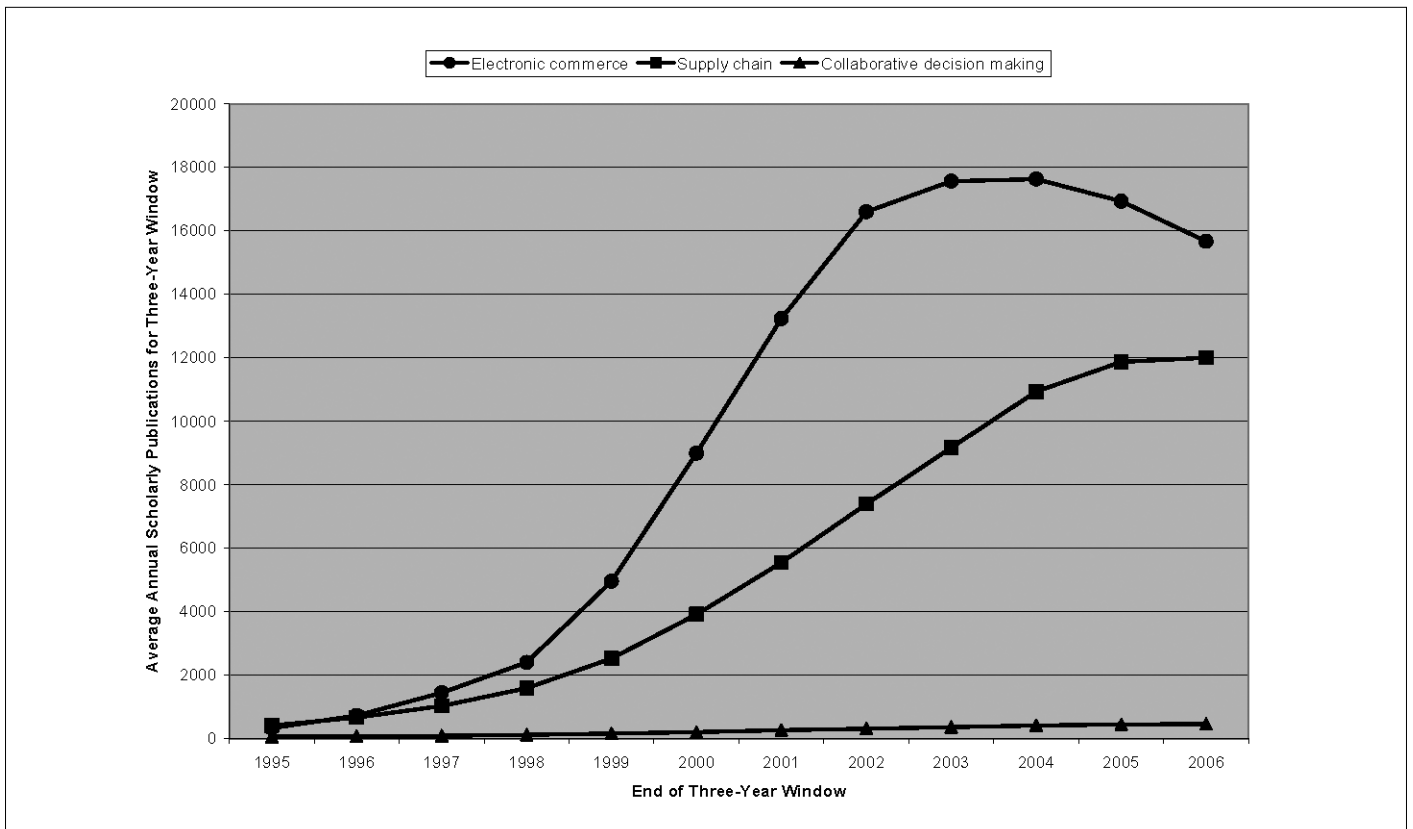


Figure 2. Trends in scholarly publications for three decision sciences topic areas.

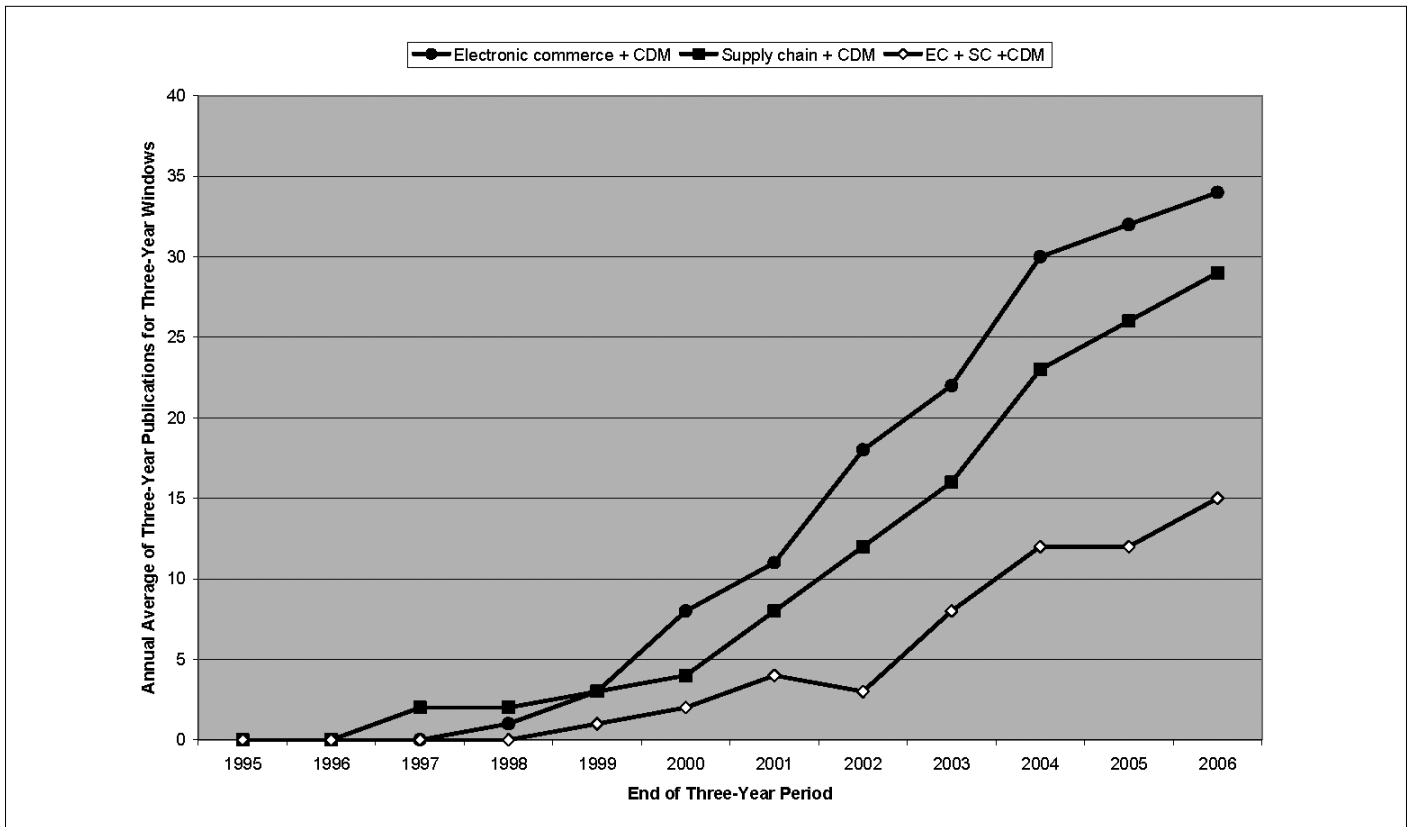


Figure 3. Trends in scholarly publications for collaborative decision making coupled with other areas.

versus Figure 1). We infer that CDM is a lightly studied topic.

But shouldn't there be far more attention directed toward studying, cultivating, supporting, and applying collaborative decision making? In a world of global/dynamic markets, network organizations, pervasive computing, continuous learning, mass customization, socio-political diversity, and frequent storms in organizations' environments, could it be that collaborative decision making is a key to staying afloat in the competitive sea? If so, there is both an opportunity and a pressing need for greater CDM research.

In striving to make progress in this direction, we contend that CDM research can benefit by being connected to other topic areas of decision sciences, such as the well-established fields of electronic commerce and supply chain management. Moreover, the EC and SC fields can benefit from advances in the understanding of CDM. So far, there are some light connections between CDM and EC and between CDM and SC. These two pairings are illustrated in Figure 3. While the volumes are far from overwhelming, the upward trends are noteworthy. Additionally, observe that there have been few scholarly publications that refer to all three topic areas

(15 annually in the most recent 3-year window).

The current state of EC, SC, and CDM inter-relationships is depicted by the dots and connections in Figure 4, where dot size is indicative of scholarly activity. Notice the direct connection between EC and SC is far more pronounced than the indirect connection via CDM. Yet, this indirect connection represents a major potential for research advances that can enrich all three topic areas, contributing mightily to organizational performance. As a call for decision science researchers to actualize this potential, we develop a perspective of collaborative decision making as a nexus linking EC with SC. The basic idea is suggested by the two arrows in Figure 4. Specifically, electronic commerce needs to increasingly be seen and investigated as a means for supporting collaborative decision making, and a supply chain needs to increasingly be seen and investigated as being a manifestation of collaborative decision making.

We begin with a consideration of collaborative decision making in an electronic commerce context and then look at CDM in a supply chain context. Along the way, we identify salient questions that need to be asked, and share a few answers that we have found from

more than 25 case studies of collaborative decision making in diverse supply chains. We conclude by pointing out the importance of the CDM nexus for EC and SC from a science of competitiveness viewpoint.

Collaborative Decision Making in the E-Commerce Context

In the formative years of electronic commerce, a large number of EC definitions were advanced. Analysis of many dozens of these yields a five-fold taxonomy of viewpoints about the nature of EC, and an integrated definition of EC that subsumes the multiplicity of definitions involved in these five EC perspectives:

EC is an approach to achieving business goals in which technology is used to manage knowledge for purposes of enabling or facilitating the execution of activities in and across value chains as well as the making of decisions that underlie those activities. (Holsapple & Singh, 2000, p. 164)

Perhaps the most common viewpoint of EC, the trading view (see, for example Golicic, 2002), is one that focuses on computer-based means for conducting commercial transactions—the electronic buying and selling of goods and services. While collaboration of a transactional nature is vital and widespread (e.g., via EFT, EDI, online purchasing/payment), we must not overlook the tremendous importance and potential that EC holds for enabling or facilitating decision making.

Much of the EC support for decision making takes the form of an individual seeking knowledge (e.g., via the Internet) that he/she needs to reach a decision inherent in some goal-oriented activity. However, many instances of decision making involve multiple participants, often in geographically distant locations. EC support of a multi-participant decisional episode can go well beyond offering participants access to digital (or human) knowledge repositories. They do so by enabling or facilitating collaborative aspects of the decision participants' activities—guiding the workflow within a hierarchic team as it makes

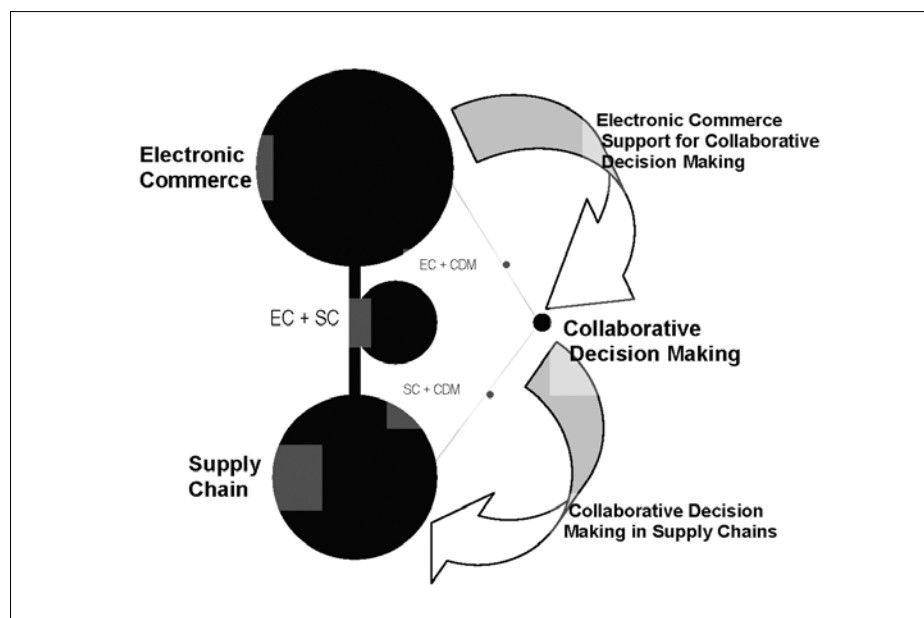


Figure 4. Connecting the dots.

decisions about a project, furnishing a market whose participants reach a joint decision about who gets what products at what price, coordinating knowledge flows among a government agency's workers in their deliberations about disaster relief, linking the efforts of a firm's employees as they interact across time and space to reach a decision about what competitive action to take, or providing a forum for enhancing supply chain participants' knowledge visibility as they struggle to make joint decisions about flows of goods and services. While such EC systems to support collaborative decision making exist and are used, Figure 3 suggests that there is comparatively little scholarly work aimed directly at the increasingly important connection between EC and CDM.

Strengthening the connection between EC and CDM requires a much better understanding of CDM itself. The CDM dot in Figure 4 needs to grow. There is a substantial literature on the general notion of collaboration that can be used as a foundation for more in-depth investigation of CDM. Although an analysis of this literature reveals many differing definitions of collaboration, it also leads to an integrated definition that subsumes the key points of differing views:

Collaboration is an interactive, constructive, knowledge-based process that involves multiple autonomous and voluntary participants employing complementary skills and assets, with a collective objective of achieving an outcome beyond what the participants' capacity and willingness would allow them to accomplish individually. (Hartono & Holsapple, 2004)

In the case of CDM, the collective objective is to make a joint decision. Tailoring the foregoing integrated definition of collaboration to the particular case of CDM, we offer the following definition:

Collaborative decision making is an interactive, knowledge-based decision-making process, involving multiple autonomous organizations that voluntarily employ complementary resources (skills and assets), with a collective objective of achieving a joint

decision about their interlinked business processes beyond what any single organization's capacity and willingness would allow it to accomplish individually.

This definition identifies a collection of parameters that we can use as a common base for studying instances of CDM, for comparing various CDM episodes with each other, and for framing the evaluation of alternative CDM practices. For instance, the *interactive* parameter can vary in degree (e.g., minimal, extensive), mode (e.g., electronic, face-to-face), representation (e.g., visual, audio, textual, pictorial, static, animated), timing (e.g., synchronous, asynchronous), regularity (e.g., periodic, sporadic), drivers (e.g., a "lead" participant, any participant, a coordination system), direction (e.g., push, pull), mediation (e.g., direct interactions, use of intermediaries, interactions involving message deposit/withdrawal via a shared repository), and so forth.

For practitioners, the definition's parameters form a check-list of considerations and options that should not be overlooked as they strive for successful CDM participation and valuable CDM ventures. For researchers, these parameters need to be considered in research designs adopted for the investigation of questions. They suggest a host of independent variables, control variables that should not be overlooked, and perhaps some salient moderating variables. The definition also suggests dependent variables involving the process or outcome of a CDM episode. In the electronic commerce context, the CDM definition and parameters highlight several directions for the future development and research that could strengthen the EC+CD connection shown in Figures 3 and 4.

Collaborative Decision Making in the Supply Chain Context

Supply chain management (SCM) is among the most significant innovations in all of business in recent years. According to the definition given by the Council of Supply Chain Management Professionals,

[SCM] encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, SCM integrates supply and demand management within and across companies.

(<http://cscmp.org/AboutCSCMP/Definitions/Definitions.asp>)

Note that collaboration among participants is explicitly stated to be important for SCM. Moreover, decision making is inherent in the "planning and management of all activities" in a supply chain. It follows that issues of collaborative decision making connected to supply chains are worthy of investigation.

However, issues pertaining to the CDM+SC link do not appear to have been heavily investigated (recall Figures 3 and 4) in terms of its means, technologies, or outcomes. Examples of such issues include collaboratively deciding on:

- collective supply chain objectives that are consistent with individual goals of all participants in the supply chain (Jiao et al, 2006)
- compliance mechanisms to employ in supply chain processes (Arino & Reuer, 2004).

An example of technology that can support collaborative decisions about supply chain objectives or infrastructure involves the use of intelligent agents (Caridi et al, 2005; Jiao et al, 2006). Internet-based support for collaborative decision making in supply chains falls into the relatively underdeveloped realm of organizational decision support systems (Chi et al, 2007), where the supply chain collaborators comprise a virtual organization susceptible to computer-based decision support.

What Do We Need?

The foregoing sketch of EC, CDM, and SC connections calls attention to a substantial opportunity for investigating the little-explored EC+CDM, CDM+EC,

and EC+CDM+SC linkages. Open questions include:

- Exactly what is the role of CDM in supply chains?
 - Is CDM a necessity or optional? Why?
 - How does CDM affect the business and competitiveness of individual firms, as well as the whole supply chains in which they participate?
 - What is the role of collaborative decision making in your strategy development and in operations?
 - How often are decisions collaboratively made in supply chains (relative to non-collaborative decisions)?
- Why and under what circumstances do you and your supply chain partners adopt collaborative decision making (CDM)?
 - With whom do you make decisions collaboratively? Upstream? Downstream? Intermediaries?
 - When and where does that CDM occur?
 - Why do you adopt CDM? (e.g., because of business dependency? competitive pressure in the industry/market?)
 - What are obstacles/bottlenecks for CDM? (e.g., lack of trust, lack of effective governance/coordination/communication? lack of collaborative technologies)
- How did you and your SC partners implement CDM?
 - What/who triggers a CDM process?
 - What are the major phases of CDM?
 - Who dominates or what controls the CDM process?
 - During a CDM process, is it important to acquire knowledge from outside the SC?
 - How are resultant decisions assimilated into the supply chain?
- At what stages are EC technologies used to support CDM in supply chain processes?
 - What types/forms of EC technologies are employed for each stage?
 - How does availability of technology affect the usage of technology in CDM?

- Who provides the technology resources?
- How does EC technology contribute to CDM in supply chain?

To begin to answer such questions, we are undertaking a series of more than twenty-five case studies. Each focuses on a firm (based in the U.S. or China) involved in supply chains. The firms represented in this series cover a diverse set of industries and are of various sizes (with the majority being large firms).

Preliminary results from these studies offer evidence that collaborative decision making among supply chain partners is regarded as commonplace, and typically essential for supply chain success. The informants generally agree that the definitions of CDM and SCM presented above cover the important aspects of these two phenomena. The cases indicate that making decisions collaboratively helps ensure that supply chain strategy and operations are executed in a coordinated fashion, with positive effects on SC efficiency and effectiveness. It appears that two major issues that must be handled in order to experience positive outcomes from a CDM episode within a supply chain are the assurance of knowledge quality—flows of knowledge among CDM participants that are sufficiently accurate and useful—and the creation of new knowledge from those flows. Notice that these two issues are closely aligned with a central aspect of the EC definition discussed above—technology being used for managing knowledge to enable/facilitate making of decisions that underlie activities executed across value chains. This alignment suggests that EC has a key role to play in addressing these two major issues

Initial analysis of the cases suggests that potential benefits of CDM in supply chains can be organized into the categories of productivity gains, greater agility, innovation, and enhanced reputation (PAIR). The first two categories relate mainly to improvement in decisional processes because of more efficiency or greater alertness and response-ability. The latter two relate to

improvements in decisional processes and/or the outcomes of those processes by a greater ability to integrate/synthesize/create knowledge (i.e., learn) and by increased quality and strengthened relationships (i.e., trust). For an individual firm, or for an entire supply chain, some of the PAIR benefits can be more pronounced than others.

The cases suggest that CDM should be avoided in some situations, may be optional in others, and is vital in still others. It seems to be most important in situations of great uncertainty/turbulence, high complexity, high expense, or knowledge intensity, and also where participant buy-in is important for successful implementation of the decision.

Face-to-face CDM is very important in supply chains. But, in almost all of the cases, EC technologies are also regarded as indispensable for the success (or even feasibility) of CDM in supply chains. In some cases, using collaborative technologies (Massey, 2007) in CDM is a requirement for participation in the supply chain. It appears that technology-supported CDM yields benefits in one or more of the PAIR directions. Knowledge sharing/analyzing and communication are two of the main reasons we encountered for using technology in CDM. Most often mentioned at the top of wish lists for technological support, we find improved systems for integrating, reconciling, and synthesizing knowledge relevant to the CDM episode at hand.

In sum, the cases reinforce our contentions that CDM is an important facet of supply chains, some collaborative technologies used for electronic commerce are beneficial for successful CDM in this context, and that there is plenty of room for new technologies that better support collaborative decision making. They also suggest that questions such as those listed above are relevant for SC practitioners and EC researchers, and that answers to them will help develop the CDM topic area as an important nexus for better understanding the connections between EC and SCM (and other inter-organizational decision making contexts).

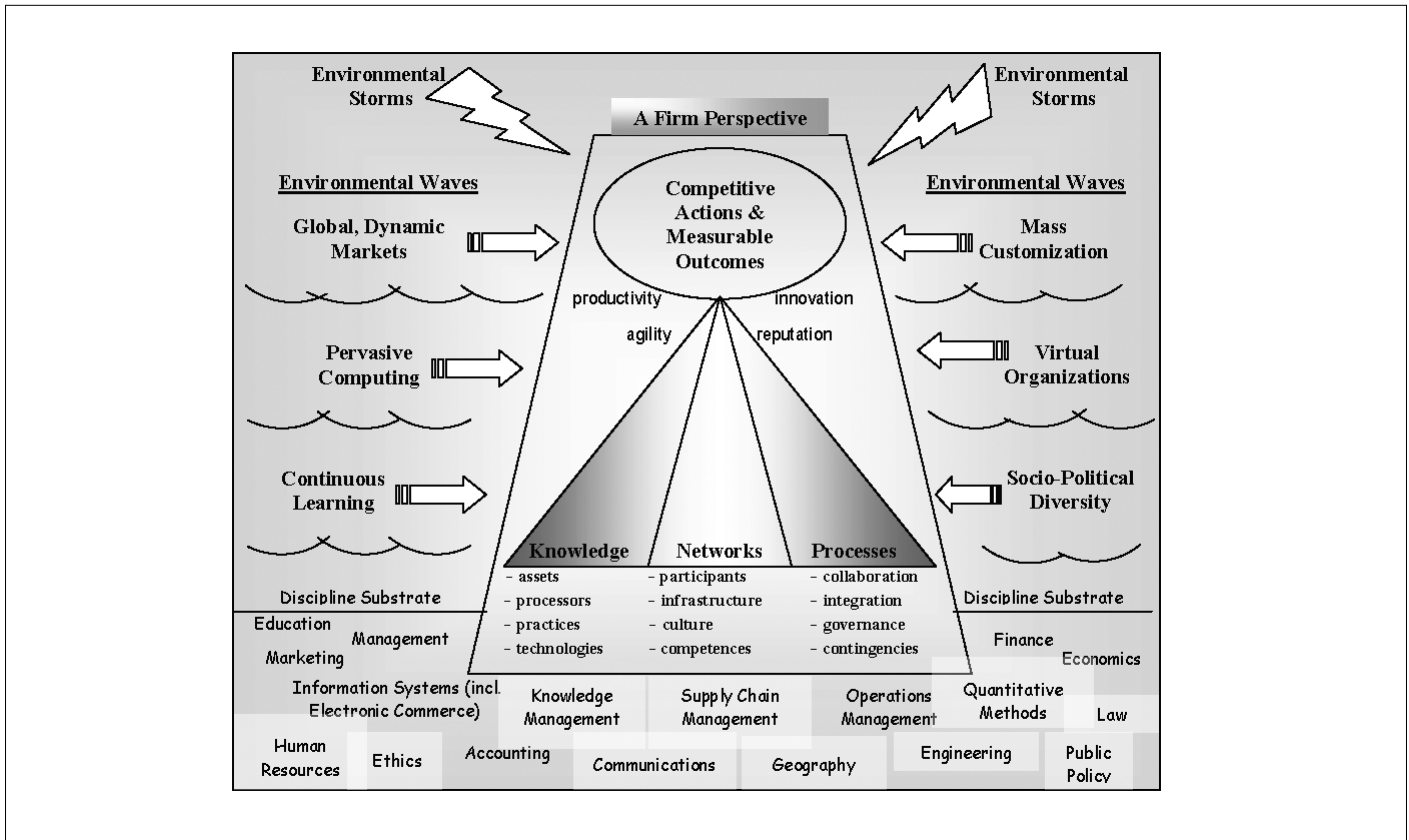


Figure 5. Toward a science of competitiveness (adapted from Chi et al., 2007).

The Science of Competitiveness

As investigations of the EC+CDM+SC connections unfold, it may be helpful to frame them within the science of competitiveness (SoC), as they are ultimately concerned with enhancing the competitiveness of both individual firms and networks of firms. Because of the complexities, challenges, and opportunities posed by today’s environment, competitiveness is a pressing concern that demands never-ending attention. We contend that a better appreciation of the nature and potentials of EC+CDM+SC connections can emerge by considering a further kind of connection: links to the SoC, which is concerned with the antecedents, cultivation, sustainability, and consequences of competitiveness—at all levels ranging from individual to organizational to inter-organizational and beyond.

Although much is known about competitiveness, the SoC idea is only just emerging. As it develops, we will

see a systematic elucidation of what practicing managers should consider as they strive to guide their organizations through today’s business environment of turbulent waves and frequent storms. We will see a succession of increasingly detailed and comprehensive frameworks that identify and describe regular patterns involving entities, objects, events, and causal links concerned with competitiveness (Chi et al, 2007).

A high-level perspective on the science of competitiveness is shown in Figure 5: seeking explanations and prescriptions for ways in which an organization’s knowledge, networks, and processes can be configured to yield actions that enhance its competitiveness (and ultimately fulfilling its mission). In the case of inter-organizational networks, such as supply chains, collaborative decision making enabled/facilitated by EC technologies is instrumental in determining configurations of knowledge (i.e., knowledge assets,

processors that build on these assets, ways of allocating processors and assets, technologies for knowledge handling), networks (i.e., participants, infrastructure, culture, competences), and processes (collaboration approaches, process integration capabilities, governance protocols, contingency capabilities). By improving knowledge management, network management, process management, and integration of these three, we can expect PAIR improvements which form a basis for realizing greater competitiveness.

As Figure 5 indicates, collaborative decisions about configuring knowledge, networks, and processes for competitive actions occur in an environment that impinges on the CDM. This environment is characterized by several persistent waves, including the six shown in Figure 5: globalized/dynamic markets, pervasive computing, continuous learning, mass customization, virtual enterprises, and socio-political diver-

sity. Practically all of these waves are driven by, enabled by, or amplified by the advances of electronic commerce over the past fifteen years. Successful competitors are those who find ways to surf at least one of these six kinds of waves without being inundated by the others. Moreover, they find ways to cope with environmental storms that arise, sometimes quite unexpectedly, so as not to be knocked off course, sink into an abyss of mediocrity, or worse. It is in this turbulent environment that decisions must be made. Collaboration in the making of these decisions potentially gives a wider base (of knowledge), a more expansive span (of attention), and a greater flexibility (of processing) for dealing with the turbulent environment in PAIR directions.

The SoC ideas portrayed in Figure 5 provide a frame of reference for future consideration and study of the CDM nexus linking EC and SC. By their very nature, EC+CDM+SC structures are necessarily concerned with knowledge, networks, and processes. In the interest of helping organizations survive and even excel in the competitive environment, the decision sciences community needs to more fully elucidate the design

and implementation possibilities for EC+CDM+SC structures and their connections to competitiveness. Here we have endeavored to furnish some ideas and structure that may offer guidance in taking on this task.

References

- Arino, A., & Reuer, J. J. (2004). Designing and renegotiating strategic alliance contracts. *Academy of Management Executive*, 18(3), 37-48.
- Caridi, M., Cigolini, R., & De Marco, D. (2005). Improving supply chain collaboration by linking intelligent agents to CPFR. *International Journal of Production Research*, 43(20), 4191-4218.
- Chi, L., Hartono, E., Holsapple, C. W., & Li, X. (2007). Organizational decision support systems: Parameters and benefits. In *Handbook of Decision Support Systems: Basic Themes* (eds. F. Burstein & C. Holsapple). Berlin/Heidelberg: Springer-Verlag.
- Golicic, S. L., Davis, D. F., McCarthy, & Mentzer, J. T. (2002). The impact of e-commerce on supply chain relationships. *International Journal of Physical*

Distribution & Logistics Management, 32(10), 851-871.

- Hartono, E., & Holsapple, C. W. (2004). Theoretical foundations for collaborative commerce research and practice. *Information Systems and e-Business Management*, 2(1), 1-30.
- Holsapple, C. W., & Singh, M. (2000). Electronic commerce: From a definitional taxonomy toward a knowledge-management view. *Journal of Organizational Computing and Electronic Commerce*, 10(3), 149-170.
- Jiao, J., You, X., & Kumar, A. (2006). An agent-based framework for collaborative negotiation in the global manufacturing supply chain network. *Robotics and Computer-Integrated Manufacturing*, 22(3), 239-255.
- Markus, M. L., & Christiaanse, E. (2003). Adoption and impact of collaboration electronic marketplaces. *Information Systems and e-Business Management*, 1(2), 139-155.
- Massey, A. (2007). Collaborative technologies. In *Handbook of Decision Support Systems: Basic Themes* (eds. F. Burstein & C. Holsapple). Berlin/Heidelberg: Springer-Verlag. ■

RESEARCH, from page 9

As the number of products offered or components required to manufacture a product increases, the effort dedicated to ensuring conformance will increase. The cost increases because with increasing numbers of items to sample, the number of samples must increase if a constant detection rate is to be maintained (Grant & Leavenworth, 1980; Kapur & Lamberson, 1977). Further, these costs will grow at a decreasing rate due to better utilization of the quality function's infrastructure. Therefore, Proposition 1:

P1: As multiplicity increases, the cost of inspection for conformance quality will increase at a decreasing rate.

Greater interconnectedness in the product architecture creates greater interdependence among functional sub-

units. This results in greater difficulty diagnosing, isolating, and repairing product failures (Karmarkar et al., 1987). Therefore, while the frequency of product failures may not be affected by the interconnectedness of product elements, the cost to re-work failed products will increase. Similarly, if an assembly is used across several products in the portfolio, its failure will have larger ramifications than had it been used in a single product. This leads to Proposition 2:

P2: As interconnectedness increases, warranty costs will increase.

In conclusion, by formalizing the definition of complexity and clearly specifying the underlying dimensions, appropriate theoretical perspectives can be identified. These perspectives

then become the guide by which the topic is explored, the ultimate result being further development of TPF and TCE, theoretical understanding of product complexity, and the opportunity to use the improved understanding to improve practice. ■

References available in the pdf version of the article on the October 2007 Decision Line Web site or upon request from the author.