

Electronic Commerce: Themes, Concepts and Relationships

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ABSTRACT

In this paper, bibliometric (co-citation analysis) and social network analysis techniques are used to investigate the intellectual pillars of the electronic commerce literature as reported in SSCI and SCI journals between 2002 and 2006. By analyzing 22,760 citations of 840 articles, this study maps an invisible network of knowledge of electronic commerce studies. The paper shows that electronic commerce literature focus on three key themes: strategy and electronic marketplace, consumer behavior in electronic commerce, and implications of electronic shopping. The results of the mapping can help identify the research direction of electronic commerce research and provide a valuable tool for researchers to access the literature in this area.

Key Words: Electronic Commerce, Invisible Network of Knowledge, Bibliometric Technique, Social Network Analysis

INTRODUCTION

The past decade has seen active research in electronic commerce and thus produced an impressive array of literature in electronic commerce studies. While research findings in electronic commerce can be disseminated to scientists and practitioners in the form of journal articles, papers, books, and other documents, people are easily confused with the subjects and their contributions to the development of electronic commerce when faced with hundreds of such publications. Great efforts have been made to explore these issues, yet all the issues are usually discussed solely based on the subjective assessment of different experts, which often leads to many controversies in the electronic commerce area.

The objective of this study is to find out the invisible network of knowledge during 2002-2006 year and to explore the intellectual structure of contemporary electronic commerce research. This study also attempts to help researchers identify the linkage among different scholars and confirm the status of each scholar in their contribution to the electronic commerce field.

The research methods used for this study are bibliometric and social network analysis. Bibliometric is a theory-based citation and co-citation analysis. First, by introducing the invisible network of knowledge (INK) model, the communication process embedded in the journal or book publications is described, which consists of three stages and each stage has its distinct features. This communication process is then applied to the electronic commerce field for the period of 2002-2006. Using citation analysis, the interlinked invisible nodes are discovered from which the most influential publications and scholars in the electronic commerce field are identified. Further, co-citation analysis is conducted to utilize the social network analysis mapping the intellectual structure of electronic commerce studies and to explore the invisible knowledge nodes that have contributed most to the studies of electronic commerce and their possible evolution patterns.

THEORY OF THE INVISIBLE NETWORK OF KNOWLEDGE

Concept of Knowledge

Knowledge refers to the output of learning process, just as plans are the output of the planning process. Gibbons et al. (1994) contend that the terms of science and knowledge are frequently adopted interchangeably to form scientific knowledge. Latour (1987) defined knowledge in term of *familiarity* and argued that a novice should become

familiar with the intended knowledge generation or production system of a given field in order to understand the nature, potential uses and evolutionary process of knowledge in this field over time.

Concept of Network

Networks have been extensively applied in engineering and science for managing complex systems. In engineering and sciences, *network* commonly refers to a system or a web of inter-linked sub-systems or components, each optimally designed to perform a designated task effectively. Each sub-system is highly specialized and generally draws on high levels of accumulated knowledge and expertise within its expected domain of operations. Engineers and scientists achieve a much broader, and more complex, range of functions and capabilities than the reach of individual components or sub-systems by optimal inter-linking of these components. Theoretically, the system as a whole may not be truly optimal, yet it can be effective and flexible enough to perform the task at hand, well beyond the capabilities of its individual components. The two important components of a network are the key nodes and linkages whereby key nodes point out the system resources for knowledge generation with their connections via linkages.

Concept of Invisible Network of Knowledge (INK)

Knowledge is complex and invisible making it is very hard for those who attempt to obtain knowledge. This is because people each have their own views concerning knowledge, often results in misunderstanding about what is the knowledge add where it is residing. Consequently, an effective approach is strongly required to help people visualize knowledge, and further maintain and develop a common visualization and representation of knowledge. Chandy and William (1994) argued that each localized knowledge network is a part or sub-system of a broader and more general system. From that perspective, the knowledge network of one discipline could be viewed as an offshoot of its interacting foundational domains which are well-established sub-systems.

The concept of invisible hand reflects our admiration for the elegant and smooth functioning of the market system as a coordinator of autonomous individual choices in an interdependent world. Similarly, because the development and diffusion of knowledge of one discipline can be formulated and changed by the nature and objective of relevant journals (especially those famous and major journals in this discipline), one discipline's

journals can be regarded as an “invisible hand” influencing the locus of development and diffusion of the knowledge network of a given field.

By combining the invisible hand of journals and the knowledge in term of citation networks of scientific papers as most important scientists’ communications (Price, 1965), this study constructed a concept of Invisible Network of Knowledge production of a discipline (an INK model) to help *make the invisible more visible*. Besides the merits of the conventional concept of knowledge network, INK model focuses mostly on how invisible knowledge affects a discipline (or a field) to increase its visibility using computer-aided epistemology. The INK model can help map the knowledge network of a field (or a discipline) and reveal its locus of theory development and evolutionary trends. The invisible network of knowledge (INK) model could be an effective meta-method to represent invisible knowledge of a field. An invisible network of a field in nature can be considered as the repository of broad and complex sets of expertise, experience, and accumulated theoretical essentials in its various parts of knowledge, from which both inside and outside members can draw to help advance and refine this field.

How Has the INK of Electronic Commerce Developed?

An invisible network of knowledge of any given field embodies both the knowledge content of its nodes and the inter-linkages of those nodes within its domain and to other fields. It can be regarded as the organized and the *de-facto* mirror of a field. The INK of electronic commerce can be considered as an offshoot of its interacting foundational domains, which are well-established sub-systems of electronic commerce (i.e. publications relevant to electronic commerce). Even though these constituent or foundational fields may not contain sufficient concepts, ideas, frameworks or relevant theoretical essentials to provide adequate solutions for the emerging problems facing the field of electronic commerce, they generate an environment for the cross-fertilization of the relevant parts of constituent fields. This environment enables the field of electronic commerce to develop and mature.

The landscape of a mature knowledge network in the electronic commerce field is composed of sufficiently large quantities of published articles, active researchers (the intellectual architects) and citations appearing in various media relating to electronic commerce and other fields. The following sections describe this invisible network, which is a collection of interconnected knowledge resources in terms of the intellectual, conceptual, or theoretical linkages. This knowledge network can portray the

developmental and diffusion patterns and processes in the knowledge system of electronic commerce

METHODOLOGY

Based on the proposed INK model, the authors explored the intellectual structure of electronic commerce between 2002 and 2006. This study chose this time period because the electronic commerce studies of this century represent the most important and the most updated research in electronic commerce area. As discussed in previous sections, citation and co-citation analysis is the main method for this study. With citation and co-citation analysis, this research assumed three phases, each of which required different approaches to examining the evolution of the electronic commerce studies. First, the databases were identified as the sources of electronic commerce publications. Then data collection and analysis techniques were designed to collect the desired information about the topics, authors, and journals on electronic commerce research.

In the second phase, the collected data were analyzed and systematized by sorting, summing, sub-totaling, ranking, and screening. After a series of operations, key nodes in the invisible network of knowledge in electronic commerce studies were identified and the structures developed. In the final phase, the knowledge network of electronic commerce was mapped to describe the knowledge distribution process in electronic commerce area. The objective of the third phase research was to project the future research directions by exploring the change pattern of star scholars or documents that have the most influence.

For the data presented here, the Social Science Citation Index (SSCI) and Science Citation Index (SCI) were used as parts of the databases. The SSCI and SCI were widely used databases, which included citations published in about 6000 refereed journals. Using SSCI and SCI provided the most comprehensive and widely accepted databases of electronic commerce publications.

Unlike other prior studies, data used in this study were not drawn from journals chosen by the peer researchers (Holsapple et al., 1993; Walstrom & Leonard, 2000). Instead, the entire databases of SSCI and SCI from 2002 to 2006 served as the universe for conducting the analysis. In order to choose sample articles, this study uses “key words” method which utilizes the SSCI and SCI databases key word search in article’s title. Using “E-commerce” and “electronic commerce” as key words, this study included 840 journal articles which cited 22,760 other publications as references. The cited

publications in these papers include both published books and other journal articles.

RESULTS

Citation Analysis

Citation analysis was tabulated for each of the 840 source documents using the *Excel* package. Preliminary analyses of the data produced interesting background statistics, for example the frequency of journal citations, listed in Table 1. General management and marketing specific journals featured prominently alongside the electronic commerce specific journals; with a cluster of information systems focused titles also evident, while economic is less prominent.

The most influential documents with the most citation and the most influential scholars were then identified by their total counts of citation within the selected journal articles. Among all the cited documents, the most cited electronic commerce document between 2002 and 2006 was Davis's paper (1989) *Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information System*, followed by Hoffman's paper (1999) *Building Consumer Trust Online*, and Kalakota's book (1997) *Electronic Commerce: A Manager's Guide* (see Table 2). Journal articles and books combined, the most cited scholar between 2002 and 2006 was Bakos, followed by Porter and Gefen (See Table 3). These scholars have the most influence in the development in the electronic commerce area and thus collectively define this field. Although it does not eliminate the bias against younger authors, it still represents the focus of the main authors in the field and this gives us an indication of the popularity of certain electronic commerce topic.

Co-citation Analysis

In this stage, data mapping was conducted and an intellectual structure of the electronic commerce studies was revealed by using co-citation analysis. Co-citation analysis is a bibliometric technique that information scientists use to map the intellectual structure of a research field. It involves counting documents from a chosen field - paired or co-cited documents. Co-citation studies compile co-citation counts in matrix form and statistically scale them to capture a snapshot at a distinct point in time of what is actually a changing and evolving structure of knowledge (Small, 1993).

Co-citations were tabulated for each 840 source documents using the *Excel* package. Many of the authors had very few co-citations and were either unlikely to have had a significant impact on the development of the field and/or were too recent to have had

time to impact on the literature. To facilitate the running of our analyses and improve the probability of its success, the authors made sure that all authors in the final set had at least fifteen citations. Based on the total number of citations in the selected articles, the top 30 scholars were identified, and then a co-citation matrix (30 X 30) was built before a pictorial map was drawn to describe the correlations among different scholars. In doing so, we were following the procedures recommended by White and Griffith (1981).

Table 1 The Most Frequently Cited Journals

Journal title	Number of citations
Communications of the ACM	546
International Journal of Electronics Commerce	346
MIS Quarterly	313
Management Science	307
Journal of Marketing	250
Harvard Business Review	194
Decision Support Systems	177
Information Systems Research	174
Information & Management	155
Journal of Marketing Research	152
Strategic Management Journal	148
Internet Research	140
Journal of Consumer Research	129
Academy Management Review	121
Journal of Management Information Systems	107
Electronic Markets	100
Sloan Management Review	100
Journal of the Academy of Marketing Science	92
Academy Management Journal	89

Table 2 Highly Cited Documents (Frequency ≥ 15)

Frequency	Full Citation Index For Document
25	Davis Fd, 1989, Mis Quart, V13, P319
22	Hoffman Dl, 1999, Commun Acn, V42, P80
22	Kalakota R, 1997, Elect Commerce Manag
22	Malone Tw, 1987, Commun Acn, V30, P484
21	Maes P, 1999, Commun Acn, V42, P81
21	Zwass V, 1996, Int J Electron Comm, V1, P3
20	Brynjolfsson E, 2000, Manage Sci, V46, P563
20	Kalakota R, 1996, Frontiers Elect Comm
19	Mayer Rc, 1995, Acad Manage Rev, V20, P709
18	Iacovou Cl, 1995, Mis Quart, V19, P465
17	Bakos Jy, 1997, Manage Sci, V43, P1676
16	Bakos Y, 1998, Commun Acn, V41, P35
15	Shardanand U, 1995, P C Hum Fact Comp Sy, P210

Table 3 Author Citation Frequency (Frequency ≥ 21)

Author	Frequency
Bakos, J. Y.	65
Porter, M. E.	62
Gefen, D.	53
Jarvenpaa, S. L.	48
Kalakota, R.	48
Davis F. D.	43
Hoffman, D. L.	41
Brynjolfsson, E.	28
Shapiro, C.	24
Malone, T. W.	22
Chircu, A. M.	21
Maes, P.	21
Zwass, V.	21

Social network analysis tools can be used to graph the relations in the co-citation matrix and identify the strongest links and so the core areas of interest in electronic commerce. Figure 1 shows the core of the co-citation in this study sample articles with links of greater than or equal to five co-citations shown in the network. This was produced using UCINET software (Borgatti, Everett, & Freeman, 2002) and shows graphically the core areas of interest. The different shapes of the nodes result from performing a faction study of these authors. This method seeks to group elements in a network based on the sharing of common links to each other. These factions can be interpreted as concentrating on the interaction between strategy, electronic marketplace, consumer behavior, and electronic shopping.

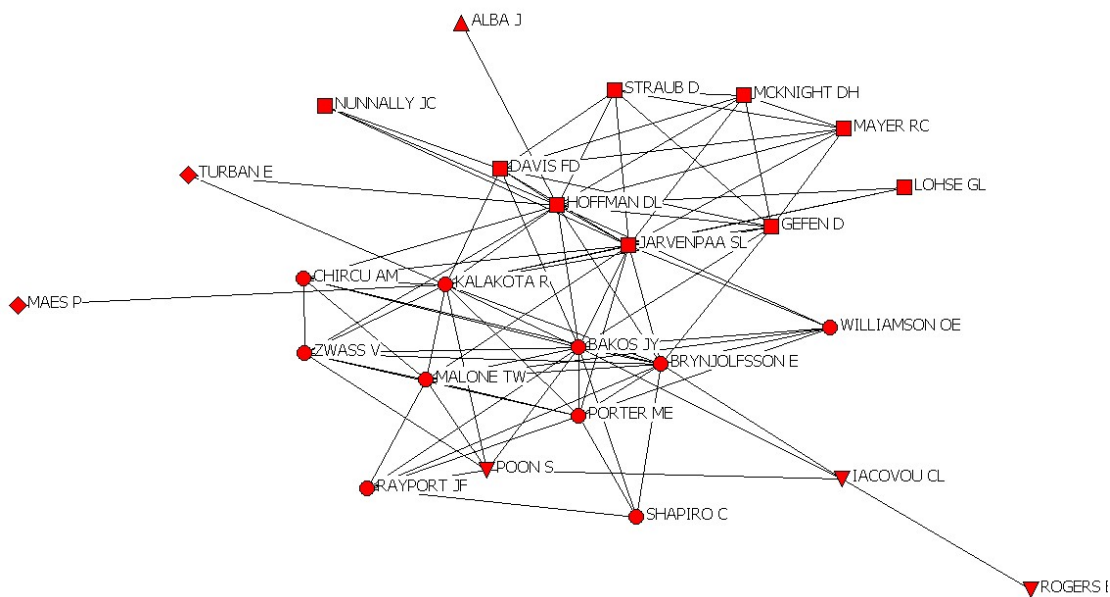


Figure 1 Core Disciplines-Co-citation Network of ≥ 5

Whilst the diagram in Figure 1 is very telling and provides a clear picture, its focus is only on the very core area and a limited amount of the data available. By taking the co-citation matrix and grouping the authors using factor analysis of the correlation between the entries determines which authors are grouped together and there for share a common element. According to this, the closeness of author points on such maps is algorithmically related to their similarity as perceived by citers. We use r-Pearson as a measure of similarity between author pairs, because it registers the likeness in shape of

their co-citation count profiles over all other authors in the set (White & McCain, 1998).

The co-citation correlation matrix was factor analyzed using varimax rotation, a commonly used procedure, which attempts to fit (or load) the maximum number of authors on the minimum number of factors. The diagonals were considered it missing data and apply the criterion of omitting the two cases (*pairwise delete*) (McCain, 1990).

Three factors were extracted from the data and together they explain over 72% of the variance in the correlation matrix. Table 4 lists the three most important factors along with the authors that had a factor loading of at least 0.4. As is usual in this type of analysis, authors with less than a 0.4 loading were dropped from the final results (White & Griffith, 1981). We tentatively assigned names to the factors on the basis of our own interpretation of the authors with high associated loadings. Implicitly, our interpretation of the analysis results is that the electronic commerce field is composed of at least three different sub-fields: strategy and electronic marketplace, consumer behavior in electronic commerce, and implications of electronic shopping. We made no attempts to interpret the remaining factors on account of their relative small eigenvalues (<7.77%). They have similarly been excluded from Table 4.

Figure 1 and Table 4 clearly indicated that the most influential scholars in electronic commerce studies between 2002 and 2006 clustered together. The main research focused on strategy and electronic marketplace. Porter (2001) submitted five forces model applied to B2B e-marketplaces. According to Porter, the most important determinant of a marketplace's profit potential is the intrinsic power of the buyers and suppliers in the product area (Porter, 2001). While the strategic implications of the Internet have been addressed (Porter, 2001; Shapiro & Varian, 1999) the nature of products and services have not received the same treatment. Shapiro and Varian (1999) submitted the Open Innovation Model that is characterized by the exploitation of intellectual property in order to create value. Using improved computing technologies and digital networks, know-based activities can be performed in cooperation with other components in social systems in almost an infinite number of ways when and how they are needed. Bakos (1991) presented a more circumscribed view of the electronic marketplace as a facilitator of information about prices and products and argued that electronic marketplace reduce the costs incurred to acquire information. Advanced, Bakos (1997) concluded that lowering the buyer's search costs enables buyers to find low-cost sellers, and that electronic marketplace will therefore promote price competition among sellers.

Table 4 Author Factor Loadings (varimax rotation) at 0.4 or Higher

Factor1: strategy and electronic marketplace	37.2%	Factor2: consumer behavior in electronic commerce	27.4%	Factor3: implications of electronic shopping	7.7%
Shapiro C	0.945	Mayer Rc	0.966	Alba J	0.683
Malone Tw	0.918	Gefen D	0.964	Resnick P	0.551
Bakos Jy	0.908	Mcknight Dh	0.962		
Chircu Am	0.906	Straub D	0.961		
Rayport Jf	0.883	Jarvenpaa	0.948		
Brynjolfsson E	0.868	Davis Fd	0.923		
Porter Me	0.855	Hoffman Dl	0.898		
Zwass V	0.793	Lohse Gl	0.769		
Williamson Oe	0.704	Nunnally Jc	0.624		
Kalakota R	0.662				

Based on Figure 1 and Table 4, the consumer behaviors in electronic commerce permeate the authors in the second group. Jarvenpaa and Todd (1996) suggested that the most important perceived benefit of Internet shopping was convenience, while poor customer service, poorly designed Websites, and that perceived risk were cited by online shoppers as the negative factors and observed that the most influential factors that lures customers to the internet is discount price: therefore, creative pricing is the core business model of many internet companies. Trust is vital to the consumer behavior in electronic commerce. According to Mayer, Davis, and Schoorman (1995) trust and risk perception are very strongly interrelated. They regarded risk as an essential component of trust; one must take a risk in order to engage in trusting action. In a related strain research, Gefen (2000) empirically revealed that individual's general trusting propensity, which is the product of lifelong socialization process, is positively related to individual's trust. Advanced, Gefen and Straub (2003) proposed a variable ('trust') for studying electronic commerce acceptance. Extending trust factor into the Technology Acceptance Model (TAM) enable better explanation of electronic commerce usage behavior. The importance of trust in electronic commerce can hardly be overestimated. McKnight and Chervany

(2001) distinguished trusting beliefs from trusting intentions in the concept of trust toward Web vendors. In electronic commerce, trusting beliefs include competence, benevolence, integrity, and predictability exhibited by Web vendors when they interact with consumers. Another, trusting intentions include the consumer's willingness to depend on and the subjective profitability of depending on the Web vendors when making a transaction (McKnight & Chervany, 2001).

Implications of electronic shopping permeate the authors in the third group. In examining the implications of electronic shopping, Alba et al. (1997) argued that response time is a key factor of interactive shopping. The response of electronic commerce has to be immediate as in face-to-face communications in physical stores. Another, using the Internet enables consumers to, fairly easily, access information about merchandise, gather vertical information at a low cost, to efficiently screen the offerings, and easily locate a low price for a specific item (Alba et al., 1997). Reputation is another important characteristic of electronic shopping. Resnick et al. (2000) stated that to operate at all, reputation systems require three properties at a minimum; entities are long-lived so that there is an expectation of future interaction, feedback about current interactions is captured and past feedback guides decisions.

CONCLUSIONS

This paper has investigated electronic commerce using citation and co-citation data published in SSCI and SCI between 2002 and 2006. A factor analysis of the co-citations suggested that the field is organized three different concentrations of interest: strategy and electronic marketplace, consumer behavior in electronic commerce, and implications of electronic shopping.

The authors have profiled the major themes, concepts and relationships which discussed within each domain. We found that the scope of electronic commerce research has been broad and there are many research opportunities emerging in the coming evolution of electronic commerce. Firms and consumers continue to innovate and adopt electronic commerce rapidly and extensively. The contribution of this paper is to provide a valuable research direction in the electronic commerce area and propose an objective and systematic mean of determining the relative importance of different knowledge nodes in the development of the electronic commerce field.

Even though this body of research has the undeniable merit of offering valuable insights into the intellectual structure of electronic commerce studies, it has some

limitations. First, our search criteria may be incomplete, and many good papers that do not have the terms electronic explicitly in the article title may not have been included. Second, the sample articles choose from 2002 to 2006, which might affect the generalization of this study.

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