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An analysis of the Information Technology Outsourcing Domain: A Social Network and Triple Helix Approach[1]

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Abstract

Information Technology (IT) outsourcing has become a widely accepted management strategy over the years. As a consequence, plenty of research on IT outsourcing domain with a wide range of issues has been carried out resulting in greater knowledge production. This study aims to investigate the IT outsourcing knowledge infrastructure from a network point of view. Triple helix indictors and social network analysis techniques are employed on 288 scholarly papers obtained from the Web of Science database using keywords related to IT outsourcing. The result mainly reveals the key players of IT outsourcing research collaborators, their network characteristics like degree centrality, and the relationship of academia, industry and government in terms of IT outsourcing knowledge production. The paper also provides results-based implications.

Keywords: *IT outsourcing; Triple Helix Model; Social Analysis Technique; University-Industry-Government Relationships*

Introduction

Information Technology (IT) outsourcing is a common business practice of turning over all or part of an organization's IT functions to an outside vendor with an expectation of cost reduction, improved productivity, and competitiveness. IT outsourcing has now become a popular strategy for all types of organizations – large or small, local or multinational, private or public (Gantman, 2011). According to Gartner (2012), IT outsourcing is on its way to reach a worldwide spending of US$ 251.7 billion in 2012, a 2.1 percent increase from 2011. IT outsourcing is a significant and an increasing practice indeed (Burnes & Anastasiadis, 2003).

Despite of this increasing IT outsourcing practice, few organizations report success (Han, Lee, & Seo, 2008). A recent study (Fraga, Varajao, Amaral, & Bulas-Cruz, 2012) shows that the failure rate of IT outsourcing ranges from 40% to 70%. The IT outsourcing practice is full of ambiguities and complexities with many pitfalls (Gantman, 2011). Effective management of IT outsourcing has become a challenge for organizations these days (Koh, Ang, & Straub, 2004). In order to understand and comprehend the IT outsourcing practice better, it is vital to investigate the IT outsourcing knowledge infrastructure from different perspectives.

Studies on IT outsourcing provide a good understanding of the practice by dealing with the questions pertaining why, what and how firms outsource, and also highlight the outcomes of the outsourcing decision (Lacity, Khan, & Willcocks, 2009). Such studies have typically employed the conventional systematic literature review (SLR) method. The SLR method is useful in understanding the common facts, but is not adequate enough in revealing the hidden structures and characteristics of research domain under study (Khan & Park, Forthcoming). Also the SLR method might lead to Type 1 and Type 2 errors as some relevant studies and topics might be

missed (Type 1 error) and/or irrelevant studies and topics might be included (Type 2 error) because of not having an automated process to carry out the study (Kitchenham, 2004; Kitchenham et al., 2009). This study employs a mixed approach (Khan & Park, 2011) of a Social Network Analysis (SNA) (Wasserman & Faust, 1994) and Triple Helix (TH) (Leydesdorff, 2003) perspective to further shed light and provide additional insights on the IT outsourcing research domain.

SNA is a way of investigating network structures of collaboration among institutions, countries and regions (Wasserman & Faust, 1994). SNA perspective reveals the hidden structure and characteristics like key players, network of key players for scientific collaborations (e.g., institution level, country level, and regional level), their network characteristics (e.g., degree centrality, density, and clusters) and the current trends, strengths and weaknesses of IT outsourcing research domain.

TH is a way of examining relationships among university, industry and government (UIG) (Etzkowitz & Leydesdorff, 2000). The UIG relationships are very important measure for the functionality of any knowledge-based novelty production system (Leydesdorff, 2003). In case of IT outsourcing, UIG has its own significance. The importance of IT outsourcing in academia can be justified by the increasing number of published articles in this field (Oliveira, Hartung, & Wendling, 2010) over time. In terms of industry, IT outsourcing is the main concern of the directors in the large firms (Joshi & Mudigonda, 2008). In government IT outsourcing is becoming an increasing common practice at all the levels (Chen & Perry, 2003) with no signs of slowdown in its practice (Lin, Pervan, & McDermid, 2007). Therefore, the objectives of this study are twofold. First, social network analysis technique is applied to analyze network structures of collaboration among institutions, countries and regions for IT outsourcing

knowledge production. Second, IT outsourcing research domain is investigated and analyzed through a triple helix network of academia, industry and government. Three research questions are specifically of focus:

(1) What are the network structures of collaboration among institutions, countries and regions for IT outsourcing knowledge production?

(2) What is the status of university-industry-government relationships in the network of IT outsourcing knowledge production? And,

(3) Who are the key players (i.e. institutions, countries and regions) contributing to the network of IT outsourcing knowledge production?

The rest of the paper is structured as follows. First, a literature review is presented to provide insight into the IT outsourcing research domain. Then, the research method used to conduct this study followed by the data collection method is discussed. Next, the paper then includes results of the study followed by the burst detection section to show the emerging trends in IT outsourcing domain. Discussion, limitations and suggestions for future research conclude the paper.

Literature Review

The IT outsourcing practice was initiated back in the 1950s but only in the 1980s did the practice gain its momentum (Oliveira et al., 2010). In the past few years, IT outsourcing has been so widely accepted that organizations now outsource a greater range and depth of services. Academic literature has examined multiple aspects of the IT outsourcing practice such as the reasons why organizations outsource and the long-term consequences of outsourcing (Lacity et al., 2009). Early research on IT outsourcing are generally motivated to explain reductions in IT

costs and has generally focused on the economic aspects of the practice. By the end of 1990s, the focus of the research work shifted from why an organization outsources to should an organization outsource. However, recent research has generally emphasized on organizational learning, managing relationships and overcoming cultural differences in IT outsourcing practice (Gantman, 2011).

Lacity et al. (2009) have examined IT outsourcing related articles published from 1990 to 2008 and found that most of the articles deal with the determinants of IT outsourcing success and the determinants of IT outsourcing followed by client and supplier capabilities, sourcing varietals, IT outsourcing risks and IT outsourcing strategies.

Gonzalez, Gasco and Llopis (2006) have analyzed the IT outsourcing articles published in various journals until 2005 and classified the research topics into five broad perspectives i) client, ii) provider, iii) client-provider relationship, iv) economic theories, and v) others. The large percentage (48.7%) of research is focused on the client perspective followed by client-provider relationship (17%), provider perspective (16%), economic theories perspective (9.2%) and others like national differences, IS staffs etc. (8.37%).

Lee, Huynh, Chi-Wai and Pi (2000) have broadly classified the IT outsourcing research into five major areas i) organization, ii) performance, iii) decision, iv) contract, and v) relationship. The organization research mainly focuses on the motivation, impact and benefits/ risks of outsourcing. The performance research generally assesses success/failure, efficiency, satisfaction, service quality and cost reduction from the outsourcing. The decision research focuses on the factors that impact the decision of outsourcing. The contract research examines the nature of contract in the outsourcing arrangements. The relationship research addresses the importance of client-vendor relationship for the outsourcing success.

Theoretically, IT outsourcing research can be generally viewed through three different perspectives i) Strategic, ii) Economic, and iii) Social (Lee et al., 2000). Strategic perspective explains why and how organizations formulate and implement outsourcing strategies in order to garner competitive advantages (Quinn, 1999) and this perspective is generally based on resource-based, resource dependency and game theories. The economic perspective examines efficiency, coordination, and governance of economic transactions between firms (Goo, Kishore, Nam, Rao, & Song, 2007) and generally this perspective is based on theories like agency and transaction cost. The social perspective explains the issue of managing inter-organizational ties in the outsourcing relationship (Goo et al., 2007) and is generally based on theories like social exchange, relational exchange, and power politics.

Research methods employed in conducting IT outsourcing studies are generally of five kinds (Dibbern, Goles, Hirschheim, & Jayatilaka, 2004) which are i) Survey, where a large number of data is collected through methods like questionnaires and interviews or from published statistics and is analyzed using statistical methods. ii) Case Study, where a small number of data is collected through methods like participant observations, in-depth interviews and longitudinal studies to investigate contemporary phenomenon within its real-life context. iii) Action Research, which combines theory and practice (and researchers and practitioners) through change and reflection in an immediate problematic situation within a mutually acceptable ethical framework (Avison, Lau, Myers, & Nielsen, 1999). iv) Conceptual, which is comprised of frameworks and arguments that sort out unstructured thoughts and concepts that circumscribe the phenomenon under study (Dibbern et al., 2004). v) Mathematical, where studies involve mathematical models and analyses that are based on a set of restrictive assumptions about the nature of the world and the rationality of the actors involved. The rationality is mostly based on the calculation of

minimizing costs or maximizing profits by changing certain parameters while holding other factors constant (Dibbern et al., 2004).

To tackle the challenges of IT outsourcing, research has been carried out pursuing a wide range of issues which have resulted in greater knowledge production. But as of our knowledge, there is no study that deals with the SNA and TH perspective on IT outsourcing. Consequently, this study is expected to play a vital role in assessing the IT outsourcing knowledge infrastructure and in revealing its hidden structures and characteristics.

Research Method

Social Network Analysis (SNA) Techniques

The hidden structures and characteristics of the IT outsourcing research domain are investigated by employing SNA techniques. The hidden structures and characteristics help to reveal the key players and their collaboration of networks (Khan & Park, 2011). SNA techniques are mainly based on graph theory (Biggs, Lloyd, & Wilson, 1986) and deals with social networks. Social networks among individuals, groups, organizations, and related systems are fundamental components of a society. Social networks are "nodes of individuals, groups, organizations, and related systems that tie in one or more types of interdependencies: these include shared values, visions, and ideas; social contacts; kinship; conflict; financial exchanges; trade; joint membership in organizations; and group participation in events, among numerous other aspects of human relationships" (Serrat, 2009, p.1). The main focus of the social network analysis is mapping the structure of the relationships among these nodes (Serrat, 2009; Wasserman & Faust, 1994).

The use of SNA as a technique/tool to analyze structure of relationship in a network (e.g. in this study co-authorship network) have several benefits. For example, relationships and knowledge flows (e.g. at country, institutional, and regional level) can be measured, monitored, and evaluated (Serrat, 2009) to enhance the organizational performance. SNA helps in identifying key players (institutions, countries, and regions in a knowledge network), structural holes at network level, and identifying opportunities to accelerate knowledge flows and sharing at institutions, countries, and the regional level (Khan & Park, Forthcoming). This information cannot be achieved through SRL.

As mentioned earlier, SNA fundamentally deals with nodes and links (or relationships) in a network. In this study, the co-authorship network among institutions, countries, and regions in the IT outsourcing research domain is considered as the network. The nodes are institutions, countries, and regions co-authoring or carrying out research collaborations. The links are the number of published IT outsourcing articles co-authored by institutions, countries and regions. Network structure of IT outsourcing research domain is measured through network centralities: degree centrality, betweenness centrality, closeness centrality, and eigenvector centrality. Degree centrality reveals the collaboration activities, betweenness centrality focuses on the ability to control or facilitate collaboration due to central position in the network, and eigenvector centrality measures the prominence of a particular node's networking ability relative to that of others (Marsden, 2008). To understand the network better, several other network measurements are also obtained, such as, Network density, clustering coefficient, and average degree (average number of publications). Density is the number of actual links divided by the number of possible links and the clustering coefficient is the degree to which nodes in a network tend to cluster

together. To draw the network diagrams and identify the network characteristics like density and clustering coefficient, NodeXL software (Smith et al., 2010) is used.

For analyzing the data and mapping the relationships, IntColl.Exe and InsColl.Exe routines are used; for mapping institutional collaboration, InsColl.Exe is used, and for mapping international collaboration, InColl.Exe is used. IntColl.Exe and InsColl.Exe routines/software which have been developed by Professor Leydesdorff are available free of charge for academic use at http://www.leydesdorff.net/software.htm.

To make the network more readable and to help identify patterns, only institutions with more than three links (publications) are considered for visualizing the network in this research.

Triple Helix Indicators

The other important component of this study is to analyze university-industry-government relationships in the IT outsourcing research domain. To analyze the relationships, the authors' affiliated institutions were divided into the three categories: U for university, I for industry, and G for government (see figure 1). A paper that is co-authored by one or more universities is expressed as U; a paper that is co-authored by one or more industries is expressed as I; and a paper that is co-authored by one or more government bodies is expressed as G. Similarly, a paper that was co-authored by university (one or more universities) and an industry (one or more firms) is expressed as a mutual UI ties; and a paper that was co co-authored by a university, industry, and government is expressed as a mutual UIG ties. A paper expressed as "G" includes the papers published by government or affiliated research institutes; and a paper expressed as "U" includes the papers published by universities, colleges, or affiliated research institutes. Similarly, a paper expressed as "I" includes the papers published by private firms or related research institutes.

The TH model is employed to systematically measure the bilateral and the trilateral relationship among universities, industry and government by using the data about UIG publications. The TH routine/program along with the related information is available at http://www.leydesdorff.net/th2/index.htm. The TH model and its indicators is a well known approach in investigating the relationship among University-Industry-Government (UIG) (Etzkowitz, 2008). Researchers (Etzkowitz & Leydesdorff, 2000; Khan & Park, 2011; Leydesdorff, 2003; Park, Hong, & Leydesdorff, 2005; Shapiro, 2007) have employed the TH approach to capture the dynamics within the three helices and a new development at the network level by demonstrating mutual information exchanges between the helices (Hossain, Moon, & Choe, 2011). For example, according to Park et al., (2005, p. 6), "the network of university-industry-government relations can be considered as an institutional knowledge infrastructure that carries a system of operations containing science, technology, and knowledge-based innovations." The network of academia, industry and government relationships can be measured using indicators like patents, scientometric indicators, various internet resources like advance search engines, (Khan & Park, 2011; Leydesdorff, 2003) and Shannon's mathematical theory of communication (Shannon, 1948).

"Insert Figure 1 here"

According to Shannon, (1948) and Shannon & Weaver, (1949), the amount of information conveyed by the occurrence of an event is inversely proportional to the probability of that event occurring, and thus, if the discrepancy is considered to be a probability distribution ($\sum i$ pi), then the uncertainty associated with the distribution (H) can be defined as follows:

$$Hi = - \sum i \, Pi \log2 (Pi) \qquad (1)$$

Similarly, the two-dimensional distribution Hij is represented as

$$Hij = - \sum I \sum j \, Pij \log2 (Pij) \quad (2)$$

Here Hij is the sum of uncertainty in the two dimensions of mutual information in each probability distribution, that is, the two variations overlap in their covariation and condition each other in the remaining variations.

Assume that "u", "i" and "g" stands for "university", "industry" and "government" respectively. Using Shannon's (1948) theory of communication, mutual information in two dimensions or bilateral relationship can be defined by using "T", transmission between two probability distributions as follows:

$$T(ig) = Hi + Hg - Hig \quad (3)$$

The equation (3) can be understood as an industry-government (ig) relationship. For completely independent distributions (i.e., the zero covariation) Hig is zero otherwise positive (Theil, 1972). Similarly, the mutual information on three dimensions or trilateral relationship among the university, industry and government can be defined as follows:

$$T(uig) = Hu + Hi + Hg - Hui - Hig - Hug + Huig \quad (4)$$

The resulting value of T for two dimensions i.e., T(ui), T(ug), and T(ig) by definition is positive and reduces uncertainty. The value of T for trilateral relationship i.e., T(uig) can be positive, negative or zero depending on the relative size of the contributing terms but trilateral terms increase the uncertainty (L Leydesdorff, 2003). In the relationship among TH components (i.e., UIG), the negative value of T(uig) indicates a decrease in uncertainty at the network level and positive or zero value of T(uig) indicates instability of the system.

Data

The data for this study are collected using the Web of Science provided by the ISI of Thomson-Reuters for the period of 1995 to October 2011. The study includes articles which have been published since 1995 because, according to Gantman (2011), the first scholarly works on IT outsourcing were published in the early 1990s after the large-scale IT outsourcing contract by Eastman Kodak in 1989. The data are the published papers in the SCI, SCIE, SSCI and A&HCI journals with the keywords: IT Outsourcing, Information Technology Outsourcing, IS Outsourcing, Information System Outsourcing, IT Offshoring, Information Technology Offshoring, IS Offshoring, Information Systems Offshoring. Using this approach, a total of 288 scholarly papers is retrieved for the analysis. This study focuses on articles published in journals with a belief that practitioners and academics prefer using journals to acquire and disseminate new knowledge (Gonzalez et al., 2006).

Results

Descriptive Statistics

"Insert Figure 2 here"

Figure 2 shows the number of IT outsourcing articles published from the years 1995 to 2011 (October). The data collected are from 1995 due to the Kodak effect that took place in 1989. The effect arose when Eastman Kodak outsourced its major IT components and IT outsourcing became a world-wide phenomenon and received much attention (Buck-Lew, 1992). This might be the reason that 19 articles were published in the year 1995 as shown in the figure 2. In 1996 the number of publications went down to 7 but then again from 2003, the publication has increased. The upward increase in publication since 2003 might be due to the fact that by then,

IT outsourcing started to be viewed from different perspectives like strategic and social perspectives. Before 2003, IT outsourcing was viewed mostly through an economic perspective only. With the beginning of 2003, IT outsourcing articles seemingly started to incorporate wider perspectives in their contents.

Table 1 shows the number of IT outsourcing articles published in different countries. As shown in the table, authors from the United States of America have published the highest number of articles (127), followed by the United Kingdom (52) and South Korea (21). The table lists only those countries that have published at least two articles at the minimum.

"Insert Table 1 here"

Table 2 shows a list of the top ten journals where most numbers of IT outsourcing articles during the period of 1995 to 2011 were published. The Journal of Information Technology has published the highest number of articles (19) followed by Information & Management (17). Computer Information Systems, the Journal of Management Information Systems and the Journal of Strategic Information Systems have published 12 articles each.

In terms of language, the majority of the IT outsourcing articles are published in English (271; 96.78%) followed by German (8; 2.85%).

"Insert Table 2 here"

Bilateral and Trilateral UIG Relationships Triple Helix Indicators

Figure 3 shows the number of solo and co-authored publications of IT outsourcing articles based on UIG relationships of TH indicators. As shown in the figure, the majority of the articles were

published by universities (250) followed by industry (17), and government (3). Through the years 1996-2001, the university publications remained low i.e. below 10 publications per year. However, the publications by universities have sharply increased during the last decade, reaching to its highest numbers during the year 2008. The possible reasons for the increment might be the fact that during the last decade, IT outsourcing started getting a reception as an accepted management practice in businesses, and researchers by then had started looking at IT outsourcing from wider perspectives like social and strategic. More IT outsourcing publications started addressing client-vendor relationships during the last decade. The decrease indicated in 2011 onward is mainly because the 2011 data was obtained in the mid of the year. The publications by industry and government sectors were low throughout the period under considerations. Similarly, as indicated in figure 3, there are not many co-authored papers by university-industry-government. These results are not surprising because universities are conventionally the sector most interested in publishing their results/studies in ISI indexed outlets.

"Insert Figure 3 here"

"Insert Figure 4 here"

Figure 4 shows the bilateral and tri-literature relations among UIG in terms of co-authorship relations calculated using Triple helix indicators. University-Industry (UI) relations are the strongest but have fluctuated throughout the period under considerations as indicated by the T-values. The UI relations were the lowest during the period 1998-1999 almost reaching no relations at all. The boom period for UI relations was during the years 1999-2003 with the relations reaching its highest point of almost 0.80 Mega bits of information transmission.

University-government (UG) relations were low throughout the period, except during 2003-2006, which showed a slight improvement. Coincidentally, this was the period when UI relations were low. It is clear from figure 4 that trilateral UIG ties were almost non-existent. These relations however, seem to be improving since 2010 as indicated by the negative T-values.

Network Analysis

Country Level Collaboration

"Insert Figure 5 here"

Figure 5 shows the country level collaboration for coauthoring and publishing the IT outsourcing papers. The node represents the degree, which is the total number of coauthored articles published for a country therefore bigger the size of the node higher is the degree. The width of the link between the nodes represents the intensity of collaboration (strength of the tie). In other words, the links between the nodes represent the number of coauthored IT outsourcing articles a country has with other countries. The thicker the link between the nodes (countries), the more coauthored IT outsourcing articles between the two countries has been published. As represented by the bigger node, the USA appears to be a leader in coauthoring more IT outsourcing articles with other countries. Based on the thickness of the link, the USA and UK have the strongest ties followed by the USA and South Korea. The list on the upper left of the figure shows the countries that have not co-authored IT outsourcing articles with other countries.

Table 3 shows a list of countries in terms of their network centrality which is the number of ties a country (node) has. The top three countries with the highest degree of centrality are the USA (16), the UK (12) and Germany (6) respectively. Based on the betweenness centrality that is the extent to which a node lies between other nodes in the network, the top three countries are the

USA (256.667), the UK (194.667) and Australia (80). Similarly the USA (0.132), the UK (0.112) and Germany (0.082) are the top three countries in the Eigenvector centrality, which is a measure of the importance of a node in a network.

"Insert Table 3 here"

Table 4 shows the network level properties of the co-authorship for the IT outsourcing research domain at the country level. The density as shown in the table is the number of actual links divided by the number of possible links, which elucidates that in IT outsourcing research domain, the network is very sparse i.e. only 7.0 % of the total possible links (i.e. co-authorship relations) have been realized. The clustering coefficient that is the degree to which nodes in a network tend to cluster together is 0.30, which is higher than the density of the network. The higher value of clustering coefficient indicates the cliquishness of the network. Countries involved in IT outsourcing research are embedded in dense local neighborhoods (clusters) indicating that co-authorship collaborations are taking place mostly in the form of local neighborhoods with limited ties outside the local neighborhoods, which might be a possible potential yet to be realized.

"Insert Table 4 here"

Institution Level Collaboration

Figure 6 represents the institution-level network in IT outsourcing research domain. It is clear from figure 6 (and table 5) that the American institutions dominate the IT outsourcing research domain. Several clusters formed by different institutions can be observed in figure 6. For example Asian, European, and American clusters are quite visible. In figure 6, the size of the

node (i.e. institute) corresponds to the betweenness centrality of the nodes (it is also shown in terms of numbers in table 5). Betweenness centrality is an important measure of the influence/power of a node in a network. For example, institutes with higher betweenness centrality have a power to control the flow of information in a network and are considered to be important players in a network. Based on the betweenness centrality (which is also the extent to which a node lies between other nodes in the network), the top three institutions are Georgia State University (having a between centrality of 892), University of Pittsburgh (862) and Nanyang Technological University (848). Based on the eigenvector centrality (shown in table 6) which is a measure of the importance of a node in the network, the top three institutions are the University (of) Pittsburgh (0.134), the University of Nevada (0.047) and the University of Minnesota (0.44). These universities are instrumental in connecting the different clusters together. One can also observe some structural holes in the institution level network shown in figure 6. For example, the cluster formed by Korea University and its linking universities is isolated from the rest of the network. Korea University (a key player in its cluster) might play a bridging role in connecting the isolated cluster with rest of the network by forming links with Georgia State University, the University of Pittsburgh, and/or Nanyang Technological University; the key universities in the network. A similar possibility exists for the University of Missouri which is a key player in an isolated cluster. With a close observance of figure 6, one can find several other structure (structural) holes that can be filled strategically by linking different institutes.

"Insert Figure 6 here"

Table 6 shows the list of institutions based on the centrality measures like degree, betweenness and eigenvector. In terms of degree centrality, which is the number of links nodes (institutes) consist, the top three institutions are the University (of) Pittsburgh (10), the University of Missouri (8), MIT (full name) (7), New York State University, Suny Buffalo (7), Korea University (7) and Erasmus University (7) respectively.

"Insert Table 5 here"

Similarly, table 6 shows the network level properties of the IT outsourcing domain. The density of the network (0.028) indicates that the network of institutions is sparse and only 2.8% of the possible network ties has been realized. The clustering coefficient as shown in the table is 0.784 which is higher than the density of the network thus indicating that the institutions involved in IT outsourcing research are embedded in dense clusters with limited ties outside local neighborhoods (clusters). The visual view of clusters can be seen in figure 6. Also the average degree (i.e. the average number of publications) is 3.1 publications. The average geodesic distance (i.e. the average length of the shortest path between two institutes) in the network is 3.6 nodes. Thus, the shortest path between the institutes in the IT outsourcing domain network is by an average of 3.6 institutes.

"Insert Table 6 here"

Region-Level Collaboration

"Insert Figure 7 here"

Figure 7 shows the regional level collaboration network in terms of co-authorship of IT outsourcing articles published. The size of a node represents the degree to which the total

number of IT outsourcing articles has been co-authored for a region. The bigger the size of the node higher is the degree. The width of the link between the nodes represents the strength of the collaboration. Thicker lines represent more collaboration in terms of co-authorships for IT outsourcing articles for a region. From the figure, North America (the USA and Canada only) and Asia have the strongest network ties and they play the central role in the contribution of the IT outsourcing research domain by coauthoring articles with other regions like Europe and the Middle East. There is no collaboration of co-authorship between Europe and the Middle East, though. Also, Africa and South America have not co-authored IT outsourcing articles with other regions.

Trends in IT outsourcing: Burst Detection

Emerging trends in any research domain are of key interest to diverse stakeholders like researchers, funding agencies, industries, librarians and the general public for various reasons such as promising new topics, funding awards, gaining competitive advantages and so forth (Guo, Weingart, & Borner, 2011). One of the approaches to identify the emerging trends in any research domain is through the burst detection algorithm (Kleinberg, 2003).

The burst detection algorithm "employs a probabilistic automaton whose states correspond to the frequencies of individual words and state transitions correspond to points in time around which the frequency of the world changes significantly. Given a set of time stamped text, e.g., abstracts and publication years of the papers, the algorithm identifies those abstract words that experience a sudden increase in usage frequency and outputs a list of these words together with the beginning and ending of the burst and the burst strength that indicates the change in usage frequency" (Guo et al., 2011, p.422- 423). Researchers Chen (2006); Chen et al. (2009); Guo et

al. (2011); Mane and Borner (2004) have applied the burst detection algorithm to identify the emerging trends on their research domain.

In this study, Kleinberg's burst detection algorithm (Kleinberg, 2003) embedded in Sci2 tool (Sci2Team, 2009) is used to identify sudden increases in the frequency of certain words/terms (i.e. burst detection). Due to the case sensitive nature of the algorithm, the data were first normalized by removing a common set of stop words. Multiple whitespaces were reduced to just one space, leading and trailing whitespace were completely removed, and all the words were lowercased.

The burst detection algorithm is applied to the keywords appearing in the titles of the 288 IT outsourcing articles published during the period of 1995 to 2011 obtained from the Web of Science database. The words in the titles of the publications tend to convey more meanings and are useful in understanding general trends related to a field (Leydesdorff, 2006).

Table 7 shows the forty burst words of the highest weight sorted by year of appearance. The length of the burst is the period of the burst measured in the number of years (generated based on (Start - End + 1)). For example, the term "firm" has a length of 2 years i.e. which indicates a sudden increase in the frequency of the word "firm" in 2008 and 2009 in the abstracts of the articles. The weight in the table represents the weight of the burst word between its lengths. The higher weight could be the result of the longer length, the higher frequency, or both. The burst words without the ending year are for those intervals which extend to the most recent publications, suggesting terms that are in the middle of a large-weight burst at present (Kleinberg, 2003).

In 2008, more words are bursting than in any other years, but surprisingly, there are no bursting words in the years 2010 and 2011. Between 2006 and 2009, more words are bursting than in any

other period. In term of burst length, the words “strategies” and “source” have the highest length of eight and seven with the end dates of 2002 and 2003 respectively. The words like “business”, “agreement” and “learn” have lengths of six and four each respectively, without the end date, which implies that these words are still of interest to the researchers.

“Insert Table 7 here”

Discussion and Conclusion

Employing the Social Network Analysis and TH model, this study has tried to examine and understand the IT outsourcing research domain in terms of the scientific publications (i.e. the final product/outcome of the scientific collaborations). Scientific publications are considered direct indicators of the existence of the collaboration (and knowledge exchange) among researchers (Savanur & Srikanth, 2010). One way to measure the exchange or transfer of knowledge (or research collaboration) is through co-authorship referring to working collaboratively on a research project involving close interactions and participation. Even though co-authorship is a contested concept, as it is difficult to judge the level of contribution by co-authors (Kartz & Martin, 1997), it is nonetheless considered a direct indicator of the existence of the collaboration (and knowledge exchange) among researchers (Savanur & Srikanth, 2010). In this regard, this study has tried to explain the collaboration of knowledge sharing in the IT outsourcing research domain.

The social network and triple helix analysis of academia, industry and government in the IT outsourcing research domain has demonstrated several key findings which are discussed here. Publications of IT outsourcing research articles have been increasing since 1999 indicating its

importance in academia. Country level analysis shows more than 44% of the IT outsourcing research articles have been published from the USA alone referring to the central role it is playing in terms of collaborating and co-authoring the IT outsourcing research with other countries. The USA and UK together account for more than 62% of the total published IT outsourcing articles. Most of the IT outsourcing articles published are co-authored between the USA and UK followed by the USA and South Korea indicating the strongest inter-regional ties in the IT outsourcing research domain. On the contrary, a further analysis shows that there is a lack of co-authorship collaboration between developed and developing countries, which might have disrupted a flow of knowledge from the developed to the developing countries. Analysis of country level collaboration shows that there are lots of unexplored potentials for the co-authorship at the country level. In terms of institutional level collaboration, several region and country based clusters are identified. Some of the visible clusters are formed by regional institutes. Several isolated clusters and structure holes that can be filled strategically are also identified which could help IT outsourcing knowledge infrastructure to be more efficient in terms of knowledge flow among different institutions. For example, Korea University and the University of Missouri have the potential to fill the structure holes in the network by forming co-authorship relations with Georgia State University, the University of Pittsburgh, and/or Nanyang Technological University, which are the key universities in the network.

Looking at the regional level collaboration, North America and Asia have the strongest ties for IT outsourcing research. Interestingly, the Middle East has ties with North America and Asia, but not with Europe. And also Africa and South America do not have ties with any of the regions, which may be due to the fact that these regions don't have many IT outsourcing publications. Beside Asia, most of the African and South American countries are developing nations; therefore,

a lack of ties might limit the transfer of knowledge from the developed to these developing countries. More collaboration for the research should be encouraged between the developed and the developing countries so that the proper transfer of knowledge takes place and the organizations in the developing countries could refer their own findings and practices for IT outsourcing. However, there might be other reasons for the holes found in the collaboration network (e.g. lack of collaboration among developed and developing regions and prominence of publications from some selected countries). For instance, the central role played by the USA and UK might be due to the use of only ISI indexed English language in this study. Nevertheless, even the absence of ISI indexed publications by some regions and countries indicate a lack of credible research presence in these regions and countries, particularly the developing countries and regions. Often ISI indexed research is considered an indicator of quality among the research community.

These findings are helpful in understanding research collaboration in the IT outsourcing domain at the country, regional, and institutional levels. Research collaboration is an important element in a knowledge-based society with knowledge being the main source of economic power in today's world. The more knowledge that is produced and shared, the greater the power it holds (as in terms of new knowledge creation). For instance (Hausmann et al., 2011) argues that the amount of knowledge embedded in a society depends upon the knowledge across the individuals and their ability to combine the knowledge making use of it through interactions but not on how much knowledge each individual holds. In this sense, research collaboration is instrumental in bridging the remote knowledge held by different individuals/institutions to create new knowledge (e.g. joint publications). Knowledge exchange in form of research collaboration have several advantages, such as, greater output and higher research quality, sharing of research

facilities, and obtaining knowledge and expertise from collaborators (Beaver, 2001; Frame & Caprenter, 1979).

There are certain limitations in this study that provide opportunities for future research. This study does not shed light on the dynamics behind the scientific collaboration network. For example, the approach used in this study, does not shed light on the influence/power of the editorial board, reviewers, and the organization in which research is carried out on the flow and dissemination of scientific outcomes (i.e. publications). Therefore, future research needs to shed light on dynamics behind the scientific collaboration network.

This study uses only 288 ISI indexed journals for the analysis purpose. There might be many other journals and publications that have published IT outsourcing articles. Future research can analyze the triple helix of IT outsourcing research with a wider range of consideration of non-indexed journals and publications. This study covers the publications since 1995 for the analysis due to the Kodak effect. There are some articles on IT outsourcing published before 1995 too; therefore, future research can be carried out within the scope of longer time frame. This study tried to understand the IT outsourcing research domain in terms of the scientific publications (i.e. the final product/outcome of the scientific collaborations). Even though scientific publications are considered direct indicators of the existence of the collaboration and knowledge exchange among researchers (Savanur & Srikanth, 2010), they do not shed light on the dynamics behind the scientific collaboration network. For example, the approach used in the study does not shed light on the influence/power of the editorial board, reviewers, and the organization in which research is carried out on the flow and dissemination of scientific outcomes (i.e. publications).

Future research can also examine why some countries/regions/institutions publish more frequently together than others, the possible consequences (positive or negative) of unbalanced

co-authorship relations and, how these co-authorship relations are formed and change over the time.

This study for the first time has applied the mixed method as suggested by (Khan & Park, 2011) to the IT outsourcing research domain. This study proves that the mixed method is useful in understanding certain hidden structures of the area under study. It also provides insights into the IT outsourcing domain from network point of view which helps researchers and policy makers to understand the hidden structures and characteristics of the IT outsourcing research domain which might not be visible otherwise.

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Table 1: Number of articles published by country

Country	N	%
USA	127	44.09
UK	52	18.05
South Korea	21	7.29
Germany	18	6.25
Canada	15	5.2
China	12	4.16
Netherlands	9	3.12
Australia/ Norway/ Singapore	8	2.77
Taiwan	7	2.43
India/ Spain	5	1.73
France	4	1.38
Turkey	3	1.04
Italy/ Sweden	2	0.69

Table 2: Number of articles published by journal

Journal	N	%
Journal of Information Technology	19	6.59
Information & Management	17	5.9
Journal of Computer Information Systems/ Journal of Management Information Systems/ Journal of Strategic Information Systems	12	4.16
Industrial Management Data Systems	11	3.81
International Journal of Information Management	10	3.47
MIS Quarterly/ Wirtschaftsinformatik	9	3.12
European Journal of Information systems/ Information System Frontiers/ Information Systems Management/ Information Systems Research/ MIS Quarterly Executive	7	2.43
Sloan Management Review/ Decision Sciences	5	1.73
European Journal of Operational Research/ Information Systems Journal	4	1.38
Computers Operations Research/ Harvard Business Review/ International Journal of Production Economics/ Journal of Global Information Management/ Journal of Global Information Technology Management/ Lecture Notes in Computer Science	3	1.04

Table 3: Countries in terms of network centrality

Country	Degree	Betweenness Centrality	Eigenvector
USA	16	256.667	0.132
UK	12	194.667	0.112
Germany	6	3.333	0.082
China	5	44.000	0.045
Spain	4	0.000	0.065
Italy	4	0.000	0.065
Netherlands	4	8.667	0.059
Canada	4	17.000	0.055
Singapore	3	5.667	0.047
Taiwan	3	2.000	0.038
Greece	3	0.000	0.054
South Korea	3	0.000	0.039
Sweden	2	42.000	0.003
India	2	0.000	0.041
France	2	0.000	0.029
Australia	2	80.000	0.019
Thailand	1	0.000	0.022
Portugal	1	0.000	0.019
UAE	1	0.000	0.008
Japan	1	0.000	0.022
Israel	1	0.000	0.022
Ireland	1	0.000	0.001
Norway	1	0.000	0.000
Finland	1	0.000	0.000

Table 4: Network level properties of co-authorship at the country level

No. of link	**No. of nodes**	**Density**	**Clustering coefficient**	**Average degree**	**Average Geodesic Distance**
84	34	0.07	0.30	3.1	2.2

Table 5: Institutes in terms of network centrality

Institute	Betweenness	Degree	Eigenvector
Georgia State University	892.000	5	0.003
University of Pittsburgh	862.000	10	0.134
Nanyang Technological University	848.000	3	0.009
University of Minnesota	828.000	4	0.044
Florida Atlantic University	476.000	4	0.033
University of Nevada	420.000	5	0.047
MIT	360.000	7	0.005
Concordia University	298.000	6	0.001
New York State University, Suny Buffalo	228.000	7	0.015
Salisbury University	228.000	6	0.016
McGill University	156.000	4	0.001
University of Missouri	88.333	8	0.000
Korea University	84.000	7	0.000
Sogang University	72.000	5	0.014
University of Arizona	72.000	4	0.015
Erasmus University	67.667	7	0.000
Kookmin University	56.000	3	0.000
University of Nebraska	48.000	3	0.000

Table 6: Network level properties at the institution level

No. of link	No. of nodes	Density	Clustering coefficient	Average degree	Average Geodesic Distance
364	115	0.028	0.784	3.1	3.6

Table 7: Burst words in the titles of the articles

Word	Weight	Length	Start	End
role	1.5	3	2009	
vendor	1.8	3	2009	
risk	1.6	1	2009	2009
empirical	2.9	3	2009	
firm	1.9	2	2008	2009
learn	2.1	4	2008	
level	2.0	2	2008	2009
agreement	1.6	4	2008	
trust	2.8	1	2008	2008
commitment	1.7	1	2008	2008
control	2.1	1	2008	2008
develop	1.7	2	2007	2008
offshore	3.8	2	2007	2008
process	1.6	2	2007	2008
impact	1.5	3	2007	2009
business	1.5	6	2006	
market	2.0	2	2006	2007
culture	2.1	3	2006	2008
versus	2.2	2	2005	2006
understand	1.7	4	2005	2008
factor	2.1	3	2005	2007
application	1.6	5	2004	2008
contract	2.0	2	2004	2005
perspective	2.1	2	2002	2003
success	2.0	4	2001	2004
provider	2.1	4	2001	2004
healthcare	1.5	4	2001	2004
explore	2.4	4	2000	2003
decision	1.9	2	1999	2000
relationship	1.6	5	1999	2003
analyze	2.6	2	1999	2000
risk	2.4	2	1998	1999
mitigate	1.8	2	1998	1999
supplier	2.3	6	1998	2003
source	3.0	7	1997	2003

case	2.3	3	1997	1999
system	3.8	3	1995	1997
practice	1.9	6	1995	2000
framework	1.8	6	1995	2000
strategies	2.5	8	1995	2002

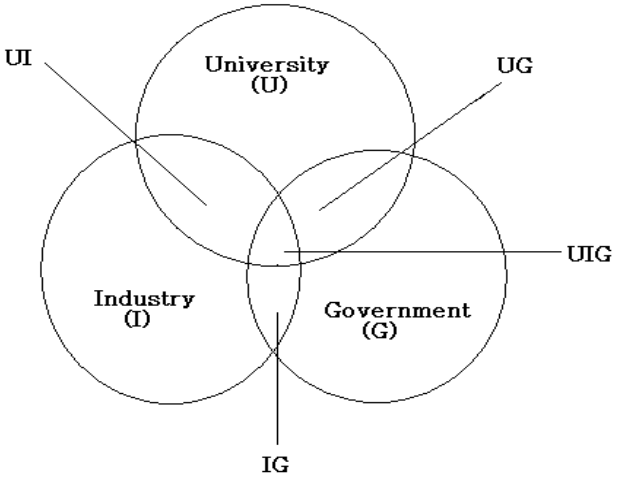

Figure 1: Triple helix model

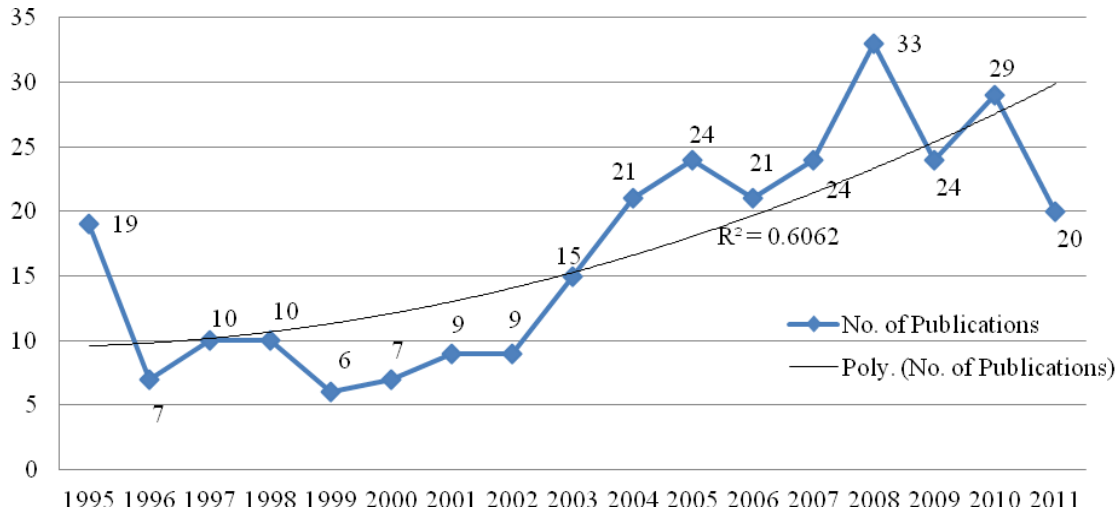

Figure 2: Number of articles published by year

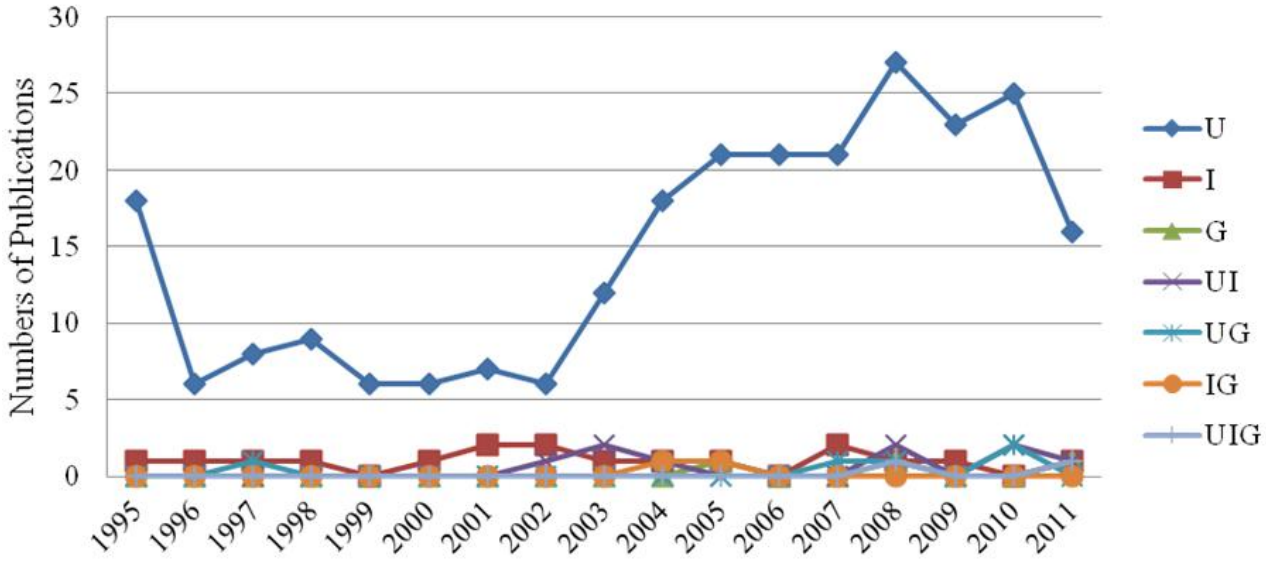

Figure 3: Number of solo and co-authored publications by UIG

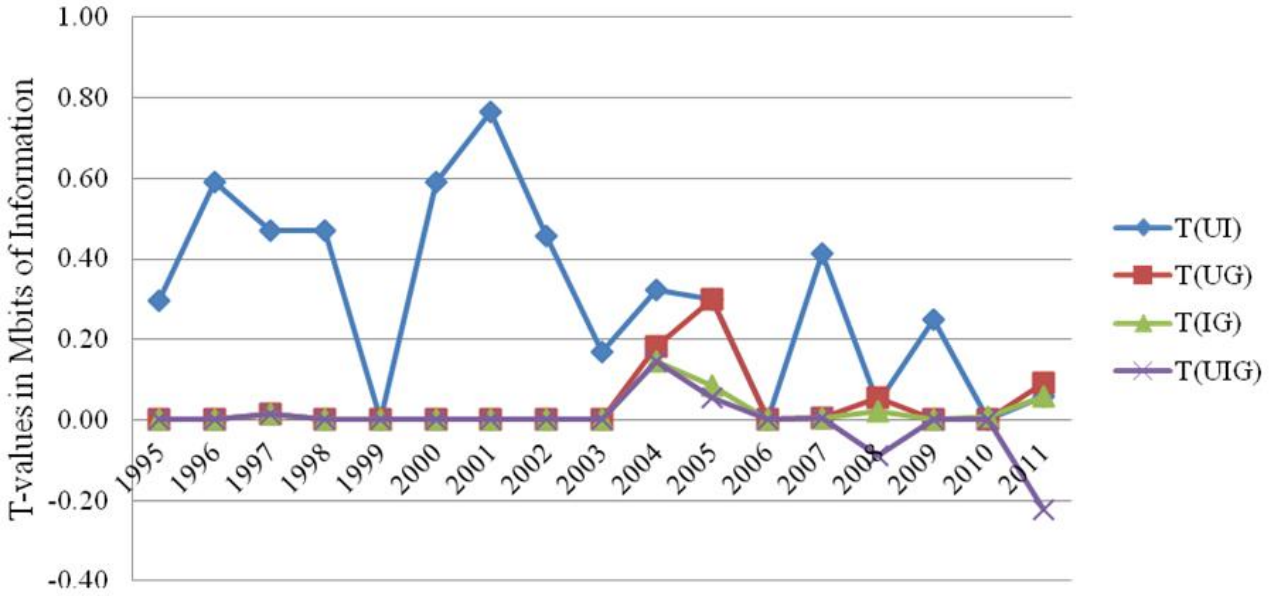

Figure 4: Longitudinal trends in the bilateral and trilateral UIG relationships in the IT outsourcing research domain

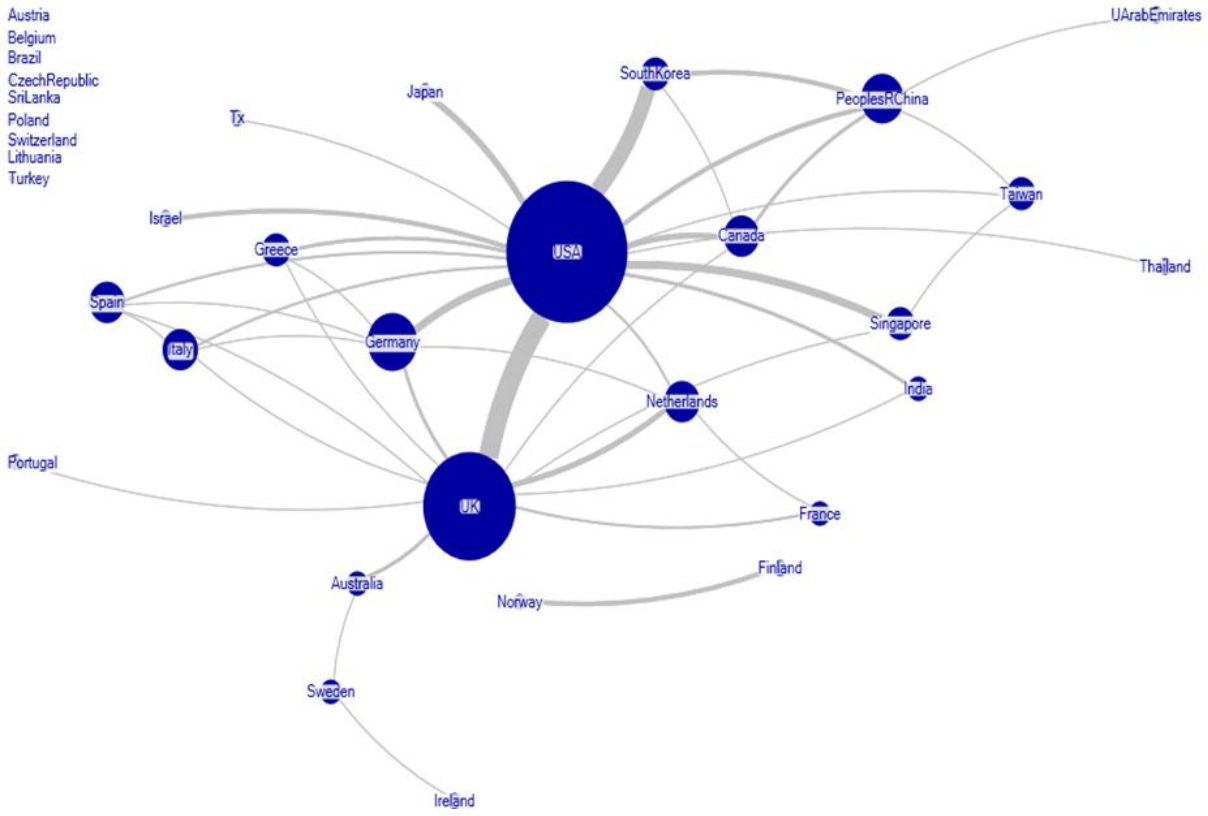

Figure 5: Country level collaboration for co-authorship

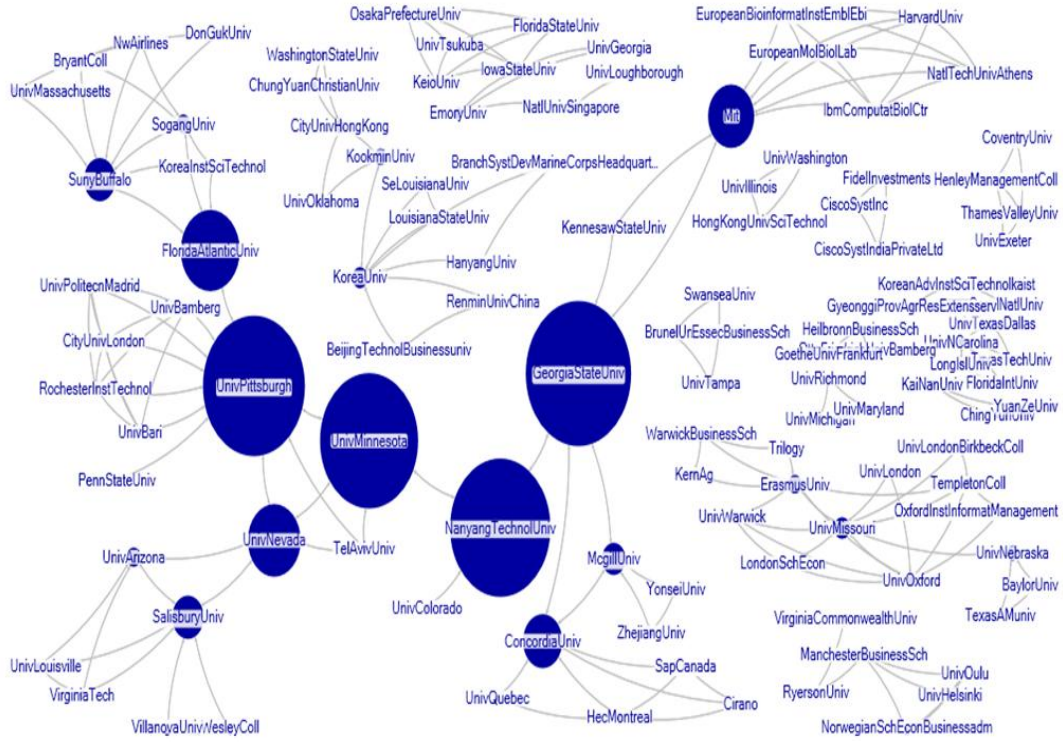

Figure 6: Institution level collaboration network (size of the node corresponds to the betweenness of the node i.e. bigger the size higher the betweenness)

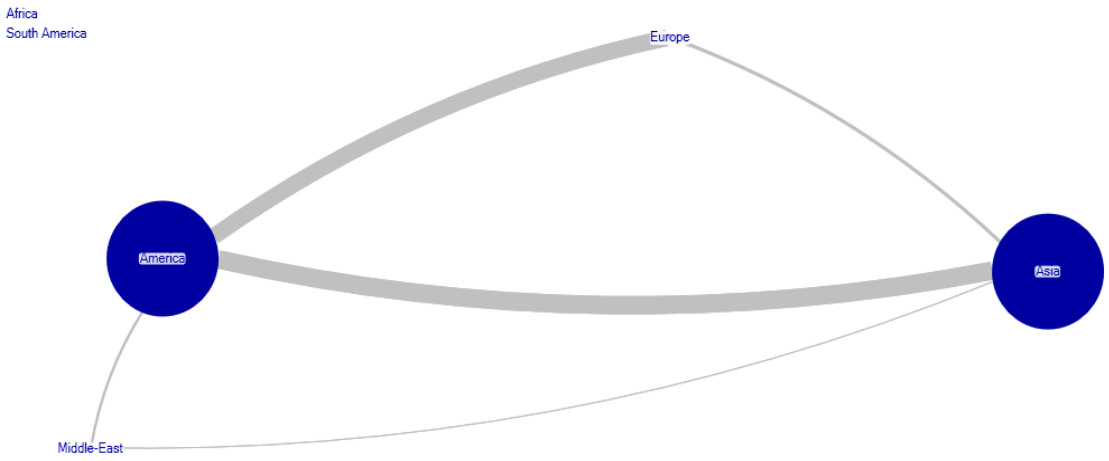

Figure 7: Regional level collaboration network