

# Communities of Practice for Inter-organizational Knowledge Management: An Empirical Study

Sujata N Gamage

*LIRNEasia, Sri Lanka, sujata@lirneasa.net*

## ABSTRACT

Facilitating communities of practice for knowledge sharing and application is a goal pursued by knowledge managers, intra-organizational or inter-organizational. One major short-coming in the CoP literature is the lack of attention paid to power relations. The term communities of practice (CoPs) invoke the notion of peers sharing knowledge as equals. In actual practice, power relations within a community or between a community and its external actors can determine the nature and the efficacy of a CoP. In this study, we apply social network analysis to illuminate the nature of power relations in communities of practice in a particular inter-organizational context. The organizations concerned are the 217 local authorities in six selected provinces in Sri Lanka and the actors are the solid waste managers in each. Social network analysis is combined with a multi-level multi-theoretical analysis to understand the factors driving the apparent self-organization of this community of practitioners as hubs and nodes.

**Keywords:** Communities of Practice, Social Network Analysis, Knowledge Management, Inter-Organizational Knowledge Management

## I. INTRODUCTION

As early as 1998, Harvard Business School published a review on knowledge management or KM (Harvard, 1998). Foray (2004) in his book titled *Economics of Knowledge* devotes a chapter to knowledge management identifying KM as a new organizational capability. The nature of the knowledge to be managed may elude an exact definition but there is general consensus that knowledge is different from information. In some definitions, knowledge is positioned at the higher end of a signal-data-information-knowledge continuum. In other, knowledge is seen as the ability to extract information out of signals or data. In practice, knowledge management involves both the management of (a) data and information processing capacity and (b) the creative and innovative capacity of human beings

in an organization (Jayam et al., 2007), with increasing attention paid to the human aspect.

Knowledge management literature is also largely about applications in organizational settings in the corporate sector. Knowledge Management at a sectoral or inter-organizational level is less well defined but is increasingly understood to be critical. Just as managers in organizations would be concerned about making the most of their knowledge assets, policy makers at sectoral level too would be concerned about the state of the knowledge assets in their respective sectors. A government agency promoting a particular trade such as the export of fruit and vegetables, an association of local government authorities promoting local governance or an intergovernmental agency such as the World Bank desiring to improve access to ICTs in developing countries understand only too well the need to cross organizational boundaries to get the best available knowledge to those who need it most.

## A. Communities of Practice

The term Communities of Practice (CoPs) was first used by Jean Lave and Etienne Wenger in their explorations on *Situated Learning* in 1991. Communities of practice (CoPs) are groups of people who share a concern for something they do and learn how to do it better as they interact regularly. Early COP theory was formulated as part of situated learning theory and highlighted the importance of addressing issues of social context and unequal power relations, but, as Fox (2000) and Contu and Wilmott (2003) argue, the literature on CoP has failed to achieve that. Wenger (2000) looks at structural features of CoPs and identifies enterprise, mutuality and a shared repertoire of knowledge as features of a CoP but fails to note any asymmetry in relationships among the practitioners in these communities. In fact, the features identified by Wenger point to a community of equals. There are attempts in more recent literature to understand power relations in CoPs, e.g., in the context of a multinational corporation (Borzillo and Kaminska-Labbé, 2011) and innovation in

the medical sector (Mørk, 2010). Probst and Borzillo (2008) identified the role of a leader/s in a CoP and Mørk (2010) looks at dynamics of changing leadership in a CoP. Contu and Wilmott (2003), Fox (2000) and later Heizmann (2011) too have attempted to understand power relations in CoPs but from a more theoretical perspective. To our knowledge there are very few empirical studies that capture the power relations in a more quantitative manner. Social Network Analysis (SNA) seems ideally suited to study Communities of Practice but the few academic papers on the topic are limited to the use of SNA tools for tracking and monitoring CoPs (e.g. Cross et al., 2006). In the present study, we focus on knowledge sharing patterns of a community of practitioners in solid waste management in local government in Sri Lanka not only to track and improve their performance, but, also to understand the theoretical underpinnings, if any, for their knowledge sharing behavior. We use SNA tools within a Multi-Level, Multi-theoretical approach proposed by Contractor and Monge (2003).

## II. METHOD

There are 335 local government authorities (LGAs) spread across 9 provinces in Sri Lanka. During the period October 2009 to January 2010, we surveyed solid waste (SW) managers in the 217 LGAs in 6 out of the 9 provinces. The survey questionnaire asked, among other things, “Who did you contact in the last 12 months to seek information you needed to improve your practice?” If each manager is considered a node in a possible network of managers, the connectedness of each manager is the number of incoming links to him or her, where an incoming link is the number of other managers seeking her/his advice on solid waste management related issues. These incoming links were coded as Government, University, Industry, Civil-society, Peer (local) or International, depending on the organizational affiliation of the manager seeking knowledge. The set of knowledge-seeking (K-S) linkages constituted the input for (a) visualizing and describing the knowledge-seeking behavior among SW managers through SNA tools such as NodeXL or Cytoscape programs and (b) explaining the knowledge-seeking behavior through the “multi-level multi-theoretical” approach proposed by Contractor and Monge (C&M).

A particular network pattern that emerges from a given set of linkages is termed a ‘realization’ of the network. While SNA tools allow one to visualize and describe an emergent realization, they don’t tell us why one particular configuration emerged out of the set of all possible configurations. C&M propose four levels of analysis - node level, dyad level, group or clique levels and the network as a whole.

For each level they identify endogenous and exogenous variables that determine the form or the realization of a network. Endogenous variables such as node centrality and network density at time  $t$ , for example, are expected to determine the realization at time  $t+1$ .

Exogenous variables are characteristics of the nodes, groups of nodes or the full set of nodes. C&M give a set of social theories that can be used by an analyst as a checklist in identifying relevant variables. The theories as summarized by them are: (1) theories of Self-interest v. Collective Action (2) Contagion, Semantic and Cognitive theories (3) Exchange and Dependency Theories (4) Homophily, Proximity and Social Support theories and (5) Evolutionary and co-evolutionary theories.

Together, endogenous and exogenous properties determine the emergent character of a network. The attachment of an incoming node to the existing network is determined by the characteristic of the individual nodes in the network, the characteristics of the network as a whole or the propensity of the incoming node and/or the existing networked nodes to act in self-interest or collective action, for example.

Contractor and Monge use a statistical/computational tool called  $p^*$  analysis to estimate the likelihood of a given set of independent variables, both endogenous and exogenous, to contribute to the realization of a network.

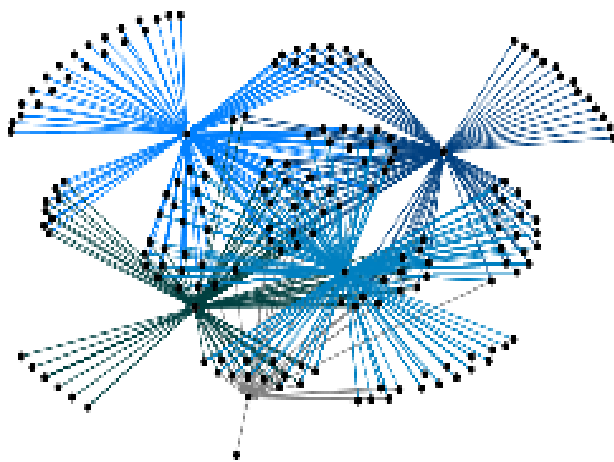
In the present study we use a more qualitative approach. Based on preliminary observations, we hypothesize that a SW manager seeking knowledge would (a) seek out and preferentially attach to other SW managers who exhibit a high degree of centrality, but, (b) also seek out SW managers who are geographically proximate to them if such managers are known to be knowledgeable about the SW management.

Part (a) is about preferential attachment driven by variables endogenous to the network –i.e. centrality. Part (b) is about preferential attachment drive by variable exogenous to the network -i.e. the proximity of others in the network. In place of the computer modeling exercise proposed by C&M we first use SNA tools to visualize the network and examine the endogenous and exogenous components separately. In the conclusion we try to bring the components together.

The number of K-S interactions or the quality of the interactions was not differentiated in the analysis because (a) it was difficult to get good data for either and (b) the limited data set was sufficient for the qualitative approach to be used in the study.

### III. RESULTS AND DISCUSSION

Of the 217 managers surveyed, 174 in all reported 614 linkages to knowledge sources. The black dots in Figure 1 (with the exception of dots with 3 or more lines pointing towards them) depicts the 174 knowledge seeking local authorities.



**Figure 1. Knowledge-seeking interactions of a community of solid waste managers in Sri Lanka, Oct 2009-Jan 2010**

The lines depict the links between knowledge seeker local authorities and five knowledge giver hubs (or dots with 3 or more links to them). The five hubs represent: (1) central government, 39% of the links (at bottom right) (2) peers, 29% (top left) (3) provincial government, 7% (bottom left) (4) university, 6% (bottom most hub) and (5) others such as local non-governmental

organizations (NGOs) and international NGOs or intergovernmental organizations, 18% (top right).

#### A. Preferential Attachment driven by Centrality, an endogenous variable

In this section we take a closer look at the category of ‘Peer Solid Waste Managers’ as knowledge givers.

Out of the 217 managers in the study 126 engaged in knowledge-based interactions with their peers. Of these, 34 were both givers and seekers and 63 were seekers only. The remaining 29 SW managers were knowledge-givers only.

Focusing on knowledge-givers, the highest number of knowledge-seeking (K-S) linkages per node was shown by the manager at the Balangoda Urban council (UC) at 40 K-S linkages. Essentially 40 of his peers cited him as somebody from whom they sought knowledge regarding solid waste management. The second highest number of 24 K-S linkages per node is found for the manager at the Weligama UC. The third highest number of 8 linkages was shown by the Negombo Municipal Council (MC). The remainder of the distribution is detailed in Table 1 and plotted in Figure 2.

**Table 1: Distribution of the ‘number of linkages per nodes’ among 63 nodes with 171 linkages**

Linkages per Nodes	Number of Nodes	Number of Linkages
40	1	40
24	1	24
8	1	8
7	2	14
4	2	8
3	4	12
2	13	26
1	39	39
All	63	171

The distribution of linkages shows a few nodes with many linkages and many nodes with few linkages characteristics of ‘self-organization with preferential attachment’ (Barbasi, 2002). Preferential attachment occurs when a new incoming node decides to link to a better linked node (or a more reputable one) over a lesser linked node.

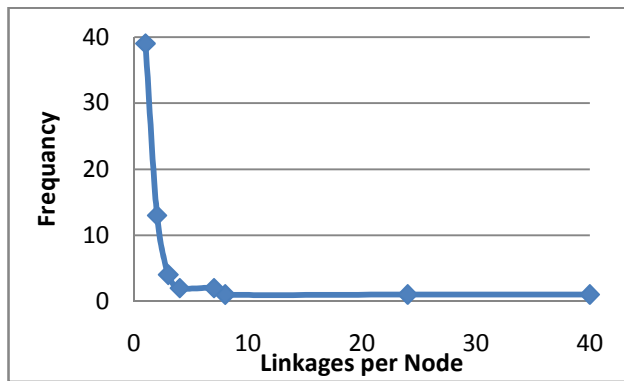


Figure 2. The ‘Frequency of Number of Linkages per Node’ against the ‘Number of Linkages per Node’ for a community of solid waste managers in Sri Lanka, Oct 2009-Jan 2010

The distribution plot in Figure 2 further illustrates the phenomena of preferential attachment driven by the centrality attribute or the rich get richer attribute of the community of SW Managers.

### B. Preferential attachment driven by proximity, an exogenous variable

Network centrality based preferential attachment can explain the occurrence of hubs among a set of networked nodes, but, one is left in the dark as to why the network takes the form it does. Why do some nodes become hubs and why do we have one hub with 24 linkages but the next hub has only 8 linkages as in Table 1? What would be the form of the network, say, in another year? How would external factors affect the network.

The list of possible endogenous factors identified by C&M can provide some guidance here.

There are nine provinces in Sri Lanka. Our data collection captured the full universe of knowledge-seeking/giving behavior of solid waste managers at each of local authorities in 6 provinces. Using the list of factors as a checklist to look for patterns in the linkages among SW managers we noted that the theory of proximity may be applicable to the SW manager community in question. SW managers in the survey preferentially attach to others who are more central to the network but they also seem to prefer peers from within their province. For example, 62% of all interactions in the community are between peers from the same province (4<sup>th</sup> row, Table 2). Further, we label all solid waste managers who were cited as

knowledge sources by more than 3 or more as peers with high centrality. Where a peer of high overall centrality (or national prominence) is concerned, a knowledge-seeking SW manager may not care whether the knowledge-giver is from one’s own province or another province because the percentage distributions of high centrality knowledge-givers is essentially independent of proximity (Table 2, row 2: Own Province, 29% and Other Province, 33%). However, knowledge-seeking SW managers seem to seek out peers from their own province even if they are of low centrality, because 33% of all knowledge-seeking is from peers of low centrality but from own province (Row 3). At 5%, peers with low centrality and from other provinces at 5% are not a significant group.

Table 2: Percentage Distribution of 171 Peer-to-Peer Knowledge-seeking linkages across type of province and type of peer

	Own Province	Other Province
Peer (of High Centrality)	29%	33%
Peer (of Low Centrality)	33%	5%
ALL Peers	62%	38%

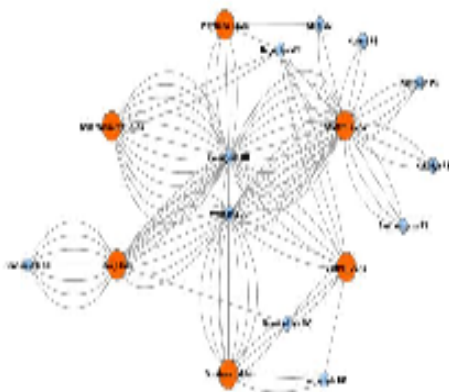
### C. Improved Visualization of a Community of Practice

Previous sections show how centrality and geographic proximity both determine the form of the realized network. In this section we combine the two observations to visualize the network better in order to make recommendations for managing knowledge across the local authorities.

We labeled SW managers with high centrality as such and named them after the local authority to which they belong. All other managers were named after the province to which their local authority belonged and the linkages map was redrawn using the NodeXL program. The derived network is shown in Figure 3.

In Figure 3, orange dots denote the 6 provinces. Blue dots denote the SW managers with high centrality. All other SW managers - whether they are knowledge seekers or givers - are placed out of sight inside the orange dots according to the province to which they belong, essentially separating the major centrality effects from the proximity effects.

Balangoda UC and the Weligama UC appear as two inter-provincial or national hubs in the center of the figure. The 12 lines connecting Balangoda UC, for example, to the orange dot on the upper left represents the solid waste managers from 12 local authorities in the Sabaragamuwa Province seeking knowledge from the solid waste manager at the Balangoda UC. Other lines connecting Balangoda UC to other orange dots represent the number of managers from each province seeking knowledge from the Manager at the Balangoda UC. The diagram clearly shows that managers at Balangoda and Weligama UC are sought out by all six provinces under consideration and hence can be termed national knowledge sources. The other nine blue dots are more limited in their scope. For example, the Negombo MC, the left-most blue dot on the top right hand corner of Figure 3, has received 8 requests in total from four of the six provinces.



**FIGURE 3. Knowledge-based interactions between knowledge-giver local authorities (small, blue) and all other local authorities clustered by their provincial affiliation (large, orange)**

#### IV. IMPLICATIONS

The term community of practice invokes the notion of a more or less flat network of interactions between peer practitioners. Our empirical study clearly points to the presence of self-organizing properties and a resulting hub and nodes scenario among solid waste managers in 6 provinces in Sri Lanka. To our knowledge, our study is the first to present empirical/quantitative evidence for self-organizing properties in a community of practice. The present study also extends the communities of practice concept to the public sector in a more systematic manner than hitherto attempted (e.g. Keen et al., 2006).

From a practical point of view, this kind of analysis points the way to a more systematic application of communities of practice concept in inter-organizational knowledge management.

Firstly, collecting data on the actual knowledge seeking and giving information among a community of practitioners and applying SNA tools to the data gives a true picture of an inter-organizational community.

Secondly, investigating the theoretical underpinnings of the network leads to improved visualization as in Figure 3. In fact the Figure 3 has been influential in convincing policymakers to support the establishment of a Solid Waste Management Training Center at the Balangoda UC as a nationally recognized center.

Thirdly, the observations in this study point to the applicability of the multi-level-multi-theoretical approach proposed by Contractor and Monge to analyze communities of practice. Our plans for future work involve a p\* analysis of the network (as proposed and detailed by Contractor and Monge (2003)), to corroborate the centrality and proximity effects that we elucidated using trial and error method and to elucidate additional factors.

In a longitudinal case study of communities of practice in Alpha Chemicals, Borzillo and Kaminska-Labbé (2011) posit the value of “conceptualizing CoPs as complex adaptive systems with emergent and intentional processes coexisting to create a virtual knowledge creation cycle”.

In the present study we only considered emergent properties in the knowledge-based interactions among solid waste managers in Sri Lanka. How much of that is emergent and how much of that is intentional we have not examined. Future modeling exercises can take into account additional intentional-process variables such as external initiatives to bring together practitioners.

Another interesting question to explore is how the form or the realization of a network affects its functions.

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