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NETWORK ENGINEERING FOR C-COMMERCE INNOVATION: THE ROLE OF TRUST

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ABSTRACT

The idea that social networks play an important role in knowledge diffusion of innovation has a long pedigree in innovation theory. In his Diffusion of Innovation (DOI) theory, Rogers (1995) argued that in the information network of the organization, managerial champions and opinion leaders could affect both organizational acceptance and also the velocity of adoption of innovation. In Small to Medium Enterprise (SME) C-commerce innovation, the role of such social factors has been understood in terms of 'embedded network structure' (Braun, 2003) that impacts on clustering behavior. This article explores the use of quantitative Social Network Analysis (SNA) to model the nature and consequences of relations based on trust in a Small to Medium Size Tourism Enterprise (SMTE) C-commerce innovation case study context.

KEYWORDS

C-Commerce, Knowledge Networks, Social Network Analysis, Knowledge Management, Trust

1. INTRODUCTION: C-COMMERCE INNOVATION, KNOWLEDGE AND LEARNING

A substantial literature exists that emphasizes the importance of clustering, networking and community building for E-commerce innovation (Braun, 2003; McGrath and More, 2002; Rowe, 2004; Nodder et al. 2003). Within this literature, the need for access to local explicit and tacit knowledge networks (Keeble & Wilkinson, 2000) is seen an important CSF in clustering. Domain relevant learning about Web strategy and the benefits of co-operative competition provides a basis for overcoming domain actors' parochial views. In practice, as Braun (2003) notes, knowledge diffusion of good practices in E-commerce and the benefits of C-commerce are more likely to fall victim to an embedded culture of competition and autonomy. Information and knowledge externality also work to frustrate knowledge diffusion of good practice and to inhibit clustering.

This situation is by no means unique to C-commerce innovation. In the wider context of Communications and Information Technology (CIT) innovation, market externalities also work against user acceptance of innovation. For example, an *information* externality might lead the market to reject superior innovation, in favor of established inferior technology. According to Li (2004) IT markets display behavior characteristic of information externality such as *herding,* where IT managers follow the adoption decisions of others and often ignoring their private information:

Herd behavior may arise because of informational cascades, which occur when rational individuals ignore their private information and instead mimic the actions of previous decision makers. Basic cascade models have been tested in laboratory experiments. Empirical evidence of informational cascades has been documented in the realms of financial investment, emerging technology adoption, animal mating behavior, and television programming. In the world of IT, such behavior results in adoption herding. In the uncertain business world, IT managers must independently make technology adoption decisions with incomplete information. In many cases, such decisions are difficult to reverse because of significant technology switching costs. These costs could easily exceed the price of the technology itself when technology adopters have such sunk costs as learning, file creation, and the development or purchase of extrinsic complementary systems.

(Li, 2004, p.93)

Work on information externalities suggests a maturing literature on the role of human and social capital in IT adoption decision making. While the idea of information externality is inherited from economics, from sociology and anthropology come understanding based on the role of *social capital* enjoyed by individuals, the information and knowledge networks of which they are part, and how both combine to determine IT adoption outcomes. As we have noted, the past five years has seen the beginnings of application of these ideas to other innovation contexts, including C-commerce type clustering. Important questions for E-business strategists concern that nature of methods and their value for understanding and shaping C-commerce clustering. In order to answer these questions, the nature of social capital and its role in innovation needs to be clearly understood.

2. FOUNDATIONS OF A SOCIAL CAPITAL INTERPRETATION OF IT ADOPTION

In his Diffusion of Innovation (DOI) Theory, Rogers (2003) argued that the adoption of an innovation is an action facilitated, firstly, by the extent to which the innovation is perceived to generate benefits that outweigh costs (ibid, p.164) and, secondly, as a consequence of the creation of critical mass (ibid, p.157). Critical mass "occurs at the point at which enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self- sustaining" (ibid).

How does critical mass come about? In CIT, exogenous factors such as CIT enabling infrastructure, demand pull and process innovation loom large in the journey to critical mass. But a variety of endogenous factors, some social in character have also been identified. In essence, on the supply side, social and knowledge capital must work to produce a critical mass of human capital committed to innovation adoption. Rogers (2003) and Coleman (2003) see endogenous social factors such as knowledge and learning, normative beliefs and opinion leadership playing a decisive role. Thus, adoption of innovation is partly a social phenomenon, where "in deciding whether or not to adopt an innovation, individuals depend mainly on the communicated experience of others like themselves" (Rogers, 2003, p.149).

This 'communicated experience' need not be grounded in rational judgments, but can be influenced by beliefs systems and other social and even anthropological phenomena. For example, the depiction of Apple's iPhone after its release in mid 2007 as the 'personal communicator for the Apple cult' is suggestive of an almost tribal or anthropological type response to an innovative technology.

A conclusion from this discussion is that successful innovation may involve the astute management of social factors, as well as the more familiar processes that go with technological innovation. But the repertoire of knowledge that E-commerce strategists and other professionals have to draw upon in the application of these ideas to C-commerce clustering is slim and largely subsumed within the broader discourse on stakeholder engagement in project management. The following case study in C-commerce innovation is offered to illustrate the role played by one of the more important social ties- *trust* in the accumulation of social capital conducive to innovation.

3. SOCIAL NETWORK ANALYSIS, SOCIAL CAPITAL AND THE ROLE OF TRUST

The idea of *trust* as a Critical Success Factor (CSF) in E-commerce adoption is widely articulated in terms of factors such as secure transactions and the need to protect privacy. Trusted infrastructure is seen as necessary condition for acceptance of online retailing. Beyond infrastructure, trust can be considered a state of mind or attitude held by an individual. In the social domain of information systems, *trust* manifests itself as an attitude toward the integrity and credibility of organizations and individuals identified with business solutions and other technology propositions. Trust *(t)* can be considered a social tie or relation that determines the extent to which we are prepared to interact *(i)* with advocates of innovative solutions, whether a solution champion is effective and whether an individual or organization is authoritative as a source of learning. In this sense trust can be regarded as a form of social capital that attracts to individuals or organizations. Since many innovative technologies involve learning and knowledge *(k)* transfer for acceptance, whether an organizational or individual node in a network is considered authoritative is also an important question. Further, if an organization or individual is not respected as a source of knowledge, their power as an advocate or opinion leader in innovation decision making is diminished.

These observations point to an interpretation of innovation as a social network phenomenon defined in part around social relations such as knowledge, trust and the social and knowledge capital enjoyed by network nodes. Why do individuals participate in such networks and how important are they to success or failure of innovation? Whether manifested in Listservs, bloggs, wikis or by good old fashioned social interaction, we engage in *information* and *knowledge* seeking behavior about innovations because of perceived appropriable benefits that accrue to such behavior (e.g. improved productivity, cost reduction or income generation).

How important is such a process to the success or failure of an innovation? Without efficient knowledge diffusion of the nature and benefits of innovation and formation of human capital in the form of *commitment, responsibility* and *skills and capabilities,* the critical mass required for successful innovation may not eventuate. Opinion leadership that works to harness commitment to innovation is also critical in the journey to critical mass.

4. CASE STUDY IN MODELLING NETWORK BEHAVIOR

A case study in C-commerce innovation that provides evidence of the role played by trust relations is provided by the Cape Range Ningaloo Ecovortal, a project that operated as a quasi-experiment within the School of Computer and Information Science at Edith Cowan University between 2003 and 2005. The project was based on an innovative C-commerce eTourism platform created for the Cape Range Ningaloo World Heritage region of Western Australia. The project introduced a mobile data integration capability for destination marketing of ecotourism destinations, a *resource advantage* not available to firms acting outside the cooperative portal platform. The portal also introduced social networking and collaborative tools that provided a vertical platform encompassing community, business and scientific constituencies. In effect, an innovation stimulus had been applied to an adopter community of Small to Medium Sized Tourism Enterprizes (SMTEs). But encouraging early adoption incomes were not sustained, with no critical mass of operators prepared to the tertiary mobile integration phase of the project.

In the wake of effective abandonment of the platform by operators, efforts were made in 2005 to assess reasons for failure of the project. Empirical Social Network Analysis (SNA) methods were used to evaluate:

- Social and knowledge capital enjoyed by the local project champion (node N2) ;
- Characteristics of other network nodes and relations that may also have impacted on the adoption outcome.

SNA provides a way of understanding how ties or relations work in social networks to shape the formation of social capital. Tie analysis can be applied to a variety ties- in the utilitarian view of C-commerce innovation based on networks- we are concerned with knowledge *(k),* its accessibility *(a),* its perceived value *(v)* and whether the source can be trusted *(t).* In an innovation network context we would expect these ties to determine the extent to which individuals interact *(i)* with each other. Validation of these measures in the wider discourses of learning and knowledge networks has been established. For example, in an empirical study that focused on the kinds of relationships that influence information seeking behavior, Borgatti and Cross (2003) found that appreciation of a person's knowledge, the value placed on this knowledge in the knowledge domain of the problem and the accessibility of the source were statistically significant determinants of information and knowledge seeking behavior. Table 1 shows summary statistics for tie (t) in the twelve node network making up the adopter group for the Cape Range Ningaloo Project.

Mean and Std. Dev. showed that *distrust* and *trust* were about as common in the network and that considerable variability existed in terms of how nodes perceived the trustworthiness of other nodes. Analysis of row data shows how each node viewed the *trustworthiness* of other nodes in the network as sources of E-commerce knowledge:

Mean and Std. Dev. for N1, N2 and N10 showed that these nodes predominantly viewed other nodes in the network as *untrustworthy* sources of E-commerce knowledge (Table 2). Thus, whilst these nodes are to a lesser (N2) or greater extent (N1 and N10) prepared to concede that E-commerce knowledge exists elsewhere in the network, the trustworthiness of this knowledge is assessed as low.

Table 1. Summary Statistics: Tie *(t)*

Mean	0.526
Std. Dev.	0.499
Sum	40.000
Variance	0.249
Minimum	0.000
Maximum	1.000
N of Obs.	76

Table 2. Summary statistics Tie *(t)* by rows

	Mean	Std. Dev.	Sum	Var.
N1	0.222	0.416	2.000	0.173
N2	0.111	0.314	1.000	0.099
N3	0.857	0.350	6.000	0.122
N4	0.875	0.331	7.000	0.109
N5	0.500	0.500	4.000	0.250
N6	0.750	0.433	6.000	0.188
N7	0.833	0.373	5.000	0.139
N8	0.429	0.495	3.000	0.245
N9	0.500	0.500	3.000	0.250
N10	0.375	0.484	3.000	0.234

As the *Netdraw* diagram in Figure 1 shows, reciprocity exists in the elite sub group consisting of N1, N2 and N10, but only one directed tie *(t)* existed outside this faction from N10 to N3. The column wise view (Table 3) shows capital enjoyed by nodes as measured by directed Trust *(t)* ties.

Inspection of the data column wise, shows that N1, N3 and N10 were the most trusted nodes in the network in terms of directed trust ties, as measured by Mean and Sum values. The portal champion, N2, enjoyed few directed trust ties and N7 is not trusted by anyone. In SNA, the so-called Matrix Reciprocity Value (MRV) provides a measure of the extent to which dyads are reciprocal or unidirectional. Dyad based reciprocity, a measure of the extent of mutual trust, was measured at 0.3793.

5. SUMMARY

To summarize findings from quantitative analysis of the operation of tie (t) within the Ecovortal C-commerce adoption group:

- Column wise analysis of the Tie (t) matrix data showed that many nodes in the network did not trust other nodes;
- An aggregate measure of extant trust was obtained by measuring dyad based reciprocity. Using this technique, it was found that only 37.93% of all nodes, or slightly better than one third of nodes trusted each other;
- Although the portal champion, *N2,* was energetic as an advocate of the C-commerce solution, analysis of directed trust ties showed that this node possessed insufficient social capital in the form of trust to effectively function in this role. *N3, N1* and *N10* were more widely trusted and presented as better candidates in terms of this criterion.

Clearly, the clustering potential of this network, as measured by tie (t), was insufficient to drive the C-commerce project forward to a condition of critical mass.

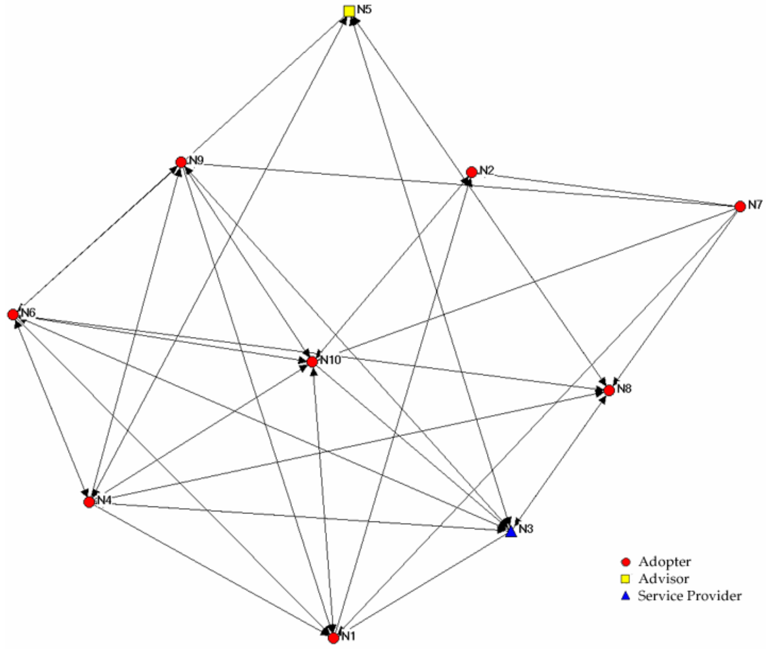

Figure 1. Tie *(t)* in the portal group: *Netdraw* view

Table 3. Summary statistics: Tie *(t)* by cols.

	Mean	Std. Dev.	Sum	Var.
N1	0.750	0.433	6.000	0.188
N2	0.333	0.471	3.000	0.222
N3	0.667	0.471	6.000	0.222
N4	0.500	0.500	3.000	0.250
N5	0.500	0.500	3.000	0.250
N6	0.500	0.500	4.000	0.250
N7	0.000	0.000	0.000	0.000
N8	0.625	0.484	5.000	0.234
N9	0.444	0.497	4.000	0.247
N10	0.750	0.433	6.000	0.188

6. CONCLUSION

Trust is an acknowledged CSF drawn from the wider research oriented literature on C-commerce adoption and social network analysis (Rosenfeld, 1997; Braun, 2003; Rowe, 2004; Vangen and Huxham 2006; Håkansson, H., and Snehota, 1995; Krackhardt, 2000). This research showed that the predominantly interpretive methods currently used to assess social capital such as trust and hence network behavior, can be enriched by the application of empirical methods. In regional clustering of SMTEs for C-commerce using shared infrastructure solutions, this research suggests that assessment of project feasibility should involve calculations of trust in the network of potential adopters. In a heuristic sense, sufficient aggregate and vector based trust should exist in a candidate network, if it is to provide a suitable basis for C-commerce type innovation. The decision by a node to collaborate with other nodes in a cluster involves an assertion of trust in others nodes, a relation which ideally is reciprocated. Trust also determines a node's preparedness to admit a lack of knowledge or expertise to other nodes in a network and commit to a process of learning (Cross, Parker, Prusak and Borgatti, 2003) paving the way for diffusion and innovation adoption.

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