STRUCTURE AND COOPERATION IN ONLINE COLLABORATION

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Abstract

Different network configuration influences users' motivation in collaborating online. While dense and strong ties network induced trust and close collaboration, it restrict expansion. On the other hand, sparse and weak ties stimulate expansion but less trusted collaboration. In addition, there are three instances that would encourage collaboration online. First, certain types of threat exist in online collaboration in the forms of losing reputation, structural position, and censorship. Second, communication augment credibility of threat by accentuating the consequences of threat and reminding of group desired consensus. Finally, online configuration creates 'sense of community' that deters deviation.

Keywords: *Public goods, online collaboration, cooperation*

Abstrak

Konfigurasi jaringan yang berbeda mempengaruhi motivasi pengguna dalam berkolaborasi secara online. Sementara padat dan kuat ikatan jaringan diinduksi kepercayaan dan kerjasama yang erat, hal itu membatasi ekspansi. Di sisi lain, hubungan jarang dan lemah merangsang ekspansi tetapi kolaborasi kurang dipercaya. Selain itu, ada tiga kasus yang akan mendorong kolaborasi online. Pertama, beberapa jenis ancaman yang ada di kolaborasi online dalam bentuk kehilangan reputasi, jabatan struktural, dan sensor. Kedua, komunikasi meningkatkan kredibilitas ancaman dengan menonjolkan konsekuensi dari ancaman dan mengingatkan kelompok konsensus yang diinginkan. Akhirnya, konfigurasi secara online menciptakan 'rasa komunitas' yang menghalangi penyimpangan.

Kata kunci: *Barang publik, kolaborasi online, kerjasama*

How do virtual collaborative media promote the establishment of collaboration and voluntary contribution of information? Contractor and Monge (2002) claims that explaining motivation of individual decisions to forge, maintain, or dissolve network sharing ties and information contribution should be managed from multilevel theoretical perspectives, it contain social, technological, and communicative aspects (Contractor & Monge, 2002).

In this regards, this paper will compare and contrast three different literatures from economics, information systems, and social network. Within information system literatures, technology acceptance and users' decision to use technology is motivated by technology usefulness and ease of use. This paper argues that in term of online collaboration, technology usefulness and ease of use depends on network structure and the norms and cost of cooperation and monitoring.

Different network configuration influences users' motivation in collaborating online. In addition, there are three instances influencing collaboration online, namely: 1) the existence of certain types of threat online, 2) communication augments credibility of threat by accentuating the consequences of threat and reminding of group desired consensus, 3) online configuration creates 'sense of community' that deters deviation.

Collaborative technologies allow people to easily exchange information and sharing. Participating in electronic collaboration media allows geographically dispersed individuals to gain access to new information, share expertise, and discuss idea that are often not available locally (Wasko, Faraj, & Teigland: 2004). Virtual collaborative media, such as wiki provide a space for individuals to have a high quality, collaborative, active, and vibrant discussion of issues that is lack in 'traditional' sessions.

Online collaboration is characterized by voluntary participation and non restrictive access. In online collaboration media, individuals will determine themselves what, when, how much, and how often, they would like to contribute and participate in sharing information. In addition, in online collaboration media commonly there is no limitation on access other than access to technology (Wasko, Faraj, & Teigland, 2004).

When individuals commit to participate in online collaboration, these individuals are creating and sharing continuous stream of knowledge by posting and responding to messages or comments. In addition to the exchange, these messages and comments are saved in online repository as archive of collective information (Wasko et al., 2004).

This exchange and participation in online collaboration exhibits the aspects of public goods in two ways. *First*, comments or messages posted by individual in the collaborative media will benefits all other members non-exclusively. *Second*, the archive of collective information stored online is accessible to others members and consumption by one member will not diminish the value of the collective information for others. Thus, logically if online information as public goods is non-restrictive and non-exclusive, this

media will generate high motivation to join and contribute in online sharing.

However, there are many instances where online spaces or media for collaboration that are created for information exchange remain empty, either no one comes and contributes to the space or while initially sustained participants, they lose interest and leave the space (Wasko & Faraj, 2000). Hence, what motivate individual decisions to create, maintain, or dissolve their participation and contribution in online collaborative media?

In information systems literatures, motivation to use collaborative electronic media is influenced by the perceived usefulness and ease of use of technology and the task characteristics (Jarvenpaa & Staples, 2000) and relational structure, norms, and heterogeneity of individuals attributes (Wasko & Faraj, 2000). This paper will expands the determinants of online collaboration motivation in information systems perspective by accentuate more on the effects of network configuration and most importantly applying economic framework of public goods.

Hence, the organization of this evaluative review will be structured as follows. *First*, describing the definition and the determinants of online collaboration media usage in the perspectives of information system literatures. This section also briefly compares and contrasts different forms of interaction, namely: face-to-face and three online media (email, chat, and wikis) based on media richness theory. *Second*, it will expand the discussion of relational social ties within information system perspectives by elaborating on the structural holes and closure views of social network theory. *Third*, enrich the discussion of collective action in online collaborative media build up on the economic theory of cooperation and public goods.

Online Collaboration Media: Definition and Determinants of Use

Online collaboration media refers to the media based on computer-mediated communication technology that enable users to discuss, debate, and share knowledge (Wasko et al., 2004). It is a platform that allow the accomplishment of information activities, such as accessing, searching, sharing, storing, and publishing information (Jarvenpaa & Staples, 2000), based on and by integrating users' generated knowledge, skills, and information (Wagner & Schroeder, 2010). The propensity of users to voluntarily participate and contribute their knowledge, skills, and information determines the key success factors of online collaboration media usage (Wasko et al., 2004). Hence, what influences users behavior to contribute and participate in online collaborative media?

Researcher in information system argues that propensity to share information and volunteering are forms of pro-social behavior aimed at maintaining others and individual well-being and integrity (Jarvenpaa & Staples: 2000). However, individual motivation to use technology for sharing information and collaborate is also affected by the technology attributes. Individuals will be more willing to engage in higher sharing using collaborative media if the technology attributes and conditions

decrease the psychological cost of sharing (Jarvenpaa & Staples: 2000). The cost of sharing is a tradeoff between the benefits received from using the technology against the cost to access, learn, and use of technology. Thus, literatures in information system assert that individual acceptance on technology is influenced by the usefulness and ease of use of the technology itself (Hossain & de Silva, 2009).

Perceived usefulness of technology refers to the benefits that users get from using the technology. Logically, users who gain larger benefits of using technology will be more likely to use it as compare to users who gain less. Jarvenpaa & Staples (2000) found that the use of electronic media for communicating and sharing was strongly associated with user's belief that the technology provides valuable information and in more effective way. In addition, the propensity of users to use electronic media to share information is significantly associated with their task's interdependence.

Ease of use refers to the level of effort that users have to spend to use the technology. Users will be more likely to accept and use the technology and share information if the level of effort that users have to spend to learn and use the technology is in moderation. Jarvenpaa and Staples (2000) found a positive and significant relationship between users' adequacy in computer skill and user' comfort in technology with their propensity to use electronic collaborative media for sharing information.

There are various technologies that could provide or mediate online collaboration and information sharing. Each of these technologies has distinct attributes that differentiate them from one to another. Likewise, users' perception on technology usefulness and ease of use will be differed for each of these different technologies. To differentiate the technology acceptance and use, this paper will compare and contrast face-to-face and three different online collaboration technologies, namely: email, chat, and wikis, based on the media richness theory.

The media richness theory differentiate the ability of technology to convey information from four perspectives, namely: immediacy of feedback, multiplicity of cues, language variety, and personal focus (Wagner & Schroeder, 2010). Immediacy of feedback refers to the extent that the technology provides users with rapid responses. Multiplicity of cues is number of ways information is communicated. Language variety refers to the ability of particular technology to convey natural language. Finally, personal focus is the extent to which technology support personalization of information (*for comparison refers to table 1*).

Table 1. Media Richness of Online Collaborative Technology

Technology	Immediacy of Feedback	Multiplicity of Cues	Language Variety	Personal Focus
Face-to-face	High	High	High	High
Email	Low	Low	Medium	Medium
Chat	High	Low	Low	Low
Wikis	Low-medium	Low-medium	High	Low

Source: Wagner & Schroeder (2010)

Based on the table, it is apparent that in term of richness, face-to-face communication is the best. However, the trade-off of richness in face-to-face communication is on the restriction of distance and time. Longer distance and asynchronous time induce

high cost of face-to-face communication. The different richness of technologies conveys the usefulness for users. For instance: users who value immediacy of feedback and less concern about content will perceive chat as more useful for collaboration. On the other hand, users who value variety of content might prefer wikis to collaborate.

Nonetheless, although user's perception on usefulness and ease of use of technology subsequently influence their choice of technology usage, it does not explain why when using the similar technology (ex. Wikis), some sites attract and able to sustain high participation while others are not.

Wasko and Faraj (2000) assert that maintaining and attracting contribution and participation in online collaboration media is also depends on the relational structure of social ties and norms of collective behavior. They further assert that the network structure underlying online collaboration is like a star, where a critical mass of individuals sustains the network by responding to all others in the network. In addition, the relation depends on the strength of ties among actors in the network (Wasko & Faraj, 2000). In subsequent section, this paper argue that in addition to star-structure and tie strength, the position of actors in the network and to whom actors will connect themselves are important in sustaining online collaboration.

Relational Structure and Social Network Configuration on Online Collaboration Media

Wasko and Faraj (2000) capitalized from Wellman research emphasize that in the online collaborative network, actors will formed critical mass in the shape of stars and the relationship is affected by strength of the ties. This means that few influential actors will sustain the network and mediate and correspond with the rest of the network members. These few influential actors act as the core of the network while the rest of the network members are in the periphery. The core of the network will interact among themselves while also maintain relationship with the others.

In addition, Wasko and Faraj (2000) also assert that the social ties in the network may be of a strong, intermediate, or weak in nature. However, they did not explain in what conditions different level of tie strength are more preferable than other. This section will argue that in addition to strong and close network in the formed of star configuration, online collaboration will also gain benefits if the network has less dense and more holes in the network. In addition, it is argue that different collaboration conditions necessitate different strength of ties, some tie strength are more beneficial for a particular task or collaborative initiative than others.

Having high density network with core periphery structure might create benefits for the online collaboration. The benefit of dense network is that transfer of knowledge and information become faster. It will increase the time needed to transmit message from one member to the other. Agrawal & Goldfard (2008) found the top-down tier of task distribution among research collaborators from top universities to the middle universities. It is also found that benefits of information technology

were greatest in collaborations when pairs were close together, hence in denser network (Agrawal & Goldfarb, 2008). In addition, star configuration with core periphery structure increase the visibility of the central actors. The central and core partners have signaling benefits, it make central actors more attractive to others (Walter, Lechner, & Kellermanns, 2007).

On the other hand, dense network and core-periphery structure also create several disadvantages. *First*, it is likely to make redundant and obsolete knowledge and information. Research by Orsenigo et.al indicate that persistent core-periphery structure in Pharmaceutical Industry in Italy lead to more specialized firms in the periphery and retain general knowledge only in the core (Orsenigo, Pammolli, Riccaboni, Bonaccorsi, & Turchetti, 1998). Consider figure 1 (initial) below, if group ***xyz*** did not make any attempt to connect to other group, than the information exchange in their collaboration is limited only to their group and with time it might obsolete. *Second*, it will limit the search horizon; the close group cannot expand to search for new information. *Third*, it will increase the structural barrier.

Thus, to improve information sharing and collaboration the existence of structural holes also important. One of main benefits of structural hole is in facilitating the expansion of network (Ahuja, 2000). For instance, in figure 1 structural hole exist between group *ABC* and group *123* to group ***xyz***. In figure 1 next (b), group *ABC* will have better expansion if (for example) instead of actor *B* connect to actor *1*, actor *B* should connect to actor ***x***. Hence, relation between actor *B* and ***x*** will fill the structural hole and expand the collaborative network. Creation of ties that filled structural holes will be more beneficial in expanding the collaborative network.

Different tie strength asserts different benefits in different situations. Strong ties are not always useful so do weak ties, it is depend on the context of collaboration. Strong ties induce trust in the relationship, reciprocity, and strong social norms in facilitating cooperation (Walter et al., 2007). In cooperation that values strong trust and reciprocity, such as early inception of research collaboration and idea development, having a strong tie is desirable. On the other hand, weak ties signify outgoing, openness, and expansiveness. In online collaboration that value expansiveness and mass, such as: in idea or product diffusion, having a weak tie is more desirable.

Hence, position and structural configuration will also influence user's motivation in collaborating online. If the network is dense and close and the tie among existing members is strong, it will create barrier of entry that could de-motivate new users to participate. On the other hand, dense and close network represent higher trust among network members, hence it is also create a barrier of exit for the existing member.

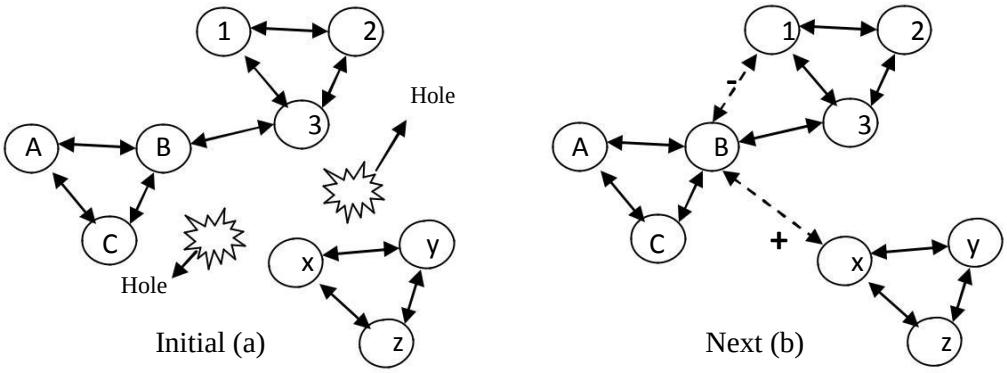

Figure 1. Anecdotal Collaborative Network

Thus, network structure explains the ability to retain members to collaborate. It partly explains why users of similar online collaboration technology stick together while some other collaborative network crumble and dissolved. However, it does not adequately explain the level of contributions of users; why some users contribute more in quantity and frequency, while other deviate. In order to understand the mechanism of cooperation, this paper will derived the insight from economic framework.

Cooperation Norms and Collective Sanction in Online Collaboration Media

As have been previously mentioned, due to non-rivalry and non-excludability of information generated in online collaboration media, it exhibits the aspect of public goods. Economic literatures provide great contributions in the study of public goods.

The studies of public goods in economics assert that public good exist in or create a social dilemma. In the sense that in the situation where everybody could consume public goods without ever have to contribute to its creation or development, the dominant strategy for individual is not to contribute and to free-rides. However, if everyone decided not to contribute, than information and knowledge repository in online collaboration would not be created and everyone will be worse off. Punishment is one of the tools that can be used to enforced cooperation, but punishment is deemed less feasible in online collaboration media due to its participatory nature.

Before delving into users' motivation to contribute online, this section will begin by explaining the social dilemma in voluntary online collaboration. To illustrate the social dilemma in voluntary online collaboration, the 'Prisoner Dilemma' scenario is used.

Prisoner dilemma is a situation where two individuals are given two dilemmatic choices, to confess or not to confess, or in this context, it should be to contribute or not contribute in online collaboration. If both choose not to contribute, then they will have higher payoff since both does not have to assume the cost (efforts to contribute). If both choose to contribute, then they will have to pay for effort to contribute but their cost (effort) is subtracted by the satisfaction in contribution, hence result in lower cost. If one of them decides to contribute while other not, than the

person contributing assume larger cost and made worse off. In this scenario, the dominant strategy is not to contribute. Achieving desired level of contributions is attainable in sub-game perfect Nash equilibrium, and achieving sub-game perfect require credible threat.

It is argue that three instances influence individual to contribute voluntarily in online collaboration and deter or diminish free-riders. *First*, although it is participatory in nature, certain types of punishment and threat exist in online collaborative media. *Second*, communication could augment the credibility of threat. *Third*, visibility and structure of online configuration help create 'sense of community' that could play significant role in deterring free-riders.

First, if online collaboration is voluntary and individual received no monetary payoff in using it, then what would be the form of punishment mechanism or threat that exist in online collaborative media. In this paper it is argue that threat and punishment in online collaborative media is manifested in the forms of losing reputation, structural position, or censorship.

Economics research in cooperation of public goods claims that other preferences than monetary payoff also influences sharing. Individual willing to enforced cooperation due to individual emotion (Fehr & Gacther, 2000; Frohlich & Oppenheimer, 1998), perception of fairness (Carpenter, 2007), and conformity to altruism (Bochet, Page, & Putterman, 2006). Sharing is pro social behavior. Individual is willing to share since sharing positively reflects individual integrity and self-worth. The propensity to share is individual personal norms reflecting the cost and benefit of sharing and contributing online (Jarvenpaa & Staples, 2000).

Thus, inability to share comments or messages due to censorship by administrator will diminish individual self-worth. It will affect their reputation and will reduce the trust of other members. In addition, network structure accentuates the structural restriction to deviate. For instance, as central actor in the network, individual action is more visible to other member. Hence deviation is more costly for center actors as compare to periphery actors. Ultimately, individual self-worth, reputation, and trustworthiness served as form of online punishment tools to complement non-existence of monetary punishment in online collaboration media.

Second, to achieve sub-game perfect and enforce participation, threat should be made credible. It is argue that the increased communication in online collaboration media itself augments the credibility of threat and different forms of media induce different level of threat credibility. The role of communication in augmenting credibility of threat is in two ways, *first*, it accentuates the consequence of deviation and *second*, it served as reminder of the group desired consensus.

Brochet, Page, and Putterman (2006) found that communication improve the efficiency of punishment since communication allow subject to strengthen the consequence of punishment. They found no significant difference in adding punishment to the communication treatment (Bochet et al., 2006). Verbal communication by

itself increased cooperation so much that the adding impact of punishment is limited. Subject uses communication media to convinced 'potential' free-riders of the dire consequences of reneging on agreement.

One could argue that public goods experiment in economic setting is created to reflect dilemmatic situation while in online collaboration it is less problematic. Research finding from Froehlich and Oppenheimmer (1998) suggest that even in less problematic situation, communication is still important, particularly to convey the 'consensus' desired by other group members.

Froehlich and Oppenheimmer (1998) conduct experiment based on Prisoner Dilemma in two different environmental setting, one that reflect the problematic dilemma of choices and the other, what they called 'impartial prisoner dilemma', reflect non-problematic dilemma. Their overall findings suggest that communication media enhance the level of contribution and deter free riders both in problematic and non-problematic situation. In 'impartial prisoner dilemma' or non-problematic situation where the outcome from each player's choosing the dominant strategy is itself optimal, communication is needed as coordination tools (Froehlich & Oppenheimer, 1998) to convey the consensus of group.

Both result from Brochet, et.al. (2006) and Froehlich and Oppenheimer (1998) suggest not only that communication is important to ensure cooperation, but the types of communication media also has different impact on accentuating the credibility of threat. Different media convey different richness of information, thus it differ the ability to change the understanding of information (Wagner & Schroeder, 2010).

Face-to-face communication has the highest richness, in particular since face to face enable visual and removal of anonymity. Hence, it is found that face-to-face shown to provide more effective platform to convey threat (Bochet et al., 2006) and it could lead to complete cooperation in public good dilemma (Frohlich & Oppenheimer, 1998). Although information technology could reduced the cost of long distance communication, face-to-face meeting is still important to foster and maintain research collaboration (Agrawal & Goldfarb, 2008).

Electronic collaboration media is also found to improve effectiveness of cooperation. Brochet et.al. (2006) found that text-based chat was also surprisingly effective means of reaching agreement and fostering commitment. On the other hand, the impact of email is less profound than face to face communication. Email could still induce higher cooperation even without punishment but it is less effective than face-to-face (Frohlich & Oppenheimer, 1998).

Finally, the visibility and structure of online collaboration media create sense of community. This sense of community could inhibit free riders. Individuals are more likely to suppress self-interest when there are strong, positive association between individuals and group. Fehr & Gatcher (2000) found that in the partner treatment in which similar experiment subject meet repeatedly in finite times, only negative deviation from the group

is punished. The frequent of interaction in partner treatment enable the creation of common behavior that inhibits free riders.

The creation of common behavior standard is more difficult to achieve in stranger condition (Fehr & Gacther, 2000). In accordance, Carpenter (2007) found that collective action in larger group have larger impact on deterring free riders. The possibility of 'collective shunning' has force the free-riders to conform to the group's objectives (Carpenter, 2007). However, this condition is also mediated by the number of the group members (a.k.a. Punishers). The free riders will dig their heel and ignore the punisher if the number of punishers is few.

Conclusion

Voluntary and participatory exchange in online collaboration media exhibits the aspect of public good in two ways. *First*, comments or messages posted by individual in the collaborative media will benefits all other members non-exclusively. *Second*, consumption by one member will not diminish the value of the collective information for others. Anecdotally, if online collaboration is non-restrictive and non-exclusive than it will generate high motivation to join and contribute. However, there are many instances where online spaces or media for collaboration remain empty, either no one come and contribute or while initially sustained participants, they lose interest and leave the space.

Then the question in this paper is what motivates individual decisions to create, maintain, or dissolve their participation and contribution in online collaborative media? It is argue that motivation to cooperate and collaborate in online collaboration platform is not only due to the perceived usefulness or ease of use of technology. This paper contends that network configurations and norms and threat influence creation, maintenance, and dissolution of online collaboration.

Position and structural configuration will influence user's motivation in collaborating online. If the network is dense and close and the tie among existing members is strong, it will create barrier of entry that could de-motivate new users to participate. On the other hand, dense and close network represent higher trust among network members, hence it is also create a barrier of exit for the existing member.

Likewise, there are three instances that would encourage individual level of voluntary contribution in online collaboration and deterrent of free-riders. *First*, although it is participatory in nature, certain types of punishment and threat exist in online collaborative media. Threat and punishment in online collaborative media is manifested in the forms of losing reputation, structural position, or censorship. *Second*, communication could augment the credibility of threat. The role of communication in augmenting credibility of threat is in two ways, 1) it accentuates the consequence of deviation and 2) it served as reminder of the group desired consensus. *Third*, visibility and structure of online configuration help create 'sense of community' that could play significant role in deterring free-riders. Individuals are more likely to suppress self-interest when there are strong,

positive association between individuals and group.

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