

SNS Cyberinfrastructure and Incubating Global Virtual Teams

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Abstract

This paper explores the potential usefulness of social networking site technology (SNS) to fostering the formation of global virtual teams. This paper introduces the idea of how Virtual Organization Breeding Environments (VBEs) with rich SNS infrastructure could potentially facilitate the development of Virtual Organizations (VOs). Through this conceptual framework, I hypothesize that SNS may positively affect the development of global virtual teams through SNS-enabled VBEs. I conducted a pilot study of Google Wave and found it unsuitable to meaningfully answer the research questions I posed. The key purpose of this paper is not to present any substantive empirical findings from this work on Google Wave, but rather to advance the study of SNS and global virtual teams by reviewing relevant literature and sharing our thoughts on how to pick suitable case studies to evaluate if and how SNS may be valuable to the success of global virtual teams.

1. Introduction

The formation of virtual organizations (VOs), a temporary coalition of geographically dispersed individuals formed to achieve a common goal or task [1], is usually dependent on Internet-based communicative tools. As Collins [2] highlights, VOs have experienced an exponential growth in the last decade as government, educational institutions, and industry have found they are flexible, cost effective, efficient, and not geographically constrained. Virtual Organization Breeding Environments (VBEs), virtual spaces which are responsible for encouraging the formation of VOs have a longer-term focus in which members can develop rapport and a community ethos which seeks to help other members can also emerge. VBEs often do not use social networking site technology (SNS), cyberinfrastructure which in theory could promote VO development. Web applications involving interactive and user-generated

dynamic content have become ubiquitous (the publicly accessible social networking site Facebook is over seven years old and has over 600 million users) and can offer tools which facilitate the convergence of communicative technologies. This paper explores questions around the use of SNS in VBEs and to highlight the potential of SNS to foster trust and social cohesion between potential global virtual team members. The paper expands from my exploratory pilot study which examined Google Wave as a potential incubator of global virtual teams. The paper's purpose is not to share detailed empirical results from the pilot study of Google Wave. Rather, this paper will glean selected insights from this study for the explicit purpose of sharing observations on what characteristics one should look for when evaluating potential case studies to test hypotheses on the relevance of SNS to global virtual teams. My current project on SNS and life science VBEs was developed from lessons learned exploring Google Wave.

This paper explores the question of whether SNS can facilitate the work of VBEs and, ultimately, of global virtual teams (which we see as one type of VO). Although VOs benefit from not being confined geographically, they are limited by barriers to social interaction among team members. As Bavec [3] and Handy [4] have shown, meaningful social contacts foster trust, a critical element to developing collaborative work among dispersed individuals and to promoting cutting edge knowledge generation. The central purposes of this paper are to (1) introduce literature in this field, (2) posit questions to help guide researchers in their evaluation of whether SNS can meaningfully facilitate social interactions among individuals in VBEs, thereby building trust and cohesion before a VO is even formed, and (3) provide a set of characteristics researchers should take into account when selecting case studies in this field.

2. Background Overview

2.1 What is a VO?

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Virtual organizations are organizations/enterprises not tied to a singular physical locality (i.e. a specific lab or work place), and are a product of changes in global economic, social, and political systems. A useful working definition of VOs is provided by Travica [5] who views them as manifesting themselves as a 'collection of geographically dispersed individuals, groups, organizational units - either belonging or not belonging to the same organization - or entire organizations that depend on electronic links in order to complete the production process.' Travica's definition highlights several key features of VOs, especially their deterritorialization and dependency on electronic technology. These elements continue to distinguish VOs from more 'traditional' organizations. During the early 1990s, emergent literature on VOs such as that by Travica and others sought to map out the changing terrain of organizations. For example, Bleecker [6] highlights the rise of the 'Road warrior', a mobile worker who utilizes new communication technologies to break the limitations of traditional geographically-bound organizations. For Bleecker [6], the strength of virtual organizations and virtual enterprising is the possibility 'to draw upon vital resources as needed, regardless of where they are physically'. As he observes, 'the "office" is where the worker is - not the other way around'.

Mowshowitz [7] argues that virtual organizations can be understood by examining their concomitant parts of virtual memory, virtual reality, virtual classrooms, virtual teams, and virtual offices. A key focus of Mowshowitz's work was to demonstrate the increased flexibility and responsiveness of virtual organizations which stemmed from improved resource utilization. He offers the example of a hypothetical virtual organization, whose function is to ship products sold through a catalog. Mowshowitz argues that such a VO gains in efficiency through computer technology which facilitates dynamic and seamless switching (e.g. if a product's shipping method needs to be changed from UPS to Airborne Express); a VO is much more efficient (and less costly) to accomplish this task than a traditional organization.

The work of Travica, Bleecker, and Mowshowitz, though useful in defining elements of VOs and mapping their history, does not offer a general articulation of what constitutes a virtual organization. Indeed, VOs are conceptualized differently in different contexts. One clear example of VOs is in grid computing, the sharing of computing resources

from multiple institutions to perform specific tasks. In this iteration, individuals and institutions associated with the relevant computing resources 'join together to form new VOs in order to effectively execute tasks within given time steps' [8]. Here, a VO is a temporary combination of individuals and institutional computing resources connected virtually to perform a specific task in a given time. The VOs form, disband, and re-configure as required for the task.

2.2 What is a VBE?

VOs need a fertile environment in which to be born. If VOs are task- or goal- oriented, they need a wrapper community which serves as an anchor point for the potential team members to establish connections and to build a robust virtual organization that can be sustained for the length necessary to accomplish the task or solve the problem. In the case of grid computing, central gateways track supercomputing cycles and provide a clearing point for new VOs to form to complete specific tasks. Because the resources are human in the case of global virtual teams, an automated or semi-automated gateway is not enough. Virtual Organization Breeding Environments (VBEs) offer a way to create a long-term anchor point for virtually interacting to form meaningful virtual organizations.

VBEs are platforms/spaces which facilitate the creation of virtual organizations. They serve as a stable 'base' with a common environment for communication, an interoperable infrastructure of tools, and common goals among members. Their prime purpose is to provide a virtual space where members can interact, network, and build trust. A prominent example is ECOLEAD, a European Commission funded VBE which sought to provide a long-term Virtual Breeding Environment with infrastructure drawn from multiple organizations which could support a variety of industries spanning mining to motorsports [9]. The VBE literature [10-12] demonstrates that they are an effective environment for the creation of VOs. A key function is for them to serve as a long-term association or community of individuals with varying expertise and common interests, while the VOs born from VBEs tend to be 'a short-term association with a specific goal' [13]. Because VBEs have a longer-term focus, members can develop rapport and a community ethos which seeks to help other members can also emerge.

Current VBE cyberinfrastructures are disproportionately focused on the technical aspects of the VBE (e.g. matching technical competencies) and

this comes at the expense of the social aspects of relationship-building. Empirical and theoretical work on VBEs emphasizes the critical importance of trust to fostering a VBE with ‘collaborative culture’ [11, 14]. Indeed, VBEs often become ‘stunted’ without trust between partners [14]. Pioneering work on virtual collaborative networks placed emphasis on eclipsing geographical constraints and ‘reduc[ing] dependence on humans’ [7]. In this early work the success of VOs could be analyzed using technical management theory. The rise of sociotechnical theory, which views society and technology as mutually interlinked, has challenged this view and empirically demonstrated the critical role of social contexts to the functioning of virtual organizations [e.g. 15, 16-18].

However, despite the advances in sociotechnical literature, empirical research exploring the role of new communicative technologies to developing ‘community’ in VBEs is almost nonexistent. At the same time, interactive SNS-driven technologies are not being ignored [19]. An important question this paper seeks to explore is the extent to which and how SNS could potentially (1) help VBEs function and (2) support the development of VOs from the VBE base. Understanding the role played by SNS in VBEs could help entities in industry, government, and research decide whether and how to incorporate SNS into future VBE cyberinfrastructures. If SNS technology helps build stable, long-term relationships among global virtual teams, these VBEs could provide a platform for the creation of new VOs focused on new problems.

2.3 What is Social Networking Site technology (SNS)?

Social networking sites (SNS) have a simple mission – to support network-building through existing and compound relations (i.e. ‘friends of friends’) and communication within networks. The growth of the most popular site, Facebook, demonstrates web users’ urge not only to map out their social networks meticulously, but also to converse semi-publicly with these ‘friends’ about their daily lives. Today, Facebook is the world's fastest growing social networking website and has over 600 million users [20]. The site is built through algorithms which regularly identify potential ‘friends’. Users keep their profiles updated by posting autobiographical material, including personal photographs, diary entries, and personal information (e.g. educational and work background as well as hobbies, pastimes, and interests).

Some aspects of SNS are the result of first-generation collaborative Internet technologies. For example, the ‘wall’ discussion board section of many SNS such as Facebook are the byproduct of listserv e-mail lists, message boards, and early virtual communities such as The WELL. These early communicative technologies fostered trust and enabled regular users to build reputations within the user community [21]. One major difference between SNS and these earlier technologies is that SNS is built upon the convergence of new Internet applications (e.g. digital video, digital images, and other dynamic user-generated content). Another difference is that unlike their predecessors, SNS leverage a formalized social network, where one maintains a constellation of ‘friends’ (some interlinked and others existing as islands) rather than the more loose and flat configuration of e-mail lists. Furthermore, SNS use ‘profile’ pages to map out a user’s educational background, professional status, and social interests amongst other things. Profile pages can also integrate reputation systems, where members are rated based on reviews and contributions. In the context of this paper, VBEs using SNS usually implement profile pages (with the ability to post autobiographical information), forums, and shared ‘work’ spaces. SNS in VBEs may have the potential to support aspects of VBEs and VOs. Specifically, reputation systems found in SNS cyberinfrastructure could be perceived by users as fostering trust. Similarly, the regular posting of autobiographical material could be perceived by users as fostering social cohesion in VBEs and VOs.

2.4 What potential use do SNS have for VBEs?

One of the potential limitations of VBEs as opposed to physical organizations is limited social interaction among participants, an aspect especially studied in the telecommuting literature [22]. As Oshri, et al. [23] argue, this lack of face-to-face interaction can seriously impede the development of shared norms, attitudes, and behaviors - critical factors to a healthy VBE. From a sociological perspective, sharing social experiences, exchanging social information, and representing oneself through meaningful and renewed networked social interactions [24] builds communal cohesion [25]. SNS has the capacity in theory to permit members of a virtual group to share experiences, exchange information, and present themselves in real-time [26], and thus to be able to form socially cohesive interpersonal networks. The question is whether SNS

technology can be implemented to foster earnest and sustained socially networked interactions? There is some evidence that highly skilled scientists can use SNS to collaborate globally in knowledge sharing and scientific discovery (see Fig. 1 for an example of SNS being used in life science research).

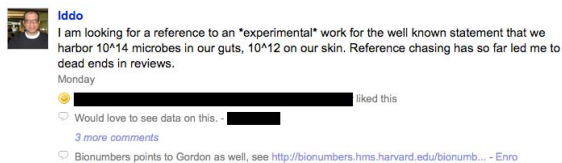


Figure 1. A discussion feed from ‘The Life Scientists’ on the SNS FriendFeed

For example, research by a team at Harvard Medical School [27] applied SNS technologies to the life sciences and developed Cellucitate, an application which provides a web-based interface for modeling and simulating complex cell signaling systems. Several researchers from different institutions can use the web interface to collaborate on developing a single scientific model. Indeed, Fontana, a member of the research team who was involved with Cellucitate, makes the comparison to SNS himself, referring to his wish for the application to become the ‘Facebook of proteins’ [cited in 28]. The metaphor of Facebook here is that Cellucitate, like Facebook, would provide a shared area of discussion among social networks of collaborators. In Cellucitate’s case, the idea is that this online space of discussion and interaction will foster the development of ‘consensus views’ [cited in 28] of protein systems.

3. Was Google Wave a VBE capable of breeding global virtual teams?

Google Wave, a legacy collaboration tool designed by Google, was introduced for the purpose of facilitating global collaboration across a variety of topics. Each group was termed a ‘Wave’ and could be public or access restricted (see Fig. 2 for a sample list of public Waves). In an exploratory pilot study, relationships between participants in the Waves were coded. Participants of each Wave were coded as a cluster so that comparative statistical analysis could be done between participants of multiple Waves. Data was exported and analyzed in Pajek, a Social Network Analysis software package.

Technologies including Google Wave have the potential to facilitate the emergence of virtual organizations. My study found that some Waves

within Google Wave can be conceived as VOs with individuals who emerge as leaders through the moderation of discussion threads as well as commenting and steering sub-discussions (See Fig. 3,4 for illustrations). Ultimately, however, it was not found to be analytically meaningful to conceive of Waves as VOs.

The study considers an active Google Wave as a network of actors [29]. Using Waves which are publicly accessible (searched by using ‘with:public’), this study used Social Network Analysis [30] to chart the relationship of actors within each Google Wave. Using measures of the centrality of actors to the network and the density of their interactions, public Waves were studied to address three key research questions: 1) whether the Waves tend towards cohesiveness or not 2) if leaders emerge in these Waves (and are they Wave creators) who help promote cohesiveness or whether cohesiveness emerges from a less hierarchical social network and 3) the influence of peripheral actors on the network. This study used three-dimensional network visualizations to gain a bird’s eye view of Waves as networks (See Fig. 4) in order to perform targeted statistical analysis (including correlations which examine whether being a leader in one Wave increases one’s likelihood to lead another).

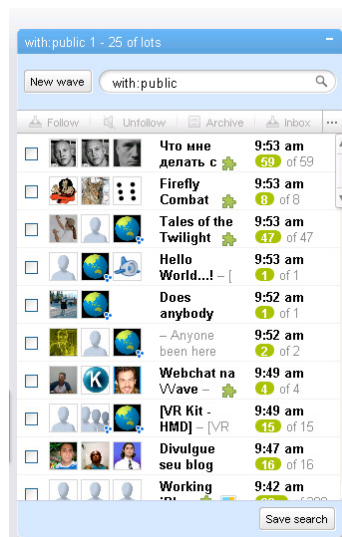


Figure 2. Public Waves on Google Wave

Particularly important to the study was the examination of correlations of various clusters of users within Waves to help answer our study’s research questions. Network maps (see Fig. 3) for selected Waves were generated using Pajek. The aggregate data set and Wave visualizations were

studied to answer the project’s three research questions (as outlined above). Visualization viewed through the Kinemages format was used to ‘spin’ networks of the Waves and to confirm the validity of statistical conclusions by examining them for density, cohesion, and the emergence of leaders (see Fig. 4).

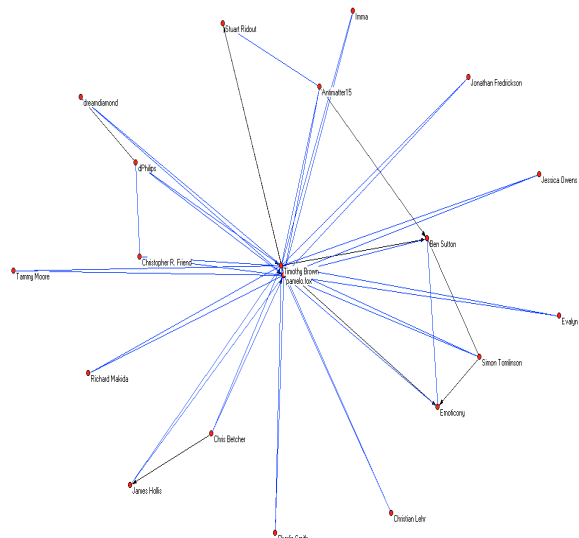


Figure 3. ‘Uses of Google Wave in the classroom’ Wave produced by Author

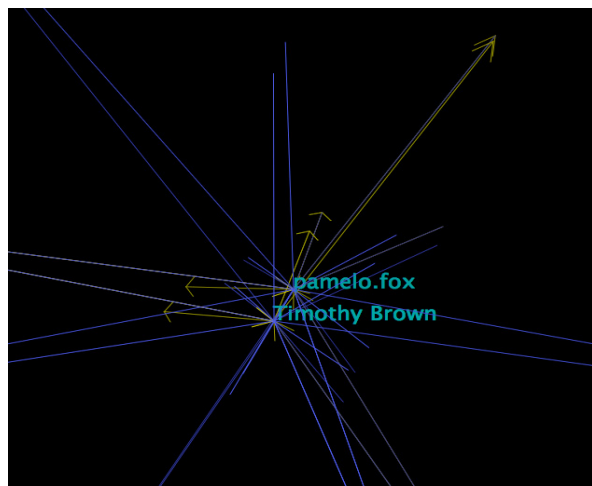


Figure 4. Zoom to leaders of ‘Using Google Wave in the Classroom’ Wave

By exploring public waves with participant relationships through network visualizations, I found that I was able to map which individuals emerge as having ‘influence’ within each Wave. However, this did not, in itself, confirm that SNS has utility to promote trust and cohesion in VOs. In 2010, Google shut down Google Wave due to perceived low user

uptake [31]. Though not apparently closed for reasons to do with its shortcomings as an incubator of VOs, the pilot study revealed that though some Waves can theoretically be conceptualized as VOs, it is not analytically meaningful to do so. Furthermore, Google Wave itself can not be conceptualized as a VBE given, amongst other things, that it lacked a stable social networking infrastructure to support successful interactions to breed VOs. Ultimately, Google Wave was an ill-suited case study for the research questions posed. However, the upside is that the study provides important insights on developing the field of study of SNS and VBEs.

Google’s new platform, Google+, may have resolved some of the shortcomings of Google Wave by incorporating a longer-term SNS infrastructure with profiles, ‘Circles’ (temporary or longer-term associations of people), and focused collaborative innovation tools (e.g. ‘Hangout’, a video-based meeting space). Future research which explores global virtual teams on Google+ to answer the research questions posed would be useful to advancing the field. Ultimately, the benefit of this pilot project, despite its shortcomings, is that it has provided me with a clearer idea of how better to evaluate choosing case studies to test the posed hypotheses. In section 4 below, I provide a set of characteristics – a sort of rudimentary framework - for evaluating case study selection. Its development has led to my current work which studies SNS within two life science VBEs.

4. Towards a Framework for Choosing Case Studies to evaluate SNS within Global Virtual Teams

4.1 Look for case studies which have SNS which can foster reciprocal communication

Virtual organizations are, by design, highly rational organizations. This rationality can help or hinder knowledge generation, depending on organizational structure, management techniques, and social relationships among other things. As Weber [32] has argued, rationalization brought ‘the depersonalization of social relationships’ and, as VOs become more and more rationalized through their reliance on information and communication technologies (ICTs), the clear danger is a further depersonalization. Wilson [33] found, contra literature which often discusses the high efficiencies of virtual organizations [e.g. 7, 34], that VOs can erode true participation due to the over-formalization

of social relationships mediated through ICTs. Hughes et al. [35] add that virtual organizations often slip into a “buck passing” culture’ in which reciprocal communication which crosses the ‘organisational divide’ does not emerge. However, Axelrod’s [36] prominent work on game theory and cooperation concludes differently. He argues that cooperation is best served when individuals feel that their contributions are rationally reciprocated: ‘a single individual who offers cooperation cannot prosper unless others are around who will reciprocate’ [37]. Furthermore, he adds that ‘different kinds of social structure affect the way cooperation can develop’ [37]. For him, a key aspect of this is the development and maintenance of reputation. Livingstone [38] demonstrates that SNS has facilitated reciprocity and reputation building and maintenance in diverse settings. The pilot study of Google Wave demonstrated major issues with facilitating reciprocity and reputation building, issues which Google+ may potentially have resolved. Therefore, the first indicator to look for in choosing an empirical case study to evaluate SNS and global virtual teams is the presence of socially oriented reputation building and reciprocal communication.

4.2 Look for case studies which have intuitive synchronous communicative tools

Like Ivanova and Alam [39], the pilot study quickly revealed that Google Wave had innovative tools for maintaining near synchronous collaboration. A key issue seen with Google Wave was that the geographic dispersal of potential team members necessitated effective synchronous communication tools within the platform itself, but many users reported that they had difficulty in understanding Google Wave’s purpose and its tools [40]. Geographic dispersal, for Hughes et al. [35], can impact communication adversely. Intuitively, the lack of ‘water cooler moments’ is perceived as limiting social interaction. Some scholars criticized virtual communities for their lack of direct social interactions [41, 42]. Bavec [43], for example, observes that virtual organizations have significantly reduced social interactions and the impact of this has often been underestimated. Bavec argues that virtual organizations are complex and this deficit in social interactions must be reflected in any theory (management or otherwise) of virtual organizations as sociotechnical systems. Wiesenfeld et al. [44] concur, arguing that virtual workers ‘are often separated from coworkers, supervisors, and other organization members, leading to feelings of

isolation, greater need for self-organization, and sometimes greater stress.’ However, the virtual organizational structure does not need to inherently translate into reduced social interaction. Rather, as Wiesenfeld et al. [44] observe, this ‘isolation and dispersion necessitates new communication systems, information systems, and sometimes even organizational culture change’. In choosing a case study to evaluate research questions similar to the ones posed in this paper, choose platforms which not only have SNS technologies which may have the ability to answer Wiesenfeld et al.’s call through new modes of synchronous communication, but also ones which are intuitive. For example, SNS cyberinfrastructure in Google+ has intuitive synchronous communicative tools including video-based meeting spaces (i.e. Google’s ‘Hangout’) which could potentially ameliorate some of the limitations of the less intuitive collaboration tools in Google Wave.

4.3 Look for case studies which have SNS systems conducive to community building in diverse contexts

The various failures of Google Wave have been bountifully documented, ranging from people not altogether clear what the purpose of the platform was [45] to labeling it as one of Google’s ‘most prominent flops’ [46]. Though Google Wave had many highly innovative features [39, 47], one of the aspects the pilot study found hindered it from success in fostering global virtual teams was its difficulties in fostering a ‘community ethos’. Though patterns of leadership were observed, the levels of regular, close collaboration needed for being a collaboration platform for global virtual teams were not seen. When looking for case studies to think about SNS in global virtual teams, it is critical to think about how SNS may or may not foster a community ethos. When doing this, it is also important to take into account national and cultural differences. For example, Morán et al. [48] found particular forms of impromptu SNS best suited to use in a Mexican hospital and Takahashi [49] illustrates differences in Japanese culture which affect the ways in which Japanese SNS have been designed.

Any successful global virtual team needs to eclipse the social constraints posed by the fact that individuals cannot interact face-to-face. Face-to-face communication is clearly critical in ‘traditional’ organizations. Communication is also ‘embedded in social process’ [50]. Following this line, Martins et al. [17] argue that VOs and virtual communities ‘face

a more difficult challenge in attaining effective communication due to reduced social context cues'. Much of this is due to the lack of spatial proximity and visual and audio clues. As Scott and Johnson [51] argue, traditional organizations can interact in 'overlapping settings', both at work as well as in community institutions and informal social settings. Though physical proximity can more easily foster rich chains of communication in the concomitant social networks, Scott and Johnson [51] ultimately conclude that 'e-communities can provide venues for rich and sustaining personal communication'.

Bell [52] argued that our 'post-industrial society [...] is also a "communal" society in which the social unit is the community rather than the individual'. The shift in organizational culture from organizations as only physically bound to the rise of virtual organizations follows this communality. Starting from Bell's work over 30 years ago, one can make the macro-sociological argument that if virtual organizations are to function as a cohesive social unit, they must have a 'community' ethos rather than function as atomized social units. Recent work suggests that this is true. For example, Blanchard and Marcus' [53] work makes the distinction between 'sense of community' (SOC) from 'sense of virtual community' (SOVC). They conclude that the lack of physical interactions in virtual spaces leaves individuals unsure on how to establish individual identity and communal rapport. Their work illustrates how communication and community building are qualitatively different in virtual organizations, but ultimately suggests that VOs can foster a 'community' ethos, akin to physical organizations, through the ongoing exchange of support and a shared sense of trust. Conway and Crowther [54] argue that early cyberinfrastructure including web-based bulletin boards did not do this. Therefore, successful studies of SNS in global virtual teams need to evaluate whether, in the chosen case study, SNS cyberinfrastructure may be able to foster shared norms and practices which overcome spatial, temporal, and cultural separation - encouraging a perceived sociometric proximity.

4.4 Look for case studies which have SNS systems conducive to trust development

A significant shortcoming of the pilot Google Wave study was the lack of coherent trust structures within individual Waves. Furthermore, it was difficult to structure research questions which could meaningfully evaluate specific Google Wave SNS functions and their ability to breed trust, which is

centrally important to the success of VBEs and VOs [4, 55] and, ultimately, global virtual teams. The VO literature has also begun to address this and has suggested that the communication of trustworthiness can be facilitated by ICT [56].

The SNS literature demonstrates that e-communities can facilitate extremely high levels of trust. For example, when a user logs onto Facebook, they are presented with a customized 'news feed', which aggregates information about all of one's friends (e.g. social events they are attending, status updates, messages they have posted, and pictures they have uploaded). This news feed continually engages users and encourages them to increase their interactions with their friends (e.g. posting a quick message or looking at a friend's photos). Cascio's [57] study of 29 virtual teams concluded that the exchange of social messages is highly correlated with trust in these teams, an argument which lends to the potential of SNS cyberinfrastructure facilitating trust in VBEs and VOs.

Trust between individuals is traditionally conceptualized as a product of personal perceptions of a person's past actions. In this model, trust is built over time, developing from shared experiences, repeated interactions, and shared social norms [58]. However, in temporary teams brought together for completing specific, directed tasks, team members most likely will not have met each other previously [59]. However, these groups can exhibit high levels of trust [60] despite having no prior trust 'track record' [61]. A useful model to understanding forms of trust in virtual temporary teams is 'swift trust', which is a form of trust conferred *ex ante* which 'accounts for the unique form that trust assumes in temporary systems' [59]. Following the model of swift trust, when choosing case studies, look for SNS that can foster individuals developing trust relationships *ex ante*. Having transparent and robust reputation systems can help enormously with this. Google Wave did not have reputation systems conducive to this type of trust (e.g. profiles or a point/rating system). Rather, the pilot study found that many Waves often lacked a regularity of updates, reciprocal exchange of social messages, and messages which are redolent of key trust factors such as 'benevolence' and 'integrity' (though we saw posts demonstrating 'ability') [58]. If further analysis was conducted, a lack of the development of 'benevolence', the 'extent to which a trustee is believed to feel interpersonal care and concern [...] to the trustor beyond an egocentric profit motive' [62], would be anticipated.

5. Conclusions

The exploratory pilot study which examined Google Wave and its potential to facilitate successful global virtual teams found that individual actors can be identified as having influence within individual Waves, but the study found that the platform is lacking in terms of being able to meaningfully test posed hypotheses of whether SNS technology fosters global virtual teams. Specifically, Google Wave lacked intuitive tools which consistently fostered focused collaborative activities.

Though significant levels of cohesion in specific Waves were found, the shortcomings of the exploratory pilot study led to the conclusion that Google Wave was not a well-suited case study for the posed objectives. In choosing the case studies for my current work, I reflected upon those four observations, looking for global breeding environments that seemed to use SNS to foster reciprocal social communication (often on non-professional themes), which was hypothesized to lead to meaningful forms of trust (which was hypothesized as being able to foster the development of successful global virtual teams). Drawing a line from the exploratory work on Google Wave to my current research work on life science VBEs, I see SNS as potentially providing a key ingredient to facilitating modes of 'swift trust'. Global virtual teams can potentially develop trusting relationships based on the 'integrity' of SNS profiles *ex ante* and further develop this trust through benevolent interactions (mediated by SNS).

Ultimately, the most important conclusions of this study are the development of basic ideas and pointers on how to think about this important field and observations on how to choose case studies for future work on SNS and global virtual teams. The observations include considerations of the need for reciprocal communication, intuitive synchronous communication tools, SNS systems conducive to community building, and SNS systems conducive to trust development. There are a broad range of disciplines which rely on global virtual teams and are evaluating the utility of SNS cyberinfrastructure. Furthermore, outside academia, technologists in the private sector who develop or are involved with the design/implementation of SNS for global virtual teams would benefit from thinking through the four observations raised and literature reviewed. Given an increasing interest in integrating SNS cyberinfrastructure in global virtual teams, it is critical that we think about core questions and critical case study selection.

6. References

- [1] Kerschbaum, F., Haller, J., Karabulut, Y., and Robinson, P., "Pathtrust: A Trust-Based Reputation Service for Virtual Organization Formation", in (Stolen, K., Winsborough, W.H., Martinelli, F., and Massacci, F., 'eds.'): Trust Management, Springer-Verlag, Berlin, 2006, pp. 193-205.
- [2] Collins, S.D., Communication in a Virtual Organization, Thomson, Mason, Ohio, 2003.
- [3] Bavec, C., "Trust -- the Basis of a Virtual Organization", Organizacija, 37(10), 2004, pp. 594 - 595.
- [4] Handy, C., "Trust and the Virtual Organization", Harvard Business Review, 73(3), 1995, pp. 40-50.
- [5] Travica, B., "The Design of the Virtual Organization: A Research Model", Americas Conference on Information Systems, 1997, pp. 417-419.
- [6] Bleecker, S.E., "The Virtual Organization", The Futurist, 28(2), 1994, pp. 9 - 14.
- [7] Mowshowitz, A., "Virtual Organization", Commun. ACM, 40(9), 1997, pp. 30-37.
- [8] Han, L.X., "The Performance Model of Dynamic Virtual Organization (Vo) Formations within Grid Computing Context", Chaos Solitons & Fractals, 40(4), 2009, pp. 1599-1608.
- [9] Afsarmanesh, H., Camarinha-Matos, L., and Ortiz, A., "A Framework for Management of Virtual Organization Breeding Environments Collaborative Networks and Their Breeding Environments", In Collaborative Networks and their Breeding Environments, (PRO-VE'05), 2005, pp. 35-48.
- [10] Msanjila, S.S., and Afsarmanesh, H., "Trust Analysis and Assessment in Virtual Organization Breeding Environments", International Journal of Production Research, 46(5), 2008, pp. 1253-1295.
- [11] Vallejos, R., Lima, C., and Varvakis, G., "A Framework to Create a Virtual Organization Breeding Environment in the Mould and Die Sector", IFIP International Federation for Information Processing, 224(2006), pp. 599-608.
- [12] Ermilova, E., and Afsarmanesh, H., "Modeling and Management of Profiles and Competencies in VBEs", Journal of Intelligent Manufacturing, 18(5), 2007, pp. 561-586.
- [13] Plisson, J., Ljubic, P., Mozetic, I., and Lavrac, N., "An Ontology for Virtual Organization Breeding

- Environments", *Ieee Transactions on Systems Man and Cybernetics Part C-Applications and Reviews*, 37(6), 2007, pp. 1327-1341.
- [14] Sánchez, N.G., Apolinar, D., Zubiaga, G., Atahualpa, J., González, I., and Molina, A., "Virtual Breeding Environment: A First Approach to Understanding Working and Sharing Principles", *InterOp-ESA'05*, 2005.
- [15] Bergquist, M., and Ljungberg, J., "The Power of Gifts: Organizing Social Relationships in Open Source Communities", *Information Systems Journal*, 11(4), 2001, pp. 305-320.
- [16] Desanctis, G., and Monge, P., "Introduction to the Special Issue: Communication Processes for Virtual Organizations", *Organization Science*, 10(6), 1999, pp. 693-703.
- [17] Martins, L.L., Gilson, L.L., and Maynard, M.T., "Virtual Teams: What Do We Know and Where Do We Go from Here?", *Journal of Management*, 30(6), 2004, pp. 805-835.
- [18] Wellman, B., Salaff, J., Dimitrova, D., Garton, L., Gulia, M., and Haythornthwaite, C., "Computer Networks as Social Networks: Collaborative Work, Telework, and Virtual Community", *Annual Review of Sociology*, 22(1), 1996, pp. 213-238.
- [19] Cummings, J., and National Science Foundation, *Beyond Being There : A Blueprint for Advancing the Design, Development, and Evaluation of Virtual Organizations*, NSF, Arlington, Va., 2008.
- [20] Kirkpatrick, D., *The Facebook Effect : The inside Story of the Company That Is Connecting the World*, Simon & Schuster, New York, 2010.
- [21] Hew, K.F., and Hara, N., "An Online Listserv for Nurse Practitioners: A Viable Venue for Continuous Nursing Professional Development?", *Nurse Education Today*, 28(4), 2008, pp. 450-457.
- [22] Cooper, C.D., and Kurland, N.B., "Telecommuting, Professional Isolation, and Employee Development in Public and Private Organizations", *Journal of Organizational Behavior*, 23(4), 2002, pp. 511-532.
- [23] Oshri, I., Kotlarsky, J., and Willcocks, L.P., "Global Software Development: Exploring Socialization and Face-to-Face Meetings in Distributed Strategic Projects", *The Journal of Strategic Information Systems*, 16(1), 2007, pp. 25-49.
- [24] Moody, J., and White, D.R., "Structural Cohesion and Embeddedness: A Hierarchical Concept of Social Groups", *American Sociological Review*, 68(1), 2003, pp. 103-127.
- [25] Forrest, R., and Kearns, A., "Social Cohesion, Social Capital and the Neighbourhood", *Urban Studies*, 38(12), 2001, pp. 2125 - 2143.
- [26] Cachia, R., Compañó, R., and Da Costa, O., "Grasping the Potential of Online Social Networks for Foresight", *Technological Forecasting and Social Change*, 74(8), 2007, pp. 1179-1203.
- [27] Feret, J.R.M., Danos, V., Krivine, J., Harmer, R., and Fontana, W., "Internal Coarse-Graining of Molecular Systems", *Proceedings of the National Academy of Sciences*, 106(16), 2009, pp. 6453-6458.
- [28] Dougherty, E., "Oh, Behave: Web Tools Tame Molecular Behavior, Make Advances toward Drug Discovery", *Focus: News from Harvard Medical, Dental, and Public Health Schools*, 2009,
- [29] Latour, B., *Reassembling the Social : An Introduction to Actor-Network-Theory*, Oxford University Press, Oxford ; New York, 2005.
- [30] Wasserman, S., and Faust, K., *Social Network Analysis : Methods and Applications*, Cambridge University Press, Cambridge ; New York, 1994.
- [31] Hölzle, U., "Update on Google Wave", *Official Google Blog*, 2010,
- [32] Weber, M., *The Protestant Ethic and the Spirit of Capitalism*, George Allen & Unwin Ltd, London, 1930.
- [33] Wilson, F., "Cultural Control within the Virtual Organization", *The Sociological Review*, 47(4), 1999, pp. 672-694.
- [34] Strader, T.J., Lin, F.-R., and Shaw, M.J., "Information Infrastructure for Electronic Virtual Organization Management", *Decision Support Systems*, 23(1), 1998, pp. 75-94.
- [35] Hughes, J.A., O'brien, J., Randall, D., Rouncefield, M., and Tolmie, P., "Some 'Real' Problems of 'Virtual' Organisation", *New Technology, Work & Employment*, 16(1), 2001, pp. 49.
- [36] Axelrod, R.M., *The Evolution of Cooperation*, Basic Books, New York, 1984.
- [37] Axelrod, R.M., *The Evolution of Cooperation*, Basic Books, Rev. edn, New York, 2006.
- [38] Livingstone, S., "Taking Risky Opportunities in Youthful Content Creation: Teenagers' Use of Social Networking Sites for Intimacy, Privacy and Self-Expression", *New Media Society*, 10(3), 2008, pp. 393-411.

- [39] Ivanova, M.S., and Alam, J., "Wave for Personal Learning Network Forming and for Collaborative Knowledge Transfer", *Annual Journal of Electronics*, 4(1), 2010, pp. 157-160.
- [40] Fitzpatrick, S.F., "Google Wave Is All Washed Up", *American Libraries*, 41(9), 2010, pp. 12-12.
- [41] Smith, M.A., and Kollock, P., *Communities in Cyberspace*, Routledge, London, 1999.
- [42] Turkle, S., *Life on the Screen : Identity in the Age of the Internet*, Simon & Schuster, New York, 1995.
- [43] Bavec, C., "On the Way to the Theory of Virtual Organizations", *Organizacija*, 35(4), 2002, pp. 221 - 227.
- [44] Wiesenfeld, B.M., Raghuram, S., and Garud, R., "Organizational Identification among Virtual Workers: The Role of Need for Affiliation and Perceived Work-Based Social Support", *Journal of Management*, 27(2), 2001, pp. 213-229.
- [45] Ovadia, S., "The Viability of Google Wave as an Online Collaboration Tool", *Behavioral & Social Sciences Librarian*, 29(2), 2010, pp. 158-161.
- [46] Cain Miller, C., "Google Gives up on Wave Service", *New York Times*, 2010, pp. 5.
- [47] Rethlefsen, M.L., "Google Wave: Collaboration Reworked", *Library Journal*, 135(2010), pp. 32-33.
- [48] Morán, A.L., Rodríguez-Covili, J., Mejia, D., Favela, J., Ochoa, S., Kolfshoten, G., Herrmann, T., and Lukosch, S., "Supporting Informal Interaction in a Hospital through Impromptu Social Networking Collaboration and Technology", *CRIWG'10 16th international conference on Collaboration and technology 2010*, pp. 305-320.
- [49] Takahashi, T., "Myspace or Mixi? Japanese Engagement with SNS (Social Networking Sites) in the Global Age", *New Media & Society*, 12(3), 2010, pp. 453-475.
- [50] Yates, J., and Orlikowski, W.J., "Genres of Organizational Communication: A Structural Approach to Studying Communication and Media", *The Academy of Management Review*, 17(2), 1992, pp. 299-326.
- [51] Scott, J.K., and Johnson, T.G., "Bowling Alone but Online Together: Social Capital in E-Communities", *Journal of the Community Development Society*, 36(2005), pp. 9-27.
- [52] Bell, D., *The Coming of Post-Industrial Society; a Venture in Social Forecasting*, Basic Books, New York,, 1973.
- [53] Blanchard, A., and Markus, M., "Sense of Virtual Community-Maintaining the Experience of Belonging", *Proceedings of the 35th Annual Hawaii International Conference on System Sciences (HICSS'02) -Volume 8*, 2002
- [54] Conway, S., and Crowther, D., "Virtual Networking Pre-and Post-Cyberspace: An Assessment of the Implications for Social Cohesion", *Studies in Social Marketing Working Papers Series*, 11, 2001.
- [55] Clases, C., Bachmann, R., and Theo, W., "Studying Trust in Virtual Organizations", *International Studies of Management & Organization*, 33(3), 2003, pp. 7-27.
- [56] Kasper-Fuehrera, E.C., and Ashkanasy, N.M., "Communicating Trustworthiness and Building Trust in Interorganizational Virtual Organizations", *Journal of Management*, 27(3), 2001, pp. 235-254.
- [57] Cascio, W.F., "Managing a Virtual Workplace", *Academy of Management Executive*, 14, 2000, pp. 81-91.
- [58] Jarvenpaa, S.L., and Leidner, D.E., "Communication and Trust in Global Virtual Teams", *Organization Science*, 10(6), 1999, pp. 791-815.
- [59] Meyerson, D., Weick, K.E., and Kramer, R.M., "Swift Trust and Temporary Groups", in (Kramer, R.M., and Tyler, T.R., 'eds.): *Trust in Organizations : Frontiers of Theory and Research*, Sage Publications, Thousand Oaks, Calif., 1996, pp. 166-195.
- [60] Xu, G., Feng, Z., Wu, H., and Zhao, D., "Swift Trust in a Virtual Temporary System: A Model Based on the Dempster-Shafer Theory of Belief Functions", *Int. J. Electron. Commerce*, 12(1), 2007, pp. 93-126.
- [61] Robert, L.P., Dennis, A.R., and Hung, Y.-T., "Individual Swift Trust and Knowledge-Based Trust in Face-to-Face and Virtual Team Members", *J. Manage. Inf. Syst.*, 26(2), 2009, pp. 241-279.
- [62] Jarvenpaa, S.L., Knoll, K., and Leidner, D.E., "Is Anybody out There?: Antecedents of Trust in Global Virtual Teams", *J. Manage. Inf. Syst.*, 14(4), 1998, pp. 29-64.