Building an Inductive Theory of Collaboration in Virtual Teams: An Adapted Grounded Theory Approach

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Abstract
In this paper, we outline how the grounded theory methodology (Strauss and Corbin’s version) was adapted to develop a theory of collaboration in virtual teams. Specifically, we studied virtual teams composed of students from a US and a Canadian university engaged in 14 week long systems development projects. We analyzed data using adapted versions of open coding, axial coding, and selective coding. Based on our theoretical sensitivity, we also developed a meta-theoretical framework through a synthesis of the data we interacted with, the symbolic interactionist perspective, and structuration theory. We used this framework as an alternative to the “paradigm model” during selective coding of data. This paper makes two important contributions: 1) methodologically, it can serve as a guide for researchers interested in using the grounded theory approach; and 2) substantively, it presents a holistic and processual understanding of virtual teams that researchers in this area have called for.

1. Introduction
In this paper, we illustrate how the grounded theory methodology, suitably modified, can be used to develop theory about new forms of IT-enabled organizations and associated phenomena in a creative yet systematic fashion. As innovative forms of human organizations such as “virtual teams” appear, there is a need to understand these organizations in order to evaluate them and manage them [13, 20, 22]. Specifically, our objective in this project was to develop a theoretical understanding of collaboration in virtual teams engaged in the analysis, design, and implementation of information systems. Given the nascent state of knowledge on virtual teams in our discipline (IS), we felt that it would be appropriate for us to adopt an inductive methodology that would guide theory development on virtual team collaboration based on the experiences of those who are, or have been, members of virtual teams. Of the different methodologies available for inductive theory, we chose the grounded theory methodology, which has the following salient features: a) it emphasizes the need for the researchers to be immersed in data, and highlights the need to consciously guard against imposing a theory from a related substantive area [9, 21]; b) it does not require the researchers to suspend or ignore all pre-existing theoretical knowledge, but instead encourages the development/enrichment of inductively derived theories by drawing upon (though not driven by) broad theoretical approaches that are not in the same substantive area [8]; c) it involves both inductive and deductive thinking [6, 19]; and d) it synthesizes subjective sampling and analysis techniques with systematic coding procedures [19], thus allowing the researcher to be flexible and creative, yet rigorous.

The rest of our paper is organized as follows: We first discuss the Strauss and Corbin version of the grounded theory methodology [18, 19] that has gained immense popularity in many arenas of social science since its publication. Next, we step the reader through the process of coding using the adapted version of Strauss and Corbin’s guidelines [19], and present an abbreviated version of the model of virtual team development that is grounded in data generated during virtual collaboration. Finally, we conclude our paper with a summary of contributions.

†All three authors contributed equally to the project and to the paper.
2. A summary of Strauss and Corbin's version of the grounded theory approach

The grounded theory approach is a "qualitative research method that uses a systematic set of procedures to develop an inductively derived grounded theory about a phenomenon" [19]. The methodology is designed to help researchers produce "conceptually dense" theories that consist of relationships among concepts representing "patterns of action and interaction between and among various types of social units" [19]. Potential sources of data for developing grounded theory include interviews, field observations, documents, and videotapes [18].

At the heart of the grounded theory methodology, are three coding procedures of open coding, axial coding, and selective coding [19]. These codes are generated and validated using the constant comparative method, and coding, at each stage, terminates when theoretical saturation is achieved with no further codes or relationships among codes emerging from the data.

Open coding involves "breaking down, examining, comparing, conceptualizing, and categorizing data" often, in terms of properties and dimensions [19]. The examination of data in order to fracture it and generate codes could proceed "line by line" (most tedious but most generative, and therefore, often recommended during the initial phases of analysis), by sentence or paragraph, or by a holistic analysis of an entire document. The open coding process, while procedurally guided and promoting a realist ontology, requires researchers to "include the perspectives and voices of the people" whom they study [18]. Data, for open coding, is selected using a form of theoretical sampling known as "open sampling." Open sampling involves identifying situations/ portions of the transcripts that lead to greater understanding of categories and their properties. Grounded theory coding and sampling must never be delegated to hired assistants, but must be done by the researchers who have a stake in the theory emerging from the project [8, 19].

Axial coding refers to the analytic activity for "making connections between a category and its sub-categories" developed during open coding [19], i.e., reassembling fractured data by utilizing "a coding paradigm involving conditions, context, action/interactive strategies and consequences." Strauss and Corbin [19] warn researchers that "(u)nless you make use of this (paradigm) model, your grounded theory will lack the density and precision." During the process of axial coding, the relational and variational sampling technique is used, where data is sought depending on its ability to suggest relationships among a category and its sub-categories, or its ability to support or falsify a plausible relationship of a category with its subcategories.

Selective coding involves the identification of the "core category" (central phenomenon that needs to be theorized about) and linking the different categories to the core category using the paradigm model (consisting of conditions, context, strategies, and consequences). Often, this integration takes the shape of a process model with the linking of action/interactive sequences. In creating a process model, according to [19], the researcher:

..must show the evolving nature of events by noting why and how action/interaction – in the form of events, doings, or happenings – will change, stay the same, or regress; why there is progression of events or what enables continuity of a line of action/interaction, in the face of changing conditions, and with what consequences.

The theoretical sampling strategy of discriminate sampling is used to select appropriate data at this stage such that weak connections between the categories can be inductively strengthened, and relationships that have already emerged can be deductively tested.

Another issue that we would like to touch on, at this stage, is the role of theoretical sensitivity. Theoretical sensitivity as "the ability to recognize what is important in data and to give it meaning" by drawing on the literature and personal experience, and by interacting with the data [19]. In other words, the grounded theory methodology does not view "inductive theory building" as implying that the researchers need to flush out their pre-existing theoretical conceptions or knowledge about the phenomenon under investigation, and just let the data speak for itself. In fact, the background that the researcher brings to the interaction with data often leads to creative and important insights [19]. However, the grounded theory researcher is required to be self-reflective so as to be wary of potential biases resulting from her background, and rigorously validate categories and hypotheses emerging as a result of her theoretical sensitivity.

3. Our methodology – an adapted grounded theory approach

In this section, we describe our study, the data, and the coding process, sources of our theoretical sensitivity, and our deviations from Strauss and Corbin’s grounded theory methodology, along with the justifications.
3.1. An overview of the study and data sources

In the context of our study, the virtual teams were comprised of students from a Canadian university (UA) and a U.S. university (UB), working collaboratively to study a business information systems problem, converting it into a systems design, and then developing a working prototype. Each of the 12 virtual teams participating in the study consisted of 4-5 "internal" or "local" group members who were matched with 4-5 "external" or "remote" members from the other university. Thus, each virtual team consisted of about 8-10 members drawn almost equally from UA and UB. The projects lasted for about 14 weeks. While UA members were primarily responsible for formulating the information requirements and the end-user interface requirements, UB members were responsible for the design and development of the systems.

A number of communication and coordination technologies were available to the virtual team-members, including web-based conferencing called Webboard®, e-mail, videoconferencing, faxes and telephones. Webboard was officially designated as the primary channel of communication throughout the life of the project. While e-mail allowed communication on a one-to-one basis, the Webboard allowed communication to take place in a public domain, and thus, be visible to all other students as well as the faculty involved. While all communication on the Webboard was automatically recorded and saved, students were asked to provide all e-mails exchanged, and post "minutes" of all videoconferences, telephone conversations, and Internet chat sessions. We recognize that, in virtual teams, the members can be spread across multiple locations in time and space; however, in our case, the members were located in just two geographically separate locations, representing a dyad. We refer to the two sides of the dyad as UA and UB.

3.2. Data Collection

Empirical material included Webboard and e-mail messages, logs of on-line chats, video-conferencing tapes, direct observation by facilitators, final team project reports, reflection documents, and diaries.

3.3. Informal Data Analysis

Data analysis was done in both informal and formal sessions. Informal data analysis started as soon as the virtual teams were "formed" in the first week of the project. The three researchers (two of them played the roles of participant observers) informally interacted with the data as messages were posted and events started unfolding, deriving theoretical sensitivity from the process of interaction with the data and among themselves, consistent with the recommendations of Strauss and Corbin [19]. At this stage, we, the researchers, also started identifying aspects of their own backgrounds that could be brought to bear in the theorizing about virtual collaboration. We also identified additional readings in areas such as symbolic interactionism, while "guarding against becoming captive" to any literature [19], and paying heed to Glaser [8] who states:

It is vital to read, but in a substantive field different from the research. This, maximizes the avoidance of pre-empting, pre-conceived concepts which may easily detract from the input.

Being located in two different universities in different countries, we, the researchers, were ourselves collaborating in a virtual environment, and this personal experience further sensitized us to virtual team related issues [19].

3.4 Formal data analysis and theory development using open, axial, and selective coding

Formal data analysis started after the data collection had been completed. Being familiar with the hermeneutic processes of distantiation, autonomization, social construction, and appropriation [14], we recognized that it would be difficult (though not impossible) to generate codes that would be true to the realist ontological assumptions underlying the open coding procedures, if we were separated in space and time during coding. As a result, coding was done during three research trips when all three researchers could work together, face-to-face.

Open coding was done line-by-line initially, and thereafter, open sampling and open coding was done at the Webboard/ e-mail message level. Other documents such as reports, reflections and diaries were sampled and coded at a document level. We generated several hundred codes using the open coding procedure. We offer an example to illustrate how we open coded. In Table 1, we show the first three messages posted by the UA members of a particular team. The UB members had not posted any message up to this point. The only other messages that had been posted, were from the facilitators, who had listed the members of each team, and provided some guidelines for communication and collaboration.

Two important codes were also generated as we considered the three messages as a unit or "strip", and compared it with comparable strips, i.e., messages posted

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\*“A strip is a bounded phenomenon against which an ethnographer tests his or her understanding” [1]. We adapt this concept to signify a “unit” of datum used to generate/verify a concept or a relationship.
in other teams during the same stage. One was the directionality of the messages. It is clear that in this case, all messages were being posted by UA members, with no acknowledgement or response by UB members. In fact, it was not even clear if UB members were co-present, i.e., monitoring the communication media linking the virtual members. Another interesting code that emerged was the nature of the messages (social, project-oriented, mixed). It is clear that UA members in this particular team did not feel it necessary to develop a rapport with remote members at UB, by talking about weather, games, music, personal interests, before focusing on project related norms. Some of the other teams, for example, talked about the Lewinsky affair with Clinton, Olympic hockey, drinking, rock groups, etc. presumably to build a social relationship with virtual partners.

Through the use of the constant comparative method, we continued to merge, change, and occasionally, eliminate codes and their labels. We would like to report, however, that we were unsuccessful in developing dimensionized properties of each category/sub-category, as recommended by Strauss and Corbin [19]. As we attempted to generate codes with dimensionized properties, we found that it was difficult to distinguish between properties and sub-categories in many instances. Also, looking ahead, it was getting clear to us, given the large number of categories/sub-categories that were emerging, it would be virtually impossible for us to hypothesize and deductively validate relationships (among sub-categories and categories during axial coding, and between the core category and other categories during selective coding) based on all combinations of properties. After struggling for several hours with, what we felt was a cumbersome procedure without commensurate benefits, we decided to depart from this specific methodological guideline.

The goal of axial coding is to facilitate the linking of sub-categories with their respective categories. Strauss and Corbin [19] propose a “paradigm model” (see below for a simplified version) for structuring this linking process:

CAUSAL CONDITIONS \(\rightarrow\) PHENOMENON \(\rightarrow\) CONTEXT \(\rightarrow\) INTERVENING CONDITIONS \(\rightarrow\) ACTION/INTERACTION STRATEGIES \(\rightarrow\) CONSEQUENCES.

While we found the concepts embedded in the “paradigm model” helpful in thinking about ways to relate sub-categories with categories, we found the structure of the paradigm model too mechanistic and unnecessarily constraining. Not all sub-categories of a category could be neatly categorized as causal conditions, context, intervening conditions, action-interaction strategies, or consequences. In addition, in many cases, unidirectional deterministic relationships between the causal conditions and phenomenon, and between the phenomenon and its consequences, were not apparent from the data, and needed to be forced. As we went through the process of trying to fit our data to the paradigm model, we began to understand the severe criticism of the Strauss and Corbin version by Glaser, the co-originator of the grounded theory methodology [7]:

When I first read Basics of Qualitative Research, I was outraged at the non-scholarly changes in grounded theory, the reversion to the verificational approach and the required paradigm, the putting back of all the ills of preconception and forcing into the method, why it didn't appear like what he (Strauss) had truly read and understood what we had written together, why he seemed to ignore my fundamental inputs into his version of grounded theory and so forth (emphasis added).

We attempted to accomplish the objective of “axial coding” (i.e., connecting sub-categories with categories) by:

* Identifying the major categories (e.g., technology, norms, communication, social practices, stages of team development, frames of reference), hierarchically relating them to sub-categories, and entering them into NUD*IST [17]. For example, the category of technology was linked to the subcategories of purpose of technology, class of technology, nature of ownership, future potential, degree of novelty, etc. At the next level, purpose of technology was linked to information sharing, triggering effect, relationship management, identity articulation and territory definition, record keeping, team memory, justification, bridging time and space, etc. Similarly, other sub-categories were linked to other sub-sub-categories.

We would like to note that, during this step, we had to revisit and refine our open codes, thereby alternating between the “distinct analytic procedures” of open coding and axial coding modes [19].

* Creating an integrative memo on each of the major categories, that was interpretive in nature. Our attempt was to integrate as many sub-categories as possible within the memo on a category. As in the case of categories/subcategories identified through open coding, the memos (the outcome of axial coding) also continued to evolve as we continued sampling for axial coding, and later, for selective coding. Presented below, is the first draft of our integrative memo\(^6\) (with minor modifications to improve readability) for the category:

\(^1\) Interestingly, we did not find this methodological guideline in other articulations of the methodology in the literature, or find evidence of its application in well-recognized grounded theory research [15, 21].

\(^6\) This memo attempts to integrate the sub-categories and the sub-sub-categories of technology presented during the discussion on open coding. Also, we do not claim that this memo is exemplary in the way it
Collaboration across time and space requires mediation by technology for both symbolic and substantive purposes. Substantive purposes include sharing information, record-keeping, managing relationships, pacing, and triggering of activities in collaboration. Some symbolic uses of technology involve the articulation of self and group identity and legitimizing different courses of action by appealing to the use of technology.

Different classes of technology provide different capabilities, some of them different from the features of technology as defined from the designers’ or the implementers’ points of view. For example, we wanted Webboard to be a public record. Students have extended this use by creating a local enclave for information exchange with local members in a domain traditionally thought of as being public. The Webboard has also become a project archive, conserving team memory through the documentation of agendas, minutes, project steps, and deliverables.

Virtual teams build their own sense of interconnectedness into their practices. Switching between e-mail, Webboard and fax. Threads of communication appear to be unique across teams. It depends on personalities involved, task at hand, accessibility to technology, preferences (more individual than group), immediacy of tasks, time deadline...

Videoconferencing was seen as positive not because of project experiences but because it was viewed as highly novel with future career potential. In some cases, videoconferencing was seen as the project.

Multiple tasks and technologies were used in the project, they were effective for some aspects of the project but not others. Depends on how people have appropriated a communication technology for different tasks. The two popular theories are information richness and social definition. Our experience is that neither seems to explain the situation...

In understanding the local appropriation of technology, social definition is only one part of the equation. Manner in which social definition takes place because of the virtual group setting needs to be investigated.

Use of different technologies dependent on the interconnectedness with other technologies and people at a particular time and location influenced the use of different media (technologies) for different purposes... All kinds of hassles involved with booking locations and synchronizing for videoconferencing. While it has broader “bandwidth”, it has other contextual constraints. Participants (students) tended to see it negatively as videoconferencing ruined their Saturdays. Perceptions regarding technology get shaped by the context, which influence the participants’ technological frames and their use of technology.

Similar integrative memos were developed for other major categories as part of axial coding.

The objective of selective coding is to explicate a story by identifying a core category and linking the other categories around the core category. We found that identifying and committing to a story line is no easy task since “one is so steeped in the data that everything seems important, or more than a single phenomenon seems salient” [19]. Strauss and Corbin again propose the “paradigm model” as the solution, arguing that the model would structurally facilitate the arrangement, rearrangement, and linking of categories and sub-categories. While we agree with Strauss and Corbin regarding the need of a framework to identify and develop the story line, we feel that the “one best approach” of forcing the “paradigm model” in every grounded theory project, is limiting and not true to the idea of “emergence,” as Glaser has argued [7]. Instead, we feel that broad theoretical frameworks (meta-theories) that the researchers identify as relevant based on their interaction with the data may be more useful. In our case, we felt that the meta-theories of symbolic interactionism [2, 3, 4] and structuration [10, 11, 12] provided the mechanism for explicating a story line that was grounded in the data. We now provide an overview of the meta-theoretic perspective that we used to undertake selective coding.

3.4.1 Meta-theories used in developing the story line.

An important realization we had as we started interacting with the data, is that all action, in the context of virtual teamwork where members were not co-located in space and time, had to be understood on the basis of communication. Thus, we needed a framework that would guide our understanding of the action that was implied in the communication transactions among members of a virtual team. We found the work of Carl Couch very useful in this regard. Couch describes the study of communicative action and practices as key to understanding human societies, and maintains that any adequate theory of human conduct must use the concepts of communicative transactions, information symbols, and the directionality of communication as the basic units of analysis [2]. We take these three units of analysis suggested by Couch, along with the notion of co-presence, a prerequisite to achieving communication, as the analytical framework to develop a micro-level understanding of communicative action in virtual teams.

We now discuss these concepts as they apply to virtual teamwork.

Co-presence refers to the situation in which potential collaborators share consciousness of each other’s presence through some combination of text, auditory, and visual contact. Communicative transactions represent the basic units of communication such as messages that are exchanged between the members, using e-mail, computer...
conferencing, or other appropriate media/technologies. The message contents and the media used, taken in conjunction, has been conceptualized as the communicative transaction. Information symbols may be of two types: referential and evocative [2]. Referential symbols denote objects, events and sequences in the communication process, and are useful in coordinating communication processes. In comparison, evocative symbols help members to develop social solidarity, for example, through the sharing of humor, stories, or personal anecdotes that are not formally (or directly) related to the project. Communication directionality, in the context of virtual teams with its members distributed across two geographical locations, is of three types. Unidirectional communication refers to the communication pattern where members at one physical location are sending messages but members on the other side are not responding. Bi-directional conversation is said to occur when members from both sides are sending messages, but not actually responding to messages from the other side in a substantive and cooperative manner. In a sense, they are speaking past, or in Couch’s terms, with respect to each other, since the actors are not sharing affect or co-orientation. Mutual communication develops with growth of shared co-orientation. Members on both sides start to speak with each other, responding to each other’s messages, mutually sharing common experiences, and planning/acting not only as per individual or local interests but by taking the priorities, constraints, and interests of team-members in other locations.

By examining the communicative transactions, information symbols, and communication directionality within the specific context of a virtual team project, we develop inferences about the nature of communicative actions.

Giddens’ structuration theory [10, 11, 12] provided us with an avenue to link the communicative action with the structures associated with the virtual teams. (Since structuration has been a popular meta-theory among IS researchers, we do not discuss it in detail in this paper.) Consistent with [10, 11, 16], we take structure to represent the team-members’ interpretations of the norms, resources, and the shared frames that are available to their (virtual) teams, which are drawn upon to facilitate, legitimate, and make sense of their communicative actions. It is important to emphasize that structure is not static but continuously changing. Over the period of a project, different structures are created, reproduced, and transformed through communicative action of the virtual team-members. These very structures provide a framework within which subsequent action can proceed.

Our task, during the process of selective coding, was to utilize the meta-theoretical framework derived from symbolic interactionism and structuration to interpretively string together a theory involving all major categories/sub-categories, while continuously seeking to verify/falsify aspects of the emerging theory using data obtained through discriminate sampling.

Strauss and Corbin argue that it is essential that the grounded theory researchers choose one category as the core category “in order to achieve tight integration and dense development of categories required of a grounded theory” [19]. They add, that other important categories may be treated as the core category in a different paper where a different grounded theory may be formulated and articulated. In our case, the theoretical sensitivity derived from Couch as well as Giddens allowed us to select “stages of team development” as our core category (at least for this paper), to conceive it as a changing structure of the team, and link it to communication (and the implied action), using the categories of norms, shared frames, technology along with the respective sub-categories. To maintain the focus in our story line, we had to refine and also drop a number of sub-categories that had earlier been included in our axial coding memos. We next provide a summary of our grounded theory as a testimony to the power of the adapted methodology.

### 3.5. A grounded theory of virtual team development

Our “story” describes how virtual teams pass through different stages of development during the course of the project. We term these stages as initiation, exploration, integration and completion. It is important to note, however, that different groups have varying rhythms and mechanisms by which transitions take place (or not) from one stage to another.

In the initiation stage, after teams have been “formed,” distributed members of virtual teams experience considerable ambiguity regarding their roles, the shared goals of the overall project, and the norms by which teamwork should proceed. Adding to this ambiguity and complexity, is the absence of shared norms on the use of communication/coordination technologies, since team members in different locations have varying backgrounds and experiences with different technologies.

Within these circumstances, the facilitators play a key function in partially defining the context around which the project should proceed. However, the “external norms” proposed by the facilitators have to be appropriated by the virtual team members in order to guide their communicative action. Team members’ prior experience with collaborative work and technology mediates how external norms are internalized by particular members, reinvented, and then proposed to other team members over the communication medium.
Initiation involves planting of the seed of an effective social relationship across time and space. Time-space adds to the uncertainty since there is no name to the face, and members are separated by time-zones, geographical distances, and culture, giving a sense of the unknown on one hand, and the wonder of a new experience, on the other. In this context, it becomes important as to which group starts the process of proposing norms, what norms are proposed, the manner in which it is done, and the interpretive schemas through which members try to internalize it.

The nature of communication in the initiation stage is typically unidirectional. Members of the team taking the lead in communication may entrust themselves with the initial responsibility of establishing their own and their local team members' co-presence on different communication media by posting their names, email addresses and ICQ-Ids, etc. The more proactive members may invite remote members to become co-present on the communication media in different ways. A number of mechanisms (e.g., wooing, reference to external norms/higher authorities, reference to deadlines) can be used for enabling this process of enrollment and to make the transition from the initiation stage to the next stage of exploration. Transition to the next stage of exploration takes place as members of the other side of the virtual team establish their co-presence, start monitoring the different communication channels, and respond to the invitations or coercions of remote members.

The exploration stage of virtual team development is characterized by active co-presence of the remote members, being reflected by the fact that messages are posted and monitored by both sides. Each side is in the process of proposing, however tentatively, their sets of norms and expectations about how the project should proceed. While there is evidence of bi-directional communication, there is a notable absence of mutuality. Members of each side monitor each other's presence in the communication technology medium and provide information to each other, without responding specifically to each other's concerns. There is a clear differentiation between intra- and inter-location interests and norms at this stage, with little evidence of merger of interests taking place between self (local team members) and the others (remote team members). Rather than discussing overall project goals, the team members appear to focus on local goals and concerns. In this stage, team members explore the process by which the norms of communication and collaboration should develop, and also try to deal with their sense of identities. Influencing this process of exploration, is the manner in which information transfer takes place between the team members. Information when publicly articulated through the use of technologies such as the Webboard, usually allows for its greater visibility to the rest of the team. If widely shared among team members, information can help form the basis for developing a shared focus and doing work in a coordinated fashion. It is important to note that a widespread diffusion of norms may not take place if the majority of communicative transactions use email directed to individuals, since the lack of visibility of information to all team members may make the global acceptance of the norms more difficult. Some members also experience a tension between their local versus global identities during this stage.

To facilitate the transition of the virtual teams to the next stage of integration, which involves a higher degree of mutuality in communication and consequently coordinated action, virtual teams appear to use the three following mechanisms: external events, use of technology, and the building of social solidarity. External events such as project deliverable deadlines may act as a powerful external force for members to work together in a coordinated fashion. This occurs as team members from different locations rally around an external event thereby moving from the state of bi-directional to mutual responsiveness. The use of technology such as videoconferencing, in addition to providing an occasion for coordinated work by its technical properties of synchronicity and multiple channels of audio and video, enables real-time contact. This real-time “audio” and “visual” contact between team members can help in the clarification of local versus global objectives, which can then help enable the transition to the next stage of integration.

Finally, social solidarity allows team members to emotionally respond to similar occasions, setting stage for the transition to the next stage of integration. Social solidarity is developed through the use of evocative symbols in communication, such as humor, personal anecdotes, and other stories. While the evocative symbols may be unrelated to the substantive aspect of the project, they can help in communicating a sense of intimacy and closeness between the members.10

The integration stage of virtual team development is characterized by the formation of a shared frame of reference, mutuality in communication, and substantive focus in the communications. Shared frame of reference implies that both local and remote members have a common understanding of their goals, their roles, and the norms guiding their communication/collaboration. This leads to the development and articulation of a shared

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10 It may be useful, from the methodological point of view, to note here, that each of the three mechanisms of transition to the integration stage was verified using discriminate sampling of relevant strips. Interestingly, a mechanism of increased frequency of message posting that was suggested by the data initially, did not survive the deductive tests using data obtained through discriminate sampling.
focus and common team-level identities irrespective of the physical locations of the team-members.

In this stage, mutuality of communication is also evident, as team members show empathy and respect for the suggestions, objectives, and constraints (e.g., schedules) of remote members. In addition, the communication in this stage of integration involves intensive discussion around substantive issues relating to the completion of the project. Since mutual trust and respect has already been established between team members, it becomes easier for substantive discussions around project related issues to take place. It is important to recognize that the creation and maintenance of social solidarity through the use of evocative symbols has an important role in sustaining the integration among team-members. While social solidarity is not a necessary condition for effective collaboration in a virtual team, it is the "glue" that prevents the team (in the integration stage) from regressing to its earlier stages (initiation or exploration) in the event of misunderstandings among remote team-members regarding referential symbols11.

Transition to the final stage of the virtual team development may involve the following two mechanisms: a sense of anticipation of project completion and impending external deadlines.

The completion stage involves the physical closure of the project by handing over the final project deliverables to the project authorities and the subsequent disbanding of the virtual teams. This sense of nearing the end of the project is expressed by virtual team members in either positive or negative ways, depending on the overall project outcome and the experiences that the members have had during the course of virtual work.

There are two ways in which celebration of the joint achievement can be expressed by team members: first, through communication which expresses joy on the completion of the project satisfying external requirements, but in which emotional involvement is at a minimum, as evident from a formal but cordial nature of parting company with remote members; second, this celebration may be expressed through communication that reflects the positive shared social experiences of members working together and in successfully accomplishing work in a virtual team, with participants expressing their emotional attachment with other team-members and signifying the pain of parting company.

Alternatively, teams not experiencing success in their project may express their sense of project closure in two ways. First, there could be a sense of individual relief that the stressful experience of virtual teamwork is over. Often, the remaining priority of the team members may be to minimize the damage of negative outcomes to their professional careers. Second, such teams may reach closure by publicly expressing their misgivings regarding other virtual team members, the technology used, and the entire process of collaboration itself.

4. Discussion and conclusion

In this paper, we have argued for the need to study new forms of organizations such as virtual teams using a predominantly inductive approach. The grounded theory methodology provides an excellent apparatus for inductive theory building. While we find elements of the popular version of the methodology [19] mechanistic, and implicitly encouraging “forcing” rather than “emergence,” we feel the approach can be very useful, especially when adapted in accordance with the nature of topic of investigation and the data collected, philosophical and methodological assumptions of the researchers, and the accepted norms of methodological rigor required in the academic discipline within which a grounded theory inquiry is being conducted. Our own adaptation of the methodology had many similarities but few differences with the Strauss and Corbin version, which we summarize in Table 2.

Specifically, with respect to open coding, we feel that even without the use of dimensionalized properties, the coding procedure ensured that we intimately knew our data. Having undertaken other forms of qualitative research that involve holistic understanding of the transcripts, we feel that we are in a position to say that open coding would contribute positively to any genre of inductive qualitative research by facilitating the immersion of the researcher in the data. The researcher should, however, be aware that open coding (and open sampling) could continue endlessly [5] unless the researcher uses her instincts to terminate the process.

In attempting to achieve the goals of axial and selective coding, we were forced to sort our codes, think of possible relationships among them, and refine the codes as well as the relationships among them. However, we did not adopt the “paradigm model” that Strauss and Corbin proposed. Instead, our tactic of axial coding involved creating memos for each category, where we attempted to interpretively link important sub-categories to the category. By viewing our data in this form, we could learn a great deal on what we thought were the important categories, and this learning proved to be a useful foundation during the selective coding step.

We found that it is extremely difficult to undertake selective coding without the guidance of a (meta-theoretical) framework. We see the “paradigm model” [7]
as one possible framework facilitating selective coding, with its own set of assumptions and structure of the theory it generates. In our case, we used the symbolic interactionist and the structurational perspectives to select a core category as the focus of our theory, and then weave the other categories and sub-categories into this theory. We do believe that without this theoretical sensitivity acting as a scaffold\textsuperscript{12}, we would be hard-pressed to link different categories into a coherent theory. At the same time, without our intimate understanding of the data, the meta-theoretical perspectives could not have led to the development of the theory.

We would also like to point out, that like “dimensionalized properties” and the “paradigm model,” the criterion of “theoretical saturation” for terminating the coding process, while theoretically useful, is of little practical value. In this connection, Flick comments that “the criterion of theoretical saturation leaves it to the theory developed up to that moment, and thus to the researcher, to make such decisions of selection and ending.” [7] making the distinction between method and building is ultimately an art, but this does not preclude the use of systematic procedures such as those offered by grounded theory methodologists to ensure a strong foundational structure for the artistry to flourish.

In closing, we believe that the adapted grounded theory methodology that we describe in this paper can accommodate the creativity, flexibility, and the insightfulness of researchers, while incorporating the rigors of systematic data collection (sampling), data analysis, and deductive verification of inductively derived codes/relationships. Few methodological approaches can accommodate the ontological and epistemological range as the grounded theory, and we invite other researchers to utilize and evaluate the adapted version of the methodology in their future investigations of emergent forms of organizations and technologies.

5. References


\textsuperscript{12}The concept of “scaffold” was suggested to one of the co-authors of this paper by Prof. Geoff Walsham in relation to another project.
### Table 1. Open coding illustration

<table>
<thead>
<tr>
<th>Message</th>
<th>Post date, Week#, Time</th>
<th>Sample Codes generated (underlined) &amp; notes</th>
</tr>
</thead>
</table>
| Hi there in UB, I’m Henry. I just wanted to say hello and provide you with the rest of our group members’ e-mail address…. [Names and e-mail addresses] Well, I guess we’ll see each other on Saturday at the videoconference | 1/22/98, week 1, 1:41:52 PM | 1. Leadership – initiative to represent  
2. Establishing team’s co-presence on the internet  
3. Implying preference for communication technology (e-mail)  
4. Implying technology (VC) can bridge the time and space gap. |
| Hello UB, Just letting you know that you are free to e-mail us anytime. I might be getting an ICQ account going so that if any of you are into real-time chat and wish to communicate that way, it might be something to try…. | 1/26/98, week 1, 2:56:37 PM | 1. UB members’ identity viewed at an aggregate level (as in msg. #1)  
2. Collapsing/bridging across time boundaries  
3. Invitation  
4. Implying preference for communication technology  
5. Properties of communication technology/medium (real-time, synchronous?)  
6. Novelty of technology, recognizing the need to try/explore |
| This is Johnny here from the UA. I think that it would be nice to start collaborating on a regular basis so that we can get into the groove of doing it regularly. We will e-mail you as well as post information on the Webboard so please keep updated by checking both regularly. Thanks and I look forward to working with you on this project. | 1/28/98, week 1, 2:44:06 PM | 1. Self-identity associated with local/physical affiliation.  
2. proposing norms of collaboration, technology-use, timeliness  
3. Implying preference with respect to technology; only partially accepting and modifying the external norm of technology (Webboard use) suggested by professors.  
4. Expressing focus on joint future |

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### Table 2. A comparison between the Strauss & Corbin approach and our approach

<table>
<thead>
<tr>
<th>Aspect of the methodology</th>
<th>Strauss and Corbin’s approach [19]</th>
<th>Our Adapted Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Data sources</td>
<td>Interview transcripts, field observations, documents, video, etc.</td>
<td>In addition to all sources mentioned under Strauss and Corbin, we utilized communication transactions generated by participants during virtual collaboration.</td>
</tr>
<tr>
<td>2. Open coding</td>
<td>Involves immersion in the data and generation of concepts with dimensionalized properties using constant comparison.</td>
<td>Almost same; no dimensionalizing of properties involved; hermeneutic process. NUD*IST used to link “strips” of data to categories/subcategories.</td>
</tr>
<tr>
<td>3. Axial coding</td>
<td>Identifying categories and mechanistically linking them with respective sub-categories using the “paradigm model”</td>
<td>Identifying categories and sub-categories. Next, generating integrative memo for each category, which involves linking the category to its sub-categories in an interpretive manner. However, the patterns suggested in the memos are continually challenged and validated. NUD*IST used to store interpretive memo.</td>
</tr>
<tr>
<td>4. Selective coding</td>
<td>Selecting a core category and creating a story line about the core category. This story line links other categories to core category. Selection of the core category and linking it with other categories involve the application of the “paradigm model” at the level of categories.</td>
<td>Selecting a core category and creating a story line about the core category. This story line links other categories to core category. We argue that the “paradigm model” is just one possible framework that may be used. The alternate model that we propose based on our theoretical sensitivity is structurally more flexible and interpretive.</td>
</tr>
</tbody>
</table>