Leading conversations: Communication behaviours of emergent leaders in virtual teams

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Abstract

Virtual teams and their leaders are key players in global organisations. Using teams of workers dispersed temporally and geographically has changed the way people work in groups and has redefined the nature of teamwork. Emergent leadership issues in computer-mediated communication are vital today because of the increasing prevalence of the virtual organisation, the flattening of organisational structures and the corresponding interest in managing virtual groups and teams. This paper examines the communication behaviours of participants in two different case studies to determine if number, length and content of messages are sufficient criteria to identify emergent leaders in asynchronous and synchronous environments. The methodology used can be embedded in collaborative virtual environments as technology for detecting potential leaders.

1. Introduction

Research on virtual environments suggests that CMC impacts on team work in a number of ways. The communication medium is leaner [1], the hierarchical structure is "flattened" [2, 3], social cues are reduced [4], participants are depersonalised [5, 6], and overall volume of communication is less [7].

Research on communication in virtual teams is less well documented [8] yet using teams of workers dispersed temporally and geographically has changed the way people work in groups and has redefined the nature of teamwork [9-11]. Relatively little is known about how leadership activities influence collaborative processes [12].

Leadership issues in CMC are vital today because of the increasing prevalence of the virtual organisation, the flattening of organisational structures and the corresponding interest in managing virtual groups and teams. Can people be as efficient leaders in a geographically dispersed and mediated environment without meeting team members face-to-face as they would in a traditional co-located environment? How will leadership be reflected in communication patterns and communication style among team members? Are there differences in the trend of these patterns in different scenarios; for example, leading a group of autonomous and diverse individuals using an asynchronous communication medium over a relatively long period of time versus a group of individuals using a synchronous communication medium and bound by the communication network for a short period of time?

2. Emergent Leadership

In this paper, a distinction is made between *assigned* leadership and *emergent* leadership. An assigned leader is an individual who is assigned to a position of leadership. An emergent leader, on the other hand, is an individual who is not assigned to a leadership position, has the same status as other team members initially, but gradually emerges as a leader through the support and acceptance of the team over a period of time [13]. Their support and acceptance is a result of the individual's actions and their communication behaviours, which include being involved, informed, firm but seeking the opinion of others, and initiating new ideas [14]. Leaders emerge according to the needs of the group [15] and usually exhibit the following characteristics: (i) participate early and often; (ii) focus on communication quality as well as quantity; (iii) demonstrate competence; and (iv) help build a cohesive unit [16].

Research shows that, in face-to-face environments, leaders are identified by high participation rates in discussions [17-19]. McCroskey and Richmond [20] relate effective leadership to "talkativity". Yoo and Alavi [21], however, proposed that because of the reduced awareness of social presence and social context, the receiver of a message via CMC pays more attention to the message than the messenger. This observation led Yoo and Alavi to study emergent leaders in virtual teams. They found that, in asynchronous communication, emergent leaders could be identified by the number, length and content of messages. Not only did emergent leaders send more messages and longer messages, their messages were more task-oriented than other team members.

This paper examines the communication behaviours of participants in two different case studies to determine if number, length and content of messages are sufficient criteria to identify emergent leaders in both synchronous and asynchronous environments.

3. Case Studies

The first case study (Case Study 1) was a two-year collaborative research project conducted by an international group of volunteer researchers, most of whom had never met either online or offline. The collaborative activity of the group was the collection and analysis of data from electronic discussion groups. Computer-mediated asynchronous communication, both public and private, was used for coordination, participant recruitment, distribution of information, formulation and discussion of policies, decision making, encouragement and technology transfer. The number of members varied at any one time but there were 143 members who were consistently involved in the project. Two participants were assigned leadership roles and they took on the facilitating task of encouraging the group to work together interdependently in a collaborative manner.

The other case study (Case Study 2) was a group of 18 students engaged in collaborative learning in a series of nine one-hour workshops over a two-and-a-half month period. The workshops took place in a chatroom and were part of a unit of study in the School of Information Technology, Murdoch University. Although the participants lived within a 100 km range of Perth, Western Australia, and were studying within the same university, the majority of the participants had never met either online or offline. A different moderator was appointed for each workshop. Moderators were required to lead the group discussions and facilitate learning through discussion of set readings.

The two case studies, therefore, differed in all features, as indicated in Table 1.

Table 1. Feature summary of two case studies.

Feature	Case Study 1	Case Study 2
Medium	Email	Chatroom
Mode	Asynchronous	Synchronous
Duration	2 years	4 months
Leadership	Assigned	Appointed
Formation	Spontaneous	Predefined
Meetings	Unstructured	Structured
Purpose	Research project	Workshop series
No. of participants	131	16
Location of participants	Global	Mostly Australia
Age group	20-65	Mostly 20-30
Process	Unstructured	Structured

4. Methodology

The methodology in this study is based on [22]. The integrated data sets include participant observations, archived electronic discussions, and in-depth interviews of key stakeholders in each study.

Throughout the duration of each study, one of the authors was participating and observing communication processes within both case studies. Observation assisted in discovering underlying assumptions and dimensions of which group participants may have been unaware [23]. Participant observation gave access to all group discussions, thus providing richness of data [24].

In Case Study 1, team members posted 1,130 email messages while collaborating on their project. In Case Study 2, students engaged in 9 hours of synchronous discussions which were automatically logged and downloaded by one of the authors.

To be able to compare the results of two dissimilar case studies, the communication was viewed as *sets of utterances*. The CMC model, proposed by Simoff and Maher [25], is based on the premise that each communication activity is composed of: (i) a subject who performs the communication event, (ii) the content of the communication event, and (iii) an object(s) to whom the communication event is addressed. In other words, in an utterance, a subject is communicating content to an object. This general model is applicable in text-based CMC to communication activities in both *asynchronous* environments (e.g. bulletin boards, e-mail discussion lists) and *synchronous* environments (e.g. chat rooms, virtual worlds and shared whiteboards). In an initial analysis of the data, each communication event (email message or chat turn) was converted into utterances on the basis of one object (receiver) per utterance. The "object" in a communication utterance could be the whole group, part of the group or an individual. Thus the email messages and chat room logs were converted to 1,345 utterances for Case Study 1 and 4,547 utterances in Case Study 2.

All utterances were coded using an open hierarchical coding scheme (Figure 1) designed to investigate increasing levels of detail. The coding features included four categories: management, content, style and interactivity. Coding of the data was performed by three independent coders using Excel spreadsheets. Each coder was given a copy of the coding scheme with examples of each variable and then trained on a sample data. A level of accuracy was set and coders began coding when that standard of accuracy was attained.

In addition to a content analysis of the data, nine members of Case Study 1 and three members of Case Study 2 were interviewed in a semi-structured format. Each interview took approximately one hour.

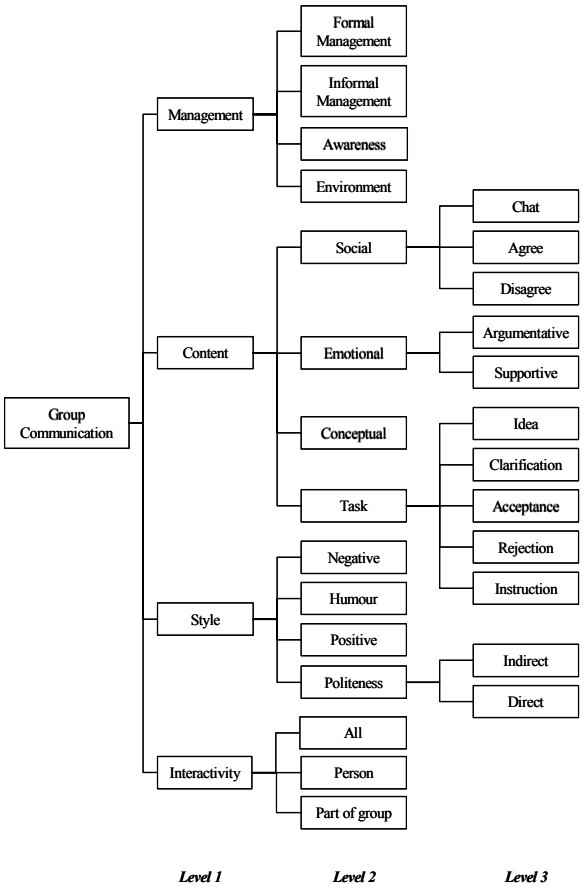

Figure 1. Tree representation of the open hierarchical coding scheme.

Table 2. Descriptive statistics of utterances for Case Studies 1 and 2.

	Case Study 1	Case Study 2
Total number of utterances	1343	4547
- In terms of characters		
Average utterance length	776	48
Median	401	34
Mode	37	3
Average deviation	679	35
Standard deviation	1,218	58
Range of the length	15,970	908
Minimum length	3	1
Maximum length	15,973	909
Characters (total)	1,0417,99	218,950
Characters (without spaces)	865,414	183,298
Heterogeneity	13	16
- In terms of words		
Average utterance length	120	10
Median	67	7
Mode	7	1
Average deviation	117	7
Standard deviation	214	11
Range of the length	2817	163
Minimum length	1	1
Maximum length	2,818	164
Words (total)	177,932	40,185
Heterogeneity	13	15

5. Analysis

The descriptive statistics of the utterances in both case studies is presented in Table 2. In Case Study 1, where each of the utterances represents a communication act via an email message, the average length of an utterance is 776 characters (~120 words) whereas the average length of an utterance in Case Study 2 is 45-50 characters (~9-11 words). The distribution of utterances in both cases contains a number of extreme cases far from the average, which is indicated by the differences between the mean and the other measures of location – the median and the mode. The data sets in both case studies are positively (right) skewed. In Case Study 1, the range of utterance length is from 3 characters (1 word) to almost 16,000 characters (2,818 words), whereas the range of utterance length in Case Study 2 varies from 1 character to 909 characters. The maximum range across the groups is fairly consistent, varying between 663 and 909 (112-163 words). The distributions of utterance lengths in both case studies are heterogeneous, as indicated by the relatively large value of the heterogeneity factor.

5.1. Case Study 1

The activity level of 143 participants were initially analysed in terms of: (i) number of utterances; (ii) total number of words; (iii) average utterance length; and (iv) task-related utterances sent. Figure 2 illustrates the total number of utterances over the entire period of Case Study 1. The utterance level is organised in five intervals. The first bin [1, 10] of the lowest number of utterances accommodates the levels of activities of typical participants; that is, 78% of the group members. The remaining 22% of the group are spread across the other five bins. The two bins of the highest activity (more than 40 utterances), representing only 8 participants (6% of the group) are highlighted.

Rather than using the whole data set of 143 participants, the 31 participants who were the most active on any of the four activity criteria (number of utterances, total number of words, average utterance length, activity-related utterances) were selected. These 31 participants generated 78% of the utterances throughout the project. The measures for the participants who rated highest on the four activity criteria are given in Table 3.

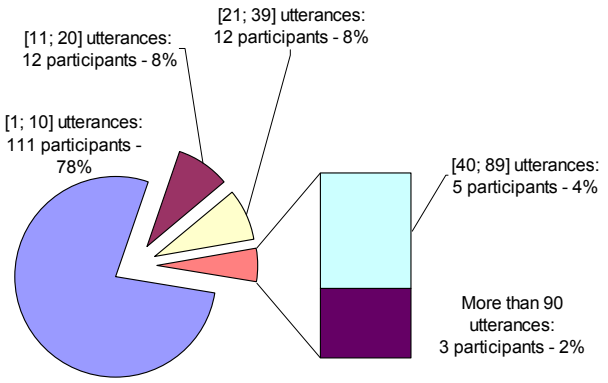

Figure 2. Activity levels of different participants

From these activity measures, participants were tentatively classified as one of three types:

- *assigned leader* (participants who has been assigned as leader explicitly or implicitly in the beginning of the project),
- *emergent leader* (participants who are identified as potential emergent leaders using the number of utterances, total number of words, average utterance length, and task-related utterance criteria), or
- *participant* (participants identified as non-leaders).

With an appropriate combination of inductive techniques, a collection of attributes is used to ascertain which of these attributes are most important in characterising three participant types. The collection of attributes include the four activity criteria plus the number of utterances received by an individual, and the number of task-related utterances received by an individual. Table 4 lists the set of six attributes which were used as candidates for defining *Participant Type*. In our classification problem *Participant Type* is the target ("dependent") variable and the six attributes listed in Table 4 are the "independent" variables. The analysis included two inductive techniques: (i) decision (classification) tree induction [26], that was run in exploratory mode; and (ii) visual clustering. First, the CART (Classification and Regression Trees) [27] technique produced a classification tree of *Participant Type*.

Table 3. Comparison of eight participants who rated highest on the number of utterances, density of utterances and activity-related content criteria

a. Number		*b. Density*				*c. Content*	
Participant	*No. of utterances*	*Participant*	*Total no. of words*	*Participant*	*Average utterance length*	*Participant*	*Activity-related utterances*
Fay	160	Stephen	28408	Jonathan	291	Fay	111
Stephen	101	Fay	22994	Stephen	281	Jeff	71
Jeff	90	Jeff	16770	Jeff	186	Stephen	61
Barbara	47	Jonathan	12211	Jamie	183	Jonathan	35
Catherine	47	Barbara	6863	Daniel	149	Barbara	33
Deborah	42	Eric	5675	Barbara	146	Catherine	31
Jonathan	42	Nadia	3960	Fay	144	Eric	25
Eric	40	Catherine	3958	Eric	142	Deborah	21

Table 4. Attributes used for defining *Participant Type*

Attribute	*Description*
Utterances	Total number of utterances
Total Number of Words	Total number of words posted by an individual
Average Length in Words	Average length of utterances in words of an individual
TSK+CON(U)	Number of activity-related utterances sent by an individual
Addressed	Number of utterances of any variable addressed to an individual
TSK+CON(A)	Number of activity-related utterances addressed to an individual

The second step, visual clustering (Miner3D), was performed, guided by the derived classification tree. The major goal in looking at a decision tree model is to understand the attributes that are responsible for the phenomenon. The derived tree offers a description of the concept of *Participant Type* (i.e. *Assigned Leader*, *Emergent Leader* and *Participant*) in terms of the six attributes.

Figure 3 shows the derived classification tree. The classification tree derived isolates each of the three participant types (assigned leaders are coded blue; emergent leaders are coded green; participants are coded red). This induction technique shows that *Utterances* (number of utterances sent) is the primary attribute which splits the sample of participants into 'assigned leaders' and the rest. In the next level, the attribute

TSK+CON(U) (activity-related utterances sent by an individual) captures a significant portion of the leadership characteristics. In the next level, the *Utterances* and *Total Number of Words* attributes split the sample into 'emergent leader' and 'participant' classes. These three attributes partitioned the data to cover all participant types in Case Study 1. The CART technique is then complemented by visual clustering. Visual clustering is the process of finding a partitioning of the data set into homogeneous sub-sets (clusters) [28]. The key element in this technique is the mapping between the attributes and the corresponding visual features; in other words, this technique looks for groups of instances (individuals) that "belong together". Once the mapping is done the visual clustering is an interactive procedure. In our case the procedure is guided by the results of the decision tree induction. As this is an unsupervised technique the clusters are not known in advance. Figure 4 to Figure 5 show the results of visual cluster analyses performed on the data set of 31 participants and the six attributes in Table 4.

Figure 4 shows the initial visualisation of the data set with the same colour code as used in the classification tree (i.e. blue for *Assigned Leader*, green for *Emergent Leader*, and red for *Participants*). The X, Y and Z axes are *Utterances*, *TSK+CON(U), Total Number of Words* respectively. The value of the *Average Length in Words* attribute has been used to define the size of the spheres.

Guided by the classification tree (Figure 3), in which the *Utterances* attribute splits the data at >31, *Utterance* is set to '32. This setting filters out a cluster of 23 participants. The remaining nine individuals are shown in Figure 5.

Again, guided by the classification tree, in which the *TSK+CON(U)* attribute splits the data at >16 and the *Total Number of Words* attribute at >2074 (see Figure 3), these attributes are set at '17' and '2075' respectively in Figure 5. The same nine individuals remain; that is, two *Assigned Leaders* (blue) and seven *Emergent Leaders* (green). Figure 6 is an enlargement of a section of Figure 5 showing the seven *Emergent Leaders* identified by name; that is, Jeff, Jonathan, Barbara, Eric, Catherine, Deborah and Nadia.

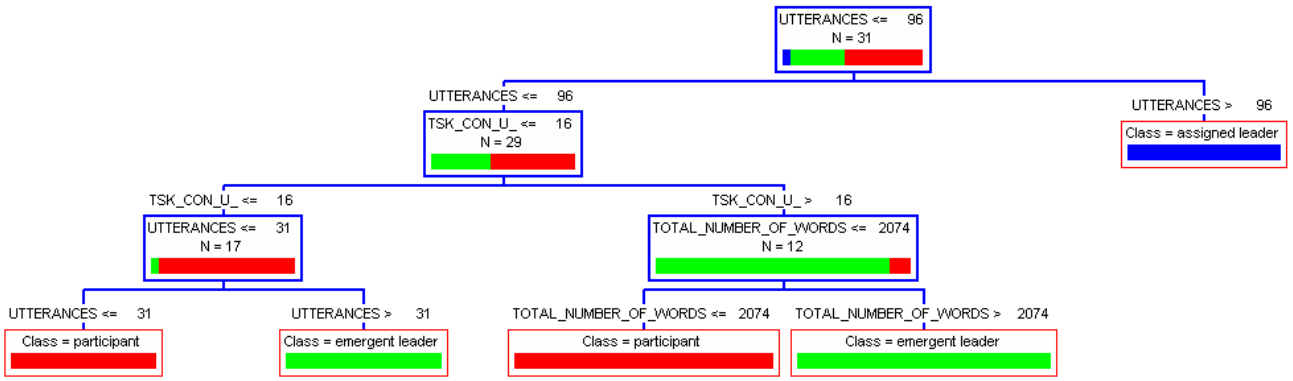

Figure 3. The decision (classification) tree for participant type in Case Study 1.

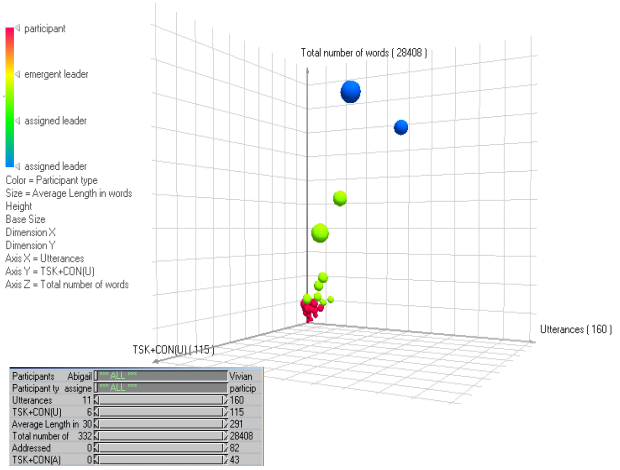

Figure 4. Initial visualisation of the data set

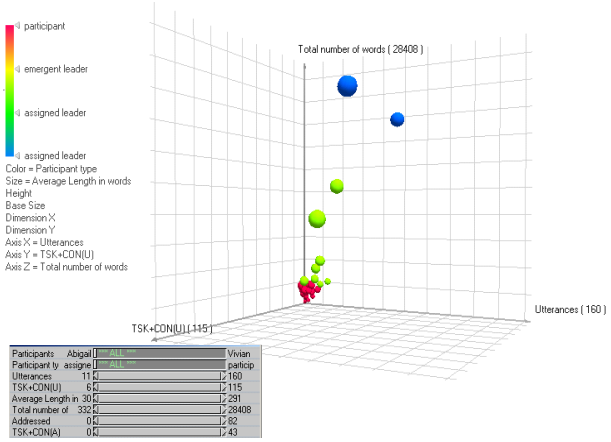

Figure 5. Clustering on *Utterances* attribute at value '32', *TSK+CON(U)* attribute at '17' and *Total Number of Words* attribute at value '2075'.

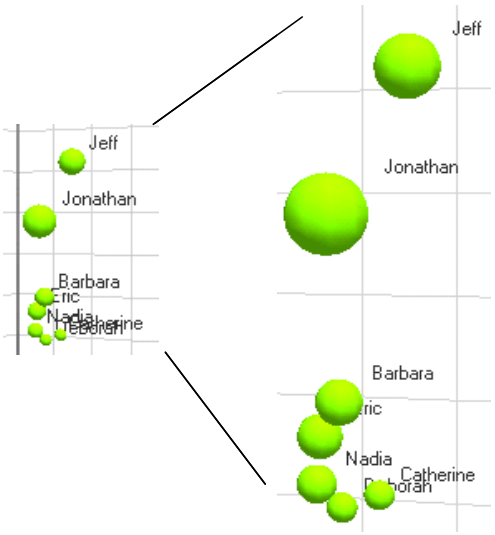

Figure 6. Enlargement of the emergent leaders identified in Figure 5.

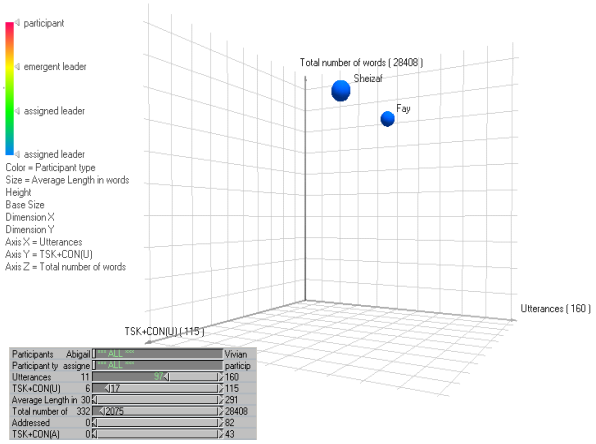

Figure 7. Clustering on *Utterances* attribute at value '97' identifies *Assigned Leaders*.

Figure 7 shows that when the *Utterances* attribute is set to 97 (see Figure 3, which indicates that the *Utterances* attribute splits the data again at >96), Fay and Stephen, are identified as *Assigned Leaders*.

Hence, the classification tree in Figure 3, visualised as clusters in Figure 4 to Figure 7, show that the attributes *Utterances*, *TSK+CON(U)* and *Total Number of Words* were able to split the sample of 31 active participants into three *Participant Types* as listed in Table 5.

The descriptive statistics indicated four strong emergent leaders (Jeff, Barbara, Jonathan and Eric) and two weaker candidates (Catherine and Deborah). When additional criteria were added and the data analysed with the CART and cluster tools, it was found that the *TSK-CON(U)* attribute (number of activity-related utterances) contributed to the identification of the same four strong emergent leaders (Jeff, Barbara, Jonathan and Eric) and another three (Catherine, Deborah and Nadia). The engagement graph confirms the set of six emergent leaders identified by the descriptive statistics (Jeff, Barbara, Jonathan, Eric, Catherine and Deborah) with Nadia at the highest end of the mean engagement level.

Table 5. Assigned leaders, emergent leaders and participants

Assigned leaders	*Emergent leaders*	*Participants*	
Fay	Jeff	Donna	Michael
Stephen	Jonathan	Marian	Daniel
	Barbara	Ben	Stuart
	Eric	David	Nicola
	Catherine	Vivian	Brad
	Deborah	Brent	Jamie
	Nadia	Sally	Marie
		Chloe	Andy
		Tom	Clive
		Sarah	Peter
		Carleen	Abilgail

The combination of two attributes – *Utterances* and *Addressed* – would also give a measurement of the intensity of engagement for any participant. Figure 8 illustrates the engagement level for the 31 participants examined in the classification tree model.

The circle in the middle of Figure 8 corresponds to the mean level of engagement across the data set of 31 participants. The graph illustrates the findings of CART (and visualised in Minder3D); that is, the two assigned leaders (Fay and Stephen) have the highest level of engagement, while six of the emergent leaders (Jeff, Catherine, Barbara, Deborah, Jonathan and Eric) are above the mean level of engagement. Nadia has the next highest level of engagement and was identified in the CART procedure. These nine participants are indicated in bold.

Thus, it has been demonstrated that the criteria used for descriptive statistics (number of utterances, total number of words, average utterance length, and activity-related utterances), classification tree and clustering (number of utterances sent, total number of words, average utterance length, activity-related utterances sent, number of utterances received, activity-related utterances received), and the radar chart on engagement level (number of utterances and utterances received), all point to a set of leaders that emerged during the life of the group.

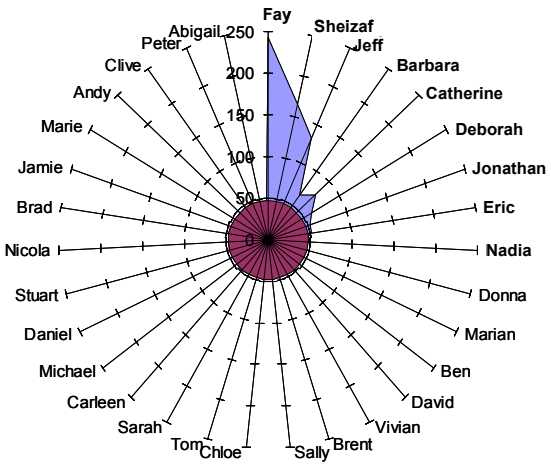

Figure 8. Engagement level of participants.

5.2. Case Study 2

As mentioned earlier, the communication mode in Case Study 2 was synchronous. Being a moderator in one workshop only, each participant would be expected to dominate discussions in that workshop. Hence, the participation pattern would be a large number of utterances in one workshop and a smaller number of utterances in the remaining eight workshops. Thus, the contributions to the discussions from each participant were potentially equalised across the period of the nine workshops. The number and density of utterances are effective criteria for measuring verbosity in participants. Figure 9 illustrates the activity level of different participants, measured as the total number of utterances over the entire period of Case Study 2. The appointed leader and Gail communicated most intensively (bin [500; 800]), with Doug and Lorna communicating more than the other fifteen participants (bin [300; 499]).

Density of utterances is measured by total number of words throughout the workshop series, and the average utterance length in words. Note that average number of words per utterance is not as informative as for Case Study 1 since the range for Case Study 2 is 1-10 words. What this measure does highlight is the very different style of communication in a synchronous compared with an asynchronous environment. Utterances in a synchronous environment are short, often abbreviated, or acronyms (e.g. "ROTFL" meaning "rolling on the floor laughing").

When using the number of utterances criteria, the potential emergent leaders were Gail, Doug, Lorna, Henry, Kirk, Leah and Joe, in order of most frequent utterances (see Table 6). When using the total number of words criteria, the potential emergent leaders were Gail, Doug, Henry, Duncan and Lorna, in order of most words. When using the average utterance length, the potential emergent leaders were Gail, Henry, Duncan, Leah and Donald, in order of longest average utterance. Adding task-related content as a criteria for identifying leadership characteristics refines the set of emergent leaders. Apart from the appointed leader, only Gail, Henry and Kirk show evidence of emergent leadership. If any three of the four criteria are taken into account, then Doug, Lorna and Leah are also a contenders.

An expanded set of criteria was used to explore the emergent leadership within the group. Similar to Case Study 1 we reframe the problem as a classification task, looking at classifying the group members in as one of the following participant types: (i) appointed leader (participant who has been appointed as leader); (ii) emergent leader; or (iii) participant. Note that in, the case of synchronous communication, the total number of words was not depicted as a parameter in the emergent leadership classification model. The classification tree model is presented in Figure 10.

The results of the visual clustering are shown in Figure 11 and Figure 12.

Table 6. Comparison of eight participants who rated highest on different criteria

a. Number		*b. Density*				*c. Content*	
Participant	*No. of utterances*	*Participant*	*Total no. of words*	*Participant*	*Average utterance length*	*Participant*	*Activity-related utterances*
Fay	743	Gail	7039	Gail	10	Fay	471
Gail	626	Fay	5743	Henry	10	Gail	432
Doug	410	Doug	3834	Duncan	10	Lorna	228
Lorna	317	Henry	2688	Fay	8	Doug	225
Henry	256	Duncan	2583	Leah	7	Henry	180
Kirk	225	Lorna	2328	Donald	7	Leah	166
Leah	209	Joe	1849	Kirk	6	Kirk	158
Joe	205	Kirk	1807	Louis	6	Susan	133

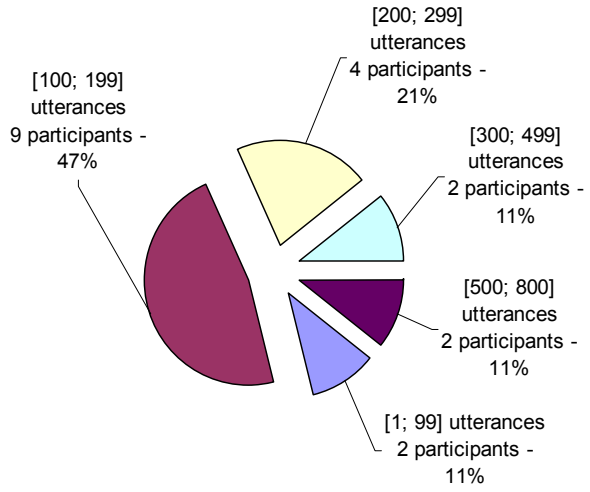

Figure 9. Activity levels of different participants

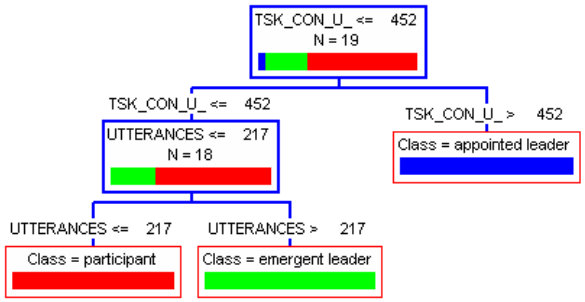

Figure 10. The decision (classification) tree for participant type in Case Study 1.

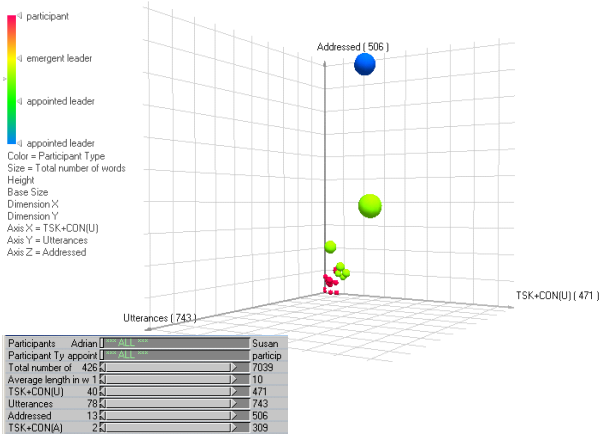

Figure 11. Visual clusters of data set of *Appointed Leader*, *Emergent Leaders* and *Participants* for Case Study 2.

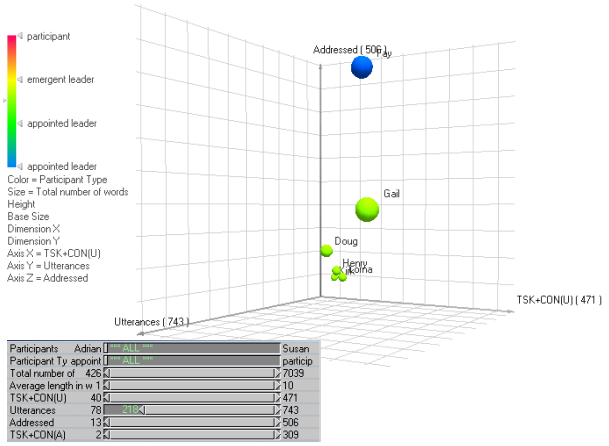

Figure 12. Clustering on *Utterances* attribute at value '218'.

The descriptive statistics indicated three strong emergent leaders (Gail, Henry and Kirk) and three weaker candidates (Doug, Lorna and Leah). When additional criteria were added and the data analysed with CART and the visual cluster tools, it was found that the *Number of Utterances* attribute contributed to the identification of the same three strong emergent leaders (Gail, Henry and Kirk) and two of the weaker candidates (Doug and Lorna). The engagement graph in Figure 13 confirms the set of five emergent leaders identified by the descriptive statistics, and the classification tree model and clustering.

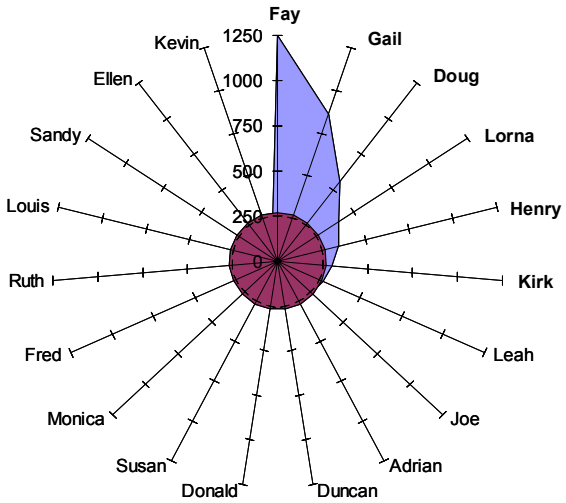

Figure 13. Engagement level of participants.

6. Discussion and conclusions

The increasingly global nature of business is associated with an increased role of virtual distributed teams that communicate electronically. If such virtual organisations are to be successful, they will have to

ensure that aspects of team organisation transfer. We have focused on emergent leadership, as it has received little attention within the literature when compared to other models of leadership [29]. Emergent leadership proposed that leaders emerge during the life of the group.

We looked at the patterns of communication that indicate the emergence of leaders. Three criteria were added to verbosity criteria to identify emergent leaders: number of utterances addressed to an individual, number of activity-related utterances sent by an individual; and number of activity-related utterances addressed to an individual. In both case studies, a non-parametric technique and a visual clustering procedure identified a small group of participants who emerged as leaders. The findings therefore suggest that frequency, density, content and engagement level of communication contribute to detecting emergent leadership within virtual teams.

In Case Study 1, three attributes were instrumental in categorising assigned leaders, emergent leaders and participants: number of utterances sent, number of activity related utterances sent; and total number of words. In Case Study 2, two attributes categorised appointed leaders, emergent leaders and participants: number of activity related utterances sent; and number of utterances sent.

In both asynchronous and synchronous environments, there were several people who emerged as leaders, i.e. emergent leadership functions were shared. Emergent leaders send more messages but the messages are more likely to be task-related. In other words, sheer volume of words does not make an emergent leader but frequent messages with topic-related content does contribute to leadership qualities.

These findings give support for Yoo and Alavi's work on emergent leaders in virtual teams in asynchronous environments [21, 30]. These findings also demonstrated that emergent leadership patterns were consistent in both synchronously and asynchronously mediated virtual teams.

The study reported here provides parameters that can be used to monitor communication of team members in collaborative virtual environments for predicting emergent leaders within the groups. Emergent leaders may impact the group dynamics and predicting the potential leaders may assist smart project management in virtual organisations.

The application is useful in both the educational and organisational setting. Researchers in organisational science have increased their efforts in group development in organisations. These studies have been motivated by the increased "flattening" of organisational structures, which leads to the emergence of informal groups. Knowing the structure of such emergent groups and their emergent leaders is invaluable for company management. The development of methods that assist in identifying such structures and emergent leaders is directly related to the research work presented in this paper.

Emergent leadership plays an important role in collaborative learning. Group development is one of the key components of social learning in on-line (flexible) learning strategies. The approach presented in this paper is appropriate for conducting detailed study of social learning in flexible (compute-mediated) learning environments.

6. Acknowledgements

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