Knowledge Management in a Virtual Community of Practice using Discourse Analysis

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Abstract: The topic of Community-of-Practice (CoP) has been discussed in the management literature in the earlier part of 1990's, and since attracted a lot of attention from academics and professionals around the globe. Communities of Practice (CoP) have become a strategic approach for fostering learning and transferring knowledge. However, there are a few studies, which explain what makes a community to engage in a discussion to share their knowledge and experience. This paper discusses the anatomy of a CoP, and examines a number of knowledge management tools such as story telling and discourse analysis to illustrate how knowledge is transferred and learning takes place in a virtual Community of Practice. Results are presented from a 'live' virtual community of practice, which is in the maturity period of its life cycle to discuss the role of domain experts and moderators how they facilitate to engage the community in dialogues and help generate the new knowledge. Also using Nonaka and Takeuchi's knowledge spiral model it is explained how learning takes place in this virtual community of practice.

Keywords: Community of practice, discourse analysis, knowledge management, story telling, Nonaka and Takeuchi's knowledge spiral model.

1. Introduction

A recent survey by the Institut für e-Management e. V. (2001) proposes Communities of Practice (CoPs) as one of the top ten topics of Knowledge Management (KM). Co-founders of this concept, Lave and Wenger, go to extent of considering CoPs "an intrinsic condition for the existence of knowledge" (Kimble; Barlow, 2000). The CoP has been particularly recognised as main tool for converting "implicit" knowledge into "explicit" form of knowledge (Davenport and Prusak 1998). Reports from American Productivity and Quality Center (APQC, 2000) survey suggest that 95% of the Best Practice organisations consider CoPs very important to their KM Strategy. According to the survey, firms such as *Ernst and Young* consider CoPs an equivalent to Knowledge Management. Almost 33% participants included in the survey represented consulting firms, which demonstrate that consulting which highly knowledge-intensive industry value CoPs as a valid method knowledge acquisition and transfer. In this paper Wenger's and Snyder's definition is considered for co-presence of distributed groups if they can still be considered Community-of-Practice (2000). Lave's and Wenger's initial analysis relate to the groups those were exclusively co-located in non-IT-settings (e.g. tailors, quartermasters, butchers and claims processors). They suggest that the co-presence should not be seen as essential condition for forming a CoP (McDermott, 1999). Since Brown's and Duguid's (1996) influential case study on CoP at Xerox, other case studies of distributed and computer–mediated Communities have been published as explained in the subsequent sections.

2. Community-of-practice (CoP)

The famous case study with Xerox PARC, done by Brown and Duguid in 1996, helped rejuvenating the modern notion of "Community of Practice" (CoP). They defined CoPs as "peers in the execution of real work, held together by a common sense of purpose and a real need to know what each other knows" (Brown and Duguid, 1998). Again, Wenger and Snyder (2000) two of the most recognised theorists on the topic define CoP as ‘‘groups of people informally bound together by shared expertise and passion for a joint enterprise" (Wenger, 2000) The key points of other CoP definitions include knowledge sharing, learning (Reinemann-Rothmeier and Mandl, 1999), a common practice or solving of common problems of the group and construction of a common knowledge repository (Stewart, 1996, McDermott, 1999). However, there is a close relationship of CoP topic with the notion of "Business Communities" which is defined as groups formed around a topic, which is relevant for business (Gruban, 2001). It is assumed that these groups have been working for some time together, while manifest other characteristics of being a community, such as, sharing a common meaning; identity and common language derive from common practice and common interest(s) (Hildreth et al, 1998). We, therefore agree with following working definition of CoP for the purpose of this paper:

> *"Group(s) of people, which have an interest in the same topic over a longer period of*

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time and who are engaged in an activity of sharing their opinions on this topic." (Probst, 1999)

Wegner (1998b) define life cycle of a CoP into five stages of maturity as shown in Figure 1.

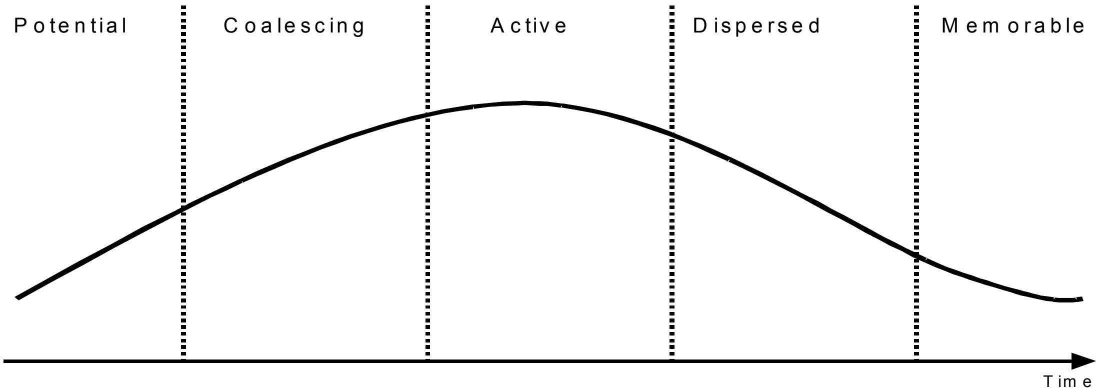

Figure 1: Life Cycle of a Community of Practice (CoP)

The first stage Potential is about finding people with similar interests, establishing contacts, and\\\\ building informal relations. The second stage Coalescing is where identity is formed and the values are discussed. The members move from a loose network to a common sense of purpose. This is an engagement stage where discussions in the field of interest start taking shape. The third stage Active is where CoP becomes highly dynamic and comes into its own by engaging in a high level of activity. This is where permanent generation of new knowledge takes place. The fourth stage is Dispersed where at first members of the periphery and then core members themselves loose interest in the topic. As there is less activity, the influx of new knowledge is reduced, which makes the CoP become less attractive. The fifth stage Memorable is the collection of memorabilia. Here the CoP is dispersed, however tales and anecdotes live on for a while. People still associate with the CoP as a significant part of their identity. In each of these stages of the life cycle the CoP is confronted with specific problems and therefore there are different ways to support a CoP. Cohen (1998) argues that the evolution of CoP life cycle has a strong correlations with its membership size. The CoP counts the most members in the stage of coalescing and activity. When the number of members exceeds a certain limit, cohesion is not valid any longer and sub-communities are formed. In this article we describe a CoP which is mature (started in 1991) and is in the "active" stage of its life cycle.

3. Understanding knowledge dynamics

Literature provides very clear links of learning and knowledge management (Hafeez and Abdelmeguid, 2003). Also learning is an essential ingredient for developing individual and corporate competences in the knowledge society (Hafeez et al., 2002a, 200b, 2002c). Here we would consider two specific tools for knowledge management, namely, Nonaka and Takeuchi's spiral model (1995) and story telling. We would argue these are useful tools to explain knowledge dynamics in a virtual CoP context.

3.1 Knowledge transfer (SECI) spiral model

Nonaka and Takeuchi (1995) spiral model illustrates how knowledge is created and transferred in an organisation through interactions between tacit and explicit knowledge. More specifically they recognise these interactions as 'knowledge conversion'. There are four modes of knowledge conversion, namely, socialisation, externalisation, combination and internalisation (see Figure 2) as summarised in the following:

- Socialisation (from tacit to tacit): where knowledge transfer takes place in a tacit form. Here, an individual acquires tacit knowledge directly from others through shared experience, observation, imitation and so on.

- Externalisation (from tacit to explicit): through articulation of tacit knowledge into explicit concepts. This field prompted by meaningful dialogues or reflections.

- Combination (from explicit to explicit): through a systematisation of concepts drawing on different bodies of explicit knowledge present in the environment of an organisation.

- Internalisation (from explicit to tacit): through a process of "learning by doing" and through a verbalisation and documentation of experiences.

The main benefit of this model is that it provides a mechanism to provide an understanding on the epistemology and dynamism of knowledge itself, and provides a framework for management of the relevant knowledge management processes from the ontological perspective. We will use this framework to discuss how knowledge is shared and generated and learning take place in a virtual CoP.

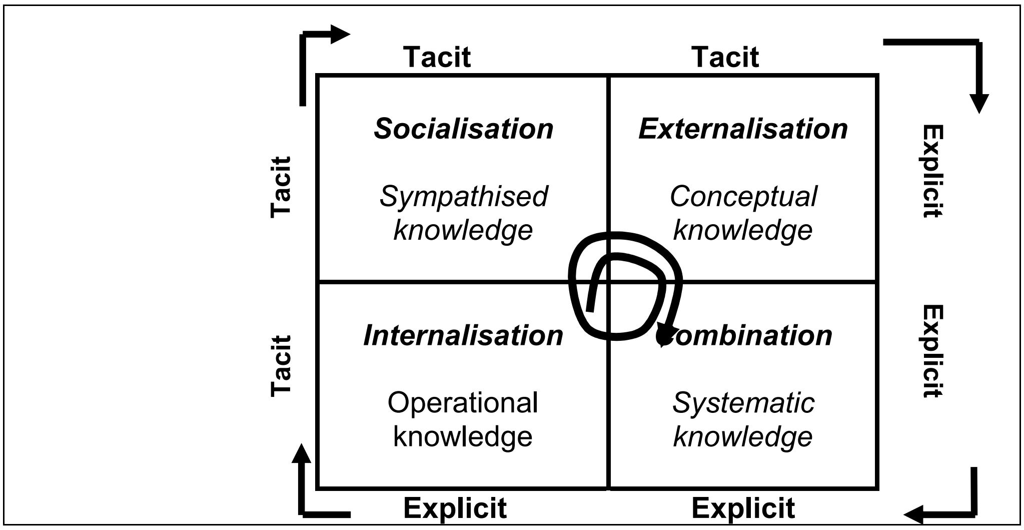

Figure 2: SECI diagram representing four modes of Knowledge conversions (Source: Nonaka and Takeuchi, 1995)

3.2 Story telling

Storytelling is the use of stories in organisations as a communication tool to share knowledge (Snowden, 1999). Stories can be used to serve a number of different purposes in an organisation to meet different context, for example Denning (2000) identifies that there are eight purposes for storytelling, which all relates to expressing complicated ideas and concepts. The aim is to produce clear communication for converting knowledge into a form in which easier for others to understand. In a CoP context, socialising in a formal or informal way provides opportunities for stories to be told as people relate their experiences and it is through the medium of story telling that people are encouraged to share knowledge. For us storytelling is a powerful transformational tool which if used appropriately can facilitate sharing of knowledge in a virtual CoP. Recent research undertaken by (Sinclair, 2005) shows that stories can carry symbolic information and convey meaning as well as greatly enhance both commitment and recollection as it help readers feel a closer connection to the issues and people whom the stories are told about. We would explain how various domain experts have made use of story telling in our case virtual CoP for generating participant's interests and keeping them engaged with dialogue.

3.3 Discourse analysis

Discourse analysis is a way of identifying, categories and developing relationships between exchanges, sequences, and episodes of messages (Sherry, 2000). Discourse analysis is good way of determining the relationships between the concepts that are presented and discussed in the conversation. Spradley (1980) recommends four levels of investigation in order to conduct a discourse analysis as explained in Table 1.

Table 1: Different investigation levels for discourse analysis (Spradley, 1980)

Level of investigation	**Description**
Domain analysis	This means capturing the parts or elements of cultural meaning that occur in the conversation by identifying the discrete set of moves used by the participants.
Taxonomic analysis	This is a search for the way that the cultural domains are organised. It usually involves drawing a graphical interpretation of the ways in which the individual participants' moves, form groups and patterns that structure the conversation.
Componential analysis	This means searching for the attributes of the terms in each domain, the characteristic phrases or sentences that tend to recur within each category of moves.
Theme analysis	The last and final step is to search for patterns or recurrent relationships among domains. If certain moves or language functions tend to enhance learning, then these patterns need to be identified.

In a virtual CoP context, we feel the above relationships, as well as the interaction of the moderator could construct the subsequent structure of the conversation. Such electronic dialogue could be characterised by a dynamic membership of the community members that are distributed across space and through time. We have further developed the discourse according to the nature of the discourse and type of discourse as explained in the next section.

4. Methodology

System Dynamics association has been around for about 50 years to act as a platform to develop System Dynamics Discipline. The System Dynamics (SD) discipline itself was conceived due to the cross-fertilisation of the fields of management science, control theory and computer simulations. It aims to represent time behaviour of a "real world" system using some well-known pattern such as learning curve or S-curve. More complex models are readily developed using non-linear algebraic equations, however, the main aim is to understand the dynamics and behavioural changes in a system over time rather focusing on actual numbers or quantitative outputs. Such analysis is therefore suitable to study medium to long-term changes in a system or organisation to generate or test appropriate policies.

The analysis in this paper concerns the System Dynamics CoP, which related to System dynamics

Society. The System Dynamics Society was established around thirty years ago with key aim to provide

Platform. For researchers, educationalist and practitioners for exchange of ideas. Over the years the

Activities Of the Society have evolved in many forms such as organising workshops, conferences and doctoral colloquiums. The front end of the website is illustrated in Figure 3, (this may be viewed at: http://www.ventanasystems.co.uk/forum/)

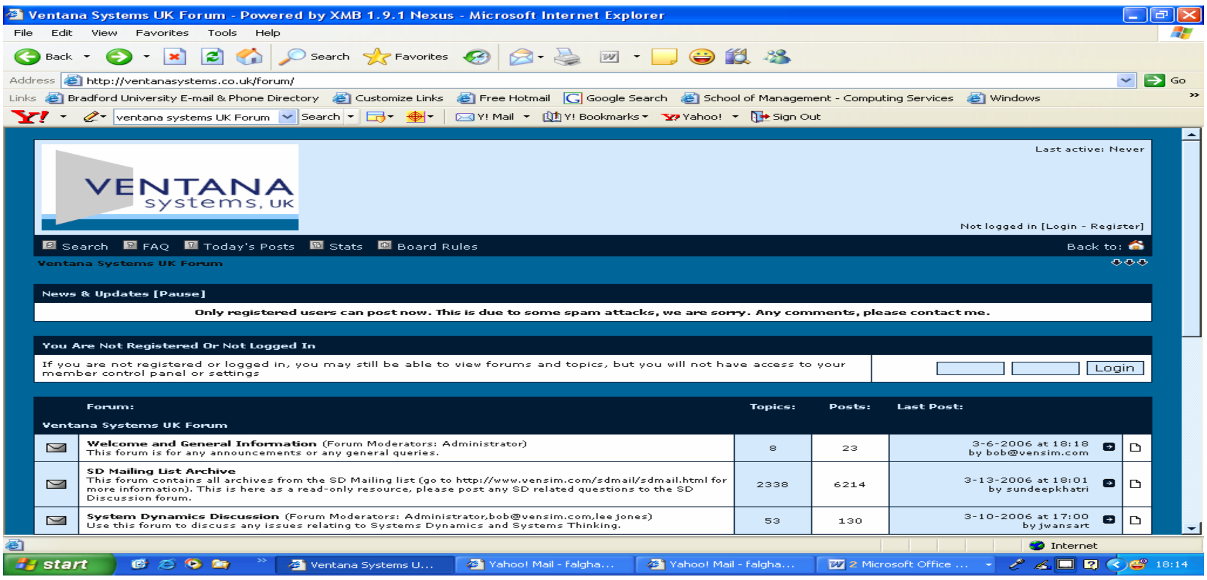

Figure 3: SD CoP interface: http://www.ventanasystems.co.uk/forum/

The virtual systems dynamics CoP is a specialist community involving technical expertise of domain experts, teachers, consultants and students. The reason for choosing this CoP was our own knowledge, interest and expertise of this subject area. Also we have been part of this community since the coalescing stage (within the first 4 years) of its inception and have been a member of it for the past 16 years. This allows us to ascertain the membership position within the community and make us understand who is the domain expert in the different areas of the System Dynamics (SD) discipline. Also we have an active participant in the past for various discussions of this CoP. However, we have been an observant during the case study period. We analyse two topics of discussions which overall reflect a period of two years. However, duration of discussion for each of these topics lasted not more than 20 days. We have analysed these topics by who are the participants of the discussion (for example, topic initiator, community member, domain expert (DE)) (see Table 3) We have given each member a code (for example, A, B, C, etc.) to further analyse their overall contribution in a quantitative way during the whole discourse. We have counted total number of messages for each topic and have categorised the Message length under 1-50 words: Very Short (VS); 51-100 words: Short (S); 101- 250 words: Medium (M); 251-500 words: Long (L); 501- 1000 words: Very Long (VL); +1000 words: Extended Contribution (EC).

We have classified the nature of discourse within discussion as follows:

- Inquiry (Inq.): to inquiring specific knowledge (technical or non-technical); this is mainly used to initiate the discourse.
- Explanation (Exp.): to make something clear by giving reasons
- Story telling (ST): to narrate an interesting event to enhance an idea
- Support: to show one's loyalty or approval of belief

We have classified each reply into five types of discourse:

- Technical Dialogue (Tech): Participants apply specific knowledge (qualitative or quantitative) from a particular field
- Experiential Dialogue (E): Participants use anecdotes and reflections based on from their own experiences to argue for their case.
- Philosophical Dialogue (Ph): Participants refer to or are guided by a particular school of thought.
- Academic Dialogue (Ac): Participants draw upon specific academic references.
- Mixed (Mix): Participants combine two or more of the above categories.

The analysis discussed in this paper illustrate how domain expert in the field are acting as a voluntary mentors for educating the students, semi experts and experts in the field. We also illustrate how these mentor experts share their subjective and tacit knowledge to act as a catalyst to generate new ideas, and maintain the interest of the community to remain engaged in a dialogue. Some recent studies have already shown that leadership is a key success factor for managing a virtual community of practice (Bourhis et al.; 2005). We further explore a number of knowledge management tools to illustrate how learning takes place in this CoP and individual as well as domain knowledge is expanded.

5. Case study: System dynamic society virtual CoP

We have selected two topics from the System Dynamic virtual CoP for further analysis as illustrated in Table 2.

Table 2: A list of selected topics from SD CoP

	Topic	No. of replies	Topic generator	Posted on	Discussion date	Discussion period
1	Can system dynamics models learn	46	Martin F. G. Schaffernicht	17 April 2003	18/4/03 to 7/5/03	20 days (3 wks)
2	Using statistics in dynamic models	28	Jay Forrest	29 Jan 2004	29/1/04 to 6/2/04	9 days

An analysis of these topics is presented in the subsequent sub-sections.

5.1 Topic 1- 'Can SD models learn?'

The Query*:* Inspired by the development in the machine learning field, the CoP bulletin board received a question from one member (Martin Schaffernicht) inquiring:

> *"Is it possible to build a system dynamic model that 'learns'?*

Developing a context to his query, Martin Schaffernicht argues that this is possible only in so far as some decisions may change values of converters that are used by other decisions; but if learning means that some existing variable is replaced by a new one (second loop changes objectives and values), it seems hardly possible. His specific request worded "if anyone have an academic paper or some other written material about this theme".

Explaining the Nature of discourse**:** Over the past twenty years many of the non-deterministic problems are modelled using some learning algorithms such as neural networks, fuzzy logic, genetic algorithm or some other kind of probabilistic reasoning method such as stochastic automata. The non-deterministic problem are those where an exact mathematical solution does not exists, and only way to achieve a near optimum solution through trial and error. This discipline is more recently evolved as "machine learning" and the underlying logic of these models is to bring the output of the model as close to target as possible. Therefore after each simulation, an error function (which is the difference between the target and actual output) is generated. If the new error function is less than the previous one, a corresponding input is generated based on a fractional association to the new error function such that overtime the error reduce to zero or as close as possible. In contrast, system dynamics generates a non-exact solution based on complex mathematics. However, the SD algorithm does not go through any optimisation runs to find a near exact solution, as explained earlier the main aim of SD study is to understand the time behaviour of a system in terms of increasing or decreasing trends such as impact of educational interventions to cut down smoking in teenagers, which would be quantifiable after a few years of implementation.

Figure 4 shows the time history and Table 3 provides a discourse analysis how the discussion took place.

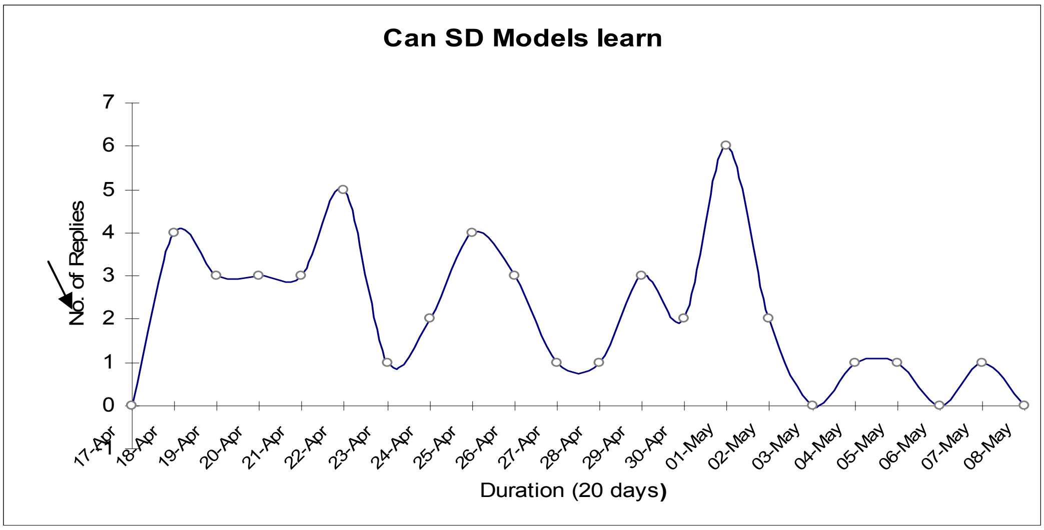

Figure 4: Discussion profile for the Topic "Can SD models learn"

We would regard the query as a mixed type as it include search for technical information as well as need for developing an academic dialogue to provide an answer to this discussion. The query initially attracted 18 responses over the first 5 days. The first contributions expressed opinions regarding different System Dynamic approaches. The overall analysis suggests that the members who participated here were the active participants of this debate. From our knowledge of the subject area we would regard them as domain experts. Figure 4 shows that the message sent on the 1st of May 2003 by J. Lauble was the last substantive contribution to the discussion. There were two further contributions made in this CoP, however, these were general comments to support the previous arguments and to thank participants for their inputs.

The topic can be regarded as highly technical, which, in general, led to a very focused discussion. However, despite its highly technical nature, most of the experts posted relatively long (250-500 words) or very long (501-1000 words) messages. The interests from other members in terms of accepting or rejecting different opinions encouraged the experts to make further contributions. An analysis of the total dialogue reveals that, overall, academic contributions to the discussion were almost 40%, whereas around 16% came from experts belonging to some professional organisation (for example Strategy Academic Solution, PA Consulting Group and Sports Business Simulation Inc.).

Table 3: Discourse analysis for the Topic: "Can SD models learn?"

Number of participants	Community Members	Membership Code	Number of Messages	Message Length (in words)	Nature of Discourse	Type of Discourse
-	M Schafernicht	-	1	S (topic initiator)	Inq. (topic generator)	Mix
1	Bill Harris	A	1	VS first reply (DE)	Exp.	Ac
2	Paul Newton	B	1	VS	Exp.	Ac
3	Ignacio Mayano	C	1	VS	Exp.	Ac
4	Natarajan R. C.	D	2	M, M,	ST, Exp.	E, Mix
5	Raymond Joseph	E	5	L, L, VL, M, L	Exp., Exp., Exp., Exp., Support Exp.	Mix, Ac., Tech, Mix, Mix
6	Magna Myrtveit	F	1	M	Support	Ph
7	George Backus	G	1	S	ST, Exp., Exp.	Ph
8	John Sterman	H	3	M, VL, L (DE)	Exp., Support	Mix, Ac, Ac
9	Alan Graham	I	2	L, M	Exp., Cont.	Ac, Mix
10	Yamen Barles	J	2	L, L	Support	Ph, Mix
11	George Lofdahl	K	1	S,	ST, Exp., Exp., Exp., Exp.	Ac
12	Jim Hines	L	5	S, L, M, L, L	Support, Con., Exp.	Ac, E., Mix, Ac, Mix
13	Bill Braun	M	3	S, VL, S	Cont., Exp.	Ph, Mix, Ac
14	Rainer	N	2	M, L	Exp.	Ac, Mix
15	Niko Papula	O	1	M	Cont.	Ac
16	Rod Brown	P	1	VS	Exp.	Ac
17	Finn Jackson	Q	1	L	Support	Mix
18	Marsha Price	R	1	VL	Support	Mix
19	Cleotlide Gorrzalez	S	1	S	Exp., Exp.	Ac
20	George Richardson	T	2	L, VL (DE)	Support	Ac, Mix
21	Brain Daingerfield	U	1	L	Support	Mix
22	Martens	V	1	M	Exp.	Ac
23	F. G. Schaffernicht	W	1	L	Inq.	Mix
24	Carlos Arisa	X	1	M	Exp.	Ac
25	Dave Paker	Y	1	M	Support	Mix
26	Z. Abraham	Z	1	L	Inq. and Exp.	Ac
27	Allocar Strasbourg	AA	1	VL	Support	Mix
28	Jim Thompson	AB	1	S	Support	Ph
29	David Kreutzer	AC	1	L (last reply)		Mix

Key:
Community member: Domain Expert (*DE*)
Message Length (in words): 1-50 Very Short (VS); 51-100 Short (S); 101- 250 Medium (M); 251-500 Long (L); 501- 1000 Very Long (VL); +1000 extended contribution (EC)
Nature of discourse: Explanation (Exp.); Support; Contradict (Cont.); Storytelling (ST); Inquiry (Inq.)
Type of Discourse: Technical (Tech); Experience (E); Philosophy (Ph); Academic (Ac)

We have used life cycle term very loosely here to explain the life cycle of the topic itself rather life cycle for the community of practice as suggested by Wenger (1998). Figure 4 illustrates various fluctuations in the intensity of discussions. We would relate some of these fluctuations due to the broadness of the topic area-giving rise to related sub-questions, but not attracting much attention from wider community members. However, in our view the main reason for the success of this topic as can be seen from the discussion profile (Figure 4) is that every time the community started to lose interest with the topic (the ''dispersed stage''), a new related question was posted that sparked off the interest from other members, upon which domain experts were quick to jump in to share tacit knowledge and experience by giving opinions. In total, five sub questions were raised during this discussion. These were as follows:

- What kinds of things could continuous aggregate models like system dynamics models learn?
- Did the system lose focus?
- Does the SD model meet all "learning" needs?

- Are there other arguments for SD being used in learning?
- Why did a correspondent make bad decisions despite possessing sufficient information to make more appropriate decisions regarding SD?

The nature of the discussion was predominantly explanation. The discussion classification was mostly academic or mixed where participants combined more than one dialogue such as technical, philosophical, or experience in their messages (see Table 3).

Figure 5 provides a percentage contribution of the key authors illustrating that the engagement of various domain experts of the discipline provided the stimulus in this debate. There were 29 members involved in this discussion of which we would regard fourteen (14) having substantial experience in the discipline. These experts belonged to academic institutions, businesses as well professional organisations. The analysis suggests that the domain experts overall posted 36% of the total replies. The replies constitutes, giving relevant suggestion to participants, express their own opinions and relating to their own experiences to contextualise any emerging questions and sometimes even acting as a *moderator* to summarise the discussion in a concise way.

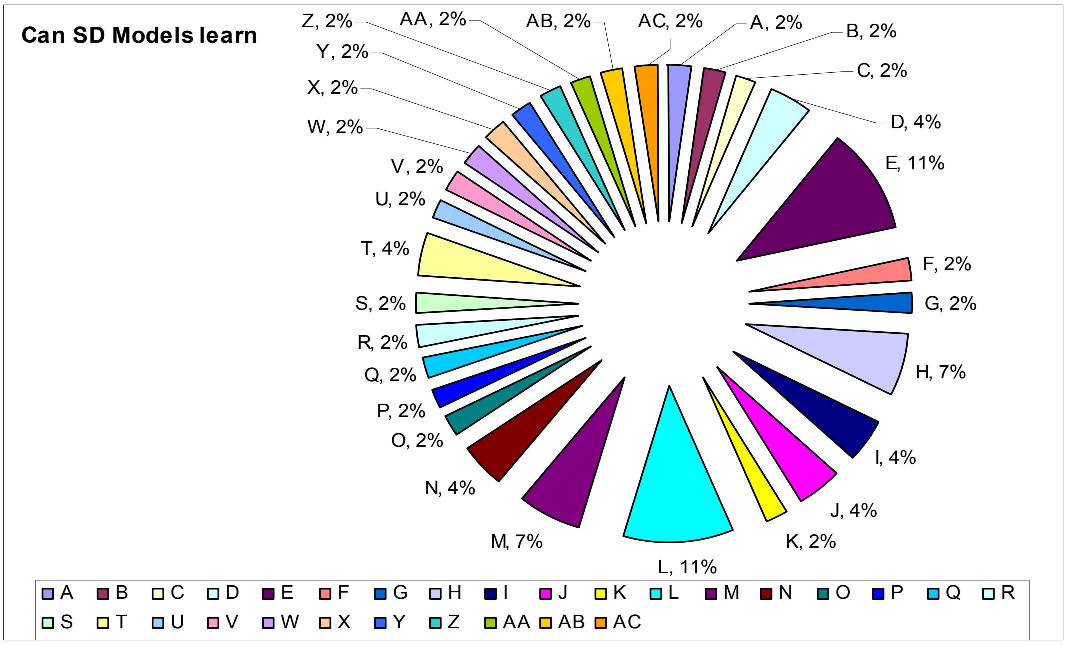

Figure 5: Authors relative contribution in the discourse: 'Can SD models learn'

5.2 Topic 2- Using SD in statistics

The Query*:* This topic was generated by the originator of system dynamics discipline Jay Forrester himself. The topic was initially springs from a previous discussion on the subject by another domain expert Jim Hines. The question worded:

> *"How statistics can be used in the System Dynamics Models"?*

The Nature of discourse: The query was actually trying to give an answer to the question itself. The question was posed in an academic context and caused an initial flash of interest with five contributions being posted to the discussion on 29th January 2004. These contributions expressed opinions representing a range of positions; primarily there was a division between those who considered stories to be a valid means of understanding cultural transmission in themselves and those who suggested that the strength of such stories in transmitting cultures could be tested through statistical analysis. One contributor sought to find a middle-way between these two opposing views by emphasising the value of using stories and statistics together. From this contributor's perspectives, anecdotes provided a picture of events while statistics could be used to explore how applicable these stories might be to other situations.

As the discourse of the discussion moved from a relatively general set of responses into more detailed consideration of analytical rigour (for example the reliability of statistical testing), the number of responses declined significantly. This decline was reversed, however, when one respondent involved in the detailed methodological discussion included a number of additional comments on the topic in hand. The wider range of subjects for people to address seemed to stimulate renewed interest and point of entry for potential participants. As illustrated in Figure 6 that participation rate increased after such interventions. This interest was sustained up until 3rd of February 2004, although total participation never reached the initial interest in the topic. On 3rd of February 2004 John Gunkler tried to focus to the nature of the discussion by pointing towards the original question asking the community whether the topics had become too broad (for example the almost philosophical discussions on the nature of proof occurring on 1st and 2nd February 2004); and whether the thread should be broken into separate discussions. Thereafter contributions to this discussion declined with the final entry being made on 6th February 2004 when J. Lauble usefully summarised the points raised and thereby provided a concise conclusion to this discussion.

Based on the fact that all the participating members have knowledge about SD discipline, nearly one third of contributions came from domain experts. This composition of the participant group may be a reason for the broad nature of the discussion, as opposed to a series of narrowly focused contributions closely related to the topic under discussion. As acknowledged by John Gunkler this does produce an interesting discussion and can stimulate creation of potential new threads but can also require some experts to help retain the focus of discussions; or even bring discussion back on track. The summary provided by the final contributor is a good example of how an expert can perform a "management" role in such wide-ranging discussions, the comprehensive entry posted by an expert who summarises the previous arguments clearly and added some new material to stimulate further discussion. In this discussion, altogether eighteen members took part. Out of those, we regard ten (about 56%) are the domain experts belonging to either academia or business and consulting organisations. The nature of the discussion took the forms of explanation and support in most replies, in spite of there being other forms that could have been utilised, such as storytelling, inquiry and contradiction (see Table 4). Observing the general tone and language adopted by the participants, the discussion appeared to be one of friendly exchange based around developing mutual understanding around this topic. Even when participants disagreed, they either made efforts to point out where they could agree with another contributor, or were very articulate in explaining the basis for their disagreement. The extracts, which we term explanatory, had worked examples or experiential dialogue in an attempt to clarify the points what a contributor was trying to make. Around 61% of the contributions could be classified as either long (251-500 words) or very long (501 – 1000 words), whereas, 39% were medium (101 – 250 words) or short (51 to 100 words) replies (see Table 4). Similar to the first topic, three domain experts lead this discussion as they posted 43% of the overall contributions (12 contributions out of 28).

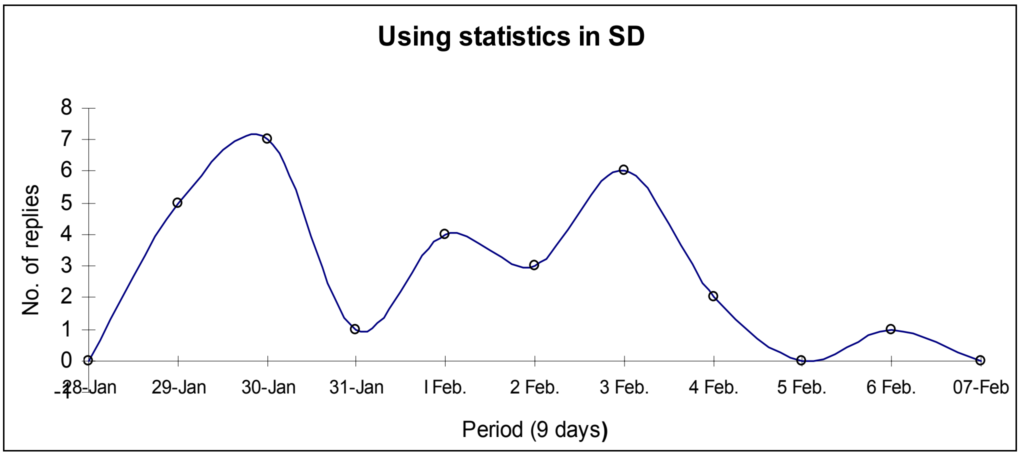

Figure 6: Discussion profile for the Topic "Using statistics in SD"

6. Discussion

One key area of our interest with this research is to find out how knowledge transfer takes place in virtual community of practice. Adapted from Nonaka and Takeuchi (1995), Figure 7 provides a summary of the results in terms of how a CoP allow transfer of knowledge and instigate learning within the virtual community. The analysis reveals that the Systems Dynamics CoP under investigation do facilitate the processes of socialisation, externalisation and combination. The community organise annual seminars and special chapter workshops each year that help to socialise and develop community ethos. Thereby, it allows members to share knowledge through chat rooms in a virtual context. Interacting with domain experts creates new knowledge. The CoP practice hold a structured archive that contains all the discussions ever took place since the start of the CoP in a topic-by-topic structure. In the combination process, the structured archive that the CoP hold, makes it possible for members to access information over a period of time, and benefits through the use of "organisation memory" if one is faced in a knowledge crises situation. Also, some of the topics that are discussed in virtual context become a topic for future face-to-face workshops and conferences. System Dynamics society issues its own electronic newsletter for promoting events, courses, publications and stories that helps in the internalisation of knowledge within the community boundary. The analysis of the SD CoP reveals how individual's tacit knowledge may be transferred into explicit knowledge and communicated. Participants adopt devices of story telling and other appropriate interventions not only to crystallise their own tacit knowledge but also to express their views and thereby share their knowledge. This demonstrates not only a willingness to engage with CoP members on a particular topic for exchanging knowledge. From the analyses of these topics, it is evidenced that some of the participants hidden or 'tacit' knowledge is converted to explicit knowledge, as the information is stored in a systematic way.

Using statistics in dynamic models

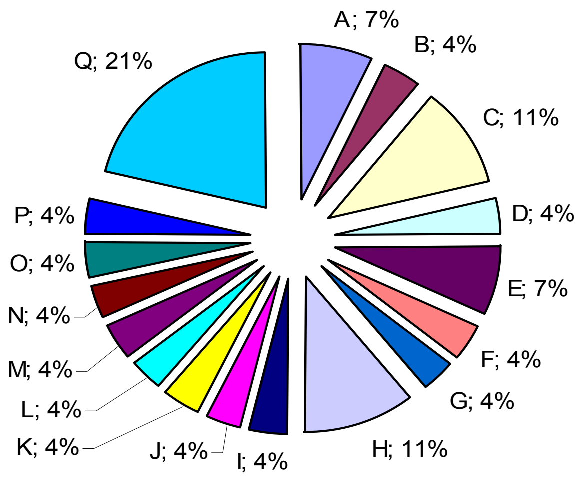

Figure 7: Authors relative contribution in the discourse: ''Using statistics in dynamic models''

Table 4: Discourse analysis of the Topic: Using statistics in SD

Number of participants	Community Members	Membership Code	No. of Messages	Message Length (in words)	Nature of Discourse	Type of Discourse
-	Jay Forrester	-	-	L (topic generator)	Exp.	Ac
1	Joal Rahn	A	2	L (first reply), VL	Support and Exp., Cont. and Exp.	Mix, Mix
2	Kim Warren	B	1	L	Support	Mix
3	Jim Hines	C	3	M, VL, M	Exp.and ST, Expand Inq, Exp (DE)	Ac, Mix, Mix
4	Finn Jackson	D	1	M (*DE*)	Support	Mix
5	Bill Harris	E	2	S, L	Exp., Cont.	Ac, Ac
6	Gorey Lofdahl	F	1	L	Exp.	E
7	John Voyer	G	1	L	ST	Ac
8	Alan Graham	H	3	M, EC, M	Exp., ST, Exp. (DE)	Ac, Mix, Mix
9	Camlo Olayo	I	1	L	Support and Exp.	Tec.
10	Enting Moxnes	J	1	L	Exp.	Ac
11	George Backus	K	1	EC*	Exp.	Mix
12	Michael Evans	L	1	M	Support and Exp.	Ac
13	Kia Arild Lohre	M	1	L	Exp.	Ac
14	Santaigo Arango	N	1	M	Exp.	Ac
15	John Gunkler	O	1	L	Support and Exp.	Ac
16	Carlous Grutters	P	1	L	Cont.	Ac
17	Jean Lauble	Q	6	M, VL, M, VL, M, VL (last reply)	Exp., Exp., Exp., Exp., Exp., Exp.	Ac, Mix, Ac, Mix, Ac, Mix

	To Tacit Knowledge	**To Explicit Knowledge**
From Tacit Knowledge	**Socialisation** • *Planned expert conference and chapter meetings* • *Community stories*	**Externalisation** • *Sub-CoP,* • *Emails and newsletters,* • *Detailed knowledge stores, databases and bulletin boards.*
From Explicit Knowledge	**Internalisation** • *Email newsletter* • *Community ethos*	**Combination** • *Emails (no chat rooms).* • *Ventana interface which include:* • Welcome and General Information • SD Mailing List Archive *(This is here as a read-only resource).* • System Dynamics Discussion *(members post any SD related questions to this forum).*

Figure 8: SECI Spiral diagram for the System Dynamics Community of Practice (Adapted from Nonaka and Takeuchi, 1995).

7. Conclusion

The topic of Community-of-Practice (CoP) has been discussed in the management literature since the earlier part of 1990's, and has attracted a lot of attention from academics and professionals around the globe. However, there are a small number of studies, which explain what makes a community to engage in a discussion to share their knowledge and experience. This paper discusses how knowledge transfer takes place in a virtual community of practice. The discourse analysis conducted in this study illustrates that participation of domain experts play a crucial role to conduct a vibrant and meaningful debate. The domain experts not only provided the needed stimulus when the discussions was cooling off but also intervened to help focus on the main issues of the debate when the community was about to disperse the essence of the debate in sub threads. Also they provided a meaningful dialogue at times to sum up the debate. It is also interesting to note that although the SD CoP is a mature site existed for over twenty years; there was little crossover between the domain experts for the two topics. In addition, our analysis suggests if a topic is initiated by a domain expert (Topic 2), it attracted relatively more domain experts for the discussion. Moreover the responses were relatively more personalise as these were directed to a particular domain expert either supporting or contradicting his/her views. However, topic initiated by a well-known domain expert does not necessarily means more contents and debate, as the participation level and membership for Topic 1 initiated by non-domain expert was relatively higher. However, for the both cases, the members adopted an explanatory discourse with academic style, and relied upon medium (100 – 250 words) and long (251–500 words) messages. We find Nonaka and Takeuchi's knowledge spiral model, story telling and discourse analysis as useful knowledge management tools to investigate and explain how knowledge is transferred and learning takes place in a virtual Community of Practice context. Also, we have found out that domain experts relatively used a story telling approach to develop their arguments.

The System Dynmaics CoP under investigation facilitates the processes of socialisation, externalisation and combination through chat rooms where new knowledge is created by interacting with more knowledgeable participants. In the combination process, the structured archive that the CoP hold, make it possible for members to access to all past and present discussions if needed when faced by a particular problem. Our analysis also reveals that socialising through face-to-face chapter meetings and annual conferences have been a crucial mechanism for the community members to develop community ethos and personalisation to become more enthused in virtual debates. This paper reports on two discussions that had good "replies" rate involving a disparate group of participants. The limited contribution by most individuals taking part in these discussions is somewhat unfortunate because it does not allow us to see how individuals' views developed through the interactive process of this discussion. This limitation to the study is readily accepted, however, it this does not prevent us to support the broader methodological approach we have adopted to analyse a virtual CoP.

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