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Temporal and environment preferences: impact of virtual working on creative problem solving

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Abstract

The trend over the last few decades has been towards more virtual working activity, especially in technology based environments such as development teams. Previous work indicates that virtual teams face more challenges than face to face teams. It is more difficult communicating when team members are dispersed in location (including different countries) and have different working days timing constraints – all of which impact the effectiveness of individuals and the team as a whole. Results from the previous work (involving qualitative reflections from team participants and observing communication channels) indicate that individual team members have their own preferences in times and possibly the environment in which they engage in tasks and in online activity. In addition, existing literature also indicates possible preferences over individual or team-working on tasks. This paper investigates these preferences further by exploring people's individual preferences for environments, times and, group or individual engagement in creative problem solving activity. The initial results show considerable diversity in preferences, which it is argued, need to be taken into account to improve virtual team performance on creative problem solving tasks. The paper contributes to the development of management practice for virtual groups.

Keywords: temporal and environment preferences, virtual teams, creative problem solving

1.0 Introduction

Virtual teams are an increasingly important part of Information Systems development practice. There are considerable challenges in virtual working particularly with regard to creative problem solving tasks. The temporal, physical and perceived distance between team members can provide extra barriers to sharing ideas and developing group collaboration (Cohen and Mankin 1999, Adams 2007). Effective virtual working may require different thinking to that of face-to-face working.

This paper investigates preferences for creative problem solving activity including environments, times and team and individual engagement in creative problem solving tasks. The motivation for the investigation is the result of a previous study that indicated participants in virtual teams have preferences for the environment and times when they engage in tasks. The research in this paper involves a survey of

undergraduate and postgraduate students taking Information Systems or Computer courses, the rationale being that these are likely to be the candidates for careers in Information Systems development.

There is clearly a need to better understand virtual teams and how they can be supported in creative problem solving activity (Adams 2005; Sudweeks 2008). It is hoped the research will inform the management of virtual teams including selection of team members, task allocation, communication processes, protocols and motivation. The paper contributes to the development of management practice for virtual groups.

2.0 Virtual Teams and Virtual Collaboration

Virtual collaboration with teams composed of dispersed groups of people, either from the same company or from different companies, is now the norm for many organisations. A significant challenge for managers is how to support collaboration in virtual teams particularly when the tasks involve creative problem solving around shared problem spaces. Cascio (1999) argues that “Perhaps the most common forms of virtual teams are task forces and project teams. These are temporary groups (e.g., in legal cases, consulting projects, or within-company task forces). Such teams are formed specifically to solve a particular problem or to perform a specific task. When the problem has been solved or the task completed, the virtual team disappears and team members go back to their normal duties” (Cascio 1999, p7).

Perhaps some of the best examples of such project-based virtual teams are information systems development (ISD) projects, especially those that involve some form of outsourcing or projects for multinational organizations requiring interactions from several dispersed stakeholders. Even moderate sized in-house development projects can involve outsourcing/ofshoring for well defined tasks (Adams 2005). Typically the main outsourcing drivers for many organizations has been cost reduction and cost containment (Carmel and Tjia 2005) In addition, outsourcing can provide both access to expertise not available internally and the ability to keep pace with technological change. It is these capabilities that are often likely to contribute to the long term success of a system or business (Aalder 2001, Kratz et al 2006, Adams

2007). Outsourcing in a global business environment often means offshoring: moving the service delivery to a different country with lower labor costs (Porter 2003, p57).

All collaborations have challenges in achieving common goals, group cohesion and getting the best from team members. This is particularly so for ISD projects which require the developers and stakeholders to share a common set of goals – such as developing and delivering an appropriate system within time and budget. Within a virtual environment these challenges become more pronounced. For instance, with a virtual team involving a mix of outsourced and in-house developers there are likely to be mixed loyalties and mixed goals. The temporal, physical and perceived distance between the group members will also provide extra barriers for close team working (Cohen and Mankin 1999, p119). The virtual medium provides extra limitations for communicating compared to the face to a face environment. Adams (2007) identifies some of the main differences and challenges between virtual and face-to-face teams, as represented, below, in Table 1. Further challenges for virtual teams emerge when we consider that it takes time to develop good functioning and communicating teams (Poole 1990). With project based virtual teams the team members have a finite time to develop team cohesion before the team is disbanded and the team members move on to other projects.

Virtual environments	Face-to-face environments
Contact is mostly formalized where meeting are usually formal or planned events	Formal and informal meeting, with planned and ad hoc events
Meetings usually limited to a defined formal purpose, such as requesting information or reporting on progress	Wider range of type of meetings, from formal to social
Less opportunity for team cohesion with less social contact	Team cohesion is supported with social contact, such as informal coffee meetings
Embedded ‘them and us’ attitude	Easy to foster ‘can help’ attitude
Distance, time and location barriers to sharing problems, ideas and solutions	Same locality supports sharing problems, ideas and solutions

Table 1: Main differences between a virtual and face-to-face environment (from Adams 2007).

3.0 Virtual Team Development

A previous research project focussed on the development of good support structures for virtual teams. The previous work is covered more fully in Adams et al (2010).

It is inherently difficult to undertake robust research using real virtual teams since each team will be unique in terms of team members, project focus and operating environment. The approach taken in Adams et al (2010) was to limit the number of factors and variables by developing an experiment involving a set of problem solving tasks and using a set of 'artificial virtual teams'. One of the biggest challenges for the research was to get a sufficient number of virtual teams together, ideally with team members located in different countries or time zones. In addition, the team members needed to be comfortable and willing to work with technology in a virtual environment. One group of people that seemed to fit these criteria were distance learning students. A distance learning Master's level unit, covering Strategic Information Systems, was chosen. The unit topics included virtual working activities (some of which were already part of the assignment), and as a distance learning unit the activities already involved some virtual group interaction. A common set of tasks was developed meeting both the research and unit assessment. Part of the unit assessment included a reflective report on students' experience of virtual working and the collaboration process. Overall 17 virtual teams, each consisting of 3 -5 people, were involved.

The tasks included the students identifying several current examples of corporate systems (three required from each student) and for the virtual team to collaborate and choose one of the examples for more full analysis (identifying strengths and weaknesses, areas for improvement along the development of a set of criteria). The final task was for the virtual team to develop suggestions for improves their chosen example corporate system. The assignment tasks followed a 7 week set of activities with defined outputs each week.

The results of the interaction indicated that some of the virtual team members preferred working at night, others in the morning or day time. Some people liked to discuss the tasks within the online sessions, often coming up with consensus solution within the sessions. Others seemed to prefer turning up to sessions with their own worked out solution which they would then discuss and compare to other people's

solutions. Individual preferences clearly were impacted how the students engaged in the virtual tasks. Discovery of these individual preferences provided the impetus for the study reported in this paper into individual preferences for creative problem solving.

4.0 Individual preferences for creative problem solving

A survey was chosen as the most suitable mechanism to identify individual preferences. The target audience for the questionnaire of undergraduate and postgraduate students taking information systems, technology management and computing courses was selected as these will be the prime source, or 'raw materials', of candidates for careers in Information Systems development environments. The selection strategy included getting responses from students at different undergraduate and master's levels.

The main aims of the survey were to investigate if there are preferences in the timing, context and environment for people to develop their creative solutions to problems and also preferences for individual or group work. The overall aim was to inform virtual working practices particularly those that call for creative problem solving activity.

The survey consisted of tick-box questions covering times and spaces that have supported creativity and open-ended questions covering influences on creativity and problem solving. The questions also explored the amount of group or individual activity that usually takes place in the creative thinking and problem solving process. The first question asked them to rate how creative they classed themselves. Then two questions examined the time of day when they prefer to be creative and solve problems. Four questions examined specific environments and context that the literature indicate have been supportive for creative moments. Further questions asked for their preferences for individual or group environments for problem solving and creativity.

The survey sample consisted of student groups on a range of modules, though all students were studying Information Systems/Computing related degree programmes:

- Group A: Students on an undergraduate final year technology related module, run at a UK university. Sample size 60 students, usable responses 33 (response rate 55%)
- Group B: Students on an undergraduate final year technology related module (similar in scope to that taken by students in Group A) run at a franchise college (see below for details). Sample size 27 students, usable responses 20 (response rate 74%)
- Group C: Part-time Masters students taking a strategic information systems module at the same UK university as those in Group A. Sample size 11, usable responses 8 (72%)
- Group F: Undergraduate final year students on a technology/IS based unit. Sample size approx. 76, useable responses 44 (response rate 58%)

[Note: for this submission, it was only possible to code the responses from the above groups (i.e. was not able to complete the full coding of data in time for submission to the conference)]

- Group D: Undergraduate first year students on an information systems unit at the same UK university as Group A. Sample size approx. 100, useable responses 48 (response rate 48%)
- Group E: Undergraduate second year students taking a technology based unit at the same UK university as Group A. Sample size approx. 60, useable responses 26 (response rate 43%)
- Group G: Masters level, IS/ technology related module. Sample size 41, usable responses 33 (80%)

The full set of data includes 212 usable responses, from a sample size of approximately 375, giving an overall response rate of 56%.

For this submission (**see note above**), 101 usable responses were processed with a response rate of approximately 60%. The analysis below is based on the responses from these, i.e. Groups A, B and C. The analysis of the full set of responses will be available for the next round of review.

The students at the franchise college consisted of international students mainly from the Far East, but also Africa and a few from Europe. The part-time MSc students were all working and from different parts of the World, but mostly from the Middle and Far East.

Given the relatively small sample sizes it is not suitable to provide significance testing on the results (the more full set of data will address this limitation). For some questions respondents indicated more than one option, for instance in the times of day when they have creative moments. The results have been collated and represented as a percentage of responses for each category in Table 2 below.

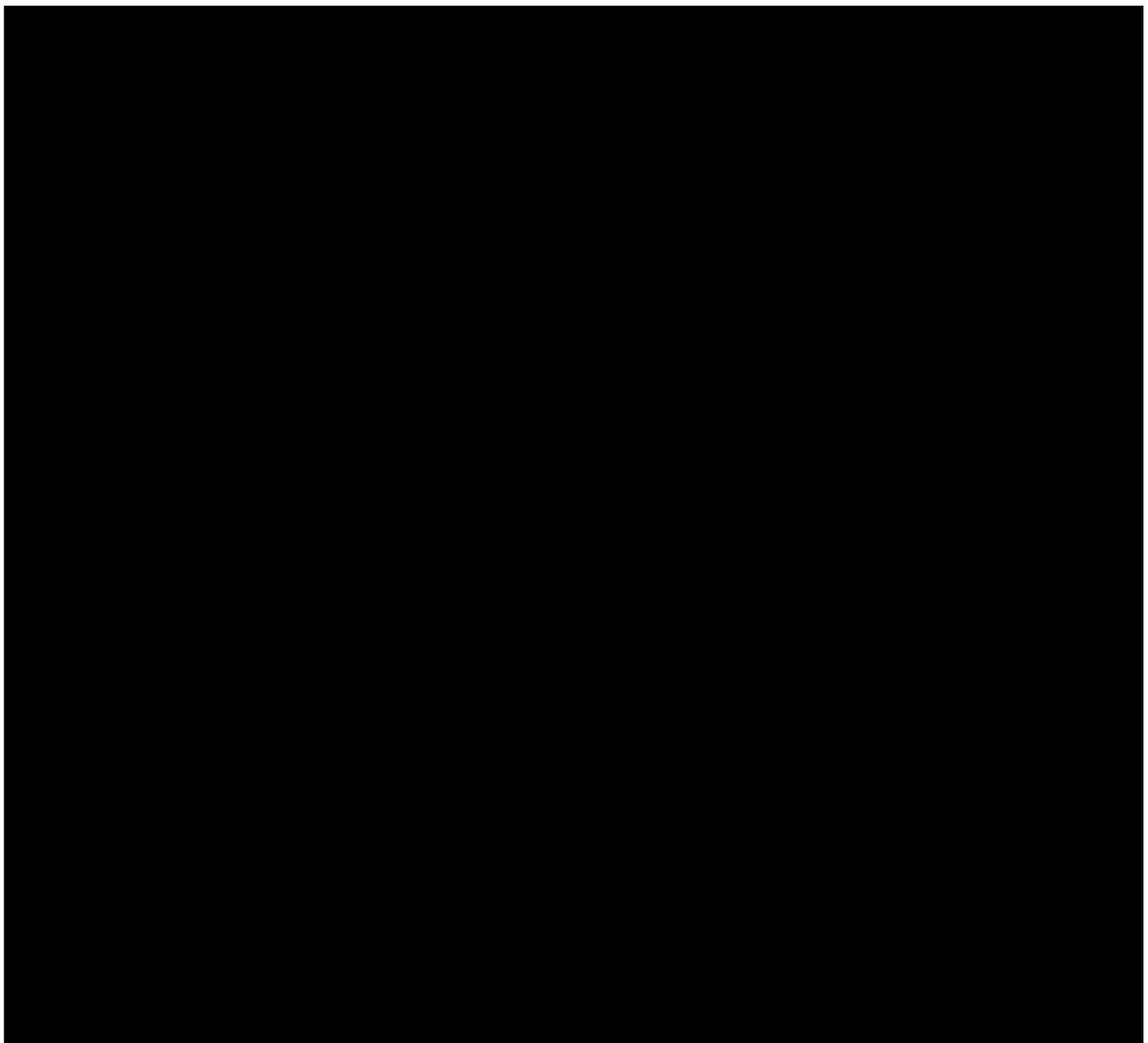


Table 2: Summary of questionnaire responses

The results were fed back to the students to help inform their understanding of challenges and opportunities for virtual working. The feedback activity also consisted

of a focus group type discussion with the students to generate a richer set of responses and to see how representative they were for the student cohorts. The discussions seemed to match the survey responses in the range of preferences from individuals. In addition the discussion brought out further barriers to thinking creatively and other spaces for being creative.

Most respondents classed themselves as fairly creative, the average being 6.3 on a scale of 1 (low) to 10 (high). This was supported with the focus group type discussions where most of the students classed themselves as 'fairly creative' but also liked being creative. The respondents seem to have distinct preferences for the time of day when they are at their best for problem solving and being creative: Some are biased towards being morning-creative while others have a bias towards being evening-creative. Interestingly, the responses from the part-time Masters students were different to the other students' responses when identifying the best times of day for both thinking creatively and concentrating on problems. The undergraduate students had a spread of time of day with peaks in the early morning, afternoon and evening/night time. The Masters students' responses were polarised at early morning or late evening / night time.

The discussions with the Masters students, who were all in full-time employment, indicate that the practicalities of the working environment affect being able to think creatively (i.e. difficult to think creatively when in a busy stressful environment). These results relate to the practicalities of working environment that have been highlighted in the study discussed earlier covering virtual groups.

The mostly anecdotal literature on moments of creativity, discussed above, also suggested that many inventors' ideas arose while the inventors were in different relaxing environments such as while dreaming, out walking, sitting and relaxing or while taking a shower. A set of questions in the survey looked at how frequently the participants had their creativity moments in each of these environments. No respondent selected never for all the environments, and few selected never for each of the particular environments (the most common 'never' responses were for dream and shower environments, and these were less than 20%). For most of the respondents at least, a relaxing environment is productive and needed for idea generation. A further

set of questions focussed on the preferences for group or individual activity for generating solutions to problems or generating ideas.

The largest proportion of respondents (45%) generated their solutions and sparks of ideas equally through group interaction or while on their own. However, over a third of respondents said they generate their solutions or get sparks of ideas either all on their own (5%) or mostly on their own (30%). This preference in the respondents for generating ideas, solutions and creative thinking while on their own was supported in the discussions with students. However, some students voiced that for them the group social environment, such as being in a pub or having lunch with colleagues, is often the best place to generate ideas.

The open question responses generally supported the need for a quiet and private place for thinking about problems and for creative thinking:

- “most of the time I solve problems while I walk and on my own. I feel more creative and more concentrated late at night”
- “when you are alone in the desert you think more deeply”
- “[the] few problems I came across, I came up with solutions and problems in my solutions during or after offering prayer ...”
- “when I am half asleep”

Interestingly, other environments for thinking about problems include while driving or travelling. This may represent for some people the main or only time when they can be on their own:

- “[creativity thinking] while driving and in bed”
- “I am creative most of the time when I am travelling or on holiday”
- “Nice views when I am travelling”
- “I can concentrate and think differently when I am on my own and there is absolutely no noise around me”

Different barriers and enablers to creativity were raised a few times in the open questions and discussion, and items such as stress and the working environment were issues for some of the respondents:

- “What hinders my creativity is demanding and relatively redundant duties, lack of outdoor sport and reduced stamina and fresh air. ...
- What helps creativity, dynamic environment where exposed to different situations from time to time. Time spent alone, outdoor exhilarating activities...”
- “while eating, it stimulates, relaxes you, focus ...”
- “Work hours – mostly sets into a repetitive fashion of work or priorities and tasks keep changing, a pressurized environment [all] curtail my creativity”
- “noise hinders my creativity”, “road works – irritating noises”
- “hindrance- noisy environment; help – quiet, serene environment”
- “When I am watching TV or in a crowd or when there is too much noise I find it difficult to concentrate on an idea”
- “...Stress or pressure hinders my creativity”
- “I am not creative whenever I am going through some personal issues”
- “when under pressure I perform poorly and loose concentration but when relaxed I perform perfectly”
- “under pressure I am not creative”
- “not creative under stress”

A few suggest a socialising environment for stimulating ideas;

- “The pub for a conversation with colleagues makes you trigger ideas”
- “Beer helps”

5.0 Limitations, Discussion and Conclusion

There are many limitations to the responses from the survey presented in this paper, not least a small sample size and a focus on student responses. There are dangers in generalising the results given the small sample sizes, though analysis of a larger set of responses should address this. There is strong rationale for targeting Information Systems/Computing technology students for the survey, namely because these are the ‘raw materials’ for people making careers in Information Systems development. However, there were still concerns over the use of student responses particularly with the potential phenomena of “captive audiences”, i.e. felt like they had to participate because they were in a class or captive environment (Ammer, 1997). This was

addressed by having a title on the surveys “Optional Creativity Questionnaire” and being explicit in the instructions to students that it was optional. The response rates were respectable but not excessive indicating that captive audience biases was less of an issue.

The responses seemed to indicate people have different creativity profiles where they have distinct preferences for time, environment and individual/group interaction. Some people seem to be biased towards being morning-creative or evening-creative, similarly towards being individual-creative or group-creative. If the remaining survey responses are similar to the partial responses presented here then there are implications for virtual team management and support in Information Systems development projects. In addition, the partial responses indicate the respondents classed themselves as fairly creative and also that they liked being creative. This seems to indicate that Information Systems development is very much a ‘creative rich’ domain. If this is supported with the full set of responses then this is clearly a message that needs to be feed back to course and career recruitment.

The partial responses from the survey seem to support the literature on moments of creativity: There seems to be a bias toward individual activity in problem solving and idea generation and many of the ideas originate in relaxing environments such as while half-dreaming, walking, sitting or even some while taking a shower. The qualitative responses seem to point to the importance of having some private, quiet place and a stress-free environment to support creative thinking activity.

It seems clear that organisations that have virtual teams engaged in some innovation and creative problem solving activity could benefit from being aware of the profiles of the virtual team members. Designing working practices around those profiles could bring out the best creative talents of team members. For instance, there seems to be opportunity to match up evening-creativity people in one part of the world with morning-creative people in another, especially if they have a bias towards being group-creative. Equally, individual-creative people typically need their own space and environment to enhance their creative performance, so it need not be a problem for idea generation activities for every team member to online at the same time.

The next stage of the research is to complete the coding and processing of the collected responses for groups D to G. In addition, these responses indicate that the ISD domain is a creative rich environment, so one area for follow on work is to compare these responses with responses from students on traditional 'creative' courses.

6.0 Impact on virtual collaboration

The discussion earlier covering outsourcing shows the trend has been towards outsourcing tasks to countries with lower labour costs (Porter 2003, p57, Carmel and Tjia 2005, Kratz et al 2006), such as India or China. One of the assumptions of this outsourcing/offshoring activity is that the host company holds the 'innovation space' (i.e. has the innovation and creativity edge) while the offshoring company just develops the innovative ideas from the host company. For instance, are the creative profiles for similar students in China or India the same as in the UK? This is an area calling for further research. There are other areas of potential interest such as 'do the most creative people work better on their own or in a group?', or are there any differences in profiles based on age or gender?

Virtual and transient teams are the reality of business activity for many organisations, large and small. This paper has identified some of the challenges and issues of virtual working covering creative problem solving activity. The paper shows a novel approach to investigating problem solving activity within virtual groups. It is inherently difficult to undertake robust research using real virtual teams as each team will be unique in team members, tasks and context. Consequently there are likely to be many factors and variables to contend with making comparisons between virtual teams difficult. The approach adopted in this research has limitations (such as the use of students in the virtual teams) but provides mechanisms to limit the number of factors and variables of virtual environments. Consequently the research hopes to make contribution towards researching virtual working activity. The focus in this paper on creative problem solving has highlighted some structures that contribute to successful virtual teams, much of which supports other works (such as Latham 2005 and Cooper 2000).

The investigation of virtual teams with a common set of tasks also highlighted other avenues for contribution: individual preferences of team members towards times, environment and group/individual interaction that will impact creativity and problem solving activity within virtual environments. This is an area calling for further investigation and offers much potential to inform working practices, protocols and virtual team composition.

Innovation and creativity has much potential to flourish in the virtual environment, however, managers must use the attributes of the virtual environment and match those to the creative problem solving tasks and the team member preferences. There is a clear need for research into the practice and reality of creative problem solving, particularly research that addresses the current state of the virtual operating environment.

It seems clear that organisations that have virtual teams engaged in some innovation and creative activity could benefit from being aware of the creativity profiles of the virtual team members. Designing working practices around those profiles could bring out the best creative talents of team members. For instance, there seems to be opportunity to match up evening-creativity people in one part of the world with morning-creative people in another, especially if they have a bias towards being group-creative. Equally, individual-creative people typically need their own space and environment to enhance their creative performance, so it need not be a problem for idea generation activities for every team member to be online at the same time.

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