Diverse virtual social networks: implications for remote software testing teams

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Abstract

This paper evaluates offshore outsourcing in the IT testing industry and determines what conditions determine its success. There is particular focus on the influence of diversity in teams on group relationships. Two studies are described: the first, investigated the perceptions of professional software testers on the critical factors of offshore outsourcing; and the second study looked at the ability for diverse teams to form close working relationships through virtual networks. We find that overt diversity factors inhibit interaction across nationality boundaries. The limitations of virtual networks for fostering personal communications is apparent in preventing group members from overcoming the initial aversion to mix with out-group members, which could be achieved with closer and more personal communications between members with different diversity factors in normal face to face communications. Where software testing teams are outsourced globaly, and must rely on virtual communications, there seems potential for significant difficulties in developing close working relationships, which on the one hand, can be negative for group cohesion, but one the other hand, can be positive for encouraging imparitality.

Keywords: Outsourcing, Offshore, Culture, Diversity.

1 INTRODUCTION

We investigate the consequences of teamworking from racial, cultural and gender diversity. Our concerns are with basic research to learn about the influences of various diversity factors on mixed teams of workers. It is intended that the findings would have application to many work settings including the IT sector. The article presents results of projects linked by the common theme of teamwork amongst people of different diversity dimensions. First, we establish that understanding of different cultures and communications among culturally diverse groups is a critical success factor as perceived by professional software testers. Secondly, we examine the efficacy of virtual communication and knowledge sharing networks on fostering better relationships accross diversity lines. Of particular note is the influence of culture on the effectiveness of teamworking. The intention is to investigate how independent test groups composed of personnel from different cultures in different countries can relate to each other over virtual networks.

A great deal has been written about the benefits and problems of diversity in groups (e.g. Roberge & van Dick, (2009), for a recent review), and common thought is that many intervening factors can help or hinder group performance and dynamics under particular prevailing circumstances. The

complexities inherent in this field reflect the difficulties facing managers of multicultural workforces in their efforts to promote greater team effectiveness and productivity. As the business world adapts to the potential and necessity of globalisation (see Nayyar, 2006 for a discussion), and work practices evolve towards knowledge working in a multidisciplinary setting, there is ever increasing reliance on multiskilled groups of functionally disparate and possibly dispersed knowledge workers. Globalization, market liberalisation and outsourcing mean that cultural competency is as vital as technical and management skills for managers, requiring thought, effort and perseverance for successful outcomes (Cordesman, 2002). Hofstede (1980) defines national culture as "the collective programming of the mind which distinguishes the members of one human group from another" (p. 21). According to Lederach (1995), culture is "the shared knowledge and schemes created by a set of people for perceiving, interpreting, expressing, and responding to the social realities around them". Thus culture influences the way individuals communicate and behave as it implies a set of norms encompassing thought patterns, beliefs, self-image and emotional responses (Muir, 2007). Understanding cultural differences is obviously a critical factor in diversity management which led Earley & Mosakowski (2004) to introduce the concept of 'Cultural Intelligence' (CQ). The failure of most international joint ventures can be ascribed to inabilities to understand another party's culture (Yau, 2004), different ways of working (Krishna *et al*, 2005) and/or different approaches to communication (Brett *et al*, 2006). Perceptions of culture can also have tangible effects, as Hahn and Bunyaratavej (2009) show that the level of offshore service agreements created for a country can be affected by that country's rating on Hofstede's (2001) culture dimensions.

It is important, therefore, for teams composed of members from different cultures, races, nationalities, ages etc. to be managed with awareness of the consequences of different levels of diversity on the team's ability to form strong working relationships, which eventually lead to higher levels of productivitiy and performance. Moreover, with increasing reliance on the internet and other forms of telecommunications as the primary medium of formal contact among team members, the traditional mechanisms through which friendships and relationships develop (e.g. casual face to face encounters, shared emotional experiences, etc.) are no longer relevant.

The following section provides brief reviews of the literature on group diversity, outsourcing, and software testing, before the two studies are presented.

2 BACKGROUND

2.1 Group Diversity

The dimensions of diversity include gender, race, culture, age, family/career status, religion, disability and others including educational qualifications, work experience, languages and other relevant attributes and experiences that differentiate individuals (Krishna *et al*, 2004). Triandis *et al* (1994) offer a somewhat broad definition of diversity as being ''any attribute which may lead people to the perception that that person is different from me'' (p.772). However some of these dimensions are more readily apparent than others, prompting Harrison *et al* (1998) to categorise so-called 'surface-level characteristics' (e.g. race, gender) versus 'deep-level characteristsics' (e.g. attitudes, opinions, values) with these latter characteristics only becoming known over time as the result of interaction. Such a typology may also be dependent on context (Pelled *et al*, 1999). Whatever the differences, apparent or otherwise, the emphasis within a management of diversity perspective is that all perceived differences amongst groups and individuals should be valued (Kandola and Fullerton, 1998; Stone, 2005). This point leads Muir (2007) to argue that the importance of diversity should be communicated constantly to employees.

A mainstay of diversity research has been Tajfel's Social identity theory (Tajfel, 1979), which considers the influences on a person's sense of identity steming from both individual and social. In

this view, a person at one time may create a unique identity of themselves, which serves to differentiate them from others. At another time, the same person can choose to self-categorize with another individual or group and thereby give more salience to social identity. It is postulated that the purpose of social identity is to raise self-esteem through positive contrasts with other groups. The in-group reinforces their identity in order to differentiate with an out-group considered undesirable in some way. This behaviour can be either positive towards the in-group or discrminatory to the out-group. Furthermore, group-efficacy, which is the group's belief in its ability to perform at a high level, although, not as widely applied to diversity research as social identity theory, is relevant when determining the dependence of group outcomes (i.e. performance) on intervening variables (such as social cohesiveness) and group composition (i.e. level of diversity). Sargent & Sue-Chan (2001) for instance, suggests that increasing levels of diversity may counter the debilitating effects of poor group integration by enhancing perceptions of group efficacy, which leads to better performance (generally, thought to be improved at later stages of the task when stronger relationships have formed). Furthermore, in some cases, social cohesiveness can be improved with greater racioethnic diversity, and that further supports group efficacy. However, the circumstances under which self-categorization occurs, the influences on individual attitudes to diversity, and the mediating or inhibiting effects of diversity are not universally agreed and the subject of current investigations.

2.2 Outsourcing

Outsourcing can be described as the moving of some or all of an organisation's operations to a contracted company. There are various types of IT outsourcing contracts, and one of the most popular is offshore outsourcing - the sourcing abroad of a business process to tap into favourable price differentials, skill and performance resources. There has been a rapid growth in information technology outsourcing to the benefit of organisations as they can use IT outsourcing strategically. 'While early deals focused on the cost reduction, many organisations in their second or third generation of IT outsourcing are seeking significant business advantage' (Lacity & Willcocks, 2001). Within the IT industry it has become common practice for organisations to opt for software testing to be executed by an Independent Test Group (ITG), and to outsource this operation to a company based in another country. Smith (2006) poses an important question 'Is offshoring at the expense of quality?' Many organisations are now opting for a strategy of outsourcing a '…targeted set of discrete IT activities.' (Lacity & Willcocks, 2001). In the software development process, it has become an increasing trend for organisations to outsource some or all of the testing phases to an Independent test group (ITG). 'Software testing is very labour intensive and expensive and accounts for a significant portion of software system development cost.' (Ferguson & Korel, 1996). Therefore many organisations are taking advantage of established and emerging IT industries in the developing world, to outsource software testing too.

2.3 Software testing

Within a software development project, testers may comprise of a subset of the developers, an independent test group (ITG) or a combination of the two (Perry, 2000). There is opinion that the test organisation should be as far removed as possible from the development organisation in terms of the structure of the company (Myers, 2004). A common practice for many businesses is to outsource or subcontract a portion of testing to a company that specialises in various aspects of software testing which would act as an ITG (Patton, 2001). An ITG may also act as an Application Service Provider (ASP) to make available a system or automated software testing programs. However more importantly they would provide trained technical labour that would use their testing experience, knowledge and ability to find defects. An ITG would be able to mitigate risk and crucially would be valuable in providing an unbiased view to ensure the software meets the expectations of the stakeholders. The decision to outsource IT services in an organisation is a crucial strategic choice due to the profit maximisation opportunities, emotional arguments and complex links with the organisation's structure and processes. When outsourcing, an organisation (customer) will consider many issues, such as the quality of the service and possible language, cultural and commitment issues.

3 STUDY 1

In order to investigate the issues outlined above, the first stage of the research programme was to conduct a survey in a software testing house in the UK to determine what factors were considered most influential in offshoring. Opinions of 15 experienced IT workers were sought in order to develop an idea of their perceptions of offshore outsourcing. Qualitative primary data were collected via questionnaires and semi-structured interviews. Participants all had experience working within organisations that conduct some form of offshore software testing. Their roles in their respective organisations involved working with or relying on the offshore test team in someway; there were at least two participants for each role to provide unbiased results. Participants were principally in IT based roles; less IT orientated roles included business analysts and business project managers.

The questionnaire was designed to address offshore testing, with three question types.

Select an answer on a scale of 1-5 e.g. 1 = strongly disagree and 5 = strongly agree.
Options yes or no.
Rank criteria from 1-5, 5 = highest and 1 = least.

For example: Do you believe the offshore test team are aware of the overall aims of the project? The offshore team provides an impartial view of the system they are testing? Select:

Five main factors of offshore coutsourcing were identified from secondary data collection and discussions with managers in the software house (*culture*, *integration*, *commitment*, *impartiality*, *communication*); these were the subject of a follow-on investigation in which the participants (15 software test engineers) were asked to rank each characteristic in terms of its relevance to soutsourcing testing procedures. A mode analysis was employed to priorities the findings. Table 1 provides definitions (deriveed from consensus of opinion from managers) of the factors given in rank order of perceived importance.

	Criterion	Meaning
ITG	Culture	understanding cultural differences.
	Integration	Accuracy and timeliness of data and information flow.
	Commitment	Alignment between a worker's personal goals and those of the organisation.
	Impartiality	Adherence to sound principles and justifiable judgement
	Communication	Clarity and convenience of information flow.

Table 1. Working definitions of assessment criteria

It can be seen that the most important criterion is understanding cultural differences. Under certain circumstances the offshore outsourcing structure can work for ITGs, by overcoming cultural, communication and commitment difficulties. Our findings support those of a recent study (Nakatsu and Iacovou, 2009) in which barriers in project communications and cross-national cultural differences were identified as the top two risk factors of offshore software development, and those of (Aundhe and Mathew, 2009), which identified cultural differences as particular risks for offshore outsourcing from the service provider's perspective too. Organisations are willing to accommodate the perceived risks in order to gain strategic advantages over competitors. We look at this issue in more detail below.

3.1 Culture

Ting-Toomey's (1999) work on inter-cultural communication theories highlights problems with communicating across cultures. In an attempt to resolve communication and culture problems providers in India train recruits in techniques aimed at 'accent neutralization' by watching their customer countries sitcoms and news programs (Blunden, 2004). Also establishing a methodology with the support of tools can improve communications and accessibility (Hackett, 2007). Cultural differences between the customer and provider vary accordingly to where each business operates. By learning and understanding cultural differences, they can be tolerated or steps can be implemented to avoid issues. This can be achieved via formal communication to enhance cultural understanding, such as committees and workgroups (Yang *et al*, 2005).

Interestingly, the remoteness of offshore teams and the vendor makes it difficult to establish close ties, which, beneficially, avoids the problems associated with too close a relationship that could cloud judgement and hinder impartiality in quality assessment. However, remoteness can also inhibit the development of strong group identities (Sakthivel, 2005).

The literature on collaborative work and learning has called for greater research emphasis on communicative processes. Communities develop their practice though a variety of activities such as problem solving, requests for information, seeking experience, reusing assets, discussing developments, mapping knowledge and identifying gaps. One method for analysing communicative processes is the investigation of structural locations within a system using social networking analysis (SNA). SNA has been used to shed light on several online collective learning contexts, including identifying central and peripheral actors (Lave & Wengner, 1991) and group cohesion. We examine some of these issues in study 2 below.

4 STUDY 2

The second study (longitudinal) sought to investigate the influence of particular diversity factors on the social dynamics between dispersed members of a professional community. Trainee and professional journalists were monitored as they participated in a specially facilitated online social network. Although we studied a non-IT sector, the issues of concern are sufficiently general as to enable transfer to the IT sector, such as software-testing in offshore groups. The participants were from Iran and Afghanistan (both Farsi speaking nations, although with some dialectical differences) and comprised a mix of males and females, and a range of age and experience in journalism (figure 1). The objective of the study was exploratory to understand the pattern of interrelationships that formed between the different subgroups. Our aim was to determine whether virtual work through social networks holds promise for professional practice in a global context.

The following research question was the focus:

To what extent are participants forming networks that cut across gender, experience, and nationality categories?

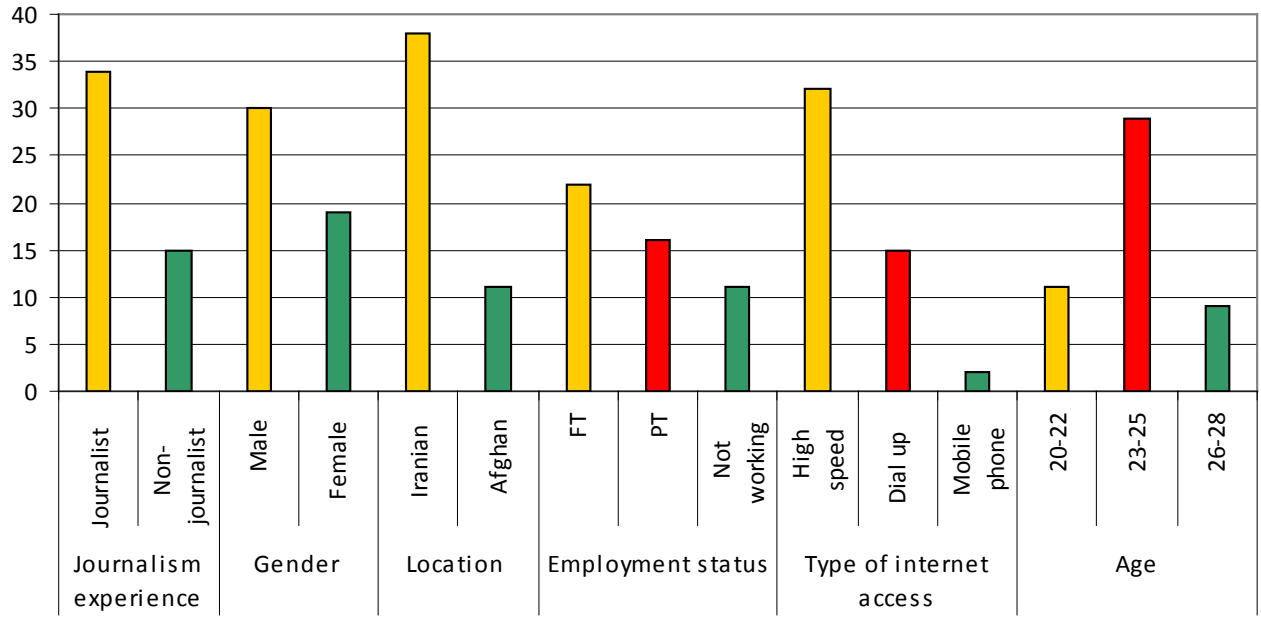

Figure 1. Sample profile (in absolute numbers)

The study began in December 2008 and lasted 20 weeks, in which trainees communicated through the social networking applications using discussion boards, blogs and emails. Social networking analysis (SNA) was applied to reveal patterns in the behaviour data about the interactions taking place. Online trainee behaviour on the web was generated automatically using Web usage mining. The Web-data provides an insight into the way trainees and mentors interact, for instance who (trainee) is posting or replying to the discussion forums; or the time and frequency of interactions. Social network analysis was applied to the recorded communication logs (discussion forum, blog and email) in order to identify and measure network communication flow using UCINET software (Version 6.0), which supports features such as detecting cohesive subgroups and measuring degree centrality. Figure 1 shows the distribution of interactions in the discussion forum. Node attributes are shown by shape, colour, and size. Shape of nodes indicates ethnicity, colour indicates gender, and size indicates length of journalism experience.

5 RESULTS

Social network analysis (SNA) was employed to identify a friendship structure among trainees. Data representing gender, location and experience were analysed by applying SNA to investigate the friendship network structure. Figure 2 visually represents the friendship network, which may be considered *assortative* (c.f. Fu *et al*, 2008), that is, nodes with large connectivity are connected to other nodes of large connectivity. According to literature, key actors or communicators can be identified by several measures such as the overall size of the network and centrality within the system being analysed (Tichy, 1981).

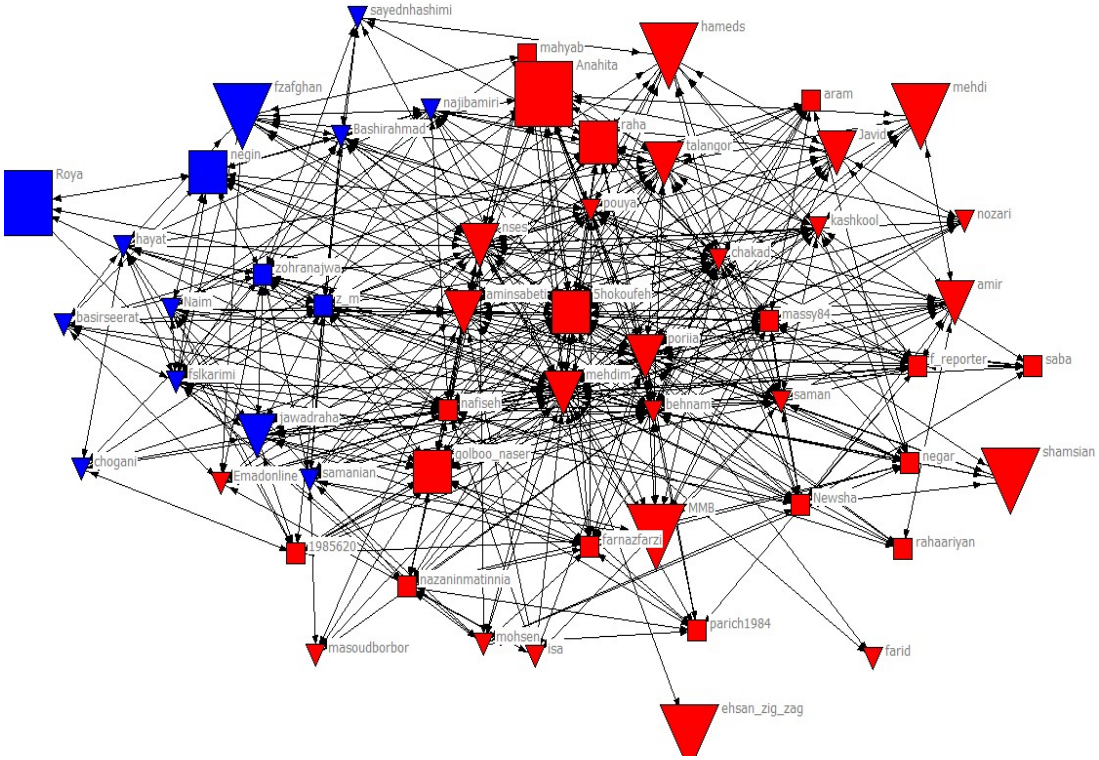

Figure 2. Friendship network. Nodes closer to the centre are more influencial, while the size of the node indicates level of activity.

With reference to Figures 2 and 3, there seemed to be a distinct effect of nationality, since Iranian trainees held strongly central and prestigious positions, while most Afghan trainees were located in peripheral positions. Moreover, within-nationality communications were greater than across-nationality, for both Iranians and Afghans. Also, evidence of experience effects was shown, since central and prestigious positions were held by non-journalist trainees (i.e. low levels of journalism experience), and most of them were male. Interestingly, central positions are often perceived to be correlated with individual performance levels (e.g. Yang and Tang, 2004). Although, it was not possible to test for performance, an inexperienced trainee at the centre would be counter-intutitve to the prediction that better individual performance would occur by more central nodes (relative to others). A status hierarchy emerged with Iranian males at the top and Afghan females at the bottom. There is also a communication pattern among male and female trainees regardless of their nationality, since in general, male trainees contributed more to the discussion forums by making more comments than females. Furthermore, there is a distinct pattern of across-gender interaction, with male trainees and female trainees communicating amongst themselves more than within gender (i.e. male-male, and female-female) (derived using block modelling analysis). An asymmetrical hierarchical relationship appeared with Afghan journalists interacting more with Afghan non-journalists rather than their peers, whereas, Afghan non-journalists responded equally to all Afghan males. Gender differences also emerged in the Afghan nationals, with most communications along gender distinctions (possibly again due to cultural influences).

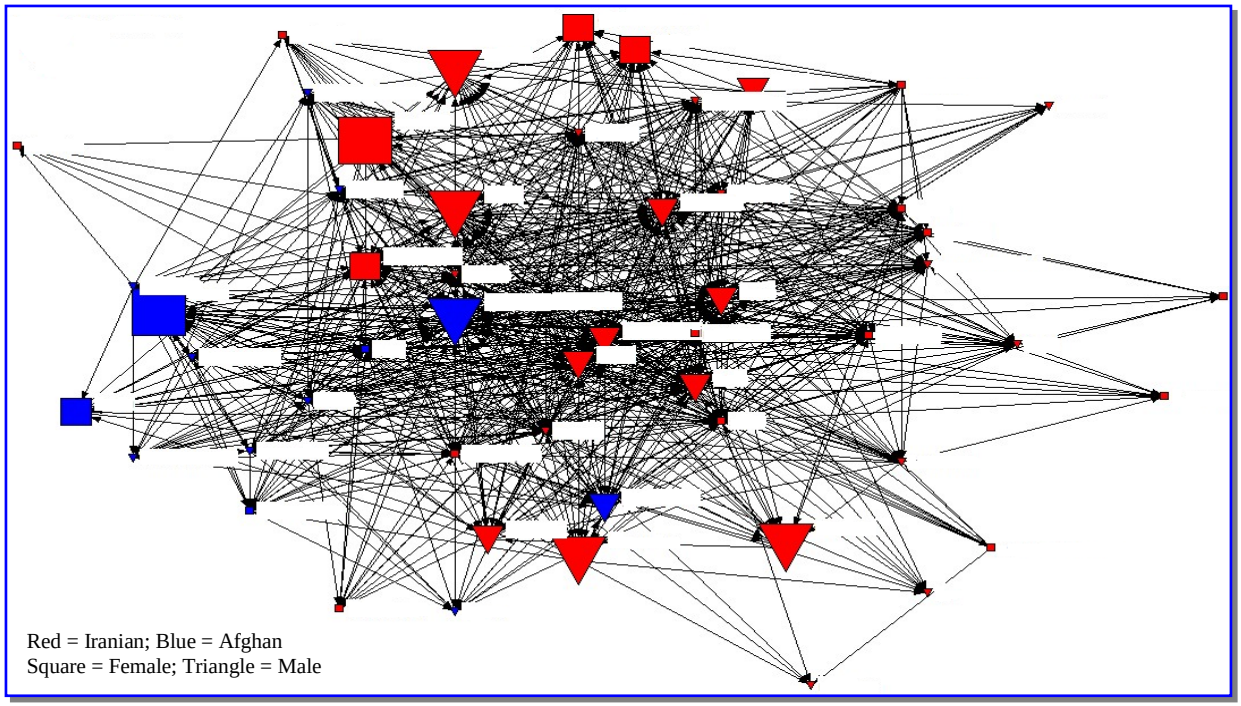

Figure 3. The discussion forum network by gender, location and journalism experience

6 DISCUSSION

It is proposed in van Oudenhoven-van der Zee (2009) that there are two measures of diversity effects: *affective* and *productive*; and they suggest that greater diversity is anticipated to reduce feelings of oneness but raise expectations of better performance. As a way to manage diversity, organisations should seek to emphasise the productive outcomes of diversity in the workplace, and diminish the automatic concerns over affect. According to the Personalization Model (e.g. Ensari and Miller 2006), discrimination in the workplace can be diminished through encouraging personal contact amongst workplace colleagues, which provides opportunities to learn about other groups and so produce a greater sense of commonality. But one should be aware that such a policy can create emotionally charged situations that can have negative effects on an organisation's attempts at diversity management. Within the context of dispersed software test groups, we have seen that communications and cultural understanding are important to developing strong working relationships, but that remoteness of physical location and time differences can hinder relationship building. Also, Babar *et al* (2007) found that cultural understanding was perceived (by software developers) to be a critical element of establishing trusting relationships between service providers and clients. Close relationships, although generally thought to be positive for performance, can interfere with the level of impartiality in test groups, where assessments of quality and thoroughness is demanded.

There is evidence that social networks for professional use can be helpful in locating experts and knowledge sharing (e.g. Yang and Chen, 2008). However, the effects of diversity on knowledge sharing are less well understood. In study 2, nationality is found to be the most divisive factor and significantly moderates group dynamics; whereas, gender is a mediating factor that promotes group dynamics, although it does tend to be asymmetrical (from males to females). The effects of experience on group dynamics is inconclusive since for Iranians it can be moderating (i.e. subgroups are formed along lines of experience) whereas for Afghans, there was no consistent pattern. All three diversity factors were evident in the status system that emerged, since due to the greatest level of activity, Iranian, non-journalist males moved to the most central and influential positions in the network. The results for nationality and gender are much in keeping with previous studies in the literature, but here, we see that

the same effects are evident in online groups too, where the overt and superficial differences of nationality (e.g. colour, accent, language) are not so easily discerned or even relevant. It seems that the large number of similarities in demographic factors (since Iranian and Afghan individuals share many common visible traits), are not sufficient to produce identity categorizations stronger than the fault lines of nationality (or simple country location), in an environment (i.e. online forum) where origins should not be a relevant issue. In the absence of other similarity factors (i.e. appearance), members of the group rely on posted information (such as ones profile) and give greater importance to the remaining overt factors of diversity (namely, nationality). Thus, virtual collaboration does not lend itself to developing strongly cohesive groups that can easily overcome disparities (Pyora, 2009).

For software test groups working across national borders, we can conclude that separation of parts of the test group from the main software development team may be problematic with respect to forming strong and close relationships where there exist clear overt diversity dimensions, and communications are primarily through remote channels. Cunningham (2004) draws on social identity theory and similarity attraction paradigm (Byrne, 1971) to suggest that overt diversity factors, such as ethnicity can seve as easy determinants of self-categorization, while less obvious factors, such as experience in a work role, can help to establish similarity amongst colleagues, which fosters better working relationships. Overt diversity factors (age and race) have been suggested to lead to better group effectiveness through intervening factors, such as perceived diversity (Cunningham, 2007), though gender diversity was less salient. Thus Mitchell *et al* (2006) conclude that "the effect of diversity in characteristics that are subject to social categorization processes potentially will lead to reduced cohesion within the group, while the influence of diversity in attributes that are perceived as being task-orientated potentially will lead to increased group performance" (p. 461). Results are unclear on how diversity affects the intervening processes, such as communications, but it is thought that better social relationships between ethnically diverse teams could translate in to better performance (outcome).

7 CONCLUSION

We have examined the influence of diversity dimensions on the ability to form relationships through virtual communication networks, and seen that overt diversity factors inhibit interaction across nationality boundaries. The limitations of virtual networks for fostering personal communications is apparent in preventing group members from overcoming the initial aversion to mix with out-group members, which could be achieved with closer and more personal communications between members with different diversity factors in normal face to face interactions. Where software testing teams are outsourced globally, and must rely on virtual communications, there seems potential for significant difficulties in developing close working relationships that overcome cultural differences, which on the one hand, can be negative for group cohesion, but on the other hand, can be positive for encouraging impartiality. The work could have been improved through inclusion of participants from different cultural and technological backgrounds, and through the use of collaborative work in a technological setting as the focus of activity for the social/professional network. Further investigation could focus on exploring in more depth the particular cultural factors that are perceived to be a hindrance to outsourcing. For example, language, work practice, social relationships, among others, could be targetted. And more consideration of the facilitators of knowledge sharing across cultural divides, e.g. trust, would be worthwhile in explaining network dynamics.

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