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ABSTRACT

In the present research, we developed a causal model of organizational innovation incorporating the literature on top management teams (TMT) and knowledge-sharing in organizations. We hypothesized that top team composition and trust would predict organizational innovation through the mediating variables of task reflexivity and knowledge-sharing. We tested the model using data collected from thirty-five knowledge intensive firms in Ireland operating in the software industry. Results indicated that top team trust, knowledge-sharing and task reflexivity have both direct and indirect relationships with organizational innovation. Implications for research and practice are discussed.

***Key Words*:** Innovation; Top Management Teams; Upper Echelons Theory; Trust; Reflexivity; Knowledge Sharing

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INTRODUCTION

An important body of literature has begun to examine how firms develop competitive advantage through organisational innovation (Nahapiet & Ghoshal, 1998; Schulz, 2001; Tidd, Bessant & Pavitt, 2005). Research on small and medium sized enterprises (SMEs) has shown that measures of success based on profitability and productivity are highly related to the emphasis a company places on innovation (Baldwin, 1995). Firms that innovate to improve their processes or differentiate their product have been shown to regularly outperform their competitors in terms of profitability, market share and growth (Tidd, 2001). Workplace innovations such as re-engineering have been linked to productivity growth in the US (Black & Lynch, 2004) and both product and process innovations are positively linked to business performance such as sales, profitability and market share (Prajogo and Ahmed, 2007) among Australian firms.

While there has been a tendency to focus on organisational structure variables within the organisational innovation literature, there has been some research investigating the influence of top team composition and group processes on innovation. The capacity to innovate has been linked to top team diversity, participative leadership, trust, reflexivity (McHenry 1989; Song & Dyer, 1998; Kimberly, 1981; West 2000) and knowledge sharing (Nonaka, 1999; Anderson and West, 1996; Smith, Collins & Clark, 2005). The composition of the top management team (Bantel and Jackson, 1989) and the values of senior management team (O'Hage and Dewar 1973) have been shown to be related to organisational innovation. West and Anderson (1996) found top team support for innovation (the expectation, approval and practical support of attempts to introduce new ways of doing things in the workplace) to be the principal predictor of innovation in their study of UK hospitals. However, with the exception of the TMT composition/diversity literature, there is relatively little research conducted on TMT processes that may directly affect organisational innovation.

The general innovation literature suggests that team processes and behaviours such as reflexivity, task conflict and knowledge sharing are important predictors of innovation (DeDreu, 2002; Tjosvold, Tand & West, 2004; DeDreu, 2006). Knowledge sharing in particular is considered an important dimension of innovation, particularly the sharing of new, diverse knowledge (Nonaka & Takeuchi, 1995; Spencer, 2003; Mascitelli, 2000, Smith et al, 2005). Hence, in this paper we aim to combine the top team and the innovation literature to develop and test a model of innovation incorporating TMT variables and knowledge-sharing variables. We draw on the upper echelons and group process theories (Carpenter, Geletkanycz and Sanders, 2004; Hambrick & Mason, 1984; Shaw, 1981) and the knowledge sharing literature (Nahapiet & Ghoshal, 1998) to develop our hypothesized model. We then test this model using data collected from thirty five software companies in Ireland. We suggest that insights concerning innovation can be derived from exploring both the composition and the team processes of the top management team. The principle aim of this study is to build a model that captures how the top management team might

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foster innovation at an organizational level, incorporating both top team composition (who the team are) and the processes they engage in (what the team does).

This paper is organised into four sections. In the next section, we develop our hypothesized model using the literature on top management teams and knowledge sharing. We then present the methodology used to test the hypothesized model followed by the results of our study. Finally, we conclude with implications for research and practice.

REVIEW OF THE LITERATURE AND MODEL DEVELOPMENT

The Nature of Innovation

Despite the many definitions of innovation, the various definitions tend to be reasonably similar in their approach. Kimberley and Evanisko (1981) describe innovation as occurring in three ways: as a process, as discrete items including products and services and as an attribute of the organisation (i.e. an innovative organisation). These three innovation types are not mutually exclusive. Rather they are conceptually compatible and inextricably linked as "the innovation 'process' culminates with innovation 'items', and firms that cycle through the process relatively frequently are described as 'innovative'" (Bantel & Jackson, 1989, p. 108). The ultimate test of any innovation – new products or services – is the market place. Innovative firms gain and sustain their competitive advantage through the development of new market offerings which are appealing to existing and new custormers. Such new products are critical because of their ability to become a means of market share gain and revenue growth (Bergstein & Estelami, 2002). Lyon and Ferrier (2002) focus on 'product-market' innovation, a measure of innovation that incorporates both product design and market related activities. Consistent with this philosophy, we focus on the percentage of new products targeted at new markets as our measure of innovation. The central argument of this paper is that the top teams behaviours and decisions are particularly significant in influencing the process of innovation in firms (Bantel and Jackson, 1989). Specifically, we focus on top team composition, trust, reflexivity and knowledge sharing. In the process, we integrate concepts from the upper echelons, TMT group processes and knowledge sharing literatures to develop and test a causal model to predict organisational innovation.

Top Team Composition

One important influence on TMT functioning resides in the composition of the group. Hambrick and Mason's seminal upper-echelons (UE) theory hinges on the principle that the make-up of the TMT in terms of age, educational level and tenure can have a significant impact on organizational outcomes as they are considered to be proxies for the underlying social psychological processes of the group that are difficult to measure. Hambrick (2005) argues that UE theory is essentially an information-processing theory. He uses it to help explain how the executive's orientation affects

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the selection, perception and interpretation of information and ultimately organizational outcomes such as innovation and company performance. In addition to the main effects of demographic characteristics, demographic dispersion has been widely studied as a determinant of team behaviour and organizational outcomes (Peterson et al., 2003). A large proportion of the upper-echelons studies focuses on the homogeneity or diversity of the top management team. The evidence from many studies suggest that a variety of factors related to the composition of the top team may both directly and indirectly impact organisational outcomes such as innovation (Lyon & Ferrier, 2002; Van de Ven et al, 1999; Camelo-Ordaz; Hernandez-Lara & Valle-Cabrera, 2005). These include the main effects of composition (i.e., educational level) and the demographic dispersion within the TMT (i.e., diversity in tenure, diversity in functional background, age diversity).

Certain TMT composition measures provide more consistent results than others. For example, there is general agreement in the literature that the higher the level of education attained, the more receptive to creative solutions and innovation the person will be (Bantel and Jackson, 1989; Hambrick and Mason, 1984; Thomas, Litschert, and Ramaswamy, 1991; Camelo-Ordaz, Hernandez-Lara & Valle-Cabrera, 2005). Smith and Clark (2005) found education indirectly affected the number of new products and services through the firm's knowledge creation capacity and they argue the level of education can also be considered an indication of the 'knowledge stock' of the top management team. West, Patterson and Dawson, 1999) research found educational level to be the strongest predictor of profitability and, to a lesser extent, productivity of 160 UK manufacturing companies studied over a ten year period. The vast majority of the research on educational diversity elicits similar results (Hambrick et al., 1996; Chaganti and Sambharya, 1987; Bantel, 1993; Smith et al., 1994).

On the contrary, the majority of research on age diversity suggests negative results. It can result in dysfunctional conflict, lack of consensus and ineffective communication as age diversity can deter the development of a shared language between individuals that results from similar background and experiences (Pfeffer, 1983; Zenger and Lawrence, 1989). West et al (1999) found that the more teams differed in age, the lower the profitability of their company. In explaining this finding, they speculate that difference in age is associated with difference in worldviews or mental model. Teams that do not possess a shared mental model of the task objectives, find it difficult to communicate, collaborate and co-ordinate their strategies as a team.

Research investigating the relationship between other diversity measures and organizational outcomes yields more mixed results. For example, West, Borrill and Unsworth (1998) suggest that functional diversity will lead to innovation where the group's task is complex and the environment is uncertain. Empirical work confirms this. Bantel (1993) found that functional diversity within teams leads to clearer corporate strategies while Hambrick, Cho and Chen (1996) also found functional diversity to have positive effects for the firm, leading to market share and profit

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growth. Bantel and Jackson's (1989) study of the banking sector found a positive association between functional diversity and administrative innovations in the banking sector and Smith et al's (1994)study found functional diversity influenced innovation through the firm's knowledge creation capacity. Camelo-Ordaz et al (2005) found functional diversity had a positive effect on innovation but only when there is consensus with the top team. However, Knight et al.'s (1999) study investigating how demographic diversity and group processes influence strategic consensus within TMTs found functional diversity hindered strategic consensus and Daellenbach et al. (1999) found functional diversity did not emerge as a predictor of innovation.

Similarly, there are inconsistent findings when exploring the relationship between TMT tenure and organizational outcomes. Diversity in team tenure was found to decrease levels of cohesion and trust and lead to lower levels of group specific knowledge (Lawrence, 1997). O'Reilly and colleagues (1989) found tenure diversity was negatively related to group-level social integration as well as to individual integration and Wagner, Pfeffer and O'Reilly (1984) found a negative relationship between organizational tenure and turnover. However, there are also arguments suggesting tenure diversity may lead to positive cognitive outcomes. O'Reilly and Flatt (1989), and Katz (1982) argue that diversity in tenure leads to increased creativity and innovation. Boeker's (1997) research found positive associations between TMT tenure diversity and strategic change and Hambrick et al. (1996) found tenure diversity positively associated with increased market share and profit growth. Knight et al.'s (1999) study of US and Irish TMTs found that, contrary to their expectation, tenure diversity was positively related to strategic consensus.

Overall, the research on demographic diversity suggests that diversity can lead to positive cognitive outcomes (e.g. debate, decision quality, enhanced creativity, innovation) but may negatively affect affective outcomes (turnover, consensus) (Milliken and Martins, 1996). Hence; we hypothesize that:

Hypothesis 1: Education level, functional diversity and tenure diversity will be positively associated with innovation while age diversity will be negatively associated with market innovation.

Hypothesis 1a: Education level, functional diversity and tenure diversity will be positively associated with reflexivity and knowledge sharing while age diversity will be negatively associated with reflexivity and knowledge sharing.

TMT Intragroup Trust

During the 90's much of the TMT literature focused on group processes; how members got along with each other and how they worked with each other as a team or what Clark and Smith (2006) identify as a move from an 'attribute approach' (what attributes the TMT have) to a more relational approach (how the TMT get along). With this approach comes the recognition that both the task and social processes engaged in by the TMT can affect outcomes such as innovation. A similar concept is

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trust within the team – the expectation that another's action will be beneficial rather than detrimental (Gambetta, 1988). We argue that trust within the TMT is an important variable in the innovative process and we utilise a framework developed by Mayer et al (1995), which highlights three important attributes of trust: ability, benevolence and integrity. Clegg et al.'s results (2002) provide support for the relationship between trust and innovative behaviour. They found that employee trust in the organization affects both idea generation and idea implementation. Ruppel and Harrington's (2000) study of IT managers similarly found a positive association between trust and innovation. Trust may also influence innovation in a more indirect manner. Research conducted by Edmondson (1999) found an association between psychological safety (a concept entailing trust) and team learning. Schippers et al. (2004) found a positive association between intragroup trust and team reflexivity. O'Reilly, Chatman and Anderson (1987) maintain that trust leads to increased dialogue and shared communication which in turn opens up the opportunity to exchange information and knowledge. Similarly, Maghavan and Grover (1998) argue that trust in team orientation and competence are important process variables for the creation of new knowledge.

There is little research focusing on trust levels between members of senior management with the exception of Simons and Peterson (2000) and Farrell et al (2004) who found top team intragroup trust mediated the relationship between TMT leadership and organisational knowledge sharing. Intragroup TMT trust can increase team safety and can reduce opportunistic and self-interest seeking behaviours among team members and may create a common purpose. TMT trust can allow team members to be tolerant of dissent and disagreement without triggering dysfunctional conflict (Ensley, Pearson & Amason, 2000) and Clarke and Smith (2006) argue that innovation is more likely to occur in TMTS where members trust each other. Hence, members are more willing to share their experiences and knowledge with the others in the team thus resulting in greater reflexivitiy and knowledge-sharing (Edmondson, 2004). Hence, we hypothesize that:

> ***Hypothesis 2:*** Intra-group TMT trust will positively affect innovation, task reflexivity and knowledge sharing.

Task Reflexivity and Innovation

One of the task group processes under investigation in this study is task reflexivity, defined by West (1996:559) as the "extent to which team members collectively reflect upon the team's objectives, strategies and processes as well as their wider organisations and environments, and adapt them accordingly". Reflexivity in an organisational setting involves individuals or teams reflecting upon their preferred work methods and modifying them where necessary according to the needs of the task or environment. Reflexivity is more than merely reflecting on what has already taken place. It is a multifaceted concept involving questioning, reviewing, evaluating,

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debating and adapting. West (2002) describes a team demonstrating high reflexivity as one characterised by greater detail, inclusiveness of potential problems and long as well as short range planning. He argues that activities such as planning can create a 'conceptual readiness' for innovation.

While there are few empirical studies investigating the effects of reflexivity on organisational outcomes, reflexivity has been found to be associated with team outcomes, e.g.team innovation (West and Anderson, 1996; Carter and West, 1998; West, Patterson and Dawson, 1999; De Dreu, 2002) and has generated a lot of interest recently in the organisational learning and innovation literature (Carter & West, 1998; West, 2000; DeDreu, 2002; Schippers, Den Hartogg, Koopman & Wienk, 2003).. Although the majority of the research on reflexivity and innovation explores innovation at a team level (West et al., 1998; West, 2000), it is plausible to suggest that reflexivity within the top team may also have implications for the firm in terms of innovations and performance. If task reflexivity promotes team innovation, under what conditions might it promote organisational innovation? Drawing on the upper echelons theory, which suggests that top managers play a pivotal role in shaping organisational outcomes, we suggest that task reflexivity in top management teams should have a positive effect organisational innovation which is also consistent with call for the inclusion of process variables when exploring how TMTs influence firm outcomes (Carpenter et al., 1999). We therefore hypothesise the following:

> ***Hypothesis 3:*** TMT reflexivity will have a positive impact on organisational innovation.

TMT Knowledge Sharing

The related process variable under investigation is knowledge sharing within the top team. Clarke and Smith (2006) suggest that how the TMT processes knowledge and information can influence TMT decisions regarding innovation. Nahapiet and Ghoshal (1998) provide a simple but convincing model depicting learning and knowledge sharing as occurring primarily in two ways – through the *combination* and *exchange* of knowledge (Schultz, 2001; Nahapiet & Ghoshal, 1998). Combination describes the process by which prior knowledge is combined to create new knowledge. This can happen in two ways, either by combining knowledge that was previously unconnected or by finding novel ways of combining knowledge that had been previously associated. The second mechanism identified by Nahapiet and Ghoshal (1998) is the exchange of knowledge. They note that the combination of knowledge often depends on the exchange of information, especially where resources are held by different parties. In order to gain access to the information, the transfer of information from one party to another is required.

Moran and Ghoshal (1996) identified three conditions that must be satisfied in order to facilitate knowledge sharing. The first condition is access. It is imperative that the opportunity to combine and exchange information exists. In order to continue

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with these learning activities, it is important that the participants perceive the outcome to be of value, even though they may not be sure of what the outcome will be. The second condition identified by Moran and Ghoshal is that the different parties envisage the exchange and combination of knowledge to be a worthwhile activity. The third condition necessary for learning is motivation. It is not enough that the parties involved anticipate that value will be created as a result of the learning process, it is also important that they feel their own involvement will be worth their while. Participants need to feel that the outcome will be of value but also that the value will be appropriable to them even if they are not certain of what that newly created value will be.

A fourth condition necessary for learning added by Nahapiet and Ghoshal (1998) is combination capability. Even when all three conditions discussed above exist, the combination and exchange of knowledge cannot take place unless parties are capable of doing so. Cohen and Levinthal (1990) refer to this as "absorptive capacity" where the creation of knowledge depends not only on the capacity to recognise the value of new knowledge but also the ability to assimilate and use this knowledge. In addition, they maintain that this "absorptive capacity" does not reside in any one individual but depends on the links that exist between different individual's capabilities. Tsai (2001) also identifies capability as an integral factor in the learning process, recognising that even though the knowledge may be available, parties may not have the capacity to absorb and apply it for their own use.

The identification of the above conditions is useful as a meaningful theoretical construct to measure the often difficult-to-measure knowledge creation and combination (referred to as knowledge sharing hereafter).

Knowledge Sharing and Innovation

Many researchers believe organisational learning and knowledge sharing to be the principle process by which organisational innovation occurs. Stata (2004) argues that the rate at which individuals and organisations learn may become the only sustainable competitive advantage, especially in knowledge intensive industries. Nonaka (1994) further extends this argument by suggesting that the ability of organisations to act innovatively is critically dependent on how the organisation obtains and exploits new sources of information (higher learning or double loop learning). West and Anderson (1996) identified the cross fertilisation of information as integral to the creative and innovative process. Findings from their longitudinal study of 27 top management health teams indicate that participation and information sharing within top teams predicts the number of innovations introduced by the team. Caloghirou, Kastelli and Tsakanikas (2004) argue that the firm's internal capabilities and openness towards knowledge sharing are critical to a firm's innovative performance. Similarly, Tsai (2001) in his research on business unit innovation found knowledge access and learning capacity were critical to innovation. Similarly, Basarde and Gelade (2006) argue that knowledge apprehension and utilisation are key dimensions of innovation.

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We suggest that the level of knowledge sharing within TMTs will have an impact on the wider organisation and hypothesise that:

> ***Hypothesis 4:*** Knowledge sharing within the TMT will positively influence organisational innovation.

In the causal model developed and tested in this study, we hypothesise that TMT composition/diversity – education level, functional diversity and age diversity – will directly affect TMT reflexivity, TMT knowledge sharing and will both directly and indirectly affect organisational innovation. We propose that TMT trust will directly affect innovation and also indirectly affect innovation through the intervening variables of TMT reflexivity and TMT knowledge sharing. Furthermore, TMT reflexivity and TMT knowledge sharing will positively affect organisational innovation. These hypothesised relationships are summarised in Figure 1.

[Insert Figure I about here]

METHOD

The sample consisted of 35 domestic Irish software firms. The focus of this study was small to medium Irish software companies. The multilevel sample for this study consisted of the top management team and core workers in these companies in order to avoid problems of single source bias. Three criteria were used to assess the suitability of participant firms in an effort to exclude exogenous influences from our results. All firms targeted were (i) involved in the software business (ii) Irish owned and (iii) had over 30 employees. The latter criterion was specifically set in order to ensure that the firms targeted had a management structure in place.

Over 1000 firms were contacted to assess their suitability for inclusion in the study. The majority of the firms contacted were excluded due to their size (i.e. less then 30 employees). Out of these 1000 firms only 150 met all three criteria listed. All eligible firms were then invited to participate. From this sample, thirty-five agreed to participate resulting in a final response rate of 23%. The companies that agreed to participate did not differ significantly in terms of employee numbers ($t_{140} = 1.585$, ns). The number of members in the top team ranged between two and eight and the average team size in the sample was five. The average number of top team members who responded to the survey was three. The TMT response rate per company varied from 33% to 100%.

The TMT data in this study was collected using a self report survey questionnaire. During a semi-structured interview the CEO of each company identified the TMT members who were to receive the study questionnaire. The research methodology involved two levels of analysis. Data were gathered from the CEO and the senior team members. The main research tools utilized in this study were the top team survey

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(TMT members responded to composition, trust, reflexivity and knowledge sharing items) and the CEO Interview where the innovation data was gathered.

Measures

Innovation

In this study, we measured innovation using a measure adapted from Bantel & Jackson (1998). The measure of innovation used in this study is the percentage of new products sold to new markets. This measure ties in with Miller and Friesen (1978) and Lyon and Ferrier (2002) who focus on both product and market related activities. Lyon and Ferrier (2002; 457) describe market innovation as 'specific, externally directed and observable competitive moves initiated by a firm to enhance its competitive position'**.** CEOs were asked to identify the percentage of sales revenue generated by new products targeted at new markets over the last 3 years.

TMT Composition

The demographic measures used include both demographic dispersion measures (age diversity, tenure diversity and functional diversity) and direct measures (education level). To measure functional diversity, respondents were asked to indicate which category most represented their functional background. Functional diversity was calculated using Blau's (1977) heterogeneity index ($1-\Sigma\ pi^2$) where p is the proportion of group members in a category and i is the number of different categories represented in the team. Blau's heterogeneity index is used extensively throughout the diversity literature (Bantel & Jackson, 1989; Knight et al., 1999; Simons, Pelled & Smith, 1999; Wiersema & Bantel, 1992). A higher score on this indicates a higher level of functional diversity and a low score represents a lower level of functional diversity. Age diversity was calculated as the coefficient of variation in age of team members as a direct method for obtaining a scale invariant measure of dispersion (Allison, 1978; Bantel and Jackson, 1989; Knight et al., (1999). A score of zero indicates perfect homogeneity along the given dimension and a higher score indicates a higher level of diversity. Education was computed as mean of the number of years of postsecondary education for each top management team. The team composition/diversity measures were gathered using the TMT survey.

TMT Trust

This study adapts Mayer et al.'s (1995) measure of trust. This measure was chosen because it was specifically designed to measure perceived trustworthiness (Costa, 2003) and has demonstrated excellent psychometric properties and parsimoniously captures the key aspects of the expectations about others' intentions and behaviours (Becerra & Gupta, 2003, p.37). We used eight items to measure trust and sample items included "I feel very confident about the top management team's members' skills", "Managers in the TMT try hard to be fair in their dealings with others" and "Members of the TMT really look out for what is important to me". Responses were

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gathered on a five point Likert scale, which ranged from 1= strongly disagree to 5 = strongly agree. The data was coded such that a higher score indicated higher levels of intragroup trust. Direct report subordinates of the CEO (i.e. members of the TMT as designated by the CEO) completed the trust measures. This scale exhibited an internal consistency reliability of 0.81. In terms of intra-group agreement, the James, Demaree and Wolf (1984, 1993) within-group inter-rater agreement statistic for multiple items scale, RWG (j) was used. The observed value of 0.89 quite exceeded the minimal threshold value of 0.70 suggested by James et al., (1993) as acceptable level of within-group agreement. Hence, we aggregated the individual responses of the TMT members to obtain a measure of TMT trust at the firm-level.

Knowledge-Sharing

We measured knowledge-sharing using the measure developed by Smith, Collins and Clark (2005) that draws upon Nahapiet and Ghosal (1998). Nahapiet and Ghosal (1998) identified four core processes as important in knowledge sharing: access, motivation to combine and exchange knowledge, anticipated value and combination capability. Responses to the seventeen items incorporating these core processes were subjected to exploratory factor analysis to uncover the underlying factor structure. The seventeen items measuring knowledge sharing loaded on two factors. Six items measuring the motivation to share information loaded onto factor one. Each of the six items loaded on factor one well above the .50 level indicating that together they form a factor entitled motivation to share information. Tests on the scale reliability of these six items indicate a Cronbach's alpha score of 0.84. Sample items include 'Employees find exchange\combination of ideas with members of this firm one of the most motivating parts of their jobs' and 'Employees believe that by combining and exchanging information they create value for the organisation'. This scale was labelled "the motivation to share knowledge".

Six items with factor loadings of over .50 loaded on factor two. Four of these items represent the extent to which employees access the information. Another two of the items measure the combination capability of the organisation's members. This scale measures the extent to which employees' access knowledge, share knowledge and information. Together these six items represent the underlying factor of knowledge sharing: access to the requisite knowledge and the ability to share that knowledge (Farrell et al, 2005). This measure was labelled ability to share knowledge and items include "Employees meet frequently to discuss ideas and new developments", "Employees are capable of sharing expertise to bring new projects to fruition" and "Employees are proficient at combining and exchanging ideas to solve problems/create opportunities". The Cronbach's alpha for this scale was 0.81. The RWG(j) values for both ability and motivation to share information were .92 and .91, respectively. Hence, these indices were aggregated to the level of the team.

Reflexivity

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The reflexivity items in the questionnaire are representative of Carter and West's (1998) model of reflexivity and have demonstrated acceptable reliability in several studies (De Dreu, 2002; Hirst & Mann, 2004; Tjosvold, Hui and Yu, 2003; West, Patterson & Dawson, 1999). Task reflexivity refers to the extent the team reflects upon and questions how they carry out tasks. The data from TMT questionnaires was combined in order to derive a team level measure of reflexivity. Three examples of the reflexivity items are "We regularly discuss whether the TMT is working effectively together", "The TMG often reviews its objectives" and "In TMG we modify objectives in light of changing circumstances". The scale reliability of these four items indicates a Cronbach's alpha score of 0.80. The RWG(j) value is .81 indicated that it was acceptable to aggregate to team level.

Data Analyses Strategy

We used the methodology suggested by Pedhazur (1982) to derive the path coefficients. The path coefficient from a predictor to the dependent variable is the standardized regression coefficient for the predictor controlling for all other predictors in the equation. We used one tailed t-tests to test for the significance of the hypothesized path coefficients. In order to test for the significance of the overall model, we conducted the log likelihood test suggested by Pedhazur (1982, p. 619) that tested the over-identified model with the constrained paths with the just-identified model with all possible paths. The null hypothesis tested was that the over-identified model fits the data as well as the just identified model. When the resultant Chi-square statistic for the over-identified model is less than the critical Chi-square with the number of constrained paths as the degrees of freedom ($p>.05$), the null hypothesis is retained suggesting that the over-identified model adequately fits the data as good as the just-identified model. Since the Chi-square statistic is greatly influenced by the sample size and has a tendency to reject the null-hypothesis even when the model fits the data well (Joreskog & Sorbom, 2001), we also examined the measure of goodness of fit (Q), suggested by Pedhazur (1982) for over-identified models. This measure of goodness of fit can range from 0 to 1 with a value of 1 indicating a perfect fit and a value of 0 indicating no fit at all.

RESULTS

Table 1 shows the means, standard deviations and inter-correlation matrix of the variables used in this study. Figure 2 presents the model that emerged indicating the path coefficients with the associated significance levels. We obtained a goodness of fit index (Q coefficient) of 0.78 which indicated that the over-identified model obtained in our study fits the data as well as the just-identified model. Although a fit index of 0.90 or higher is preferable, given the small sample size of thirty-five firms, the fit index is at an acceptable level. Further, the Chi-square statistics of 6.24 with 14 degrees of freedom (number of constraints imposed on the data) obtained in our study

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fell between the α = 95 and α = 98 range, thus failing to reject the null hypothesis that the overidentified model fits the data as well as the just identified model.

[Insert Table 1 about here]

Hypothesis 1 indicated that TMT composition would directly affect innovation. This hypothesis was not supported as the path coefficient from diversity measures to innovation was not significant. Further, TMT composition did not directly influence the group processes thus failing to support Hypothesis 2 fully. The absence of a significant relationship between functional diversity and innovation is particularly surprising given that this variable is the most commonly linked with innovation (Camelo-Ordaz et al, 2005). However, two TMT composition variables directly influenced the TMT trust of the top team. The level of qualification (p = .36**) and age diversity (p= -.44**) had a direct effect on TMT intragroup trust. No direct relationship between trust and innovation emerged in this study. However, TMT trust had a direct effect on TMT task reflexivity (p=.34*) and the ability to share knowledge (p=.43**), thereby indirectly influencing innovation and partially supporting Hypothesis 2.

As shown in Figure 2, both TMT task reflexivity (p=.43**) and TMT motivation to share knowledge (p = .42**) had direct effects on innovation. We hypothesised that all the group process variables (task reflexivity, ability/access to share knowledge, motivation to share knowledge) would be associated with innovation. However, the ability to share knowledge did not directly effect innovation although it did indirectly influence innovation through the intervening variable: motivation to share knowledge (p=.33*). Thus we found partial support for the hypothesised relationship between TMT group processes and innovation. Overall, the model seemed to fit better with the addition of a direct path between the ability to share knowledge and the motivation to share knowledge.

DISCUSSION AND CONCLUSION

In this study we integrated the upper echelons, group process and knowledge sharing literatures to explore the impact on innovation. The core objective of this study was to investigate the determinants of innovation in knowledge intensive companies and from this, to build a more informed and evidence based picture of the innovative process. In doing this, the role of top management team composition, trust and group processes in fostering innovation was investigated. Our hypotheses were partially supported and are discussed further below.

Using upper echelons research we hypothesised that TMT composition would have a direct effect on innovation and also an indirect effect through the intervening group process variables. This was not supported in this research. There were no significant relationships between TMT composition and innovation, nor were the composition variables significantly related to the group processes variables.

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Contradictory and inconclusive results tend to characterize the UE literature and that is borne out in this study. Exploring any relationship between TMT diversity and organisational outcomes in isolation is unlikely to yield a definitive understanding of the role of diversity in predicting innovations in firms. However, studying TMT diversity in conjunction with other team and organisational variables can give rise to a more robust understanding of the role of TMT. Two TMT composition variables were significantly related to TMT intragroup trust; age diversity and education level.

There is a significant and negative relationship between diversity in age and trust. Because difference based on age is often value laden, it may be that this type of diversity is more likely to lead to distrust. This is not to suggest that age diversity within teams should be avoided. Age diversity and the different perspectives that come with it can also facilitate group creativity and debate (Bantel & Jackson, 1989), However this study suggests that it is more likely to be associated with low levels of trust within the team and any associated negative outcomes of lack of trust. It is therefore necessary that teams are cognisant of such negative outcomes and are trained to work effectively together to achieve shared understanding (West et al, 2000). We found a positive relationship between TMT education and trust levels within the team. This would suggest that the more educated the TMT members, the more likely it is that other team members will trust their other team members. We suggest that the competence component of trust is important here.

We predicted that TMT intragroup trust would be directly related to innovation. This was not supported in this study. We also predicted that TMT trust would be indirectly linked to innovation through the intervening group process variables, TMT task reflexivity and TMT knowledge sharing (the ability to share knowledge and the motivation to share knowledge). This hypothesis was partially supported. There is a positive association between TMT trust and levels of TMT task reflexivity. Where there are high levels of trust, there is more likely to be honest group discussion and reflection. Edmondson (1996) found that psychological safety (a concept incorporating trust) within teams increased the potential for review and reflecting upon mistakes. This study suggests that the more a team trust in each other's competence and good will, the more likely it is they will admit to and discuss mistakes and question why projects failed and try to rectify those mistakes.

We also predicted a significant and positive relationship between TMT intragroup trust and the two knowledge sharing variables. There is a positive and significant relationship between trust and the ability to share information. This would suggest that trust is important if TMT members are to come together to share information. However, TMT trust did not predict the motivation to share knowledge. The *motivation* to share information is rooted in the perceived value associated with this activity. The individual perceives the outcome from the learning process to be valuable – and more so, when that value is of personal benefit to him or her. The findings in this study suggest that TMT intragroup trust is associated with employees' access and ability to share knowledge but not with their *motivation* to share

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knowledge. In other words, trust is associated with the engagement in knowledge sharing but is not associated with the value that people attach to that activity. This suggests that while trust may be an important catalysing first step in the knowledge sharing process, it is not sufficient for its sustenance. In order to continue to share information, employees need to experience tangible outcomes of value to both themselves and the organisation that are explicitly associated with the knowledge sharing process. This could come in the form of reward or improved ways of working directly linked to knowledge sharing.

TMT task reflexivity was predicted to have a positive relationship with innovation. This hypothesis is strongly supported as task reflexivity was significantly and positively associated with the percentage of new products going to new markets.. Reflexivity has been found to be positively associated with team outcomes such as team innovation (West & Anderson, 1996), team effectiveness (Tjosvold, 1990) and effective problem solving (Bottger & Yetton, 1987). Teams with a high level of reflexivity and minority dissent were found to be more effective and innovative than teams that had low levels of reflexivity (De Dreu, 2002). This is one of the few studies exploring the relationship between reflexivity and organisational outcomes and these results indicate that how the TMT approach the tasks that face them on a daily basis is directly associated with innovation – the more review, reflection and questioning regarding tasks that the TMT engage in, the more beneficial in terms of its association with innovation.

We also predicted a positive association between the TMT knowledge sharing and innovation and looked at two important dimensions of knowledge sharing; the *ability* to share knowledge and the *motivation* to share knowledge (Nahapiet & Ghoshal, 1998). Only one of these dimensions is directly associated with innovation in this study – the *motivation* to share knowledge. The *ability* to share knowledge is not linked to innovation suggesting that having access to knowledge sharing opportunities and believing that others are capable of sharing knowledge is not enough to generate innovation. While the *ability* to share knowledge may be an important step in starting the knowledge sharing process, the findings suggest that it is the *motivation* to continue to do so that is important in terms of its relationship with innovation in this study. This is consistent with much of the literature on motivation, in particular expectancy theories (Vroom, 1964). In order to be motivated to exchange knowledge, individuals need to expect an outcome that will be of personal value to them even if they are not certain of what that newly created value will be (Nahapiet and Ghoshal, 1998). This research indicates that the sharing knowledge predicts innovation when employees can experience the value in the learning activity.

Limitations

There are a number of limitations to this study. This study focuses on companies in the indigenous software industry. While this approach has helped in the interpretation of the data, it does limit the generalisation of the findings to other industry

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environments. Replicating this study in other industries would increase generalisability and confidence in the results. The sample in this study consisted of only 35 top management teams. Given the nature of our study with its focus on TMTs the sample may be considered acceptable but would have liked to have a larger sample size. One of the main limitations concerns the cross-sectional nature of the research design. Therefore caution is necessary when making inferences about the direction of the relationships between the variables in this research. Nevertheless, our use of the data sources from different respondents of the company may partially alleviate the problems associated with cross-sectional studies.

Implications for Management

Both TMT reflexivity and the motivation to share knowledge emerged as important processes in this research as significant associations surfaced between both variables and innovation (percentage of new products going to new markets). Task reflexivity is an activity that is gaining prominence in the literature but is still relatively rare in practice (West, 1996; 2000). This study indicates that this team process can influence organisational outcomes. However, in ever changing, fast paced dynamic environments this process is often considered to be a luxury rather than a necessity. This research suggests a change of mindset is needed regarding reflection. Managers need to encourage this activity within teams, focusing on both dimensions of reflexivity – reflection and adaptation. In order to do so, certain behaviours should become routine. These include questioning, planning, exploratory learning, analysis, diversive exploration, making use of knowledge explicitly, planning and reviewing past events with self-awareness. It is also important to encourage the sharing of knowledge that is considered to be both personally and organisationally valuable to team members. In order to encourage the continuation of this behaviour at team and organisatonal level, the TMT must demonstrate an explicit link between this behaviour and valuable outcomes. This study suggests that both processes are facilitated if there is trust within the team.

Conclusion

Moss Kanter (1988) argues that social arrangements foster innovation and that an organisation's leaders can design these social arrangements. She believes that an organisations top team and the 'right' team environment are important predictors of the innovative process. While the exploration of the role of top team and the 'right' environment in determining innovation is nothing new, most studies focus on either one or the other. This research contributes by integrating both processes. It explores the process of innovation at a top team level and extends upper echelons theory by including unexplored variables in order to get a richer understanding of this valuable yet often elusive phenomenon. The evidence presented in this study indicates that certain TMT processes are associated with innovation. By empirically linking TMT reflexivity to innovation, we provide a more complete picture of how TMTs can

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influence innovation. This study investigated the relationship between the *ability* to share knowledge, the *motivation* to share knowledge and organisational innovation. While knowledge sharing is often associated with innovation, this study isolates one dimension of knowledge sharing as being particularly pertinent to organisational innovation; the motivation to share knowledge.. Links to innovation only emerged in this research when the sharing of knowledge was perceived to be valuable and meaningful to those engaged in the activity. Therefore, it is not sufficient to provide opportunities to share knowledge, management must also encourage this activity and link it with visible and valuable outcomes. This distinction highlights the gap between innovation capacity and innovation practice.

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TABLES AND FIGURES

Table 1: Means, Standard Deviations and Correlations of Study Variables

Study Variables	Mean	SD	1	2	3	4	5	6	7	8	9
1. TMT education	5.9	.46	1.00								
2.TMT functional diversity	.66	.66	-.01	1.00							
3. TMT age diversity	.16	.16	.11	-.03	1.00						
4 TMT tenure diversity	..92	..37	-.01	-.17	-.05	1.00					
5. TMT trust	3.4	.37	.31*	-.10	-.40**	.31*	1				
6. TMT task reflexivity.	3.2	.43	.32*	.15	-.07	..20	.40*	1.00			
7. TMT acess/ability to knowledge share (KS)	3.5	.30	.13	.21	.21	.11	.41**	.23	1.00		
8. TMT Motivation to KS	3.6	.20	.13	.30	.25	.07	.13	.03	.37*	1	
9. Innovation -% of new products to new markets	.23	.25	.21	-.10	-.23	.03	.28	.42**	.10	.41*	1.00

Note: p < .05, ** p < .01, **, p< .001***

Figure 1: Top Team Composition, Group processes and Innovation: A Conceptual Model

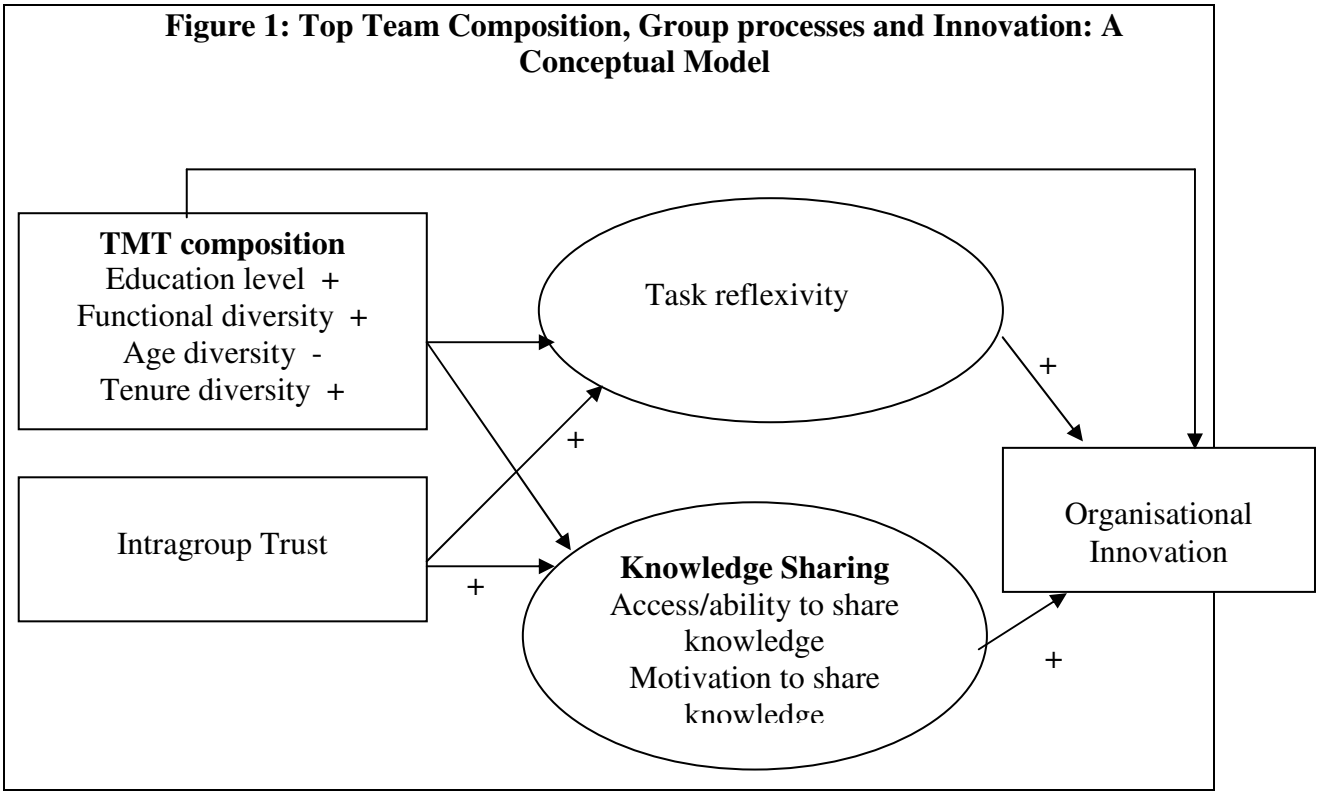

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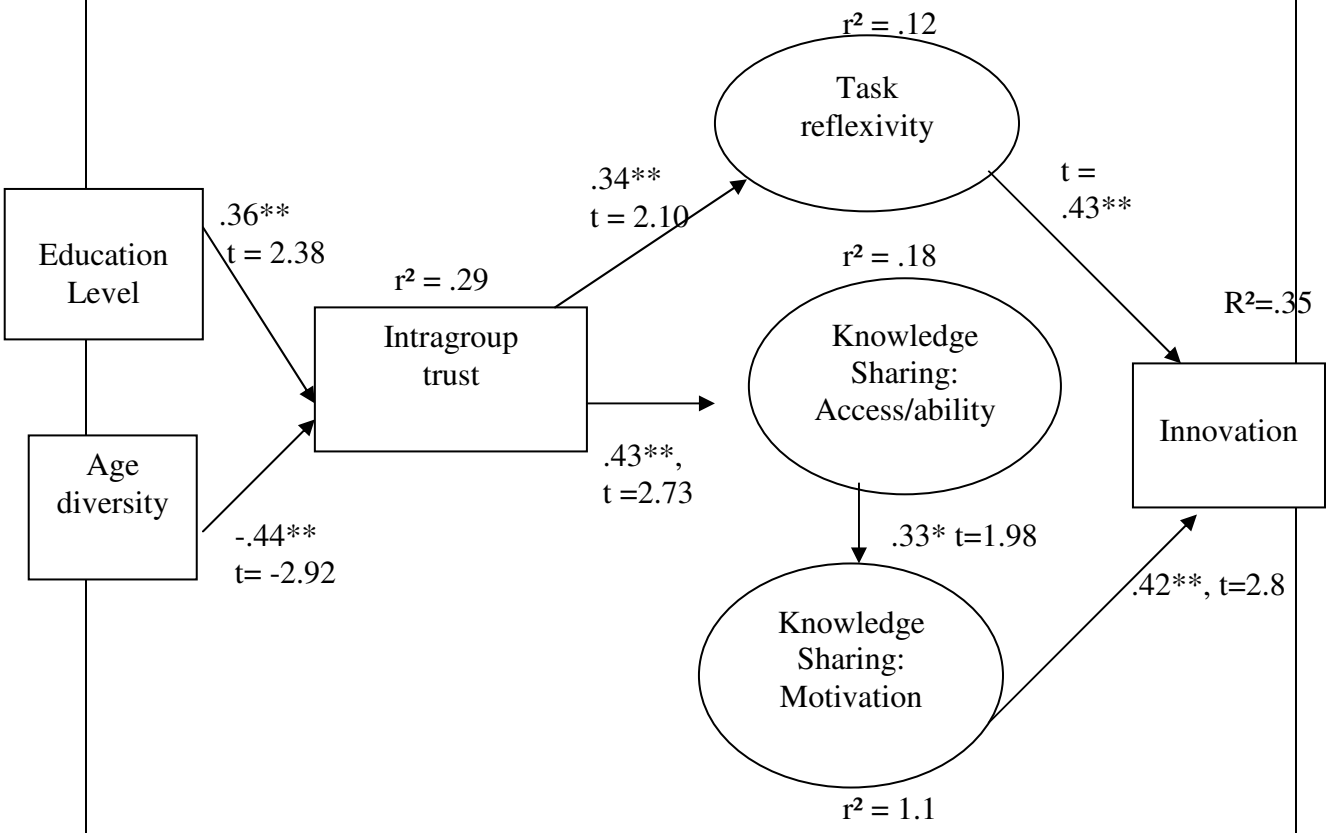
Figure 2: Top Team Composition, Group processes and Innovation: An Emergent Model



Note: both TMT tenure diversity and functional diversity were not significantly related to any of the study variables

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