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THE ROLE OF WORKER TENURE AND EMPLOYMENT HETEROGENEITY ON SOFTWARE DEVELOPMENT WORK ACTIVITIES

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ABSTRACT

Software development group effectiveness depends on many factors, and understanding those factors is vital to project success, especially when considering the time and money that is dedicated to said projects. Therefore, this study examines the role of worker tenure and employment heterogeneity on exploration and exploitation work completed within an organization's software development group. Analysis of time tracking data within one financial services organization over a three years period demonstrates that worker tenure and employment heterogeneity do play an important role in shaping work activities. Worker tenure exhibited a negative relationship with exploration and exploitation activities, suggesting a critical mechanism through which an organization can elicit innovative and incremental development efforts. Further, the positive effect of employment heterogeneity on exploration and exploitation suggests that employment diversity can also provide a means to encourage innovative and incremental development activities. Findings highlight the notion that group composition plays a meaningful role in shaping the focus of software development work within an organization.

Keywords: software development, exploration, exploitation, worker tenure, employment heterogeneity

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1. INTRODUCTION

Research on software development has a rich history, often with a focus on issues such as development methodologies (Lindstrom & Jeffries, 2004), project management practices (Verner & Evancho, 2005), design patterns and organizational outcomes (Gopal, Krishnan, Mukhopadhyay, & Goldenson, 2002). Technical and procedural issues certainly play an important role in shaping the effectiveness of a software development group, but productivity is also largely impacted by dynamics within the group. For example, software development team outcomes can be influenced over time by how well expertise is coordinated (Faraj & Sproull, 2000), the interplay among different personalities (Hannay, Arisholm, Engvik, & Sjøberg, 2010), and/or the presence of social rewards (Roberts, Il-Horn, & Slaughter, 2006). While researchers have examined the impact of group dynamics on software developer activities, issues such as group composition remain understudied and deserve greater attention (Moreland, Hogg, & Hains, 1994).

Software provides an important mechanism for organizations to rapidly apply knowledge within key strategic and operational processes. An organization's software development function allows the firm to exploit extant knowledge through incremental changes to existing systems (e.g., maintenance & support activities) while also enabling the exploration of new avenues for action through the creation of new systems (e.g., new software project initiatives). When operating well, an organization's software development function can provide the digital options necessary to achieve long term success in the marketplace (Sambamurthy, Bharadwaj, & Grover, 2003). In contrast, an ineffective software development function can hamper the development and utilization of organizational knowledge and prevent timely responses to market changes (Lyytinen & Robey, 1999).

The purpose of this study is to further the understanding of software development group work by examining the influence of worker tenure and employment heterogeneity on exploration and exploitation activities completed within an organization's software development group. This research adds to literature on software development group effectiveness by examining how group composition influences the nature of development work undertaken. We draw on both group development and management theories to examine the relationship between software development group composition and exploration- and exploitation-related work activities. The paper begins by drawing on literature from group development and management domains to clarify the impacts of group composition on exploration and exploitation activities. Data from a financial services firm is analyzed with regards to stated hypotheses and findings are discussed. The paper concludes by acknowledging research implications, limitations and future directions.

2. DEVELOPMENT OF THE RESEARCH MODEL

As a means of addressing the occurrence of exploration and exploitation activities over time, this study focuses on two varying characteristics of an organization's IT human resource: worker tenure and employment heterogeneity. IT

workers often possess a skill that is not constrained to specific organizations or industries, impacting their stability or longevity within an organization. Further, organizations often utilize both employee and contract software developers, a mix that can fluctuate over time. Both worker tenure and employment heterogeneity have an immediate and direct impact on the level of exploration and exploitation activities undertaken within an IT group. As a means of clarifying factors that shape work activities, the following sections examine the impact of changes in worker tenure and employment heterogeneity over time. The proposed research model is pictured in Figure 1 and detailed in the following paragraphs.

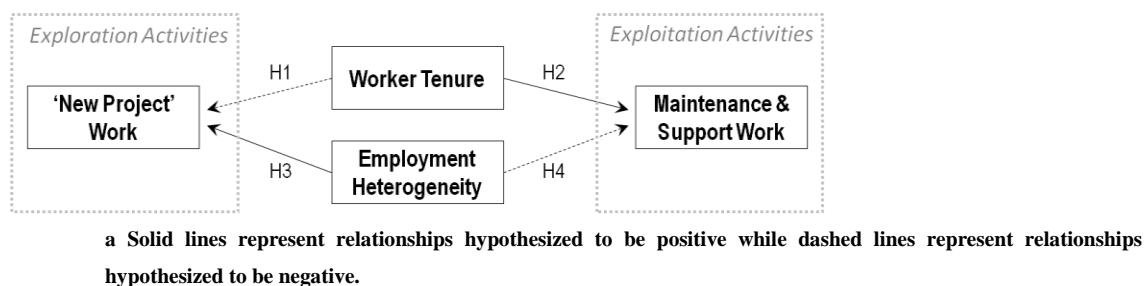


Figure 1. Proposed Research Model^a

The Role of Worker Tenure on Work Activity

Turnover of IT personnel is a legitimate concern for modern organizations (Hacker, 2003), especially within those that employ IT workers in a support function (Ang & Slaughter, 2004). Worker tenure, which describes how long a worker has been with the organization, has specific implications on the work activities undertaken within an organizational group. For example, research has shown that member turnover within a group often has a negative impact on learning processes, which directly hinders team effectiveness (van der Vegt, Bunderson, & Kuipers, 2010). Further, turnover has been found to disrupt established routines that are necessary for effective team operations (Zellmer-Bruhn, 2003). The following sections theorize regarding the impact that worker tenure will have on exploration and exploitation activities within a software development group.

First, we consider the potential impact of changes in worker tenure on exploration activities, represented by ‘new project’ work being undertaken by the software developers. Exploration activities demand high levels of specialization. As tenure increases, workers identify more closely with the team and are more likely to conform to institutionally acceptable ways of doing business. Specifically, “old timers, on average, know more, but what they know is redundant with knowledge already reflected in the code...they are less likely to contribute new knowledge on the margin” (March, 1991, p. 79). While some level of conformity is important for enabling coordination and establishing credibility within a group, it can adversely impact specialization in numerous ways. For example, as group tenure increases, members often become less likely to modify their work specializations (Lewis, Belliveau, Herndon, & Keller, 2007). Rather than focusing on innovating, members draw on

previous group experiences and drift towards working in ways they have in the past. Further, members will utilize past experiences to infer expectations about how other members will work (Lewis et al., 2007). Routines become established, and members become less likely to deviate from them. Specifically, “if accepted behaviors and belief systems become institutionalized, innovation will become stifled, because tacit social pressures may prevent individuals from deviating from established procedures and practices” (Dess & Shaw, 2001, p. 454). In these cases, specialization becomes less evident and its benefits are reduced within the group.

Reductions in employee tenure can encourage exploration activities within the group. The exit of group members can result in a loss of critical business knowledge, especially tacit knowledge that is very difficult to transfer between individuals in a group (Szulanski, 1996). However, this loss of knowledge can actually encourage a redefinition of work routines and processes (Kane, Argote, & Levine, 2005; Zellmer-Bruhn, 2003). Further, the addition of new members can complicate coordination and credibility within the group, hampering each member’s ability to locate and validate specialized knowledge within the group (Kane et al., 2005). A less coordinated knowledge structure forces external knowledge searches that can introduce novel problem solving approaches. Adding new members is also an important means of increasing the specialization within a group, and has been shown to be important in encouraging innovation (Choi & Thompson, 2005). Taken together, these assertions suggest a negative relationship between worker tenure and ‘new project’ work activities.

H1: Worker tenure within a software development group will have a negative impact on the amount of ‘new project’ work undertaken.

Worker tenure is an important indicator of the experience and knowledge an individual has with regards to the norms, processes and structures of the organization. For most workers, increases in organizational tenure encourages a stronger identity with the organization itself (George & Chattopadhyay, 2005). Even with temporary workers, commitment to the client organization is a frequent consequence as tenure increases (Koene & Riemsdijk, 2005). Organizational identity and commitment is especially critical within a software development group since developer participation has been shown to be a function of the degree of social identity and situated learning (Fang & Neufeld, 2009). When group members become more accustomed to each other, they are more likely to move past surface level differences in order to focus on task requirements (Harrison, Price, Gavin, & Florey, 2002). Because expectations of member behavior become clearer over time, trust and stability grow as group members continue to interact (Williams, 2001), allowing members to evaluate each other primarily on the basis of expertise and competence (Rulke & Rau, 2000). As a result, coordination and perceived credibility are allowed to blossom as group tenure increases. The flow of knowledge within the group, then, is smoothed so that it can be applied to meet existing needs. Software developers are more likely to undertake exploitation activities, represented by maintenance & support activities, because their ability to tie organizational needs to specialized knowledge will increase over time.

In contrast, decreases in worker tenure through the exit or entry of workers in the group will cause a disruption in group coordination and credibility perceptions. Changes in team composition can create procedural ambiguities and potentially harm perceptions of psychological safety (van der Vegt et al., 2010). Further, changes to

team structure can impede an individual's ability to locate and utilize specialized knowledge within the group (Rico, Sánchez-Manzanares, Gil, & Gibson, 2008). While valuable knowledge may exist within the team, problems of coordination and credibility minimize the opportunity for members to use that knowledge to address existing needs. These assertions lead to the next hypothesis:

H2: Worker tenure within a software development group will have a positive impact on the amount of maintenance & support work undertaken.

While worker tenure plays an important role in the type of work completed by software developers, employment heterogeneity is also expected to influence the work undertaken by a software development group.

The Role of Employment Heterogeneity on Work Activity

Organizations frequently employ a mix of employees and contract workers within their software development group (Ang & Slaughter, 2001). Contract workers are utilized for a number of reasons, including obtaining specialized knowledge, fulfilling short term resource needs, reducing the fixed costs associated with internal labor, and enabling overall resource flexibility (Connelly & Gallagher, 2004). In a software development context, contract workers are often used as a means of gaining specialized knowledge that is not available within the client organization (Ang & Slaughter, 2001), such as that demanded by a new programming environment, technology innovation, or business process. Utilizing software developers from outside the organization provides a critical means of exploring new technological opportunities for the organization (Matusik & Heeley, 2005). Research is clear that heterogeneity in employment arrangements has specific consequences on worker attitudes, turnover, and intra-group information sharing (Broschak & Davis-Blake, 2006). The employment heterogeneity of a software development group, then, must be considered in terms of its impact on exploration and exploitation activities undertaken by development workers.

First, employment heterogeneity has specific implications for exploration activities. At the group level, diversity has been shown as an important factor that shapes overall idea creation and quality (Cady & Valentine, 1999). Research has demonstrated that cognitive differentiation within a group has a direct impact on creative, or innovative, behavior (Horwitz & Horwitz, 2007; Janssen & Huang, 2008). The diversity afforded by a heterogeneous work group allows the group to recombine old knowledge into new, innovative knowledge (Wiersma, 2007). With regards to heterogeneity of work arrangements, the use of contract workers often results in a flow of specialized knowledge that allows for experimentation and exploration of new opportunities (Cardon, 2003; Connelly & Gallagher, 2004). Further, group homogeneity allows institutional pressures to surface and permeate that can impede exploration activities. Similarities within the group reduce communication inhibitors and "predispose [team members] to select, codify, and retrieve information in a like manner" (Rico et al., 2008, p. 171). Through homogenization, the group is encouraged to view the world through a similar lens and operate within institutionally acceptable ranges (Rentsch & Klimoski, 2001). As a result, innovative thinking and behavior is expected to be less evident as employment heterogeneity decreases. This leads to the third hypothesis:

H3: Employment heterogeneity within a software development group will have a positive impact on the amount of ‘new project’ work undertaken.

As employment heterogeneity grows, it is expected that exploitation activities will decrease. Increasing the heterogeneity of employment arrangements within a group has been shown to strain team relations and, consequently, coordination capabilities (Broschak & Davis-Blake, 2006). Employment concerns can often hamper the trust between employees and contract workers, reducing a general desire to share information and socialize (Connelly & Gallagher, 2004). Further, employment heterogeneity can produce harmful conflict within and beyond the group (Davis-Blake, Broschak, & George, 2003). Increased heterogeneity also impacts perceptions of credibility within the group. Specifically, “while contingent workers’ knowledge may be valuable, it is not necessarily valued” (Connelly & Gallagher, 2004, p. 972). In contrast, reductions in employment heterogeneity can act to smooth coordination and credibility necessary for exploitation to occur. Homogenization within the group encourages acceptance of institutionalized beliefs and perspectives (Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000), producing synergies necessary for exploitation to occur. Member similarities reduce opportunities for misunderstanding and friction; “team members anticipate the actions and needs of their colleagues and task demands and dynamically adjust their own behavior accordingly, without having to communicate directly with each other or plan the activity” (Rico et al., 2008, p. 164). These arguments lead to the final hypothesis:

H4: Employment heterogeneity within a software development group will have a negative impact on the amount of maintenance & support work undertaken.

3. METHOD

Data

To investigate the impact of worker tenure and employment heterogeneity on exploration and exploitation activities, software development project information for the years 2005 through 2007 was collected from an U.S.-based financial services organization. With yearly assets exceeding \$9 billion and net income in excess of \$200 million during this time, the firm was considered a top performer among peer institutions. This particular organization utilized an internal IT group dedicated to developing, implementing, customizing, and maintaining business software (hereafter discussed as the software development group). The software development group employed between seven and fifteen workers during this period and varied its use of contract workers over time based on project demands (between 0% and 53.3% of the software development team). During this three year period, all software project work was managed by employees of the organization.

The organization provided access to a database containing all software development worker time tracking information during this time period. Within this particular organization, employee and contract software developers were required to electronically document the nature and duration of their work activities on a daily basis, assigning each activity to a specific organizational project. Projects were defined for all software development work within the organization, including new software development initiatives, maintenance & support work, operational activities and personal time (including professional development, sick and vacation time).

Management expected each software developer, whether employee or contract worker, to document all working time for each working day as a means of internally billing work performed to business units within the organization.

In order to properly analyze data, time tracking data were aggregated into work weeks. Weeks were coded using the ISO week date system, as specified in the ISO 8601 date and time international standard (International Organization for Standardization, 2004). Because this leads to occasions where there are 53 weeks identified in a year, and weeks 1 and 53 can represent less than a full work week, week 1 of 2005 and week 53 of 2007 were removed to ensure that all weeks analyzed included a full week of data. This resulted in 156 weeks of usable data for the analyses.

Dependent Variables

Outcome variables utilized in this study address exploration and exploitation activities within the organization, expressed through actual work completed by software developers between 2005 and 2007. In order to allow the internal billing of software developer time, organizational projects were created for every type of work undertaken within the group. As each new project was created in the organization's time tracking system, it would be assigned a 'project type' designation to indicate the overall type of work that was being undertaken. As defined by management, 'project type' included categories such as 'new project' work, existing application maintenance and support, administrative tasks, meetings, and personal time (e.g., sick, vacation and training). Management required all software developers to track their time each day by assigning durations to specific projects.

Relying on this project classification scheme implemented by the organization, *Hours of 'New Project' Work per Week* (exploration) was extracted from the database. Because this work focuses on the impact of software developers, only time entered by software developers was included (e.g., manager and analyst time was not included). In a similar manner, *Hours of Maintenance & Support Work per Week* (exploitation) was extracted from the time tracking database. An overview of the weekly work hours recorded by software developers within the organization for new project and maintenance & support work is provided in Figure 2.

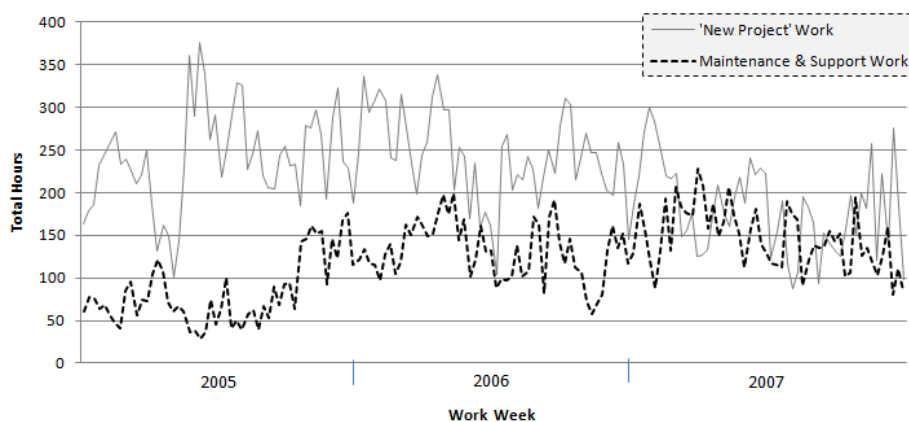


Figure 2. Software Developer Work Hours per Week (2005-2007)

Independent Variables

The present study focuses on understanding the impact of worker composition on actual work that is completed in a software development group. To examine this, two worker composition variables were specified for inclusion in the study: worker tenure and employment heterogeneity. First, **Worker Tenure** was determined by identifying active software developers for each week and then computing an average organizational tenure for those specific workers. To accomplish this, worker tenure was derived for each individual worker by identifying their first time entry date in the time tracking system and getting the difference, in weeks, between that start date and the week of interest. All worker tenure values were then combined and averaged for each week based on active workers for that particular week. The result of this process was an average worker tenure value (in weeks) for each week being investigated.

For **Employment Heterogeneity**, we examined heterogeneity of employment arrangements within the software development group. Employees and contract software developers were identified in the data set and an index of heterogeneity was created for each week being investigated. To accomplish this, Blau's index of heterogeneity (Blau, 1977) was utilized because of its ability to handle categorical data and its wide acceptance in social science research (Carpenter, 2002; Richard, Barnett, Dwyer, & Chadwick, 2004; Shin & Zhou, 2007). Following Blau's (1977) definition, the index was calculated by $1 - \sum(P_i)^2$, where P_i represents the percentage of individuals in the

i th category (employee or contract worker), and results in a theoretical value between 0 (completely homogenous) and 1 (completely heterogeneous). In this sample, weekly employment heterogeneity values range from 0 (no contract workers utilized) to a maximum of 0.50 (evenly divided between employees and contract workers).

Control Variables

In order to parse out the effect of worker tenure and employment heterogeneity on actual work performed, several control variables were included. First, the amount of work completed in a week is influenced by whether a holiday occurs during that week. In weeks where a work holiday exists, the time spent working that week will be less than would normally occur. In order to identify weeks where a work holiday occurred, time tracking information was parsed for time entries that indicated that time was taken for a work holiday. Because a floating holiday was provided for each worker in the organization, special care was taken to ensure that those dates were also considered in identifying holiday weeks. The **Holiday Week** variable was binary, where 1 indicated the week was a holiday week and 0 that it was not. A total of 21 weeks (7 weeks per year) were identified as holiday weeks within the current sample.

Next, the number of active workers will have a direct impact on the total number of hours worked during the week. As the number of workers increases, it is understood that the number of hours worked within the group is likely to also increase. When investigating the hours of 'new project' worked per week, '**New Project' Worker Count** was derived by getting the total number of workers that entered time (e.g., completed 'new project' work) for each week being examined. Similarly, examination of maintenance & support work required capturing **Maintenance & Support Worker Count**, represented as the total number of workers that entered time (e.g., completed maintenance & support work) for each week.

Finally, worker time is a constrained organizational resource. In weeks where workers were required to focus on work not related to ‘new projects’, there was less time available to spend on ‘new project’ work (the same holds true for maintenance & support work). To control for this effect, ***Hours of Other Work per Week*** was included as a control for ‘new project’ work and maintenance & support work respectively. This value was derived by taking the total work time per week and removing the hours of work attributed to the dependent variable being examined (‘new project’ or maintenance & support work).

4. ANALYSES AND RESULTS

Table 1 (‘new project’ work) and Table 2 (maintenance & support work) report the means, standard deviations and correlations for variables employed in this research. Results show that ‘new project’ work tended on average to have greater employment heterogeneity and a shorter tenure than demonstrated with maintenance & support work. On average, the amount of ‘new project’ work completed each week (221.33 hours, Table 1) was much higher than that of maintenance & support work (120.26 hours, Table 2). As expected, each control variable was significantly correlated with both ‘new project’ and maintenance & support work completed by software developers. This provides further support for including these specific variables as controls in the regression analysis. Tenure and heterogeneity variables were also significantly correlated with the amount of ‘new project’ and maintenance & support work completed each week.

Table 1. ‘New Project’ Work Means, Standard Deviations, and Pearson Product Moment Correlations^a

Variables ^b	Means	s.d.	Correlations				
			1	2	3	4	5
1. Hours NP Work per Week	221.33	60.34					
2. Holiday Week	0.13	0.34	-0.25**				
3. NP Worker Count	9.90	1.60	0.59**	0.07			
4. Hours Other Work per Week ^c	165.65	52.50	-0.48**	0.19†	0.12†		
5. Worker Tenure	139.64	23.15	-0.61**	-0.02	-0.63**	0.02	
6. Employment Heterogeneity	0.38	0.15	-0.61**	-0.00	0.40**	-0.30**	-0.68**

^a $N=156$, † $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$

^b NP = ‘New Project’

^c Other work refers to developer work activities beyond ‘new project’ work

Table 3 presents the results of hierarchical multiple regression analyses for both ‘new project’ work (Model 1) and maintenance & support work (Model 2). For both regression analyses, a hierarchical approach was used to force the entry order of variables. Block 1 included control variables only while Block 2 added both worker tenure and employment heterogeneity variables. For both models, there was a significant change in F between Blocks 1 and 2 ($p \leq 0.01$), demonstrating that the primary research variables provide important explanatory power for the full model above that offered by control variables alone.

Table 2. Maintenance & Support Work Means, Standard Deviations, and Pearson Product Moment Correlations^a

Variables ^b	Means	s.d.	Correlations				
			1	2	3	4	5
1. Hours of M&S Work per Week	120.26	45.24					
2. Holiday Week	0.13	0.34	-0.23**				
3. M&S Worker Count	7.76	1.73	0.78**	-0.06			
4. Hours of Other Work per week ^c	266.72	56.02	-0.36**	0.10	-0.25**		
5. Worker Tenure	175.79	24.38	0.68**	0.02	-0.80**	0.05	
6. Employment Heterogeneity	0.22	0.15	0.53**	-0.13†	0.56**	0.12†	-0.45**

^a $N=156$, † $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$

^b M&S = Maintenance & Support

^c Other work refers to developer work activities beyond maintenance & support work

Analysis confirmed that worker tenure was inversely related to the amount of ‘new project’ work completed within the group (H1, $p \leq 0.01$). Results also supported the assertion that increasing levels of employment heterogeneity exerts a positive impact on the amount of ‘new project’ work undertaken (H3, $p \leq 0.01$). Results failed to support the relationships posited in H2 and H4.

Table 3. Results of Linear Regression Analyses^a

	‘New Project’ Work		Maintenance & Support Work	
	β	t	β	t
Control Variables				
- Holiday Week	-0.199	- 4.856**	- 0.149	- 3.324**
- Hours of Other Work ^b	-0.447	- 9.986**	- 0.271	- 5.434**
- Worker Count	0.472	8.999**	0.352	3.996**
Research Variables				
- Worker Tenure	-0.197	- 3.004**	- 0.184	- 3.698**
- Employment Heterogeneity	0.156	2.633**	0.184	3.803**
Full Model				
R ²	0.76		0.71	
F	94.03**		73.36**	

^a $N=156$, * $p \leq 0.05$, ** $p \leq 0.01$ ^b Other work refers to developer work activities beyond each model's dependent variable

5. DISCUSSION

An organization's software development function serves two critical purposes: it enables the exploitation of existing knowledge and allows the exploration and realization of new knowledge. Findings in this study illustrate that software development group characteristics do impact the realization of that group's exploration and exploitation capabilities. Specifically, results demonstrate that both worker tenure and employment heterogeneity directly shape new project and maintenance work within a software development group.

As confirmed in H1, increased worker tenure does indeed reduce the occurrence of 'new project' work activities within the group. This finding is consistent with research showing that 'old timers' within a group often naturally gravitate towards existing mental models to accomplish work objectives, a tendency that can adversely impact innovative thinking and action (Lewis et al., 2007). Variance in group tenure is then especially important because it supplies cognitive diversity within the team. Cognitive diversity then provides the team with the ability to solve complex problems with innovative solutions (Larson Jr., 2007).

Support for H3 confirms that employment heterogeneity within a group also plays an important role in encouraging ‘new project’ work activities. This finding is consistent with research highlighting the value of heterogeneity for encouraging innovative group behavior (Homan et al., 2008), as demonstrated in contexts such as corporate boards of directors (Rindova, 1999), top management teams (Carpenter, 2002) and workers in the financial services sector (Broschak & Davis-Blake, 2006). Employment heterogeneity within a software development group, enabled through the intermingling of employee and contract workers, provides an important avenue through which exploration activities can be surfaced. Facilitators of deep level diversity seem to be especially important within a software development environment where work compartmentalization is the norm and development tasks are complex.

Contrary to our expectations, worker tenure and employment heterogeneity impacted the level of maintenance & support work in an opposite direction of what was hypothesized. While we posited that exploitation activities would move in the same direction as worker tenure (H2), the evidenced negative relationship implies a different process is at work. There are two likely explanations for this finding. The first is suggested within research on organizational identification (OI). OI is rooted in social identity theory and describes the degree that an individual ties their identity to the organization where they reside (Ashforth & Mael, 1989). Importantly, OI is “more than just considering oneself a member of an organization; it is the extent to which one includes the organization in his or her self-concept” (Sluss & Ashforth, 2008, p. 812). As worker tenure increases, workers are more likely to experience an OI that pulls them away from job-related activities and more into the social structure of the organization (e.g., talking around the water cooler, participation in meetings). An expectation to participate in activities beyond the domain of an individual’s explicit job requirements can redirect limited worker resources. As such, increases in worker tenure can actually serve to reduce the amount of job-related work undertaken. Another possible explanation for these findings might relate to a modification of work expectations that result from changes in tenure. Shifts in worker tenure (e.g., exit of existing workers and the addition of new workers) can drive management to implement coping mechanisms that minimize anticipated negative impacts on a group (Droege & Hoobler, 2003). For example, management will be acutely aware of changes in worker resources and subsequently adjust the scope and focus of the group’s project portfolio to fit the current resource pool (Engwall & Jerbrant, 2003). Further, the exit of workers can force remaining members to discover, learn and ingest activities that have been orphaned through attrition. As these orphaned activities are reassigned, workers must invest time and attention so that the activities can be understood and addressed. While these two possible explanations seem reasonable, further research is needed to clarify the relationship between worker tenure and exploitation.

Further, the proposed negative relationship between employment heterogeneity and exploitation activities (H4) was found to be positive and significant. Despite our assertions that heterogeneity complicates the coordination and credibility necessary for exploitation of existing resources, it is possible that the relatively small size of this particular software development group allowed specialized knowledge to flow even in the face of employment heterogeneity. Importantly, contract workers are able to provide “a fresh look at processes [which] enhances the speed of learning, particularly for routine processes” (Wiersma, 2007, p. 1907). Further, the knowledge gained

through new product development could offer important lessons for exploitation of existing systems. The small group size in this particular organization and frequent interaction of all members (through weekly meetings) allowed each person to have a fairly comprehensive view of all ongoing development work. With a greater diversity of knowledge in the group, and a consistent means of distributing that knowledge, all workers were able to apply a more critical view towards existing systems. As such, the diversity within this particular group could possibly have worked to promote exploitation of existing resources. Future research is needed to clarify the impact of employment heterogeneity on exploitation activities.

6. IMPLICATIONS

Findings hold several important implications for both researchers and practitioners. Within the research community, the proposed model and associated findings highlight that the changing nature of group characteristics are integral to understanding the expression of a group's work activities. In order to properly examine the nature of work being performed within a software development group, one must account for worker tenure and employment heterogeneity. By examining these specific group characteristics, this research extends existing perspectives on factors which influence innovative behavior (Doll & Deng, 2011). For worker tenure, analysis revealed a negative relationship with both 'new project' work (exploration) and maintenance & support work (exploitation). Exploration findings suggest that team turnover creates an environment where knowledge search and recombination produce innovative thinking and novel problem solving. Future efforts can extend this research by specifically considering how turnover shapes the production, distribution and integration of knowledge within a group. Further, exploitation findings suggest that factors beyond the developer's control (e.g., task re-assignment and work expectations beyond explicit job requirements) might play an important role in shaping actual work activities. Future research can examine this issue by explicitly examining managerial and social aspects of the development environment.

For employment heterogeneity, findings confirm the importance of diversity for exploration activities while also demonstrating that heterogeneity can play an important role in determining the level of exploitation work that occurs within a group. Our findings suggest that coordination mechanisms can adeptly shift within a project-oriented environment, attenuating the potential negative effects of increased employment heterogeneity. Future research can draw on these ideas to take a more detailed look at how groups alter coordination approaches in the face of changes to group-level heterogeneity.

Further, these results offer researchers a new approach for examining group outcomes. Specifically, this work examined two important types of software development group work: exploration and exploitation. While a large body of research exists where innovative group outcomes are considered (e.g., exploration), very few explicitly examine factors that shape incremental outcomes (e.g., exploitation). Future research can draw on this knowledge-based view of work to extend group-level research towards a more robust view of group dynamics.

Findings also have important implications for managers, especially those within software development environments. Results suggest that managers should pay special

attention to the work effects that result from an entrance and exit of disparate workers. In cases where worker tenure changes significantly, managers should take efforts to ensure that specialization, coordination and credibility are nurtured. By focusing on the shared knowledge within a group, managers can reduce the negative effects of worker transition and increase the potential for exploration and exploitation activities. Utilizing a heterogeneous workgroup can yield important results for both exploration and exploitation, provided that specialized knowledge remains accessible to all group members.

7. LIMITATIONS

While implications of this research are important, results must be viewed in light of several important limitations. The most critical limitation relates to the lack of generalizability that is inherent when investigating phenomena within one organization. Specifically, findings could be the result of idiosyncrasies within this one organization. While this is certainly a limitation, the abundance of longitudinal data within this particular organization allows us to investigate the impact of worker tenure and employment heterogeneity in a rich and meaningful way. To address this limitation, future research should seek to gather data from a large sample of firms so that the impact of worker tenure and employment heterogeneity can be confirmed across organizations and industries. Future studies should also incorporate measures that could affect software development group success, such as the project type and size, the size of the organization, the overall years of experience for the group member, and the size of the software development group itself. For example, studies should seek to determine if small versus large software development groups have the same factors of impact. Additionally, the use of archival data does not allow us to examine group dynamics which are certainly important in shaping group productivity. For example, the existing data set does not allow us to examine the role of team synergy, a factor that has been shown to be critical for successful and productive heterogeneous group (Larson Jr., 2007). Future research can extend these findings by observing and documenting how teams work together during the software development process so that a richer understanding can be achieved. Additionally, future research studies should consider surveying the software development group members in order to confirm the archival data findings.

Interestingly, our findings related to the adverse effect of worker tenure on exploitation behaviors seemingly conflicts with observations in a recent meta-analysis where worker tenure was found to have no effect on individual creativity (Ng & Feldman, 2010). While creativity and exploitation (e.g., innovation) are highly related terms, the variance between findings could suggest that these concepts are distinct. Further, the discrepancy could also reflect a difference in the use of objective measures in our study versus perceptual creativity measures utilized in their meta-analysis. This study also differed by examining group exploitation outcomes versus individual outcomes, a perspective which could result in different findings. Future research should examine these differences in order to clarify the impact of worker tenure on broader measures of innovative behavior.

While this study looked at one characteristic of diversity, that of a contract worker versus an employee, research has shown that a more nuanced view of diversity is needed to understand the full impact of group heterogeneity on outcomes (Thatcher, Jehn, & Zanutto, 2003). Future studies should incorporate other important measures of deep- and surface-level diversity, such as expressed in member skills, job function, gender, age, and race. Finally, organizational size is an additional limitation that must be acknowledged. The development group being considered in this study was relatively small, which can potentially impact the distribution of knowledge within a group. A larger software development group could possibly demonstrate findings more in-line with the original hypotheses. Future studies should examine a large, medium, and small software development groups in order to provide a more complete picture of how worker tenure and employment heterogeneity impact work activities.

8. CONCLUSION

This paper extends existing research on software development productivity by examining how changes in group composition can impact work activities within a software development group. Findings demonstrate that worker tenure and employment heterogeneity play an important role in influencing the exploration ('new project') and exploitation (maintenance & support) activities undertaken within the software development group. This insight is especially important within contemporary organizations, where developer turnover and a mixed workforce (employee and contract workers) are often a reality.

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