Knowledge Work and Teams:
Analyzing Labor Productivity when Tasks are Interdependent

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Abstract

Economic research on organizations traditionally focuses on three different levels of aggregation: (a) the business unit or establishment, (b) sub-units that have easily-identified output metrics, such as manufacturing lines within a plant, and (c) individual workers. Yet there is another level of aggregation that is important for understanding productivity at the different levels, and which has been largely ignored by economists: groups or teams of workers. A main reason for the inattention is measurement: when individual tasks are interdependent and quantifiable output metrics are absent, it is difficult to objectively evaluate groups. Yet groups are the organizing logic behind many complex production processes, and thus must be studied to fully understand productivity at higher levels of aggregation. This paper provides a comprehensive look at the issues surrounding the economic analysis of group-level processes and productivity.

The first part reviews the economic and behavioral science literatures on group processes and effectiveness, identifying the measurements that are best-suited for inclusion in economic models. Particular attention is paid to issues surrounding the economic analysis of groups engaged in interdependent knowledge work. To illustrate the empirical issues, the second part of the paper provides an in-depth case study of geographically distributed software development using data from a multinational technology company with operations in the United States, Europe and Asia. The analysis is an exhibit of the kind of multi-level analysis needed to undertake a comprehensive treatment of individuals' contributions to groups, and groups' contribution to unit- and firm-level productivity.

1. Introduction

Consider the following two questions: What is the best way to measure worker productivity? What are the boundaries of the firm? To a great extent these are treated as entirely distinct issues, addressed respectively and separately by labor economists and by industrial organizational economists. Yet there is one aspect of the way work is organized that impacts both questions equally: the degree of interdependence between tasks and between jobs.

In economic terms, interdependence means that the output on a task or job is maximized only when conducted in conjunction with another task or job. The classic case described by Alchian and Demsetz (1972) is a form of team production "in which 1) several types of resources are used and 2) the product is not a sum of separable outputs of each cooperating resource" (p. 779). The example they provide which illustrates this vividly is two people jointly lifting heavy cargo into trucks: unless both people contribute at the same time, the cargo is too heavy for either to lift alone and the task cannot be completed. This notion of team production aligns fairly closely with the behavioral science view of teams, the definition of which includes "a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and who are seen by others as an intact social entity embedded in one or more larger social systems (for example, business unit or the corporation), and who manage their relationships across organizational boundaries" (Cohen and Bailey, 1997, p. 241).

This paper reviews the issues surrounding interdependent work and teams, drawing insights from both the economics and behavioral science literatures. It also provides empirical evidence on team processes and productivity using a software development case study. The paper is structured as follows. First, the theoretical economics literature on groups is reviewed to draw a distinction between the narrow definitions of teams above and the more loose definition

of teams that has been used to refer to much larger groups or even entire organizations. The key defining concept used to separate "real" teams from more generic groups within firms is interdependence.

The notion of teams is then used to demonstrate the difficulty of measuring job productivity when tasks are interdependent across jobs. The ability to have teams that operate across time and space, particularly in knowledge work settings, also has implications for organization design and the boundaries of the firm. The conclusion that is reached is that the relative lack of attention paid to teams by economists needs to be remedied. The paper then presents data from a case study of globally distributed software development teams to illustrate the issues involved at the individual and group levels when analyzing team productivity in knowledge work settings. Because the behavioral science empirical literature on teams is much more developed than it is within economics, the former is used to frame the analysis and draw implications for future analyses of teams within the economics literature.

2. Interdependence, teams and productivity

Many economic models of "teams" are about generic groups that can produce greater output when working under the umbrella of an organization than when working as independent agents and using market mechanisms and formal contracting to coordinate their work (Alchian and Demsetz, 1972; Che and Yoo, 2001; Gibbons, 2003; Holmstrom, 1982; Kvaloy and Olsen, 2006). In this sense "team" is just a shorthand notion for the boundaries of the firm. The more narrow concept of teams as defined by the behavioral science literature fits within this framework, but is different in at least one key respect: interdependence. A group of salespeople may be more effective when operating as employees of the organization than as independent contractors, however there is no reason to believe that such optimization implies interdependence

in their work; to the contrary, making their jobs more interdependent might hamper productivity unless there are joint resources that they use in the process of making sales.

Interdependence exists virtually everywhere throughout organizations and, if interpreted too broadly, is just another way of saying that the outputs from one job serve as the inputs to another. For example, an accountant who is responsible for filing a firm's income tax forms depends on actions of others in the organization to perform her job effectively and thus displays a type of sequential interdependence: if the information is not provided according to a fixed time schedule, then she cannot do her job properly. A janitor's job is interdependent to the extent that much of the work has to be scheduled around the work patterns of people in the firm. Yet these are not the kinds of interdependence that are at the heart of behavioral science models of teams.

In order to be more useful than a tautology, interdependence should be limited to mean that jobs can vary in the extent to which they must closely interact with other jobs to have maximum impact on the organization. Consider the example of another accountant working on a cross-functional mergers and acquisitions team responsible for evaluating prospective companies to acquire. In order to perform her job effectively she has to closely interact with the other team members to process large amounts of information on a wide range of issues related to finance, logistics, personnel, HR policies, etc. Effective processing of such information often requires face-to-face meetings in which the experts from the different functional areas share their information and interpretations so that a collective recommendation can be made regarding the value of a prospective acquisition, often under tight deadlines. Making the members of the team jointly responsible for processing the information and making a recommendation as a group on whether a prospective firm should be acquired is often more efficient than having each functional

expert work independently and channel all information up the firm's hierarchy so that higher level managers must integrate and decipher it before making a final decision.

The need for real-time information sharing and the complexity of the work involved are hallmarks of teams as defined by the behavioral science literature (Hackman and Oldham, 1980; Cohen and Bailey, 1997). The merger and acquisitions team's non-sequential interdependence that requires close coordination among the members of a group to process information is at the heart of what we shall consider to be "true" interdependence in this article. Indeed, the behavioral science literature explicitly acknowledges the usefulness of teams as "lateral integrating mechanisms" that enable different parts of a functionally-organized firm to address information analysis and decision making problems under conditions of change and uncertainty that otherwise would be handled inefficiently within the traditional hierarchical decision making structure (Galbraith, 1973; Mohrman, Cohen and Mohrman, 1995).

Economics certainly has not ignored the issue of decision rights within organizations, which has been a hallmark of the entire field of industrial organization. Hayek (1945) was the first to recognize the benefits of locating decision making authority as close as possible to where there is local knowledge, a theme that continues in more recent economic theories of the firm (see, for example, Jensen and Meckling, 1995). Milgrom and Roberts (1988b) directly model one aspect of Galbraith's (1973) observations regarding the importance of information processing as a determinant of organizational form, noting that firms can treat communication with customers and inventories as substitutes in manufacturing. Milgrom and Roberts (1988a) further conjecture that "increases in the complexity of the product and the frequency of product change can be met by using more highly trained employees performing less specialized tasks" (p. 455), which sounds like a quote that just as easily could have come directly from the behavioral science

literature on job design. Thus there is close alignment between many principles within the industrial organization field and the behavioral science view of teams. Yet despite this alignment of general principles, industrial organization has essentially ignored the interdependent teams that are the hallmark of behavioral science.

A related point about teams is that they often are a choice that firms face when designing jobs and organizations, representing one end on a continuum that is anchored, at the other end, by jobs that are epitomized by the scientific management approach (Taylor, 1923), i.e. narrow, simple, lower-skilled (relative to the occupational norm), and highly supervised. The literature on job and team design (Hackman and Lawler, 1971; Hackman and Oldham, 1980) proposes that firms can choose different points on the continuum for a given set of tasks, either bundling them together in one job or separating them into different jobs. More than just a simple academic idea, there are ample examples from manufacturing in which formerly narrow jobs are made more complex by pooling together tasks so that a group of workers is held collectively accountable for a more complete piece of work (Appelbaum and Batt, 1994), a trend that was first perfected by Japanese manufacturers and then adapted by their U.S. competitors. Such changes are usually measured as part of a larger system of workplace innovations that have been dubbed high performance or high involvement work systems (Lawler, 1991; Appelbaum and Batt, 1994)

It is beyond the scope of this paper to provide a comprehensive treatment of all the job design issues that are related to interdependence and the measurement of productivity. Instead the focus will be on a few key issues. The first point is that designing one job to be interdependent with another job is no guarantee of increased productivity. Increased interdependence means the individual has less control over the output to be produced, which diminishes the organization's ability to align compensation with marginal productivity at the

individual level; instead there must be a greater reliance on group-based compensation and evaluation schemes (joint performance evaluation instead of relative or absolute performance evaluation). This increases free rider and other related problems, which can be justified only if the gain in total productivity (and revenue) from interdependent production offsets the increased monitoring difficulty. It is for this reason that the behavioral science literature on teams focuses so much attention on how to design and manage teams to achieve maximum effectiveness.

This point is worth noting for labor economists who are interested in understanding the extent to which wages represent payment for marginal value contributions. In an interdependent job, it may be very difficult to impossible to isolate that's job true marginal contribution to output and profits. This is particularly true for knowledge work, which has been growing in importance in recent decades. With interdependencies in mind, it may be possible to reinterpret some of the longstanding debates within labor economics with respect to differences in wages between workers. For example, the debate over the wage returns to computer usage, a type of knowledge work, has shown that wage premiums are positively associated both with greater computer usage (Krueger, 1993; Autor, Katz and Krueger, 1998) and with greater pencil usage (DiNardo and Pischke, 1997). The interpretation is that there must be an omitted variable, ability or something else, that is positively correlated with both computer usage and pencil usage. Taking a job design perspective, however, it may be that part of the wage differential is due to jobs that are more complex and require greater thinking (and writing) skills and/or are more interdependent with the other jobs around them. Such complexities and interdependencies could easily warrant a wage premium, particularly in team-based work.

The use of teams is fairly extensive, covering at least half of an organization's core employees in approximately forty percent of all private sector establishments with fifty or more

employees (Osterman, 1994, 2000); if the measure is more broadly defined as using teams at all, the percentage rises to fifty-five percent of all such establishments (Osterman, 1994).[1] Interestingly, despite the rapid growth in other forms of "new" work practices (job rotation; total quality management; quality circles) between 1992 and 1997, the overall usage of teams for half or more of organizations' core employees did not change (Osterman, 2000).

Yet this impression of a cross-sectional steady-state is an illusion: there was a lot of cycling of firms between the two groups (usage of teams for at least half of core workers versus less than half of core workers), with half of all establishments scaling back their use of teams while an equal number scaled up. Such dynamics may indicate changing business realities that alter the latent demand for teams. However, I am more inclined to agree with Osterman's (2000) interpretation that "teams are probably the most difficult work innovation to implement and the one that is most likely to be disrupted by turnover and restructuring" (p. 186), which concurs with the view of team complexity from behavioral scientists who have studied the dynamics of teams in detail (Mohrman, Cohen and Mohrman, 1995; Gibson and Cohen, 2003). Organizations appear to be in a continual state of flux with respect to teams, sometimes expanding their use and sometimes contracting as they struggle with the ability to effectively design and manage them.

Because there are real tradeoffs between using teams and more interdependent forms of production versus less interdependent forms of production, what we observe in a cross-section should be teams in situations where, on average, they are better suited to improving productivity. Because the use of teams, particularly production teams, often involves cross-training (Cohen and Bailey, 1997), the jobs on teams can have greater skill requirements, which in theory could

[1] Osterman (2000) notes that the percentages of employees working in teams in his survey is higher than in other surveys, which in large part is likely due to his focus on "core" employees – the largest group of non-supervisory, non-managerial workers directly involved in making the product or providing the service. Because these are the employees at the heart of any complex process, they are the most likely candidates to be on teams. In contrast, one would expect the janitors at an establishment to be more peripheral and thus less likely to be on teams.

lead to higher wages. Countering this, however, is the argument from a job design perspective that the process of creating teams can take narrow jobs and make them more intrinsically motivating by increasing responsibilities and decision making authority (Hackman and Oldham, 1980). This would be equivalent, within a standard economic model, of increasing the utility derived from working on the job, even if wages are held constant. Thus the increase in intrinsic motivation may work to counter the upward pressure on wages from increased skill demands.

There is little systematic research at a national level into the impact of teams on wages and on productivity. For wages, the exceptions are Black and Lynch (2004) and Black, Lynch and Krivelyova (2004), who, using the same data set, find essentially no link between teams and wages, and Osterman (2006) who finds a positive link between greater usage of teams and manufacturing wages. For labor costs and productivity, Cappelli and Neumark (2001) find weak evidence at best; Black and Lynch (2004) find a *negative* relationship between teams and productivity, which they attribute to possible short-run set-up costs for teams. Nicholson, et al., (2004), in contrast, find evidence of a positive correlation between the extent to which a worker functions as part of a team and the cost to the firm of an absence. While this does not ensure positive wage differentials for workers on teams, it certainly implies that either profits, wages or both are higher under team production.

Clearly, much more evidence is needed before a definitive conclusion can be reached regarding the productivity and wage impacts of teams. Yet, based on the theories and evidence from the behavioral science literature, there are good reasons to believe that it may be hard to use economists' preferred approach of measurement by looking for average treatment effects in representative samples of workers and workplaces with different usages of teams. First, because teams are complex to set-up and manage, there are substantial differences in effectiveness across

teams, differences that are related to factors including task design, group composition, organizational context (including the types of rewards used), group processes, and more (Hackman and Oldham, 1980; Cohen and Bailey, 1997). Data sets and analyses that fail to capture these measurement issues will suffer from omitted variables that bias the measured impact of teams toward zero (by improperly averaging together "good" and "bad" teams).

Second, because the effectiveness of teams depends on their relevance for a particular type of production process, there is diminishing marginal productivity of teams across the entire spectrum of work processes. Thus, it is to be expected that teams will be implemented beyond the point of highest marginal return to the point where the average differences between groups with and without teams are equalized. This would reduce the average "treatment" effect size of teams as measured in a cross-section to zero.

Third, the theory on teams and related "high performance" processes strongly points toward the need to implement sets of complementary practices, such as training, job rotation, group-based rewards, etc. (Appelbaum and Batt, 1994; Mohrman, Cohen, and Mohrman, 1995). Thus the marginal impact of introducing teams alone should be lower than when introduced along with other practices, i.e. there is an interdependency between introducing teams and introducing other practices. On this the evidence is much more clear and favorable (Huselid, 1995; Ichniowski, Shaw and Prennushi, 1997; MacDuffie, 1995; Osterman, 2006). In particular, Boning, Ichiowski and Shaw (2001) show that the positive impact of teams on productivity within manufacturing is larger in more complex production lines and when adopted alongside group-based incentive pay. Wageman (1995) finds that groups of repair technicians performed best when organized either independently with individually-based compensation or as a group with group-based compensation, but not when hybrid forms (individual for tasks and group for

rewards, or vice versa) were used. Because of the potential simultaneity of teams and other workplace changes, analyses that look for impacts of teams on productivity and wages at the same time as other practices may erroneously find no impact of teams, particularly when such analyses are drawn from national samples that lack details that would enable analyses such as those conducted by Boning, et al. (2001) and Wageman (1995).[2]

Aside from their prevalence, a main theoretical reason why economists should consider studying teams more directly is because they exist as a type of intermediate organizational form that is at a higher level of aggregation than individual workers, but below the typical levels of aggregation often used to study productivity, such as firms and establishments. Productivity measurements at the firm and establishment level range from net revenues to stock market returns to (often imputed) physical output measures. These approaches allow for data collection on a large scale, but the analyses can suffer from identification problems because of the level of aggregation (for example, Andrade, Mitchell and Stafford, 2001; Criscuolo, Haskel and Slaughter, 2005; Foster, Haltiwanger and Krizan, 2002; Griliches, 1998; Katayama, Lu and Tybout, 2003; Peristiani, 1997).

In a smaller number of cases, economists and management researchers have been able to obtain output data at a sufficient level of disaggregation so that their analyses can reach much stronger conclusions about causal factors that impact productivity, not just poor proxies for productivity (for example, Athey and Stern, 2002; Henderson, 1993; Henderson and Cockburn, 1996; Hubbard, 2003; Ichniowski, et al., 1997). What is interesting about this set of studies is that they differ from traditional economic productivity studies in one important respect: they all

[2] This is a potential issue for Black and Lynch (2004), Black, Lynch and Krivelyova (2004), and Cappelli and Neumark (2001), who all used a simultaneous approach. When Osterman (2006) compares the two approaches directly, he finds a positive and statistically significant impact of teams on wages when modeled alone, and a positive but insignificant impact of teams when modeled simultaneously with quality circles, total quality management, and job rotation.

required primary data collection by researchers working with companies to obtain data that was not already available from a public source. This type of data collection is rare in economics, but is the norm within the behavioral sciences. The one difference with the approach of these researchers and the data collected for the study in this paper (described below) is the lack of survey data collected from individual employees. I argue below that this is one way that economists should expand their primary data collection methods to improve the analysis of teams and other processes that occur inside the "black box" of organizations. Moreover, once the focus is on a sufficiently disaggregated level such as projects (e.g. R&D efforts) or product lines, teams quite likely are the organizing framework that the organizations are using anyway for the employees dedicated to the work. Ignoring the opportunity to collect information on team characteristics and processes could easily lead to omitted variable bias problems.

Because teams are put together to achieve specific organizational objectives, in theory it is possible to measure those objectives as a way to gauge productivity at intermediate stages of production and service delivery. This is an important point with respect to the proper level of analysis and difficulties of measuring productivity in complex environments. What is interesting about the history of productivity analyses in economics is the inordinate attention paid to both physical output measures and the role of information technology. The former is due to basic measurement problems: manufacturing for generations of researchers was both the easiest to measure and accounted for a significant portion of all economic activity. In recent decades, however, the continuing shift toward service work has created measurement challenges that researchers are only beginning to successfully address, albeit slowly (Griliches, et al., 1992; Griliches and Mairesse, 1993). One advantage of the behavioral science approach (described below) to measuring team productivity is the existence of "effectiveness" measures that, while

not as easy to justify scientifically as physical output measures in manufacturing, offer the ability to compare productivity of groups whose output is not easy to measure – an ideal criteria for many service industries and knowledge-based work.

The history of the study of technology starts of course with the Solow residual, which attributed improvements in total factor productivity unexplained by increases in measured capital and labor entirely to amorphous technological change. As the recent literature on high performance work systems demonstrates, however, technology changes alone should not be viewed as the only source of productivity growth; changes in the organization of work may play as large or an even larger role as changes in capital equipment and computer software and hardware. This idea certainly is not in conflict with Solow's interpretation of the residual, but it is at odds with decades of research into the measurement of the impact of technology change (spending in particular) and productivity growth. The debate over the correlation between computer use and wages, discussed above, is one example.

Another example is the correlation of new technology adoption and productivity changes. An example of this work is Doms, Dunne and Troske (1997), who find that plants adopting new factory automation technology have more skilled workers (and pay higher wages) both pre- and postadoption. This result is hard to explain in a traditional economic model of technology and productivity growth; it is easier, on the other hand, to fit these patterns into a job design model of organizations where higher skills, interdependent work, group-based compensation schemes and teams are used together. There are not an overwhelming number of examples of the integrated approach to evaluating the impact of technology adoption within a job design framework in economics, though the body of evidence has been growing recently (Bartel, Ichniowski and Shaw, 2005; Bresnahan, Brynjolffson, and Hitt, 2002; Brynjolffson, and Hitt, 2000).

Finally, it is worth noting that the behavioral science literature was touting the importance of changes in job and organization design long before the economics audience caught on. Given the dearth of attention paid to teams within economics, and the great attention paid within the behavioral literature, it would be naïve for economists to presume that there is nothing to be learned from the behavioral literature on teams before examining what it has to say. The second half of this paper provides such an opportunity using a case study from a company with globally distributed software development teams.

Before turning to the literature on teams, it is worth noting how a consideration of interdependence and the related job design issues could shed insights into labor market phenomena that may be related to teams only tangentially. First, the implementation of teams is only one prediction of the theory of job enrichment, which posits that productivity can be enhanced by designing jobs to have more complexity, skill variety, task significance, autonomy and direct feedback from doing the work (Hackman and Lawler, 1971; Hackman and Oldham, 1980). For an economic interpretation of job enrichment see Gibbs and Levenson (2002).

One implication of job design theory is that, even in the absence of teams, jobs should cluster into different groups, where some jobs are high on factors such as skills, complexity, autonomy and interdependence, and other jobs are low on all these factors. This appears to be the case both when comparing jobs within the same occupation, and when comparing jobs across occupations within the same firm and establishment (Zoghi, Levenson & Gibbs, 2005). Such patterns could be and likely are related to the proliferation of teams, but the theory does not necessarily require such a link, and the evidence almost certainly is driven by more than just teams. For example, sales people can be given greater discretion to set prices in reaction to

changing or uncertain demand elasticities and be rewarded for maximizing the profitability of a portfolio of products, all without operating as part of a team.

One example of an outstanding economic issue that might be better understood by considering job design theory and interdependence is the literature on interindustry wage differentials. Rather than representing rents or efficiency wages, interindustry wage differentials within occupations could be due to differential use of teams or other differences in job design that cause workers in an occupation in one industry to be more interdependent (and thus, potentially, to have greater marginal value product for the firm) than workers in the same occupation in another industry. While such analyses are beyond the scope of this paper, they suggest additional ways that interdependence and related job design issues could be used to gain deeper economic insights into how productivity and wages are determined.

3. The behavioral literature on teams and geographic dispersion

The extensive behavioral literature on teams and group dynamics dates back over half a century (for example, Deutsch, 1949). No attempt is made here to provide a comprehensive review of the literature. Instead, the focus is issues more likely to resonate with economists' concerns regarding the measurement of group productivity and factors that influence it.

Interdependence and rewards. With respect to interdependence, groups can be designed to have different levels, and doing so has impacts on how the group members interact with each other (Thomas, 1957). A key aspect of group design is rewards, and the importance of aligning the extent of interdependence with the use of joint versus relative or absolute performance evaluation (Berkowitz, 1957; Mitchell and Silver, 1990; Rosenbaum, et al., 1980; Wageman, 1995). The conclusion from this research is that, at least for certain tasks, there may be choices of degree of interdependence, and the group's overall effectiveness depends on striking the right

balance between the degree of interdependence and group-based or individual-based rewards. The greater the interdependence and mutual accountability for outcomes, the more like a true team the group is.

Outcome measures. Numerous studies use objective output measures to evaluate team effectiveness. Cohen and Bailey's (1997) review found that about half of the studies of work teams (teams responsible for making the product or service) had such objective measures. Where such objective measures are not available, and often even when they are, researchers use surveys to collect data from the team members themselves and from managers who oversee the team members; Cohen and Bailey (1997) found a fairly even balance between measures collected from both groups. A typical survey question will ask the respondent to rate the team's performance along various dimensions, using either a numerical score (e.g. 0-100) or categorical response scale (e.g. strongly disagree – strongly agree; not at all effective – highly effective).

For project teams, which produce one-time outputs such as a new product, service, information system, or new plant, the situation is much different; none of the studies reviewed by Cohen and Bailey (1997) used objective outcome measures – all used team members' and managers' survey ratings. The lack of objective measures might seem surprising, given that creating something new is an activity that can be measured – if the yardstick is whether the activity occurred or not. But for organizational success (profits, market share, return on investment, etc.), what matters typically is not whether a project occurred, but how it performed relative to multiple benchmarks. So rating a project team on setting up a new plant means considering how they performed in terms of timeliness, whether the plant has the full functionality expected of it, and actual costs relative to budget. Similar issues are encountered for the software development teams that form the case study covered later in this article. In such

situations, resorting to team member and manager ratings of performance relative to the appropriate benchmarks often is the only feasible solution.

Intermediate outcomes / team effectiveness drivers. There are numerous measures that the behavioral science literature uses to address why effectiveness varies across teams (Cohen and Bailey, 1997; Gibson and Cohen, 2003; Mohrman, et al., 1995). Some of the more relevant ones for an economics audience include:

1. Trust: Trust is supposed to be a key factor that measures whether team members can work together effectively.
2. Integration: Measures the extent to which team members who come from different disciplinary backgrounds can resolve their different perspectives.
3. Intergroup cooperation: The integration construct measures within-team cooperation; this construct measures cooperation between functions and sites within the organization, which can and often go beyond the team members.
4. IT support: Measures whether the organization provides sufficient technology support.
5. Resource commitment: Similar to the previous construct, but focused broadly on any type of resource the team might need to be effective.
6. Individual and team rewards: Finding the right balance of individual versus group-based rewards is a key challenge when designing teams. This construct measures the extent to which rewards are adequately aligned at the individual and group level with the individual's and the team's efforts and contributions.
7. Measurable outcomes: Having measurable outcomes should make it easier for team members to focus their efforts on actions that enhance effectiveness. This is of particular concern in knowledge work settings.

8. Team networking: Measures the extent to which the team works with other people in the company that can help it achieve its objectives.
9. Group leadership: Measures team member attitudes regarding leaders' roles in facilitating the team's work.
10. Team cohesion: Measures the extent of conflict among members of the team.

In addition to the measures focused on the team's processes above, there is an additional set of variables that are commonly used to measure how the team members feel about their job and the organization. These often are used to gauge whether the person will leave the organization, which could prove disruptive to the team's effectiveness:

11. Intention to leave: A precursor to turnover, intention to leave has been shown to be a fairly reliable predictor of actual turnover.
12. Pay satisfaction: An attitudinal measure of whether the person is receiving wages at or above the reservation wage.
13. Job satisfaction: Though economists typically focus solely on the wage or total monetary compensation, models of job matching can be easily enhanced to include search for nonmonetary aspects in addition to monetary ones. This construct measures the overall quality of the match across all jobs aspects.
14. Career satisfaction: In addition to point-in-time issues related to a job match, the job may provide opportunities for career advancement through skill building that is needed for subsequent jobs.
15. Development support: On-the-job learning is a conscious activity that typically is acknowledged by economists only in the guise of formal training. However, the behavioral literature has long recognized that there are active processes in which the employee can

engage, including working with mentors and getting feedback on ways to improve skills on the job. This construct addresses those issues.

16. Work-life imbalance: Economic models of the labor market rarely address hours constraints, except in the context of dual job holding (Paxson and Sicherman, 1996). Such models focus on binding upper limits on hours worked that are created by overtime laws. Virtually ignored is the issue of binding lower limits on hours worked, something that has been noted in the nonacademic literature as a concern for professional workers (Schor, 1991), and which has been addressed in the behavioral literature as work-life imbalance.

The standard approach when collecting attitudinal measures is to ask multiple questions designed to address the same concept, and then use factor and reliability analysis to verify that the individuals' responses to the separate questions are sufficiently correlated that they can be combined together in indexes, using simple averages of the individual questions.

Geographic dispersion. The behavioral science literature on teams in recent years has documented a rising use of teams that operate across both space and time boundaries (Gibson and Cohen, 2003; Martins, Gilson and Maynard, 2004). While the telephone has always allowed the possibility for work to be coordinated across long distances, it appears that only with the recent rise in the internet, high quality videoconferencing and other real-time collaboration technologies have organizations become more aggressive at exploring the boundaries of how the work of teams can be organized remotely. This expands the potential pool of labor for the team in terms of both depth and price, opening up the possibility of finding better quality labor at the same wage, cheaper labor for the same quality, or both. Note that for our purposes here we are concerned only with work that has some degree of true interdependence. For example, companies that purchase from suppliers in other countries are not the focus; in contrast, a cross-

national team charged with reducing supply chain operations costs across the different parts of a multinational firm would be.

Levels of analysis. There is considerable complexity and debate regarding the level of analysis that should be used when analyzing teams (Firebaugh, 1978; Klein and Kozlowski, 2000; Bliese, 2000). As summarized by Bliese (2000), the main categories of models include:

(a) Top-down: higher-level (organization level; business unit level) factors impact individual team member perceptions and actions. Examples include differences in reward systems, career development opportunities, and other factors that can vary systematically across organizations or business units. A parallel within traditional labor economics are models that allow for local labor market variables to influence individual-level processes and outcomes.

(b) Bottom-up homogeneous ("composition processes"): individual-level perceptions or actions coalesce to form group norms or common ways of addressing an issue, which create mean differences in group-level norms or actions. Examples include perceptions about a team's culture or norms that allow the researcher to classify teams as having distinct types that are defined by the culture or norms. These types of models are the least familiar to economists.

(c) Bottom-up heterogeneous ("compilation processes"): differences at the individual level within a group impact group-level outcomes. For example, groups with higher average levels of satisfaction with various individually-oriented organizational processes (compensation, promotion opportunities, training, etc.) may function better as a group. In such models it may be fruitful to examine measures of within-group variation in addition to mean differences across groups, in the event that within-group differences might exert an independent effect on the team's ability to function effectively (e.g. differences in within group disparity may negatively impact performance when comparing groups that have comparable means).

(d) "Fuzzy" composition processes: team-level variables that are aggregated from individual level variables are both related to and different from the individual-level variables (Firebaugh, 1978). For example (Bliese, 2000), gender at the individual level may be hypothesized to have a different relationship with individual actions than the relationship between diversity and group level outcomes. Another example is absenteeism (Mathieu and Kohler, 1990), which can be modeled as both an individual level process (what factors determine whether someone will be absent) and group level process (are there cultures of absenteeism that vary from group to group).

It is beyond the scope of this article to address the intricacies of these different group process models. For the case study, we focus on bottom-up heterogeneous processes that can be modeled at either the individual or (averaged) group level as a way to demonstrate the range of analyses and interpretations that are typical for analyses of team productivity and effectiveness.

4. The case study

The data for this study were collected as part of a larger project to measure the productivity of software development at different sites within one company that are distributed in the U.S., Europe and Asia. A multi-method research approach was used, including interviews, site visits, and a survey, all at a large multinational technology company. Levenson (2006) discusses the case study in detail, and analyzes differences in productivity measured at the site level, and their relationship to geographic dispersion of the team members. That analysis used only the individual level data, and focused on the relationship between geographic dispersion and productivity. Here, in contrast, the analysis is at both the team and individual levels, and is focused on a broader set of issues related to team effectiveness and the roles of interdependence, rewards, information technology and team composition.

The data are useful for exploring issues that are of potential economic interest:

- What are the different ways to evaluate team effectiveness, and how do they relate to the use of information technology? In the context of software development, relevant outcome measures include overall effectiveness, speed, cost, technical performance, innovation, and customer satisfaction. For geographically dispersed software development teams, the importance of different types of information and communication technology (telephone, e-mail, videoconferencing, knowledge repositories, and collaborative software) for the different types of outcome can be addressed as well.
- The behavioral science distributed teams literature emphasizes the importance of both initial and ongoing (as needed) face-to-face contact to counteract the problems of communicating electronically and asynchronously (Gibson and Cohen, 2003). We can thus examine the perceived importance of face-to-face communication directly as a correlate of effectiveness, testing whether those people and teams who place greater emphasis on face-to-face communication, even when operating in a distributed environment, achieve better outcomes.
- Companies' rationale for choosing the team members. The behavioral science literature offers a wealth of insights on this issue (Cohen and Bailey, 1997), which are not tested here. However, there are certain aspects that are consistent with human capital models of the labor market which have received less attention in the behavioral literature. The importance of on-the-job experience is one of them. If teams are relatively complex things that are difficult to manage, then one measure of team-related skills could be prior experience working on teams. Given the challenges of working on distributed teams, we would expect that experience to have an independent effect as well, aside from general team experience. Finally, because teams are embedded within organizations that have unique processes and ways of creating

value for customers, it is reasonable to expect in addition that organizational tenure could play in role in determining the probability that someone would be included on a team.[3]

- Team effectiveness drivers: Though the intermediate outcomes above are not familiar to economists, it is not a stretch to expand traditional frameworks to include such measures because they are relatively factual: they seek to describe what happens within teams, not asking for opinions of why those things happen. Thus, they ostensibly are phenomena that could be measured by outside observers, but which typically are not because of the prohibitive costs of doing so. Thus, asking the participants for their views in a non-emotional way can be an effective way of producing measures of processes that are relatively objective.
- Given the evidence on the importance of using group-based approaches to job design and to compensation at the same time (Boning, Ichniowski, and Shaw. 2001; Wageman, 1995), we can use the case study to examine the relationship between the two in these data.
- Attitudes as precursors to outcomes that labor economists care about, such as turnover: To what extent do attitudinal satisfaction measures correlate with individuals' willingness to stay with the organization? Are there systematic differences among team members across teams that create greater propensities for turnover at the team level?

The survey was administered on-line anonymously in 2004 to all development engineers and on-site managers at each site, approximately 750-800 members of different teams. The precise number of teams and recipients in the survey population is unknown because it was administered anonymously – the company distributed an e-mail request to all of the team members and on-site managers using an e-mail alias list that was not shared with the researchers.

[3] These predictions are framed as being for teams that are used for only a subset of workers within a firm. It is conceivable, though perhaps rare, that an organization might use teams for an entire set of processes or products, and all workers involved therein. However, the nascent work on team-based organizations (Mohrman, et al., 1995) suggests that such organizations are rare enough to be the exception that proves the rule that teams are typically applied differentially across workers within the same organization (Osterman, 1994, 2000).

Valid responses were received from 204 people, for a response rate of approximately 25-30 percent. The company indicated that this response rate is consistent with their experience with other surveys. The respondents predominantly came from two sites in California, France, the Czech Republic, and India. There were only a small number of respondents from a third site in California, Texas, and Norway. At least two responses were received from fourteen unique teams, with 9 teams providing at least five responses per team.

The individual survey items that form each construct are detailed in Appendix A. The results of the Oblimin-rotated exploratory factor analysis using Principal Axis Factoring indicated that the items included in each construct factored with relatively high loadings within each construct and low cross-loadings across constructs (typically less than .3). The alphas from the reliability analysis are reported in Appendix A.

For the effectiveness measures, the respondents were asked to rate their team along seven dimensions: (i) overall, (ii) quality, (iii) speed, (iv) cost, (v) technical performance, (vi) innovation, and (vii) customer satisfaction, using a 0-100 scale. To check the accuracy of the team members' perspectives, senior level managers (who did not take the survey) familiar with the team's objectives and processes were asked to rate the teams using the same effectiveness measures. These individual ratings were combined with those of the on-site managers to produce team-level aggregate (mean) manager ratings which were compared to team-level aggregate employee ratings. The correlation between the manager and employee means across the seven outcome measures and fifteen teams was .41, which indicates a reasonable amount of agreement. While we would have preferred even greater consistency between manager and employee ratings of team effectiveness, given the small sample size we opted for combining the employee and on-site manager data when conducting the regression analyses. Because the on-site managers were

active team members, including writing software computer code side-by-side with the nonmanagers, including their observations in the analysis seems warranted.

5. Results

Appendix B reports summary statistics for the 14 teams. A detailed discussion of the company's decisions to locate its software development work in these different areas is provided in Levenson (2006), so we will not repeat the details here. To start, consider the level of interdependence of each team. The interdependence rating can range from 1 to 5, and the actual variation among the teams is quite narrow: 3.9 – 4.6, indicating both a high level of interdependence within each team and consistency across teams in that level. Thus in the traditional sense of interdependence as defined in the behavioral literature (Cohen and Bailey, 1997), these appear to be "real" teams. Because of this, and because of the lack of variation at the team level, we consider interdependence to be largely a "fact" of these teams, and not something to be examined as a design (choice) variable that can explain differences in team effectiveness. One exception, which is addressed later, is the extent to which the team members are evaluated and held accountable for outcomes on an individual versus group basis.

Turning to the issue of outcome measures and information technology, the statistics in Appendix B indicate that the members of these teams rate them fairly highly (at least 60 out of 100) on each of the effectiveness outcomes. This could be somewhat due to response bias, but just as likely reflects actual performance: when examining a set of existing teams, survivorship bias should lead the average performance of that set of teams to be greater than a more complete set that included teams that failed and are no longer in existence. As for usage of communication and information technology, e-mail clearly is viewed as the most important, followed by knowledge repositories and telephone, with collaborative software a distant fourth and video

conferencing clearly in last place. In contrast, the importance of face-to-face communication is viewed as of roughly equal importance as knowledge repositories and telephone. Despite the theoretical allure of video conferencing, the interviews of team members suggested that the technology did not work seamlessly enough to ensure reliable communication, as compared to the telephone which was virtually error-free (from a pure technological perspective, though not necessarily from a strength-of-communication-content perspective).

Table 1 presents the correlations of each effectiveness measure with the importance ratings for each type of information/communication medium, using the individual level data. Despite e-mail's overall high average rating, it is not statistically significantly positively correlated with any of the effectiveness measures, though that may be due to relatively little variation in the perceived importance of e-mail (range restriction). Of the other four technologically-mediated communication methods, only telephone and collaborative software are positively correlated with effectiveness outcomes: people who place greater emphasis on those methods also report greater team effectiveness. Interestingly, differences in the perceived importance of face-to-face communication are not correlated with any of the effectiveness measures, at least at the individual level.

To gauge the relative importance of each, Table 2 presents a regression of overall effectiveness on the perceived importance of each of the communication methods, first excluding and then including face-to-face communication. The results indicate that people who give greater importance to telephone, communications, knowledge repositories and collaborative software all report greater overall team effectiveness. The opposite holds for video conferencing.

Table 3 presents the individual level correlations between organizational tenure, experience working on distributed teams, the number of teams, and the number of distributed

teams. Each correlation is positive and significant, indicating that this firm values both organizational experience and prior distributed team experience for those it puts on teams in general and on distributed teams. This supports the notion that team experience builds specific human capital that is valuable in future team work.

Table 4 presents the individual level regressions linking the effectiveness drivers with each effectiveness outcome. Trust, intergroup cooperation, IT support, resource commitment, team networking, and team cohesion all are statistically significantly positively related to at least one effectiveness outcome, which is consistent with the findings from the behavioral science literature (Cohen and Bailey, 1997; Gibson and Cohen, 2003; Mohrman, et al., 1995).

Tables 5.A and 5.B repeat the team effectiveness analyses from the previous tables using the team-level aggregated variables. Because there are many fewer degrees of freedom, we first look for the subset of variables that are consistent with the behavioral science literature's predictions and are most likely to have explanatory power in these data. To that end, Table 5.A presents the bivariate correlations between the overall team effectiveness measure and each of the information technology / communication variables, years of experience working on distributed teams, the percentage of team members who are co-located, and each of the effectiveness drivers. Of these, Table 5.B presents regressions using the variables with the largest bivariate correlations in various combinations. Doing so reveals the "preferred" specification in the final column, which includes the importance of face-to-face communication, years of experience working on distributed teams, and intergroup cooperation, each of which is positively and statistically significantly related to overall team effectiveness. Thus teams that collectively put a greater emphasis on face-to-face communication, have greater experience working in a

distributed fashion, and perceive greater cross-functional and cross-location cooperation are more effective than other teams that are low on each of these measures.

Comparing the individual and aggregated team level results shows some interesting patterns consistent with "fuzzy" composition processes. At the individual level, putting greater emphasis on face-to-face communication is not significantly correlated with effectiveness while putting greater emphasis on a number of information technology media is. In contrast at the group level, only differences in the emphasis on face-to-face communication are a distinguishing factor. One way to interpret this is as follows. At the individual level, there are significant differences across people within each in team in the extent to which they rely on different types of electronic communication and their ability to contribute to the team's success. At the team level, however, the extent to which this is the case is roughly the same, or at least does not vary systematically with differences in overall team effectiveness, which is why none of the electronic communication variables is significant at the team level.

For the importance placed on face-to-face communication, in contrast, the situation is reversed. While it does not vary with effectiveness systematically in any meaningful way at the individual level (which is dominated by within-group variation), once the within-group variation is obscured by the team level aggregates, the meaningful across-group variation emerges as relevant. For these teams that all have members located on different continents, electronic communication apparently helps team members accomplish their individual objectives on a daily basis. But it is managing the extent and quality of face-to-face communication that is the bottleneck that prevents some of the teams from equaling the productivity of the other teams.

Table 6 reports the results from regressing the amount of interdependence (aggregated to the team level) on the extent to which the team shares responsibility for deliverables and on the

extent to which each member is held personally accountable for team results. Consistent with the literature on complementarity of task design and rewards (Boning, Ichniowski, and Shaw. 2001; Wageman, 1995), only the extent of shared responsibility is positive and statistically significantly related to the degree of interdependence. It is noteworthy that such a significant relationship emerged at all given the small sample size (14 teams) and range restriction on the amount of interdependence. This suggests that within a larger sample of geographically distributed software development teams with greater heterogeneity in interdependence, the measured relationship with the extent of group-based rewards likely could be much stronger.

Finally, Tables 7.A and 7.B present the results from estimating the intention to leave models at both the individual and (aggregated) team levels. At the individual level, job satisfaction, career satisfaction, development support, and work-life balance all are significantly related to employee retention. At the group level, however, the only statistically significant variable is job satisfaction. This is consistent with the behavioral science literature on turnover, which finds job satisfaction to be the strongest job attitudes variable in predicting actual turnover (Griffeth, Hom and Gaertner, 2000). Thus teams with higher average levels of job satisfaction have fewer employee retention problems.

The final column of Table 7.B substitutes the team's overall effectiveness rating for job satisfaction in the intention to leave regression. As noted at the bottom of the table, at the team level, average job satisfaction and overall effectiveness are correlated at .59, which is significant at the 95% confidence level. Thus job satisfaction and team effectiveness cannot be included in the regression at the same time (doing so reduces both coefficients to insignificance because of the multicollinearity). This is consistent with the behavioral science literature's findings with respect to job performance and satisfaction. It is strongly argued (Lawler, 2003) that the evidence

points toward a strong causal link from job performance to satisfaction, but not the reverse. The idea is that people almost always derive satisfaction from doing a good job. The converse is not always the case, however, because high job satisfaction that is driven by an ability to shirk critical job duties does not lead to good job performance and productivity.

6. Discussion and conclusion

The growth in teams and knowledge work present challenges to economic researchers who prefer easily quantifiable output measures when analyzing productivity. The complexity and intangible nature of many of today's products and services mean that such output measures often are unavailable. An alternative, as introduced by the behavioral science literature and described in this article, is to collect team-based measures of effectiveness and correlate them with both attitudinal and process measures to model the drivers of team effectiveness.

While the challenges involved in collecting team-level data are not insignificant, expending the effort could yield very fruitful data that sheds important insights into economic theories of the firm, productivity, and human capital. For example, in the present case study of globally distributed software development teams, individual- and team-level data enabled a look inside the "black box" of productivity and the role of information technology. Utilizing a framework that has been well tested within the behavioral science literature, the analysis considered both measures of information technology usage that are consistent with standard economic models of productivity as well as a new measure, the importance of face-to-face communication. The results showed the importance of the latter for explaining between-group differences in productivity.

The framework and results presented here provide an avenue for reconsidering economic models of the firm that emphasize highly the importance of understanding the assignment of

decision rights, while emphasizing much less other potentially important factors such as interdependence. With factors such as interdependence and teams included, researchers interested in the economic analysis of firms may increase their ability to explain growth and productivity at the job, product, business unit, and firm levels. A deeper understanding of interdependence and the division of work across time and space offers the promise of improving economic models of outsourcing and offshoring, models that can better capture the full range of costs and benefits of such distributed work. These and other new lines of inquiry that can be derived from the behavioral sciences literatures on job and organization design offer the promise of interesting insights if properly incorporated into future economic theoretical and empirical analyses of the firm and productivity.

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Table 1: Effectiveness and Electronic Communication Importance Correlations - Individual Level Data

	% Effectiv. Quality	% Effectiv. Speed (cycle time, time to market)	% Effectiv. Cost Effectiveness	% Effectiv. Technical Performance	% Effectiv. Innovation	% Effectiv. Customer Satisfaction	% Effectiv. Overall Effectiveness	Importance Email	Importance Telephone	Importance Knowledge Repositories	Importance Collaborative Software	Importance Video Conferencing	Importance Face to Face
% Effectiveness: Speed (cycle time, time to market)	.618* (167)												
% Effectiveness: Cost Effectiveness	.495* (132)	.546* (132)											
% Effectiveness: Technical Performance	.610* (159)	.561* (159)	.681* (131)										
% Effectiveness: Innovation	.556* (151)	.530* (151)	.401* (126)	.680* (147)									
% Effectiveness: Customer Satisfaction	.670* (144)	.565* (143)	.522* (118)	.649* (138)	.571* (136)								
% Effectiveness: Overall Effectiveness	.776* (163)	.729* (160)	.761* (132)	.814* (156)	.725* (149)	.802* (141)							
Importance: Email	.056 (173)	-.009 (167)	-.059 (134)	-.067 (160)	-.056 (150)	.051 (144)	.002 (165)						
Importance: Telephone	.197* (169)	.102 (163)	.102 (130)	.154 (156)	.125 (146)	.088 (140)	.201* (161)	.310* (194)					
Importance: Knowledge Repositories	.145 (164)	.127 (159)	.126 (129)	.084 (153)	.090 (144)	.070 (139)	.138 (157)	.204* (187)	.098 (186)				
Importance: Collaborative Software	.162* (161)	.168* (156)	.220* (127)	.181* (151)	.327* (143)	.212* (138)	.200* (156)	.022 (184)	.251* (182)	.174* (181)			
Importance: Video Conferencing	.110 (163)	-.024 (158)	.132 (128)	.085 (152)	.102 (142)	-.041 (137)	-.005 (156)	-.012 (187)	.267* (186)	.155* (184)	.289* (182)		
Importance: Face to Face	.076 (166)	.030 (160)	-.164 (128)	-.072 (153)	.005 (143)	-.114 (138)	.020 (158)	-.027 (191)	.137 (189)	-.072 (183)	.012 (181)	.139 (184)	
Extent Reliant on Electronic Communication	.109 (167)	.107 (161)	.147 (129)	.160* (154)	.195* (146)	.155 (141)	.169* (160)	.441* (191)	.200* (187)	.078 (180)	.190* (177)	-.044 (180)	-.032 (185)

Numbers of observations are in parentheses. * Correlation is significant at the .05 level.

Table 2: Overall Team Effectiveness and Importance of IT – Individual Level Regressions

	% Effectiveness: Overall Effectiveness	
Importance: Email	-3.55 (3.10)	-3.79 (3.13)
Importance: Telephone	3.56** (1.54)	3.79** (1.60)
Importance: Knowledge Repositories	2.93** (1.48)	2.82* (1.50)
Importance: Collaborative Software	2.64** (1.31)	2.62* (1.35)
Importance: Video Conferencing	-2.57* (1.51)	-2.90* (1.56)
Importance: Face to Face		-.04 (1.36)
Constant	68.05*** (14.48)	69.44*** (15.43)
Adjusted R Square	.066	.062
N	152	149

Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.10

Table 3: Tenure, Distributed Team Experience, and Team Membership – Individual Level Correlations

	Tenure at the Company	Years of Experience Working on Distributed Teams	Number of Teams/Projects Involved With
Years of Experience Working on Distributed Teams	.164** (164)		
Number of Teams/Projects Involved With	.269*** (173)	.475*** (164)	
Number of Teams/Projects Involved With that Operate Primarily Distributed	.247*** (169)	.558*** (163)	.860*** (169)

Numbers of observations are in parentheses. *** p<.01, ** p<.05, * p<.10

Table 4: Team Effectiveness Regressions – Individual Level Data

	Overall Effectiveness	Quality	Speed	Cost Effectiveness	Technical Performance	Innovation	Customer Satisfaction
Trust	4.34*	3.69*	2.73	2.87	4.80**	-.35	2.79
	(2.28)	(2.12)	(2.73)	(3.29)	(2.32)	(3.09)	(2.95)
Integration	-2.88	.53	-3.86	-4.53	-.00	5.66	1.81
	(3.04)	(2.93)	(3.70)	(3.95)	(3.14)	(4.15)	(4.02)
Intergroup Cooperation	2.10	1.08	-1.68	-1.02	.82	6.23***	5.47**
	(1.69)	(1.62)	(2.05)	(2.15)	(1.75)	(2.34)	(2.15)
IT Support	.67	.91	1.40	3.74**	2.44*	.22	1.42
	(1.42)	(1.33)	(1.69)	(1.79)	(1.40)	(1.86)	(1.78)
Resource Commitment	4.44***	2.84**	5.14***	.65	1.95	2.18	3.45*
	(1.48)	(1.41)	(1.76)	(2.00)	(1.49)	(2.02)	(1.85)
Individual & Team Rewards	1.81	2.33	.38	3.42	1.48	1.95	.88
	(1.66)	(1.58)	(1.98)	(2.07)	(1.69)	(2.32)	(2.08)
Measurable Outcomes	1.25	1.20	-.34	3.35	1.62	.84	-.99
	(1.83)	(1.72)	(2.21)	(2.34)	(1.86)	(2.53)	(2.36)
Team Networking	3.96*	2.80	6.89**	1.82	1.22	2.07	5.13*
	(2.29)	(2.14)	(2.69)	(2.88)	(2.31)	(3.12)	(3.03)
Group Leadership	.26	-2.40	2.19	.19	-.03	.21	.95
	(1.67)	(1.54)	(2.08)	(2.20)	(1.76)	(2.30)	(2.21)
Team Cohesion	3.06	2.96	4.24	2.71	2.05	9.24**	-.90
	(2.77)	(2.60)	(3.27)	(3.91)	(2.98)	(3.78)	(3.45)
Constant	12.53	23.25	20.50	37.97**	22.24	-28.76	.34
	(15.53)	(14.61)	(18.90)	(18.95)	(15.96)	(21.03)	(20.09)
Adjusted R Square	.253	.172	.147	.165	.173	.225	.171
N	140	147	142	109	135	126	120

Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.10

Table 5.A: Correlations of Team Effectiveness with Potential Drivers
Aggregated team-level variables

	% Effectiveness: Overall Effectiveness		% Effectiveness: Overall Effectiveness
Importance: Email	-.284 (14)	Trust	.199 (14)
Importance: Telephone	-.233 (14)	Integration	.066 (14)
Importance: Knowledge Repositories	.063 (14)	Intergroup Cooperation	.535** (14)
Importance: Collaborative Software	.351 (14)	IT Support	-.365 (14)
Importance: Video Conferencing	.066 (14)	Resource Commitment	.373 (14)
Importance: Face to Face	.489* (14)	Rewards for Individual & Teamwork Performance	.219 (14)
Extent Reliant on Electronic Communication	.172 (14)	Measurable Outcomes	.702*** (14)
Years of Experience Working on Distributed Teams	.458* (14)	Team Networking	.090 (14)
Percentage of Team Members Co-Located	.385 (14)	Group Leadership	.349 (14)
		Team Cohesion	.277 (14)

Numbers of observations are in parentheses. *** p<.01, ** p<.05, * p<.10

Table 5.B: Team Effectiveness Regressions Using Aggregated Team Variables
(Weighted by number of team members)

	% Effectiveness: Overall Effectiveness				
Importance: Email	-.145 (7.83)				
Importance: Collaborative Software	4.34 (2.62)	4.59 (2.63)	1.63 (1.81)	2.27 (1.56)	
Importance: Face to Face	7.09* (3.75)	6.37 (3.69)	9.31*** (2.17)	6.96** (2.21)	7.81*** (2.03)
Percentage of Team Members Co-Located		.04 (.10)			
Years of Experience Working on Distributed Teams			2.91*** (.76)	1.37 (.96)	2.19** (.79)
Intergroup Cooperation				5.71* (2.80)	5.52* (2.72)
Measurable Outcomes				1.84 (2.77)	
Constant	39.37 (46.17)	38.05** (13.55)	21.88** (9.74)	8.87 (9.90)	14.58 (9.49)
Adjusted R Square	.227	.241	.685	.772	.759
N	14	14	14	14	14

Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.10

Table 6: Interdependence and Accountability Regression
(Aggregated team variables weighted by number of team members)

	Interdependence
Each member of this team is held personally accountable for team results.	.22 (.17)
On this team, we share the responsibility for our deliverables.	.30* (.15)
Constant	2.31*** (.73)
Adjusted R Square	.289
N	14

Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.10

Table 7.A: Intention to Leave Regression – Individual Level Data

Pay Satisfaction	-.05 (.05)
Job Satisfaction	-.61*** (.07)
Career Satisfaction	-.16** (.07)
Development Support	-.17** (.07)
Work-Life Imbalance	.16*** (.05)
Constant	5.54*** (.32)
Adjusted R Square	.526
N	179

Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.10

Table 7.B: Intention to Leave Regressions – Team Level Data
(Aggregated team variables weighted by number of team members)

	Intention to Leave			
Job Satisfaction	-.79** (.28)	-.83*** (.25)	-.90*** (.19)	
Career Satisfaction	-.25 (.36)			
Development Support	.073 (.39)			
Work-Life Imbalance	-.03 (.33)			
% Effectiveness: Overall Effectiveness		-.01 (.02)		-.04** (.02)
Constant	6.39*** (1.47)	6.41*** (1.02)	6.08*** (.72)	5.78*** (1.37)
Adjusted R Square	.515	.591	.617	.239
N	14	14	14	14

Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.10
The correlation between the team-level job satisfaction and overall effectiveness measures is .59, and is significant at the 95% confidence level.

Appendix A: Glossary of survey constructs

❖ TRUST, SHARED UNDERSTANDING, INTEGRATION & COMMUNICATION

TRUST (alpha = .90)

E2. We can count on the people in our team to perform their jobs proficiently.
E10. Team members trust each other to contribute worthwhile ideas.
E12. We can trust that the members of our team have the knowledge and skills to complete their work.
E3. Team members always do what they say they will do.
E5. The people on our team are reliable in their work.
E7. Team members believe that others on our team will follow through on their commitments.

INTEGRATION (alpha = .58)

I2. I try to investigate an issue with others to find a solution acceptable to all.
I3. I try to integrate my ideas with those of others to come up with a decision jointly.

INTERGROUP COOPERATION (alpha = .70)

D12. There is good cooperation between functions.
D15. There is good cooperation between sites.

❖ IT SUPPORT & RESOURCES

IT SUPPORT (alpha = .71)

G3. We receive prompt technical assistance when our computer systems are not working.
G9. Company provides adequate information technology support.

RESOURCE COMMITMENT (alpha = .75)

G1. Company has committed the resources required to do this work.
G5r. * We can't count on continuity of the resources we need. *(reversed)*
G8r. * We have to fight to hold on to the resources we need. *(reversed)*

❖ REWARDS & GOAL SETTING

INDIVIDUAL AND TEAM REWARDS (alpha = .90)

F2. How much pay I receive depends almost entirely on how well I perform my job.
F4. My contributions to this team are rewarded by the company.
F7. My pay level is determined by my individual job performance.
F13. My pay depends on the success of the teams I work with.
F17. Members of this team are rewarded commensurate with their contributions.
F18. Teams are rewarded in line with their performance here.

MEASURABLE OUTCOMES (alpha = .74)

F8. Our team's work has measurable team outcomes.
F16. Our team has quantifiable targets.

❖ NETWORKING, CONFLICT & LEADERSHIP

TEAM NETWORKING (alpha = .59)

F3. My team forms alliances with people in different units at the company to work toward mutual objectives.

F6. My team maintains contacts with people in other parts of the company who can be a useful source of information, resources, and support.

GROUP LEADERSHIP (alpha = .77)

D6. My immediate supervisor attempts to resolve disagreements in a constructive manner.
D7r. *Our leader is hesitant about taking initiative in the group. *(reversed)*
D11r. *Our leader fails to take necessary action. *(reversed)*

TEAM COHESION (alpha = .82)

D1r. * How often do people in your team disagree about opinions regarding the work being done? *(reversed)*
D2r. * How much are personality conflicts evident in your team? *(reversed)*
D3r. * How frequently are there conflicts about ideas in your team? *(reversed)*
D4r. * How much tension is there among members in your team? *(reversed)*
D9. My team attempts to resolve disagreements in a constructive manner.

❖ SATISFACTION, EQUITY & SUPPORT

INTENTION TO LEAVE (alpha = .82)

J7. I plan to look outside the company for a new job within the next year.
J16. It is likely that I will quit my job in the next 12 months.

PAY SATISFACTION (alpha = .94)

J2. I am satisfied with my total compensation.
J12. I am satisfied with my current salary.

PAY EQUITY (alpha = .74)

J1. I believe I am fairly paid compared to my peers at company who are at equivalent job levels and who are equivalently skilled.
J9. I believe I am fairly paid compared to my peers in other companies who are at equivalent job levels and who are equivalently skilled.

JOB SATISFACTION (alpha = .84)

J4. All in all, I am satisfied with my job.
J19. In general, I like working here.

CAREER SATISFACTION (alpha = .84)

J6. I am satisfied with the progress I have made toward meeting my overall career goals.
J13. I am satisfied with the progress I have made toward meeting my goals for advancement.

DEVELOPMENT SUPPORT (alpha = .81)

J15. The company has a good process for mentoring employees.
J20. The company has a good process for identifying employees' development needs.

WORK-LIFE IMBALANCE (alpha = .85)

J3. My work takes up time that I would like to spend with family/friends.
J18. My family/friends dislike how often I am preoccupied with my work while at home.
J21. On the job I have so much work to do that it takes away from my personal interests.

Appendix B: Summary statistics by team														
Team	**Team 1**	**Team 2**	**Team 3**	**Team 4**	**Team 5**	**Team 6**	**Team 7**	**Team 8**	**Team 9**	**Team 10**	**Team 11**	**Team 12**	**Team 13**	**Team 14**
Number of Respondents	**31**	**26**	**33**	**3**	**21**	**2**	**3**	**11**	**10**	**14**	**10**	**6**	**2**	**2**
Where is your immediate supervisor located? *(Choose one response only) (%)*														
■ Co-located with me (same site)	71.0	84.6	66.7	66.7	61.9	100	100	81.8	90.0	64.3	60.0	100	50.0	100
■ Different location, same time zone	0	7.7	15.2	0	19.0	0	0	0	0	35.7	10.0	0	0	0
■ Different location, 1-3 time zones away	0	7.7	6.1	0	14.3	0	0	9.1	10.0	0	10.0	0	0	0
■ Different location, 4-7 time zones away	3.2	0	0	0	0	0	0	9.1	0	0	0	0	0	0
■ Different location, 8-9 time zones away	25.8	0	0	33.3	4.8	0	0	0	0	0	0	0	0	0
■ Different location, 10-12 time zones away	0	0	12.1	0	0	0	0	0	0	0	20.0	0	50.0	0
Approximately what percentage of the members of your team are co-located? (Average %)	69.1	66.7	49.2	45.0	51.7	85.0	95.0	70.9	89.5	44.5	46.5	92.0	50.0	65.0
Do you communicate regularly with members of your team at other sites?														
■ Yes *(%)*	80.6	92.3	90.9	100	85.7	100	33.3	90.9	70.0	78.6	90.0	83.3	100	100
■ No *(%)*	19.4	7.7	9.1	0	14.3	0	66.7	9.1	30.0	21.4	10.0	16.7	0	0
If yes, where are the other members located? *(Choose all that apply) (% Indicating Yes)*														
■ Different location, same time zone	22.6	65.4	42.4	0	38.1	0	0	27.3	20.0	28.6	20.0	16.7	50.0	0
■ Different location, 1-3 time zones away	12.9	46.2	30.3	33.3	42.9	0	0	0	30.0	50.0	20.0	16.7	50.0	0
■ Different location, 4-7 time zones away	9.7	7.7	9.1	0	9.5	50.0	33.3	72.7	10.0	7.1	20.0	16.7	0	50.0
■ Different location, 8-9 time zones away	67.7	26.9	27.3	66.7	23.8	100	0	63.6	10.0	7.1	10.0	33.3	50.0	100
■ Different location, 10-12 time zones away	12.9	34.6	39.4	33.3	57.1	0	33.3	9.1	50.0	42.9	90.0	66.7	100	50.0
Are you actively involved in ensuring that communication occurs between your team and other members of the company?														
■ Yes *(%)*	48.4	73.1	75.8	66.7	66.7	50.0	66.7	72.7	70.0	71.4	80.0	66.7	100	100
■ No *(%)*	51.6	26.9	24.2	33.3	33.3	50.0	33.3	27.3	30.0	28.6	20.0	33.3	0	0
If yes, where are the other members located? *(Choose all that apply) (% Indicating Yes)*														
■ Co-located with me (same site)	16.1	53.8	42.4	33.3	47.6	0	0	27.3	50.0	50.0	10.0	16.7	50.0	100
■ Different location, same time zone	9.7	46.2	33.3	0	23.8	0	0	9.1	10.0	35.7	10.0	16.7	50.0	0
■ Different location, 1-3 time zones away	9.7	30.8	27.3	33.3	38.1	0	0	9.1	10.0	42.9	20.0	16.7	50.0	0
■ Different location, 4-7 time zones away	3.2	11.5	6.1	0	14.3	50.0	0	54.5	10.0	7.1	0	0	0	50.0
■ Different location, 8-9 time zones away	48.4	23.1	39.4	33.3	23.8	50.0	0	45.5	0	14.3	20.0	0	50.0	100
■ Different location, 10-12 time zones away	3.2	42.3	30.3	33.3	28.6	0	66.7	18.2	30.0	21.4	80.0	33.3	100	50.0

Team	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6	Team 7	Team 8	Team 9	Team 10	Team 11	Team 12	Team 13	Team 14
Number of Respondents	**31**	**26**	**33**	**3**	**21**	**2**	**3**	**11**	**10**	**14**	**10**	**6**	**2**	**2**
Work Location: *(%)*														
■ Texas	0	0	0	0	0	0	0	9.1	0	0	0	0	0	0
■ India	0	0	15.2	0	0	0	0	0	0	14.3	40.0	83.3	50.0	0
■ France	0	0	0	0	0	0	0	81.8	0	0	0	0	0	0
■ California 1	16.1	84.6	69.7	33.3	81.0	0	100	0	100	50.0	40.0	16.7	50.0	100
■ Czech Republic	77.4	0	0	66.7	0	0	0	0	0	0	0	0	0	0
■ Norway	0	0	0	0	0	100	0	0	0	0	0	0	0	0
■ California 2	0	0	0	0	0	0	0	0	0	28.6	0	0	0	0
■ Other	6.5	15.4	15.2	0	19.0	0	0	9.1	0	7.1	20.0	0	0	0
How many years of experience do you have working on distributed teams? (Avg.)	4.3	6.1	6.5	3.7	5.7	9.0	4.3	6.2	2.9	5.1	4.5	6.0	7.5	6.0
How long have you been with the company?														
■ 1 year or less	3.2	23.1	9.1	0	0	0	0	0	0	0	0	0	0	0
■ 2-3 years	12.9	11.5	18.2	0	4.8	100	0	18.2	10.0	21.4	30.0	60.0	0	50.0
■ 4-5 years	67.7	53.8	39.4	100	23.8	0	0	36.4	20.0	64.3	10.0	40.0	100	0
■ 6 or more years	16.1	11.5	33.3	0	71.4	0	100	45.5	70.0	14.3	60.0	0	0	50.0
How many teams/projects are you involved with? (Average number of teams)	2.3	2.4	3.4	3.3	3.8	3.0	2.7	3.6	2.6	2.6	2.5	2.6	2.0	1.5
How many of these operate primarily distributed? (Average number of distributed teams)	1.6	1.9	2.7	2.7	2.6	1.0	2.0	2.0	1.6	2.4	1.9	2.0	2.0	1.0

Team	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6	Team 7	Team 8	Team 9	Team 10	Team 11	Team 12	Team 13	Team 14
Number of Respondents	**31**	**26**	**33**	**3**	**21**	**2**	**3**	**11**	**10**	**14**	**10**	**6**	**2**	**2**
Trust, Shared Understanding, Integration & Communication (Response scale: 1=Strongly Disagree, 2=Slightly Disagree, 3=Neither, 4=Slightly Agree, 5=Strongly Agree)														
■ Trust	3.9	4.0	4.2	4.6	4.3	4.6	4.3	4.2	3.9	3.9	4.0	3.9	3.9	4.9
■ Interdependence	3.9	4.3	4.4	4.5	4.4	4.8	4.5	4.1	4.0	4.1	4.4	4.1	4.5	5.0
■ Integration	4.4	4.5	4.5	4.7	4.7	4.5	4.2	4.5	4.6	4.5	4.4	4.0	4.5	4.3
■ Intergroup Cooperation	3.4	3.8	4.0	3.3	4.0	4.3	3.0	3.9	3.4	3.0	3.4	3.8	2.8	4.3
■ Open Communication	4.2	4.3	4.3	4.3	4.6	4.5	3.2	4.7	4.0	4.2	4.2	4.0	4.8	4.5
IT Support & Resources (Response scale: 1=Strongly Disagree, 2=Slightly Disagree, 3=Neither, 4=Slightly Agree, 5=Strongly Agree)														
■ IT Support	3.1	3.1	3.8	4.3	3.6	2.5	3.8	3.8	4.3	3.2	3.2	2.8	3.8	4.3
■ Resource Commitment	2.9	2.8	2.5	2.6	2.4	3.0	2.6	2.9	3.0	1.8	2.4	3.2	2.0	3.3
Satisfaction, Equity & Support (Response scale: 1=Strongly Disagree, 2=Slightly Disagree, 3=Neither, 4=Slightly Agree, 5=Strongly Agree)														
■ Pay Equity	3.0	2.9	3.3	3.8	3.3	2.3	2.8	3.0	2.9	3.0	2.9	2.3	1.5	3.0
■ Pay Satisfaction	2.9	2.9	3.3	2.3	3.3	2.3	2.5	2.9	2.9	3.0	2.5	1.8	1.5	2.0
■ Job Satisfaction	3.7	3.9	3.6	4.0	4.2	4.0	3.3	4.2	3.7	3.0	3.9	3.3	3.0	4.3
■ Satisfaction with Growth Needs	3.2	3.9	3.5	3.0	3.8	3.3	2.7	4.2	3.6	3.0	3.2	3.0	3.0	4.0
■ Career Satisfaction	3.2	3.1	3.2	2.7	3.4	3.3	2.0	3.1	3.2	2.8	3.0	2.6	2.5	2.5
■ Perceived Utilization of Skills	3.2	3.4	2.6	3.0	3.1	3.0	2.0	3.2	3.2	2.6	3.0	2.6	2.8	2.0
■ Development Support	2.6	2.6	2.7	1.8	2.5	3.0	2.3	2.5	2.2	2.3	2.3	3.2	3.3	1.8
Rewards & Goal Setting (Response scale: 1=Strongly Disagree, 2=Slightly Disagree, 3=Neither, 4=Slightly Agree, 5=Strongly Agree)														
■ Rewards for Individual & Teamwork Performance	2.6	2.7	3.1	2.6	2.8	2.7	2.6	3.0	2.4	2.8	2.6	2.9	3.3	2.3
■ Mutual Accountability														
■ "Each member of this team is held personally accountable for team results"	3.0	3.3	3.4	4.0	3.1	3.0	4.0	3.9	2.8	3.5	3.5	3.6	3.5	4.0
■ "On this team, we share the responsibility for our deliverables"	4.0	3.8	4.2	4.3	4.4	4.0	4.7	3.9	3.5	3.3	4.3	4.4	4.0	5.0
■ Measurable Outcomes	3.7	3.6	4.2	4.2	3.7	3.8	3.3	4.0	3.0	3.2	3.4	3.9	3.3	3.0

Team	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6	Team 7	Team 8	Team 9	Team 10	Team 11	Team 12	Team 13	Team 14
Number of Respondents	**31**	**26**	**33**	**3**	**21**	**2**	**3**	**11**	**10**	**14**	**10**	**6**	**2**	**2**
Dissatisfaction with Work (Response scale: 1=Strongly Disagree, 2=Slightly Disagree, 3=Neither, 4=Slightly Agree, 5=Strongly Agree)														
■ Intention to Leave	2.5	2.6	2.9	2.5	2.3	1.8	2.8	2.4	2.7	3.3	3.2	3.3	4.3	2.3
■ Work-Life Imbalance	3.5	3.6	3.2	3.1	3.1	4.0	2.8	3.0	2.8	3.5	3.1	3.8	4.5	2.8
■ Control Over Hours Worked														
■ "I have very little control over the hours I am expected to work"	2.3	2.6	2.9	1.3	2.0	2.5	2.3	3.0	2.1	2.6	2.3	2.3	4.0	3.0
Networking, Conflict & Leadership (Response scale: 1=Strongly Disagree, 2=Slightly Disagree, 3=Neither, 4=Slightly Agree, 5=Strongly Agree)														
■ Team Networking														
■ "My team forms alliances with people in different units at the company to work toward mutual objectives"	3.4	3.6	3.9	4.0	4.0	3.5	3.7	3.7	3.2	3.2	3.6	3.3	4.0	3.5
■ "My team maintains contacts with people in other parts of the company who can be a useful source of information, resources, and support"	3.8	4.1	4.3	4.0	4.5	3.0	3.7	4.1	3.9	4.1	3.5	4.3	4.0	3.5
■ Group Leadership	4.1	3.8	4.0	3.8	4.0	4.7	3.4	4.3	3.6	3.2	3.4	3.5	4.2	4.8
■ Team Cohesion	3.5	3.3	3.6	3.8	3.3	3.9	2.1	3.7	3.4	2.6	3.6	3.2	3.2	3.8
Changes (Response scale: 1=Strongly Disagree, 2=Slightly Disagree, 3=Neither, 4=Slightly Agree, 5=Strongly Agree)														
■ Changing Work Environment	3.4	3.9	4.3	3.5	4.4	3.5	3.5	3.9	4.2	4.0	4.3	3.4	4.0	4.5
■ Team Change														
■ "The members of our team change frequently"	1.9	2.4	3.3	2.3	2.4	1.5	2.0	1.6	2.4	2.4	3.2	1.8	3.0	1.0
■ Changing Work Priorities														
■ "Priorities keep being changed"	3.3	3.7	3.9	3.3	3.9	3.5	4.0	3.6	2.9	4.2	3.7	3.3	3.5	3.0
■ "The people who use my work keep changing their requirements"	3.0	3.1	3.1	2.3	2.9	3.5	3.0	2.8	2.7	2.8	2.9	3.8	2.5	2.5

Team	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6	Team 7	Team 8	Team 9	Team 10	Team 11	Team 12	Team 13	Team 14
Number of Respondents	**31**	**26**	**33**	**3**	**21**	**2**	**3**	**11**	**10**	**14**	**10**	**6**	**2**	**2**
Outcomes (Compared to what is possible (100%), estimate how effective your team has been at each of the following using a percentage.) (Average Percent Effectiveness)														
■ Quality	76.7	79.4	79.1	85.0	80.6	92.0	80.0	85.0	72.8	68.8	71.7	71.0	47.5	80.0
■ Speed (cycle time, time to market, etc.)	77.6	84.7	78.9	65.0	74.3	75.0	92.5	69.5	73.8	58.2	58.8	80.0	77.5	60.0
■ Cost effectiveness	76.7	78.5	83.9	NR	78.0	70.0	NR	80.5	69.3	74.4	77.9	89.0	90.0	80.0
■ Technical performance	75.2	84.9	81.0	90.0	81.9	90.0	80.0	83.2	73.8	73.6	76.1	80.0	70.0	70.0
■ Innovation	70.4	87.0	73.8	90.0	67.7	87.5	40.0	66.0	63.8	47.5	58.8	53.0	90.0	60.0
■ Customer satisfaction	62.6	78.0	67.9	80.0	80.8	90.0	80.0	74.4	68.6	60.0	62.9	74.0	70.0	60.0
■ Overall Effectiveness	73.3	78.0	76.5	75.0	74.6	85.0	75.0	79.1	68.9	61.7	68.9	76.0	70.0	65.0
Degree of Distributed Work (Response scale: 1=Not Important, 2=Somewhat Important, 3=Important, 4=Very Important, 5=Extremely Important) (Average)														
■ Email	4.6	4.6	4.8	5.0	4.9	4.5	5.0	4.6	4.8	4.9	4.7	4.2	4.5	5.0
■ Telephone	3.1	3.1	3.8	3.0	3.2	2.5	4.3	3.5	3.6	3.5	3.7	3.6	4.0	4.0
■ Knowledge repositories (e.g. intranet, shared data bases)	3.4	3.4	3.4	4.0	3.8	3.5	4.0	3.8	3.4	3.5	3.6	3.0	3.5	3.0
■ Collaborative software (e.g. remote presentation software)	2.3	3.2	2.6	3.0	2.2	1.5	2.0	2.5	1.9	2.1	2.3	1.7	4.0	3.0
■ Video conferencing	1.7	1.7	1.8	1.7	1.4	1.0	1.0	2.2	1.1	1.6	2.3	1.5	1.0	2.5
■ Face to face	3.8	3.5	3.3	3.7	3.3	3.5	3.3	4.1	3.6	2.8	3.7	3.6	2.0	2.5
■ To what extent are you reliant on electronic communication to accomplish your collaboration in your team? *(1=Not at all, 2=Some Extent, 3=Moderate Extent, 4=Considerate Extent, 5=Very Great Extent)*	4.1	4.6	4.8	5.0	4.8	5.0	4.7	4.3	4.5	4.5	4.2	3.8	5.0	5.0
Satisfaction with Distributed Work (Response scale: 1=Very Dissatisfied, 2=Dissatisfied, 3=Neither, 4=Satisfied, 5=Very Satisfied) (Average)														
■ Amount of travel	3.2	3.9	3.5	3.7	3.4	2.5	4.0	2.9	4.1	3.3	3.2	3.0	3.0	4.0
■ Flexibility	3.7	4.4	4.2	4.0	4.0	4.0	4.3	4.1	4.8	3.6	4.4	3.6	2.5	4.5
■ Gaining technology skills	3.4	4.0	3.9	4.0	3.9	4.0	3.7	3.8	4.0	3.0	3.8	2.4	2.5	3.5
■ Developing new relationships	3.4	3.9	3.8	3.7	3.8	4.0	3.0	4.2	3.9	2.9	3.8	3.0	4.0	4.0
■ Face to face social opportunities	3.4	3.5	3.4	3.3	3.4	4.0	3.3	3.5	3.7	2.6	3.1	2.6	2.5	4.0
■ Interruptions to personal life	2.9	3.3	3.4	3.3	3.5	3.0	3.3	3.1	3.3	2.9	3.2	2.2	1.5	4.0
■ Visibility of my work	3.0	3.6	3.3	3.3	3.4	3.5	2.7	4.0	3.5	2.9	3.2	2.4	2.5	4.0
■ Technological dependence	3.3	3.6	3.7	2.7	3.9	3.5	3.3	3.7	3.6	3.0	3.6	2.8	3.0	4.0