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MEASURING THE PRODUCTIVITY OF SOFTWARE DEVELOPMENT IN A GLOBALLY DISTRIBUTED COMPANY

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1. Introduction

The trend toward outsourcing that has been emblazoned in the headlines and covers of newspapers and magazines in recent years started with software development. Long before there were reports about accounting and R&D jobs moving from the United States to developing countries such as India and China, software was the story. The predominant reason for the movement of such jobs, including software-related, is labor costs. With large and growing numbers of highly educated and technically adept scientists and engineers in low labor cost countries, and plummeting costs for high speed telecommunications infrastructure that allows for instantaneous communication around the globe, the allure of being able to develop and produce the same product at lower costs has been too tempting for many companies to resist.

This paper documents the experience of one company that has moved extensively to take advantage of lower labor costs for technical talent by spreading its software research and development (R&D) work worldwide. The motivation for the research comes from the Sloan Foundation's desire to better understand productivity differences in the U.S. and Western Europe. After focusing on economy-wide and industry-wide differences in productivity that have left many questions unanswered, the current focus is on within-company differences: Comparing two sites within the same organization that produce similar outputs on different continents, are there productivity differences and, if so, why? The company in question has sites in both the U.S. and France, and thus appeared to be an ideal candidate for studying such differences.

Yet in the case of software development, the work that is done at "remote" sites (i.e. away from the headquarters of a company) often is a component of a larger product, which certainly was the case for the company that formed the basis for this case study. Thus, fully understanding site-level productivity differences requires examining the foundation for the company's decisions to locate work remotely, not just in France but in other sites doing development work for the same set of products on which the U.S. and French teams worked. Thus meant expanding the scope of the study to include sites in the Czech Republic and India.

Because of interdependencies in the components produced at the remote sites, measuring productivity at the site level proved to be quite difficult. Should productivity be measured on the basis of meeting project goals for timeliness, cost and design specifications for a particular component? Should it be measured based on the ability of the project integration teams to get the component to work seamlessly with the software? Is it possible to have site-level productivity measures when the final product is produced from components that are combined across sites?

Because of the challenges involved, the research used measures of self-reported effectiveness measured with respect to group-level objectives, derived from a survey administered to the group members, and from interviews conducted with both managers and employees at the sites. The combination of survey and interview data provides a detailed case study of the issues involved in distributing software R&D work across the U.S., Western Europe, and less-developed countries.

2. Previous literature

While economists are the intended audience for this article, the existing literature on which the research approach is based lies predominantly outside of economics. The reason for this is because economics has only fairly recently begun to model the internal working of organizations, with a primary focus on principal-agent and property rights issues that have implications for organization design, including the boundaries of the firm, and the allocation of decision making and the structuring of incentives within the firm. The decision issue in this case, however, deals primarily with aspects of job design and organization design that address what Lawrence and Lorsch (1967) call the challenges of differentiation and integration: which tasks in the R&D and production process should be differentiated as separate from each other and thus can be located in different parts of the organization both conceptually and potentially also physically, and which tasks need to be integrated and thus are conceptually tightly linked, with potential implications for physical proximity as well.

While a detailed analysis of the economic and behavioral literatures on organization design is well beyond the scope of this paper, it is worth noting how economics does (and does not) address the issue of groups and teams within organizations. Economics typically has focused on issues of where decision making happens in organizations (e.g. centrally or decentralized). While groups are sometimes addressed, the groups that exist within economic models are collections of individuals whose actions aggregate to form a collective output with complete efficiency (Marschak and Radner, 1972; Gibbons, 2003). In particular "all team theoretic models share one key feature: they ignore the interests of the team members – there is no shirking, free-riding, lying, lobbying or strategizing of any kind … the organization is a machine; its parts can be designed (and their interactions controlled)" (Gibbons, 2003, p. 761). Unfortunately, anyone who has worked in groups, including academic departments, knows that these team theoretic models fall far short of describing the range of behaviors that exist and which impede efficiency in the real world.

The behavioral literature, in contrast, has an entire discipline devoted to the study of groups and the difficulties in getting group members to behave in the ways the organization intends. Indeed, there are separate strands that focus, for example, on mandatory participation groups (often called teams) versus voluntary participation groups (called, among other things, social networks and learning networks). In these literatures, a group typically consists of three or more individuals, though two-person groups have been studied.[1]

For an economist, the theoretical justification for studying groups is grounded in specialization. Groups are the answer to the question: What happens when product profit maximization requires individuals to rely closely on the output of others (interdependence) and it is not feasible to assign full accountability for the overall product in piecemeal fashion? The traditional assembly line is a good example of interdependence: the ability of any assembly line worker to complete her task is directly tied to the actions of the worker immediately before her on the assembly line. Yet the traditional assembly line is not designed to assign accountability for the overall product to each individual worker, at least not in a profit maximizing way. The problem is that defects in the overall product quality often are not detected until well after they have occurred in the production process. While an individual worker can be held accountable for performing a very narrow task, such as inserting a screw, the worker cannot be held accountable in a cost effective way if minor deviations in the quality of the work are revealed only after the complete product has been assembled.

Traditional economic models would posit the use of monitoring and monetary incentives to produce the desired outcome. Yet examples from the "real world" show that organizations often deal with the problem by focusing on outcomes that can be measured only at the group level, and which necessitate holding a collection of individuals jointly responsible for the group output. In the case of assembly lines, the team-based approach which was pioneered by the Japanese auto manufacturers has been come a standard adopted in manufacturing around the world. In this approach, groups of workers are jointly responsible and held accountable for assembling parts (or all) of the car in a way that allows for internal quality control within the group that can be accurately verified by others outside the group.

[1] The most common example of two-person groups from the teams literature is airline pilots. If the focus is expanded to include interactions between two individuals who are not peers, then there are entirely separate literatures on relationships that exist both as defined by the formal hierarchy of the firm (supervisor-subordinate relationships) and which emerge voluntarily as a response to the organizational structure and individual's desire for outcomes such as career advancement (mentor relationships).

Other examples include the design of new products, which require input from individuals with various specialized skill sets (engineering, marketing, design, finance, etc.) yet which also can only be measured as successful or not when the final product is produced, and the piloting of large jet planes. In the new product case, if it failures in the marketplace, it may be due to the standalone contributions of individual team members falling short, or to the fact that the individuals did not properly work together (cross-functionally) in the design of the product. The former is a failure of contribution, which can be measured at the individual level; the latter is a failure of cooperation, which can be measured only at the group level and which might not be objectively assessed by someone external to the group. In the jet plane case, the firm does not need, neither is it optimal, to know how the pilot and co-pilot divide the flying tasks, so long as the plane reaches its destination safely. The problem from the firm's perspective is how to create the right set of incentives for the individuals in the group to work together to achieve the outcome. The answer, as the behavioral literature has shown, often is to create a team (Hackman and Oldham, 1980; Hackman, 1987).

According to the behavioral literature, a team is "a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and 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). For economists, the latter two parts of the definition require further explanation. An "intact social entity" is another way of saying that the members of the group have to interact with each other in often fluid ways in order to accomplish the shared objectives. Having to "manage their relationships across organizational boundaries" means that traditional hierarchical approaches to organizing, evaluating and rewarding individuals may not help, and might even hinder, achieving the group's objectives; successful performance may require ignoring or redefining those approaches.

Because economists typically prefer causal models, the prospects of focusing on fluid social interactions and how relationships get managed raises the uncomfortable specter of endogeneity. As such, to the extent that economists have focused on team issues, it has been limited to looking for ways that nontraditional approaches to designing work can improve productivity, of which teams form a core element as in the auto assembly case described above. These nontraditional approaches have been called both high performance work systems and innovative HR approaches, and typically are characterized by bundles of work practices that deviate from the norm found in the job design approach used in traditional assembly lines (for example, Appelbaum and Batt, 1994;

Cappelli and Neumark, 2001; Kochan, Ichniowski, Levine, Olson, and Strauss, 1996; Ichniowski, Shaw and Prennushi, 1997). While there is some debate regarding the size of effects and the impacts on profitability (Cappelli and Neumark, 2001), the economic and behavioral literatures typically find a positive correlation between the use of these bundles of work practices, including teams, and productivity. Beyond this, however, economics largely is silent with respect to the role that teams play in organizations.

One reason why economists have been persuaded regarding the importance of innovative human resource practices and teams is the empirical evidence that comes almost exclusively from manufacturing showing their impact on productivity. Yet the use of teams is pervasive throughout all segments of the economy, not just manufacturing (Cohen and Bailey, 1997). In knowledge based work, which is a growing portion of all jobs, teams are useful in many contexts, including R&D, customer service and sales; and, in the extreme, teams can form the basic organizing principle for an entire organization (Mohrman, Cohen, Mohrman, 1995). In these settings, however, with the exception of sales, the types of productivity measures that economists prefer are difficult to impossible to come by.

The behavioral literature on teams, in contrast, has spent much time wrestling with the issue of measuring productivity in settings where physical output measures are lacking. The most common approach is to survey the team members and others in the firm (supervisors, co-workers, customers, etc.) who are knowledgeable about the team's objectives and performance, asking them to rate the team on an "effectiveness" scale, meaning ability to accomplish the team's objectives. While such measures are more subjective than physical output measures, they have the advantage of enabling the rater to take into consideration organizational and external (market-based) factors that might otherwise confound effective comparison of outcomes for teams operating under different circumstances. Thus a team that is hindered by unforeseen circumstances beyond its control could be rated more leniently than one that had smooth sailing. Similarly, any rating of effectiveness at achieving targets that can be measured using time or other counts (e.g. number of innovations) is done in relative terms, given that the rater should have a sense about how other people and teams should perform under comparable conditions. This means that effectiveness ratings can be very useful for comparing the drivers of performance across teams that have dissimilar and/or multiple objectives.

In addition to the outcome measures, the behavioral literature focuses heavily on identifying the team characteristics and intermediate factors that impact productivity (Gladstein, 1984; Keller, 1986; Campion, Medsker

and Higgs, 1993; Straus and McGrath, 1994; Campion, Papper and Medsker, 1996; Guzzo and Dickson, 1996; Cohen and Bailey, 1997; Janz, Colquitt and Noe, 1997), factors that are not familiar to economists but which should appeal to economists' desires to better understand the black box of group dynamics. These include, but are hardly limited to, the measures used in this paper, which are described in detail below.

In addition to the general factors that impact team effectiveness, the behavioral literature recently has addressed the extent to which teams that operate in traditional settings (i.e. co-located) are different from teams that are geographically dispersed (i.e. one or more member is in a different location). A main focus of this literature is understanding how such geographically dispersed teams divide the work across locations, how they use technology to facilitate communication, and how time and distance impact team effectiveness (Hiltz, Johnson and Turoff, 1986; Valacich, George, Nunamaker and Vogel, 1994; Saphiere, 1996; Graetz, Boyle, Kimble, Thompson and Garloch, 1998; Cappel and Windsor, 2000; McDonough, Kahn and Barczak, 2001; Schmidt, Montoya-Weiss and Massey, 2001; Bell and Kozlowski, 2002; Driskell, Radtke and Salas, 2003; Gibson and Cohen, 2003; Martins, Gilson and Maynard, 2004).

3. Research questions and methods

The research issues addressed in this study are as follows: Are there differences in performance between a company's software development sites located in the U.S., Western Europe and other countries? If so, what drives those differences? Why would a company choose to locate software development work in such locations? And what are the prospects for future software development work in these locations?

To answer these questions a multi-method research approach was used, including interviews, site visits, and a survey at a large multinational technology company. The company, which must remain anonymous, was chosen because two of its business units have software development engineers in the U.S., France, and Norway. Interviews with senior leaders of the firm revealed, however, that in order to understand software development location decisions, additional sites in the Czech Republic and India had to be included because development engineers in those locations worked on product in close cooperation with the engineers in the U.S. and France. The distribution of work across sites within the two business units is as follows:

- California (3 sites) – Business Units A & B
- Texas – Unit B
- France – Unit B

- Czech Republic – Unit A
- Norway – Unit A
- India – Unit B

Interviews with the senior leadership were used first to identify the business units and sites to include in the study. Site visits were conducted in California, Texas, France and the Czech Republic, and included interviews with both managers and development engineers. For the Norway and India sites, telephone interviews were conducted with the site managers. The interview results were used to define the issues to be addressed in the survey, which was subsequently sent anonymously to all development engineers and on-site managers at each site. A copy of the survey and summary statistics for each question is in Appendix B.

Figure 1 shows the model that was used to specify the regressions. It draws heavily from the work of Mohrman, et al. (1995), Gibson and Cohen (2003), and other contributions from the behavioral literature on teams. There are three main parts of the model: (a) the group-related variables that are hypothesized to impact effectiveness ("effectiveness drivers"), (b) measures of the degree of distributed work, and (c) individual attitudes and intention to leave. The latter are included to investigate the impact that having team members located apart from each other may have on employees' satisfaction and desire to remain with the organization, potentially key issues in a knowledge work environment where turnover could negatively impact productivity.

The data needed to estimate the model were collected using an on-line survey that was administered in 2004 to approximately 750-800 team members. The precise number of recipients 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. 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 of the three sites in California, France, the Czech Republic, and India. There were only a small number of respondents from the third site in California, Texas, and Norway, limiting the ability to draw direct inferences about these sites. At least one response was received from fifteen unique teams, with 13 teams providing at least five responses per team.

The survey collected three measures of geographic dispersion: (a) location of the person, (b) distance of the respondents from their immediate supervisors (measured in number of time zones), and (c) whether the respondents regularly communicated with team members elsewhere (also measured in number of time zones). The latter were

used to create dummy variables indicating the furthest distance from team members with whom the person interacted regularly. This person-specific measure of geographic dispersion was preferred to a team-level aggregate for two reasons. First, the interviews revealed that some of the teams included in the survey were predominantly co-located, with only a handful (sometimes only one or two) of members located elsewhere. Second, even within the highly geographically dispersed teams with, for example, no more than half their members at one location and the rest on different continents, many team members, according to the interviews, did not regularly communicate with other team members in far flung locations; this communication was typically reserved for the project lead or other team member playing a "lateral integrating role". Using a person-specific measure of geographic dispersion ensured that these differences in personal experience with distributed work were accurately reflected in the data and analysis.

The attitudinal measures that the survey sought to measure were drawn predominantly from previous research on teams and distributed teams in the behavior literature. 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). The results of the factor and reliability analysis produced the following measures ("constructs") for the regression analyses. 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.

1. Trust: Trust is supposed to be a key factor that measures whether team members can work together effectively in both co-located and distributed contexts.
2. Integration: Measures the extent to which team members that 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 the extent to which the team members perceive 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 the person perceives adequate alignment of rewards at both the individual and group level with both 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.
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.
11. Intention to leave: A precursor to turnover, intention to leave has been shown to be a fairly reliable predictor in a number of settings.
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 constant 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.

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.

4. Results

A. *Why did the company put software development work in these locations?*

A.1: *Interview results*: The interviews with the firm's senior leaders indicated that seeking lower labor costs for software development work has been one of the reasons for moving such work overseas, though proximity to customers and acquisitions strategies played comparable if not larger roles. The company's headquarters is in the U.S. and much of its U.S.-based software development work is located in traditional centers of technology industry concentration, including the Bay Area in Northern California, Massachusetts, and Texas. When the company first set up operations in Western Europe, the initial offices had software sales and customer support responsibility only. In subsequent years some of the end-stage development work was moved to Western Europe, including offices in France and Ireland. This included localization, which means adapting the software program to meet local language and other preferences. In keeping with the principles of distributed work, these end-stage processes are self-contained in the sense that they typically can be performed by standalone teams in the target countries with equal or better performance than if such work were performed closer to headquarters in the U.S.

The success with moving end-stage software development work to Western Europe suggested to the firm's senior leadership that it might be feasible to move some of the earlier-stage development work as well. Aside from proximity to customers, the leadership perceived labor quality that was comparable to that available in the U.S., with labor costs that were below those in the U.S.[2] The perceptions of labor quality came both from organic growth (hiring of additional software development engineers to work on existing products) and from acquisitions. In the case of Norway and the Czech Republic, part of the reason for the company's presence was due to acquiring companies based in those countries that had software products the U.S. company wanted to integrate into its own product offerings. In these cases, opening and maintaining "official" company operations offered the greatest chance of retaining the acquired firms' founders and employees who were critical to the success of the integrated products. Thus expansion in Western and Eastern Europe occurred both incrementally and in discrete jumps.

Incremental expansion only continued, however, as the company became adept at managing the work being done remotely. In each case as a new site was established abroad, there was an initial learning curve regarding the best way to set up the technology and communications infrastructure, learn the local laws and labor regulations, and iron out the kinks of managing work that was being conducted many time zones away. Consistent with the literature on distributed teams (Gibson and Cohen, 2003), the company learned the hard way the benefits of bringing team members together for face-to-face (FTF) meetings to establish trust, shared understanding and integration among members working across large time, space and culture differences, and the need for ongoing FTF work by both team members and managers at regular intervals, which is accomplished by bringing people together at both the U.S. and abroad sites, depending on the stage of work and other considerations such as enabling the abroad team members to develop relationships with senior leaders in the U.S., which both facilitates the team achieving its objectives and the individuals' ability to advance their careers within the firm.

With the perceived successful operation of software development sites in Western Europe, the company gained confidence that it could use its expertise in distributed software development to pursue even lower labor costs in India and China. In both of those cases, labor costs appear to have been more of a primary motivation than they were for the expansions into Western Europe. Interestingly, though, anecdotal evidence suggests that with the rapid expansion of outsourcing and software development work, particularly in India, labor costs have been rising much

[2] Historical data on labor cost differences was not available. However, the senior leaders' recollection is that the labor cost differences in the early years produced savings that were significant though nowhere near as much as the

faster there in recent years than in the U.S. or Western Europe, eroding some, though hardly all of the labor cost advantages. This apparently was the case with the site in Ireland, which started out with lower labor costs than the U.S. but by the time of the study had labor costs within 90 percent of the U.S.

B. *Are there differences in performance between the company's software development sites located in the U.S., Western Europe and other countries?*

B.1. *Interview results*: Labor cost differences are only one factor, albeit an important one, that impacts site performance. The other main benefit that emerged from the interviews was access to talent (skills) that are comparable or even better than the average talent available in the U.S. Countering these advantages are the higher non-labor costs from doing work over large distances. Because all software components produced abroad by this company eventually have to be integrated back into the components produced in the U.S., the costs of coordinating and integrating the work produced at remote sites is greater than at sites in the U.S.

A key factor in the higher integration costs is lack of overlap of the standard workday. For the Western European and California sites, there is only about one hour of overlap at the end of the day in Europe and beginning of the day in California, during which all synchronous problem solving has to take place. This creates a significant burden on the team members who play the integrating roles, which can impact their job and career satisfaction, not to mention their productivity. The story that emerged from the interviews is that these employees do whatever it takes to get the work done (including sacrificing time with family and friends to work either late at night or early in the morning), but that they are subject to potentially greater burnout and turnover than the other employees.

Despite these difficulties, employees on both sides of the Atlantic who discussed their frustrations with the small overlap in the working day also said that they managed to work through the problems, finding a manageable equilibrium for the most part. Those on teams with members in California and India, in contrast, had no such equilibrium: the time difference is 12 hours, meaning that there is absolutely no overlap in the standard workday. The interviews suggested that these employees would be susceptible to the biggest imbalances between work and non-work demands, with the highest potential for dissatisfaction and turnover.

B.2: *Survey results*: The results from analyzing the drivers of team effectiveness are presented in Table 1. In each case the ten effectiveness drivers are regressed on the effectiveness measure in the first stage, and then the

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current labor cost differences with Eastern Europe (approximately 50 percent of U.S. labor costs), India and China (both approximately 33 percent of U.S. labor costs).

indicators for degree of collaboration across time zones, distance from supervisor, and location are entered in the second stage.

The results in Table 1 indicate that the relationships between the effectiveness drivers and (perceived) outcome measures is consistent with the existing literature on teams. In particular, trust, intergroup cooperation, IT support, resource commitment, team networking, and team cohesion all are statistically significantly positively related to at least one of the effectiveness measures. All of the coefficients are either statistically significantly positive or not significantly different from zero; none are negative and statistically significant.

The indicators for geographic dispersion and location do not provide much support for the notion that having the software development work located in far-flung locations negatively impacts team effectiveness. Having to regularly communicate with team members either 4-7 or 8 or more time zones away does not appear to impact effectiveness, relative to those who do not regularly communicate with team members so far away. Similarly, having a supervisor 8 or more time zones away also does not differentiate effectiveness, relative to those who are co-located with their supervisors. Interestingly, those whose immediate supervisor is at a different location but in the same time zone (typically those at the California sites) report lower overall effectiveness, quality, speed, innovation, and customer satisfaction. As the results in Table 2 show, this most likely is because these same people report worse IT support and resource commitment, whereas team members in both the Czech Republic and in India report higher resource commitment than the software engineers located at the company's headquarters.[3] With the company focusing so heavily on trying to make things work for team members located on different continents, the results in Tables 1 and 2 suggest that they may be missing an opportunity to improve performance by mending the fences that are much closer to home (i.e. those who are in the same time zone but not located at headquarters).

Very few of the location indicators are significant in Table 1. Team members in France[4] report lower speed and innovation, which is consistent with the interviews. Some of the U.S. based leadership expressed high degrees of satisfaction with the French sites' quality, but low satisfaction with their responsiveness. The Czech Republic site, in contrast was viewed as having software engineers who were less complacent, more "hungry" to succeed regardless of the personal sacrifices that might be needed. Perhaps in part because of this, the respondents at the

[3] Note, however, that this effect only exists for those who are located in India and the Czech Republic who do not have to communicate on a regular basis with team members in the U.S. – the coefficients on communicating with team members both 4-7 and 8 or more time zones away are negative and significant.

[4] The indicator in the tables is for team members in either France or Norway, however the vast majority of these are in France so those respondents undoubtedly dominate the estimated relationships.

Czech Republic site reported higher cost effectiveness. They also, however, reported lower customer satisfaction; their drive to succeed within the cost parameters thus may produce unintended costs downstream with lower sales. This story is consistent with one senior leadership interviewee who expressed frustration at what appeared to be an ongoing need to have senior technical experts in the U.S. intervene in the Czech Republic team's work to fix problems that occurred with higher frequency than other sites such as France.

At this point it is worth noting the impact of both IT and HR practices in impacting effectiveness for these teams. For IT support, at first glance it may seem surprising that variation in this is related to effectiveness only on the cost and technical performance fronts. Yet this company like most strives for consistency in practices across sites within the same business unit; if a certain level of technology support is provided in the U.S. because that is what it takes to get the job done, the expectation of the company's leaders is that the same level of support will be provided at all sites. Thus within-company analyses such as these often suffer from a range restriction problem: most employees should experience much lower variation in practices within a company than if we were to compare employees across companies.

For HR practices the range restriction issue may be less stark, but still important. Range restriction is an issue because the desire to promote common ways of communicating and rewarding performance lead to consistency of HR practices across sites. The need to do some adaptation to local preferences, however, has the potential to introduce more variation in HR practices than might be expected for IT support. For the French site, in particular, the national restrictions on firing have significantly impacted how the company uses the site. Initially there was no expectation that a downturn in business would lead to headcount adjustment problems in France. Yet this is precisely what happened a few years prior to the study, when the company tried to remove costs at many of its sites around the globe in response to a business downturn. The difficulties in laying off software engineers in France led the company to manage the site differently, focusing on keeping headcount the same or even falling through natural attrition. Yet despite this emphasis, the French site continues to be given highly technical components of the work in no small part because of the stability of the employees and their high level of expertise. Thus both IT and HR practices appear to matter, but in ways that don't necessarily impact measured productivity at a single point in time, as these data do.

Moving to the attitudinal data, Table 3 reports the correlation of overall team effectiveness with the intention to leave, satisfaction, perceived development support, and work-life imbalance variables. As expected, and

consistent with previous research, there is a reasonably large positive correlation with satisfaction and development support, and negative correlation with intention to leave. As Lawler (200x) has argued, these results are consistent with mutually reinforcing HR practices and employee actions: a supportive environment creates the conditions for effective performance, which makes it easier for the firm to spend money and take the time to do things to keep its employees happy, which improves retention, which helps performance, etc. This perspective is further supported by the results in Table 4, which show a strong negative correlation between intentions to leave the firm and satisfaction, development support, and work-life balance (column 1), regardless of how geographically dispersed the team members are (column 2).

Finally, the results in Table 5 indicate that geographic dispersion of team members is not related to satisfaction, development support, or work-life imbalance. The one difference that stands out is for team members located in India, who reported lower pay satisfaction and job satisfaction. This is consistent with anecdotes that wages are rising relatively fast in India. The results indicate that the firm's HR policies regarding pay may not be responding quickly enough to changes in the external environment.

C. *What are the prospects for future software development work in these locations?*

The survey results indicated that, on average, there are not many differences in reported effectiveness for work that is done at the different sites. This in large part likely is due to the interdependent nature of work that takes place not just at those sites, but in the U.S. as well. Given the company's strong preference for making overall product decisions and doing the final integration work in the U.S., it is hard to foresee a scenario in which such integration costs could be lowered without a major shift in the way overall product development decisions are made. Thus to the extent that the company continues to do this kind of software development work in general, the data and interviews suggest that there is no reason to expect a pullback from working in these regions.

That said, the desire to seek lower labor costs suggests that future growth in software engineering headcount is liable to take place, particularly in the Czech Republic, India and China. On the one hand, at the time of the study the Czech Republic's labor costs were about one half those in the U.S., whereas the labor costs in India and China were lower, at about one third those in the U.S. Countering the lower labor costs of India and China, however, the Czech Republic is closer to the U.S. which makes synchronous communication much easier to do, even if it's concentrated at the end of the day in Europe and beginning of the day in the U.S. This suggests that the type of work that is done in the Czech Republic may have greater complexity than the work that is done in India or

China – unless, that is, the company moves toward allowing complete pieces of software to be developed in those sites that are the furthest removed from headquarters. In France, the prospects appear to be continued work, but no expansion in the number of software engineers, and thus a low or diminished profile with respect to the company's overall software development efforts.

5. Conclusions

This study has found evidence in favor of the following conclusions:

1. International differences in productivity don't appear to be a big factor in explaining cross-sectional patterns of where software development work is located.
2. To the extent that geographic dispersion matters, spreading work out to the point where there is no overlap in the standard workday may put limits on the productivity of individual team members. However, the teams as a whole appear capable of dealing with such pressures without significantly impacting the teams' overall effectiveness.
3. Even though the data did not reveal average productivity differences across sites, this says nothing about marginal productivity differences. Given a set of strengths and weaknesses associated with putting software development work in various sites, one would expect the firm to distribute the work in such a way that average productivity (and contributions to profitability) are equalized. Without a natural experiment that varies the type of work in a controlled way it may be very difficult to detect marginal productivity differences.

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Figure 1: Distributed Team Effectiveness Model

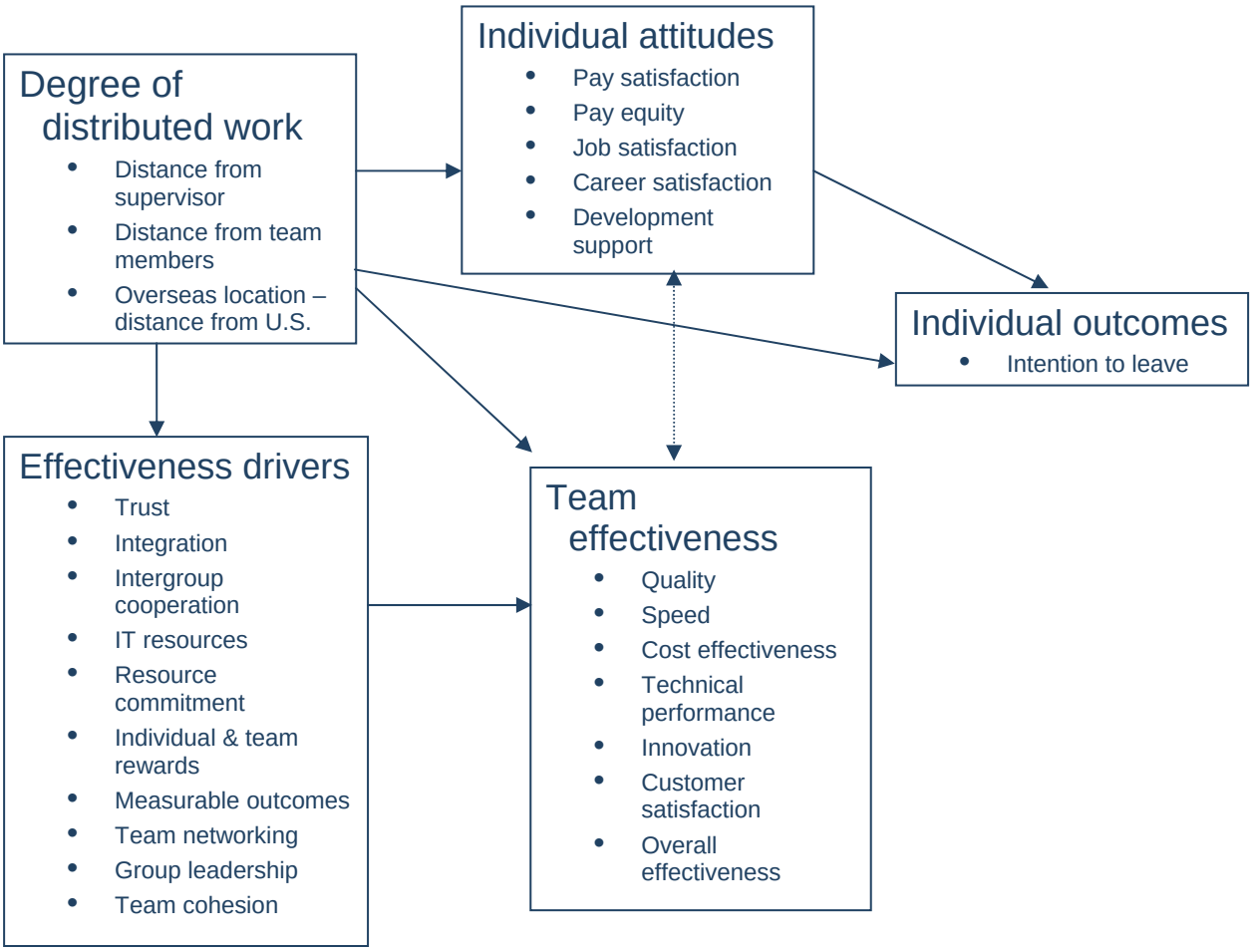

Table 1: Team Effectiveness Regressions

	Overall Effectiveness		Quality		Speed		Cost Effectiveness		Technical Performance		Innovation		Customer Satisfaction	
Trust	4.34*	5.12**	3.69*	4.18*	2.73	4.24	2.87	4.02	4.80**	5.14**	-.35	1.57	2.79	4.22
	(2.28)	(2.39)	(2.12)	(2.21)	(2.73)	(2.66)	(3.29)	(3.44)	(2.32)	(2.43)	(3.09)	(3.19)	(2.95)	(3.07)
Integration	-2.88	-3.15	.53	.13	-3.86	-5.36	-4.53	-4.12	-.00	-.94	5.66	3.82	1.81	-.11
	(3.04)	(3.25)	(2.93)	(3.09)	(3.70)	(3.69)	(3.95)	(4.20)	(3.14)	(3.33)	(4.15)	(4.34)	(4.02)	(4.31)
Intergroup Cooperation	2.10	3.09*	1.08	2.21	-1.68	-1.37	-1.02	-.14	.82	1.48	6.23***	6.35**	5.47**	5.89**
	(1.69)	(1.82)	(1.62)	(1.71)	(2.05)	(2.04)	(2.15)	(2.25)	(1.75)	(1.87)	(2.34)	(2.46)	(2.15)	(2.27)
IT Support	.67	.28	.91	.45	1.40	.31	3.74**	3.60*	2.44*	1.84	.22	-1.34	1.42	.24
	(1.42)	(1.51)	(1.33)	(1.42)	(1.69)	(1.69)	(1.79)	(1.93)	(1.40)	(1.50)	(1.86)	(1.96)	(1.78)	(1.88)
Resource Commitment	4.44***	3.55**	2.84**	2.08	5.14***	4.08**	.65	-.48	1.95	.88	2.18	1.41	3.45*	4.63**
	(1.48)	(1.65)	(1.41)	(1.60)	(1.76)	(1.84)	(2.00)	(2.16)	(1.49)	(1.65)	(2.02)	(2.21)	(1.85)	(2.09)
Individual & Team Rewards	1.81	1.53	2.33	2.43	.38	1.00	3.42	2.81	1.48	2.05	1.95	2.60	.88	1.16
	(1.66)	(1.73)	(1.58)	(1.64)	(1.98)	(1.94)	(2.07)	(2.17)	(1.69)	(1.78)	(2.32)	(2.36)	(2.08)	(2.17)
Measurable Outcomes	1.25	1.64	1.20	1.07	-.34	-.47	3.35	3.98	1.62	1.30	.84	1.45	-.99	-.99
	(1.83)	(1.94)	(1.72)	(1.81)	(2.21)	(2.17)	(2.34)	(2.51)	(1.86)	(1.98)	(2.53)	(2.62)	(2.36)	(2.45)
Team Networking	3.96*	3.43	2.80	2.57	6.89**	6.51**	1.82	1.47	1.22	1.05	2.07	.50	5.13*	3.81
	(2.29)	(2.39)	(2.14)	(2.22)	(2.69)	(2.61)	(2.88)	(3.04)	(2.31)	(2.43)	(3.12)	(3.15)	(3.03)	(3.12)
Group Leadership	.26	.12	-2.40	-2.56	2.19	2.29	.19	.21	-.03	.12	.21	.86	.95	1.62
	(1.67)	(1.74)	(1.54)	(1.58)	(2.08)	(2.00)	(2.20)	(2.29)	(1.76)	(1.82)	(2.30)	(2.32)	(2.21)	(2.29)
Team Cohesion	3.06	1.95	2.96	1.10	4.24	4.21	2.71	1.40	2.05	1.28	9.24**	9.04**	-.90	-2.18
	(2.77)	(2.94)	(2.60)	(2.79)	(3.27)	(3.29)	(3.91)	(4.11)	(2.98)	(3.15)	(3.78)	(3.94)	(3.45)	(3.63)
Supervisor located in same time zone, but different location		-8.47*		-8.04*		-15.0***		-7.61		-7.97		-18.4***		-10.18*
		(4.80)		(4.77)		(5.61)		(6.06)		(4.96)		(6.78)		(6.02)
Supervisor located 1-3 or 4-7 time zones away		.11		-5.97		-19.6***		4.36		.10		-1.86		-4.15
		(6.61)		(6.35)		(7.48)		(7.96)		(6.59)		(8.27)		(7.89)
Supervisor located 8-9 or 10-12 time zones away		.54		-2.67		-5.23		-.90		-8.81		-4.27		9.19
		(6.27)		(5.68)		(6.73)		(7.99)		(6.35)		(7.72)		(7.79)
Distance of Communication with Team Members: 4-7 time zones away		-.75		.50		6.09		1.68		-5.16		-10.32		-11.13
		(10.03)		(9.68)		(11.42)		(11.83)		(9.98)		(12.67)		(11.95)
Distance of Communication with Team Members: 8 or more time zones away		-3.68		-2.53		-5.37		-3.98		-4.05		-1.69		-1.75
		(3.76)		(3.65)		(4.44)		(4.81)		(3.81)		(5.18)		(5.04)
West Europe (France or Norway)		-1.01		5.66		-14.64*		-1.94		-1.74		-16.26*		-6.27
		(6.30)		(6.46)		(7.60)		(7.59)		(6.28)		(8.43)		(9.44)
East Europe (Czech Republic)		4.97		6.88		2.66		11.19*		6.37		.50		-11.42*
		(5.40)		(4.98)		(5.85)		(6.60)		(5.38)		(6.86)		(6.79)
India		3.00		-.51		1.34		8.58		2.79		-4.62		-10.57
		(6.09)		(5.75)		(6.85)		(7.33)		(6.15)		(7.78)		(8.43)
Small Change in Product Life Cycle		2.54		3.45		-11.27**		3.31		1.02		-3.33		8.91
		(4.56)		(4.24)		(4.98)		(5.48)		(4.55)		(6.28)		(5.56)
Constant	12.53	18.97	23.25	32.50*	20.50	35.23*	37.97**	38.00*	22.24	33.79*	-28.76	-15.54	.34	12.53
	(15.53)	(17.88)	(14.61)	(16.64)	(18.90)	(20.51)	(18.95)	(21.55)	(15.96)	(18.06)	(21.03)	(24.10)	(20.09)	(23.78)
Adjusted R Square	.253	.234	.172	.162	.147	.241	.165	.163	.173	.157	.225	.250	.171	.170
N	140	140	147	147	142	142	109	109	135	135	126	126	120	120

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

Table 2: Effectiveness Drivers Regressions

	Trust	Integration	Intergroup Cooperation	IT Support	Resource Commitment	Individual & Team Rewards	Measurable Outcomes	Team Networking	Group Leadership	Team Cohesion
Supervisor located in same time zone, but different location	.37** (.18)	-.04 (.11)	.24 (.23)	-.93*** (.24)	-.68*** (.23)	-.04 (.24)	-.05 (.23)	.02 (.17)	-.03 (.24)	-.02 (.16)
Supervisor located 1-3 or 4-7 time zones away	.07 (.24)	.13 (.15)	.11 (.30)	-.34 (.31)	.47 (.30)	-.12 (.32)	-.33 (.30)	.23 (.23)	.11 (.31)	-.04 (.20)
Supervisor located 8-9 or 10-12 time zones away	-.29 (.24)	.03 (.14)	-.16 (.28)	-.16 (.31)	-.60** (.30)	.38 (.30)	-.42 (.29)	.26 (.22)	-.09 (.30)	-.05 (.20)
Distance of Communication with Team Members: 4-7 time zones away	.35 (.36)	-.00 (.23)	.59 (.45)	-.19 (.47)	-.88* (.45)	.56 (.52)	-.30 (.46)	-.24 (.34)	.82* (.47)	.15 (.31)
Distance of Communication with Team Members: 8 or more time zones away	.20 (.14)	-.07 (.09)	.14 (.17)	-.32* (.18)	-.52*** (.17)	.09 (.19)	-.07 (.17)	-.02 (.13)	.15 (.18)	.05 (.12)
West Europe (France or Norway)	.30 (.24)	-.09 (.15)	.20 (.29)	.09 (.31)	.40 (.29)	-.06 (.30)	.39 (.29)	-.10 (.22)	.70** (.30)	.44** (.21)
East Europe (Czech Republic)	.14 (.19)	-.23* (.12)	-.17 (.23)	-.38 (.25)	.59** (.24)	-.21 (.25)	.10 (.24)	-.37** (.18)	.22 (.24)	.40** (.16)
India	.14 (.22)	-.40*** (.13)	.28 (.25)	-.36 (.29)	.72** (.29)	.20 (.29)	.40 (.27)	-.28 (.20)	.10 (.26)	.17 (.18)
Constant	3.86*** (.13)	4.59*** (.08)	3.51*** (.17)	3.92*** (.18)	2.91*** (.17)	2.70*** (.18)	3.77*** (.17)	3.92*** (.12)	3.67*** (.18)	3.27*** (.11)
Adjusted R Square	.044	.047	-.008	.062	.133	-.010	-.001	-.007	.009	.017
N	189	193	194	189	189	186	191	193	194	191

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

Table 3: Correlations of Overall Team Effectiveness and Individual Attitudes

Pearson (N)	**Overall Team Effectiveness**	Intention to Leave	**Pay Satisfaction**	**Job Satisfaction**	Career Satisfaction	Development Support
Intention to Leave	-.22*** (160)					
Pay Satisfaction	**.09 (160)**	-.33*** (190)				
Job Satisfaction	**.37*** (161)**	-.67*** (192)	**.33*** (190)**			
Career Satisfaction	.22*** (161)	-.48*** (190)	.37*** (191)	.49*** (191)		
Development Support	.31*** (160)	-.45*** (191)	.32*** (189)	.44*** (192)	.49*** (190)	
Work-Life Imbalance	.09 (160)	.19*** (191)	-.11 (189)	-.03 (192)	-.05 (190)	-.05 (191)

* Correlation is significant at the .10 level.
** Correlation is significant at the .05 level.
*** Correlation is significant at the .01 level.

Table 4: Intention to Leave Regressions

Pay Satisfaction	-.05 (.05)	-.03 (.06)
Job Satisfaction	-.61*** (.07)	-.62*** (.08)
Career Satisfaction	-.16** (.07)	-.13* (.07)
Development Support	-.17** (.07)	-.19*** (.07)
Work-Life Imbalance	.16*** (.05)	.13** (.06)
Supervisor located in same time zone, but different location		-.32 (.20)
Supervisor located 1-3 or 4-7 time zones away		.12 (.26)
Supervisor located 8-9 or 10-12 time zones away		-.13 (.25)
Distance of Communication with Team Members: 4-7 time zones away		-1.06*** (.37)
Distance of Communication with Team Members: 8 or more time zones away		.09 (.16)
West Europe (France or Norway)		-.09 (.26)
East Europe (Czech Republic)		-.06 (.21)
India		-.02 (.27)
Organization Tenure		-.09 (.08)
Years of Experience Working on Distributed Teams		.02 (.02)
Constant	5.54*** (.32)	5.76*** (.42)
Adjusted R Square	.526	.540
N	179	179

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

Table 5: Individual Attitudes Regressions

	Pay Satisfaction	Job Satisfaction	Career Satisfaction	Development Support	Work-Life Imbalance
Supervisor located in same time zone, but different location	.56** (.28)	-.27 (.22)	.36 (.27)	.05 (.25)	-.07 (.26)
Supervisor located 1-3 or 4-7 time zones away	.46 (.37)	.60** (.29)	.02 (.35)	-.53 (.33)	-.19 (.34)
Supervisor located 8-9 or 10-12 time zones away	.28 (.34)	.33 (.27)	.29 (.33)	.37 (.31)	.52 (.32)
Distance of Communication with Team Members: 4-7 time zones away	-.25 (.57)	.27 (.44)	.47 (.53)	-.11 (.50)	-.34 (.52)
Distance of Communication with Team Members: 8 or more time zones away	-.30 (.21)	.19 (.17)	-.11 (.20)	-.30 (.19)	.01 (.19)
West Europe (France or Norway)	-.40 (.37)	.30 (.29)	.11 (.34)	.12 (.32)	.06 (.33)
East Europe (Czech Republic)	-.19 (.29)	.04 (.23)	.09 (.27)	-.01 (.25)	-.19 (.26)
India	-1.06*** (.31)	-.43* (.26)	.07 (.30)	.28 (.30)	-.15 (.30)
Constant	3.20*** (.21)	3.58*** (.16)	3.10*** (.19)	2.71*** (.18)	3.31*** (.18)
Adjusted R Square	.082	.036	-.020	.005	-.019
N	193	193	193	192	192

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

Appendix A: Glossary, Scales and Reliabilities

❖ 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.

A. DETAILS OF THE WORK

1. Please select your team: (NOTE: If you are on multiple teams, please answer this survey regarding the team on which you spend most of your time.) *(required)*

2. At what location do you primarily work? *(required)*

3.9%	Texas	**17.2%**	California site #2
10.8%	India	**1.0%**	Norway
4.9%	France	**2.5%**	California site #3
37.7%	California site #1	**9.3%**	Other (please specify): _____
12.7%	Czech Republic		

3. What is your main function on this team? *(required)*

42.6%	Development Engineer	**1.5%**	Technology Specialist
3.4%	Release Engineer	**4.4%**	Architect
2.5%	Human Interface Engineer	**10.3%**	Engineering Manager
6.4%	Sustaining Engineer	**2.5%**	QA Manager
12.3%	Quality Engineer	**0%**	Documentation Manager
0%	Localization Engineer / Testing	**1.5%**	Product Manager
1.0%	Marketing	**7.8%**	Other (please specify): _____
3.9%	Documentation		

4. How long has this team been in existence? *(round off to nearest number of months)* **3.73** years

5. How long have you been on this team? *(round off to nearest number of months)* **2.65** years

6. At what stage in the product life cycle is your team's work? (choose one response only)

- **24.1%** First release / entirely new product
- **7.0%** Updating an existing product with minor changes
- **62.8%** Updating an existing product with major changes
- **6.0%** Sustaining an existing product with little to no changes
- **0%** End of product life cycle / Ending an existing product

7. Where is your immediate supervisor located? (choose one response only)

72.8%	Co-located with me (same site)	**1.5%**	Different location, 4-7 time zones away
10.9%	Different location, same time zone	**5.0%**	Different location, 8-9 time zones away
5.4%	Different location, 1-3 time zones away	**4.5%**	Different location, 10-12 time zones away

8. Approximately what percentage of the members of your team are co-located? ..... **61.2 %**

9. Do you communicate regularly with members of your team at other sites?.....**83.8%** Yes **16.2%** No
If yes, where are the other members located? (choose all that apply)

34.3%	Different location, same time zone	**34.8%**	Different location, 8-9 time zones away
30.4%	Different location, 1-3 time zones away	**42.6%**	Different location, 10-12 time zones away
15.2%	Different location, 4-7 time zones away		

10. Are you actively involved in ensuring that communication occurs between your team and other members of the company?.....**67.3%** Yes **32.7%** No
If yes, where are the other members located? (choose all that apply)

37.3% Co-located with me (same site)

25.0% Different location, same time zone

25.5% Different location, 1-3 time zones away

13.2% Different location, 4-7 time zones away

30.4% Different location, 8-9 time zones away

31.9% Different location, 10-12 time zones away

B. OUTCOMES

Compared to what is possible (100%), estimate how effective your team has been at each of the following using a percentage. For example, if Team X meets 80% of its quality goals compared to what is possible, enter 80% in the first item. If they do not apply, leave blank.

		Percent Effectiveness
1.	Quality	**77.9** %
2.	Speed (cycle time, time to market, etc.)	**75.0** %
3.	Cost effectiveness	**79.1** %
4.	Technical performance	**80.1** %
5.	Innovation	**71.3** %
6.	Customer satisfaction	**72.3** %
7.	Overall effectiveness	**75.0** %

C. DEGREE OF DISTRIBUTED WORK

For items 1-6, rate using two columns: How important are each of the following technologies to getting your work done in this team? In the second column, indicate the % of your time spent on each technology (the total across all six technologies should equal 100%).

		Not Important	Somewhat Important	Important	Very Important	Extremely Important	Mean	% of Time Spent on Each Technology
1.	Email	**0**	**0**	**3.5**	**19.7**	**76.8**	**4.73**	**48.5%**
2.	Telephone	**5.2**	**11.9**	**34.5**	**34.5**	**13.9**	**3.40**	**12.9%**
3.	Knowledge repositories (e.g. intranet, shared data bases)	**4.3**	**14.4**	**24.1**	**41.7**	**15.5**	**3.50**	**14.4%**
4.	Collaborative software (e.g., remote presentation software)	**22.8**	**37.0**	**18.5**	**15.8**	**6.0**	**2.45**	**6.8%**
5.	Video conferencing	**58.3**	**19.8**	**14.4**	**6.4**	**1.1**	**1.72**	**2.6%**
6.	Face to face	**3.1**	**17.8**	**31.4**	**24.1**	**23.6**	**3.47**	**20.6%**
								Total 100%

7. To what extent are you reliant on electronic communication to accomplish your collaboration in your team?

0	0.5	9.8	25.4	64.2	**4.53**
Not At All	Some Extent	Moderate Extent	Considerate Extent	Very Great Extent	**Mean**

D. PROCESSES

Please respond to the following regarding the processes inside your team:

		Never	Rarely	Sometimes	Often	Constantly	Mean
1.	How often do people in your team disagree about opinions regarding the work being done?	**1.0**	**17.9**	**48.0**	**29.1**	**4.1**	**3.17**
2.	How much are personality conflicts evident in your team?	**5.6**	**49.2**	**33.0**	**8.6**	**3.6**	**2.55**
3.	How frequently are there conflicts about ideas in your team?	**3.6**	**23.0**	**51.0**	**19.4**	**3.1**	**2.95**
4.	How much tension is there among members in your team?	**10.3**	**49.2**	**30.8**	**7.2**	**2.6**	**2.43**
5.	My team's dealings with other teams go smoothly	**4.1**	**10.2**	**11.7**	**47.4**	**26.5**	**3.82**

6.	My immediate supervisor attempts to resolve disagreements in a constructive manner	**4.1**	**8.6**	**9.6**	**32.0**	**45.7**	**4.07**
7.	Our leader is hesitant about taking initiative in the group.....	**38.1**	**28.4**	**11.3**	**15.5**	**6.7**	**2.24**

D. PROCESSES (continued)

Please indicate the extent to which you agree or disagree with the following statements:	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree	Mean
8. Members are free to be assertive about what they think and feel	1.5	5.1	7.7	36.4	49.2	4.27
9. My team attempts to resolve disagreements in a constructive manner	2.1	6.2	8.7	46.7	36.4	4.09
10. When there's a problem, members talk about it.	1.0	8.8	10.3	39.7	40.2	4.09
11. Our leader fails to take necessary action	36.7	31.6	15.3	10.2	6.1	2.17
12. There is good cooperation between functions.	4.6	10.8	13.3	46.2	25.1	3.76
13. Members are able to say what they think	1.5	6.2	6.7	36.9	48.7	4.25
14. My immediate supervisor proposes a reasonable approach to resolve disagreements	4.6	8.2	17.4	35.9	33.8	3.86
15. There is good cooperation between sites	4.6	12.3	23.1	40.0	20.0	3.58
16. Our leader lets others take away the leadership of the group	23.4	24.0	21.9	23.4	7.3	2.67
17. My team proposes a reasonable approach to resolve disagreements	2.6	4.2	19.9	47.6	25.7	3.90
18. There is good communication between the people that need to work together	2.6	6.7	8.8	54.1	27.8	3.98

E. ENABLING CONDITIONS

Please indicate the extent to which you agree or disagree with the following statements:	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree	Mean
1. There is agreement about our priorities in our team	5.1	15.4	12.3	40.0	27.2	3.69
2. We can count on the people in our team to perform their jobs proficiently	2.1	7.2	8.2	37.6	44.8	4.16
3. Team members always do what they say they will do.	2.1	10.9	12.4	47.7	26.9	3.87
4. We have a shared understanding of what we are trying to accomplish	3.1	8.8	10.9	42.5	34.7	3.97
5. The people on our team are reliable in their work.	2.1	3.6	9.3	41.5	43.5	4.21
6. There is an agreed way of getting the work done in our team	1.6	8.9	14.1	43.5	31.9	3.95
7. Team members believe that others on our team will follow through on their commitments.	2.1	4.2	9.9	50.3	33.5	4.09
8. Everyone on our team has similar goals.	6.3	14.7	23.0	36.1	19.9	3.49
9. We have good acceptance of process and methods in our team.	6.8	17.7	18.2	34.9	22.4	3.48
10. Team members trust each other to contribute worthwhile ideas.	2.1	6.8	11.5	45.3	34.4	4.03
11. In our team, members agree on work standards and procedures	3.7	13.7	16.8	43.2	22.6	3.67
12. We can trust that the members of our team have the knowledge and skills to complete their work	2.1	4.2	6.8	42.4	44.5	4.23

F. COLLABORATION STRUCTURE

Please indicate the extent to which you agree or disagree with the following statements:	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree	Mean
1. Members have to obtain information and advice from each other in order to complete their work	1.0	5.8	7.9	44.0	41.4	4.19
2. How much pay I receive depends almost entirely on how well I perform my job	22.8	23.3	23.8	21.2	8.8	2.70
3. My team forms alliances with people in different units at the company to work toward mutual objectives	1.6	11.4	23.8	45.6	17.6	3.66

F. COLLABORATION STRUCTURE

Please indicate the extent to which you agree or disagree with the following statements:	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree	Mean
4. My contributions to this team are rewarded by the company	15.5	20.7	28.0	28.5	7.3	2.91
5. Each member of this team is held personally accountable for team results	5.2	17.1	24.4	38.9	14.5	3.40
6. My team maintains contacts with people in other parts of the company who can be a useful source of information, resources, and support	0.5	3.6	12.4	55.7	27.8	4.07
7. My pay level is determined by my individual job performance	18.8	21.5	23.0	30.4	6.3	2.84
8. Our team's work has measurable team outcomes	4.2	14.1	15.6	42.7	23.4	3.67
9. The members of our team change frequently	29.2	31.8	14.6	16.7	7.8	2.42
10. My immediate supervisor forms alliances with people in different units at the company to work toward mutual objectives	2.6	8.4	19.9	42.9	26.2	3.82
11. On this team, we share the responsibility for our deliverables	2.1	7.3	11.9	43.0	35.8	4.03
12. The contributions of each member to this team are valued by their subunit	3.2	7.9	22.1	41.6	25.3	3.78
13. My pay depends on the success of the team I work with.	18.9	18.9	24.2	28.4	9.5	2.91
14. In order to complete our work, we have to obtain information and advice from each other	0	5.3	7.4	43.7	43.7	4.26
15. My immediate supervisor maintains contact with people in other parts of company who can be a useful source of information	2.1	5.8	16.8	42.9	32.5	3.98
16. Our team has quantifiable targets	3.1	10.5	19.4	39.3	27.7	3.78
17. Members of this team are rewarded commensurate with their contributions	16.4	22.8	37.0	19.6	4.2	2.72
18. Teams are rewarded in line with their performance here	19.6	24.9	31.2	19.6	4.8	2.65

G. RESOURCES AND WORK ENVIRONMENT

	Strongly Disagree	Slightly Disagree	Neither	Slightly Agree	Strongly Agree	Mean
1. The company has committed the resources required to do this work	22.4	24.0	13.5	27.1	13.0	2.84
2. It seems that everything is changing around here	2.1	8.4	22.5	31.4	35.6	3.90
3. We receive prompt technical assistance when our computer systems are not working	8.9	15.6	16.1	38.5	20.8	3.47
4. Many aspects of the company are changing at the same time	2.1	4.1	17.1	34.2	42.5	4.11
5. We cannot count on continuity of the resources we need	7.9	13.2	21.1	34.7	23.2	3.52
6. We waste considerable time in doing our work because of information technology problems that are not fixed.	20.3	34.9	21.4	16.7	6.8	2.55
7. Priorities keep being changed	5.7	11.9	22.3	36.3	23.8	3.61
8. We have to fight to hold on to the resources we need	6.8	10.4	22.4	31.8	28.6	3.65
9. Company provides adequate information technology support	6.3	14.8	21.7	41.3	15.9	3.46
10. The people who use my work keep changing their requirements	10.9	25.5	32.8	20.3	10.4	2.94

H. SATISFACTION WITH DISTRIBUTED WORK

Please indicate how satisfied you are with the following characteristics of distributed work:	Very Dissatisfied	Dissatisfied	Neither	Satisfied	Very Satisfied	Mean
1. Amount of travel	6.7	10.9	30.6	33.7	18.1	3.46
2. Flexibility	1.5	6.2	13.3	41.0	37.9	4.08

3.	Gaining technology skills	**2.6**	**14.4**	**20.0**	**42.6**	**20.5**	**3.64**
4.	Developing new relationships	**3.6**	**10.8**	**21.6**	**47.4**	**16.5**	**3.62**
5.	Face to face social opportunities	**6.2**	**21.5**	**25.1**	**34.9**	**12.3**	**3.26**
6.	Interruptions to personal life	**6.2**	**17.1**	**37.8**	**29.5**	**9.3**	**3.19**
7.	Visibility of my work	**7.2**	**17.9**	**25.1**	**40.5**	**9.2**	**3.27**
8.	Technological dependence	**2.1**	**6.8**	**39.8**	**42.4**	**8.9**	**3.49**

I. PERSONAL CHARACTERISTICS

Please indicate the extent to which the following describe you personally:	**Strongly Disagree**	**Slightly Disagree**	**Neither**	**Slightly Agree**	**Strongly Agree**	**Mean**
1. It is inappropriate to express negative emotions in the workplace	**9.8**	**26.3**	**17.0**	**31.4**	**15.5**	**3.16**
2. I try to investigate an issue with others to find a solution acceptable to all	**0**	**1.0**	**2.6**	**42.3**	**54.1**	**4.49**
3. I try to integrate my ideas with those of others to come up with a decision jointly	**0**	**0.5**	**2.6**	**49.2**	**47.7**	**4.44**
4. I am eager to tell outsiders that this is a good place to work	**6.7**	**10.3**	**32.0**	**31.4**	**19.6**	**3.47**
5. I am satisfied with the chances I have to do something that makes me feel good about myself as a person	**6.7**	**16.6**	**18.1**	**36.8**	**21.8**	**3.50**
6. I am satisfied with the chances I have to accomplish something worthwhile	**7.3**	**15.0**	**18.1**	**40.9**	**18.7**	**3.49**

J. ATTITUDES

Please indicate the extent to which you agree or disagree with the following statements:	**Strongly Disagree**	**Slightly Disagree**	**Neither**	**Slightly Agree**	**Strongly Agree**	**Mean**
1. I believe I am fairly paid compared to my peers at company who are at equivalent job levels and who are equivalently skilled	**13.9**	**23.2**	**24.7**	**25.8**	**12.4**	**2.99**
2. I am satisfied with my total compensation	**12.3**	**28.7**	**17.9**	**28.2**	**12.8**	**3.01**
3. My work takes up time that I would like to spend with family/friends.	**8.2**	**14.4**	**21.6**	**41.2**	**14.4**	**3.39**
4. All in all, I am satisfied with my job	**6.1**	**12.7**	**15.7**	**47.7**	**17.8**	**3.58**
5. Developing employee skills is a high priority for managers at the company	**16.8**	**20.4**	**21.4**	**27.0**	**14.3**	**3.02**
6. I am satisfied with the progress I have made toward meeting my overall career goals	**10.7**	**24.4**	**17.8**	**36.5**	**10.7**	**3.12**
7. I plan to look outside company for a new job within the next year	**17.4**	**18.5**	**31.8**	**19.5**	**12.8**	**2.92**
8. I am satisfied with the chances I have to accomplish something worthwhile	**6.7**	**15.9**	**23.1**	**41.0**	**13.3**	**3.38**
9. I believe I am fairly paid compared to my peers in other companies who are at equivalent job levels and who are equivalently skilled	**13.3**	**15.9**	**32.8**	**27.2**	**10.8**	**3.06**
10. I have very little control over the hours I am expected to work	**20.1**	**36.6**	**20.1**	**17.5**	**5.7**	**2.52**
11. My job enables me to use all my capabilities	**13.3**	**26.7**	**15.9**	**33.3**	**10.8**	**3.02**
12. I am satisfied with my current salary	**18.1**	**26.9**	**18.1**	**24.4**	**12.4**	**2.86**
13. I am satisfied with the progress I have made toward meeting my goals for advancement	**9.8**	**24.4**	**21.2**	**31.6**	**13.0**	**3.13**
14. I am satisfied with the chances I have to do something that makes me feel good about myself as a person	**7.3**	**15.6**	**20.3**	**45.3**	**11.5**	**3.38**
15. The company has a good process for mentoring employees	**24.0**	**28.1**	**29.7**	**13.5**	**4.7**	**2.47**
16. It is likely that I will quit my job in the next 12 months	**26.6**	**22.4**	**29.2**	**13.0**	**8.9**	**2.55**
17. My work enables me to use my full range of expertise	**13.5**	**26.0**	**20.3**	**29.2**	**10.9**	**2.98**

18. My family/friends dislike how often I am preoccupied with my work while at home	**14.5**	**18.7**	**23.3**	**28.0**	**15.5**	**3.11**
19. In general, I like working here	**3.1**	**6.7**	**13.5**	**49.7**	**26.9**	**3.91**
20. The company has a good process for identifying employees' development needs	**21.6**	**26.8**	**27.8**	**20.6**	**3.1**	**2.57**
21. On the job I have so much work to do that it takes away from my personal interests	**9.8**	**16.6**	**22.3**	**30.1**	**21.2**	**3.36**
22. I am satisfied with the chances I have to learn new things at work	**4.2**	**17.8**	**20.9**	**42.4**	**14.7**	**3.46**

K. DEMOGRAPHICS

1. **How long have you been with the company?**

   7.4% 1 year or less
   16.3% 2-3 years
   40.1% 4-5 years
   36.1% 6 or more years

2. **How many teams/projects are you involved with?**..... **3.03** (number of teams)

3. **How many of these operate primarily distributed?** ..... **2.20** (number of distributed teams)

4. **How many years of experience do you have working on distributed teams?** **5.77** years

5. **What is the level of your education? (Please indicate highest completed.)**

   2.0% High school or equivalent
   3.5% Some college or technical training, but no degree, beyond high school (1-3 years)
   2.0% Associate's Degree or equivalent (2-year degree)
   44.1% Graduated from 4-year college (BA, BS, or other Bachelor's degree)
   41.6% Master's degree or equivalent
   6.9% Doctorate degree or equivalent

6. **How old were you on your last birthday?**

   0% 19 years or younger
   2.0% 20 to 24
   13.3% 25 to 29
   24.1% 30 to 34
   23.2% 35 to 39
   16.3% 40 to 44
   10.8% 45 to 49
   7.4% 50 to 54
   2.5% 55 to 59
   0.5% 60 years or older

7. **Country you live in now:**
   Canada **(0.5%);** Czech Republic **(11.8%);** France **(4.9%);** India **(10.3%);** Norway **(1.0%);** USA **(67.2%)**

8. **Country/region you were born in:**

   1.0% Africa and Middle East
   29.7% Asia
   27.2% Europe and Russia (including UK)
   1.0% Latin America (including Central & South America, and Mexico)
   40.1% USA and Canada
   1.0% Other: _____

9. **Is English your first or native language?** **46%** Yes

If no, do you speak English fluently? 96% Yes