

**A New Survey of Workplace Skills, Technology, and
Management Practices (STAMP):
Background and Descriptive Statistics**

Michael J. Handel
Department of Sociology
Northeastern University
m.handel@neu.edu

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Direct all correspondence to Michael J. Handel, 500 Holmes Hall, Department of Sociology, Northeastern University, Boston, MA 02118 (m.handel@neu.edu). This research was supported by the National Science Foundation (grant number IIS-0326343), the Russell Sage Foundation, and the Wisconsin Alumni Research Fund.

There is a widespread belief that the skill requirements of jobs are growing significantly and the kinds of skills required are changing as a result of the spread of computer technology and organizational changes that increase employee involvement in workplace decision-making. Researchers across several fields, including sociology, labor economics, education, and public policy analysis, are keenly interested in questions of skill shifts, technology, and workplace reorganization because of their centrality to a number of broader research topics. These topics include:

- growth of wage inequality in the last two decades (Katz and Murphy 1992; Danziger and Gottschalk 1995; Autor, Katz, and Krueger 1998; Morris and Western 1999; Fernandez 2001; Bresnahan, Brynjolfsson, and Hitt 2002)
- earnings and employment prospects of less-skilled workers (Holzer 1996)
- trends in racial inequality, poverty, and movement from welfare to work (Wilson 1996; Moss and Tilly 2001; Holzer and Stoll 2001)
- potential for remediation of inequality through improved education, smoother transitions from school to work, and diffusion of employee involvement or "high performance" workplace practices (Murnane and Levy 1996; Rosenbaum and Binder 1997; U.S. National Commission on Excellence in Education 1983; Smith 1997; Appelbaum, Bailey, Berg, and Kalleberg 2000; Osterman 2000)

All of this research rests on some theory, research conclusions, or assumptions regarding the nature, level, and trend of job skill requirements. However, one problem is that these studies use either rough proxy measures of job skill demands available in nationally

representative data sets or, more rarely, finer measures of job skill demands constructed for unique surveys administered to restricted samples. In addition, almost no survey has equally strong coverage of job skill requirements, technology use, and high performance workplace practices despite their presumed interrelationships. Consequently, researchers have only cloudy information on levels and kinds of job skill requirements, rates of change, and the dimensions along which job skills are changing.

Until recently, existing measures of job skill demands were either indirect, such as the average education levels of workers within occupations, or outdated and otherwise limited, such as the job analysis ratings contained in the Dictionary of Occupational Titles (DOT) (1977) (Cain and Treiman 1981). Few detailed, national surveys of work were conducted since the Quality of Employment Surveys in the 1970s. Many subsequent surveys with small sets of items on job characteristics used subjective rather than behaviorally specific measures, which tend to have significant measurement error (Handel 2000). Other research was based on either special samples (e.g., Holzer 1996) or qualitative cases studies using unstandardized methodologies (e.g., Rosenbaum and Binder 1997). Much of the remaining literature is simply speculative or based on impressionistic evidence (e.g., U.S. Department of Labor. Secretary's Commission on Achieving Necessary Skills 1991).

The U.S. Department of Labor's Occupational Information Network (O*NET) database is a major effort to address some of these issues, but also has some limitations. O*NET will not be fully populated with recent survey data until summer 2008; ratings for some occupations still include recoded information from the DOT from the 1970s. O*NET consists of occupational means, not individual-level data. The measurement of

math, reading, and writing tasks uses rating scales that do not correspond clearly to different objective levels of complexity or easily understood categories of educational achievement. While the O*NET questionnaires have strong coverage of certain content areas, such as various kinds of knowledge, interpersonal skills, physical abilities, and thinking skills, they are weaker on other key content areas, such as information technology and employee involvement practices. Finally, important job characteristics are beyond O*NET's scope, such as promotion opportunities, downsizing/outsourcing, workload, work pace, stress, and pay and benefits.

Additional data from a different perspective can help increase understanding of levels and changes in various job skill requirements and the relationship between skill demands on the one hand and technology, work organization, and other job characteristics on the other.

I. Development of the STAMP Survey

In view of the strong convergence across disciplines in understanding job skill requirements, technology use, and employee involvement (EI) practices the survey of Skills, Technology, and Management Practices (STAMP) was written to address the following questions:

1. How many jobs require what levels of various skills, computer use¹, and participation in employee involvement practices? In other words, what is the skill profile of the American job structure?
2. What are the functional and causal relationships between skill requirements, computer use, and employee involvement?
3. What are the effects of skill requirements, computer use, and EI on wages, working conditions, and other job characteristics and correlates (e.g., work intensity, promotions, layoffs, outsourcing, unionization, job satisfaction)?

4. What are the trends in
 - a. skill requirements, technology, and employee involvement practices?
 - b. their functional and causal interrelationships?
 - c. their relationships to the other outcomes mentioned in point 3 above?

In answering these questions, the STAMP survey tried to improve upon existing measures to reduce error variance and increase the usefulness of findings for different audiences. Hopefully, they will be found worth replicating beyond the second wave of STAMP panel in the future as basic social indicators.

To identify promising items and ideas I conducted an extensive literature review of research in diverse fields, including sociology, industrial relations, labor economics, education, and psychology. Sources consulted included the Handbook for Analyzing Jobs, used by DOT field analysts, job analysis sections of human resource textbooks, and compendia of work measures used in previous research (U.S. Department of Labor 1991; Milkovich and Newman 1993; Cook et al. 1981), as well as other works cited below. I attended a two-day course on job analysis and job evaluation conducted by WorldAtWork (formerly the American Compensation Association) as part of its certification program for compensation professionals in human resource management.² I also drew upon my own experience with measures from existing surveys (Handel 2000, 2006) and reviewed the survey methodology literature for insights on question construction. I wrote an initial version of the survey, which was administered by graduate students in face-to-face interviews with over one hundred workers in diverse occupations in a medium-sized urban area.

The STAMP survey represents an iterative reworking of this earlier version by myself and survey research professionals at the Center for Survey Research (CSR) (University of Massachusetts-Boston), particularly Mary Ellen Colton and Carol Cosenza. I circulated late-stage versions of the instrument to researchers in the field, most with extensive experience conducting work-related surveys, and incorporated their comments into the final survey.³ The Center for Survey Research drew the final sample and conducted the survey, as described further below.

A number of general considerations guided the survey construction. Because of their centrality to current debates, the STAMP survey focuses on skills, technology, and employee involvement. The survey attempts to cover as much ground as possible in all three of these core areas to ensure high content validity. Items were constructed to measure a wide range of levels within different constructs to maximize variability and precision and avoid coarse scales and floor and ceiling effects.

To minimize error variance due to variation in the interpretation of items, the questions and response options were made as concrete and specific as possible. Research within IO Psychology suggests that specific and observable activities are more easily rated by job incumbents than more abstract constructs (Harvey 1991, pp.95ff.; Spector and Fox 2003). To limit the subjectivity of responses, survey questions were phrased in terms of facts, events, and behaviors rather than attitudes, judgments and evaluations, to the extent possible. The goal was to make questions and response options relatively concrete in order to give them as closely similar meanings across respondents as possible.

The kind of questions STAMP tried to avoid is illustrated by an item from the Quality of Employment Survey, which consisted of asking workers to respond to the

statement, "My job requires a high level of skill" (strongly agree, agree, disagree, strongly disagree) (Quinn and Staines 1979). Similar measures are relatively common in the study of work within psychology and elsewhere (Karasek 1979; Cook et al. 1981; pp.170ff.; Kalleberg and Lincoln 1988; Glick, Jenkins, Gupta 1986; Bosma et al. 1997; Fields 2002, pp.72ff.).

There are several potential problems with this kind of question. The blunt wording may induce self-enhancing, i.e., overly positive, responses. The concept of skill is undefined and holistic, requiring respondents to decide for themselves the facets of their job and the dimension of skill to focus on and how to weight their relative importance in deciding on a response option. The response options provide no common benchmark or yardstick that respondents could use in choosing a scale value to associate with their particular job's characteristics. In short, the highly general nature of the question and response choices means that respondents are on their own in interpreting their meanings and judging the response that applies best to their job.

Since most people are not familiar with the full spectrum of occupations and the skills they require, they are likely to evaluate their own job's skill level relative to jobs that are familiar and relatively similar to their own job, rather than evaluate their job relative to the full range of jobs. The difficulty of obtaining self-ratings based on a shared, absolute standard rather than one relative to the respondent's own particular job is a recognized problem within the field of job analysis but it is essential if the ratings are to mean the same thing across people and jobs (Harvey 1991, p.83). Highly abstract and subjective questions are less likely to produce measures with this and other desirable properties.

A related goal was to create response options that are interpretable on the basis of real-world categories that would be meaningful to respondents, researchers, and participants in policy debates. Wherever possible, STAMP avoids vague quantifiers and numbered rating scales used by the DOT, O*NET, and other surveys. For example, STAMP questions on math use at work ask specifically about arithmetic, algebra, geometry, trigonometry, statistics, and calculus, which are directly comparable to categories used in the field of education, rather than O*NET's anchored rating scales, which are not. Responses to these STAMP items can be related easily to existing questions in education and labor market research. Likewise, questions on teams ask about numerous specific areas of decision-making responsibility rather than asking for a more general or holistic rating of team authority.

Realistically, creating measures that conform to these ideals is often difficult due to practical considerations, such as survey length and the genuine diversity of what people do on their jobs. Questions framed in very behaviorally specific terms are less ambiguous but might not be meaningful or applicable to significant numbers of jobs. For example, it is not easy to construct common, behaviorally specific measures for the work intensity or task variety of engineers, real estate brokers, secretaries, police officers, welders, and janitors. Some constructs are difficult to define comparably or compactly across jobs that are qualitatively diverse and whose task content is dimensionally complex. Highly specific questions might be constructed for surveys covering a narrow range of closely related jobs, which is common in job analysis, but the measures cannot be applied to other, dissimilar jobs or used to describe the workforce as a whole. Questions using more general language will apply to a wider variety of jobs but the

wording will be necessarily more vague and subject to varying interpretations, increasing measurement error relative to more behaviorally specific items. Sometimes it is possible to construct a relatively large set of behaviorally specific questions instead of one or a few general items, but the general items are used because the longer battery would crowd out higher priority content, given the practical constraints of interview length.

Admittedly, while the STAMP survey tried to improve upon existing measures by making questions as concrete as possible it could not avoid such tradeoffs altogether.

With any survey of this kind, there is also the issue of the accuracy and reliability of job incumbents' self-reports compared to ratings by trained job analysts or other observers, such as supervisors. Incumbent self-reports may be biased due to motivational reasons, such as a desire to represent oneself in an overly positive light, or cognitive limitations, such as a restricted frame of reference, problems understanding survey questions, and difficulty in making the judgments necessary for accurate ratings or mapping them onto the response options. As one might expect, research finds incumbents generally give their jobs higher ratings than analysts, though the two sets of ratings are usually, though not always, correlated and the differences between incumbents and observers are not always large (Cook et al. 1981, pp.173ff.; Kohn and Schooler 1983, p.67; Lopata et al. 1985, pp.404ff.; Glick et al. 1986, p.449; Gerhart 1987; Harvey 1991, p.112; Cully et al. 1999, p.54; Peterson et al. 1999, pp.67, 241, 292; Manson, Levine, and Brannick 2000, p.16; Leckie et al. 2001, pp.49ff; Green and James 2003).

Trained analysts have more skill and experience rating a wide range of jobs and therefore are better able to know where to place any particular job within the full range of possible values on any given trait. They also do not have the same self-presentation

motives as incumbents. However, job analysts are not necessarily more accurate than incumbents. Their knowledge of any particular job is much less detailed than the incumbent since they observe jobs typically for a short time. Analyst ratings may also be subject to biases such as halo effects or stereotyping. Examples include the gender bias detected in the third edition of the DOT and the possibly conflation of DOT skill ratings with occupational prestige and authority, which are also said to be found in the commercial Hay system of job evaluation used by many corporations (Cain and Treiman 1981, pp.269ff.; Steinberg 1990; Spenner 1983, p.831; Attewell 1990, p.429; Peterson et al. 2001, p.484). Supervisors may also have less knowledge than incumbents or may be subject to similar biases as trained job analysts (Darrah 1994, pp.73ff.; Cully et al. 1999, pp.120, 148, 276ff.; Spector and Fox 2003, p.419; Green and James 2003).

In practice, job analysts themselves usually derive much of their information from interviews with incumbents, though they combine this information with their own and supervisors' observations and judgment. The O*NET system that has replaced the DOT itself largely abandons the use of job analysts in favor of incumbent self-reports because of the difficulty of updating the DOT in a timely and cost-effective fashion (Peterson et al. 1999). Hopefully, the greater use of concrete and objective items and scales in the STAMP survey mitigates any tendencies toward elevated self-reports found with more general items using Likert-style response formats.

Finally, it should be noted that while the STAMP survey tries to cover a lot of ground, an employee survey is not the best method for gathering information on all issues related to current debates. Some questions, such as the effects of industrial sector shifts and international trade on wages and employment, are better addressed with existing data,

such as the Current Population Survey, which has a larger sample, and official trade statistics. Other issues, such as the effects of organizational structure and strategy, are best addressed through employer surveys. A matched employer survey was not part of the research design for the current wave of the STAMP survey, but such information would be useful and could be collected following the methods used to generate the National Organizations Survey from General Social Survey respondents (Kalleberg et al. 1996).

II. STAMP Survey Administration and Sample

STAMP is a random-digit dial telephone survey of employed wage and salary workers in the United States at least eighteen years of age conducted between October 2004 and January 2006 (n=2,304). Eligible individuals were selected randomly within households. All respondents were interviewed with respect to their own jobs, i.e., no proxy reporting, and were paid \$20 for participating in the survey. Three years after the initial interview, respondents will be recontacted for reinterviews and the two waves of data used for modeling career growth and fixed effects models. The second wave will also be refreshed with a new subsample to make it representative of the overall workforce to permit trend analyses across the two waves.

As noted, the final survey is the result of an initial version piloted on over 100 employees in diverse occupations and industries in a medium-sized urban labor market, as modified by iterative revisions conducted by the author and the project team at the Center for Survey Research (CSR) (University of Massachusetts—Boston). Late stage versions were refined after two rounds of cognitive interviewing (21 respondents from

diverse occupations), behavior coding of pretest interviews (n=31), and interviewer debriefing to detect problems in question wording, respondents' understanding of the questions, and respondents' willingness or ability to provide meaningful answers. After minor revisions to address issues that emerged in cognitive interviewing and pretesting, the survey instrument was translated into Spanish and independently backtranslated into English. CSR was able to conduct complete interviews with 66% of those deemed eligible after screening. The average length of the interviews was approximately 28 minutes. STAMP contains about 166 unique items related to job characteristics, as well as other related to personal characteristics.

It is highly likely that STAMP under-represents one large group of non-English speakers, low-skill immigrants. Undocumented immigrants who were eligible for the survey because they spoke Spanish (or English) were likely reluctant to answer questions posed by a stranger about their job due to general fears of deportation. Even government surveys probably have trouble surveying this group. In addition, as with O*NET, workers who speak neither English nor Spanish well enough to be interviewed were ineligible for the STAMP survey by design because of the difficulty and expense of surveying them. Somewhat mitigating the seriousness of this problem is that of the households contacted, only 105 were deemed ineligible due to language barriers. [To do: Get Census estimate of non-English, non-Spanish speakers in U.S. XX] Given the large increase in unskilled immigration to the United States recently, itself somewhat contradicting the skills shortage thesis, the omission of a significant fraction means that the STAMP survey overestimates somewhat the quality of American jobs on dimensions such as skill requirements, technology use, and employee involvement.

If eligible individuals working on a casual basis in low-skill jobs were less likely to report themselves as working, their exclusion from the STAMP survey would also bias upward estimates of the quality of U.S. jobs.

Finally, insofar as job incumbents' self-reports are affected by some form of self-enhancing bias, this will also overstate job skill requirements in the U.S. economy, though some of this will difference out in estimates of trends over time.

III. STAMP Survey Content

Table 1 presents a summary of the content of the STAMP survey. A large group of questions relate to job skill requirements. Defining skill has proven to be somewhat controversial. For the present purposes, skill is defined simply as the ability to perform a task that is relevant to one's job, recognizing that the pecuniary rewards for different skills may be a function of historical patterns, wage-setting institutions, social power, and cultural conceptions, as well as supply and demand (Dunlop 1957; Edwards 1979; Adler and Borys 1989; Attewell 1990; England 1992, 2005).

Phenomenological accounts point to the importance of usually overlooked tacit skills. STAMP does not measure tacit skills directly because by definition they are outside normal awareness and therefore not easily measured in any survey. However, the measured skill differences between occupations is likely little affected because even though jobs considered less skilled may require more tacit skills than even workers themselves recognize (Kusterer 1978), it is likely that jobs considered more skilled require at least as much tacit skills, as well. In addition, STAMP probably captures a

large portion of such skills indirectly through questions on how long it takes people to learn their jobs.

The STAMP items are organized around a relatively conventional categorization of work tasks into cognitive, interpersonal, and physical tasks, following the DOT's data, people, and things schema. The survey uses measures of general human capital that are likely to be meaningful across diverse jobs, such as the level of math, reading, writing, problem-solving, and formal education required. Since highly occupation-specific task items would not be meaningful to most people in a nationally representative sample or comparable across jobs, levels of specific human capital are measured with items on years of previous experience required in related jobs and training time required for the current job. The latter is similar to the DOT's Specific Vocational Preparation variable and is also used by O*NET to stratify jobs into five broad levels ("zones") (Oswald et al. 1999). In addition, certain skills of low to moderate generality related to the use of particular technologies are also measured.

The survey also covers other dimensions frequently considered related to skill such as autonomy, closeness of supervision, authority, managerial responsibilities (cf. Spenner 1983; Kohn and Schooler 1983; Peterson et al. 1999, pp.251f.), as well as technology use, employee involvement, and various aspects of job downgrading that Bluestone and Harrison first described.

IV. Reliability, Validity, and Descriptive Statistics

Tables 2-16 present STAMP question text for the main job characteristics variables, means and proportions for the full sample and by occupation group, and

Cronbach's α for all multi-item scales as a measure of reliability. The order of the tables follows the order of topics in Table 1.

The quality of any set of measures can be judged by several standards of reliability and validity. Like O*NET (Peterson et al. 1999, p.46), STAMP did not collect test-retest reliability correlations and they seem relatively uncommon in the job analysis literature generally (for an exception see Wilson, Harvey, and Macy 1990). Test-retest correlations will be estimated for most variables after the second survey wave using responses for the subsample that did not change employers, occupations, and industries.

A much fuller discussion of the content, construct, and criterion validity of the STAMP items and scales appears in the survey technical report (in progress). Here it is sufficient to note with respect to criterion validity that STAMP did not include an observational component or collect sample work documents, so there is no way to know how accurately job incumbents are representing their job tasks from an external observer's perspective. Such an exercise would be useful for a small validation sample. Cognitive interviews and behavior coding did not suggest respondents had problems understanding the meaning of questions in general, though particular items may have possible problems with overly positive responses. The following tables use an indirect method of assessing criterion validity known as contrasted groups, which compares variable means across groups for which they would be expected to differ, in this case occupation, a method also used by O*NET (Anastasi 1982, pp.140f.; Bohrnstedt 1983, p.98; Peterson et al. 1999). If the skill variables show expected gradients across occupations, for example, this is evidence for their criterion validity.

The occupation groups are defined as follows:

Upper WC = upper white collar (management, professional, technical occupations)

Lower WC = lower white collar (clerical, sales)

Upper BC = upper blue collar (craft and repair workers—e.g., construction trades, mechanics)

Lower BC = lower blue collar (factory workers, truck drivers, etc.)

Service = e.g., food service workers, home health care aides, child care, janitors, police and fire fighters

Certain series of variables also represent varying levels of intensity of a single construct, such as the math, reading, writing, problem-solving, and supervisory duties (Tables 3, 5, 9). If fewer respondents give positive answers for the items intended to measure greater intensity of the latent trait, this is evidence for the items' construct validity (Anastasi 1982).

In general, the item means and proportions show the expected occupational gradients. Reading across rows for the occupational groups in the tables, there is a tendency for the proportion of positive responses to decline, as expected. Likewise, the proportion of positive responses declines within columns for math, reading, writing, problem-solving, and supervisory items, as expected.

Substantively, the results are too numerous to summarize in detail, but several key points can be noted.

The results for the math items in Table 3 show the proportion who use kinds of math more sophisticated than fractions and decimals is much lower than the percentage using simpler math. There is a clear break at this point. While 68% of all employed Americans report doing math using fractions, decimals, and percentages, only 22% report using more sophisticated math on their jobs and for most this means mostly simple algebra. Surprisingly, skilled blue collar workers report using math about as much as

managers and professionals. It seems that fairly basic levels of math, corresponding to two years of ordinary high school instruction, are sufficient for most jobs.

Most people are far more likely to report they read as part of their jobs, including larger than expected numbers for fairly sophisticated forms of reading, such as books and professional journals. It is difficult to devise questions that will measure complexity of reading material through self-reports and the item for professional journals probably represents significant over-reporting relative to what an outside observer might consider a professional journal. In addition, it was anticipated that so few people would read books on their jobs as a regular matter that the item was phrased in terms of whether people ever read work-related books. This choice probably led to over-reporting as well. These issues are discussed in greater detail in the technical report.

Far fewer people report complex writing on their jobs. Outside of managers and professionals, no occupational group has more than 15% reporting they write even five-page papers as a regular part of their job.

Over two-thirds of all wage and salary workers use forms on their jobs, but most people rate them as relatively simple, designating them as level 3 on a complexity rating scale ranging from 0 (extremely simple) to 10 (extremely complicated).

The mean for the education level respondents reported was required for their job was between high school and some post-high school education for all occupational groups except managers and professionals, for whom the mean was between some college and a bachelors degree.

Respondents reported that an average of 2.5 to 3 years of previous related experience was required for their jobs (Table 5). People with the required education and

experience could learn most jobs in one to six months, except for managers/professionals and upper blue collar workers, who required between six months and a year.

About 45% of wage and salary workers reported receiving classroom training paid by their employers in the previous three years, but the specific kind of training did not show clear patterning. One notable finding is that despite all of the discussion of the emphasis on quality, this was the least common form of employer-provided training.

As Table 6 indicates, relatively high proportions of workers responded positively to the various items on interpersonal tasks they might perform on their jobs. Although it is commonly argued that this dimension of work is becoming more important with the growth of the service sector (e.g. Reich 1991), some research suggests it is not recognized in the labor market in the form of higher wages (Glomb et al. 2004). This remains to be tested with the STAMP data.

Table 11 shows that managers/professionals and clerical/sales workers uses roughly five or six computer software applications, while other occupations use a bit less than two applications. A substantial fraction of the workforce uses software applications specific to their line of work (47%), particularly white collar workers (~60%), but relatively few people have had to learn new software within the previous three years (16%). Very few people, generally well under 10%, perform very sophisticated computer tasks, such as SQL programming with database software, programming with languages like C++, Java, or Visual Basic, or science and engineering calculations using a computer. Only about 12% report using macros or formulas with spreadsheet software. In general, most people seem to use computers for fairly mundane office tasks, though

more extensive analysis of these and other computer-related items is needed before firmer conclusions can be drawn.

It does appear that a significant proportion of skilled blue collar workers need a good knowledge of electronics, which may also reflect the increased prevalence of computers (33%). No other occupational group really requires this skill in large numbers, however.

The figures on employee involvement in Table 13 indicate that only about 20% of the workforce is engaged in a formal quality control program and only about a quarter of the workforce belongs to a self-directed work team using criteria derived from the literature on employee involvement. The average team performs a little less than six of the ten functions measured in the STAMP survey, but this drops to less than 1.5 tasks if averaged over the entire workforce. Not surprisingly, teams least commonly performed highly consequential functions usually reserved for management, such as choosing their own leader and conducting peer performance reviews. More surprisingly, a relatively small proportion of teams monitored costs, productivity, and waste, which is supposedly their *raison d'être*.

Finally, Table 16 shows that despite great concerns over outsourcing, relatively few people work in establishments that have transferred work out to other places in the previous three years, though less skilled blue collar workers were significantly more affected than other occupational groups.

V. Conclusion

STAMP was designed as part of a research agenda to help answer a range of specific questions that have been the subject of great interest in recent years across a number of fields.

The preceding represents the beginnings of a skill profile of the American job structure designed to answer the question, What do people do on their jobs? No progress in understanding the current and future skill demands of work is possible without this kind of basic picture using effective measures.

The next task is to fill out this description by providing breakdown of skills, technology, and employee involvement for other groups besides occupation whose work readiness or labor market status have been the focus of particular concern. These include groups defined by age, education, income, industry, race, and gender.

The second wave of the survey will permit analyses of trends to determine whether skill demands are rising and, if so, how quickly and for which dimensions of skill. If future waves of STAMP are funded the series can be treated as basic social indicators to measure long-term rates of change.

More analytically, I plan to model the effects of computer use and employee involvement (EI) on skills to answer the second question posed at the beginning of this paper, namely the role of new technology and workplace reorganization in driving changes in skill demands. This will include examining any mediating impact of computers on skills operating through employee involvement, given the widespread assumption that computers are also helping drive a trend toward EI.

Building on these analyses, the next step will be to investigate the impacts of all three sets of variables (skills, technology, EI) on wages, including the extent to which the

effects of skills on wages can be explained by computer use and EI. The detailed skill measures also mean that any effects of computers on wages can be distinguished as operating directly through the complexity of computer tasks themselves or indirectly through greater general human capital requirements, such as reading, writing, and math, that computer use might engender. The effects of EI on wages and the indirect effects of computers on wages through EI will also be investigated to assess the hypothesis that EI represents a possible path for the remediation of recent inequality growth.

Additional papers will extend the basic structure of these analyses to other outcome variables, such as training, promotions, supervisory duties and organizational position, job loss, downsizing, outsourcing, part-time status, work intensity, unionization, and job satisfaction. Because many of aspects of job quality tend to be less well represented on other existing data sets, the relationships between them and background variables such as age, education, occupation, industry, race, and gender will also be examined because of their intrinsic interest.

The second wave of STAMP panel data will afford several extensions these studies. The descriptive analyses can be put in the perspective of trend analyses. Changes in the strength of all the relationships described above can be examined. Fixed effects models can be estimated to check the robustness of cross-sectional models and purge omitted variable bias. Analyses that regress changes in outcomes on changes in IT use implicitly control for unmeasured permanent characteristics of workers (e.g., abilities, predispositions) that are bound to be associated with IT use and may be the true causes of the outcome of interest.

The second wave will also permit estimation of models of career growth in wages, skill requirements, organizational position, and other job characteristics and their relationship to prior person and job characteristics.

Finally, there are several ways in which the STAMP data could be augmented to improve our understanding of skills, technology, employee involvement, and other job characteristics and their implications for labor market functioning.

1. The validity of the survey measures could be investigated further through the collection of work samples, such as reading materials, which could be compared to survey responses. As discussed in the larger technical report, significant issues in measuring the complexity of survey respondents' reading, writing, and math tasks remain. Using small samples to benchmark existing measures against external observer ratings would be useful.

2. Sociologists and economists have long recognized that labor market outcomes are related to employer as well as worker characteristics. There have been a few efforts to link individual-level and employer-level data. The second wave of STAMP is will ask for employer contact information in order to permit a possible matching employer survey to be conducted if funded. This would follow the design of the National Organizations Survey which interviewed the employers of General Social Survey respondents who provided contact information.

3. The National Assessment of Adult Literacy and its predecessor and international complements, the National Adult Literacy Survey and the International Adult Literacy Survey, established a framework for measuring the literacy levels of populations. Often the results are used to draw conclusions about job competencies in

the absence of detailed information about the complexity of literacy tasks actually performed on the job. These two kinds of assessment, measuring persons and jobs, should be joined in a common instrument to understand the relationship between test scores and job tasks more deeply. Some job tasks, like complexity of problem solving performed on the job, are difficult to measure with an objective metric and probably require adjustment for persons' skills.

4. Concerns over international economic competitiveness have generated much of the concern over skill requirements, education quality, job readiness, and inequality. To address these concerns, the job measures used in STAMP could be replicated cross-nationally, as the personal literacy assessments have been. This would provide some indication of how the skill content, technology use, and other characteristics of American jobs compare to those of other countries.

¹ For ease of exposition, "computer use" is sometimes used as a shorthand to refer to the broader category "computer and other technology use."

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Table 1. STAMP Survey Content (N=number of items)

Basic Job and Organizational Information (N=12)

Occupation, industry, organizational position, organizational and job tenure,
union membership, organizational size, organization type

Skill and Task Requirements (N=60)

Cognitive skills (N=48)

Mathematics (n=12)

Reading (n=8)

Writing (n=6)

Forms and visual matter (n=6)

Problem-solving (n=3)

Education and training requirements (n=9)

Skill changes in previous three years (n=4)

Interpersonal job tasks (n=8)

Physical job tasks (n=4)

Supervision, Autonomy, Authority (N=11)

Closeness of supervision

Repetitive work

Autonomy

Supervisory responsibilities over others

Decision-making authority over organizational policies

Computer and Other Technology (N=49)

Machinery and electronic equipment (n=18)

Level of machine knowledge needed, training time

Set-up, maintenance, and repair

Automation, equipment and tool programming

Computers (n=26)

Frequency of use

Use of fourteen specific applications

Use of advanced program features, occupation-specific, and new software

Training times

Complexity of computer skills required

Adequacy of respondents' computer skills

Computer knowledge and experience in prior jobs among non-users

Other technology (n=5)

Telephone, calculator, fax, bar code reader, and medical, scientific and
lab equipment

Employee Involvement (N=18)

Job rotation and cross-training

Pay for skill

Formal quality control program

Teams activity levels, responsibilities, and decision making authority

Bonus and stock compensation

Job Downgrading (N=15)

Work load, pace, and stress

Strike activity

Promotion opportunity

Downsizing, outsourcing, technological displacement

Reductions in pay and retirement and health benefits

Job Satisfaction (N=1)

Table 2. Survey Items: Mathematics, Reading, Writing, and Forms/Visual Matter**Math***At your job, do you:*

1. use math or numbers in any way (e.g., measure or weigh things, count things, work with money)
2. use addition or subtraction
3. use multiplication or division
4. do math using fractions, decimals, or percentages
5. use simple algebra to solve for unknown values
6. use more advanced algebra to solve complex equations
7. use geometry or trigonometry
8. use probability and statistics, such as correlations and regressions
9. use calculus or other advanced mathematics

Reading*As part of your job, do you read:*

1. anything at work, even very short notes or instructions
2. anything at least one page long, including notes, memos, reports, or letters
3. anything at least 5 pages long
4. articles or reports in trade magazines, newsletters, or newspapers
5. articles in scholarly, scientific publications, or professional journals
6. instruction manuals or other reference materials
7. work-related books
8. bills or invoices

Writing*As part of your job, do you write:*

1. anything at work, even very short notes or instructions only a few sentences long
2. anything at least one page long, including notes, memos, reports, or letters
3. anything at least 5 pages long
4. articles or reports for magazines, newspapers, or newsletters
5. books or articles for scholarly, scientific, or professional journals
6. fill out bills or invoices

Forms and Visual Matter

1. As part of your job, do you use or fill out any kind of forms or reports, such as order forms, contracts, reports, or online forms? (y/n)
 2. How many different kinds of forms do you use in an average month (1-2, 3-9, 10+)
 3. How long are most of them (1 page, 2-4 pages, 5+)
 4. How would you rate the complexity of the work you do with forms? (0=extremely simple, 10=very complicated)
 5. As part of your job, do you read things that communicate information in picture form, such as maps, diagrams, floor plans, graphs, or blueprints? (y/n)
 6. Do you write or create [such things]? (y/n)
-

Table 3. Descriptives: Math, Reading, Writing, and Documents

	All	Upper WC	Low WC	Upper BC	Low BC	Service
Math ($\alpha=0.81$)						
1. Any math	0.94	0.95	0.97	0.94	0.91	0.88
2. Add/subtract	0.86	0.93	0.90	0.87	0.78	0.73
3. Multiply/divide	0.78	0.89	0.82	0.81	0.65	0.57
4. Fractions	0.68	0.82	0.68	0.70	0.58	0.40
<i>More advanced</i>	0.22	0.35	0.09	0.41	0.19	0.04
5. Algebra I	0.19	0.30	0.08	0.36	0.16	0.04
6. Geometry/trig	0.14	0.20	0.05	0.29	0.15	0.02
7. Statistics	0.11	0.22	0.05	0.10	0.06	0.02
8. Algebra II	0.09	0.14	0.03	0.16	0.08	0.02
9. Calculus	0.05	0.08	0.01	0.08	0.05	0.01
<i>Mean Level</i>	4.11	4.9	3.7	4.8	3.7	2.8
Reading ($\alpha=0.80$)						
1. Any reading	0.96	0.99	0.97	0.91	0.91	0.95
2. One page	0.82	0.96	0.86	0.72	0.57	0.67
3. Five pages	0.54	0.81	0.47	0.46	0.26	0.32
4. News articles	0.42	0.64	0.37	0.27	0.21	0.24
5. Prof'l articles	0.38	0.65	0.26	0.24	0.15	0.23
6. Books	0.53	0.76	0.40	0.53	0.35	0.38
<i>Mean Level</i>	3.8	5.0	3.5	3.2	2.5	2.9
Writing ($\alpha=0.64$)						
1. Any writing	0.91	0.99	0.93	0.83	0.80	0.83
2. One page	0.61	0.86	0.56	0.46	0.36	0.41
3. Five pages	0.24	0.47	0.13	0.12	0.07	0.09
4. News articles	0.09	0.20	0.04	0.01	0.04	0.03
5. Books/prof'l arts	0.03	0.07	0.00	0.00	0.00	0.02
<i>Mean Level</i>	1.9	2.7	1.7	1.4	1.3	1.4
Documents						
1. Use forms	0.67	0.78	0.77	0.61	0.46	0.46
2. Kinds of forms ^a	1.27	1.51	1.50	1.10	0.84	0.77
3. Form length ^b	0.99	1.23	1.09	0.83	0.62	0.65
4. Form complexity ^c	3.16	3.99	3.65	2.62	1.84	1.86
5. Use visual matter	0.52	0.60	0.41	0.82	0.55	0.31
6. Create visuals	0.32	0.43	0.19	0.62	0.22	0.15

a. 1 = 1-2 different kinds of forms, 2 = 3-9 different kinds, 3 = 10 or more (0=no form use)

b. 1 = one page long, 2 = 2-4 pages, 3 = five or more pages (0=no form use)

c. 1 = extremely simple, 11 = extremely complicated (0=no form use)

Table 4. Survey Items: Problem-Solving, Education, and Training

Problem-solving

Think of “problem solving” as what happens when you are faced with a new or difficult situation and you have to think for a while about what to do next.

1. Some problems are pretty easy and can be solved right away or after getting a little help from others. As part of your job, how often do you have to solve easy? (1=never, 4=often)
2. Other problems are hard to solve right away and require a lot of work to come up with a solution. As part of your job, how often do you have to solve hard? (1=never, 4= often)
3. In average week, about how many hard problems like that do you work on (specify number)?

Education and training

1. What level of formal education do you think is needed by an average person to do your job?
 2. How many years of work experience in other related jobs required for someone with that education would be eligible to be hired for your position?
 3. About how long would it take someone with [*specified*] education and [*specified*] experience to learn to do your job well?
 4. In the past three years, have you had any education or training to improve your work skills or learn new skills?
 - a. (if yes) Was any of that education or training paid for or provided by your current employer?
 - b. (if yes) Was any of that education formal, classroom training?
 - c. (if yes) For the following list, please indicate whether you've had that kind of training:
 - i. Reading, writing, math, or English-language skills
 - ii. Customer service or sales training
 - iii. Managerial or supervisory skills
 - iv. Communication and team skill training
 - v. Quality control techniques
 - vi. Other technical skills for your specific occupation
-

Table 5. Descriptives: Problem-Solving, Education, and Training

	All	Upper WC	Low WC	Upper BC	Low BC	Service
Problem-solving ($\alpha=0.70$)						
1. Easy problems ^a	3.48	3.73	3.40	3.46	3.14	3.29
2. Hard problems ^a	2.79	3.18	2.65	2.84	2.43	2.39
3. # Hard problems ^b	4.78 (2)	5.25 (3)	4.94 (2)	4.52 (2)	3.87 (2)	4.32 (1)
Education, training						
1. Education required ^c	4.15	5.42	3.72	3.49	3.10	3.17
2. Related experience ^d	2.94	3.35	2.65	3.46	2.59	2.37
3. Job learning time ^e	3.35	3.80	3.01	3.95	2.97	2.80
4. Employer training ^f	0.44	0.59	0.34	0.45	0.31	0.35
5. <i>Read, write, math</i>	0.12	0.18	0.04	0.15	0.08	0.12
6. <i>Customer service</i>	0.17	0.19	0.22	0.13	0.1	0.14
7. <i>Management</i>	0.19	0.28	0.15	0.16	0.11	0.15
8. <i>Communication</i>	0.22	0.33	0.16	0.17	0.10	0.17
9. <i>Quality control</i>	0.10	0.11	0.09	0.12	0.11	0.08
10. <i>Other technical</i>	0.26	0.37	0.18	0.31	0.17	0.16

Note: Cronbach's α for problem-solving includes only first two items.

a. 1=never, 2=rarely, 3=sometimes, 4=often

b. Mean (median)

c. 1=8 grade and below, 2=HS dropout, 3=HS, 4=HS + vocational education, 5=some college or two-year degree, 6=BA, 7=more than BA

d. 1=none, 2=<1year, 3=1-2 years, 4=3-5 years, 5=>5 years

e. 1=< one week, 2=one week to one month, 3=between one and six months, 4=six months to one year, 5=over one year

f. Refers to employer-provided formal, classroom training

Table 6. Survey Items: Interpersonal and Physical Tasks

Interpersonal*As part of your job, do you:*

1. ...give people information or advice?
2. ...counsel people or help them with their personal problems?
3. ...regularly have to deal with people in difficult or tense situations, such as people who are hostile, angry, or upset?
4. ...have to teach or train people?
5. ...regularly interview people, for example people applying for loans, government benefits, jobs, or other things?
6. ...give formal presentations lasting at least 15 minutes?
7. ...have any contact with people other than co-workers, for example with customers, clients, students, or the public?
8. Do you ever spend at least 15 minutes talking with someone who is not a co-worker?
9. (If yes) In a usual week, about how often do you talk to someone like that for a period of at least 15 minutes (> once a day, about once a day, a few times a week, about once a week, less often than that)?
10. Using any number from 0 to 10 where 0 is not important at all and 10 is extremely important, what number would you use to rate how important it is to your job to work well with customers, clients, students, or the public?

Physical*At your job, do you:*

1. have to stand or walk for at least 2 hours during your work day?
 2. regularly have to lift or pull anything weighing at least 50 pounds?
 3. have to perform tasks that require very good hand-eye coordination or an especially steady hand?
 4. Using any number from 0 to 10 where 0 is not at all physically demanding and 10 is extremely physically demanding, what number would you use to rate how physically demanding your job is?
-

Table 7. Descriptives: Interpersonal and Physical Tasks

	All	Upper WC	Low WC	Upper BC	Low BC	Service
Interpersonal ($\alpha=0.72$)						
Information	0.92	0.98	0.94	0.86	0.85	0.81
Counseling	0.37	0.50	0.28	0.28	0.26	0.38
Tense situations	0.60	0.65	0.60	0.51	0.49	0.65
Teach/train	0.75	0.86	0.69	0.75	0.67	0.67
Interview	0.18	0.30	0.16	0.07	0.06	0.09
Presentations	0.32	0.57	0.20	0.17	0.11	0.17
Public contact ^a	3.04	3.69	3.45	1.94	1.60	2.79
Self-rated level ^b	7.40	8.79	8.31	5.01	4.21	6.88
<i>Additive scale</i>		0.37	-0.15	-0.58	-0.75	-0.38
Physical ($\alpha=0.79$)						
Stand at least 2 hours	0.67	0.52	0.58	0.90	0.80	0.90
Lift	0.36	0.19	0.27	0.73	0.60	0.48
Coordination	0.57	0.43	0.42	0.89	0.78	0.75
Physical demands ^c	4.59	3.46	3.67	6.67	5.98	6.23
<i>Additive scale</i>		-0.32	-0.20	0.95	0.66	0.65

Note: Additive scales are the standardized sum of items used in calculating Cronbach's α ; scale is in standard deviation units.

a. Six-point scale measuring frequency of contact with people other than co-workers, such as customers, clients, students, or the public (0=none, 5= more than once a day R spends at least 15 minutes speaking to non-coworker).

b. Self-rated importance of working well with customers, clients, students, or the public on respondent's job (0-11).

c. Self-rated physical demands of job (0=not all physically demanding, 10=extremely physically demanding)

Table 8. Survey Items: Autonomy, Repetitiveness, Closeness of Supervision, Authority

1. How much freedom do you have to decide how to do your job in your own way, rather than following a fixed procedure or a supervisor's instructions? (0=no freedom, 10=complete freedom)
2. How often does your work involve carrying out short, repetitive tasks? (1=never, 5=always)
- 3a. How often does your immediate supervisor or his or her assistant check up on what you've done? (1=less often than a few times a week, 4=more than once a day)
- 3b. Overall, how closely supervised are you? (1=no supervision, 4=a large amount)
4. As a regular part of your job, do you supervise the work of other employees? (y/n)
(If yes) Do you have responsibility for...
5. ... deciding work assignments? (y/n)
6. ...disciplining workers for poor work or misconduct? (y/n)
7. ...making formal performance evaluations? (y/n)
8. ...influencing pay and promotion decisions for the people you supervise? (y/n)
9. Do you have the authority to hire or fire workers? (y/n)
10. As part of your job, do you personally participate in making policy decisions about things such as the products or services delivered, the total number of people employed, or budgets? (y/n)

Table 9. Descriptives: Autonomy, Repetitiveness, Closeness of Supervision, Authority

	All	Upper WC	Low WC	Upper BC	Low BC	Service
Autonomy	6.84	7.31	6.62	7.04	6.52	6.23
Repetitiveness	3.58	3.26	3.83	3.45	3.65	3.92
Close supervision	2.20	1.84	2.19	2.69	2.44	2.53
Decision making	0.28	0.44	0.23	0.20	0.13	0.16
<i>Additive scale</i>		0.42	-0.25	-0.19	-0.44	-0.45
Supervisory tasks						
<i>($\alpha=0.84$)</i>						
Supervise others	0.48	0.55	0.41	0.57	0.37	0.44
Work assignments	0.36	0.47	0.29	0.41	0.24	0.28
Discipline	0.25	0.36	0.19	0.25	0.11	0.21
Performance review	0.25	0.37	0.19	0.22	0.15	0.18
Pay and promotion	0.21	0.31	0.18	0.2	0.11	0.11
Hire and fire	0.16	0.26	0.12	0.13	0.06	0.09
<i>Mean tasks</i>	1.22	1.76	0.96	1.21	0.67	0.87

Note: Additive scale is the standardized sum of items used in calculating Cronbach's α ; scale is in standard deviation units.

Table 10. Survey Items: Computer Use

-
1. Frequency of computer use (everyday, a few times a week, less often)
 - Tasks and programs used:*
 2. Use a computer to do data entry
 3. (*if yes*) How much of your time spent on computer doing data entry (most, some, a little)?
 4. Word processing
 5. Spreadsheets
 6. (*if yes*) Do you use advanced functions, such as macros and complex equations?
 7. Other bookkeeping, accounting, or financial software, such as Quickbooks
 8. Presentation graphics, such as PowerPoint
 9. Database programs, such as Access, paradox, or Oracle
 10. (*if yes*) Do you program or write queries using S-Q-L, also called "Sequel?"
 11. Email for your work
 12. Internet for things other than email
 13. Design or build web sites
 14. Use a computer for inventory control
 15. Computer-aided design (CAD)
 16. Use a computer for scientific or engineering calculations, simulations, or statistics
 17. Write programs using a computer language such as C++, Java, Visual Basic, or Perl
 18. Use a computer for graphic design, commercial printing, or desktop publishing
 19. Work with customized or special computer programs found mostly in your line of work that hasn't been mentioned?
 20. (*if yes*) About how long to learn the customized or special program that took the longest to learn (<one week, one week-one month, one-six months, six months-one year, over one year)?
 21. In the last 3 years, have you had to learn any (other) new computer programs or functions taking more than a week to learn?
 22. (*if yes*) How long did the longest one take to learn? (same choices as 16a)
 23. At work, do you ever figure out on your own how to do new things on the computer using manuals, reference books, or online help screens?
 24. How would you rate the computer skills needed to do your job? (0=very basic, 10=very complex)
 25. Do you think you have all the computer skills you need to do your current job well?
 26. Has a lack of computer skills has affected your chances of getting a promotion or pay raise? (y/n)
-

Table 11. Descriptives: Computer and Other Technology Measures

	All	Upper WC	Low WC	Upper BC	Low BC	Service
Computers						
1. Special software	0.47	0.61	0.59	0.23	0.29	0.24
2. New software (3 years)	0.16	0.24	0.16	0.11	0.12	0.06
3. Spreadsheet formulas	0.12	0.21	0.11	0.02	0.06	0.03
4. SQL programming	0.03	0.08	0.01	0.01	0.01	0.01
5. Science/engineering	0.07	0.14	0.03	0.04	0.04	0.02
6. Programming	0.04	0.08	0.02	0.00	0.01	0.01
7. Applications (#)	4.02	6.06	4.68	1.68	1.91	1.41
8. Computer Skill Level ^a	4.21	5.91	5.06	1.95	2.43	1.77
<i>Additive scale</i> ($\alpha=0.71$)		0.42	0.08	-0.87	-0.76	-0.94
Other technology						
1. Heavy Machinery Use	0.20	0.07	0.11	0.65	0.46	0.12
2. Mechanical Skill Level ^b	2.50	1.73	1.38	5.97	4.55	2.12
3. Electronics Skill (y/n)	0.13	0.12	0.08	0.33	0.15	0.09

Note: Additive scale is the standardized sum of items used in calculating Cronbach's α (items 7 and 8); scale is in standard deviation units. Statistics in top panel, including scale, calculated from total sample.

a. Self-rated complexity of computer skills used on job (0=no computer use, 1=very basic, 10=very complex)

b. Self-rated complexity of mechanical skills used on job (0=very basic, 10=very complex)

Table 12. Survey Items: Employee Involvement

-
1. Has employer asked you to learn someone else's job as part of "job rotation" or "cross-training?"
 2. (if yes) Have you received a raise for learning a co-worker's job or part of their job as part of a "pay for skill" program?
 3. Do you participate in a formal quality control program, such as Total Quality Management or Quality Circles, which require employees to monitor defects, errors, or the number of customer complaints and record the information on log sheets, charts, or graphs?

Teams

4. Team member?
5. (if yes) Frequency of meetings?
Is team involved in:
 6. Job assignments (no involvement, suggests, decides on own)
 7. Scheduling work activities (no involvement, suggests, decides on own)
 8. Setting employee schedules (no involvement, suggests, decides on own)
 9. Changing how work is done (no involvement, suggests, decides on own)
 10. New equipment purchases (no involvement, suggests, decides on own)
 11. Choosing team leader (no involvement, suggests, decides on own)
- Does team:*
 12. Monitor quality (yes/no)
 13. Monitor costs, productivity, and waste (yes/no)
 14. Communicate with other departments or with customers or suppliers (yes/no)
 15. Participate in evaluating the job performance of other team members (yes/no)

Non-traditional compensation

16. Receive compensation from employer in the form of company stock in past year?
 17. Receive compensation from your employer in the form of bonuses in past year?
-

Table 13. Descriptives: Employee Involvement Measures

	All	Upper WC	Low WC	Upper BC	Low BC	Service
1. Job rotation	0.53	0.43	0.64	0.48	0.60	0.57
2. Pay for skill	0.10	0.06	0.11	0.08	0.16	0.16
3. TQM/QC	0.20	0.22	0.21	0.17	0.19	0.15
4. Team member ^a	0.26	0.27	0.21	0.28	0.25	0.26
Team functions: ($\alpha=0.69$)						
5. Job assignment ^a	0.20	0.22	0.17	0.26	0.17	0.22
6. Task scheduling ^a	0.18	0.21	0.14	0.19	0.15	0.19
7. Worker scheduling ^a	0.09	0.07	0.08	0.14	0.10	0.13
8. Changing methods ^a	0.18	0.20	0.15	0.22	0.19	0.16
9. New equipment ^a	0.18	0.19	0.14	0.25	0.18	0.17
10. Selecting leader ^a	0.08	0.10	0.05	0.13	0.08	0.04
11. Quality ^a	0.17	0.19	0.13	0.19	0.18	0.13
12. Cost, productivity ^a	0.11	0.12	0.11	0.14	0.12	0.09
13. Cross-communicate ^a	0.20	0.22	0.17	0.21	0.19	0.17
14. Performance review ^a	0.11	0.11	0.09	0.17	0.10	0.13
15. # of team functions ^a	1.41	1.49	1.21	1.81	1.44	1.26
16. # of team functions ^b	5.77	5.63	5.79	6.56	5.75	5.51

Note: Unless noted, all statistics based on full sample. Cronbach's α for team items calculated on sub-sample of team members only. Team functions (items 5-16) were dichotomized for this table such that 0=no involvement and 1=team either suggests and decides on its own.

a. Employees in self-reported management positions were ineligible for this item and coded as zero for calculations.

b. Statistics based on sub-sample belonging to teams.

Table 14. Correlations among STAMP Scales

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Math	1													
2. Read	0.44	1												
3. Write	0.42	0.65	1											
4. Form	0.25	0.33	0.34	1										
5. Form2	0.39	0.47	0.45	1	1									
6. Visual	0.42	0.33	0.31	0.15	0.24	1								
7. Problem	0.39	0.49	0.44	0.23	0.32	0.30	1							
8. Problem2	0.30	0.36	0.32	0.19	0.28	0.21	0.73	1						
9. Interaction	0.34	0.58	0.51	0.31	0.42	0.24	0.49	0.37	1					
10. Physical	-0.07	-0.20	-0.30	-0.13	-0.20	0.04	-0.10	-0.06	-0.09	1				
11. Autonomy	0.28	0.41	0.45	0.21	0.31	0.22	0.24	0.16	0.36	-0.28	1			
12. Supervise	0.21	0.31	0.34	0.22	0.33	0.13	0.21	0.15	0.50	-0.22	0.39	1		
13. Computer	0.42	0.43	0.48	0.37	0.41	0.30	0.37	0.27	0.27	-0.32	0.36	0.26	1	
14. Computer2	0.45	0.55	0.56	0.40	0.50	0.27	0.43	0.32	0.44	-0.44	0.36	0.33	1	1
15. Teams	0.23	0.15	0.15	0.10	0.18	0.19	0.21	0.15	0.23	0.05	0.15	0.23	0.18	0.21
16. Teams2	0.10	0.16	0.09	0.03	0.06	0.13	0.13	0.12	0.14	0.10	0.01	-0.08	0.06	0.08

Note: Variables with a numerical suffix were constructed for entire sample rather than only those eligible for the items and ineligibles were coded zero.

Table 15. Survey Items: Downsizing, Outsourcing, Technological Displacement

1. At the location where you work, does your company or organization employ more, less, or about the same number of people than it did 3 years ago [when you started working there (*if less than three years*)]
2. Would you say there are a lot less or a little less?
3. Have significant numbers of employees permanently laid off?
4. Has a significant part of the work usually done at your workplace been transferred out to be done somewhere else?
5. At any time in the last three years have you been laid off or lost your job?
6. (*if yes*) Was this because a machine or computer replaced your job?
7. Since you started working for your employer, have you participated in a strike or similar labor action?

Table 16. Descriptives: Downsizing, Outsourcing, Technological Displacement

	All	Upper WC	Low WC	Upper BC	Low BC	Service
<i>Employment change</i>						
Employs a lot less	6.0	5.8	4.1	8.1	12.4	2.7
Employs a little less	11.8	11.5	13.8	14.4	10.3	8.9
Employs about same	49.7	47.5	47.2	52.3	46.7	59.7
Employs more	32.5	35.2	34.9	25.3	12.1	28.7
Workplace layoffs	0.08	0.07	0.07	0.07	0.16	0.05
Outsourcing	0.04	0.03	0.03	0.05	0.13	0.02
Personally laid off						
Replaced by machine or computer						
Union membership						
Ever engaged in strike ^a						
Ever engaged in strike ^b						

a. Entire sample

b. Union members only

* Need to check eligibility for personally laid-off item. *

**A New Survey of Workplace Skills, Technology, and
Management Practices (STAMP):
Background and Descriptive Statistics**

Michael J. Handel
Department of Sociology
Northeastern University
m.handel@neu.edu

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Direct all correspondence to Michael J. Handel, 500 Holmes Hall, Department of Sociology, Northeastern University, Boston, MA 02118 (m.handel@neu.edu). This research was supported by the National Science Foundation (grant number IIS-0326343), the Russell Sage Foundation, and the Wisconsin Alumni Research Fund.

There is a widespread belief that the skill requirements of jobs are growing significantly and the kinds of skills required are changing as a result of the spread of computer technology and organizational changes that increase employee involvement in workplace decision-making. Researchers across several fields, including sociology, labor economics, education, and public policy analysis, are keenly interested in questions of skill shifts, technology, and workplace reorganization because of their centrality to a number of broader research topics. These topics include:

- growth of wage inequality in the last two decades (Katz and Murphy 1992; Danziger and Gottschalk 1995; Autor, Katz, and Krueger 1998; Morris and Western 1999; Fernandez 2001; Bresnahan, Brynjolfsson, and Hitt 2002)
- earnings and employment prospects of less-skilled workers (Holzer 1996)
- trends in racial inequality, poverty, and movement from welfare to work (Wilson 1996; Moss and Tilly 2001; Holzer and Stoll 2001)
- potential for remediation of inequality through improved education, smoother transitions from school to work, and diffusion of employee involvement or "high performance" workplace practices (Murnane and Levy 1996; Rosenbaum and Binder 1997; U.S. National Commission on Excellence in Education 1983; Smith 1997; Appelbaum, Bailey, Berg, and Kalleberg 2000; Osterman 2000)

All of this research rests on some theory, research conclusions, or assumptions regarding the nature, level, and trend of job skill requirements. However, one problem is that these studies use either rough proxy measures of job skill demands available in nationally

representative data sets or, more rarely, finer measures of job skill demands constructed for unique surveys administered to restricted samples. In addition, almost no survey has equally strong coverage of job skill requirements, technology use, and high performance workplace practices despite their presumed interrelationships. Consequently, researchers have only cloudy information on levels and kinds of job skill requirements, rates of change, and the dimensions along which job skills are changing.

Until recently, existing measures of job skill demands were either indirect, such as the average education levels of workers within occupations, or outdated and otherwise limited, such as the job analysis ratings contained in the Dictionary of Occupational Titles (DOT) (1977) (Cain and Treiman 1981). Few detailed, national surveys of work were conducted since the Quality of Employment Surveys in the 1970s. Many subsequent surveys with small sets of items on job characteristics used subjective rather than behaviorally specific measures, which tend to have significant measurement error (Handel 2000). Other research was based on either special samples (e.g., Holzer 1996) or qualitative cases studies using unstandardized methodologies (e.g., Rosenbaum and Binder 1997). Much of the remaining literature is simply speculative or based on impressionistic evidence (e.g., U.S. Department of Labor. Secretary's Commission on Achieving Necessary Skills 1991).

The U.S. Department of Labor's Occupational Information Network (O*NET) database is a major effort to address some of these issues, but also has some limitations. O*NET will not be fully populated with recent survey data until summer 2008; ratings for some occupations still include recoded information from the DOT from the 1970s. O*NET consists of occupational means, not individual-level data. The measurement of

math, reading, and writing tasks uses rating scales that do not correspond clearly to different objective levels of complexity or easily understood categories of educational achievement. While the O*NET questionnaires have strong coverage of certain content areas, such as various kinds of knowledge, interpersonal skills, physical abilities, and thinking skills, they are weaker on other key content areas, such as information technology and employee involvement practices. Finally, important job characteristics are beyond O*NET's scope, such as promotion opportunities, downsizing/outsourcing, workload, work pace, stress, and pay and benefits.

Additional data from a different perspective can help increase understanding of levels and changes in various job skill requirements and the relationship between skill demands on the one hand and technology, work organization, and other job characteristics on the other.

I. Development of the STAMP Survey

In view of the strong convergence across disciplines in understanding job skill requirements, technology use, and employee involvement (EI) practices the survey of Skills, Technology, and Management Practices (STAMP) was written to address the following questions:

1. How many jobs require what levels of various skills, computer use¹, and participation in employee involvement practices? In other words, what is the skill profile of the American job structure?
2. What are the functional and causal relationships between skill requirements, computer use, and employee involvement?
3. What are the effects of skill requirements, computer use, and EI on wages, working conditions, and other job characteristics and correlates (e.g., work intensity, promotions, layoffs, outsourcing, unionization, job satisfaction)?

4. What are the trends in
 - a. skill requirements, technology, and employee involvement practices?
 - b. their functional and causal interrelationships?
 - c. their relationships to the other outcomes mentioned in point 3 above?

In answering these questions, the STAMP survey tried to improve upon existing measures to reduce error variance and increase the usefulness of findings for different audiences. Hopefully, they will be found worth replicating beyond the second wave of STAMP panel in the future as basic social indicators.

To identify promising items and ideas I conducted an extensive literature review of research in diverse fields, including sociology, industrial relations, labor economics, education, and psychology. Sources consulted included the Handbook for Analyzing Jobs, used by DOT field analysts, job analysis sections of human resource textbooks, and compendia of work measures used in previous research (U.S. Department of Labor 1991; Milkovich and Newman 1993; Cook et al. 1981), as well as other works cited below. I attended a two-day course on job analysis and job evaluation conducted by WorldAtWork (formerly the American Compensation Association) as part of its certification program for compensation professionals in human resource management.² I also drew upon my own experience with measures from existing surveys (Handel 2000, 2006) and reviewed the survey methodology literature for insights on question construction. I wrote an initial version of the survey, which was administered by graduate students in face-to-face interviews with over one hundred workers in diverse occupations in a medium-sized urban area.

The STAMP survey represents an iterative reworking of this earlier version by myself and survey research professionals at the Center for Survey Research (CSR) (University of Massachusetts-Boston), particularly Mary Ellen Colton and Carol Cosenza. I circulated late-stage versions of the instrument to researchers in the field, most with extensive experience conducting work-related surveys, and incorporated their comments into the final survey.³ The Center for Survey Research drew the final sample and conducted the survey, as described further below.

A number of general considerations guided the survey construction. Because of their centrality to current debates, the STAMP survey focuses on skills, technology, and employee involvement. The survey attempts to cover as much ground as possible in all three of these core areas to ensure high content validity. Items were constructed to measure a wide range of levels within different constructs to maximize variability and precision and avoid coarse scales and floor and ceiling effects.

To minimize error variance due to variation in the interpretation of items, the questions and response options were made as concrete and specific as possible. Research within IO Psychology suggests that specific and observable activities are more easily rated by job incumbents than more abstract constructs (Harvey 1991, pp.95ff.; Spector and Fox 2003). To limit the subjectivity of responses, survey questions were phrased in terms of facts, events, and behaviors rather than attitudes, judgments and evaluations, to the extent possible. The goal was to make questions and response options relatively concrete in order to give them as closely similar meanings across respondents as possible.

The kind of questions STAMP tried to avoid is illustrated by an item from the Quality of Employment Survey, which consisted of asking workers to respond to the

statement, "My job requires a high level of skill" (strongly agree, agree, disagree, strongly disagree) (Quinn and Staines 1979). Similar measures are relatively common in the study of work within psychology and elsewhere (Karasek 1979; Cook et al. 1981; pp.170ff.; Kalleberg and Lincoln 1988; Glick, Jenkins, Gupta 1986; Bosma et al. 1997; Fields 2002, pp.72ff.).

There are several potential problems with this kind of question. The blunt wording may induce self-enhancing, i.e., overly positive, responses. The concept of skill is undefined and holistic, requiring respondents to decide for themselves the facets of their job and the dimension of skill to focus on and how to weight their relative importance in deciding on a response option. The response options provide no common benchmark or yardstick that respondents could use in choosing a scale value to associate with their particular job's characteristics. In short, the highly general nature of the question and response choices means that respondents are on their own in interpreting their meanings and judging the response that applies best to their job.

Since most people are not familiar with the full spectrum of occupations and the skills they require, they are likely to evaluate their own job's skill level relative to jobs that are familiar and relatively similar to their own job, rather than evaluate their job relative to the full range of jobs. The difficulty of obtaining self-ratings based on a shared, absolute standard rather than one relative to the respondent's own particular job is a recognized problem within the field of job analysis but it is essential if the ratings are to mean the same thing across people and jobs (Harvey 1991, p.83). Highly abstract and subjective questions are less likely to produce measures with this and other desirable properties.

A related goal was to create response options that are interpretable on the basis of real-world categories that would be meaningful to respondents, researchers, and participants in policy debates. Wherever possible, STAMP avoids vague quantifiers and numbered rating scales used by the DOT, O*NET, and other surveys. For example, STAMP questions on math use at work ask specifically about arithmetic, algebra, geometry, trigonometry, statistics, and calculus, which are directly comparable to categories used in the field of education, rather than O*NET's anchored rating scales, which are not. Responses to these STAMP items can be related easily to existing questions in education and labor market research. Likewise, questions on teams ask about numerous specific areas of decision-making responsibility rather than asking for a more general or holistic rating of team authority.

Realistically, creating measures that conform to these ideals is often difficult due to practical considerations, such as survey length and the genuine diversity of what people do on their jobs. Questions framed in very behaviorally specific terms are less ambiguous but might not be meaningful or applicable to significant numbers of jobs. For example, it is not easy to construct common, behaviorally specific measures for the work intensity or task variety of engineers, real estate brokers, secretaries, police officers, welders, and janitors. Some constructs are difficult to define comparably or compactly across jobs that are qualitatively diverse and whose task content is dimensionally complex. Highly specific questions might be constructed for surveys covering a narrow range of closely related jobs, which is common in job analysis, but the measures cannot be applied to other, dissimilar jobs or used to describe the workforce as a whole. Questions using more general language will apply to a wider variety of jobs but the

wording will be necessarily more vague and subject to varying interpretations, increasing measurement error relative to more behaviorally specific items. Sometimes it is possible to construct a relatively large set of behaviorally specific questions instead of one or a few general items, but the general items are used because the longer battery would crowd out higher priority content, given the practical constraints of interview length.

Admittedly, while the STAMP survey tried to improve upon existing measures by making questions as concrete as possible it could not avoid such tradeoffs altogether.

With any survey of this kind, there is also the issue of the accuracy and reliability of job incumbents' self-reports compared to ratings by trained job analysts or other observers, such as supervisors. Incumbent self-reports may be biased due to motivational reasons, such as a desire to represent oneself in an overly positive light, or cognitive limitations, such as a restricted frame of reference, problems understanding survey questions, and difficulty in making the judgments necessary for accurate ratings or mapping them onto the response options. As one might expect, research finds incumbents generally give their jobs higher ratings than analysts, though the two sets of ratings are usually, though not always, correlated and the differences between incumbents and observers are not always large (Cook et al. 1981, pp.173ff.; Kohn and Schooler 1983, p.67; Lopata et al. 1985, pp.404ff.; Glick et al. 1986, p.449; Gerhart 1987; Harvey 1991, p.112; Cully et al. 1999, p.54; Peterson et al. 1999, pp.67, 241, 292; Manson, Levine, and Brannick 2000, p.16; Leckie et al. 2001, pp.49ff; Green and James 2003).

Trained analysts have more skill and experience rating a wide range of jobs and therefore are better able to know where to place any particular job within the full range of possible values on any given trait. They also do not have the same self-presentation

motives as incumbents. However, job analysts are not necessarily more accurate than incumbents. Their knowledge of any particular job is much less detailed than the incumbent since they observe jobs typically for a short time. Analyst ratings may also be subject to biases such as halo effects or stereotyping. Examples include the gender bias detected in the third edition of the DOT and the possibly conflation of DOT skill ratings with occupational prestige and authority, which are also said to be found in the commercial Hay system of job evaluation used by many corporations (Cain and Treiman 1981, pp.269ff.; Steinberg 1990; Spenner 1983, p.831; Attewell 1990, p.429; Peterson et al. 2001, p.484). Supervisors may also have less knowledge than incumbents or may be subject to similar biases as trained job analysts (Darrah 1994, pp.73ff.; Cully et al. 1999, pp.120, 148, 276ff.; Spector and Fox 2003, p.419; Green and James 2003).

In practice, job analysts themselves usually derive much of their information from interviews with incumbents, though they combine this information with their own and supervisors' observations and judgment. The O*NET system that has replaced the DOT itself largely abandons the use of job analysts in favor of incumbent self-reports because of the difficulty of updating the DOT in a timely and cost-effective fashion (Peterson et al. 1999). Hopefully, the greater use of concrete and objective items and scales in the STAMP survey mitigates any tendencies toward elevated self-reports found with more general items using Likert-style response formats.

Finally, it should be noted that while the STAMP survey tries to cover a lot of ground, an employee survey is not the best method for gathering information on all issues related to current debates. Some questions, such as the effects of industrial sector shifts and international trade on wages and employment, are better addressed with existing data,

such as the Current Population Survey, which has a larger sample, and official trade statistics. Other issues, such as the effects of organizational structure and strategy, are best addressed through employer surveys. A matched employer survey was not part of the research design for the current wave of the STAMP survey, but such information would be useful and could be collected following the methods used to generate the National Organizations Survey from General Social Survey respondents (Kalleberg et al. 1996).

II. STAMP Survey Administration and Sample

STAMP is a random-digit dial telephone survey of employed wage and salary workers in the United States at least eighteen years of age conducted between October 2004 and January 2006 (n=2,304). Eligible individuals were selected randomly within households. All respondents were interviewed with respect to their own jobs, i.e., no proxy reporting, and were paid \$20 for participating in the survey. Three years after the initial interview, respondents will be recontacted for reinterviews and the two waves of data used for modeling career growth and fixed effects models. The second wave will also be refreshed with a new subsample to make it representative of the overall workforce to permit trend analyses across the two waves.

As noted, the final survey is the result of an initial version piloted on over 100 employees in diverse occupations and industries in a medium-sized urban labor market, as modified by iterative revisions conducted by the author and the project team at the Center for Survey Research (CSR) (University of Massachusetts—Boston). Late stage versions were refined after two rounds of cognitive interviewing (21 respondents from

diverse occupations), behavior coding of pretest interviews (n=31), and interviewer debriefing to detect problems in question wording, respondents' understanding of the questions, and respondents' willingness or ability to provide meaningful answers. After minor revisions to address issues that emerged in cognitive interviewing and pretesting, the survey instrument was translated into Spanish and independently backtranslated into English. CSR was able to conduct complete interviews with 66% of those deemed eligible after screening. The average length of the interviews was approximately 28 minutes. STAMP contains about 166 unique items related to job characteristics, as well as other related to personal characteristics.

It is highly likely that STAMP under-represents one large group of non-English speakers, low-skill immigrants. Undocumented immigrants who were eligible for the survey because they spoke Spanish (or English) were likely reluctant to answer questions posed by a stranger about their job due to general fears of deportation. Even government surveys probably have trouble surveying this group. In addition, as with O*NET, workers who speak neither English nor Spanish well enough to be interviewed were ineligible for the STAMP survey by design because of the difficulty and expense of surveying them. Somewhat mitigating the seriousness of this problem is that of the households contacted, only 105 were deemed ineligible due to language barriers. [To do: Get Census estimate of non-English, non-Spanish speakers in U.S. XX] Given the large increase in unskilled immigration to the United States recently, itself somewhat contradicting the skills shortage thesis, the omission of a significant fraction means that the STAMP survey overestimates somewhat the quality of American jobs on dimensions such as skill requirements, technology use, and employee involvement.

If eligible individuals working on a casual basis in low-skill jobs were less likely to report themselves as working, their exclusion from the STAMP survey would also bias upward estimates of the quality of U.S. jobs.

Finally, insofar as job incumbents' self-reports are affected by some form of self-enhancing bias, this will also overstate job skill requirements in the U.S. economy, though some of this will difference out in estimates of trends over time.

III. STAMP Survey Content

Table 1 presents a summary of the content of the STAMP survey. A large group of questions relate to job skill requirements. Defining skill has proven to be somewhat controversial. For the present purposes, skill is defined simply as the ability to perform a task that is relevant to one's job, recognizing that the pecuniary rewards for different skills may be a function of historical patterns, wage-setting institutions, social power, and cultural conceptions, as well as supply and demand (Dunlop 1957; Edwards 1979; Adler and Borys 1989; Attewell 1990; England 1992, 2005).

Phenomenological accounts point to the importance of usually overlooked tacit skills. STAMP does not measure tacit skills directly because by definition they are outside normal awareness and therefore not easily measured in any survey. However, the measured skill differences between occupations is likely little affected because even though jobs considered less skilled may require more tacit skills than even workers themselves recognize (Kusterer 1978), it is likely that jobs considered more skilled require at least as much tacit skills, as well. In addition, STAMP probably captures a

large portion of such skills indirectly through questions on how long it takes people to learn their jobs.

The STAMP items are organized around a relatively conventional categorization of work tasks into cognitive, interpersonal, and physical tasks, following the DOT's data, people, and things schema. The survey uses measures of general human capital that are likely to be meaningful across diverse jobs, such as the level of math, reading, writing, problem-solving, and formal education required. Since highly occupation-specific task items would not be meaningful to most people in a nationally representative sample or comparable across jobs, levels of specific human capital are measured with items on years of previous experience required in related jobs and training time required for the current job. The latter is similar to the DOT's Specific Vocational Preparation variable and is also used by O*NET to stratify jobs into five broad levels ("zones") (Oswald et al. 1999). In addition, certain skills of low to moderate generality related to the use of particular technologies are also measured.

The survey also covers other dimensions frequently considered related to skill such as autonomy, closeness of supervision, authority, managerial responsibilities (cf. Spenner 1983; Kohn and Schooler 1983; Peterson et al. 1999, pp.251f.), as well as technology use, employee involvement, and various aspects of job downgrading that Bluestone and Harrison first described.

IV. Reliability, Validity, and Descriptive Statistics

Tables 2-16 present STAMP question text for the main job characteristics variables, means and proportions for the full sample and by occupation group, and

Cronbach's α for all multi-item scales as a measure of reliability. The order of the tables follows the order of topics in Table 1.

The quality of any set of measures can be judged by several standards of reliability and validity. Like O*NET (Peterson et al. 1999, p.46), STAMP did not collect test-retest reliability correlations and they seem relatively uncommon in the job analysis literature generally (for an exception see Wilson, Harvey, and Macy 1990). Test-retest correlations will be estimated for most variables after the second survey wave using responses for the subsample that did not change employers, occupations, and industries.

A much fuller discussion of the content, construct, and criterion validity of the STAMP items and scales appears in the survey technical report (in progress). Here it is sufficient to note with respect to criterion validity that STAMP did not include an observational component or collect sample work documents, so there is no way to know how accurately job incumbents are representing their job tasks from an external observer's perspective. Such an exercise would be useful for a small validation sample. Cognitive interviews and behavior coding did not suggest respondents had problems understanding the meaning of questions in general, though particular items may have possible problems with overly positive responses. The following tables use an indirect method of assessing criterion validity known as contrasted groups, which compares variable means across groups for which they would be expected to differ, in this case occupation, a method also used by O*NET (Anastasi 1982, pp.140f.; Bohrnstedt 1983, p.98; Peterson et al. 1999). If the skill variables show expected gradients across occupations, for example, this is evidence for their criterion validity.

The occupation groups are defined as follows:

Upper WC = upper white collar (management, professional, technical occupations)

Lower WC = lower white collar (clerical, sales)

Upper BC = upper blue collar (craft and repair workers—e.g., construction trades, mechanics)

Lower BC = lower blue collar (factory workers, truck drivers, etc.)

Service = e.g., food service workers, home health care aides, child care, janitors, police and fire fighters

Certain series of variables also represent varying levels of intensity of a single construct, such as the math, reading, writing, problem-solving, and supervisory duties (Tables 3, 5, 9). If fewer respondents give positive answers for the items intended to measure greater intensity of the latent trait, this is evidence for the items' construct validity (Anastasi 1982).

In general, the item means and proportions show the expected occupational gradients. Reading across rows for the occupational groups in the tables, there is a tendency for the proportion of positive responses to decline, as expected. Likewise, the proportion of positive responses declines within columns for math, reading, writing, problem-solving, and supervisory items, as expected.

Substantively, the results are too numerous to summarize in detail, but several key points can be noted.

The results for the math items in Table 3 show the proportion who use kinds of math more sophisticated than fractions and decimals is much lower than the percentage using simpler math. There is a clear break at this point. While 68% of all employed Americans report doing math using fractions, decimals, and percentages, only 22% report using more sophisticated math on their jobs and for most this means mostly simple algebra. Surprisingly, skilled blue collar workers report using math about as much as

managers and professionals. It seems that fairly basic levels of math, corresponding to two years of ordinary high school instruction, are sufficient for most jobs.

Most people are far more likely to report they read as part of their jobs, including larger than expected numbers for fairly sophisticated forms of reading, such as books and professional journals. It is difficult to devise questions that will measure complexity of reading material through self-reports and the item for professional journals probably represents significant over-reporting relative to what an outside observer might consider a professional journal. In addition, it was anticipated that so few people would read books on their jobs as a regular matter that the item was phrased in terms of whether people ever read work-related books. This choice probably led to over-reporting as well. These issues are discussed in greater detail in the technical report.

Far fewer people report complex writing on their jobs. Outside of managers and professionals, no occupational group has more than 15% reporting they write even five-page papers as a regular part of their job.

Over two-thirds of all wage and salary workers use forms on their jobs, but most people rate them as relatively simple, designating them as level 3 on a complexity rating scale ranging from 0 (extremely simple) to 10 (extremely complicated).

The mean for the education level respondents reported was required for their job was between high school and some post-high school education for all occupational groups except managers and professionals, for whom the mean was between some college and a bachelors degree.

Respondents reported that an average of 2.5 to 3 years of previous related experience was required for their jobs (Table 5). People with the required education and

experience could learn most jobs in one to six months, except for managers/professionals and upper blue collar workers, who required between six months and a year.

About 45% of wage and salary workers reported receiving classroom training paid by their employers in the previous three years, but the specific kind of training did not show clear patterning. One notable finding is that despite all of the discussion of the emphasis on quality, this was the least common form of employer-provided training.

As Table 6 indicates, relatively high proportions of workers responded positively to the various items on interpersonal tasks they might perform on their jobs. Although it is commonly argued that this dimension of work is becoming more important with the growth of the service sector (e.g. Reich 1991), some research suggests it is not recognized in the labor market in the form of higher wages (Glomb et al. 2004). This remains to be tested with the STAMP data.

Table 11 shows that managers/professionals and clerical/sales workers uses roughly five or six computer software applications, while other occupations use a bit less than two applications. A substantial fraction of the workforce uses software applications specific to their line of work (47%), particularly white collar workers (~60%), but relatively few people have had to learn new software within the previous three years (16%). Very few people, generally well under 10%, perform very sophisticated computer tasks, such as SQL programming with database software, programming with languages like C++, Java, or Visual Basic, or science and engineering calculations using a computer. Only about 12% report using macros or formulas with spreadsheet software. In general, most people seem to use computers for fairly mundane office tasks, though

more extensive analysis of these and other computer-related items is needed before firmer conclusions can be drawn.

It does appear that a significant proportion of skilled blue collar workers need a good knowledge of electronics, which may also reflect the increased prevalence of computers (33%). No other occupational group really requires this skill in large numbers, however.

The figures on employee involvement in Table 13 indicate that only about 20% of the workforce is engaged in a formal quality control program and only about a quarter of the workforce belongs to a self-directed work team using criteria derived from the literature on employee involvement. The average team performs a little less than six of the ten functions measured in the STAMP survey, but this drops to less than 1.5 tasks if averaged over the entire workforce. Not surprisingly, teams least commonly performed highly consequential functions usually reserved for management, such as choosing their own leader and conducting peer performance reviews. More surprisingly, a relatively small proportion of teams monitored costs, productivity, and waste, which is supposedly their *raison d'être*.

Finally, Table 16 shows that despite great concerns over outsourcing, relatively few people work in establishments that have transferred work out to other places in the previous three years, though less skilled blue collar workers were significantly more affected than other occupational groups.

V. Conclusion

STAMP was designed as part of a research agenda to help answer a range of specific questions that have been the subject of great interest in recent years across a number of fields.

The preceding represents the beginnings of a skill profile of the American job structure designed to answer the question, What do people do on their jobs? No progress in understanding the current and future skill demands of work is possible without this kind of basic picture using effective measures.

The next task is to fill out this description by providing breakdown of skills, technology, and employee involvement for other groups besides occupation whose work readiness or labor market status have been the focus of particular concern. These include groups defined by age, education, income, industry, race, and gender.

The second wave of the survey will permit analyses of trends to determine whether skill demands are rising and, if so, how quickly and for which dimensions of skill. If future waves of STAMP are funded the series can be treated as basic social indicators to measure long-term rates of change.

More analytically, I plan to model the effects of computer use and employee involvement (EI) on skills to answer the second question posed at the beginning of this paper, namely the role of new technology and workplace reorganization in driving changes in skill demands. This will include examining any mediating impact of computers on skills operating through employee involvement, given the widespread assumption that computers are also helping drive a trend toward EI.

Building on these analyses, the next step will be to investigate the impacts of all three sets of variables (skills, technology, EI) on wages, including the extent to which the

effects of skills on wages can be explained by computer use and EI. The detailed skill measures also mean that any effects of computers on wages can be distinguished as operating directly through the complexity of computer tasks themselves or indirectly through greater general human capital requirements, such as reading, writing, and math, that computer use might engender. The effects of EI on wages and the indirect effects of computers on wages through EI will also be investigated to assess the hypothesis that EI represents a possible path for the remediation of recent inequality growth.

Additional papers will extend the basic structure of these analyses to other outcome variables, such as training, promotions, supervisory duties and organizational position, job loss, downsizing, outsourcing, part-time status, work intensity, unionization, and job satisfaction. Because many of aspects of job quality tend to be less well represented on other existing data sets, the relationships between them and background variables such as age, education, occupation, industry, race, and gender will also be examined because of their intrinsic interest.

The second wave of STAMP panel data will afford several extensions these studies. The descriptive analyses can be put in the perspective of trend analyses. Changes in the strength of all the relationships described above can be examined. Fixed effects models can be estimated to check the robustness of cross-sectional models and purge omitted variable bias. Analyses that regress changes in outcomes on changes in IT use implicitly control for unmeasured permanent characteristics of workers (e.g., abilities, predispositions) that are bound to be associated with IT use and may be the true causes of the outcome of interest.

The second wave will also permit estimation of models of career growth in wages, skill requirements, organizational position, and other job characteristics and their relationship to prior person and job characteristics.

Finally, there are several ways in which the STAMP data could be augmented to improve our understanding of skills, technology, employee involvement, and other job characteristics and their implications for labor market functioning.

1. The validity of the survey measures could be investigated further through the collection of work samples, such as reading materials, which could be compared to survey responses. As discussed in the larger technical report, significant issues in measuring the complexity of survey respondents' reading, writing, and math tasks remain. Using small samples to benchmark existing measures against external observer ratings would be useful.

2. Sociologists and economists have long recognized that labor market outcomes are related to employer as well as worker characteristics. There have been a few efforts to link individual-level and employer-level data. The second wave of STAMP is will ask for employer contact information in order to permit a possible matching employer survey to be conducted if funded. This would follow the design of the National Organizations Survey which interviewed the employers of General Social Survey respondents who provided contact information.

3. The National Assessment of Adult Literacy and its predecessor and international complements, the National Adult Literacy Survey and the International Adult Literacy Survey, established a framework for measuring the literacy levels of populations. Often the results are used to draw conclusions about job competencies in

the absence of detailed information about the complexity of literacy tasks actually performed on the job. These two kinds of assessment, measuring persons and jobs, should be joined in a common instrument to understand the relationship between test scores and job tasks more deeply. Some job tasks, like complexity of problem solving performed on the job, are difficult to measure with an objective metric and probably require adjustment for persons' skills.

4. Concerns over international economic competitiveness have generated much of the concern over skill requirements, education quality, job readiness, and inequality. To address these concerns, the job measures used in STAMP could be replicated cross-nationally, as the personal literacy assessments have been. This would provide some indication of how the skill content, technology use, and other characteristics of American jobs compare to those of other countries.

¹ For ease of exposition, "computer use" is sometimes used as a shorthand to refer to the broader category "computer and other technology use."

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Table 1. STAMP Survey Content (N=number of items)

Basic Job and Organizational Information (N=12)

Occupation, industry, organizational position, organizational and job tenure, union membership, organizational size, organization type

Skill and Task Requirements (N=60)

Cognitive skills (N=48)

Mathematics (n=12)*Reading* (n=8)*Writing* (n=6)*Forms and visual matter* (n=6)*Problem-solving* (n=3)*Education and training requirements* (n=9)*Skill changes in previous three years* (n=4)

Interpersonal job tasks (n=8)

Physical job tasks (n=4)

Supervision, Autonomy, Authority (N=11)

Closeness of supervision

Repetitive work

Autonomy

Supervisory responsibilities over others

Decision-making authority over organizational policies

Computer and Other Technology (N=49)*Machinery and electronic equipment* (n=18)

Level of machine knowledge needed, training time

Set-up, maintenance, and repair

Automation, equipment and tool programming

Computers (n=26)

Frequency of use

Use of fourteen specific applications

Use of advanced program features, occupation-specific, and new software

Training times

Complexity of computer skills required

Adequacy of respondents' computer skills

Computer knowledge and experience in prior jobs among non-users

Other technology (n=5)

Telephone, calculator, fax, bar code reader, and medical, scientific and lab equipment

Employee Involvement (N=18)

Job rotation and cross-training

Pay for skill

Formal quality control program

Teams activity levels, responsibilities, and decision making authority

Bonus and stock compensation

Job Downgrading (N=15)

Work load, pace, and stress

Strike activity

Promotion opportunity

Downsizing, outsourcing, technological displacement

Reductions in pay and retirement and health benefits

Job Satisfaction (N=1)

Table 2. Survey Items: Mathematics, Reading, Writing, and Forms/Visual Matter

Math*At your job, do you:*

1. use math or numbers in any way (e.g., measure or weigh things, count things, work with money)
2. use addition or subtraction
3. use multiplication or division
4. do math using fractions, decimals, or percentages
5. use simple algebra to solve for unknown values
6. use more advanced algebra to solve complex equations
7. use geometry or trigonometry
8. use probability and statistics, such as correlations and regressions
9. use calculus or other advanced mathematics

Reading*As part of your job, do you read:*

1. anything at work, even very short notes or instructions
2. anything at least one page long, including notes, memos, reports, or letters
3. anything at least 5 pages long
4. articles or reports in trade magazines, newsletters, or newspapers
5. articles in scholarly, scientific publications, or professional journals
6. instruction manuals or other reference materials
7. work-related books
8. bills or invoices

Writing*As part of your job, do you write:*

1. anything at work, even very short notes or instructions only a few sentences long
2. anything at least one page long, including notes, memos, reports, or letters
3. anything at least 5 pages long
4. articles or reports for magazines, newspapers, or newsletters
5. books or articles for scholarly, scientific, or professional journals
6. fill out bills or invoices

Forms and Visual Matter

1. As part of your job, do you use or fill out any kind of forms or reports, such as order forms, contracts, reports, or online forms? (y/n)
 2. How many different kinds of forms do you use in an average month (1-2, 3-9, 10+)
 3. How long are most of them (1 page, 2-4 pages, 5+)
 4. How would you rate the complexity of the work you do with forms? (0=extremely simple, 10=very complicated)
 5. As part of your job, do you read things that communicate information in picture form, such as maps, diagrams, floor plans, graphs, or blueprints? (y/n)
 6. Do you write or create [such things]? (y/n)
-

Table 3. Descriptives: Math, Reading, Writing, and Documents

	All	Upper WC	Low WC	Upper BC	Low BC	Service
Math ($\alpha=0.81$)						
1. Any math	0.94	0.95	0.97	0.94	0.91	0.88
2. Add/subtract	0.86	0.93	0.90	0.87	0.78	0.73
3. Multiply/divide	0.78	0.89	0.82	0.81	0.65	0.57
4. Fractions	0.68	0.82	0.68	0.70	0.58	0.40
<i>More advanced</i>	0.22	0.35	0.09	0.41	0.19	0.04
5. Algebra I	0.19	0.30	0.08	0.36	0.16	0.04
6. Geometry/trig	0.14	0.20	0.05	0.29	0.15	0.02
7. Statistics	0.11	0.22	0.05	0.10	0.06	0.02
8. Algebra II	0.09	0.14	0.03	0.16	0.08	0.02
9. Calculus	0.05	0.08	0.01	0.08	0.05	0.01
<i>Mean Level</i>	4.11	4.9	3.7	4.8	3.7	2.8
Reading ($\alpha=0.80$)						
1. Any reading	0.96	0.99	0.97	0.91	0.91	0.95
2. One page	0.82	0.96	0.86	0.72	0.57	0.67
3. Five pages	0.54	0.81	0.47	0.46	0.26	0.32
4. News articles	0.42	0.64	0.37	0.27	0.21	0.24
5. Prof'l articles	0.38	0.65	0.26	0.24	0.15	0.23
6. Books	0.53	0.76	0.40	0.53	0.35	0.38
<i>Mean Level</i>	3.8	5.0	3.5	3.2	2.5	2.9
Writing ($\alpha=0.64$)						
1. Any writing	0.91	0.99	0.93	0.83	0.80	0.83
2. One page	0.61	0.86	0.56	0.46	0.36	0.41
3. Five pages	0.24	0.47	0.13	0.12	0.07	0.09
4. News articles	0.09	0.20	0.04	0.01	0.04	0.03
5. Books/prof'l arts	0.03	0.07	0.00	0.00	0.00	0.02
<i>Mean Level</i>	1.9	2.7	1.7	1.4	1.3	1.4
Documents						
1. Use forms	0.67	0.78	0.77	0.61	0.46	0.46
2. Kinds of forms ^a	1.27	1.51	1.50	1.10	0.84	0.77
3. Form length ^b	0.99	1.23	1.09	0.83	0.62	0.65
4. Form complexity ^c	3.16	3.99	3.65	2.62	1.84	1.86
5. Use visual matter	0.52	0.60	0.41	0.82	0.55	0.31
6. Create visuals	0.32	0.43	0.19	0.62	0.22	0.15

a. 1 = 1-2 different kinds of forms, 2 = 3-9 different kinds, 3 = 10 or more (0=no form use)

b. 1 = one page long, 2 = 2-4 pages, 3 = five or more pages (0=no form use)

c. 1 = extremely simple, 11 = extremely complicated (0=no form use)

Table 4. Survey Items: Problem-Solving, Education, and Training

Problem-solving

Think of “problem solving” as what happens when you are faced with a new or difficult situation and you have to think for a while about what to do next.

1. Some problems are pretty easy and can be solved right away or after getting a little help from others. As part of your job, how often do you have to solve easy? (1=never, 4=often)
2. Other problems are hard to solve right away and require a lot of work to come up with a solution. As part of your job, how often do you have to solve hard? (1=never, 4= often)
3. In average week, about how many hard problems like that do you work on (specify number)?

Education and training

1. What level of formal education do you think is needed by an average person to do your job?
 2. How many years of work experience in other related jobs required for someone with that education would be eligible to be hired for your position?
 3. About how long would it take someone with [*specified*] education and [*specified*] experience to learn to do your job well?
 4. In the past three years, have you had any education or training to improve your work skills or learn new skills?
 - a. (if yes) Was any of that education or training paid for or provided by your current employer?
 - b. (if yes) Was any of that education formal, classroom training?
 - c. (if yes) For the following list, please indicate whether you've had that kind of training:
 - i. Reading, writing, math, or English-language skills
 - ii. Customer service or sales training
 - iii. Managerial or supervisory skills
 - iv. Communication and team skill training
 - v. Quality control techniques
 - vi. Other technical skills for your specific occupation
-

Table 5. Descriptives: Problem-Solving, Education, and Training

	All	Upper WC	Low WC	Upper BC	Low BC	Service
Problem-solving ($\alpha=0.70$)						
1. Easy problems ^a	3.48	3.73	3.40	3.46	3.14	3.29
2. Hard problems ^a	2.79	3.18	2.65	2.84	2.43	2.39
3. # Hard problems ^b	4.78 (2)	5.25 (3)	4.94 (2)	4.52 (2)	3.87 (2)	4.32 (1)
Education, training						
1. Education required ^c	4.15	5.42	3.72	3.49	3.10	3.17
2. Related experience ^d	2.94	3.35	2.65	3.46	2.59	2.37
3. Job learning time ^e	3.35	3.80	3.01	3.95	2.97	2.80
4. Employer training ^f	0.44	0.59	0.34	0.45	0.31	0.35
5. <i>Read, write, math</i>	0.12	0.18	0.04	0.15	0.08	0.12
6. <i>Customer service</i>	0.17	0.19	0.22	0.13	0.1	0.14
7. <i>Management</i>	0.19	0.28	0.15	0.16	0.11	0.15
8. <i>Communication</i>	0.22	0.33	0.16	0.17	0.10	0.17
9. <i>Quality control</i>	0.10	0.11	0.09	0.12	0.11	0.08
10. <i>Other technical</i>	0.26	0.37	0.18	0.31	0.17	0.16

Note: Cronbach's α for problem-solving includes only first two items.

a. 1=never, 2=rarely, 3=sometimes, 4=often

b. Mean (median)

c. 1=8 grade and below, 2=HS dropout, 3=HS, 4=HS + vocational education, 5=some college or two-year degree, 6=BA, 7=more than BA

d. 1=none, 2=<1year, 3=1-2 years, 4=3-5 years, 5=>5 years

e. 1=< one week, 2=one week to one month, 3=between one and six months, 4=six months to one year, 5=over one year

f. Refers to employer-provided formal, classroom training

Table 6. Survey Items: Interpersonal and Physical Tasks

Interpersonal*As part of your job, do you:*

1. ...give people information or advice?
2. ...counsel people or help them with their personal problems?
3. ...regularly have to deal with people in difficult or tense situations, such as people who are hostile, angry, or upset?
4. ...have to teach or train people?
5. ...regularly interview people, for example people applying for loans, government benefits, jobs, or other things?
6. ...give formal presentations lasting at least 15 minutes?
7. ...have any contact with people other than co-workers, for example with customers, clients, students, or the public?
8. Do you ever spend at least 15 minutes talking with someone who is not a co-worker?
9. (If yes) In a usual week, about how often do you talk to someone like that for a period of at least 15 minutes (> once a day, about once a day, a few times a week, about once a week, less often than that)?
10. Using any number from 0 to 10 where 0 is not important at all and 10 is extremely important, what number would you use to rate how important it is to your job to work well with customers, clients, students, or the public?

Physical*At your job, do you:*

1. have to stand or walk for at least 2 hours during your work day?
 2. regularly have to lift or pull anything weighing at least 50 pounds?
 3. have to perform tasks that require very good hand-eye coordination or an especially steady hand?
 4. Using any number from 0 to 10 where 0 is not at all physically demanding and 10 is extremely physically demanding, what number would you use to rate how physically demanding your job is?
-

Table 7. Descriptives: Interpersonal and Physical Tasks

	All	Upper WC	Low WC	Upper BC	Low BC	Service
Interpersonal ($\alpha=0.72$)						
Information	0.92	0.98	0.94	0.86	0.85	0.81
Counseling	0.37	0.50	0.28	0.28	0.26	0.38
Tense situations	0.60	0.65	0.60	0.51	0.49	0.65
Teach/train	0.75	0.86	0.69	0.75	0.67	0.67
Interview	0.18	0.30	0.16	0.07	0.06	0.09
Presentations	0.32	0.57	0.20	0.17	0.11	0.17
Public contact ^a	3.04	3.69	3.45	1.94	1.60	2.79
Self-rated level ^b	7.40	8.79	8.31	5.01	4.21	6.88
<i>Additive scale</i>		0.37	-0.15	-0.58	-0.75	-0.38
Physical ($\alpha=0.79$)						
Stand at least 2 hours	0.67	0.52	0.58	0.90	0.80	0.90
Lift	0.36	0.19	0.27	0.73	0.60	0.48
Coordination	0.57	0.43	0.42	0.89	0.78	0.75
Physical demands ^c	4.59	3.46	3.67	6.67	5.98	6.23
<i>Additive scale</i>		-0.32	-0.20	0.95	0.66	0.65

Note: Additive scales are the standardized sum of items used in calculating Cronbach's α ; scale is in standard deviation units.

a. Six-point scale measuring frequency of contact with people other than co-workers, such as customers, clients, students, or the public (0=none, 5= more than once a day R spends at least 15 minutes speaking to non-coworker).

b. Self-rated importance of working well with customers, clients, students, or the public on respondent's job (0-11).

c. Self-rated physical demands of job (0=not all physically demanding, 10=extremely physically demanding)

Table 8. Survey Items: Autonomy, Repetitiveness, Closeness of Supervision, Authority

1. How much freedom do you have to decide how to do your job in your own way, rather than following a fixed procedure or a supervisor's instructions? (0=no freedom, 10=complete freedom)
2. How often does your work involve carrying out short, repetitive tasks? (1=never, 5=always)
- 3a. How often does your immediate supervisor or his or her assistant check up on what you've done? (1=less often than a few times a week, 4=more than once a day)
- 3b. Overall, how closely supervised are you? (1=no supervision, 4=a large amount)
4. As a regular part of your job, do you supervise the work of other employees? (y/n)
(If yes) Do you have responsibility for...
5. ... deciding work assignments? (y/n)
6. ...disciplining workers for poor work or misconduct? (y/n)
7. ...making formal performance evaluations? (y/n)
8. ...influencing pay and promotion decisions for the people you supervise? (y/n)
9. Do you have the authority to hire or fire workers? (y/n)
10. As part of your job, do you personally participate in making policy decisions about things such as the products or services delivered, the total number of people employed, or budgets? (y/n)

Table 9. Descriptives: Autonomy, Repetitiveness, Closeness of Supervision, Authority

	All	Upper WC	Low WC	Upper BC	Low BC	Service
Autonomy	6.84	7.31	6.62	7.04	6.52	6.23
Repetitiveness	3.58	3.26	3.83	3.45	3.65	3.92
Close supervision	2.20	1.84	2.19	2.69	2.44	2.53
Decision making	0.28	0.44	0.23	0.20	0.13	0.16
<i>Additive scale</i>		0.42	-0.25	-0.19	-0.44	-0.45
Supervisory tasks						
<i>($\alpha=0.84$)</i>						
Supervise others	0.48	0.55	0.41	0.57	0.37	0.44
Work assignments	0.36	0.47	0.29	0.41	0.24	0.28
Discipline	0.25	0.36	0.19	0.25	0.11	0.21
Performance review	0.25	0.37	0.19	0.22	0.15	0.18
Pay and promotion	0.21	0.31	0.18	0.2	0.11	0.11
Hire and fire	0.16	0.26	0.12	0.13	0.06	0.09
<i>Mean tasks</i>	1.22	1.76	0.96	1.21	0.67	0.87

Note: Additive scale is the standardized sum of items used in calculating Cronbach's α ; scale is in standard deviation units.

Table 10. Survey Items: Computer Use

-
1. Frequency of computer use (everyday, a few times a week, less often)
 - Tasks and programs used:*
 2. Use a computer to do data entry
 3. (*if yes*) How much of your time spent on computer doing data entry (most, some, a little)?
 4. Word processing
 5. Spreadsheets
 6. (*if yes*) Do you use advanced functions, such as macros and complex equations?
 7. Other bookkeeping, accounting, or financial software, such as Quickbooks
 8. Presentation graphics, such as PowerPoint
 9. Database programs, such as Access, paradox, or Oracle
 10. (*if yes*) Do you program or write queries using S-Q-L, also called "Sequel?"
 11. Email for your work
 12. Internet for things other than email
 13. Design or build web sites
 14. Use a computer for inventory control
 15. Computer-aided design (CAD)
 16. Use a computer for scientific or engineering calculations, simulations, or statistics
 17. Write programs using a computer language such as C++, Java, Visual Basic, or Perl
 18. Use a computer for graphic design, commercial printing, or desktop publishing
 19. Work with customized or special computer programs found mostly in your line of work that hasn't been mentioned?
 20. (*if yes*) About how long to learn the customized or special program that took the longest to learn (<one week, one week-one month, one-six months, six months-one year, over one year)?
 21. In the last 3 years, have you had to learn any (other) new computer programs or functions taking more than a week to learn?
 22. (*if yes*) How long did the longest one take to learn? (same choices as 16a)
 23. At work, do you ever figure out on your own how to do new things on the computer using manuals, reference books, or online help screens?
 24. How would you rate the computer skills needed to do your job? (0=very basic, 10=very complex)
 25. Do you think you have all the computer skills you need to do your current job well?
 26. Has a lack of computer skills has affected your chances of getting a promotion or pay raise? (y/n)
-

Table 11. Descriptives: Computer and Other Technology Measures

	All	Upper WC	Low WC	Upper BC	Low BC	Service
Computers						
1. Special software	0.47	0.61	0.59	0.23	0.29	0.24
2. New software (3 years)	0.16	0.24	0.16	0.11	0.12	0.06
3. Spreadsheet formulas	0.12	0.21	0.11	0.02	0.06	0.03
4. SQL programming	0.03	0.08	0.01	0.01	0.01	0.01
5. Science/engineering	0.07	0.14	0.03	0.04	0.04	0.02
6. Programming	0.04	0.08	0.02	0.00	0.01	0.01
7. Applications (#)	4.02	6.06	4.68	1.68	1.91	1.41
8. Computer Skill Level ^a	4.21	5.91	5.06	1.95	2.43	1.77
<i>Additive scale</i> ($\alpha=0.71$)		0.42	0.08	-0.87	-0.76	-0.94
Other technology						
1. Heavy Machinery Use	0.20	0.07	0.11	0.65	0.46	0.12
2. Mechanical Skill Level ^b	2.50	1.73	1.38	5.97	4.55	2.12
3. Electronics Skill (y/n)	0.13	0.12	0.08	0.33	0.15	0.09

Note: Additive scale is the standardized sum of items used in calculating Cronbach's α (items 7 and 8); scale is in standard deviation units. Statistics in top panel, including scale, calculated from total sample.

a. Self-rated complexity of computer skills used on job (0=no computer use, 1=very basic, 10=very complex)

b. Self-rated complexity of mechanical skills used on job (0=very basic, 10=very complex)

Table 12. Survey Items: Employee Involvement

-
1. Has employer asked you to learn someone else's job as part of "job rotation" or "cross-training?"
 2. (if yes) Have you received a raise for learning a co-worker's job or part of their job as part of a "pay for skill" program?
 3. Do you participate in a formal quality control program, such as Total Quality Management or Quality Circles, which require employees to monitor defects, errors, or the number of customer complaints and record the information on log sheets, charts, or graphs?

Teams

4. Team member?
5. (if yes) Frequency of meetings?
Is team involved in:
 6. Job assignments (no involvement, suggests, decides on own)
 7. Scheduling work activities (no involvement, suggests, decides on own)
 8. Setting employee schedules (no involvement, suggests, decides on own)
 9. Changing how work is done (no involvement, suggests, decides on own)
 10. New equipment purchases (no involvement, suggests, decides on own)
 11. Choosing team leader (no involvement, suggests, decides on own)
- Does team:*
 12. Monitor quality (yes/no)
 13. Monitor costs, productivity, and waste (yes/no)
 14. Communicate with other departments or with customers or suppliers (yes/no)
 15. Participate in evaluating the job performance of other team members (yes/no)

Non-traditional compensation

16. Receive compensation from employer in the form of company stock in past year?
 17. Receive compensation from your employer in the form of bonuses in past year?
-

Table 13. Descriptives: Employee Involvement Measures

	All	Upper WC	Low WC	Upper BC	Low BC	Service
1. Job rotation	0.53	0.43	0.64	0.48	0.60	0.57
2. Pay for skill	0.10	0.06	0.11	0.08	0.16	0.16
3. TQM/QC	0.20	0.22	0.21	0.17	0.19	0.15
4. Team member ^a	0.26	0.27	0.21	0.28	0.25	0.26
Team functions: ($\alpha=0.69$)						
5. Job assignment ^a	0.20	0.22	0.17	0.26	0.17	0.22
6. Task scheduling ^a	0.18	0.21	0.14	0.19	0.15	0.19
7. Worker scheduling ^a	0.09	0.07	0.08	0.14	0.10	0.13
8. Changing methods ^a	0.18	0.20	0.15	0.22	0.19	0.16
9. New equipment ^a	0.18	0.19	0.14	0.25	0.18	0.17
10. Selecting leader ^a	0.08	0.10	0.05	0.13	0.08	0.04
11. Quality ^a	0.17	0.19	0.13	0.19	0.18	0.13
12. Cost, productivity ^a	0.11	0.12	0.11	0.14	0.12	0.09
13. Cross-communicate ^a	0.20	0.22	0.17	0.21	0.19	0.17
14. Performance review ^a	0.11	0.11	0.09	0.17	0.10	0.13
15. # of team functions ^a	1.41	1.49	1.21	1.81	1.44	1.26
16. # of team functions ^b	5.77	5.63	5.79	6.56	5.75	5.51

Note: Unless noted, all statistics based on full sample. Cronbach's α for team items calculated on sub-sample of team members only. Team functions (items 5-16) were dichotomized for this table such that 0=no involvement and 1=team either suggests and decides on its own.

a. Employees in self-reported management positions were ineligible for this item and coded as zero for calculations.

b. Statistics based on sub-sample belonging to teams.

Table 14. Correlations among STAMP Scales

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Math	1													
2. Read	0.44	1												
3. Write	0.42	0.65	1											
4. Form	0.25	0.33	0.34	1										
5. Form2	0.39	0.47	0.45	1	1									
6. Visual	0.42	0.33	0.31	0.15	0.24	1								
7. Problem	0.39	0.49	0.44	0.23	0.32	0.30	1							
8. Problem2	0.30	0.36	0.32	0.19	0.28	0.21	0.73	1						
9. Interaction	0.34	0.58	0.51	0.31	0.42	0.24	0.49	0.37	1					
10. Physical	-0.07	-0.20	-0.30	-0.13	-0.20	0.04	-0.10	-0.06	-0.09	1				
11. Autonomy	0.28	0.41	0.45	0.21	0.31	0.22	0.24	0.16	0.36	-0.28	1			
12. Supervise	0.21	0.31	0.34	0.22	0.33	0.13	0.21	0.15	0.50	-0.22	0.39	1		
13. Computer	0.42	0.43	0.48	0.37	0.41	0.30	0.37	0.27	0.27	-0.32	0.36	0.26	1	
14. Computer2	0.45	0.55	0.56	0.40	0.50	0.27	0.43	0.32	0.44	-0.44	0.36	0.33	1	1
15. Teams	0.23	0.15	0.15	0.10	0.18	0.19	0.21	0.15	0.23	0.05	0.15	0.23	0.18	0.21
16. Teams2	0.10	0.16	0.09	0.03	0.06	0.13	0.13	0.12	0.14	0.10	0.01	-0.08	0.06	0.08

Note: Variables with a numerical suffix were constructed for entire sample rather than only those eligible for the items and ineligibles were coded zero.

Table 15. Survey Items: Downsizing, Outsourcing, Technological Displacement

1. At the location where you work, does your company or organization employ more, less, or about the same number of people than it did 3 years ago [when you started working there (*if less than three years*)]
2. Would you say there are a lot less or a little less?
3. Have significant numbers of employees permanently laid off?
4. Has a significant part of the work usually done at your workplace been transferred out to be done somewhere else?
5. At any time in the last three years have you been laid off or lost your job?
6. (*if yes*) Was this because a machine or computer replaced your job?
7. Since you started working for your employer, have you participated in a strike or similar labor action?

Table 16. Descriptives: Downsizing, Outsourcing, Technological Displacement

	All	Upper WC	Low WC	Upper BC	Low BC	Service
<i>Employment change</i>						
Employs a lot less	6.0	5.8	4.1	8.1	12.4	2.7
Employs a little less	11.8	11.5	13.8	14.4	10.3	8.9
Employs about same	49.7	47.5	47.2	52.3	46.7	59.7
Employs more	32.5	35.2	34.9	25.3	12.1	28.7
Workplace layoffs	0.08	0.07	0.07	0.07	0.16	0.05
Outsourcing	0.04	0.03	0.03	0.05	0.13	0.02
Personally laid off						
Replaced by machine or computer						
Union membership						
Ever engaged in strike ^a						
Ever engaged in strike ^b						

a. Entire sample

b. Union members only

* Need to check eligibility for personally laid-off item. *