Skill Requirements, Skill Change and Utilization for a Sample of Manufacturing Workers in Grand Erie and Waterloo Wellington

A Report Prepared for the Grand Erie Training and Adjustment Board and the Waterloo Wellington Training and Adjustment Board

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Table of Contents

List of Tables

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Summary

This report summarizes and discusses the results of the 2005 Grand Erie and Waterloo Wellington Skills Survey administered to a random selection of local manufacturing workers between May and August 2005. The purpose of this survey was to address the interests and objectives of the Grand Erie Training and Adjustment Board (GETAB) and the Waterloo Wellington Training and Adjustment Board with respect to the skills needs in local manufacturing. The survey addressed several aspects of occupational skill, examining the skills levels, skills requirements, skills change and skills utilization patterns for ten of HRSDC's *Essential Skills* and ten Occupation-specific (or Cross-Functional) skills derived from the U.S. Occupational Information System (ONET).

The research design revolved around the administration of the survey. A questionnaire was distributed to local manufacturing workers through the random sampling of selected employers. To gain access to workers at these establishments, employer representatives were recruited who could administer and collect the questionnaires from workers on behalf of the researcher and district directors. Sampling and data collection began in March 2004 and ended in September 2004 when the final questionnaires were returned. The generally representative sample includes 153 workers from twelve industrial sectors and 15 establishments.

The survey produced several insightful and important findings. Essential Skills measures are validated against the Occupation-specific O*NET measures. Among the sample of workers, the Essential Skills of Reading, Numeracy and Working with Others score high on requirement measures (i.e., these skills are cited by workers as being requirements for entry into the jobs), highlighting the importance of pre-attained general skills for entry into manufacturing employment. Low requirement levels for Computer Use skills indicate the specialized and job-specific requirements of computer skills.

Skill Change analyses indicate deskilling and upskilling trends over a five year period. Notable Essential Skills decreases are seen for Reading, Numeracy and Writing. Occupation-specific skills decreases are seen among data-oriented skills. Essential Skills increases are seen for Working with Others, Problem-Solving, Computer Use, and Decision-Making. For Cross-Functional skills, Troubleshooting, Operation Control, Operation Monitoring and Coordination skills show the strongest increases.

Analyses of skill level and utilization responses show high levels of skill for Working with Others, Reading and Problem-Solving. High levels of skill performance are demonstrated for the occupation-specific skills of Service and Coordination. People-oriented skills score high on Essential and Cross-Functional skills measures. Utilization results show high levels for Working with Others, Problem-Solving, Numeracy and Reading. Among Cross-Functional skills, task-oriented skills such as Operation Control and Troubleshooting score high.

An analysis of human capital and skill reveals the value of specialized skills training. Workers with some postsecondary credentials score higher on skill level and utilization opportunities than workers with high school credentials or less. This suggests that specialized postsecondary training is an emerging asset in the matching of skills to jobs in manufacturing.

The strongest findings from this study concern the relationship between gender and skill. Women score lower than men on all statistically significant skill measures. These discrepancies are highest for skills involving the ability to use data or the ability to make discretionary decisions.

Rounding out the findings are relationships between job mobility and skills, job tenure and skills, and unionization and skills. These finding highlight the contributions that rewards, commitment and training investments make to the analysis of skill levels and use.

Suggestions for future action include: educating youth on the skills requirements and expectations of manufacturing jobs, particularly the value of social interaction, thinking and computer skills along with the ability to adapt to social and technical change; the ongoing encouragement of youth to complete secondary education credentials that provide solid general (Essential) skills as well as promoting alternative credentials such as PLAR to school-leavers and mature students; encouraging continuing education past high school to acquire specific skills for job-matching purposes; the encouragement of girls and women to see (and receive) value in manufacturing work and for them to participate and excel in math and technical subjects through formal and alternative adult learning avenues.

Suggestions for future research include: examining the occurrence and influence of technological and organization change on local skill needs in manufacturing; researching the form and content of computer use in local manufacturers; urging the inclusion of union perspectives in research; and investigating the training, skills and work perspectives of women in manufacturing employment.

1. Introduction: Background, Objectives and Organization.

Concerns about the state of Canada's labour force development spans over thirty years amidst significant economic and social change, generating an eclectic range of political, economic and social views concerning what skills our workers have and need, and whether the needs of our industries and services are being met. In Central Ontario, these concerns are no different. In this region, profound transformations to the labour force since the 1990s including the consequential loss of major manufacturing employers, the continued growth and stability of technology-oriented occupations (in certain communities), the ongoing growth of service sector employment and organizational restructuring have made skills assessment, adjustment, development and matching initiatives more important than ever.

These processes have brought strong compositional and distributional changes to the availability and attainment of certain skills in the labour force. These changes have implications for our population including the unemployed and underemployed and more specific groups such as youth, women, and new Canadians. To advance our knowledge about skills dynamics in our region, this study employs a selection of the most contemporary Canadian and international skills measures to investigate the skill requirement, change, and composition and utilization patterns for a sample of workers from two labour market areas: Waterloo-Wellington and Grand Erie.

This study focuses on the manufacturing sector. Although attention often focuses on issues related to service sector employment in our communities, manufacturing remains a fundamental creator of jobs and developer of skills. This study focuses on manufacturing workers outside of the skilled trades. However, the skills required for activities such as general assembly or inspection have grown in complexity due to the introduction or incorporation of computerized technologies entailing the interaction with new data and information forms, and greater social interaction on the job. Skilled manufacturing workers are required more than ever. The development and availability of these essential and specialized technical skills are necessary for the successful structure and functioning of local manufacturing employers. These skills also promote the arrival of other manufacturers into the area who are attracted to a skilled labour force. For workers, the possession of these skills offers them opportunities that perhaps were absent before.

In July 2004, Dr. Tim Gawley of Laurier Brantford, Wilfrid Laurier University, approached the Grand Erie Training and Adjustment Board (GETAB), and later the Waterloo Wellington Training and Adjustment Board (WWTAB), with an interest in the goals and activities of these organizations. At that time, Dr. Gawley was interested in conducting a study of skill distribution and composition differences between the two labour market areas of South Central Ontario. A preliminary analysis of 2001 and 1996 Canadian Census data confirmed that the Grand Erie Training and Adjustment Board's area of focus differed on key labour market aspects including lower levels of human capital attainment (in the form of formal education), higher unemployment rates, and a less technology-oriented occupational and industrial base (GETAB, 2004). This was

compared with the Waterloo Wellington Training and Adjustment Board's area that had experienced levels of economic development envied by other Canadian municipalities. It was originally the purpose of this study to gain knowledge about the composition and distribution of skills in these two labour market areas by examining whether a more technology- and service-oriented Waterloo-Wellington district would demonstrate higher levels of labour force and occupational 'upskilling' than the more traditional labour force characteristics demonstrated in the Grand Erie district.

The initial vision of this study turned out to be quite ambitious. It was originally the goal of the project to sample 1000 workers with 500 from Waterloo-Wellington (including the cities of Kitchener-Waterloo, Cambridge, and Guelph) and 500 from Grand Erie (including the city of Brantford, Brant County, and Haldimand and Norfolk counties). The project would randomly survey individuals from all nine occupational groups in accordance with Human Resource and Skills Development Canada's *National Occupation Classification* (HRSDC, 2006a). Following our ongoing discussions and our eventual adaptations to the realities of time, finite energy and funding, the directors of GETAB and WWTAB along with Dr. Gawley chose to turn our attention to skills needs in the manufacturing sector. The study's sample remained random, but smaller with a total of 153 manufacturing workers from 15 employers representing 12 industrial categories. Nevertheless, these numbers produce many insightful results that are statistically representative of the local manufacturing workforce.

The objectives of the original study would change in only one respect; no longer would the Waterloo-Wellington and Grand Erie districts be involved in comparative analysis since the skills differences that typically exist within the manufacturing sector (particularly among occupations involving processing and assembly) would be negligible between the training boards. Instead, this study became a collaborative and aggregated effort between the researcher and the two boards (along with their sponsors) to produce a manufacturing skills study wherein the results could be of benefit to them and other stakeholders throughout each district.

While a comparative analysis of the two districts would change, the following objectives of this study were pursued and achieved with great success. In particular, a primary objective of this study attends to the priorities of both boards concerning the issue of skills needs. In GETAB's "A Community Plan for Action, 2004-2005", it states "Technology, fast-paced change and global competition are demanding a more highly skilled labour force to meet the needs of a knowledge-based economy. There is a need to incorporate workplace skills and training into educational curriculum to ensure a skills match" (GETAB, 2004: 5). The "Plan of Action" further proposes the following options for addressing this issue:

1. Validate HRSD essential skills profiles against local employer needs.
2. Align educational curriculum with essential skills
3. Increase cooperative education, apprenticeship, mentoring and school-work experiences.
4. Promote HRSD Skill programs to address occupations with skills shortages

5. Identify training opportunities for non-students focused on essential workplace skills
6. TOWES – Canada's Essential Credential – Test of Workplace Essential Skills (GETAB, 2004: 5).

This study has contributed to these actions by analyzing HRSDC *Essential Skills* levels for a sample of manufacturing workers in the Grand Erie and Waterloo Wellington regions. The findings demonstrate the validity of *Essential Skills* measures against other occupational skills measures, in particular, the data-, people- and things-oriented skills measures selected from the American Occupational Information Network (O*NET), and are helpful in gauging the skills priorities in these local manufacturing sectors.

In addition to these objectives, this study accomplishes the following:

a. The results advance our knowledge of local skill levels and utilization activities in the manufacturing occupations using the most contemporary skill measures derived from the HRDC *Essential Skills Database* and the U.S. *Occupational Information Network (O*NET).* It was the researcher's interest that O*NET be applied here since it is believed that a cross-national measures of skill can be of benefit to the region, particularly for the interest of prospective international employers from the U.S. who are thinking about the benefits of Canada's labour force. The skills taxonomy included in O*NET also provides measures of occupation-specific skills not necessarily covered by *Essential Skills* or available in Human Resources and Skills Development Canada's *National Occupation Classification*.

b. The study uncovers skill composition and utilization patterns under two different labour market conditions. (i.e., is there upskilling or deskilling among the skills being examined?).

c. The study advances our understanding of how demographic, human capital and structural labour market factors contribute to these skill composition and utilization patterns (e.g., how skill level and utilization patterns differ between women and men within manufacturing).

This report is organized into the following sections. A discussion of the study's research design (including the research method, sampling, data collection, measurement and analysis) is followed by the analysis of findings. The study concludes with a summary and discussion of findings along with recommendations for future research.

2. Research Design.

2.1. Research Method: 2005 Grand Erie and Waterloo Wellington Skills Survey.

A survey in the form of a self-administered questionnaire (Appendix D) was used to collect information on the occupational skill, demographic, human capital and structural labour market characteristics of manufacturing workers in the Waterloo Wellington and Grand Erie districts. The survey asked workers to self-assess the level of skills used at their jobs, the requirements of these skills for entry into their jobs, whether these skills have changed during the past five years and the extent to which they are able to use their own skill levels on the job. The questionnaires were first administered to participating establishments, and eventually to individual workers, by Dr. Tim Gawley and by the directors of the Waterloo-Wellington (WWTAB) and Grand Erie (GETAB) Training and Adjustment Board. It was thought that self-administered questionnaires would minimize the cost of data collection (eliminating the need to hire telephone or face-to-face interviewers, pay for postage, etc.). Self-administration also assured an adequate questionnaire response. The study would remain well within available budgetary resources.

Admittedly, the questionnaire design was a risk. A pretest of the questionnaire was not administered given that the questionnaire's design mirrors the successful questionnaire design pretested by American researchers in the development of the Occupational Information System (O*NET) and the long-standing application of the Essential Skills database by other researchers and organizations (Mumford, Peterson and Childs, 1999: 68; HRSDC(c), 2006). The questionnaire was a long 23 pages. However, the questions were also spread out to four per page, and were highly repetitive. The font size was deliberately large for easy reading. Comments from employer representatives suggest that the workers were completing the questionnaire within a time range of 15 to 30 minutes. This was positive since the original estimated time of completion was 30 to 45 minutes.

2.2. Sampling and Data Collection.

Sampling for this project was greatly influenced by the procedures used in the construction of the United States' Occupational Information System or O*NET (Peterson, Mumford, Levin, Green, and Waksberg, 1999: 34-41). A cluster sampling method was used whereby a random sample of local employers was selected within each of the two districts. A listing of employers in each area was available from directories provided by GETAB and WWTAB that provided an exhaustive list of employers along with their assigned industrial codes (North American Industrial Classification System). From these sampling frames, a random sample of employers was selected using a random numbers table.

After the employers were selected, the researcher then consulted with the directors of GETAB and WWTAB about the realistic availability of the selected

establishments. A number of prospective employers were judged to be more available and willing participants than others. Another random sample was performed to boost the number of available employers. In March and April 2005, and then in August 2005, the randomly selected employers were contacted by e-mail and telephone by the directors of GETAB and WWTAB respectively to request the participation of employers in this study. Beforehand, the directors also promoted the study in newsletters and at meetings with local employers and board sponsors. Ideally, all employers in the sampling frame would agree. However, we did have non-participants and so other establishments would be randomly chosen. Once the establishments agreed to participate, an employer representative was recruited; a person who could distribute the questionnaires to a representative number of workers within their establishment. The workers had to come from National Occupation Classification Major Groups 94 through 96: *Processing and Manufacturing Machine Operators and Assemblers* and *Labourers in Processing, Manufacturing and Utilities*. The selection of workers from each employer would also reflect sex and occupational distributions found in the local 2001 Census data (Regional Analytics and Hamilton Training Advisory Board, CD-ROM).

Once employer representatives (i.e., managers, human resources officers, labour relations officers) were coordinated by the board directors, Dr. Gawley took over by calling or e-mailing the representative to set up a meeting time for questionnaire drop offs. The representatives for each establishment were instructed on how to provide a representative sample along sex and occupational lines. The recruitment of establishments and the selection of representatives progressed well enough so that the administration of questionnaires began in May 2005 and finished in September. The amount of time between the day of the questionnaire drop off and the completion of all questionnaires from a given employer ranged between one week and one month. During these times, follow up telephone calls and e-mails were made to representatives to check on the progress of the questionnaires and to address any issues or concerns that the representative or participating workers were having with the questionnaire. By early September 2005, 153 workers responded to the skills survey from 15 employers representing 12 industrial classifications. The *North American Industrial Classification System* (NAICS) groups covered in this sample can be seen in Appendix A.

2.3. Measurement.

Twenty skill measurements are derived from two sources. The first source is Human Resources Development Canada's *Essential Skills Data Base* (HRSDC, 2006c). Each of these skills is measured according to the following four themes derived from the U.S. Occupational Information System (O*NET):

a) ***Skill Level:*** the level of the skill needed to perform the job as judged by the worker (on a 1-5 point scale)

b) ***Skill Requirements:*** whether the skill is required for entry into the job or whether it is learned on the job (a three point Yes, No or Don't Know scale)

c) ***Skill Change:*** how the performance of a skill has changed from 5 years ago (on a four point scale measuring Skills Decrease, Skills Remaining Unchanged, Skills Increase and Don't Know)

d) ***Skill Utilization:*** how often the worker is able to apply their *own* skills at their job (on a 1-5 point scale).

It is recognized that in the *Essential Skills Database* the numeric scales used to assess skill levels for *Working with Others*, *Thinking Skills* and *Communication* range from 1 to 4, and so there is a slight deviation between the scaling applied in this study from the *Essential Skills* measures. A five point scale is used consistently in this study for skill level and utilization since the remaining *Essential Skills* levels are measured according to a five point scale and the skills measured in the O*NET skills taxonomy also use five point scales. Each of the ten *Essential Skills* chosen for analysis is defined below. These definitions are slightly modified from the definitions provided by HRSDC for clarity of understanding on the part of survey participants.

Reading Text: refers to reading of materials that are in the form of sentences or paragraphs. Reading text involves reading notes, memos, manuals, regulations, books, reports or journals.

Document Use: refers to tasks that involve the display of graphs, lists, tables, blueprints, schematics, drawings, signs or labels.

Numeracy: refers to the use of numbers and the ability to think in mathematical terms. For example, counting money, scheduling or budgeting, taking measurements and data analysis.

Writing: refers to writing text, writing in documents, and non-paper-writing (e.g., computer typing).

Communication: refers to the use of speech to give and share thoughts and information.

Thinking Skills:

a. *Problem-Solving:* refers to proposing solutions to problems. The ability to eliminate possible causes and propose corrections.

b. *Decision Making:* refers to the ability to make choices among different options. For example, deciding which buyers to purchase materials from, or which tools to work with on a project.

c. *Planning and Organizing:* refers to the extent that you are able to plan and organize your own work tasks.

Working with Others: refers to whether you are able to work with others to carry out work tasks. This ranges from working alone, working independently (working around others but performing tasks alone), working in a partnership, to working as a member of a formal team.

Computer Use Skills: refers to various computer use activities ranging from the basic interaction with computer-controlled equipment, multiple operation and use of a wide range of software, to designing, writing and customizing computer programs.

Also included in the *Essential Skills Database* is *Continuous Learning*. The ten skills outlined above were selected because the researcher wanted to apply a series of skills that also measured a worker's performance of *Data, People and Things* skills (DPT). The DPT scale is a common measure of skill in job analysis and is also provided in the NOC *Career Handbook* (HRSDC, 2006b) as an option for assessing the skills of particular occupational titles. Similarly, the ten skills selected from the taxonomy provided by the American Occupational Information System (O*NET) reflect the use of skills associated with the creation, managing and manipulation of data or information, interacting with people or operating things such as tools or machinery. *Continuous Learning* did not easily fit into the DPT scale and therefore was excluded from the analysis. Also, it was important to include skills for which the distinction could be made between task *autonomy and prescription*: skills that express autonomous (or discretionary) task performance and skills that express prescribed task performance. Hence, for *Thinking Skills* the researcher selected *Problem-Solving*, *Decision-Making* and *Planning and Organizing* skills as indicators of autonomous/discretionary skills.

The remaining ten skills come from O*NET (Mumford, Peterson and Childs, 1999: 50-54). The O*NET skills taxonomy provides 46 skills divided into *Basic Skills* (i.e., fundamental skills learned in the educational system and essential to all occupations) and *Cross-Functional Skills* that vary from job to job according to differences in the social and technical aspects of work. The *Basic Skills* available in O*NET parallel those defined in HRSDC's *Essential Skills Data base*, and so the remaining skills for this study measure *Cross-Functional* skills. These skills are selected according to how they reflect a worker's interaction with data, people and things:

Data:

Information Gathering: refers to knowing how to find information and identifying important information.

Information Organizing: refers to the ability to structure and classify multiple pieces of information.

Information Synthesizing: refers to the ability to combine different pieces of information to come up with different ways of doing things.

People:

Social Perceptiveness: refers to being aware of others' thoughts, feelings, and reactions, and understanding why others are thinking, feeling, and reacting the way they are.

Coordination: refers to the ability to adjust your activities in relation to the activities of others.

Persuasion: refers to the ability to convince others to approach things differently.

Service: refers to the ability to actively look for ways to help others.

Things:

Operation Monitoring: refers to watching gauges, dials, or other indicators to make sure that a machine (including computers) is working.

Operation Control: refers to the ability to control the operation of equipment or systems.

Troubleshooting: refers to the ability to determine the cause of errors and make corrections for these errors.

The following measures represent demographic, human capital and structural labour market characteristics in the survey analysis. These were used to build multiple regression models that explain which factors most strongly impact the skill levels and utilization experiences of workers in the GETAB and WWTAB areas.

Demographic and Human Capital Characteristics: Respondent's Age, Respondent's Sex, Highest Level of Education of the Respondent, and Geographic Location of the Respondent's Employment.

Structural Labour Market Characteristics**:** Respondent's Training and Adjustment Board District, Occupational Title of the Respondent, Industry of the Respondent, Respondent's Union Status, Respondent's Job Tenure, Number of Hours Worked per Week by the Respondent, Full-time and Part-time Status of the Respondent, Multiple Job Holder, Firm Size and Whether the Respondent Has Been Promoted At Least Once During the Past Five Years.

2.4. Analysis.

The survey data has been analyzed using the Statistical Package for the Social Sciences (SPSS) Version 13.0. Descriptive statistics have been analyzed for all survey appropriate measures. These include frequencies, percentages and cumulative percentages for all measures. These are available in Appendices A through C. Means and standard deviations are provided where applicable. Multiple regression was also employed to analyze the relationships between demographic, human capital and structural labour market characteristics and skills. The regression statistics reported here include the *regression coefficient* (b), *the standardized regression coefficient or Beta* (β), including the numeric rank of each Beta statistic in the skills model, and the *t-statistic*. These statistics can be interpreted in the following ways.

> ***Regression Coefficient (b):*** this value indicates that for every unit increase in the value of the *independent* measure (in this study these are the demographic, human capital and structural labour market measures), there is a specified unit change in the value of the *dependent* measure (in this study, the dependent variables are either skill level or skill utilization). For example, if the regression coefficient in the relationship between Respondent's Sex and Reading Skill Level is -.5, and females are coded 1 while males are coded 0, then for every unit "increase" in gender (moving from 0 to 1), there is a decline in the level of reading skill, meaning that on average women score .5 points lower on the Reading Skill Level scale than men.
>
> ***Standardized Regression Coefficient or Beta (β)*:** this value is a standardized version of the regression coefficient. It converts variables into a standardized scale of measurement so that the "importance" or "ranking" of measures in a regression model can be determined. By looking at the Beta, if we see that the Respondent's Union Status has a Beta of .061 and Gender has a Beta of -.231 when analyzed against Reading Skill Level, then we can say that Gender is a more "important" factor in the explanation of Reading Skills Level. The positive and negative signs only measure the direction of the relationship and do not denote rank.
>
> ***t-statistic:*** this statistic determines whether the results of a relationship are representative of the wider population at a given level of confidence (95 percent or p.05, 99 percent or p.01, or 99.9 percent or p.001).

In the multiple regression analyses, all demographic, human capital and structural labour market measures were initially entered into what became a model of manufacturing skills. *Correlation coefficients* were calculated for all measures to examine the existence of statistically significant relationships. Demographic, human capital and structural labour market characteristics were correlated with all skills measures to examine which measures, if any, demonstrated consistently significant

associations with skill. After initially including all measures into a model, it was discovered that certain measures were inter-correlated or non-significant to the analyses. These measures were eventually rejected so that in the final regression model, the following nine measures were entered into the model's equation in this sequence:

Whether the Respondent Has Been Promoted At Least Once During the Past Five Years

Respondent's Job Tenure

Number of Hours Worked Per Week by the Respondent

Respondent's Union Status

Firm Size

Respondent's Highest Level of Education

Geographic Location of the Respondent's Employment

Respondent's Sex

Respondent's Age

When reporting the regression results, only those measures that demonstrated consistency and statistical significance were discussed. All non-significant measures are excluded from the findings. The next section reports the findings of the 2005 Grand Erie and Waterloo Wellington Skills Survey.

3. Findings.

3.1. Sample Characteristics: Demographic, Human Capital and Structural Labour Market Characteristics.

Patterns and characteristics of key demographic, human capital and structural labour market characteristics are provided in *Appendix A*. The first table outlines the distribution of survey respondent's according to which training and adjustment board district they come from. The table shows a moderate overrepresentation of workers from the GETAB district (58.8 percent). GETAB employers were approached in April 2005 while WWTAB employers were approached later on in August. The discrepancy is due to the timing of the WWTAB survey administration, but also, directors for the two boards note an apparent 'survey fatigue' in their districts which may partially explain the overall sample size.

The next two tables outline the sex and age distributions of the sample. These are important for they provide a benchmark for the sample's population representation.

Looking at the *Respondent's Sex*, the distribution of Males (63.8 percent) and Females (36.2 percent) demonstrates only a slight overrepresentation of females in the sample. 2001 census data shows an average female manufacturing employment percentage of 34.5 percent between the two training boards. Pending small increases of women in manufacturing since 2001, this sample is generally representative of the population by sex. *Age* distributions show a general representation to the population with most respondents being between the ages of 35 and 54, but certain discrepancies should be noted. The sample overrepresents workers between the ages of 45 and 54, and underrepresents workers between the ages of 15 to 24 (Regional Analytics and Hamilton Training Advisory Board, CD-ROM).

It was the purpose of the study to analyze the human capital levels of manufacturing workers. The Frequency/Percentage table for the *Highest Level of Education of the Respondent* shows that the overwhelming percentage of the sample has completed a high school diploma or a college diploma, trade or vocational certificate (87.6 percent).

In the survey, respondents were asked to provide their full-time or part-time status. The results show that only one worker responded to the part-time option. Therefore, this report presents patterns for full-time workers only. Other results of interest include the *Respondent's Union Status* where 38.4 percent of respondent's belong to a union. Finally, the *Geographic Location of the Respondent's Employment* is reflective of Canadian trends where 24.2 percent of the sample works in rural establishments while 75.8 percent work in urban establishments.

3.2. Essential and Cross-Functional Skills Requirements for Manufacturing Jobs.

Table 1 summarizes the skill requirements for sampled workers. The *Essential Skills Database* offered by HRSDC proposes that the ten skills adopted for this study are essential for the productive performance of tasks in the Canadian occupational structure. The database however recognizes that certain skills are more essential than others under certain contexts. The left half of Table 1 summarizes the percentage of workers who think that the ten *Essential Skills* are required for entry into their jobs; these skills are needed to acquire a job versus those skills that are more likely learned on-the-job. The results confirm the essential character of these skills. First, the average percentage (51.1 percent) for all *Essential Skills* responses is used as a benchmark from which to analyze the skills rankings. Above the average are Reading Skills (67.8 percent), Numeracy (66.4 percent), and Working with Others skills followed by Writing, Document Use and Communication. Overall, these results bode well for any future administration of the *Test of Workplace Essential Skills (TOWES)* that tests the levels of Reading, Document Use and Numeracy Skills of Canadian workers. Below the average are Problem-Solving (46.3 percent) and Planning and Organizing (40.6 percent) followed by Decision-Making and Computer Use (29.7 percent). The vast majority of respondents think that job-related computer skills are learned on-the-job. This is not unusual when information and computer-technologies are specialized

Table 1. Essential and Cross-Functional Skills Requirements for the Jobs of Manufacturing Workers from the GETAB and WWTAB Districts (Percentage of Respondent's Reporting That Skills Are Required For Entry Into Their Jobs).

Essential Skills (N=128)[1]	%	Cross-Functional Skills (N=108)[1]	%
Reading	67.8	Social Perceptiveness	26.9
Document Use	54.4	Coordination	40.9
Numeracy	66.4	Persuasion	18.0
Writing	55.9	Service	27.1
Communication	51.2	Operation Monitoring	47.9
Problem-Solving	46.3	Operation Control	40.8
Decision-Making	39.0	Troubleshooting	32.4
Planning and Organizing	40.6	Information Gathering	24.6
Working With Others	59.9	Information Organizing	29.0
Computer Use	29.7	Information Synthesizing	22.9
All Essential Skills	51.1	All Cross-Functional Skills	31.0

[1] Numbers represent the lowest sample size reported for the twenty Essential Skills and Cross-Functional measures (Computer Use and Social Perceptiveness).

under different production conditions. The other skills are indicative of a worker's need to independently solve-problems, make decisions, plan and organize. Workers believe that such skills are generally not required for entry into their jobs and are acquired after entry.

The right side of Table 1 presents worker responses to whether the ten *Cross-Functional* skills are required for entry into their jobs. Cross-functional skills are defined as skills more likely to be specific to occupations, and so it follows that these skills are expected to receive lower scores than *Essential Skills*. The results confirm the validity of the *Essential Skills* and *Cross-Functional* skills as the average percentage of respondents believing that the cross-functional skills are required for their jobs is 31.0 percent (21.1 percent lower than the *Essential Skills* average). The majority of the *Cross-Functional* skills percentages also fall below this average. Only Operation Monitoring (47.9 percent), Operation Control (40.8 percent) and Troubleshooting (32.4 percent) fall above the respondent average. The remaining skills are primarily learned on the job.

3.3. Skill Change in Manufacturing Jobs, 2000-2005.

In previous studies of skills change, a normal pattern occurs in which the bulk of workers experience no skills change over periods of 3 to 5 years. These patterns are reflected in skills change analysis where the bulk of workers show no change to their skills levels during the past five years. It is more insightful to focus on the respondents who *have* stated some direction of skills change. Table 2 and Table 3 summarize the skill change results. Among the *Essential Skills* in Table 2, the highest percentage of workers stating a skills performance *decrease* are seen for Writing Skills (9.9 percent), Planning and Organizing (8.9 percent), Numeracy (8.4 percent), Reading (7.5 percent) and Computer Use (7.4 percent). The lowest decreases are found for Decision-Making (2.9 percent), Working with Others (4.1 percent) and Document Use (4.9 percent). While these decreased do exist, *they are small* compared to the percentage of respondents whose skills have remained unchanged or have increased.

The highest percentage of workers stating *increases* in the performance of *Essential Skills* are found for Working with Others (66.9 percent), Problem-Solving (65.8 percent), Computer Use (60.7 percent), Planning and Organizing (59.6 percent) and Decision-Making (57.9 percent). Increases are the lowest among workers for Reading (46.9 percent), Numeracy (48.3 percent), Writing (51.8 percent) and Communication (52.9 percent).

Table 2. Skill Change (%) on Ten Essential Skills Measures for a Sample of Manufacturing Workers from the GETAB and WWTAB Districts, 2000-2005.

Essential Skills (N = 135)[1]	Skill Change (%)	
	Decrease	Increase
Reading	7.5	46.9
Document Use	4.9	56.9
Numeracy	8.4	48.3
Writing	9.9	51.8
Communication	5.7	52.9
Problem-Solving	5.5	65.8
Decision-Making	2.9	57.9
Planning and Organizing	8.9	59.6
Working With Others	4.1	66.9
Computer Use	7.4	60.7
All Essential Skills	6.5	56.8

[1] **Number represents the lowest sample size reported for the ten Essential Skills measures (Computer Use Skills).**

Interesting patterns emerge from these results. The highest percentages of workers citing skills *increases* generally correspond with the lowest percentages of skills *decreases*. Working with Others, Computer Use, Problem-Solving, and Decision-Making skills show the highest increases and also show the least number of decreases, indicating a slight 'upskilling' for these skills. 'Deskilling' (the highest percentage decreases corresponding with the lowest percentage increases) is most evident for Reading, Numeracy and Writing. A speculative interpretation of these results suggests that Reading, Numeracy and Writing have decreased for this sample due to the possible adoption of computerized and information technologies that eliminate paperwork or that are equipped with calculation devices that consequently lessen or eliminate the needs for reading, writing and application of numeracy skills. Similarly, while skills such as Reading, Numeracy, Writing and Communication are among the most required skills

(See Table 1), their performance levels are comparatively constant through time in manufacturing while skills such as Working With Others, Problem-Solving, Planning and Organizing and Computer Use are possibly more sensitive to the changes that may have occurred in the social or technical aspects of production among participating employers. Skills synonymous with the need for social and technical adaptation also require periodic upgrades; hence certain employers may be upgrading employee skills through on-the-job training. Generally, these results show an overall increase in the demand for people-oriented and discretion-oriented skills in manufacturing jobs.

Table 3 summarizes the skill change patterns for *Cross-Functional* skills. Skills *decreases* are highest among Social Perceptiveness (7.5 percent), Information Organizing (7.1 Percent), Information Synthesizing (6.8 percent) and Information Gathering (6.3 percent). The lowest decreases are seen among Troubleshooting (3.5 percent), Operation Monitoring (4.3 percent), Coordination (4.4 percent) and Service skills (4.6 percent). The highest skills *increases* are found for Troubleshooting (69.0 percent), Operation Control (65.3 percent) Coordination (62.5 percent) and Operation Monitoring skills (60.3 percent). The lowest *increases* are found among Social Perceptiveness (48.9 percent), Information Gathering (49.6 percent), Persuasion and Information Synthesizing (50.4 percent) followed by Service and Information Gathering.

These results suggest a trend of *deskilling* for Social Perceptiveness skills, and for the Data-oriented skills of Information Gathering, Information Organizing and Information Synthesizing. *Upskilling* is seen among Troubleshooting, Operation Control, Coordination and Operation Monitoring. These results compliment the trends seen in Table 1. It is possible that the adoption of certain technical arrangements by employers during the past five years have contributed to a shift away from application of data-oriented skills as these skills become automated. What happens is a shift from data-oriented skills to skills requiring the Operation monitoring, Control and Troubleshooting of technological operations. Explanations for the upskilling of Coordination skills parallel those offered in the increased use of Working with Others skills: the modification of social interactions (e.g., the adoption of team production) may be accounting for an upskilling in coordination skill.

3.4. Essential Skills Levels and Utilization in Manufacturing Jobs.

The remaining sections of this report focus on the self-reported skill levels and utilization experiences of selected workers. This analysis starts with Table 4 where the means and standard deviations illustrate the skill level and skill utilization judgments of workers for the ten *Essential Skills*. Looking at the left column of Table 4, the average skill level reported for the sample is 2.85 on a scale between 1 and 5, with 1 = a low level of skill and 5 = a high level of skill. The results show that the sampled workers, on average, believe that Working with Others requires the highest level of skill than any other *Essential Skill* (Mean = 4.21) followed by Reading (Mean = 3.11) and Problem-Solving (Mean = 3.06). Also above the average are Decision-Making, Document Use, and Numeracy. Lower than average skill levels are demonstrated by Planning and

Table 3. Skill Change (%) on Ten Cross-Functional Skills Measures for a Sample of Manufacturing Workers from the GETAB and WWTAB Districts, 2000-2005.

Cross-Functional Skills (N = 131)[1]	Skill Change (%)	
	Decrease	Increase
Social Perceptiveness	7.5	48.9
Coordination	4.4	62.5
Persuasion	5.7	50.4
Service	4.6	53.4
Operation Monitoring	4.3	60.3
Operation Control	5.6	65.3
Troubleshooting	3.5	69.0
Information Gathering	6.3	54.5
Information Organizing	7.1	49.6
Information Synthesizing	6.8	50.4
All Cross-Functional Skills	5.6	56.4

[1] **Number represents the lowest sample size reported for the ten Cross-Functional Skills measures (Service Skills).**

Organizing (Mean = 2.77)and Communication (2.61). The lowest skill levels are Writing (Mean = 2.00) and Computer Use (Mean = 1.88).

The right half of Table 4 summarizes results for the extent to which workers are actually able to utilize their own *Essential Skills* at work. The average utilization for all skills is 3.61. Compared to the overall mean, workers seem to be able to utilize their own Working with Others skills most often (Mean = 4.29) followed by Problem-Solving, Numeracy, and Reading. The least utilized skills percentages are Planning and Organizing (Mean = 3.55), Decision-Making, and Writing.

Table 4. Means and Standard Deviations for Skill Level and Utilization Responses on Ten Essential Skills Measures for a Sample of Manufacturing Workers from the GETAB and WWTAB Districts.

Essential Skills	SL (N=141)[1]		SU (N=149)[1]	
	Mean	Standard Deviation	Mean	Standard Deviation
Reading	**3.11**	1.16	**3.78**	1.27
Document Use	**2.96**	1.45	**3.66**	2.92
Numeracy	**2.92**	1.57	**3.82**	1.41
Writing	**2.00**	1.22	**3.02**	1.41
Communication	**2.61**	1.22	**3.60**	1.26
Problem-Solving	**3.06**	1.48	**3.83**	1.22
Decision-Making	**2.99**	1.41	**3.51**	1.37
Planning and Organizing	**2.77**	1.60	**3.55**	4.21
Working With Others	**4.21**	1.24	**4.29**	1.13
Computer Use	**1.88**	1.09	**3.02**	1.52
All Essential Skills	**2.85**	1.34	**3.61**	1.77

SL = Skill Level
SU = Skill Utilization

[1] Numbers represent the lowest sample size reported for the ten Essential Skills measures (Communication and Numeracy Skills).

The results in Table 4 suggest that the highest *Essential Skills* levels required of the manufacturing workers are connected to interacting with people and data. The low level of Computer Use required of workers is consistent with the findings regarding skills requirements and skills change: any computerized technologies are seen by workers to involve lower level tasks.

3.5. Cross-Functional Skills Levels and Utilization in Manufacturing Jobs.

Table 5 summarizes the skills levels and utilization responses of selected manufacturing workers for the ten *Cross-Functional* skills. With respect to skill level, the highest skill levels are seen for Service (Mean = 3.28) followed by Coordination (Mean = 3.27). The people-oriented skills score above average. Similarly, things skills represented by Operation Monitoring (Mean = 3.21), Operation Control (Mean = 3.17) and Troubleshooting also require an above average level of skill. This is consistent with findings thus far where the 'things' skills are required more so than others skills. Scoring below average are Information Organizing (Mean = 2.70), Social Perceptiveness (Mean = 2.66), Information Gathering (Mean = 2.47) and Information Synthesizing.

Skill utilization patterns are consistent with skill requirement and skill change patterns. Skill utilization is highest for Operation Monitoring (Mean = 3.87) followed by Troubleshooting (Mean = 3.79) and Operation Control (Mean = 3.76). Also above average are Coordination (Mean = 3.69) and Information Organizing (Mean = 3.40). Despite the high utilization of Information Organizing skills, among the least utilized skills are Information Synthesizing (Mean = 2.90) and Information Gathering (Mean = 3.27). People skills are also not utilized at high levels including Social Perceptiveness (Mean = 3.07), Persuasion (mean = 3.03) and Service skills (Mean = 3.32). Again, skills associated with material oriented tasks are utilized at the highest levels while interactions with data and people are generally utilized less.

3.6. Human Capital and Skills.

Studies of human capital, or the attainment of formal educational diplomas, degrees or certificates, show that formal educational credentials (also called *general training*) have relatively less influence on the salaries, incomes or mobility of manufacturing workers due to the technical, occupational or industrial structure of manufacturing. Formal educational attainment is most often used as a screening device from which prospective workers can be selected. Compensation and mobility is then influenced by the successful acquisition of job-specific skills and advancement through established promotion or skills levels. In Appendix A, it is evident that an overwhelming majority of selected manufacturing workers have attained at least a completed high school diploma or more (92.8 percent), confirming the importance that the completion of a high school diploma has for job entry into manufacturing.

Table 5. Means and Standard Deviations for Skill Level and Utilization Responses on Ten Cross-Functional Skills Measures for a Sample of Manufacturing Workers from the GETAB and WWTAB Districts

Cross-Functional Skills	SL (N=138)[1]		SU (N=146)[1]	
	Mean	Standard Deviation	Mean	Standard Deviation
Social Perceptiveness	**2.66**	1.31	**3.07**	1.34
Coordination	**3.27**	1.11	**3.69**	1.32
Persuasion	**2.93**	1.25	**3.03**	1.21
Service	**3.28**	1.38	**3.32**	1.43
Operation Monitoring	**3.21**	1.39	**3.87**	1.25
Operation Control	**3.17**	1.46	**3.76**	1.29
Troubleshooting	**3.02**	1.29	**3.79**	1.22
Information Gathering	**2.47**	1.26	**3.27**	1.19
Information Organizing	**2.70**	1.15	**3.40**	1.20
Information Synthesizing	**2.48**	1.22	**2.90**	1.23
All Cross-Functional Skills	**2.92**	1.28	**3.41**	1.27

SL = Skill Level
SU = Skill Utilization

[1] Numbers represent the lowest sample size reported for the ten Cross-Functional Skills measures (Information Synthesizing Skills on both categories).

Interesting to examine however are the possible variations that exist in the skills perceptions between those with a high school diploma or less and those with at least some postsecondary credential. How do the two educational groups see their skill levels? Do these groups see differences in their abilities to use their actual skill levels at their jobs?

Table 6 shows the mean comparisons of skill level and utilization by the respondent's highest level of educational attainment. Only the seven skills for which statistically significant results were found are included. On skill level, *all statistically significant comparisons* show that respondents who's highest level of education exceeds a high school diploma (> H.S.) state higher average skill level ratings than those with High School or Less (≤ H.S). Similarly, when looking at the ability to utilize their skills, workers whose level of educational attainment exceeds a high school diploma also state a higher level of utilization at their jobs than workers who possess a high school credential or less on six of the seven measures. It should be noted that even statistically non-significant skills relationships showed that respondent's with more than a high school education cited higher skill level and utilization responses. These analyses would benefit from an increased sample size.

The majority of workers with postsecondary credentials have completed at least some College, Trade or Vocational certification (34.6 percent have completed these diplomas or certifications). It is likely that these diplomas and certifications provide workers with specialized skills that are more easily judged in comparison to the tasks being performed. Workers whose secondary education is primarily general in nature may be less able to concretely associate skill levels with their own skill capacities. What these results suggest are that workers who evidently possess more specialized forms of training or knowledge are able to perceive their tasks as higher skilled. A tighter skills-to-job match potentially improves one's judgment of skill level and utilization.

3.7. Respondent's Sex and Skills.

Perhaps the most compelling results of the 2005 Grand Erie and Waterloo Wellington Skills Survey is the relationship between Respondent's Sex and skill. The research literature on gender and skill spans over two decades. The relationship between skill level and skill utilization and gender consistently shows that women score lower on skill level and utilization scales than men. Many explanations are offered including the devaluation of work performed by women based on social constructions and biological assumptions, discouraging girls from sciences, mathematics and computer technologies in the education system, the underrepresentation of women in occupational positions where discretionary skills are permitted (e.g., management, leaders), the overrepresentation of women in unskilled sales, service and clerical occupations and the inherent bias of previous occupational and skills classification systems (Boyd, 1990; Horrell, Rubery and Burchell, 1994; Hughes and Krahn, 2000; Steinberg, 1990).

Table 6. Mean Comparisons of Skill Level and Utilization by Respondent's Highest Level of Education on Seven Skills Measures for a Sample of Manufacturing Workers from the GETAB and WWTAB Districts.

Essential Skills	SL(N=141)[1] ≤ H.S.	> H.S.		Mean Difference	SU(N=149)[1] ≤ H.S.	> H.S.		Mean Difference
Document Use	**2.44**	3.34	***	**-0.90**	**3.25**	3.94	**	**-0.69**
Numeracy	**2.37**	3.32	***	**-0.95**	**3.43**	4.09	**	**-0.66**
Decision-Making	**2.68**	3.22	*	**-0.54**	**3.16**	3.73	*	**-0.57**
Computer Use	**1.70**	2.01		**-0.31**	**2.68**	3.26	*	**-0.58**
All Essential Skills	**2.30**	2.97		**-0.68**	**3.13**	3.76		**-0.63**
Cross-Functional Skills	**SL(N=141)[1] ≤ H.S.**	**> H.S.**		**Mean Difference**	**SU(N=147)[1] ≤ H.S.**	**> H.S.**		**Mean Difference**
Coordination	**3.05**	3.43	*	**-0.38**	**3.61**	3.74		**-0.13**
Operation Monitoring	**2.90**	3.44	*	**-0.54**	**3.63**	4.05	*	**-0.42**
Operation Control	**2.98**	3.32		**-0.34**	**3.49**	3.94	*	**-0.45**
All Cross-Functional Skills	**2.98**	3.40		**-0.42**	**3.58**	3.91		**-0.33**

Analysis of Variance: *p≤ .05 **p≤ .01 *** p≤.001

SL = Skill Level
SU = Skill Utilization

M = Males
F = Females

[1] Numbers represent the lowest sample size reported for the selected Essential and Cross-Functional Skills measures (Numeracy and Coordination Skills).

Findings from the Grand Erie and Waterloo Wellington Skills Survey replicate some of these concerns. Table 7 presents the mean comparisons of skill level and utilization by Respondent's Sex on eight *Essential Skills* measures. The table shows that on all statistically significant skills level measures, women on average score lower than men. The largest discrepancies (Mean Differences) between men and women are on Numeracy, Problem-Solving, Document Use and Decision-Making. Skill utilization measures are largely non-significant. However, women's utilization scores are lower and statistically significant for Problem-Solving, Decision-Making and Document Use.

The results are particularly interesting with respect to Problem-Solving, Decision-Making and Numeracy. Problem-Solving and Decision-Making are indicative of the discretionary actions taken on the job which suggests that female respondents not only perceive their levels of Problem-Solving and Decision-Making skills as lower, they also perceive the utilization of these skills to be lower as well. The lower scores on Numeracy level and utilization possibly reflect the socially and historically problematic discouragement, non-involvement or non-recognition of girls and women in mathematics or technical skills.

Table 8 shows the same analysis for *Cross-Functional* skills where women score lower than men on all statistically significance skill level and utilization measures with the largest mean differences being on Troubleshooting, Operation Control, Information Synthesizing and Coordination. Again, women score lower on skills associated with the ability to take authoritative or discretionary actions (such as coordinating activities with others, troubleshooting and controlling operations). The ability to synthesize information also indicates some autonomy and control to manipulate information to arrive at conclusions.

It was defined in the Research Design section (Section 2) that a manufacturing skills model was developed and tested using multiple regressions. Overall, the results of the demographic, human capital and structural labour market measures were inconsistent, but one measure that was among the most powerful and consistent in the model was gender. The following results are from the multiple regressions performed for the skills level and utilization measures for all 20 Essential and Cross-Functional skills. After incorporating all statistically significant demographic, human capital and structural labour market characteristics into each model, Respondent's Sex remained statistically significant for 11 out of the twenty skill level measures and for 4 skill utilization measures. The strength, direction and importance of Respondent's Sex in these regression models are summarized in Table 9.

Table 7. Mean Comparisons of Skill Level and Utilization by Gender on Eight Essential Skills Measures for a Sample of Manufacturing Workers from the GETAB and WWTAB Districts.

Essential Skills	SL(N=140)[1]			Mean Difference	SU(N=149)[1]			Mean Difference
	M	F			M	F		
Reading	**3.36**	2.69	***	**0.67**	**3.91**	3.53		**0.38**
Document Use	**3.23**	2.42	***	**0.81**	**3.91**	3.20	**	**0.71**
Numeracy	**3.32**	2.17	***	**1.15**	**3.97**	3.53		**0.44**
Communication	**2.84**	2.22	**	**0.62**	**3.72**	3.41		**0.31**
Problem-Solving	**3.40**	2.39	***	**1.01**	**4.07**	3.40	**	**0.67**
Decision-Making	**3.26**	2.47	***	**0.79**	**3.83**	2.91	***	**0.92**
Planning and Organizing	**3.00**	2.35	*	**0.65**	**3.65**	3.38		**0.27**
Computer Use	**2.05**	1.58	*	**0.47**	**3.21**	2.72		**0.49**
All Essential Skills	**3.06**	2.29		**0.77**	**3.78**	3.26		**0.52**

Analysis of Variance: *p≤ .05 **p≤ .01 *** p≤.001

SL = Skill Level
SU = Skill Utilization

M = Males
F = Females

[1] **Numbers represent the lowest sample size reported for these Essential Skills measures (Communication Skills, Decision-Making and Planning and Organizing Skills).**

Table 8. Mean Comparisons of Skill Level and Utilization by Respondent's Sex on Eight Cross-Functional Skills Measures for a Sample of Manufacturing Workers from the GETAB and WWTAB Districts.

Cross-Functional Skills	SL(N=138)[1] M	F	Mean Difference	SU(N=146)[1] M	F	Mean Difference
Coordination	**3.53**	2.80 ***	**0.73**	**3.87**	3.36 *	**0.51**
Service	**3.50**	2.88 *	**0.62**	**3.42**	3.15	**0.27**
Operation Monitoring	**3.45**	2.75 **	**0.70**	**4.00**	3.64	**0.36**
Operation Control	**3.44**	2.68 *	**0.76**	**4.03**	3.26 ***	**0.77**
Troubleshooting	**3.33**	2.46 ***	**0.87**	**4.06**	3.30 ***	**0.76**
Information Gathering	**2.64**	2.16 *	**0.48**	**3.37**	3.09	**0.28**
Information Organizing	**2.89**	2.34 **	**0.55**	**3.54**	3.15	**0.39**
Information Synthesizing	**2.74**	2.00 ***	**0.74**	**3.07**	2.58 *	**0.49**
All Cross-Functional Skills	**3.19**	**2.51**	**0.68**	**3.67**	**3.19**	**0.48**

Analysis of Variance: *p≤ .05 **p≤ .01 *** p≤.001

SL = Skill Level
SU = Skill Utilization

M = Males
F = Females

[1] Numbers represent the lowest sample size reported for these Cross-Functional Skills Measures (Information Synthesizing for both skills categories).

Table 9. Multiple Regression Results of Skill Level and Utilization by Sex, With Demographic, Human Capital and Structural Labour Market Characteristics.[1]

	Skill Level (N = 138)[2]		
Essential Skills	***b***	***β (Rank)***	***t (sig.)***
Reading	-.521	**-.217 (1)**	-2.368*
Numeracy	-.753	**-.228 (2)**	-2.594*
Problem-Solving	-.834	**-.269 (2)**	-3.094**
Decision-Making	-.603	**-.206 (1)**	-2.216*
Cross-Functional Skills	***b***	***β (Rank)***	***t (sig.)***
Coordination	-.617	**-.265 (1)**	-2.957**
Service	-.623	**-.219 (2)**	-2.425*
Operation Control	-.737	**-.242 (1)**	-2.621**
Troubleshooting	-.839	**-.312 (1)**	-3.437***
Information Gathering	-.504	**-.194 (2)**	-2.041*
Information Organizing	-.529	**-.222 (3)**	-2.440*
Information Synthesizing	-.812	**-.324 (1)**	-3.502***
Essential Skills	**Skill Utilization (N = 149)[2]**		
	b	***β (Rank)***	***t (sig.)***
Problem-Solving	-.484	**-.194 (1)**	-2.231*
Decision-Making	-.645	**-.227 (1)**	-2.597**
Cross-Functional Skills	***b***	***β (Rank)***	***t (sig.)***
Operation Control	-.610	**-.226 (1)**	-2.541*
Troubleshooting	-.640	**-.251 (1)**	-2.871**

***p≤.05 **p≤.01 ***p≤.001**

[1] Respondent's Sex is coded as 0 = Male and 1 = Female.

[2] Number represents the lowest sample size reported for these Skill measures (Information Synthesizing and Troubleshooting).

On all statistically significant relationships (after the incorporation of all other measures), women score lower on skill level and utilization measures (indicated by the negative signs). The regression coefficients show that females score no less than .504 points lower than men on perceived skill levels (Information Gathering). The highest skill level discrepancies between women and men occur with Troubleshooting (b = -.839), Problem-Solving (b = -.834), Information Synthesizing (b = -.812) and Numeracy (b = -.553), indicating almost a full point discrepancy between men and women on the first three skill levels. The statistically significant skill utilization measures are few, but informative. The largest utilization discrepancies are found for Decision-Making (b = -.645) and Troubleshooting (b = -.640) followed by Problem-Solving and Operation Control. Again, these results suggest that women perceive their skills levels and utilization opportunities to be lower for skills associated with thinking, data-oriented or discretionary activities.

The standardized regression coefficients (β) demonstrate the importance of Respondent's Sex in each of the skills models tested. Respondent's Sex ranks as the most powerful or important measure in 10 of the 15 level and utilization measures, and as the second most important measure in 4 measures. With Respondent's Sex being such an important measure in the regression models, the remaining findings focus on those measures that rivaled Respondent's Sex in their ability to explain variations in skill level and utilization.

3.8. Job Mobility and Skills

Another factor that explains a worker's skill level and utilization is the extent to which the worker is rewarded. To account for these factors, multiple regression analyses included the measure for *Whether the Respondent Has Been Promoted At Least Once During the Past Five Years.* Where this promotion measure was statistically significant, Table 10 shows that respondent's who received at least one promotion during the past five years scores anywhere between .553 (Information Gathering) and .739 (Operational Control) points higher on skill level than those who did not receive at least one promotion. For skill utilization, scores range from .484 (Document Use) to .678 (Reading) higher for promotion receivers than non-receivers.

Table 10. Multiple Regression Results for Skill Level and Utilization by Whether the Respondent Has Been Promoted at Least Once During the Past Five Years, With Demographic, Human Capital and Structural Labour Market Characteristics.[1]

	Skill Level (N = 138)[2]		
Essential Skills	***b***	***β (Rank)***	***t (sig.)***
Document Use	.664	**.214 (1)**	2.559*
Problem-Solving	.600	**.186 (3)**	2.263*
Cross-Functional Skills	***b***	***β (Rank)***	***t (sig.)***
Operation Control	.739	**.232 (2)**	2.666**
Troubleshooting	.600	**.213 (2)**	2.483*
Information Gathering	.533	**.196 (1)**	2.191*
Information Organizing	.559	**.224 (1)**	2.618**
Information Synthesizing	.494	**.188 (2)**	2.138*
	Skill Utilization (N = 149)[2]		
Essential Skills	***b***	***β (Rank)***	***t (sig.)***
Reading	.678	**.245 (1)**	2.958**
Document Use	.484	**.161 (3)**	2.049*
Numeracy	.589	**.194 (3)**	2.329*
Writing	.649	**.214 (2)**	2.785**
Communication	.527	**.194 (1)**	2.332*
Planning and Organizing	.560	**.180 (2)**	2.158*
Computer Use	.548	**.168 (1)**	2.019*
Cross-Functional Skills	***b***	***β (Rank)***	***t (sig.)***
Social Perceptiveness	.625	**.216 (1)**	2.563*
Information Gathering	.503	**.194 (2)**	2.313*

***p≤.05 **p≤.01 ***p≤.001**

[1] Whether the Respondent Has Been Promoted at Least Once During the Past Five Years is coded as 0 = No Promotion and 1 = Promotion.

[2] Number represents the lowest sample size reported for these Skill Level measures (Information Synthesizing and Numeracy Skills).

3.9. Job Tenure and Skills.

Another factor to consider in how manufacturing workers judge their skill level and utilization experiences is a worker's the length of commitment to a job. Table 11 summarizes the multiple regression performances of job tenure in the analysis of all twenty *Essential* and *Cross-Functional* skills. The tenure measure was statistically recoded into two categories; those with less than five years of tenure and those with five years or more of tenure. The results show that, similar to Respondent's Sex and Promotion, statistically significant Tenure measures rank within the top three most important measures in the models. The regression coefficients show that workers with tenure of five years or more score higher on level and utilization than workers with less than five years of tenure. The highest discrepancies among skill level are for Problem-Solving (b = .875) and for Operation Monitoring skills (b =.660). The highest discrepancies on skill utilization are for Numeracy (b = .845), Writing (b = .710) and Document Use (b = .657) while Operation Control shows the greatest discrepancy for Cross-Functional skills utilization. The results suggest that the longer a worker remains at a particular job, the more likely they are to require and use higher levels of thinking or data-oriented skills such as figuring out problems, using numbers, writing, and referring to documentation.

3.10. Unionization and Skills

A fourth and unexpectedly influential measure for the analyses of skill level and utilization is Respondent's Union Status. Being the member of a union remains statistically significant for only twelve analyses, but these analyses are nevertheless informative. Table 12 shows that among the *Essential Skills*, union members score lower on skill levels than non-union members for Planning and Organizing (b = -.782) and Working With Others (b = -.726), with each union instance ranking as the most powerful measure in the respective models. Among *Cross-Functional* skills, union members score lower on skill level for Coordination, Persuasion and Service. In the utilization analysis, union members score lower on the *Essential Skills* of Reading (b = -.478) and Working with Others while utilization levels are lower for union members on the *Cross-Functional* skills of Persuasion (b = -.541) and Coordination (b = -.531).

The results show that unionized respondents score lower on the skill level and utilization measures associated largely with People and Data (or Thinking skills). These results most likely reflect the relational and organizational aspects of local unionization and industries with respect to training investments rather than the motivations of the unions themselves. The People and Data skills presented in Table 12 can also be considered as *general skills.* These are skills that are transferable to jobs in other firms. In manufacturing establishments where union representation is present, the wage levels, training and skills are potentially set by collective bargaining agreements. Therefore the incentive for employers, unions or workers to invest or acquire skills, particularly general skills, is decreased since such training is not necessarily rewarded (Boheim and Booth, 2004). Unionized employees may also have higher than market

Table 11. Multiple Regression Results for Skill Level and Utilization by Respondent's Job Tenure, With Demographic, Human Capital and Structural Labour Market Characteristics.[1]

	Skill Level (N = 141)[2]		
Essential Skills	***b***	***β (Rank)***	***t (sig.)***
Problem-Solving	.875	**.280 (1)**	3.094**
Decision-Making	.555	**.187 (2)**	2.035*
Planning and Organizing	.620	**.184 (2)**	2.029*
Cross-Functional Skills	***b***	***β (Rank)***	***t (sig.)***
Operation Monitoring	.660	**.224 (1)**	2.459*
Information Organizing	.538	**.223 (2)**	2.493*
	Skill Utilization (N = 138)[2]		
Essential Skills	***b***	***β (Rank)***	***t (sig.)***
Document Use	.657	**.225 (2)**	2.726**
Numeracy	.845	**.283 (1)**	3.159**
Writing	.710	**.240 (1)**	2.099*
Communication	.527	**.184 (2)**	2.099*
Decision-Making	.591	**.204 (2)**	2.349*
Planning and Organizing	.572	**.189 (1)**	2.153*
Working With Others	.441	**.185 (3)**	2.167*
Cross-Functional Skills	***b***	***β (Rank)***	***t (sig.)***
Service	.523	**.173 (3)**	2.027*
Operation Control	.682	**.256 (1)**	2.849**
Information Gathering	.595	**.236 (1)**	2.659**

***p≤.05 **p≤.01 ***p≤.001**

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Table 12. Multiple Regression Results for Skill Level and Utilization by Respondent's Union Status, With Demographic, Human Capital and Structural Labour Market Characteristics.[1]

	Skill Level (N = 141)[2]		
Essential Skills	***b***	***β (Rank)***	***t (sig.)***
Planning and Organizing	-.782	**-.238 (1)**	-2.778**
Working With Others	-.726	**-.281 (1)**	-3.386*
Cross-Functional Skills	***b***	***β (Rank)***	***t (sig.)***
Coordination	-.434	**-.188 (2)**	-2.276*
Persuasion	-.579	**-.229 (1)**	-2.568*
Service	-.648	**-.231 (1)**	-2.746**
	Skill Utilization (N = 147)[2]		
Essential Skills	***b***	***β (Rank)***	***t (sig.)***
Reading	-.478	**-.182 (2)**	-2.219*
Working With Others	-.504	**-.217 (2)**	-2.696**
Cross-Functional Skills	***b***	***β (Rank)***	***t (sig.)***
Social Perceptiveness	-.496	**-.178 (2)**	-2.143*
Coordination	-.531	**-.193 (2)**	-2.396*
Persuasion	-.541	**-.219 (1)**	-2.564*
Service	-.486	**-.166 (5)**	-2.041*
Information Gathering	-.470	**-.193 (1)**	-2.301*

***p≤.05 **p≤.01 ***p≤.001**

[1] Respondent's Union Status is coded as 0 = Non-Union Member and 1 = Union Member.

[2] Number represents the lowest sample size reported for these Skill Level measures (Coordination and Social Perceptiveness Skills).

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

competitive wages that affect an employer's ability to invest in training. When making a choice to invest in training, employers are more likely to invest in job-specific training while choosing not to invest in general skills. For unions, job-specific training also provides security for workers. Unions will agree to job-specific skills training as this provides job protection for its members (Doucouliagos and LaRoche, 2003). Alternatively, non-unionized workers may be employed in more flexible product market or wage environments where upgrading and skills adjustments are greater priorities for establishments. Skills such as coordination, persuasion and working in groups are likely to be more essential under these conditions. The most likely scenario for the results in Table 12 is that these skills are general skills which are less likely to receive investments in negotiated wage settings, particularly if these workers are employed in establishments with predictable production markets.

4.0. Summary and Recommendations for Future Action and Research.

The results for the 2005 Grand Erie and Waterloo Wellington Skills Survey provide us with several insights into the skill dynamics of local manufacturing jobs. First, an analysis of Essential Skills requirements highlights the importance of Reading, Numeracy, Writing, and Document Use as prerequisites for entry into manufacturing. While it would be expected that these skills be required, more surprising are the high scores for Working with Others and Communication. Skill requirements, levels and utilization responses suggest that Thinking Skills such as Problem-Solving, Decision-Making and Planning and Organizing are also on the rise. While Computer Use skills were shown to *not be essential* for entry into manufacturing jobs, this does not mean that computer skills are not important. Skill change analyses suggest that Computer Use skills have increased among more workers than most skills during the past five years, exceeded only by Working with Others. Cross-Functional skills analyses show upskilling, high levels of performance and utilization in task- or things-oriented skills such as Troubleshooting, Operation Control and Monitoring. Perhaps it is the possible shift from traditional to computerized and flexible technologies that are responsible for these skills enhancements.

These results indicate that job designs in manufacturing do not necessarily resemble the images of Charlie Chaplin's *Modern Times* in which workers are isolated cogs in an assembly line. Essential for entry into many 21st century manufacturing jobs is the need to work and communicate with others, the ability to think about problems, make decisions and the abilities to plan and organize. This report recommends that youth in particular be educated on the skills requirements and expectations of contemporary manufacturing jobs, particularly the value of social interaction, thinking

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

skills and basic level computer skills along with the ability to adapt to social and technical change. Not all manufacturing jobs entail these skills, however when youth are equipped with these skills and know the possibilities, they can be more selective about whom they provide their skills to.

General skills, in the form the Essential Skills, are extremely important to the success of workers and the productivity of manufacturing employers. These skills are screened upon entry with the completion of a secondary credential and improved with additional postsecondary experiences. However, general skills need to be emphasized and promoted among local youth which means urging them to remain in school to complete at least a secondary degree. Essential and Cross-functional skill results suggest that general job transferable skills such as those relating to thinking, people or information processing are not invested in as highly by employers as occupation-specific skills. This human capital trend is particularly evident among (but not necessarily limited to) unionized employees. Students in school or those requiring alternative learning outlets need to be encouraged to complete and acquire general skills to the best of their abilities. It is recommended that local alternative adult learning options such as Prior Learning Assessment and Recognition (PLAR) also be publicized and promoted for school-leavers or mature students so that general skills are recognized.

The importance of youth education is reinforced when we look at the relationship between human capital and manufacturing skills. The vast majority of workers in our sample have completed a secondary school credential or higher, reinforcing the importance of completing high school in order to even enter manufacturing positions. But students should not stop there. Skills-job matches are achieved to a greater extent among workers who have completed at least some postsecondary credential, particularly a college, trade or vocational credential. Such credentials provide the specific skills that workers need and can use at their jobs. While general skills are essential, specific skills acquired in these postsecondary programs also help workers to perform at higher levels and use their skills to a greater extent.

The most insightful results of this study concern the relationships between Respondent's Sex and skills. Women score lower than men on all (statistically significant) measures of skill level and skill utilization. In particular, the largest discrepancies are found for Thinking Skills (Problem-Solving and Decision-Making) and Document Use. Also problematic is the significant discrepancy in the level and utilization of Numeracy skill. This is especially significant given the apparent increase of these skills among manufacturing workers during the past 5 years. Among Cross-Functional skills, women score lower on Troubleshooting and Information Synthesizing Skills. The common themes running through each of these skills are that these represent thinking and discretionary activities. A couple of explanations for these

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

results are suggested here.

First, women may score lower on these skills if the women in the survey have been systematically undervalued in society or in their jobs. Maybe they see their work as less skilled and therefore will judge their skills lower than men. Second, it has even been suggested in previous studies that since men link their wage work to personal identity more than women, men may see their work as more skilled while women may compare their wage work to other spheres such as family or community activities (Horrell, Rubery and Burchell, 1994). These social processes are difficult to identify in this current study, but this report recommends that girls and women be encouraged to enroll and excel in mathematics and technology-oriented educational curricula in secondary school and beyond. The personal and workplace specific skills that women bring to the manufacturing sector also have to be valued and treated with legitimacy. Also required is the continued promotion of work environments in which women can develop and express their thoughts and skills with value and respect. Perhaps there are activities in the education system or in local social services, either through extracurricular activities, counseling or guidance services, where these issues are being addressed. If these exist, they could be further encouraged and developed.

To conclude, while this study has generated many findings it has also generated topics for further research. A measure that could have been included in the Grand Erie and Waterloo Wellington Skills Survey concerns the presence or experience of social or technological change in local manufacturing establishments. Future research can examine the occurrence and influence of technological and organizational change on local skill needs in manufacturing. Researching the form and content of computer use in local manufacturers is also a topic worth pursuing. The insightful findings associated with union membership and skills suggest that future research strongly encourage the direct inclusion of union perspectives. Finally, our knowledge about skills in this region can benefit from a qualitative investigation of the training, skills and work perspectives of women in manufacturing employment.

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Appendix A
Frequency/Percentage Tables for Demographic, Human Capital and Structural Labour Market Characteristics

Training and Adjustment Board District

District	Frequency	Percent	Cumulative Percent
WWTAB	63.0	41.2	41.2
GETAB	90.0	58.8	100.0
Total	153.0	100.0	

Respondent's Sex

Sex	Frequency	Percent	Cumulative Percent
Male	97.0	63.8	63.8
Female	55.0	36.2	100.0
Total	152.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Respondent's Age

Age Category	Frequency	Percent	Cumulative Percent
15-24	11.0	7.2	7.2
25-34	21.0	13.8	21.1
35-44	39.0	25.7	46.7
45-54	61.0	40.1	86.8
55-64	20.0	13.2	100.0
Total	152.0	100.0	

Highest Level of Education of the Respondent

	Frequency	Percent	Cumulative Percent
Less Than Grade 9	3.0	2.0	2.0
Grade 9 to 10	8.0	5.2	7.2
Grade 11 to 13	52.0	34.0	41.2
Some College, Trade or Vocational	29.0	19.0	60.1
College Dip., Trade and Voc. Cert.	53.0	34.6	94.8
Some University	4.0	2.6	97.4
University Bachelor's Degree	2.0	1.3	98.7
Professional Degree	1.0	0.7	99.3
Other	1.0	0.7	100.0
Total	153.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Respondent's Job Tenure

	Frequency	Percent	Cumulative Percent
Less Than 6 Months	7.0	4.7	4.7
7 to 12 Months	10.0	6.7	11.4
13 to 24 Months	14.0	9.4	20.8
25 to 36 Months	7.0	4.7	25.5
37 to 48 Months	12.0	8.1	33.6
More than 5 Years	99.0	66.4	100.0
Total	149.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Number of Hours Worked per Week by the Respondent

	Frequency	Percent	Cumulative Percent
20 Hours or Less	2.0	1.3	1.3
21-40 Hours	79.0	52.7	54.0
41-50 Hours	67.0	44.7	98.7
More Than 50 Hours	2.0	1.3	100.0
Total	150.0	100.0	

Current Job Title of the Respondent (Occupation)

Occupational Title	Frequency	Percent	Cumulative Percent
Folder	1.0	0.7	0.7
Shipping/Receiving	4.0	2.7	3.4
Bindery Supervisor/Worker	3.0	2.1	5.5
Press Feeder	2.0	1.4	6.8
Press/Printer Operator	3.0	2.1	8.9
Supervisor	1.0	0.7	9.6
Production Operator/Assembler	81.0	55.5	65.1
Plastic Welder	2.0	1.4	66.4
Sewing Machine Operator	6.0	4.1	70.5
Forklift Operator	1.0	0.7	71.2
Mill Wright	2.0	1.4	72.6
Technician	12.0	8.2	80.8
Oiler/Greaser	1.0	0.7	81.5
Process Assistant	1.0	0.7	82.2
Maintenance	4.0	2.7	84.9
Testing/Inspection	4.0	2.7	87.7
Designer	1.0	0.7	88.4
Tool and Die	5.0	3.4	91.8
Mechanics	1.0	0.7	92.5
Builder	1.0	0.7	93.2
Fabricator	2.0	1.4	94.5
Team Leader	2.0	1.4	95.9
Electrical	6.0	4.1	100.0
Total	146.0	100.0	

[1] **Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.**

[2] **Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).**

Worker's Job Position Compared To Five Years Ago

Worker's Job Position	Frequency	Percent	Cumulative Percent
Hold Different Position	61.0	39.9	39.9
Hold Same Position	92.0	60.1	100.0
Total	153.0	100.0	

Whether the Respondent Has Been Promoted At Least Once During the Past Five Years

Promotion	Frequency	Percent	Cumulative Percent
No Promotion	104.0	70.3	70.3
Promotion	44.0	29.7	100.0
Total	148.0	100.0	

Full-time or Part-time Status of the Respondent.

	Frequency	Percent	Cumulative Percent
Full-time	149.0	99.3	99.3
Part-time	1.0	0.7	100.0
Total	150.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Respondent's Union Status.

	Frequency	Percent	Cumulative Percent
Non-Union Member	93.0	61.6	61.6
Union Member	58.0	38.4	100.0
Total	151.0	100.0	

Firm Size

	Frequency	Percent	Cumulative Percent
0-49	3.0	2.0	2.0
50-99	25.0	16.4	18.4
100-199	30.0	19.7	38.2
200-499	57.0	37.5	75.7
500 or more	37.0	24.3	100.0
Total	152.0	100.0	

Multiple Job Holder Status of the Respondent

	Frequency	Percent	Cumulative Percent
No	136.0	88.9	89.5
Yes	16.0	10.5	100.0
Total	152.0	99.3	100.0

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Geographic Location of the Respondent's Employment

	Frequency	Percent	Cumulative Percent
Rural	37.0	24.2	24.2
Urban	116.0	75.8	100.0
Total	153.0	100.0	

Industry of the Respondent (NAICS)

	Frequency	Percent	Cumulative Percent
Food, Beverage and Tobacco Products: NAICS Codes 311, 312	14.0	9.2	9.2
Apparel Manufacturing: NAICS Code 315	3.0	2.0	11.2
Printing and Related Support Activities: NAICS Code 323	14.0	9.2	20.4
Chemical Products: NAICS Code 325	11.0	7.2	27.6
Nonmetallic Mineral Products: NAICS Code: 327	9.0	5.9	33.5
Fabricated Metal Products: NAICS Code: 332	33.0	21.6	55.1
Machine Manufacturing NAICS Code: 333	44.0	28.8	83.9
Computer and Electronics: NAICS Codes 334, 335	9.0	5.9	89.8
Transportation Equipment NAICS Code: 336	6.0	3.9	93.7
Miscellaneous Manufacturing NAICS Code: 339	10.0	6.5	100.0
Total	153.0	100.0	

[1] **Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.**

[2] **Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).**

Appendix B
Frequency/Percentage Tables for Skills Requirements: Essential and Cross-Functional Skills

1. Essential Skills:

Reading Skills Required for Entry Into the Job?

Reading Skills Requirements	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	47.0	32.2	32.2
Yes, Required for Entry	99.0	67.8	100.0
Total	146.0	100.0	

Document Use Skills Required for Entry Into the Job?

Document Use Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	68.0	45.6	45.6
Yes, Required for Entry	81.0	54.4	100.0
Total	149.0	100.0	

Numeracy Skills Required for Entry Into the Job?

Numeracy Skills Requirements	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	47.0	33.6	33.6
Yes, Required for Entry	93.0	66.4	100.0
Total	140.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Writing Skills Required for Entry Into the Job?

Writing Skills Requirements	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	60.0	44.1	44.1
Yes, Required for Entry	76.0	55.9	100.0
Total	136.0	100.0	

Communication Skills Required for Entry Into the Job?

Communication Skills Requirements	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	63.0	48.8	48.8
Yes, Required for Entry	66.0	51.2	100.0
Total	129.0	100.0	

Problem-Solving Skills Required for Entry Into the Job?

Problem-Solving Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	79.0	53.7	53.7
Yes, Required for Entry	68.0	46.3	100.0
Total	147.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Decision-Making Skills Required for Entry Into the Job?

Decision-Making Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	83.0	61.0	61.0
Yes, Required for Entry	53.0	39.0	100.0
Total	136.0	100.0	

Planning and Organizing Skills Required for Entry Into the Job?

Planning/Organizing Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	85.0	59.4	59.4
Yes, Required for Entry	58.0	40.6	100.0
Total	143.0	100.0	

Working With Others Skills Required for Entry Into the Job?

Working With Others Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	59.0	40.1	40.1
Yes, Required for Entry	88.0	59.9	100.0
Total	147.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Computer Use Skills Required for Entry Into the Job?

Computer Use Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	90.0	70.3	70.3
Yes, Required for Entry	38.0	29.7	100.0
Total	128.0	100.0	

2. Cross-Functional Skills:

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Social Perceptiveness Skills Required for Entry Into the Job?

Social Perceptiveness Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	79.0	73.1	73.1
Yes, Required for Entry	29.0	26.9	100.0
Total	108.0	100.0	

Coordination Skills Required for Entry Into the Job?

Coordination Skills Requirements	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	78.0	59.1	59.1
Yes, Required for Entry	54.0	40.9	100.0
Total	132.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Persuasion Skills Required for Entry Into the Job?

Persuasion Skills Requirements	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	100.0	82.0	82.0
Yes, Required for Entry	22.0	18.0	100.0
Total	122.0	100.0	

Service Skills Required for Entry Into the Job?

Service Skills Requirements	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	94.0	72.9	72.9
Yes, Required for Entry	35.0	27.1	100.0
Total	129.0	100.0	

Operation Monitoring Skills Required for Entry Into the Job?

Operation Monitoring Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	73.0	52.1	52.1
Yes, Required for Entry	67.0	47.9	100.0
Total	140.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Operation Control Skills Required for Entry Into the Job?

Operation Control Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	87.0	59.2	59.2
Yes, Required for Entry	60.0	40.8	100.0
Total	147.0	100.0	

Troubleshooting Skills Required for Entry Into the Job?

Troubleshooting Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	94.0	67.6	67.6
Yes, Required for Entry	45.0	32.4	100.0
Total	139.0	100.0	

Information Gathering Skills Required for Entry Into the Job?

Information Gathering Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	104.0	75.4	75.4
Yes, Required for Entry	34.0	24.6	100.0
Total	138.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Information Organizing Skills Required for Entry Into the Job?

Info. Organizing Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	98.0	71.0	71.0
Yes, Required for Entry	40.0	29.0	100.0
Total	138.0	100.0	

Information Synthesizing Skills Required for Entry Into the Job?

Info. Synthesizing Skills Req.	Frequency	Percent	Cumulative Percent
No, Learned On-the-Job	101.0	77.1	77.1
Yes, Required for Entry	30.0	22.9	100.0
Total	131.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Appendix C
Frequency/Percentage Tables for Skills Change Results: Essential and Cross-Functional Skills

1. Essential Skills:

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Reading Skills Change Since Five Years Ago.

Reading Skills Change	Frequency	Percent	Cumulative Percent
Decreased	11.0	7.5	7.5
Unchanged	67.0	45.6	53.1
Increased	69.0	46.9	100.0
Total	147.0	100.0	

Document Use Skills Change Since Five Years Ago.

Document Use Skills Change	Frequency	Percent	Cumulative Percent
Decreased	7.0	4.9	4.9
Unchanged	55.0	38.2	43.1
Increased	82.0	56.9	100.0
Total	144.0	100.0	

Numeracy Skills Change Since Five Years Ago.

Numeracy Skills Change	Frequency	Percent	Cumulative Percent
Decreased	12.0	8.4	8.4
Unchanged	62.0	43.4	51.7
Increased	69.0	48.3	100.0
Total	143.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Writing Skills Change Since Five Years Ago.

Writing Skills Change	Frequency	Percent	Cumulative Percent
Decreased	14.0	9.9	9.9
Unchanged	73.0	51.8	61.7
Increased	54.0	38.3	100.0
Total	141.0	100.0	

Communication Skills Change Since Five Years Ago.

Communication Skills Change	Frequency	Percent	Cumulative Percent
Decreased	8.0	5.7	5.7
Unchanged	58.0	41.4	47.1
Increased	74.0	52.9	100.0
Total	140.0	100.0	

Problem-Solving Skills Change Since Five Years Ago.

Problem-Solving Skills Change	Frequency	Percent	Cumulative Percent
Decreased	8.0	5.5	5.5
Unchanged	42.0	28.8	34.2
Increased	96.0	65.8	100.0
Total	146.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Decision-Making Skills Change Since Five Years Ago.

Decision-Making Skills Change	Frequency	Percent	Cumulative Percent
Decreased	4.0	2.9	2.9
Unchanged	55.0	39.3	42.1
Increased	81.0	57.9	100.0
Total	140.0	100.0	

Planning and Organizing Skills Change Since Five Years Ago.

Planning/Organizing Skills Change	Frequency	Percent	Cumulative Percent
Decreased	13.0	8.9	8.9
Unchanged	46.0	31.5	40.4
Increased	87.0	59.6	100.0
Total	146.0	100.0	

Working With Others Skills Change Since Five Years Ago.

Working With Others Skills Change	Frequency	Percent	Cumulative Percent
Decreased	6.0	4.1	4.1
Unchanged	43.0	29.1	33.1
Increased	99.0	66.9	100.0
Total	148.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Computer Use Skills Change Since Five Years Ago.

Computer Use Skills Change	Frequency	Percent	Cumulative Percent
Decreased	10.0	7.4	7.4
Unchanged	43.0	31.9	39.3
Increased	82.0	60.7	100.0
Total	135.0	100.0	

2. Cross-Functional Skills:

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Social Perceptiveness Skills Change Since Five Years Ago.

Soc. Perceptiveness Skills Change	Frequency	Percent	Cumulative Percent
Decreased	10.0	7.5	7.5
Unchanged	58.0	43.6	51.1
Increased	65.0	48.9	100.0
Total	133.0	100.0	

Coordination Skills Change Since Five Years Ago.

Coordination Skills Change	Frequency	Percent	Cumulative Percent
Decreased	6.0	4.4	4.4
Unchanged	45.0	33.1	37.5
Increased	85.0	62.5	100.0
Total	136.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Persuasion Skills Change Since Five Years Ago.

Persuasion Skills Change	Frequency	Percent	Cumulative Percent
Decreased	8.0	5.7	5.7
Unchanged	62.0	44.0	49.6
Increased	71.0	50.4	100.0
Total	141.0	100.0	

Service Skills Change Since Five Years Ago.

Service Skills Change	Frequency	Percent	Cumulative Percent
Decreased	6.0	4.6	4.6
Unchanged	55.0	42.0	46.6
Increased	70.0	53.4	100.0
Total	131.0	100.0	

Operation Monitoring Skills Change Since Five Years Ago.

Op. Monitoring Skills Change	Frequency	Percent	Cumulative Percent
Decreased	6.0	4.3	4.3
Unchanged	50.0	35.5	39.7
Increased	85.0	60.3	100.0
Total	141.0	100.0	

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Operation Control Skills Change Since Five Years Ago.

Operation Control Skills Change	Frequency	Percent	Cumulative Percent
Decreased	8.0	5.6	5.6
Unchanged	42.0	29.2	34.7
Increased	94.0	65.3	100.0
Total	144.0	100.0	

Troubleshooting Skills Change Since Five Years Ago.

Troubleshooting Skills Change	Frequency	Percent	Cumulative Percent
Decreased	5.0	3.5	3.5
Unchanged	39.0	27.5	31.0
Increased	98.0	69.0	100.0
Total	142.0	100.0	

Information Gathering Skills Change Since Five Years Ago.

Info. Gathering Skills Change	Frequency	Percent	Cumulative Percent
Decreased	9.0	6.3	6.3
Unchanged	56.0	39.2	45.5
Increased	78.0	54.5	100.0
Total	143.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

Information Organizing Skills Change Since Five Years Ago.

Info. Organizing Skills Change	Frequency	Percent	Cumulative Percent
Decreased	10.0	7.1	7.1
Unchanged	61.0	43.3	50.4
Increased	70.0	49.6	100.0
Total	141.0	100.0	

Information Synthesizing Skills Change Since Five Years Ago.

Info. Synthesizing Skills Change	Frequency	Percent	Cumulative Percent
Decreased	9.0	6.8	6.8
Unchanged	57.0	42.9	49.6
Increased	67.0	50.4	100.0
Total	133.0	100.0	

[1] Respondent's Job Tenure is coded as 0 = Less Than 5 Years, 1 = Five Years or more.

[2] Number represents the lowest sample size reported for these Skill Level measures (Operation Monitoring, Numeracy and Service Skills).

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