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PATHWAYS TO EQUITY

Narrowing the Wage Gap by
Improving Women's Access
to Good Middle-Skill Jobs



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ABOUT THIS REPORT

This report addresses women's access to well-paid, growing, middle-skill jobs (jobs that do not require a bachelor's degree). It documents sex segregation in middle-skill jobs, and discusses how gender integration of good jobs could both reduce skill-shortages and improve women's economic security. The report focuses on middle-skill "target" occupations in manufacturing, information technology, and transportation, distribution, and logistics that have high projected job openings and that typically employ few women. Using an innovative methodology based on the U.S. Department of Labor's O*Net database, Marc Bendick, Ph.D., of Bendick and Egan Economic Consultants, Inc, joined IWPR researchers Ariane Hegewisch, Barbara Gault, Ph.D., and Heidi Hartmann, Ph.D. to identify lower paid predominantly female occupations that share many of the characteristics of the "target" occupations and can serve as "on-ramp" occupations to good middle-skill jobs for women seeking to improve their earnings, and employers looking to fill the vacancies. The report is part of the Institute for Women's Policy Research's *Pathways to Equity: Women and Good Jobs* initiative, funded by a grant from the JPMorgan Chase Foundation as part of its \$250 million, five-year New Skills at Work initiative.

More information and a full list of growing well-paid middle-skill occupations with potential "on-ramp" occupations for women can be found at www.womenandgoodjobs.org.

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The Institute for Women's Policy Research (IWPR) conducts rigorous research and disseminates its findings to address the needs of women, promote public dialogue, and strengthen families, communities, and societies. The Institute's research strives to give voice to the needs of women from diverse ethnic and racial backgrounds across the income spectrum and to ensure that their perspectives enter the public debate on ending discrimination and inequality, improving opportunity, and increasing economic security for women and families. The Institute works with policymakers, scholars, and public interest groups to design, execute, and disseminate research and to build a diverse network of individuals and organizations that conduct and use women-oriented policy research. IWPR's work is supported by foundation grants, government grants and contracts, donations from individuals, and contributions from organizations and corporations. IWPR is a 501(c)(3) tax-exempt organization that also works in affiliation with the women's studies and public policy and public administration programs at The George Washington University.

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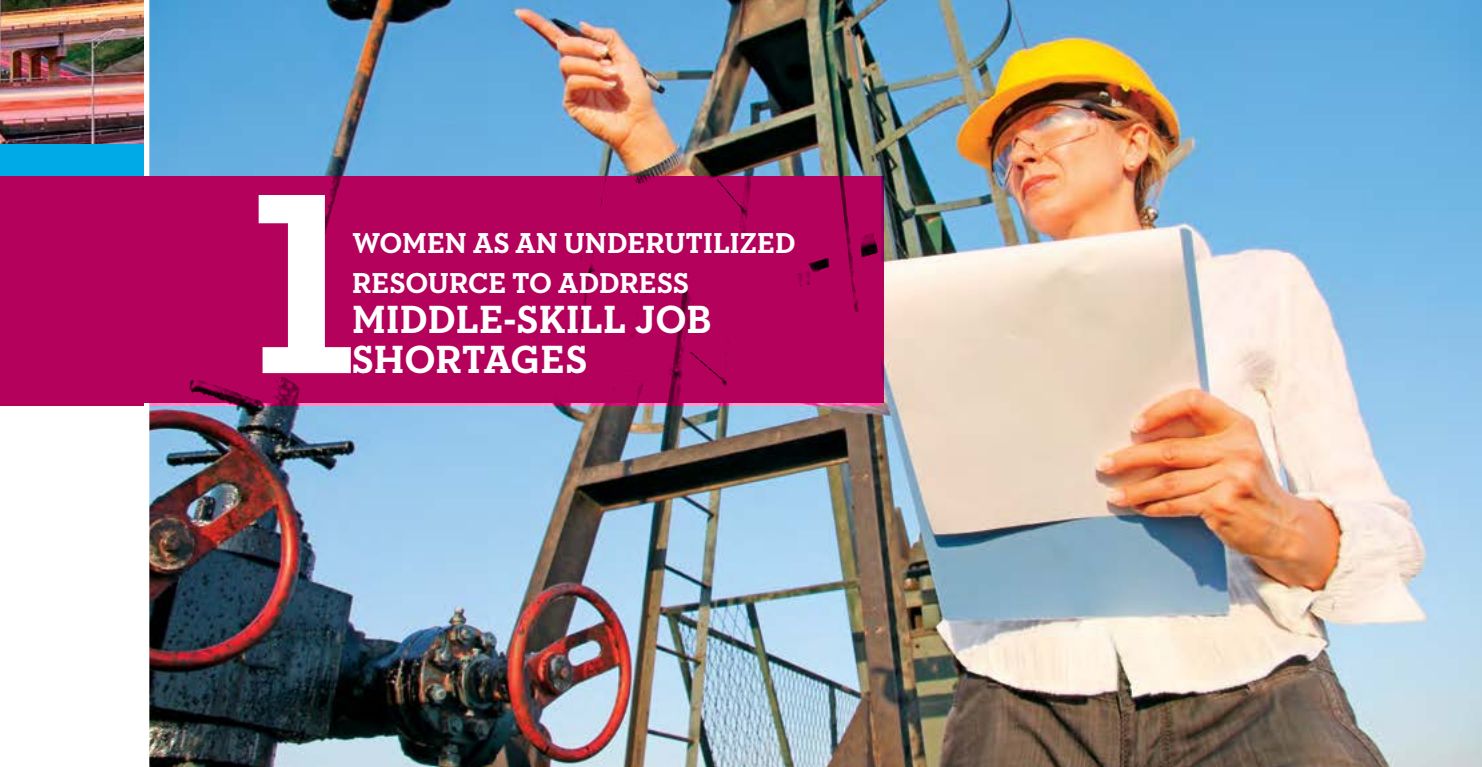
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1 WOMEN AS AN UNDERUTILIZED RESOURCE TO ADDRESS MIDDLE-SKILL JOB SHORTAGES

Introduction

Many middle-skill jobs—those jobs that require more than a high school diploma but less than a bachelor’s degree—offer the potential of employment with family-sustaining earnings. Well over a third of all workers (37.2 percent) are employed in these occupations, and over a third (34.4 percent) of all projected job openings are in middle-skill occupations.¹ While not all middle-skill occupations offer family-sustaining wages, the majority of projected job openings (55 percent) are in occupations with median annual earnings of at least \$35,000,² and may be stepping stones to higher paid careers. Many employers report difficulty finding workers to fill vacancies in middle-skill occupations, including in the key growth sectors of advanced manufacturing; transportation, distribution, and logistics;

and information technology (Accenture et al 2014; National Skills Coalition 2014).

Women are only 29 percent of workers in growing middle-skill IT occupations, and they are fewer than 10 percent of workers in growing advanced manufacturing or transportation, distribution, and logistics occupations.

Women need better access to middle-skill jobs with family-sustaining wages. Women serve as the primary or co-breadwinner in half of U.S. families (Hess et al 2015). As the economy has recovered, millions of workers found jobs, but many of these new jobs pay too little to lift a family out of poverty. Women are the majority of full-time workers whose earnings leave them in near poverty.³ One in four Hispanic women (24.2 percent) and close to one in five Black women (18.1 percent) work full-time and earn less than \$400 per week (U.S. Department of Labor unpublished).

1 IWPR analysis based on IWPR O*Net database and 2014-2024 BLS projections (see Appendix A) of total job openings (resulting from job growth and employee turnover). In 2014, 53.8 million workers were employed in middle-skill occupations, 37 percent of all workers.

2 IWPR analysis based on IWPR O*Net database (see Appendix A) and 2014-2024 BLS projections of total job openings in middle-skill occupations, excluding openings in occupations projected to decline.

3 Near-poverty is defined as 200 percent or less of the federal poverty threshold; the threshold varies by family type. In 2014, the near-poverty threshold for one adult with one child was \$32,634 or \$627.58 per week. The near poverty threshold for an adult with two children was \$733.58 per week, or annual income of \$38,146 (U.S. Census Bureau 2015).

Women are **83 percent** of workers in middle-skill occupations that pay less than **\$30,000** per year but they are just **36 percent** in growing middle-skill occupations that pay at least **\$35,000** per year.

Many women are working in middle-skill occupations—indeed, women are over half (56 percent) of workers in occupations that require some college education and on-the-job training but do not pay family-sustaining wages—but they are much less likely than men to work in well-paid middle-skill occupations. Women are 83 percent of workers in middle-skill occupations that pay less than \$30,000 per year but they are just 36 percent in growing middle-skill occupations that pay at least \$35,000 per year. Women are only 29 percent of workers in growing middle-skill IT occupations, and they are fewer than 10 percent of workers in growing advanced manufacturing, or transportation, distribution, and logistics occupations.

In the coming decade these occupations will have substantial job openings both from growth and from the coming retirement of many workers who are now in these jobs. If employers are going to successfully fill the skills gaps resulting from retirement, turnover, and employment growth in advanced manufacturing, IT, and transportation, distribution, and logistics, they can ill-afford to ignore the potential talent of women workers.

Targeting women for middle-skill jobs in these sectors makes business sense. Diverse workplaces are more productive (see for example Ellison and Mullin 2014 or Herring 2008). Women are more likely than men to invest in education beyond high school, and thus to have the basic skills and knowledge sets required in middle-skill occupations. Many women already work in occupations that have similar skills, knowledge, and ability characteristics to the occupations employers are seeking

to fill, but are lower paid. Although these target middle-skill occupations currently employ only a small minority of women, there is little to suggest that there are not many women who could successfully train for these occupations. Recruiting more women to fill skills gaps in growing middle-skill occupations is a viable, if not necessary, strategy for employers, while for women such occupations present pathways to higher earnings and economic security.

This report provides information intended to facilitate the greater gender integration of good middle-skill jobs. Using an innovative methodology based on the U.S. Department of Labor's O*Net database of occupational characteristics, this report highlights well-paid occupations with current and projected skill shortages in middle-skill occupations that do not require a bachelor's degree but pay family-sustaining wages in manufacturing, information technology, and transportation, distribution, and logistics. The report also identifies potential on-ramp occupations in similar fields or with similar characteristics—matching many of the job requirements, attitudes, experiences, and attributes of workers in the target occupation—that employ many women. Because of gendered assumptions of which jobs may be appropriate for women—assumptions held by women themselves, and by employers, trainers, educators, and workforce developers—women in these jobs may not be seen as a logical pool of talent for these growing middle-skill occupations.



Identifying Pathways to Greater Gender Equity in Middle-skill Occupations: A New Methodology

This report is based on an innovative methodology for comparing occupations. It takes growing well-paid target occupations which currently employ few women and identifies potential on-ramp occupations which share many characteristics with the target occupation but have lower median annual earnings and employ many women. This methodology draws on the U.S. Department of Labor's O*Net database. O*Net describes occupations through 252 individual attributes that captures work organization, the work environment, typical tasks and worker attributes, and the knowledge and skills required. Using O*Net occupational characteristics makes it possible to compare occupations from different fields that initially look very different, but may actually have considerable similarity in what it takes to perform the work. Collected from individual workers as well as from occupational experts, O*Net data include information on the characteristics of workers currently in the job (such as their average educational attainment, occupational interests, work values and styles); on the nature of work in the occupation (difficulty of work activity, tasks, tools, and technologies used, organizational and work context); and the level of experience and training required in the occupation (See Appendix A for a more detailed description of O*Net).⁴

The O*Net database includes general employment data about each occupation but does not do so separately for women and men. To provide a gendered overview of occupations, occupational data from O*Net has been integrated with data from the American Community Survey on total employment, combining five years of data (from 2009–2013) to get a sufficient sample for male and female workers in each occupation. Data on median annual earnings of full-time workers are estimated based on the 2013 Current Population Survey.⁵ Our integrated IWPR O*Net database further includes projected job openings and employment growth for each occupation between 2014 and 2024, from the U.S. Bureau of Labor Statistics. Altogether data are available for 473 occupations (see Appendix A).

In a pairwise statistical procedure that compares the values of 252 occupational attributes (described in the appendix), an occupational distance variable is calculated for each occupation in relation to every other occupation in the data set; this variable indicates how much different occupations have in common with each other. For example, of the 473 occupations, the most similar occupation to Welders, Cutters, and Welder Fitters is Engine and other Machine Assemblers with a value of 0.067; the least similar is Chief Executive with a value of 0.286.

4 A small number of other studies have systematically analyzed O*Net data (or subsets of it) to identify career paths and occupational change (Abel and Gabe 2010; Alterman et al. 2008; Indiana Department of Workforce Development and Indiana Business Research Center 2011; Johnson, Mermin, and Resseger, 2013) but have not specifically focused on gender differences in occupations.

5 Earnings data have been updated to 2014 dollars based on the Consumer Price Index Research Series (CPI-U-RS); U.S. Bureau of Labor Statistics <<http://www.bls.gov/cpi/cpirsai978-2014.pdf>> (accessed September 2015).

An illustration of this circumstance is provided by the recommendation (see Figure 4.2) of cooks as a potential on-ramp occupation for truck drivers.^{6,7} In our immediate mental images, nothing could seem more unlike each other than the chef in her toque and the truck driver rolling down an interstate highway. However, when we score each of these jobs on the 252 O*Net characteristics describing the actual nature and duties of these positions, we find that, overall, cooks are more similar to truck drivers than 70% of the 473 occupations we have analyzed. For example:

- The occupations are very similar to each other in terms of the amount of instruction needed to learn the job; the use of deductive and inductive reasoning; the need to be able to visualize physical arrangements; required command of the English language; the extent to which the occupation satisfies a worker’s “enterprising” occupational interest; the extent to which the work is paced by the speed of equipment; the frequency of exposure to physical hazards; and the extent to which the job involves administrative “paperwork.”

6 The closeness value for Sales/Truck Drivers and Cooks is 0.89, a lower value than Sales/truck drivers and Bus Drivers (0.90).

7 Examples of other O*Net based comparisons of skills sets (engineers and nurses, construction managers and convention planners, and firefighters and personal and home care aides) can be found on the iseek careers website of Minnesota State Colleges and Universities <<http://www.iseek.org/careers/skillsets.html>> (accessed February 9, 2016). See also Figures 2.2 (p.20) and 4.3 (p.32).

- Where the jobs are very dissimilar, the dissimilarities typically involve relatively limited characteristics (such as the extent to which the job involves sitting rather than standing or involves distance vision rather than near vision), and differences readily addressable through training (such as workers’ knowledge of food production).

Middle-skill occupations almost by definition require some investment in training and education, from individual workers, employers, and the workforce system more broadly. Identifying potential on-ramp occupations that already employ many women may increase the likelihood that the target occupation will be a good fit for women seeking to improve their earnings and maximize their returns on their investment in training.

This report highlights high-growth middle-skill occupations in manufacturing, information technology, and transportation, distribution, and logistics, together with findings on close predominately female occupations that offer “on-ramps” to some of the shortage middle-skill occupations in these promising fields. It also makes the case that implementing promising strategies to integrate women into these good middle-skill jobs can help to reduce gender differences in earnings in the labor market overall, and improve family economic security.



The Gender Wage Gap and Educational Attainment

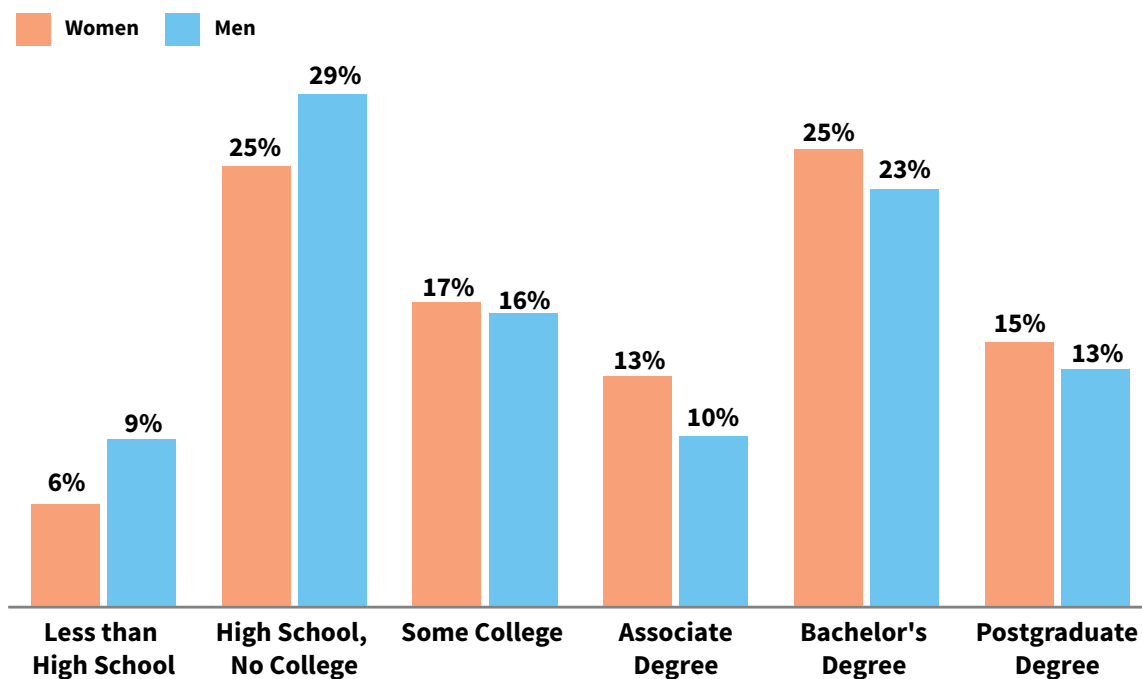
In 2015, the median earnings for women working full-time, year-round were only 79 percent of men’s median earnings. Women’s lower earnings are not due to lack of educational attainment: women in

the workforce are more likely than men to have finished high school, have some post-secondary college qualifications, and to have a 2-year or 4-year degree (Figure 1.1).

FIGURE

1.1 WOMEN WORKERS ARE MORE LIKELY THAN MEN TO INVEST IN THEIR EDUCATION

The Distribution of Workers Ages 25 and Older by Highest Educational Attainment and Gender, 2014



Notes: Workers in the civilian labor force, ages 25 and older. Full-time is defined as 35 hours or more per week.

Source: IWPR analysis Current Population Survey Merged Outgoing Rotation Groups as provided by the National Bureau of Economic Research (<http://www.nber.org/cps/>)

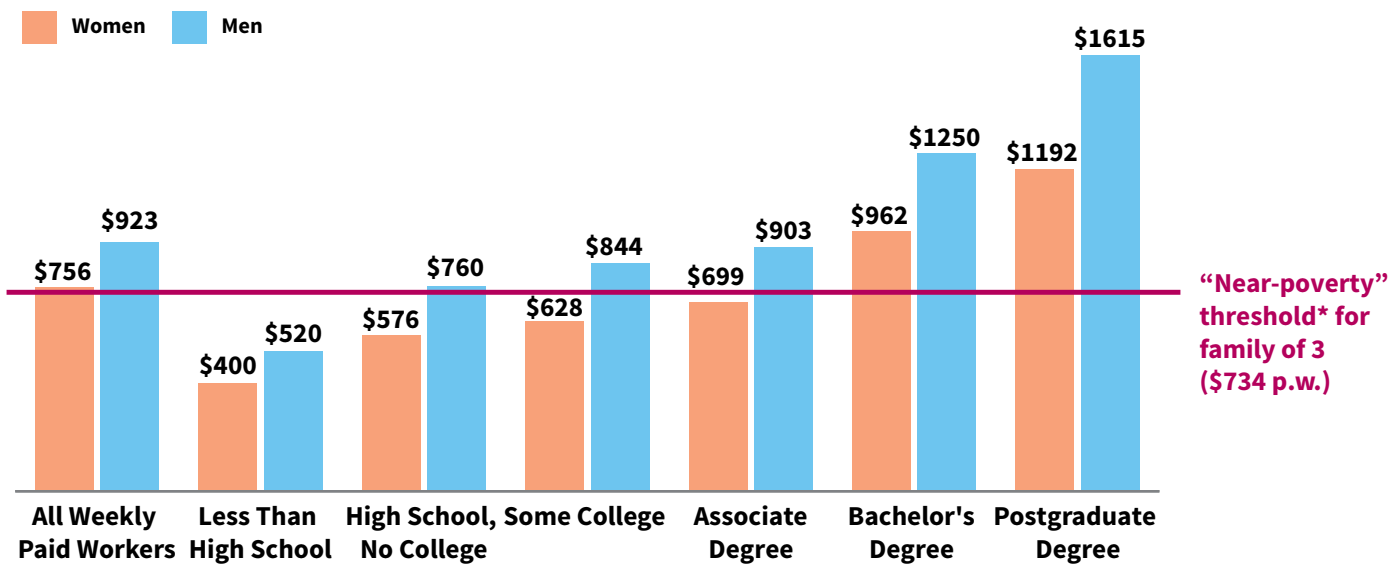
At each level of educational attainment, women’s earnings are lower than men’s. The median weekly earnings of men with a high school diploma are higher than the median weekly earnings of women with some college or even an associate degree. Even with some

college or an associate degree, women’s median weekly earnings for full-time work leave a household of one adult with two children in near-poverty. It takes a bachelor’s degree to lift the median weekly earnings of women out of near-poverty; it takes some college

for men’s median weekly earnings to rise to that level (Figure 1.2). Women’s higher educational attainment and lower median earnings for full-time work suggest that

something is amiss. Women are pursuing education and training but are less likely than men to be in jobs that pay wages that can make families self-sufficient.

FIGURE 1.2 WOMEN NEED AT LEAST A BACHELOR’S DEGREE TO LIFT THEIR FAMILIES OUT OF NEAR-POVERTY
Median Weekly Earnings of Full-Time Wage and Salary Workers Age 25 and Older by Sex and Educational Attainment, 2014 Annual Average



Notes: Full-time workers (working at least 35 hours per week) in the civilian labor force. *Near-poverty threshold defined as 200 percent of federal poverty guidelines; in 2014 this ‘near-poverty’ threshold for an adult with two children was \$733.58 per week, or annual income of \$38,146 (U.S. Census Bureau 2015).

Source: IWPR analysis Current Population Survey Merged Outgoing Rotation Groups as provided by the National Bureau of Economic Research (<http://www.nber.org/cps/>).

Over half of the gender wage gap is due to the fact that women and men tend to work in different occupations and sectors of the economy (Blau and Kahn 2016). The integration of occupations since the 1960s made a major contribution to earnings increases for women (Hsieh et al. 2013) but since the beginning of the 2000s further

occupational integration has stalled, along with further progress in closing the gender wage gap (Blau, Brummund, and Liu 2013; Hegewisch and Hartmann 2014). Occupational gender segregation is particularly pronounced for workers who do not have a bachelor’s degree (Hegewisch and Hartmann 2014).



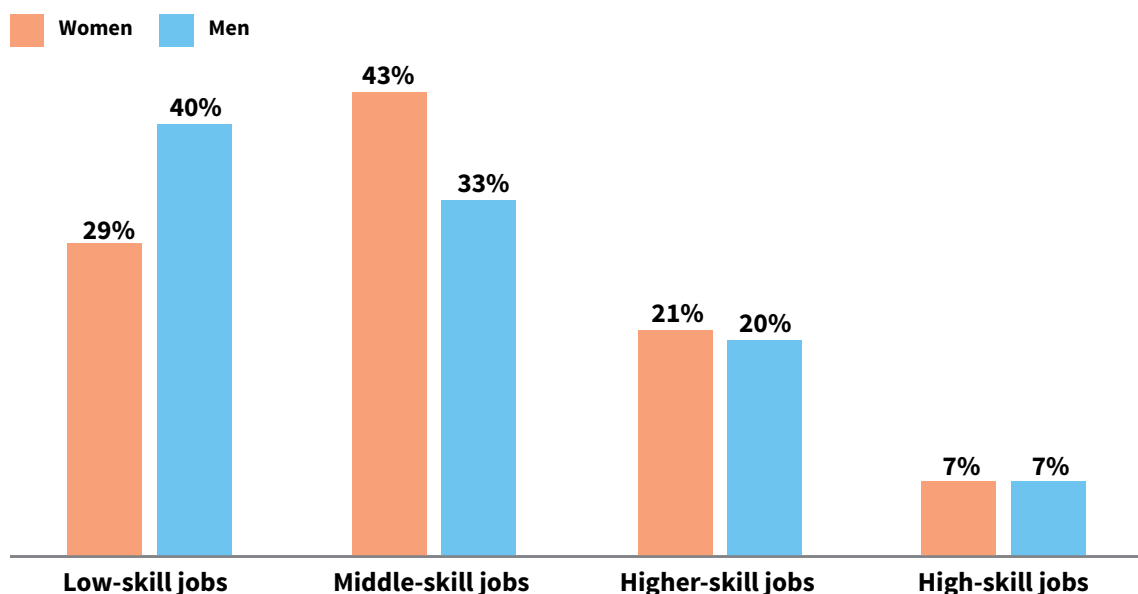
Middle-skill Jobs and Women’s Earnings

Drawing on the U.S. Department of Labor’s O*Net database, this report classifies occupations into four broad skill levels: low-, middle-, higher-, and high-skill occupations. The O*Net database assesses occupations both by formal educational attainment and on-the-job training and preparation required for a worker to become competent.⁸

- **Low-skill:** Occupations that require a high school diploma or less, and little to moderate experience on the job (for example waiters/waitresses or security guards).
- **Middle-skill:** Occupations that require at least post-secondary certification but less than a bachelor’s degree, and moderate to substantial on the job-experience and training, including apprenticeships (for example, nursing and psychiatric aides, teachers’ assistants, carpenters, or firefighters).
- **Higher-skill:** Occupations that require a bachelor’s degree, and typically some on-the-job experience (for example accountants, teachers, computer programmers).
- **High-skill:** Occupations that require postgraduate or professional degrees, and typically some on the-job-experience (for example, librarians, lawyers, and physicians).

⁸ The O*Net database classifies occupation into five broad Job Zones; see Appendix A for a detailed description. For the purposes of this report, occupations in Job Zone 1 and Job Zone 2 that require high school only and limited on the job training are classified as low-skill. Occupations in Job Zone 2 that require high school only but considerable on-the-job preparation/apprenticeships are classified as middle-skill. Occupations in Job Zone 3 that require a bachelor’s degree have been classified as higher-skill.

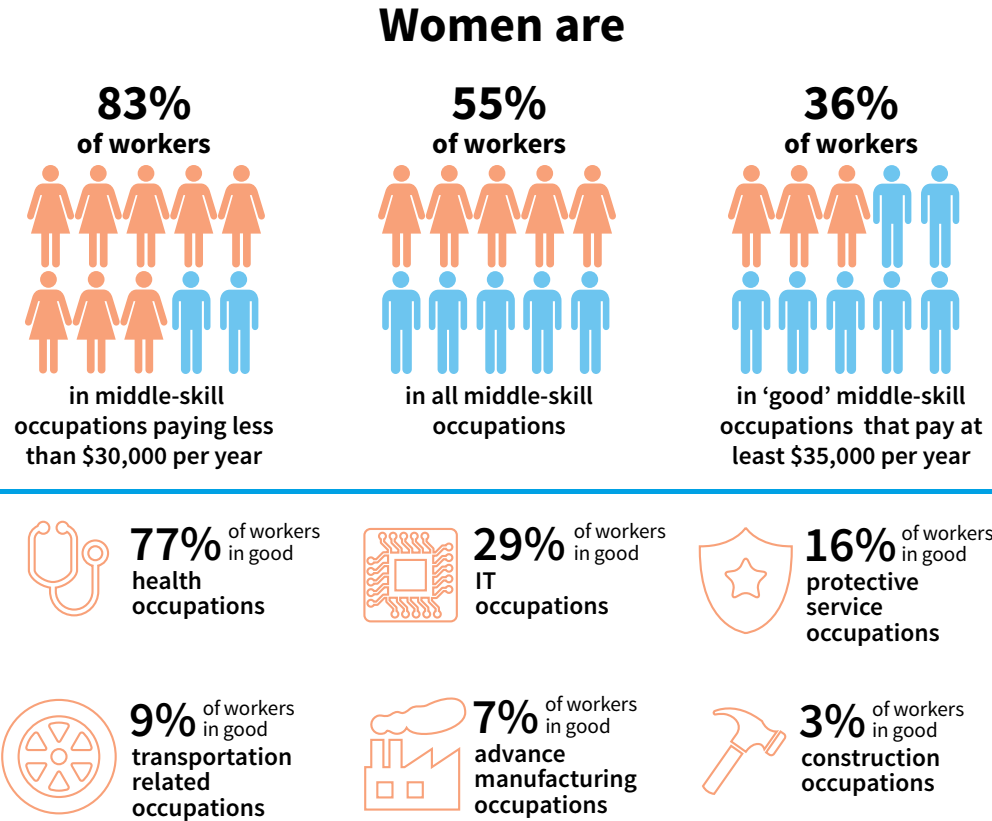
FIGURE 1.3 WOMEN ARE MORE LIKELY THAN MEN TO WORK IN MIDDLE-SKILL OCCUPATIONS
The Distribution of Women’s and Men’s Employment across Occupations by Broad Skill Levels, 2009–2013



Notes: Employment in occupation is five year average 2009-2013.

Sources: IWPR calculations based on IWPR O*Net database (see Appendix A).

FIGURE
1.4 WOMEN'S SHARE OF MIDDLE-SKILL OCCUPATIONS



Notes: * Excludes middle-skill occupations projected to decline. For definition of middle-skill jobs see Appendix A.

Source: IWPR calculations based on IWPR O*NET database.

Women are more likely than men to work in middle-skill occupations, men are more likely than women to work in low-skill occupations, and men and women are proportionately equally likely to work in higher or high-skill occupations. More than four in ten women (43 percent) compared with one in three men (33 percent) work in middle-skill occupations, while four in ten men (40 percent) and three in ten women (29 percent) work in low-skill occupations (Figure 1.3).

While women are 55 percent of all middle-skill workers they are 83 percent of workers in middle-skill occupations that have median annual earnings for full-time work of less than \$30,000. In good middle-skill occupations—those that pay at least \$35,000 per year and are not declining—women's share of workers falls to 36 percent.⁹ In many of the growing good jobs women's share of workers is much lower (see Figure 1.4).

⁹ IWPR calculations based on O*Net dataset and Current Population Survey earnings data for 2013, adjusted to 2014 real dollars.



Women’s concentration in lower paid middle-skill occupations is related to women’s work in predominantly female occupations. Moreover, a high number of middle-skill occupations, particularly those that are better paid, are predominantly male and nontraditional for women. The Workforce Innovation and Opportunity Act of 2014 defines occupations where women are fewer than 25 percent of all workers as a nontraditional occupation for women; and correspondingly a nontraditional occupation for men is one where at least 75 percent of workers are women.¹⁰ Median annual earnings are substantially lower in female-dominated occupations than in more integrated or male-dominated occupations. The median annual earnings for full-time year-round workers in predominantly female middle-skill occupations were \$31,985, in middle-skill integrated occupations (where the share

of both male and female workers is higher than 25 percent), and in predominantly male occupations (occupations that are nontraditional for women), they were \$48,550 (Table 1.1). Workers in middle-skill female-dominated occupations only earn 66 cents for every dollar made by workers in middle-skill male-dominated occupation.¹¹ This occupational wage gap is in addition to the gender wage gap within each occupation (Hegewisch and Ellis 2015).

Workers in middle-skill female-dominated occupations only earn 66 cents for every dollar made by workers in middle-skill male-dominated occupations.

Higher earnings in predominantly male occupations are not due to higher educational requirements. Average educational requirements in middle-skill predominantly male occupations are marginally lower than those in

10 29 U.S.C. § 3102(7).WIOA SEC.3 (37)

11 IWPR calculation based on Table 1.2.

TABLE 1.1 MEDIAN ANNUAL EARNINGS AND SHARE OF WORKERS IN PREDOMINANTLY MALE, PREDOMINANTLY FEMALE, AND MIXED MIDDLE-SKILL OCCUPATIONS

Workers in Female Dominated Occupations (75% Plus Female)	Workers in Mixed Occupations (25–74.9% Female)	Workers in Male Dominated Occupations (Less Than 25% Female)
Distribution of full-time year-round workers in middle-skill occupations		
32.6%	38.1%	29.3%
Median annual earnings for full-time year-round workers middle-skill occupations		
\$31,985	\$45,020	\$48,550

Note: Full-time year-round defined as at least 35 hours per week for at least 50 weeks per year. Earnings adjusted to 2014 real dollars.

Source: IWPR calculations based on IWPR O*NET database (see Appendix A).

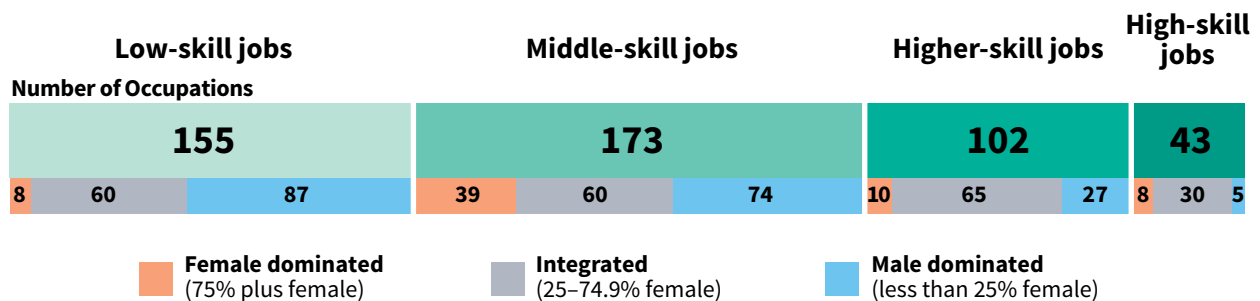
predominantly female occupations, and substantially lower than those in integrated occupations.¹² In predominantly male occupations, on-the-job training tends to play a greater role than post-secondary college level qualifications. Becoming a fully-skilled worker through on-the-job training can take several years. In some occupations such pathways are formalized through apprenticeships that provide a formal ‘earning-while-learning’ pathway toward industry-recognized certification

¹² IWPR calculation based on O*Net database; data not shown.

in many middle-skill male-dominated technical occupations. Women are fewer than one in ten apprentices in the U.S. (U.S. Department of Labor ETA 2015b).

Gender segregated occupations, and particularly predominantly female occupations, are more common among middle-skill jobs than in low-, higher-, or high-skill occupations but occupational gender segregation is not limited to middle-skill occupations. Of all 473 occupations included in the IWPR O*Net Database, fewer than half are relatively integrated (Table 1.2).

TABLE 1.2 473 OCCUPATIONS BY SKILL LEVEL AND GENDER SEGREGATION



Notes: Numbers refer to number of occupations in each skill category, further disaggregated by gender type of occupation. Classification of occupations into gender types is based on full-time year-round workers.

What if just Ten Percent of Women Moved Occupations: A Thought Experiment

The difference in earnings between predominantly female and predominantly male occupations at the same broad skill level (or indeed, at higher skill levels in female-dominated occupations) suggests that women’s earnings could increase if they moved to different occupations. By integrating the O*Net analysis of closeness/

distance between occupations (see above) with data on employment, gender, and median annual earnings, we can estimate what would happen if women’s employment was more optimally distributed across the economy. Optimal is defined in two different ways: Goal A is a more even distribution of women across occupations; Goal B is



the maximization of women's earnings. In the illustrative analysis reported here, the number of women moving between occupations is limited to 10 percent of women workers overall and to no more than 50 percent of currently employed women moving out of any individual occupation. Both optimizations assume that there is no change in the earnings in any one occupation, and that no additional workers join the economy. Under the wage optimization strategy, the median annual earnings of women who move would increase by over 50 percent, from \$36,779 to \$55,860 (based on 2013 earnings levels). The move would translate into a 5 percent increase in earnings of all women. Goal A, the greater integration of occupations, would result in a 27 percent increase of the median annual earnings of the women who move, translating into a 2.5 percent increase of the earnings of all women (see Appendix B Table B1 for full results). Both strategies would see a reduction in the number of women working in the lowest paid occupations (with median annual earnings of less than \$25,000).

Realizing such gains in earnings would require investments in training and education for many women moving into new occupations. Under the wage maximizing strategy, average education and on-the-job experience are slightly higher in the post- than in the pre-move occupations; this is not the case under the occupational integration strategy, but of course moving into a middle-skill occupation is likely to require some occupation-specific skills. Yet the pathways identified by this approach generate much higher potential earning gains than traditional career pathways that narrowly focus on one occupational

field. Moving from being a library assistant, with median annual earnings of \$29,026, to becoming a library technician, with median annual earnings of \$32,318, requires a bachelor's degree and some post-graduate qualifications; investing instead in an associate degree to become a computer user support specialists can lead to a job with median annual earnings of \$52,917. Both jobs require substantial interface with computer software, hardware, and databases, and both require being able to communicate with clients and customers.

Higher earnings in predominantly male occupations are not due to higher educational requirements.

Occupational gender segregation is a result of many factors: stereotypes, social values, myths about women's work and skills, and discriminatory practices in training programs and workplaces (Bergmann 2011; Cotter, Hermsen, and Vanneman 2011; England 2010; 2011). Women's low numbers in middle-skill technical jobs reduces pressures and innovation in the way work is organized to make it more amenable to modern workers with work-family responsibilities; this in turn makes such jobs potentially less attractive to women—creating a chicken-and-egg barrier to change (Turnbull 2013). It also reflects lack of information about available opportunities (Negrey et al. 2002). Focusing on the similarities between occupations may encourage individual women, and workforce developers advising their clients, to see beyond existing occupational pathways for women and focus instead on those that optimize earnings for a set investment in training and education.

Manufacturing, information technology, and transportation, distribution, and logistics are clear targets for such an approach. Women are a minority of employees in each of these sectors; they are particularly underrepresented in growing well-paid middle-skill occupations. The report will look in turn at well-paid growing

occupations in which employers report difficulties in finding workers in each sector and identify occupations that could serve as on-ramps for women to better paying jobs. Information on potential target and on-ramp occupations in other sectors is available at www.womenandgoodjobs.org.



2 MIDDLE-SKILL OPPORTUNITIES IN MANUFACTURING

THE MANUFACTURING INDUSTRY

employs twelve million workers in the United States (U.S. Bureau of Labor Statistics Current Employment Statistics 2015). Compared to the U.S. economy overall, manufacturing employs a higher share of non-college educated workers, with higher median hourly earnings, than other non-college educated workers (Scott 2015) and a greater likelihood that employers provide benefits such as retirement contributions or healthcare insurance (Joint Economic Committee 2013). After several years of decline, employment in manufacturing has started to grow again (Scott 2015). Added to growth in the number of jobs are projected recruitment needs due to the prospective retirement of a substantial number of the current workforce; over half of all workers in the industry are 45 years and older (Joint Economic Committee 2013). Industry estimates suggest that over the coming decade the industry will need to fill 3.4 million jobs (80 percent of these due to pending retirement of baby boomers). Industry estimates further suggest that only 1.4 million of the projected 3.4 million manufacturing jobs can be filled by the current workforce, requiring substantial investments in training and education to

ensure that manufacturing growth is not held back by skill shortages (Deloitte and Manufacturing Institute 2015). Job growth and employment in manufacturing is not evenly spread across the country, but a number of localities, including Michigan, New York, Illinois, Oregon, Tennessee, and Wyoming have seen a resurgence of employment in the sector (Kotkin and Shires 2015). Hard-to-fill vacancies in middle-skill manufacturing jobs are a theme echoing across the country (JPMorgan Chase *New Skills at Work*, various). Some argue that the difficulty in finding suitably trained workers to fill these vacancies is threatening to hold back the growth of the manufacturing sector and the return of manufacturing jobs to the United States (Accenture & Manufacturing Institute 2014).

So far women have not benefitted from the renewed growth in manufacturing: while men's employment in manufacturing increased from 2010 to 2014, women's has remained flat. Between 2010 and 2014 men's employment in manufacturing grew by 614,000 jobs (to 8.8 million); women's employment in manufacturing during the same period only increased by 44,000

In manufacturing, there will be **533,000** good jobs openings over the next decade.

Currently, only **7 percent** of workers in these jobs are women.

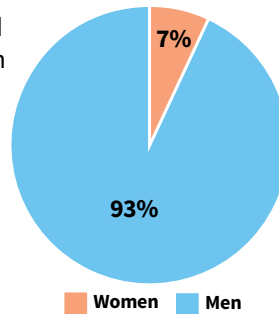
FIGURE

2.1 WOMEN ARE A SMALL MINORITY OF WORKERS IN GOOD GROWING MANUFACTURING JOBS

Women’s Share of Employment in Advanced Manufacturing Occupations with a Minimum of 25,000 Job Openings and at least \$35,000 Median Annual Earnings

Note: For definition of good middle-skill jobs see Appendix A.

Source: IWPR calculation based on IWPR O*Net database (see Appendix A).



jobs – just 7 percent of all new jobs in manufacturing even though women are 27 percent of the manufacturing workforce.¹³

Table 2.1 shows the four middle-skill manufacturing occupations projected to have the highest number of job openings nationally between 2014 and 2024. Each of these occupations has median annual earnings that would lift an adult with two children out of near-poverty, and none of them require an associate or bachelor’s degree. Women are a minority of workers in each of these occupations, and in three of the occupations women are fewer than one in ten of current workers. The pending generational change in manufacturing, and the resulting need for training of a new generation of middle-skill workers in manufacturing, provides an opportunity to improve the diversity of the workforce and increase the number of women working in these occupations.

¹³ IWPR calculations based on Bureau of Labor Statistics Current Employment Statistics survey. Data extracted using the Bureau of Labor Statistics Series Report tool, “Employment, Hours, and Earnings from the Current Employment Statistics survey (National).” Manufacturing, Series Id: CEU3000000010, Not Seasonally Adjusted, Data Type: ALL WOMEN EMPLOYEES, THOUSANDS, Years: 2010 to 2014, accessed February 22, 2015; Men’s data is calculated as the difference between ALL EMPLOYEES and ALL WOMEN EMPLOYEES where ALL EMPLOYEES data are: Industry: Manufacturing, Series Id: CEU3000000001, Not Seasonally Adjusted, Data Type: ALL EMPLOYEES, THOUSANDS, Years: 2010 to 2014, accessed February 22, 2015.

Table 2.1 also lists five potential on-ramp occupations for women to these occupations: the occupations have lower median annual earnings; they are majority female or employ at least 100,000 women; and—apart from being female and lower paid—have comparatively similar occupational attributes, as measured through O*Net, to those required in the growing higher paid middle-skill occupations employers are seeking to fill.

The largest non-clerical manufacturing occupation is ‘Packaging and Filling Machine Operators and Tenders,’ an occupation which employs over 200,000 women (who are 56 percent of workers in the occupation). Typically working in this occupation requires a high school diploma, as well as some on-the-job training. Median annual earnings for full-time work are only \$25,851 (and just \$23,183 for women). Women working as ‘packaging and filling machine operators and tenders’ are already familiar with the manufacturing environment; the skills profiles of the occupation is similar to the fast growing higher paid predominantly male occupations in Table 2.1. Figure 2.2 lists the most relevant attributes for the occupation of welders, and matches the O*Net values for each attribute for welders and packaging and filling machine operators. Just as welders or machinists, they require arm-hand steadiness, manual dexterity, and control precision; work activities require controlling machines and processes, wearing protective clothing, and being on one’s feet most of the time (Figure 2.2).







‘Electrical, electronics, and electromechanical assemblers’ provide a similar example of an occupation that shares many attributes with the high growth advance manufacturing occupations in which employers report skill



shortages. The occupation employs more than 100,000 women and is declining. To advance from working as a packaging and filling machine operator or an electrical, electronics, and electromechanical assembler to working as a welder or machinist requires additional training on and off the job. Yet the women working in these jobs already

have many of the required experiences and attributes, most importantly a familiarity with working in manufacturing. Women working in these low-skill manufacturing occupations provide a good recruitment pool for identifying workers interested in advancing their careers through further training and education.

TABLE 2.1 MIDDLE-SKILL MANUFACTURING OCCUPATIONS WITH HIGH LEVELS OF PROJECTED JOB OPENINGS AND POTENTIAL FEMALE ON-RAMP OCCUPATIONS

OCCUPATIONAL TITLE	 Median Annual Earnings	 Workers in Occupation	 Percent Female ¹	 Job Openings 2014-2024	 Job Zone	 Education
Machinists	\$45,902	397,500	4.5%	154,700	3	Post-secondary certificate ²
Welders, Cutters, and Welder Fitters	\$38,762	457,500	4.8%	145,600	3	Post-secondary certificate ³
Inspectors, Testers, Sorters, Samplers, and Weighers	\$39,307	496,600	36.2%	124,800	2	Post-secondary certificate ⁴
Computer-controlled Machine Tool Operators, Metal and Plastic	\$42,440	148,800	8.1%	71,200	3	Post-secondary certificate ⁵

POTENTIAL ON-RAMP OCCUPATIONS EMPLOYING LARGE NUMBERS OF WOMEN

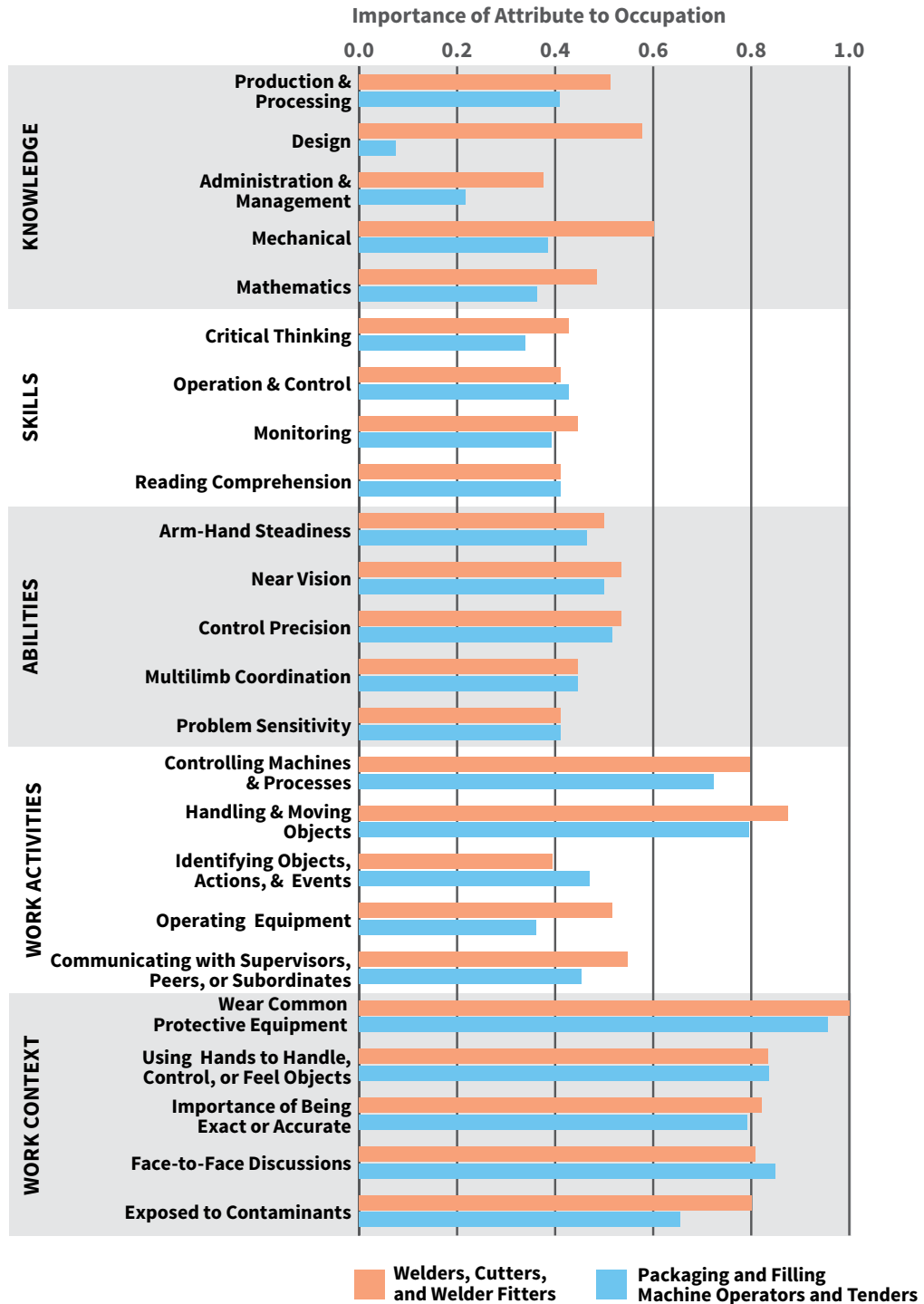
Packaging and Filling Machine Operators and Tenders	\$25,851	378,040	56.2%	138,700	2	High school diploma
Electrical, Electronics, and Electromechanical Assemblers (-)	\$30,638	269,400	52.2%	33,900	2	High school diploma
Food Batch Makers (-)	\$27,576	122,500	60.3%	26,400	2	High school diploma
Shipping, Receiving, and Traffic Clerks	\$31,185	670,200	30.4%	145,500	2	High school diploma
Cooks	\$20,652	2,290,800	41.9%	792,800	2	High school diploma

Notes: (-) Occupation is projected to decline. Projected job openings from employment growth and employee turnover; full-time year-round earnings and full-time year-round workers in occupation. (1) Percent of full-time year-round workers in 2013. (2) 50 percent of respondents to O*Net survey for occupation had a post-secondary certificate; 34 percent had a high school diploma or equivalent; and 5 percent had an Associate degree. (3) 41 percent of respondents to O*Net survey for occupation had a post-secondary certificate; 40 percent had a high school diploma or equivalent; and 13 percent had some college or no degree. (4) 52 percent of respondents to O*Net survey for occupation had a high school diploma or equivalent; 14 percent had less than a high school diploma; and 14 percent had a post-secondary certificate. (5) 39 percent of respondents to O*Net incumbent survey for occupation had a high school diploma or equivalent; 19 percent had a post-secondary certificate; and 15 percent had some college or no degree.

Source: U.S. Department of Labor “O*Net online <http://www.onetonline.org/> and IWPR O*Net Database.

FIGURE

2.2 SKILLS PROFILES: WELDER (MEDIAN EARNINGS OF \$38,762) AND PACKAGING AND FILLING MACHINE OPERATORS AND TENDERS (MEDIAN EARNINGS OF \$25,851)



Notes: *O*Net data collection uses different scales for different attributes; to allow comparability, all scales have been normalized to 0.0 to 1.0 scale. Median earnings are for full-time, year-round workers in 2014 dollars; see Appendix. Attributes listed are those highlighted as most important for welders on O*Net database. Welders are five percent female, packaging machine operators 56 percent.

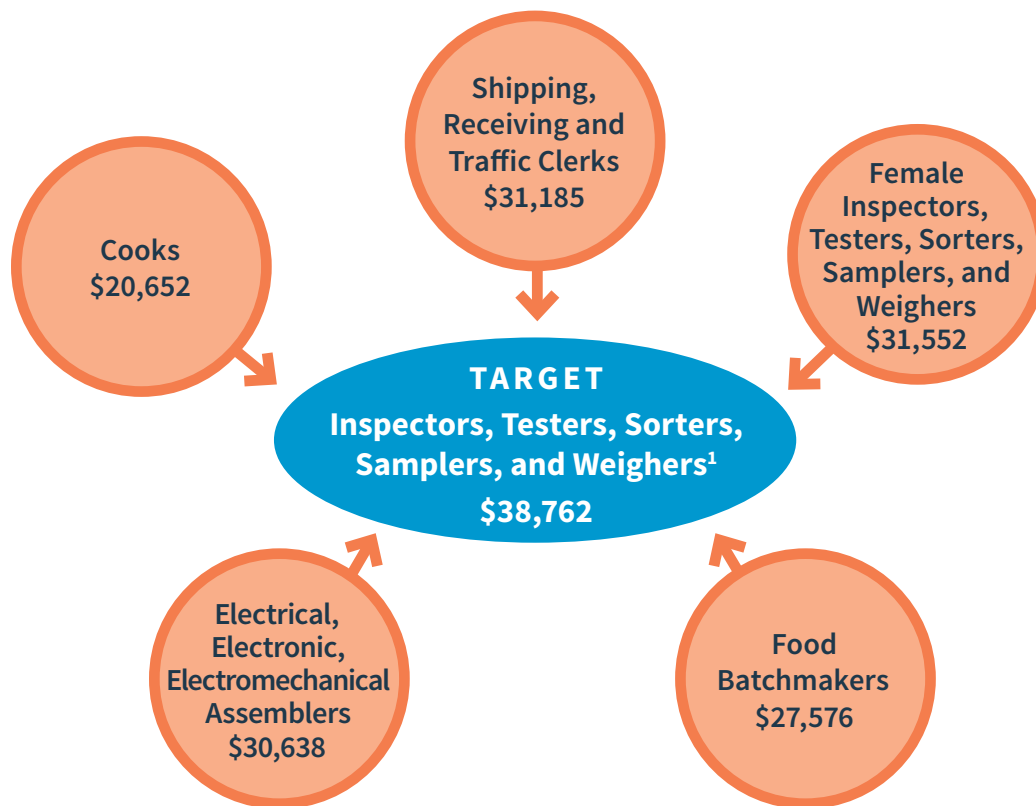
Source: IWPR compilation based on U.S. Department of Labor O*Net online <http://www.onetonline.org>



‘Inspectors, testers, sorters, samplers, and weighers’ is the manufacturing occupation with the third highest level of projected job openings; unlike the other high growth target occupations in Table 2.1, a substantial number of women already work in this occupation (36.2 percent of full-time, year-round workers, and 40.4 percent of all workers, Table 2.1 above). Yet women fare rather differently in the occupation than men. While the occupation provides access to family-sustaining wages for men—median annual earnings for men in the occupation

were \$44,265—median annual earnings for women were much lower at just \$31,552, a gender earnings ratio of only 71.3 percent. This suggests that women working in this occupation are either segmented into a lower paid subsection of the occupation, or are employed in firms that provide lower earnings. For employers seeking to fill vacancies starting with an active search for women workers already in the occupation may be the most cost effective route to address their need for skilled staff.

FIGURE 2.3 INSPECTORS, TESTERS, SORTERS, SAMPLERS, AND WEIGHERS AND POSSIBLE ON-RAMP OCCUPATIONS WITH A HIGH NUMBER OF LOW WAGE WOMEN



Notes: (1) 52 percent of respondents to O*Net incumbent survey for occupation had a high school diploma or equivalent; 14 percent had less than a high school diploma; and 14 percent had a post-secondary certificate. Median earnings are for full-time, year-round workers in 2014 dollars, adjusted using CPI-U-RS; see Appendix. The distance value from ‘inspectors’ to food batch makers is 0.065; to shipping & receiving clerks 0.079; to packaging and filling machine operators 0.087; and to cooks 0.089. See methodology section.

Source: U.S. Department of Labor “O*Net online and IWPR analysis of IWPR O*Net database (see Appendix A).

‘Food batch makers’ is an example of an on-ramp occupation, that is, it is lower skilled (requiring a high school diploma) and lower paid than ‘inspectors, testers, sorters, samplers, and weighers’, but has many similar occupational attributes. Food batch makers work in food processing plants and may record production and test data for each food product batch, follow recipes to produce food, and set up, operate, clean and sterilize food processing equipment.¹⁴

Many employers in manufacturing are recognizing that increased diversity is a necessary part of addressing their needs for talent

Slightly more than half of 105,000 workers in the occupation are women, with median full-time year-round earnings of \$27,565. Career advancement to ‘inspectors, testers, sorters, samplers, and weighers’ does not only offer higher earnings but also more secure employment prospects given the prospective long-term decline of employment of ‘food batch makers.’ Almost as closely matched to inspectors are ‘shipping, receiving, and traffic clerks,’ another low-skill occupation that employs 170,000 women (the occupation is 30.4 percent female), with median earnings for all workers of \$31,185.

¹⁴ See Summary Report for: 51-3092.00 food batch makers, O*Net Online <<http://www.onetonline.org/link/summary/51-3092.00>> (accessed February 9, 2016).

A somewhat less traditional example of a possible on-ramp occupation is ‘cooks.’ ‘Cooks’ are a large occupational group, with more than 2 million workers, including 780,000 women. Median annual earnings for full-time work were only \$20,652. Just as in manufacturing, work as a cook typically requires being on one’s feet for most of the day, manual dexterity and arm-hand steadiness, work with potentially dangerous equipment, and knowledge of production processes, quality control and other techniques for maximizing the effective manufacture and distribution of goods (O*Net Online 2015). Manufacturers often lament the lackluster reputation of the manufacturing industry as a barrier to recruitment: too noisy, dirty, and not seen as cutting edge by parents or prospective trainees. Women and men working as cooks in institutional and restaurant kitchens share many of the same work environment and worker attributes. Focusing on the similarities between these occupations may persuade some cooks that manufacturing could present a viable, more lucrative career choice when they are considering their next steps toward gaining skills and developing credentials.



Attracting women to manufacturing

Many employers in manufacturing are recognizing that increased diversity is a necessary part of addressing their needs for talent. Initiatives include enhanced outreach and recruitment efforts, explicit messaging and changes in organizational culture, networking and mentoring for women already in the industry, and flexible working practices that make it possible for (male as much as female) employees to be both effective at work and care for their families (Deloitte 2015). Initiatives to attract women to manufacturing tend to be focused on more highly skilled executive and professional positions. Yet there are initiatives that specifically target women for pathways to middle-skill manufacturing occupations. The American Welding Society has reached out to women as part of its drive to diversity the occupation and address recruitment issues (American Welding Society 2013). The Industrial Division of the Communications Workers of America (IUE-CWA), for example, along with others, has instituted women's councils to uproot the stereotype of manufacturing as male-dominated (Pastor and Sanchez, 2015).

Pathways to skilled occupations in advanced manufacturing are provided through the U.S. Department of Labor's (DOL) *American Apprenticeship* \$175 million grant program (U.S. Department of Labor, 2015a). An explicit goal of the apprenticeship initiative is to market the value of apprenticeship as a pathway to a certified skilled workforce, and to make apprenticeship more attractive to women. A number of the projects funded under

the grant program are explicit about their efforts to increase women's access to apprenticeships in advanced manufacturing (U.S. Department of Labor 2015b):

- The Wisconsin Apprenticeship Growth and Enhancement Strategies (WAGE\$) project is receiving grant funding to train 1,000 new apprentices and 542 upskilled incumbent workers in 12 high-growth occupations in the Advanced Manufacturing and other high growth sectors. Partners in the WAGE\$ project include Chicago Women in Trades (CWIT) who will provide technical assistance and pre-apprenticeship programs to ensure women have a fair shot as these opportunities.
- The Southeast Michigan Community Alliance is receiving grant funding to develop its Advance Michigan Center for Apprenticeship Innovation (CAI) project, specifically targeted at building and developing apprenticeship programs in the high-demand, new-age automotive and transportation sectors of the Advanced Manufacturing industry. The grantees plan to work with organizations such as the Michigan Council of Women in Technology, Detroit Area Pre-College Engineering Program and Black Girls Code. CAI will serve more than 800 workers in the State of MI.

Focusing on the similarities between these occupations may persuade some cooks that manufacturing could present a viable, more lucrative career choice

- Marshall University Research Corporation's Robert. C. Byrd Institute for Advanced Flexible Manufacturing is receiving grant funding to build a National Advanced Manufacturing Apprenticeship Program, with the explicit goal of expanding existing innovative apprenticeships and promote advanced manufacturing pre-apprenticeships for women, transitioning military personnel, and disadvantage youth. The program will serve 1,000 apprentices and 415 pre-apprentices nationwide.

A small number of community training programs offer pre-apprenticeship programs for women in manufacturing. Pre-apprenticeship programs provide a basic introduction to what it is like to work in advanced manufacturing; they can help women decide whether, and which parts of the industry, may be right for them and they prepare the pre-apprentice to meet the entry requirements of apprenticeship programs (U.S. Department of Labor ETA 2015). Chicago Women in the Trades (CWIT) and Oregon Tradeswomen Inc. (OTI) are offering women-only programs directly relevant to advanced manufacturing (see Appendix C for more details). An example of a women-only program in welding at community and technical colleges is provided by Wisconsin Indianhead Technical College.

3 MIDDLE-SKILL OPPORTUNITIES IN INFORMATION TECHNOLOGY

AS ONE OF THE FASTEST GROWING INDUSTRIES in the United States, information technology (IT) is part of the science, technology, engineering, and mathematics (STEM) sector that is driving economic growth (Csorny 2013). Information technology skills are an important component of the skills required in many growing middle-skill occupations; middle-skill jobs in IT have the geographic advantage of being more evenly spread throughout the country than jobs in sectors such as manufacturing (Rothwell, 2013). Middle-skill jobs with the highest growth rates require the use of digital skills in one way or another (Burning Glass Technologies, 2015) and have higher and more persistent vacancy rates (Rothwell 2013). Certificates and degrees related to IT skills have higher median earnings than others (Carnevale et al 2014). While many information technology related jobs require bachelor's degrees- or increasingly employ workers who have at least a four-year college degree- the field includes some growing occupations that are open to people with an associate degree. Indeed, while computing and IT jobs at the beginning of the computing revolution were mainly higher skilled occupations requiring a four-year college degree, as computing and

information technology have become more common place in the economy, they have led to the rise of complementary middle-skill jobs, such as computer user support specialists, which does not require a four-year college degree (Chapple 2005).

Table 3.1 shows the middle-skill occupations in IT services with the highest projected job openings. According to the Occupational Information Network (O*Net), these jobs typically only require long term on-the-job training, vocational certificate or two-year Associates' Degree (although in practice a significant number of workers in these jobs do have bachelor's degrees; Table 4.1). Women are the minority of workers employed in each of these occupations, although their under-representation is not as stark as in the manufacturing occupations reviewed above.

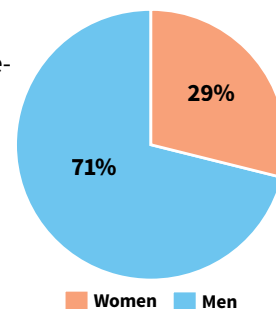
FIGURE 3.1 WOMEN ARE A MINORITY OF WORKERS IN GROWING MIDDLE-SKILL IT JOBS

Women's Share of Employment in Good Middle-skill IT Occupations

Note: For definition of good middle-skill jobs see Appendix A.

Source: IWPR calculation based on IWPR O*Net database (see Appendix A).







In information technology, there will be **240,000** good jobs available over the next decade. Currently only **29 percent** of workers in these jobs are women.



None of these occupations are strictly ‘nontraditional’ for women (that is women are at least 25 percent of workers in each of the occupations). Table 3.1 also shows female-dominated occupations that are most similar to the attributes of these target occupations. Yet, rather than a traditional on-ramp occupation that is similar, but lower skilled

(and lower paid), these occupations require considerably higher investments in education to get to the same or lower earnings. Librarians provide a particularly striking example. Close to nine in ten librarians have a master’s degree; they earn marginally less than computer user support specialists, seven in ten of who have an associate degree

TABLE 3.1 HIGH JOB OPENING TARGET MIDDLE-SKILL INFORMATION TECHNOLOGY OCCUPATIONS AND POTENTIAL ON-RAMP OCCUPATIONS BASED ON O*NET CHARACTERISTICS

OCCUPATIONAL TITLE	 Median Annual Earnings	 Workers in Occupation	 Percent female ¹	 Job Openings 2014-2024	 Job Zone	 Education
Computer System Analyst	\$82,710	568,000	36.2%	191,000	4	Associates Degree ⁵
Web Developers	\$62,500	141,400	35.2%	50,700	3	Associates Degree ³
Computer Network Support Specialists	\$61,830	181,600	26.6%	39,600	4	Associates Degree ²
Computer User Support Specialists	\$52,917	586,000	26.6%	150,500	3	Associates Degree ¹

POTENTIAL ON-RAMP OCCUPATIONS EMPLOYING LARGE NUMBERS OF WOMEN

Compensation, Benefits, and Job Analysis Specialists	\$51,804	84,700	75.9%	24,000	4	BA degree
Librarians	\$49,694	143,100	82.4%	29,500	5	Master’s degree
Clinical Laboratory Technologists and Technicians	\$46,069	328,200	73.4%	130,500	4	AA/ BA degree
Statistical Assistants	\$41,989	16,600	63.5%	6,700	3	BA degree

Notes: (1) 29 percent of respondents to O*Net incumbent survey for occupation had a BA degree. (2) 47 percent of respondents to O*Net incumbent survey for occupation had a BA degree. (3) 43 percent of respondents to O*Net survey for occupation had a BA degree. (5) 26 percent of respondents to O*Net incumbent survey had a BA degree. (6) Insignificant percent of respondents to O*Net incumbent survey had BA degree. Projected job openings from employment growth and employee turnover; full-time year-round earnings and full-time year-round workers in occupation.

Source: U.S. Department of Labor “O*Net online” and U.S. Department of Labor, Bureau of Labor Statistics and U.S. Census Bureau.



or less. Librarians are required to have knowledge of computers and electronics, they need to be able to use a variety of software programs, and need to be able to communicate with the public, just as computer user support specialists. The comparison of librarians and computer user support staff is of particular relevance to someone still considering their careers. A library assistant, for example, a more junior occupation that shares many attributes of computer user support tasks, with median annual earnings of \$29,026, may follow a traditional pathway of six years of college to become a librarian. Instead she can opt to build on her experience by pursuing an associate degree to become computer user support specialist, which requires about half of the years in college and promises annual earnings that are as high if not higher than librarians.

The lower returns to formal education in fields which a majority female are also illustrated by ‘statistical assistants’ and ‘compensation, benefits, and job analysis specialists’, both occupations which require a bachelor’s degree, but have lower median earnings than ‘web developers,’ where an associate degree is the standard requirement and in which fewer than half of workers have bachelor’s degrees, according to O*Net’s database (Table 3.1).

Women’s underrepresentation in information technology, and other STEM fields, has been on the policy agenda for a considerable time. While men and women do not differ significantly in ability in mathematics and science, they do differ in perceived skills and confidence, and in opportunities to develop their skills and their confidence; Hill, Corbett, and Rose (2010) provide a comprehensive review of research on the factors that lead to women’s and girls’

underrepresentation in computing and other STEM fields. Policy efforts and research in information technology fields have typically focused on schools and colleges, highlighting how changed teaching styles and resource allocation can increase girls’ interest and success in STEM fields. Yet, although women are less likely than men to have prerequisite IT skills, there are many women who do, or who have skills and work experience in similar fields which provide a stepping stone to full careers in the sector. Companies can better ensure that women know about these opportunities, and that the working environment doesn’t isolate women but rather allows them to prosper in the field.

While men and women do not differ significantly in ability in mathematics and science, they do differ in perceived skills and confidence, and in opportunities to develop their skills and their confidence

Attracting women to IT

A 2011 Department of Commerce report cited that women who work in STEM fields on average earn 33 percent more than women in other fields (U.S. Department of Commerce, 2011). Additionally, women working in STEM jobs face a lower gender wage gap than women working in many other fields. Advancing women in IT positions serves as a crucial pathway into high-paying and fast-growing jobs. Women are proportionately less likely to have jobs in computing than they were twenty years ago (AAUW, 2015). Women are less likely than men to work in the IT industry, and within the IT industry, they are less likely to work in IT specific positions. For example, at Google, women make up 30 percent of the company’s total workforce, and only 18 percent of tech-related positions (Google, 2015). These numbers illustrate a challenge in the IT field with attracting

new and retaining existing women workers. Encouraging and retaining women into IT positions requires a combination of supportive academic environments for young women and girls, and workplaces that encourage and promote the advancement of female employees.

Organizations such as the National Girls Collaborative Project and Million Women Mentors (MWM) are working to create a more supportive and encouraging environment in schools, colleges, and universities. MWM teams to increase the number of women in the pipeline for STEM jobs. The National Center for Women and Information Technology (NCWIT), a non-profit organization initiated in 2014 by the National Science Foundation, convenes a coalition of over 575 corporations, academic institutions, small businesses, and non-profits to increase the presence and retention of women in computing positions. The organization works with its partners to coordinate a national pipeline for women in computing, change workplace conditions to challenge the stereotype that computer science or IT is male-dominated profession, and create resources, tool-kits, and best practices for members and employers in the network (NCWIT).

As IT occupations developed and grew with the rapid development of the industry from the 1990s onwards, IT qualifications have become more formalized and employers are more likely to look for bachelor's degrees when hiring IT staff. Yet, given the demand for workers with IT related skills, there continue to be opportunities for workers to move into lower level positions, as attested by successful training programs focused on creating pathways for workers with less

formal qualifications to occupations such as computer support specialists (see for example, Chapple and Zook, 2002).

Opportunities are also provided through new apprenticeships in the IT field. LaunchCode, a non-profit in Saint Louis, has created pathways into IT jobs for people who are unemployed or seeking to move into this higher paid field of work. LaunchCode provides access to IT specific on-line training programs and then arranges job placements- or apprenticeships- with companies to provide an opportunity for the trainees to show their expertise.¹⁵ The Washington State Department of Labor and Industries is receiving a grant through the U.S. Department of Labor's Apprenticeship Initiative to create an information technology apprenticeship program in partnership with Washington Technology Industry Association (WTIA), Microsoft, AT&T, Impinj, F5, and Accenture. The apprenticeship program will target recruiting women, people of color, and transitioning military members into more than 600 IT apprenticeships. The planned program of work includes the development of a new training curriculum that speeds the time to acquire IT skills (U.S. Department of Labor 2015b). Philadelphia Works received a grant to expand an existing computer support Specialist/IT apprenticeship, and to focus its activities on youth and women. Philadelphia Works received \$2.9 million to help expand an existing Computer Support Specialist/IT apprenticeship and focus on recruitment of youth and women in the Pennsylvania area (U.S. Department of Labor 2015b).

¹⁵ For more information about LaunchCode see <<https://www.launchcode.org/about>> (accessed February 9, 2016); the program is expanding to other localities.



4 MIDDLE-SKILL OPPORTUNITIES IN TRANSPORTATION, DISTRIBUTION & LOGISTICS

In transportation, distribution, and logistics, there will be **1.3 million** good jobs available over the next decade. Currently, only **9 percent** of workers in these jobs are women.

THE U.S. DEPARTMENT OF TRANSPORTATION projects a large number of job openings for skilled and semi-skilled workers over the next decade and concludes that “the recruitment and training of new workers who will be responsible for the operation, maintenance, and construction of the nation’s transportation infrastructure will be critical” (U.S. Departments of Transportation, Education, and Labor, 2015). Between 2012 and 2022, the Bureau of Labor Statistics estimates that employment in transportation will grow by 417,000 but because of retirement and high turnover in parts of transportation, this translates into substantially more job openings. Over half of current workers are at least 45 years old, and over a third of transit workers, as well as almost three in ten railroad workers, are 55 years or older. As with manufacturing, the extent of job opportunities varies across the country: New York City, Dallas, Los Angeles, Houston, and Chicago are projected to have the highest numbers of job openings.

The U.S. Department of Transportation expects potential difficulties in filling projected job openings because the number of people graduating in educational programs related to some of these middle-skill occupations are not keeping pace with projected job openings (Figure 4.2).

In 2014 almost one million women worked full-time in transportation and material moving occupations, including 221,000 as laborers and freight, stock, and material movers, 136,000 women bus drivers and 100,000 women ‘drivers, truck and sales’¹⁶ (U.S. Department of Labor 2015c). Yet overall this sector is only half as likely to employ women as the economy overall, and women are fewer than one in ten workers in growing better paid middle-skill jobs in the industry (Figure 4.3).

¹⁶ For the purposes of having a sufficient sample of women working in the occupation, the IWPR O*Net database had to combine three occupations into the category ‘drivers, truck and sales’: Heavy and Tractor-Trailer Truck Driver, a position that needs a commercial HGV license and has earnings of \$19.00 hourly, and is taken as the reference group for earnings and job zone requirements; Light Truck or Delivery Services Drivers, with median hourly earnings of \$14.21, and Driver/Sales Workers- delivery drivers- with median hourly earnings of just \$10.70 (ONet OnLine 2016).

FIGURE 4.1 WOMEN ARE A MINORITY OF WORKERS IN GROWING WELL-PAID TRANSPORTATION, DISTRIBUTION, AND LOGISTICS JOBS

Women’s Share of Employment in Good Middle-skill Transportation, Distribution, and Logistics Occupations

Note: For definition of good middle-skill jobs’ see Appendix A.

Source: IWPR calculation based on IWPR O*Net database (see Appendix A).

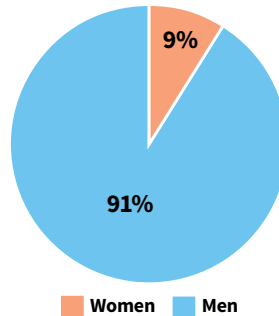


Figure 4.2 lists the middle-skill transportation, distribution and logistics occupations with the highest projected job openings nationally between 2014 and 2024. Women are fewer than 10 percent of workers in trucking, the occupation with the highest number of openings; they are fewer than 5 percent of workers in mechanical and technician positions. Women make up a higher

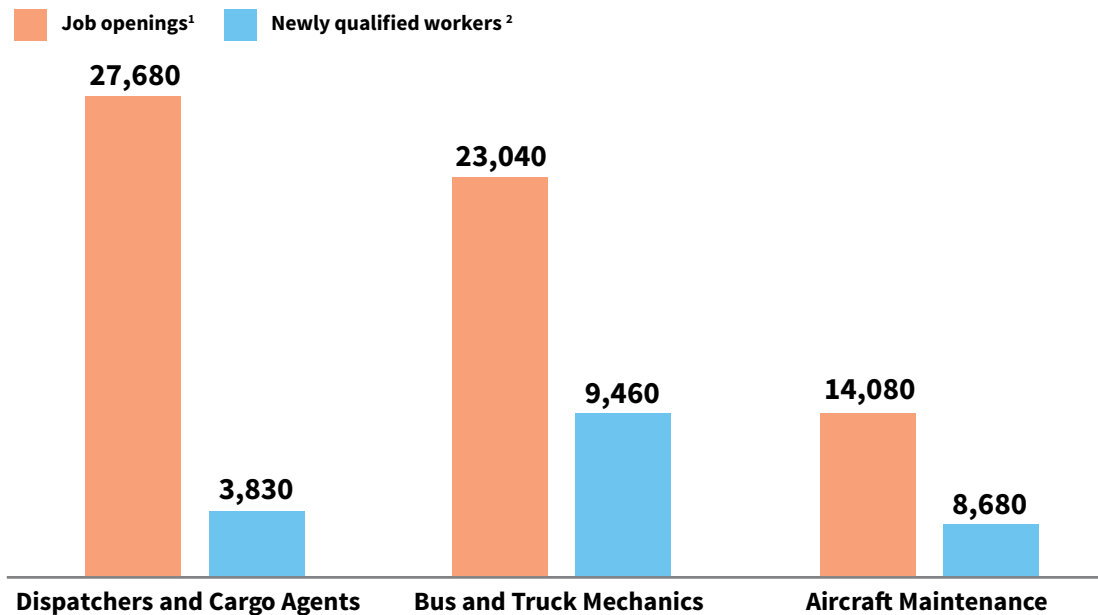
proportion of the workforce in bus services and urban transit, and of dispatchers.

Truck Driving

‘Heavy and Tractor-Trailer Truck Drivers’ is the occupation with the highest projected number of job openings in transportation; between 2014 and 2024, the industry expects 404,500 job openings. Median hourly earnings for full-time, year round work in 2013 were \$40,588; for women working full-time in this occupation however earnings were only \$27,657, a gender earnings ratio of only 67.7 percent. In 2013 there were 236,600 women who worked full-time as truck drivers¹⁷; women currently

¹⁷ See note above, includes women working as Light Truck or Delivery Services Drivers.

FIGURE 4.2 PROJECTED ANNUAL JOB OPENINGS AND GRADUATES OF RELATED EDUCATIONAL PROGRAMS IN MIDDLE-SKILL TRANSPORTATION, DISTRIBUTION, AND LOGISTICS OCCUPATIONS








Notes: (1) Job openings are projected annual average of change 2012 to 2022. (2) 2012 completion of related educational programs.

Source: Compilation of U.S. Departments of Transportation, Education, Labor (2015), p.26.



TABLE 4.1 HIGH JOB OPENING TARGET MIDDLE-SKILL OCCUPATIONS IN TRANSPORTATION, DISTRIBUTION AND LOGISTICS

OCCUPATIONAL TITLE	 Median Annual Earnings	 Workers in Occupation	 Percent female ¹	 Job Openings 2014-2024	 Job Zone
Heavy and Tractor-Trailer Truck Drivers	\$41,164	1,701,500	7.4%	464,700	Postsecondary non-degree award with short on-the-job training
Automotive Service Technicians and Mechanics	\$36,073	739,900	1.4%	237,200	High school diploma with long on-the-job training
Dispatchers, except Police, Fire, and Ambulance	\$ 37,332	301,500	61.0%	84,100	High school diploma with moderate on-the-job training
Bus and Truck Mechanics and Diesel Engine Specialists	\$43,477	263,900	0.3%	76,900	High school diploma with long on-the-job training
Automotive Body and Related Repairers	\$39,582	149,700	1.6%	48,100	High school diploma with moderate on-the-job training
Aircraft Mechanics and Service Technicians	\$56,866	119,900	3.3%	30,100	Postsecondary non-degree award with short on-the-job training

Notes: Earnings are for workers who work at least 35 hours per week for at least 50 weeks per year. Projected job openings from employment growth and employee turnover; full-time year-round earnings and full-time year-round workers in occupation. (1) Percent of full-time year-round workers in 2013

Source: U.S. Department of Labor “O*Net online;” U.S. Department of Labor, Bureau of Labor Statistics and U.S. Census Bureau

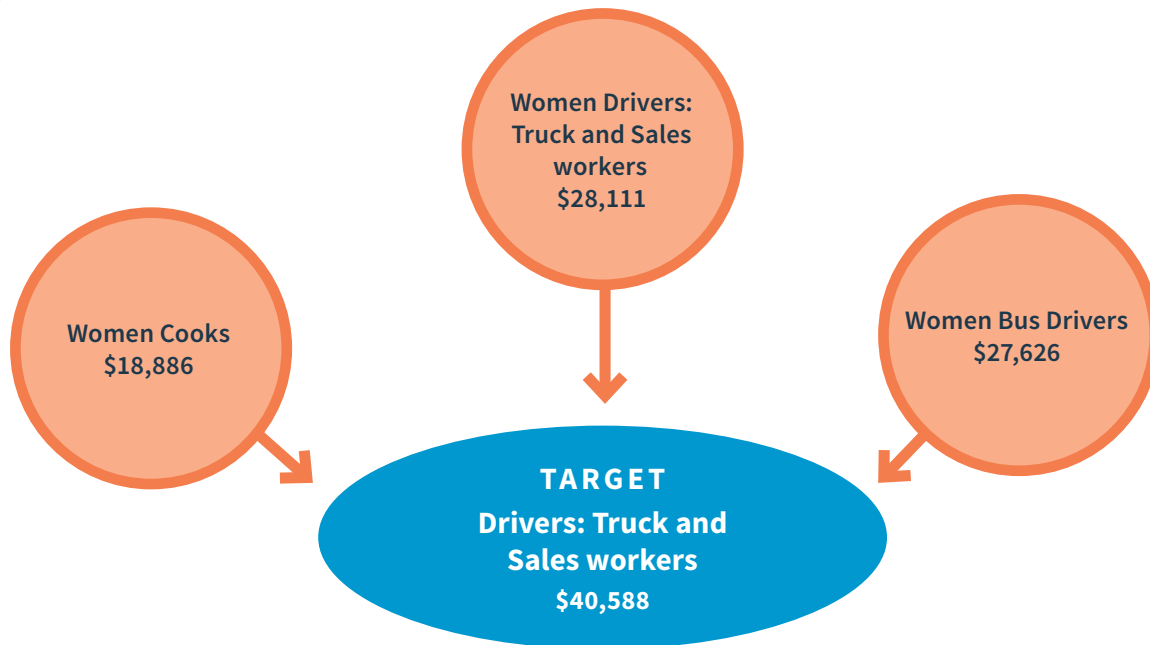
working in these positions may be interested in pursuing employment opportunities in the higher paid segments of the industry. Another close occupation is bus driving; 342,464 women were working full-time as bus drivers in 2013, with similarly low median annual earnings as women truck drivers (of \$27,180). Thus, quality employers seeking to fill vacancies for truck drivers in the first instance may look to women already working in the industry.

Yet the occupation that is closest in its overall profile to truck drivers and employs a substantial number of women are cooks. Cooks are not in the transportation industry of course, but the profile of the occupation overall is as similar to truck drivers as bus

drivers. As discussed above, overall cooks are more similar to truck drivers than 70% of the 473 occupations we have analyzed, and the job requirement of cooks share many similarities with those of truck drivers according to the O*Net database.

Job quality and earnings in trucking vary widely (perhaps illustrated most strongly by the high number of workers who leave the industry each year). Jobs with the highest earnings potential in the industry require investment in commercial driver’s license and on-the-job training with a senior driver. The industry has some formal apprenticeship schemes, providing an opportunity to become qualified while working and earning. One barrier identified

FIGURE 4.3 TRUCK DRIVERS AND POTENTIAL ON-RAMP OCCUPATIONS EMPLOYING LOWER WAGED WOMEN



Notes: The target occupation uses summary report information for heavy and tractor-trailer truck drivers. Closeness value Truck drivers to Bus drivers: 0.090; to cooks 0.089.

Source: U.S. Department of Labor “O*Net online and IWPR analysis of IWPR O*Net database (see Appendix A).

by women working in the industry is a sometimes rather hostile working environment.¹⁸ Yet these are barriers that are not insurmountable and certainly not a reflection on women’s capacity to succeed in these jobs. Creating and maintaining work cultures that respect workers and protect their opportunities to be trained and become skilled workers, irrespective of who they are, will benefit the industry overall, not just women seeking to enter the industry.

Mechanics and Service Technicians

The Department of Transportation has highlighted aircraft mechanics and service technicians as one of the occupations

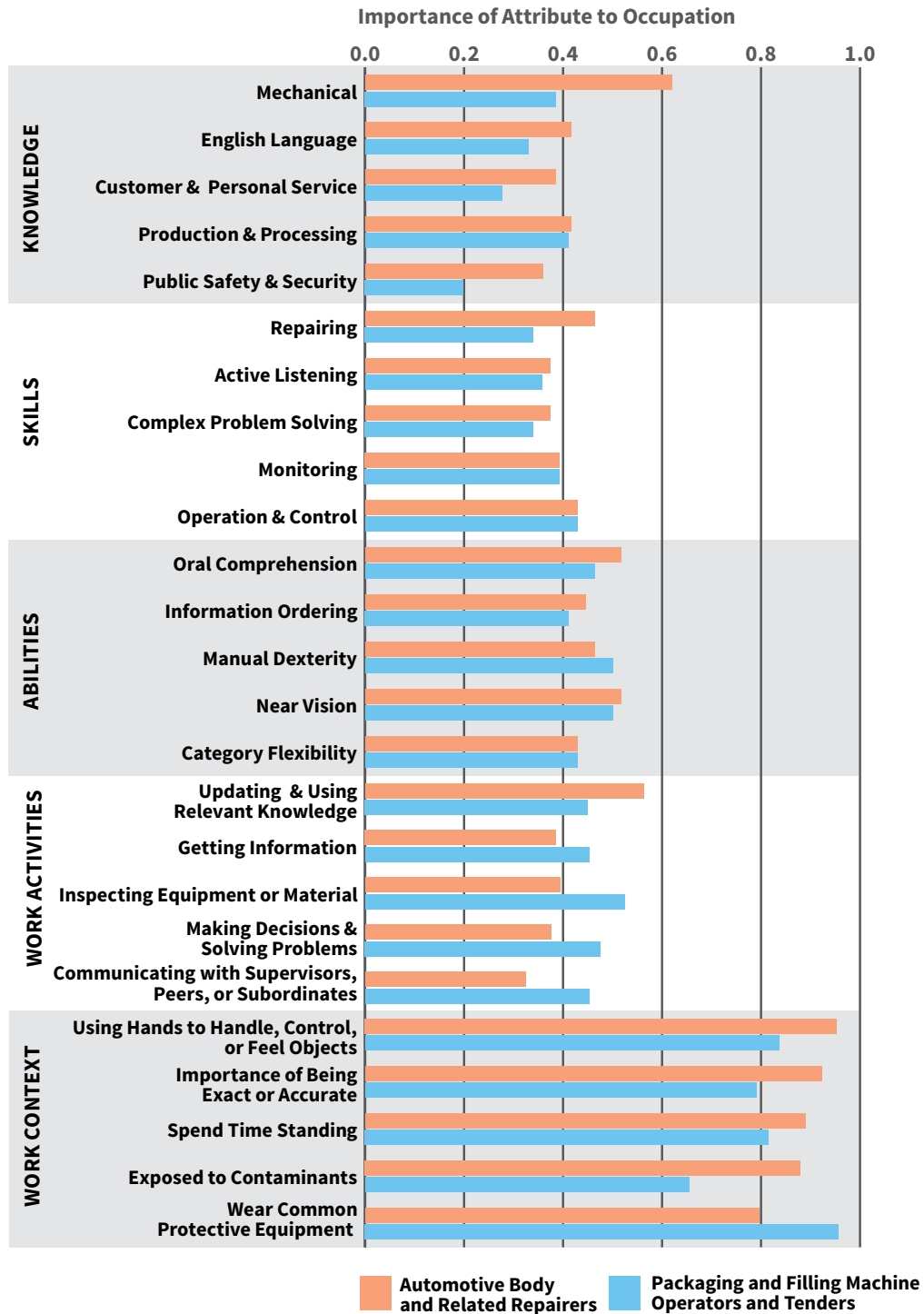
likely to face skill shortages because of the gap between skilled workers leaving the occupation and new workers becoming skilled (Figure 4.2 on page 26). Workers in the occupation had median annual earnings of \$56,866 in 2014; the large majority of workers do not have associate degrees. Although median annual earnings are slightly lower in other mechanic and technician jobs in the transportation industry, these also provide good earnings without the need for high levels of investment in formal education (Table 4.1). Yet technicians and mechanics are occupations virtually devoid of women. Women are 5 percent of aircraft mechanics, and fewer than 2 percent of car or bus and truck mechanics.

¹⁸ See for example EEOC (8-18-14).



FIGURE

4.4 SKILLS PROFILE: AUTOMOTIVE BODY AND RELATED REPAIRERS AND PACKAGING AND FILLING MACHINE OPERATORS AND TENDERS



Notes: *O*Net data collection uses different scales for different attributes; to allow comparability, all scales have been normalized to 0.0 to 1.0 scale. The closeness value between the two occupations based on all attributes in the O*Net database is 0.096. Median earnings are for full-time, year-round workers in 2014 dollars, adjusted using CPI-U-RS. Attributes listed are those highlighted as most important for Automotive Body and Related Repairers in the O*Net database.

Source: IWPR compilation based on U.S. Department of Labor "O*Net online <http://www.onetonline.org/> and IWPR O*Net database.

The occupation of ‘automotive body and related repairers’ is projected to have almost 50,000 job openings nationally; median annual earnings in the occupations are close to \$40,000 (Table 4.1). Women are fewer than 2 percent of the workforce. Indeed, the real life job titles listed on O*Net for this occupation include ‘Body Man’ or ‘Auto Body Man,’ signaling that this is not a job typically envisaged for women. Comparing the typical skills and knowledge attributes of this occupation to those of ‘packaging and filling machine operators,’ an occupation that is majority female, shows considerable similarities but provide much lower earnings (Figure 4.3).

Creating and maintaining work cultures that respect workers and protect their opportunities to be trained and become skilled workers, irrespective of who they are, will benefit the industry overall, not just women seeking to enter the industry

Comparing mechanic and service technician occupations through O*Net characteristics does not suggest any other close occupations that already employ a large number of women. The occupations require very specific skill sets that need to be acquired in training and education programs. Yet they also require many other skills that are common in occupations that employ larger numbers of women, including in the on-ramp occupations already profiled in this report. These include precision, monitoring of operations, manual dexterity, use of software, information retrieval, working in noisy environments, and wearing protective clothing. Women and girls are less likely than men to have been given the opportunity to work with tools and to informally learn about engines, and thus may be less confident than men to apply for

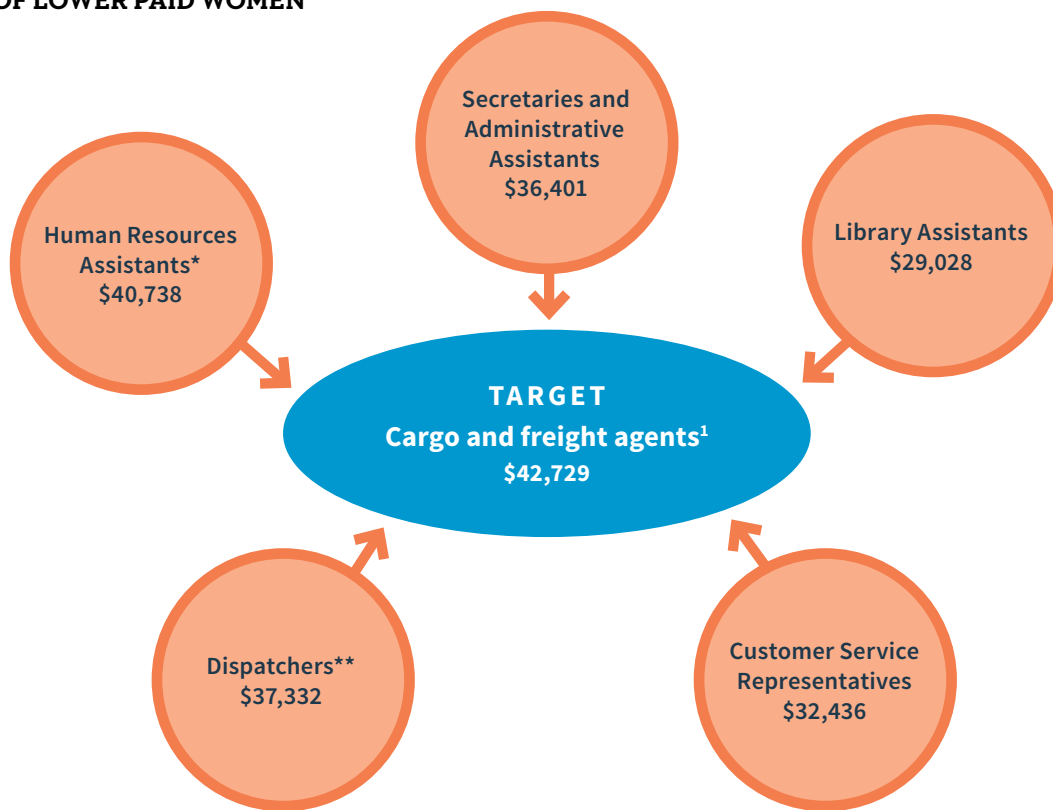
training programs in such fields. Targeted outreach and pre-training programs can overcome such barriers and improve the attractiveness of the industry to women.

Cargo and Freight Agents

A target occupation with more potential female on-ramp occupations is ‘cargo and freight agents.’ While the occupation is not large, it is fast growing and is projected to have 31,300 job openings between 2014 and 2024. ‘Cargo and freight agents’ have median annual earnings of \$42,729; work in the occupation requires a high school diploma and on-the-job experience and training but no college degree. Three of ten workers (31 percent) in the occupation are women. Figure 4.5 shows majority-female occupations that are very similar to ‘cargo and freight agents’ according to O*Net criteria. Each of the four potential majority female on-ramp occupations have lower median annual earnings and require the same if not more general level of education and on-the-job training: ‘dispatchers (except police and ambulance)’ and ‘customer service representatives,’ both occupations that are very similar, apart from being majority female (55.7 percent and 67.8 percent respectively) and having lower median annual earnings (\$37,332 and \$32,436 respectively). The next two closest occupations — ‘human resource assistants except payroll and timekeeping,’ and ‘secretaries and administrative assistants’— typically require higher levels of education (post-secondary vocational qualifications) but also provide lower median annual earnings (\$40,738 and \$36,401 respectively) and are predominantly female (80.9 and 95.4 percent respectively).



FIGURE
4.5 CARGO AND FREIGHT AGENTS AND ON-RAMP OCCUPATIONS WITH A HIGH NUMBER OF LOWER PAID WOMEN



Notes:* Human Resources Assistants, Except Payroll and Timekeeping; **Dispatchers, Except Police, Fire, and Ambulance. ¹93 percent of respondents to O*Net survey for occupation had a high school diploma or equivalent; 6 percent had an Associate degree; and 2 percent had some college or no degree. 'Distance to Dispatchers, Except Police, Fire, and Ambulance': 0.061; to Human Resources Assistants: 0.070; Secretaries and Administrative Assistants: 0.071; to Customer Service representatives: 0.072; to Library Assistants: 0.098.

Source: IWPR O*Net database (see Appendix A).

Attracting women to middle-skill jobs in transportation, distribution, & logistics

The U.S. Department of Transportation (DOT, 2015) has recognized the severity of women’s underrepresentation in the industry and the need to address it if the industry is to have a realistic chance at meeting forecasted skills needs. The DOT has identified the factors as contributing to women’s low numbers in the industry:

- Women’s lower level of technical skills and knowledge of tools because they have fewer opportunities to learn these while growing up.
- A work culture that is not welcoming to women who may be a minority of one.
- Lack of workplace supports for workers with family responsibilities.
- Lack of reliable transportation and access to tools for transportation jobs that require workers to travel to job sites.
- Lack of information about the opportunities in transportation jobs.

These barriers are not unique to the transportation industry, and solutions, such as educational approaches that provide career and technical education in an inclusive manner, and women-only pre-apprenticeship programs or specific events and workshops for women and girls can make up for such potential deficits. The long-standing Climb Wyoming program, which trains unemployed or low-income single mothers to become truck drivers, shows the potential of proactive collaborations between workforce developers and employers to tackle poverty while filling urgent skills needs (Climb Wyoming 2016). The Department of Labor’s American Apprenticeship Grant Program includes some grants specifically targeted at the skills needs of the transportation industry (U.S. Department of Labor 2015b):

- The Transportation Learning Center (TLC) received grant funding to develop new registered apprenticeships for

Signals Maintainers and Transit Coach Operators, as well as for the expansion of existing programs. TLC is working with Chicago Women in the Trades and Amalgamated Transit Union to design an apprenticeship programs from scratch, and design it in a manner that is inclusive and open to women and underrepresented minorities. The grant will provide training for close to 1,300 frontline workers in the public transportation/electro-mechanical industry.

- The Minnesota Apprenticeship Initiative, through the Minnesota Department of Employment and Economic Development, is receiving grant funding to bring workers in newly registered apprenticeships in almost 30 growing occupations through more than 100 employer partners and across five key industries, including transportation.



5 RECOMMENDATIONS FOR ACTION

MANY EMPLOYERS are reporting difficulties with filling vacancies for middle-skill jobs in manufacturing, information technology, and transportation, distribution, and logistics. Common to many of the jobs with the highest projected job openings in these sectors are that they do not require a bachelor's degree, pay family sustaining wages, and employ very few women. Indeed, occupational segregation in fast growing middle-skill occupations in manufacturing and transportation is striking, with women making up fewer than 10 percent of workers in many of them. Employers are losing out on half of the workforce, and on the half that has the higher and more rapidly rising educational attainment.

As the report has shown, women are more likely than men to work in middle-skill occupations, and they are more likely than men to invest in formal education and training. Yet, women are much more likely than men to work in middle-skill occupations with lower median earnings- in spite of equal or higher educational requirements. Tackling women's underrepresentation in good middle-skill

jobs will improve women's earnings and the economic security of their families.

Employers are losing out on half of the workforce, and on the half that has the higher and more rapidly rising educational attainment

This report moves beyond stating that women and men often work in different jobs by highlighting that different occupations often require similar skills and attributes from women and men. Based on a focus on similarities- rather than on the unique skill set that any new worker would have to learn to become competent in an occupation- the report identifies occupations that share many of the attributes of the higher paying skill-shortage occupations, but are lower paid and employ many women. The report highlights these potential on-ramp occupations to demonstrate to employers that women working in these occupations may be good candidates for skills training and employment in the target shortage occupations. The pairing of well-paid target occupations with potential on-ramp occupations also provides information for women considering their careers.

Yet, in many ways, employers, policy makers, and workforce developers concerned with addressing skill shortages and improving women's economic security are confronted with a 'chicken & egg' problem that goes beyond the similarity or differences between individual occupations. The scarcity of women in the target occupations can make

Employers are losing out on half of the workforce, and on the half that has the higher and more rapidly rising educational attainment

women feel isolated, may expose them to harassment and discrimination, and, in jobs where skills acquisition depends on the training provided by senior co-workers, may make it hard for them to become fully-skilled. Having few women moreover makes these occupations less innovative in the way work is organized to respond to workers' dual responsibilities, for paid work and for unpaid family work for children, or elderly parents or spouses who may need supports. When work is still organized as if workers had no responsibilities outside of the workplace, women don't join, or join and leave the occupation, while the occupation recreates an isolating environment that pushes women out and hinders the occupation from ever evolving. Yet, given current and projected skill shortages, past attitudes of complacency may finally become too expensive and barriers to women may come down. Many employers have already adopted more inclusive and flexible working arrangements and provide examples of what can be done.

For Employers

A 2012 report by Deloitte and The Manufacturing Institute highlights the

specific ways firms across different sectors can create more gender-inclusive environments that successfully retain female talent (Deloitte Development LLC and The Manufacturing Institute, 2012). These include targeted leadership, training, mentoring, and sponsorship programs for employees at all levels, flexible workplace policies, and a "results-driven" culture that discourages the notion that an employee must work the longest hours to be deemed successful. Steps include:

- Reviewing recruitment and outreach materials to ensure the use of inclusive language and images
- Ensuring that the channels for advertising vacancies and opportunities reach women as well as men
- Reviewing recruitment and selection processes to ensure that they are free of gender bias and affirmatively encourage female talent
- Ensuring that women, just as men, have adequate facilities, including protective gear that is appropriate to different body types and facilities that are sanitary and safe
- Actively encouraging an inclusive environment and clearly communicate that hostile behaviors, such as harassment and discrimination, are not acceptable.
- Communicating that women as well as men are expected to advance and thrive in the company
- Being deliberate: setting targets and measuring their company's progress to greater gender inclusiveness.



For Policymakers

Policymakers have several reasons for prioritizing greater gender integration in pathways to middle-skill occupations. When occupations are virtually single-sex and half of the potential workforce is left aside, bottlenecks in the labor market become worse, and productivity suffers because it is unlikely that such stark gender segregation truly reflects the underlying distribution of talent. Improving women's access to higher paid middle-skill occupations is one way to address poverty and economic insecurity. The Department of Labor supports technical assistance on the inclusion of women in apprentice-able occupations through the Women in Apprenticeship and Nontraditional Occupations (WANTO) grants (U.S. Department of Labor 2014).¹⁹ Its recently published guide *Pre-Apprenticeship: Pathways for Women into High-Wage Careers* pulls together good practice, resources,

and references on serving women in pre-apprenticeship programs run by community training programs. Policymakers can:

- Fund technical assistance and support for employers and workforce developers seeking more diversity and inclusiveness within their organizations
- Help employers and workforce developers implement flexible working practices and supportive services that recognize the family care responsibilities of their workers; policies should be adjusted to recognize that families typically do not have someone at home to do child care, domestic work, or other tasks.
- Include progress toward gender equity in the monitoring and accountability frameworks that accompany receipt of public funding.

¹⁹ Women in Apprenticeship and Nontraditional Occupations (WANTO) Technical Assistance (TA) Grant < https://www.doleta.gov/grants/pdf/wanto_SGA-DFA-PY-13-08.pdf >

For Workforce Developers

Workforce developers, educators and trainers should assess and evaluate their recruiting and placement strategies to ensure that they attract and retain women as well as men. Additionally, they should address the lack of information regarding the opportunities and benefits of middle-

When work is still organized as if workers had no responsibilities outside of the workplace, women don't join, or join and leave the occupation, while the occupation recreates an isolating environment that pushes women out and hinders the occupation from ever evolving

skill occupations. Setting goals for the number of women applicants, participants, graduates and placements can help monitoring whether materials reach women as well as men, and whether training programs are equally successful for women and men.

Jobs for the Future, a non-profit focused on developing economic opportunities, together with Wider Opportunities for Women has created a *Pink to Green Toolkit* to help employers and workforce developers create career pathways and training supports for women to enter stable middle-skill higher-paying jobs (GreenWays, 2012). The toolkit discusses methods for recruiting women, developing gender—inclusive curricula, identifying and preventing sexual harassment and hostile workplace behaviors, building job-readiness skills, and ensuring women's health and safety in industries such as construction, manufacturing, and transportation.

Additional references and guides to creating a welcoming and inclusive environment for women in workplaces, workforce development programs, and schools and colleges with the goal of increasing women's share of well-paid middle-skill occupations are included in Appendix C and on www.womenandgoodjobs.org.



APPENDIX A

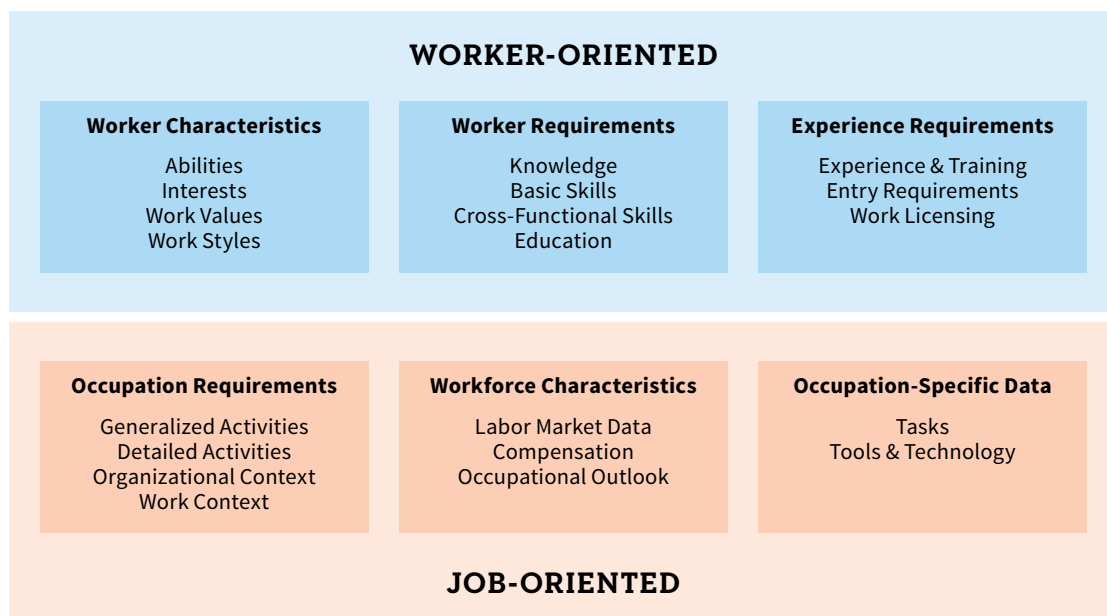
O*NET: A Valuable Tool for Analyzing Employment Opportunities

The O*NET database organizes the differences in knowledge, skills, abilities, and day-to-day tasks required by different occupations through its Content Model, an analytical framework designed to identify and categorize key information about workers, work, and work life. As seen in Figure A1, the model breaks down initial descriptors into Worker-oriented, those that reflect the character and attitudes of the workers, and Job-oriented, those that reflect the nature of the job. Worker-oriented descriptors include Worker Characteristics (Abilities, Occupational Interests, Work Values, Work Styles), Worker Requirements (Skills, Knowledge, Education), and Experience Requirements (Experience and Training, Skills). Job-oriented descriptors include Occupational Requirements (Difficulty

of Work Activity, Organizational Context, Work Context), Workforce Characteristics (Labor Market Information, Occupational Outlook), and Occupation-specific data (Title, Description, Tasks, Tools and Technology).

Each sub-descriptor includes a variety of further broken down categories; ‘Abilities’ collects information on over fifty individual attributes, ranging from Oral Comprehension, to Mathematical Reasoning, to Depth Perception; ‘Work Context’ accounts for the different factors that influence the nature of the work, including Communication Methods, Job Interactions, and Work Setting. The O*NET Content Model, which includes a total of 277 descriptors and additional data collected by the Bureau of Labor Statistics, allows for the organization and analysis of occupations and the typical workers in these fields.

FIGURE A1. MODEL OF OCCUPATIONAL INFORMATION NETWORK (O*NET).



Source: Based on O*Net Resource Center (2016)

**O*NET Data Collection:
Questionnaires, Incumbents, and
Industry Experts**

O*NET occupations are defined using the Standard Occupational Classification, an organizational system by the U.S. Bureau of Labor Statistics to classify workers into (SOC) streamlined occupational categories. The O*NET SOC taxonomy includes up to 974 occupations, based on the most recent revision of BLS SOC codes. After initial data collection in 1998, which relied on occupational analysts to populate fields, the Department of Labor (DOL) and National Center for O*NET Development evaluated the impact of job incumbent surveys on response rate to continue improving the design of data-collection process (Tippins and Hilton 2010). Initial analyses, which began in June 2001, suffered from small sample sizes and low response rates (only 181 of 661 sampled organizations completed the survey, and only 29 of 80 sampled occupations received enough information to justify analysis), however the database has been updated 15 times since the first O*NET analysis in 1998 and the data collection process has undergone multiple iterations to increase occupational samples (Peterson, Mumford, and Boreman, 2001). Cumulative response rates, tracked from June 2001 to December 2014, show that 75.9 percent (155,304/204,544) of eligible establishments and 65.0 percent (191,573/ 294,808) of eligible employees have responded to survey requests.

This process is two-fold: analysts first select a statistically random sample of businesses with plans to employ workers in targeted occupations, then use a random sample of workers in those occupations within those businesses as respondents for standardized questionnaires (O*NET Resource Center).

According to the O*NET OMB Clearance, samples are identified with probability proportional to the expected number of workers in the surveyed occupations (U.S. Department of Labor, 2015). Relevant job incumbents and occupational analysts serve as the primary data sources for the questionnaires due to the lower costs, large sample size, and experiential knowledge. The O*NET descriptors were designed to allow job incumbents to provide the most accurate information, while organizational experts and representatives provide information on work environment and organizational context (Peterson, Mumford, and Boreman, 2001). The Establishment Method, the use of employer establishments to isolate occupational incumbent samples for the surveys, accounts for 75 percent of data collection for occupations. The other 25 percent of data represents occupations with a small number of workers, low rates of employment, new or emerging occupation, or other reasons where sampling becomes unreliable. In these scenarios, O*NET relies on the Occupation Expert (OE) Method, which asks people considered experts in the target occupations (trainers, supervisors, experienced job incumbents) to fill out the questionnaires (U.S. Department of Labor, 2015).

Experts are identified by professional or trade associations as those who are knowledgeable about the occupation, have worked in the occupation for at least one year, have five years of experience as a job incumbent, trainer, or supervisor, and have had experience with the occupation within the last six months. To prevent bias from participating groups, researchers select a random sample of identified experts from each occupation. Prior to the questionnaire, analysts must meet occupational training and experience requirements, complete rater



training, and are provided written materials about the occupation and the context of skills or abilities required for that job (Suzanne Tsacoumis 2009). Trial tests of the O*NET database showed high consistency amongst the ratings completed by occupational analysts, a finding that, along with the lower costs associated with using trained analysts, justified the use of these experts as raters for certain categories of descriptors or occupations (Tippins and Hilton 2010).

The questionnaires require respondents to rate the importance or level of difficulty of selected work descriptors as it relates to their jobs, with importance typically measured on a scale of one through five and level of difficulty typically measured on a scale of one through seven. For level of difficulty, each work descriptor (e.g. static strength) is accompanied by several ‘scale anchors’ – varying behaviors or tasks relevant to that descriptor – from which respondents choose in their ratings of what level is required to perform their jobs (e.g. push an empty shopping cart, lift 75-pound bags of cement onto a truck). Subject matter experts and occupational analysts provide examples of different levels of each descriptor and then place them on a quantitative scale (Tippins and Hilton, 2010). To lessen the burden on respondents and avoid the risk of missing data, descriptors are divided amongst three questionnaires and each respondent is randomly assigned one to complete. All respondents are required to provide general demographic information. Data for Abilities and Skills (e.g. static strength, reading comprehension) are separately rated by the occupational analysts using information provided by respondents and standardized

written descriptions of the occupations (U.S. Department of Labor, 2015; Sanchez and Autor, 2010). This data accounts for approximately 37 percent of the descriptors in the questionnaire. A 2006 paper reported that 31 unique analysts had participated in the previous O*NET data collection cycles (Tsacoumis and Van Iddekinge 2006).

Past analysis of the O*NET database highlights the redundancy inherent in the ‘importance’ and ‘level’ scales across the work descriptors. In a critique of O*NET’s design, Juan Sanchez and David Autor argue that the high correlation between measures of importance and level of difficulty amongst occupations implies that ranking or organization of occupations wouldn’t change regardless of which scale was used. Their critique also challenges the use of occupational analysts as raters of the Abilities and Skills domains. Sanchez and Autor, amongst other critics of this practice, argue that analysts never speak to or observe the incumbents to help inform measurements and base their ratings on streamlined written materials. They point out that, despite, “adequate interrater reliability among analysts...interrater agreement does not imply validity” (Sanchez and Autor, 2010). Given high correlation between analyst-based Abilities and Skills ratings and incumbent-based ratings of other domains, they propose using these incumbent ratings in other domains to predict that of Abilities and Skills. Further criticism of this practice suggests that low interrater agreement among job incumbents may demonstrate legitimate, and necessary to capture, differences in how incumbents view and do their jobs (Tsacoumis and Van Iddekinge 2006).

**TABLE
A1 O*NET JOB ZONES**

JOB ZONE	Preparation Needed	Education	Related Experience	Job Training	Job Zone Examples
1	Little or none	Some of these occupations may require a high school diploma or GED certificate.	Little or no previous work-related skill, knowledge, or experience is needed for these occupations. For example, a person can become a waiter or waitress even if he/she has never worked before.	Employees in these occupations need anywhere from a few days to a few months of training. Usually, an experienced worker could show you how to do the job.	These occupations involve following instructions and helping others. Examples include taxi drivers, amusement and recreation attendants, counter and rental clerks, nonfarm animal caretakers, continuous mining machine operators, and waiters/waitresses.
2	Some	These occupations usually require a high school diploma.	Some previous work-related skill, knowledge, or experience is usually needed. For example, a teller would benefit from experience working directly with the public.	Employees in these occupations need anywhere from a few months to one year of working with experienced employees. A recognized apprenticeship program may be associated with these occupations.	These occupations often involve using your knowledge and skills to help others. Examples include sheet metal workers, forest fire fighters, customer service representatives, physical therapist aides, salespersons (retail), and tellers.
3	Medium	Most occupations in this zone require training in vocational schools, related on-the-job experience, or an associate degree.	Previous work-related skill, knowledge, or experience is required for these occupations. For example, an electrician must have completed three or four years of apprenticeship or several years of vocational training, and often must have passed a licensing exam, in order to perform the job.	Employees in these occupations usually need one or two years of training involving both on-the-job experience and informal training with experienced workers. A recognized apprenticeship program may be associated with these occupations.	These occupations usually involve using communication and organizational skills to coordinate, supervise, manage, or train others to accomplish goals. Examples include food service managers, electricians, agricultural technicians, legal secretaries, occupational therapy assistants, and medical assistants.
4	Considerable	Most of these occupations require a four-year bachelor's degree, but some do not.	A considerable amount of work-related skill, knowledge, or experience is needed for these occupations. For example, an accountant must complete four years of college and work for several years in accounting to be considered qualified.	Employees in these occupations usually need several years of work-related experience, on-the-job training, and/or vocational training.	Many of these occupations involve coordinating, supervising, managing, or training others. Examples include accountants, sales managers, database administrators, teachers, chemists, art directors, and cost estimators.
5	Extensive	Most of these occupations require graduate school. For example, they may require a master's degree, and some require a Ph.D., M.D., or J.D. (law degree).	Extensive skill, knowledge, and experience are needed for these occupations. Many require more than five years of experience. For example, surgeons must complete four years of college and an additional five to seven years of specialized medical training to be able to do their job.	Employees may need some on-the-job training, but most of these occupations assume that the person will already have the required skills, knowledge, work-related experience, and/or training.	These occupations often involve coordinating, training, supervising, or managing the activities of others to accomplish goals. Very advanced communication and organizational skills are required. Examples include librarians, lawyers, sports medicine physicians, wildlife biologists, school psychologists, surgeons, treasurers, and controllers.

Source: National Center for O*NET Development (2008).



TABLE
A2 O*NET EDUCATION, TRAINING, AND WORK EXPERIENCE

Education	Education Level	Job Zone Level
Less than a High School Diploma	1	1
High School Diploma (or GED or High School Equivalence Certificate)	2	2
Post-Secondary Certificate - awarded for training completed after high school (for example, in Personnel Services, Engineering-related Technologies, Vocational Home Economics, Construction Trades, Mechanics and Repairers, Precision Production Trades)	3	2 & 3
Some College Courses	4	3
Associate Degree (or other 2-year degree)	5	3
Bachelor's Degree	6	4
Post-Baccalaureate Certificate - awarded for completion of an organized program of study; designed for people who have completed a Baccalaureate degree, but do not meet the requirements of academic degrees carrying the title of Master	7	5
Master's Degree	8	5
Post-Master's Certificate - awarded for completion of an organized program of study; designed for people who have completed a Master's degree, but do not meet the requirements of academic degrees at the doctoral level	9	5
First Professional Degree - awarded for completion of a program that: requires at least 2 years of college work before entrance into the program, includes a total of at least 6 academic years of work to complete, and provides all remaining academic requirements to begin practice in a profession	10	5
Doctoral Degree	11	5
Post-Doctoral Training	12	5

Source: IWPR compilation based on National Center for O*NET Development (2008).

The IWPR O*Net Database

The IWPR O*Net database integrates data on occupational attributes from O*Net with data on the gender composition of employment in each occupation, data on median annual earnings for full-time year-round work, and data on projected changes in total employment and number of job openings between 2014 and 2024. The O*Net database includes data on 974 occupations (O*Net Resource Center 2016). For our analysis, occupations could be included only if occupation-specific variable were available for both O*NET and the Current Population Survey Annual Social and Economic Supplement (CPS ASEC). CPS ASEC earnings data are available for fewer occupational titles than included in the O*Net database; in some cases occupational titles are not directly matched. To include the occupations of as many workers as possible in some cases related occupations were combined prior to analysis (e.g., “Truck Drivers, Tractor Trailer” in were combined with “Driver/Sales Workers and Truck Drivers”). The result was an analysis based on only 473 occupations but still covering nearly all the workers reported in O*NET within 974 occupations defined in the Standard Occupational Code (SOC) of the U.S. Bureau of Labor Statistics.

Earnings data are based on persons employed full-time, full-year from the Current Population Survey Annual Social and Economic (ASEC) Supplement, as provided by the U.S. Census Bureau (2016a). Earnings data are for 2013, and are shown as adjusted to 2014 dollars based on the Consumer Price Index Research Series (CPI-U-RS; U.S. Bureau of Labor Statistics 2015a). Where earnings

data are not published for both genders, median earnings of all workers are applied. The share of women in each occupation is estimated based on the American Community Survey 2009-2013 (U.S. Census Bureau 2016b) as the average of women and men having worked in each occupation during the five year period, irrespective of hours worked. Data for projected change in employment and in job openings from growth and turnover are based on the U.S. Bureau of Labor Statistics Employment Projections 2014-2024 (U.S. Bureau of Labor Statistics 2015b).

Middle-skill occupations are defined as occupations which require at least high school education and some postsecondary education but less than a bachelor’s degree. Within the context of the IWPR O*Net database, middle-skill occupations are occupations in Job Zone 2 that require at least some post-secondary education (or level 3 of educational attainment), and occupations in Job Zone 3 that require at least a high school diploma but less than a bachelor’s degree (level 2 to 5 of educational attainment, See Table A2 above).

Growing good middle-skill occupations are defined as occupations with median annual earnings (for all workers) of at least \$35,000 for full-time, year-round work; projected job openings from turnover and employment growth of at least 25,000; and employment growth of 0 or more (that is, occupations which are projected to decline in their total size of employment between 2014 and 2024 are excluded).

APPENDIX B

TABLE B1 EFFECTS OF CHANGING THE OCCUPATION OF 10 PERCENT OF WOMEN UNDER TWO ALTERNATIVE STRATEGIES

Topic	Measure	Goal A Change Occupations to Maximize Occupational Integration			Goal B Change Occupations to Maximize Women's Earnings		
		Pre-Move Occupations	Post-Move Occupations	% Change	Pre-Move Occupations	Post-Move Occupations	% Change
Number of Occupational Moves	Women Who Change Occupations ¹	--	8,126,051	--	--	8,126,051	--
	Occupations Gaining or Losing Women	--	208		--	204	
Increase in Education and Training for Women who Change Occupations	Average Inter-Occupation Distance Moved ²	--	--	0.098	--	--	0.090
	Maximum Inter-Occupation Distance Moved ²	--	--	0.172	--	--	0.170
	% of Women Who Change Job Zone	--	--	36.0%	--	--	52.1%
	% of Women who Change Education Zone	--	--	51.0%	--	--	70.4%
	Average Job Zone (scale of 1-5)	2.7	2.9	4.5%	3.2	3.5	10.2%
	Average Education Zone (scale of 1-12)	3.8	3.8	-0.7%	4.3	5.1	18.7%
Effects on Women Changing Occupations	Average Earnings, All Workers ³	\$39,076	\$52,963	35.5%	\$39,288	\$63,814	62.4%
	Average Earnings, Women Workers ³	\$40,716	\$31,891	-21.7%	\$36,779	\$55,860	51.9%
	Average Women's Earnings < \$25,000 ³	35.0%	19.3%	-45.0%	14.7%	0.4%	-97.5%
	Ratio of Female Earnings to Male Earnings ³	0.83	0.83	0.0%	0.86	0.82	-4.6%
	Women % of Fellow Workers	62.0%	18.5%	-70.1%	66.4%	36.2%	-45.5%
	In a "Female-dominated" Occupation ⁴	20.2%	0.0%	-100.0%	36.3%	8.6%	-76.2%
	In a "Male-dominated" Occupation ⁴	0.0%	63.8%	63.8%	0.0%	35.5%	35.5%
	Average Annual Employment Growth Rate	0.71%	0.72%	0.3%	0.62%	0.91%	46.8%
	In a "High Growth" Occupation ⁵	1,373,273	529,700	-10.4%	1,328,959	1,501,451	2.1%
	Occupational Prestige Score	41.5	43.6%	5.2%	45.1	53.1	17.7%
	Holds a Manager or Supervisor Job Title	17.9%	13.0%	-27.6%	21.1%	18.3%	-13.3%

Topic	Measure	Goal A Change Occupations to Maximize Occupational Integration			Goal B Change Occupations to Maximize Women's Earnings		
		Pre- Move Occupations	Post- Move Occupations	% Change	Pre- Move Occupations	Post- Move Occupations	% Change
Effects on all Women in the Occupations Analyzed	Average Job Zone (scale of 1-5)	2.8	2.8	0.4%	2.8	2.9	1.1%
	Average Education Zone (scale of 1-12)	3.9	3.9	-0.1%	3.9	4.0	2.1%
	Average Earnings, All Workers ³	\$39,836	\$41,224	3.5%	\$39,836	\$42,288	6.2%
	Average Earnings, Women Workers ³	\$36,636	\$37,587	2.5%	\$36,636	\$38,544	5.0%
	Average Women's Earnings < \$25,000 ³	27.6%	26.0%	-5.7%	27.6%	26.1%	-5.2%
	Ratio of Female Earnings to Male Earnings ³	0.840	0.840	0.0%	0.84	0.84	-0.5%
	Gini Index of Earnings Inequality	0.345	0.296	-16.6%	0.345	0.330	-4.4%
	Women % of Fellow Workers	66.0%	61.6%	-6.6%	66.0%	62.9%	-4.6%
	In a "Female-dominated" Occupation ⁴	39.7%	37.6%	-5.1%	39.7%	36.9%	-7.0%
	In a "Male-dominated" Occupation ⁴	5.7%	12.1%	112.6%	5.7%	9.2%	62.6%
	Average Annual Employment Growth Rate	0.65%	0.65%	0.0%	0.65%	0.68%	4.5%
	In a "High Growth" Occupation ⁵	10,176,829	9,333,256	-1.0%	10,176,829	10,349,321	0.2%
	Occupational Prestige Score	42.5	42.8	0.5%	42.5	43.3	1.9%
	Holds a Manager or Supervisor Job Title	11.8%	11.3%	-4.2%	11.8%	11.5%	-2.4%

Notes: ¹Employment estimates based on average number of women working in an occupation between 2009-2013. ²Distances among the 473 occupations average .167 and range from .036 to .350.

³ Annual earnings for workers employed full-time full-year, based on 2013 CPS ASEC.

⁴ Male-dominated if more than 75% of workers are male; female-dominated if more than 75% of workers are female. ⁵ "High growth" if annual projected growth rate 2014-2024 is > 1.5%



APPENDIX C

Resources for Career and Technical Education for Women in Manufacturing, Transportation, and Information Technology.

Apprenticeships

- U.S. Department of Labor, “Women Build, Protect, and Move America Portal” <<http://www.dol.gov/wb/nto/>>
- U.S. Department of Labor, “Apprenticeships Near You” <<http://www.dol.gov/featured/apprenticeship/find-opportunities>>
- “CareerOneStop, “Apprenticeship Finder” <<http://www.careeronestop.org/toolkit/training/find-apprenticeships.aspx>>
- United Association Union of Plumbers, Fitters, Welders, & Service Technicians, “Apprentice Training” <<http://www.ua.org/apprenticeship>>
- U.S. Department of Labor American Apprenticeship Initiative: Information on Grants and Toolkit for Employers <<http://www.dol.gov/featured/apprenticeship/grants>>
- Apprenticeship program for women in nontraditional occupations: Human Capital Development Corp, Inc. <<http://www.hcdcwi.org/train.html>>

Skills Training for Women in Nontraditional Occupations

- Manufacturing
 - Training for young people in many skills including manufacturing technology or machining: Job Corps <<https://recruiting.jobcorps.gov/>>

- Women-only training in manufacturing: Vermont Works for Women’s Step Up to Skilled Manufacturing program; Oregon Tradeswomen: Pathways Program on Women in Metals& Manufacturing <<http://www.tradeswomen.net/women-in-metals-manufacturing/>>
- Skills training for women in manufacturing (and other technical trades): Goodwill of North Georgia <[http://goodwillng.org/Get-Training/Training-Programs/New-Choices-Woman-in-Highway-Construction-\(1\).aspx](http://goodwillng.org/Get-Training/Training-Programs/New-Choices-Woman-in-Highway-Construction-(1).aspx)>
- Welding
 - Women-only training: Chicago Women in the Trades: <http://chicagowomenintradest2.org/?page_id=49>
 - Women-only training: Mississippi Moore Community House <<http://www.moorecommunityhouse.org/winc/index.html>>
 - Wisconsin Indianhead Technical College <<http://www.witc.edu/pgmpages/welding/women.htm>>
- Transportation, Distribution and Logistics
 - Women-only truck driver training: “CLIMB Wyoming” <<http://www.climbwyoming.org/program/>>

- Training for women truck drivers: Roadmaster CDL School; <http://www.roadmaster.com/truck_school_womandrivers.php>
- U.S. Department of Transportation, “Entrepreneurial Training Women and Girls Internship Program” <<https://www.transportation.gov/careers/entrepreneurial-training-women-and-girls-internship-program>>
- U.S. Department of Transportation, “Summer Internship Program for Diverse Groups: STIPDG” <<https://www.fhwa.dot.gov/education/stipdg.cfm>>
- Vermont Agency of Transportation, Vermont Commercial Driver License skills training program for women and minority men <<http://vtranscivilrights.vermont.gov/employment/construction/cdl>>
- Skills training for women in transportation, manufacturing, and construction: Goodwill of North Georgia <[http://goodwillng.org/Get-Training/Training-Programs/New-Choices-Woman-in-Highway-Construction-\(1\).aspx](http://goodwillng.org/Get-Training/Training-Programs/New-Choices-Woman-in-Highway-Construction-(1).aspx)>
- Women-only training as auto mechanics: Vermont Works for Women, “Rosie’s Girls” <<http://vtworksforwomen.org/rosiesgirls/>>
- Career counseling and skills workshops for single parents and individuals enrolled in non-traditional programs of study: Northeast Community College, “New Beginnings Program” <<http://www.northeast.edu/Support-Services/New-Beginnings.aspx>>
- IT
 - Skills training for women in IT: Vermont Works for Women, “Step Up to IT program” <<http://vtworksforwomen.org/suit/>>
 - Training in IT for girls of color in San Francisco: Black Girls Code <<http://www.blackgirlscode.com/>>
 - Training in IT for high school girls: Girls Who Code <<http://girlswhocode.com/>>
 - Software development for women in Seattle: Ada Developers Academy <<http://adadevelopersacademy.org/about>>
 - Training in coding for women in New York: Grace Hopper Academy <<http://www.gracehopper.com/>>
 - Online training for women in coding: Women’s Coding Collective <<http://thewc.co/>>
 - Training for women with children in San Francisco: MotherCoders <<http://www.mothercoders.org/>>
 - Training for women and men in power engineering: National Association of Power Engineers [NAPE] <<http://powerengineers.com/>>



Resources

■ Manufacturing

- Women in Manufacturing Association and Resources: “WIM Works Career Center” <<http://www.womeninmanufacturing.org/wimworks70>>
- The Manufacturing Institute, “Science, Technology, Engineering, and Production (STEP) Ahead Initiative” <<http://www.themanufacturinginstitute.org/Initiatives/Women-in-Manufacturing/STEP-Awards.aspx>>
- Scholarships for women in welding: American Welding Society <<http://www.aws.org/about/page/national-scholarships>>

■ Transportation

- Network and mentorship program for women in transportation: WTS Professional Development opportunities and scholarships <<https://www.wtsinternational.org/education/scholarships/>>
- Resources and job opportunities for women truck drivers: LTD <<http://www.ladytruckdrivers.com/>>
- Scholarships and information for women in aviation: Women in Aviation, International <<http://www.wai.org/education/index.cfm>>
- Leadership development program for women in trucking: Women in Trucking <<http://womenintruck.org/>>

- Zonta International, “Amelia Earhart Fellowship” for young women in aerospace-related sciences and engineering.<<http://www.zonta.org/WhatWeDo/InternationalPrograms/AmeliaEarhartFellowship.aspx>>

■ IT

- Resources for Girls in STEM: The National Girls Collaborative Project <<http://ngcproject.org/about-ngcp>>
- Mentorship and networking for girls and women in STEM: GAINS <<http://gainsnetwork.org/>>
- Educational videos and networking for girls interested in STEM: STEM Girl Social Network <<http://stemgirlsocialnetwork.com/>>
- Resources and networking for women and girls in STEM: National Center for Women & Information Technology <<https://www.ncwit.org/>>

General Resources

- Career counseling and skills workshops for single parents and individuals enrolled in non-traditional programs of study: Northeast Community College, “New Beginnings Program” <<http://www.northeast.edu/Support-Services/New-Beginnings.aspx>>
- Women’s Institute for Leadership Development in the Labor Movement Mentoring Program <<http://wildlabor.org/mentoring-program/>> and Annual Summer Institute <<http://wildlabor.org/summer-institute/>>

- Network and mentorship program: Texas Women in Trades <<http://www.texaswomenintrades.com/>>
- U.S. Department of Labor Clearinghouse for women in nontraditional careers: “Women Build, Protect, and Move America Portal” <<http://www.dol.gov/wb/nto/>>
- Wider Opportunities for Women’s (WOW), “Pink-to-Green Toolkit”: resources and tools on recruitment, curriculum, case management, and retention focused on women (in green and other nontraditional jobs) <<http://www.jff.org/initiatives/greenways>>
- Center for Energy Workforce Development & Hard Hatted Women WISE Pathways: Toolkit for Recruiting and Retaining Women in Non-Traditional Positions <<http://www.cewd.org/toolkits/CEWDHHwtoolkit.pdf>> and Workshop Materials <<http://www.cewd.org/curriculum/wisepathways.php>>
- Reaching New Heights: Promising Practices for Recruiting and Retaining Students in Career and Technical Education Programs That Are Nontraditional for Their Gender (Report) <http://www.nwlc.org/sites/default/files/pdfs/Building_New_Possibilities.pdf>
- Career Pathways for Women and Girls; Strategies to attract Women and Girls to Emergent and Nontraditional Occupations and Industries (Report) <http://www.security4women.org.au/wp-content/uploads/eS4W-StrategiestoAttractWomen_Rationale_Final.pdf>
- Gender Equity Expert Panel: Exemplary & Promising Gender Equity Programs, 2000 (Report) <<http://eric.ed.gov/?id=ED457116>>
- LEP Guide for Workforce Professionals-how to best serve limited English proficiency population <<http://www.twc.state.tx.us/files/partners/lep-guide-module-2-nontraditional-occupations-entrpreneurial-opportunities-twc.pdf>>
- APEC Women in Transportation Forum Discussion Group Summary <https://www.transportation.gov/sites/dot.dev/files/docs/APEC%20Women%20in%20Transportation%20Forum_Discussion%20Group%20Summary_14Dec2012_FINAL.pdf>
- Dialogue for Women in Blue-Collar Transportation Careers Final Report <<https://www.transportation.gov/sites/dot.dev/files/docs/women-blue-collar-dialogue-fall-2011.pdf>>
- ILO’s Promoting the employment of women in the transport sector- Obstacles and policy options (Report) <http://www.ilo.org/wcmsp5/groups/public/-ed_dialogue/---sector/documents/publication/wcms_234880.pdf>
- How to Attract and Engage Female Truck Drivers (Article) <http://www.supplychain247.com/article/how_to_attract_and_engage_female_truck_drivers>
- Resources for increasing women in STEM: Women in STEM Knowledge Center <<http://www.wskc.org/>>



Professional and Trade Organizations, Associations, and Unions:

- American Association for University Women <<http://www.aauw.org/>>
- American Welding Society <<http://www.aws.org/about/page/national-scholarships>>
- Coalition of Labor Union Women <<http://www.cluw.org/>>
- Conference of Minority Transportation Officials Celebrating Women Who Move the Nation <http://www.comto.org/events/event_details.asp?id=698046&group=>>
- International Society of Women Airline Pilots <<http://www.iswap.org/>>
- International Organization of Women Pilots <<http://www.ninety-nines.org/>>
- International Society for the Preservation of Women in Railroading <<http://www.womeninrailroading.com/>>
- Real Women in Trucking <<http://www.realwomenintrucking.com/>>
- Women in Aviation International <<http://www.wai.org/>>
- Women in Trucking <<http://womenintrucking.org/>>
- Women in Transportation <<http://womenintrucking.org/>>
- Women's Institute for Leadership Development <<http://wildlabor.org/>>
- Trade's Women, Inc <<http://tradeswomen.org/>>

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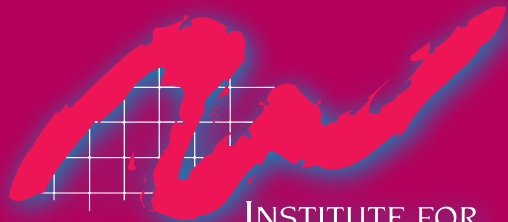
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