Workers in Declining Industries: Literacy's Role in Worker Transitions

Authors

Lee Bruno

Ying Jin

Dwayne Norris

American Institutes for Research

October 2010

Contents

Introduction

The research conducted in the 1980s and 1990s on the subject of essential workplace skills[1] was based on the recognition that global competition posed two distinct challenges to American industry. First, workers in countries with lower labor costs could perform the more mundane routine labor of most manufacturing processes just as well as U.S. workers. Second, countries with a better educated workforce, particularly in the technology sectors, could design and produce better products than American workers. The 1980s saw the United States outperformed in the manufacture of steel, automobiles, and durable goods such as appliances. The 1990s saw an outmigration of the labor-intensive garment and plastics manufacturing industries to Mexico, China, and other parts of Asia.[2] Today two of the three American auto manufacturing giants are restructuring following Government takeovers, and nearly all U.S. household appliances are manufactured outside the country.[3]

The U.S. Bureau of Labor Statistics (BLS) shows that some areas of manufacturing represent 19 of the top 20 industries in decline, while only miscellaneous manufacturing is listed among the top 20 fastest growing industries.[4] BLS projects that between 2006 and 2016 approximately 1,060,000 workers in the 20 occupations representing the greatest decline will have lost their jobs. An analysis of these 20 occupations shows them to be either low-skilled clerical or production jobs, or farm work (see Table 1).

The loss of these jobs can be attributed not only to the lure of cheaper labor in other countries but to the greater use of machines, including computer-aided devices that are more efficient than people. Many industries are achieving higher production levels using fewer workers. These job losses are permanent, the result of structural changes in the economy. Without regard to economic cycles, such as the 2008 recession, over 1 million people are or will be displaced across these 20 industries in decline.

Although structural unemployment is a national crisis, solutions to unemployment are implemented through interventions that are attuned to the idiosyncrasies of the local economies. Declining industries dislocate workers en mass with commensurate adverse impact on communities. The sheer scope of the numbers of unemployed and their concomitant economic impact requires strategies that address classes of workers rather than individual workers one at a time. A national infrastructure, similar to the Workforce Innovation in Regional Economic Development (WIRED) initiative[5], is needed to create new jobs for local economies—jobs that are attainable by dislocated workers with a minimum of training and readjustment services. The WIRED model engages key community stakeholders to integrate economic development with workforce development. This model could benefit from tools that facilitate large-scale workforce development planning.

In the report *"Are They Really Ready to Work?"* a significant barrier to creating the workforce necessary for the21st century is the lack of work preparedness skills in new

[1] Secretary's Commission on Achieving Necessary Skills (SCANS). (1992). *Learning a living: A blueprint for high performance.* Washington, DC: U.S. Department of Labor. Retrieved from http://wdr.doleta.gov/SCANS/lal/lal.pdf

[2] Pierce, L. (2004). Plastics products, not elsewhere classified (SIC 3089): America and the world. In *Encyclopedia of American industries* (4th ed., Vol. 1). Farmington Hills, MI: Thomson Gale; Gereffi, G., Spener, D., & Bair, J. (2002). *Free trade and uneven development: The North American apparel industry after NAFTA* (p. 24). Philadelphia: Temple University Press.

[3] U.S. Census Bureau. (2009). *Annual current industrial report: Major household appliances* (Current Industrial Report Series 2008 MA335F). Washington, DC: Author. Retrieved from http://www.census.gov/cir/www/instructions/ma335f.pdf.

[4] Bureau of Labor Statistics, U.S. Department of Labor. (2009 November). Industry output and employment projections to 2018. *Monthly Labor Review.* Washington, DC: Author.

[5] A current initiative in operation supported with funding by the U.S. Department of Labor, Employment and Training Administration www.doleta.gov/WIRED.

Table 1: Projected job losses in declining occupations, 2006–2016

Occupation	Occupation category	Job losses (thousands)	Percent change
Farmers and ranchers	Farming, Fishing, nursery	90	–8.5
Farmworkers and laborers—crop, nursery, and greenhouse	Farming, Fishing, Nursery	20	–3.4
Stock clerks and order fillers	Office/clerical	131	–7.7
Computer operators	Office/clerical	32	–24.7
File clerks	Office/clerical	97	–41.3
Order clerks	Office/clerical	66	–24.3
Word processors and typists	Office/clerical	21	–11.6
Packers and packagers, hand	Production	104	–12.4
Sewing machine operators	Production	63	–27.2
Electrical and electronic equipment assemblers	Production	57	–26.8
Cutting, punching, and press machine setters, operators, and tenders, metal and plastic	Production	40	–14.9
Inspectors, testers, sorters, samplers, and weighers	Production	35	–7.0
First-line supervisors/managers of production and operating workers	Production	34	–4.8
Photographic processing machine operators	Production	25	–49.8
Machine feeders and offbearers	Production	22	–15.2
Packaging and filling machine operators and tenders	Production	21	–5.4
Paper goods machine setters, operators, and tenders	Production	21	–18.2
Telemarketers	Sales	39	–9.9
Cashiers, except gaming	Service	118	–3.4
Driver/sales workers	Transportation	24	–5.3

workers, not technical or occupational skills. Work preparedness skills are organized into two groups: basic knowledge and applied social skills.[6] Basic knowledge includes the literacy skills of mathematics, English reading comprehension, and English writing, in addition to subjects that are standard high school fare—foreign languages, economics, history, science, and humanities. Social skills are the interactive skills that support teamwork, good interpersonal communications, and responsible workplace behavior, also commonly referred to as "the work ethic." Workers in declining industries have demonstrated that they have the requisite social skills, but do they have the basic knowledge skills?

The American Institutes for Research (AIR), under contract to the U.S. Department of Labor, Employment and Training Administration (ETA), uses data collected from the 2003 National Assessment of Adult Literacy (NAAL),[7] to examine workers in declining occupations in order to address the following questions:

- What distinguishes workers in declining occupations from workers in the general population?
- What are the literacy requirements that pose barriers to high-growth occupations?
- How can ETA's workforce investment system[8] expedite workers' transition from a declining industry to expanding industries?

Workers in Declining Occupations Compared With the General Population of Workers

Demographic and Socioeconomic Comparisons

The NAAL research is based on a 2003 household sample of U.S. adults 16 years of age or older that constitutes a nationally representative probability sample. Proper weights were applied in all analyses to reflect the general population. This allows the data used in this report to accurately reflect the general U.S. adult population 16 years of age or older. That is not the case in the analysis of workers in declining industries; data on workers in declining industries are not necessarily representative of all workers in declining industries. Nevertheless, the sample size is large enough to lend credence to observations discussed in this report.

In addition to assessing the literacy skills of the general working population and those respondents representing workers in declining occupations, NAAL gathered extensive background information on respondents' demographic and socioeconomic characteristics (e.g., age, gender, race/ethnicity, nativity status, schooling, labor force status, and household income), along with their literacy practices. Table 2 compares age, gender, race/ethnicity, and educational attainment of NAAL respondents working in

[6] The Conference Board, Corporate Voices for Working Families, Partnership for 21st Century Skills, & Society for Human Resource Management. (2006). Are they really ready to work? Employers' perspectives on the basic knowledge and applied skills of new entrants to the 21st century U.S. workforce. New York: Authors. Retrieved from http://www.21stcenturyskills.org/documents/FINAL_REPORT_PDF09-29-06.pdf.

[7] The 2003 NAAL study (http://nces.ed.gov/naal/) provided information on the literacy proficiency of nearly 18,000 adults, 16 years of age or older. See the appendix of this report for a description of the study. For an interpretation of the literacy scales and performance levels on the NAAL assessment, see Kutner et al. (2007).

[8] ETA funds job training, income maintenance, labor market information, and job placement services through a system of state and local One-Stop Service Centers http://www.doleta.gov/etainfo/wrksys/WIMission.

Table 2: Demographic comparisons between NAAL sample of workers in declining occupations and U.S. population

	Workers in declining occupations	U.S. Population
Age	23%*	14%
18–24	30%	28%
25–39	21%	21%
40–49	20%	22%
50–64	7%*	16%
65+	48%	52%
Sex/Gender	52%	48%
Female	63%*	71%
Male	14%	11%
Race/Ethnicity	18%*	12%
White	5%	6%
Black	2%	1%
Hispanic	6%	6%
Other	13%*	9%
Education	7%*	5%
Still in high school	38%*	27%
0–8 years	5%	6%
9–12 years	13%	12%
GED/equivalency**	10%	12%
High school graduate	6%*	23%
Vocational degree	23%*	14%
Some college	30%	28%
Associate of Arts degree/2 years of studies	21%	21%
College graduate and Graduate studies/degree	20%	22%

* Significantly different from the general population at the significance level of 0.05.
**General Education Development.

declining occupations with these characteristics of workers in the general population of NAAL respondents.[9]

Age. In terms of age, there is little to distinguish workers in declining occupations from workers in the general population during the prime working years, between 25 and 64 years of age. Workers in declining occupations are more likely to include more young workers (18–24 years of age) and fewer older workers (older than 65 years of age) than the general population. Since many of the declining occupations call for physical strength or manual dexterity rather than education or experience, younger workers have an advantage and older workers a distinct disadvantage in gaining jobs in these occupations.

Gender. Workers in declining occupations generally match the general population with regard to gender. Women are only slightly less represented in declining occupations (48%) than they are among workers in the general population (52%). Declining occupations are gender neutral.

Ethnicity. Workers in declining occupations are mostly white (63%). However, minorities, consisting of blacks and Hispanics, represent a larger proportion of workers in declining occupations (32%) than in the general population of workers (23%).

Educational Attainment. Forty-five percent of workers in declining occupations and 32 % of the general population have high school diplomas or General Education Development (GEDs). Workers in both groups show the same levels (18%) of postsecondary education in the form of either vocational school or "some" college; however, nearly twice as many workers in the general population (35%) as workers in declining occupations had either a 2-year or 4-year college degree. It is the variation in college-level educational attainment that represents the single greatest distinction between workers in declining occupations and workers in the general population.

In the context of the report "Are They Really Ready to Work?" according to which high school and 2-year degrees were basic qualifications for the 21st century workforce, 79% of workers in declining occupations and 85% of the U.S. general population of workers represented in the NAAL study have graduated from high school. Thirty-four percent of the workers in declining occupations and 55% of the general population of workers have postsecondary educations. This would suggest that U.S. workers generally are failing to attain the education levels demanded by today's jobs.

Prose and Quantitative Literacy Levels

NAAL measured respondents' proficiencies on three literacy scales: prose, document, and quantitative. Because the correlation between the prose and document scores reviewed

[9] Many of the background variables examined in this report are based on self-reported data, and because they are also related to one another, complex interactions and relationships among them cannot be explored. Therefore, readers are cautioned not to draw causal inferences based solely on the results presented here.

Table 3: Comparisons of literacy levels between workers in declining occupations and workers in general U.S. population

	Prose	Quantitative		
	Mean Scores	Mean Scores		
Workers in declining occupations	259.52*	272.78*		
General population	275.00	283.00		
	Below basic	**Basic**	**Intermediate**	**Advanced**
Prose				
Workers in declining occupations	16%	38%*	41%	6%*
General population	14%	29%	44%	13%
Quantitative				
Workers in declining occupations	24%	38%*	31%	8%*
General population	22%	33%	33%	13%

* Significantly different from other workers at the significance level of < 0.05.

for this report revealed no new information, the analyses in this section are based on the prose and quantitative literacy scales only. For each, proficiency was measured on a scale that ranged from 0 to 500. Scores on each of the three literacy scales were characterized in terms of four literacy proficiency levels: *Below Basic*, *Basic*, *Intermediate*, and *Proficient.* A brief description of the four levels of literacy follows.[10]

Prose

- **Below Basic**—locating easily identifiable information in short, commonplace prose texts, with literacy assessment scores ranging from 0 to 209
- **Basic—**reading and understanding information in short commonplace texts, with literacy assessment scores ranging from 210 to 264
- **Intermediate**—reading and understanding moderately dense, less commonplace prose texts, as well as summarizing, making simple inferences, determining cause and effect, and recognizing the author's purpose, with literacy assessment scores ranging from 265 to 339
- **Proficient**—reading lengthy, complex, abstract prose tests, as well as synthesizing information and making complex inferences, with literacy assessment scores ranging from 340 to 500

Quantitative

- **Below Basic—**locating numbers and using them to perform simple quantitative operations (primarily addition) when the mathematics information is very concrete and familiar, with literacy assessment scores ranging from 0 to 234
- **Basic—**locating easily identifiable quantitative information and using it to solve simple, one-step problems when the arithmetic operation is specified or easily inferred, with literacy assessment scores ranging from 235 to 289
- **Intermediate—**locating less familiar quantitative information and using it to solve problems when the arithmetic operation is not specified or easily inferred, with literacy assessment scores ranging from 290 to 349
- **Proficient—**locating more abstract quantitative information and using it to solve multistep problems when the arithmetic operations are not easily inferred and the problems are more complex, with literacy assessment scores ranging from 350 to 500

Table 3 presents a comparison of the prose and quantitative literacy of workers in declining occupations and workers in the general population of NAAL respondents. The table first compares the average scores for each group and then presents the percentage distribution of each group across the four levels of literacy proficiency.

In terms of average literacy scores, there is a significant difference between the prose and quantitative score means of workers in declining occupations and those of the general population of workers, with prose score averages showing the larger difference. More workers in declining occupations had Basic literacy than did those in the general population. In contrast, more workers in the general population had Proficient literacy than did those in declining occupations.

It is interesting to note that the distribution of literacy levels of both groups of workers correlate closely with the groups' distribution across educational attainment. In both instances, there is little to distinguish the two groups until they are compared at the upper ranges of educational attainment (college degrees) and literacy levels (Proficient). This suggests that the groups are very similar except when individual circumstances make higher education feasible.

Literacy and Occupations

The NAAL data offer an opportunity to compare the literacy levels of workers in declining industries with the literacy requirements of occupations in high-growth industries. To do this, 50 occupations that did not require 4-year college degrees and were representative of those in high-growth

[10] *Source:* Hauser, R. M., Edley, C. F. Jr., Koenig, J. A., & Elliot, S. W. (Eds.). (2005). *Measuring literacy: Performance levels for adults, Interim report.* Washington, DC: National Academies Press; White, S., & Dillow, S. (2005). *Key concepts and features of the 2003 National Assessment of Adult Literacy* (NCES 2006-471). Washington, DC: U.S. Department of Education, National Center for Education Statistics.

industries were selected.[11] Next, multiple regression models were developed by AIR to integrate the Occupational Information Network (O*NET)[12] data and the NAAL literacy measures**,** and each occupation's literacy requirements were derived and then compared with the average literacy levels of the NAAL respondents who were employed in declining occupations.[13]

Table 4 compares the average literacy prose (260) and quantitative (273) scores of workers in declining occupations with the prose and quantitative scores that correspond to each of the 50 high-growth occupations. Also included is the educational attainment of the distribution of workers holding these occupations (i.e., high school, some college, and bachelor's degree).

Table 4: Literacy and educational requirements of demand occupations

Occupation	Industry	Prose	Quantitative	Difference in prose score	Difference in quant score	Percent of workers 25–44 years of age, by educational attainment		
						H.S. or less	Some college	Bachelor's degree or higher
Painters, transportation equipment	Transportation	235	251	–24.51	–21.55	75.4	20.8	3.8
Railroad conductors and yardmasters	Transportation	244	272	–15.91	–0.89	37.7	51.7	10.6
Operating engineers and other construction equipment operators	Construction	245	255	–14.45	–18.11	77.8	19.6	2.6
Medical transcriptionists	Health care	248	293	–11.79	20.18	30.6	58.9	10.4
Mates—ship, boat, and barge	Transportation	252	276	–7.98	2.79	54.9	24.2	20.9
Dental assistants	Health care	252	282	–7.87	9.67	33.6	57.5	8.9
Dental hygienists	Health care	252	276	–7.11	3.60	2.9	63.8	33.3
Pipelayers	Energy	255	256	–5.01	–16.74	67.6	28.5	3.9
Bus and truck mechanics and diesel engine specialists	Transportation	256	266	–3.54	–7.21	65.7	31.2	3.1
Truck drivers, heavy and tractor–trailer	Transportation	256	270	–3.26	–3.17	70.7	25.2	4.1
Excavating and loading machine and dragline operators	Energy	257	263	–2.57	–9.47	78.8	17.7	3.5
Chefs and head cooks	Hospitality	258	285	–1.07	11.91	47.7	38.8	13.5
Automotive body and related repairers	Automotive	260	281	0.38	8.59	74.3	22.5	3.1
Security and fire alarm systems installers	Homeland security	262	288	2.17	15.59	48.3	44.0	7.7
Freight and cargo inspectors	Homeland security	262	273	2.69	0.19	42.8	41.7	15.5

[11] See www.careervoyages.gov. This Web site was the primary source for the selection of occupations. In some instances (e.g., construction), when occupations meeting the criteria were numerous, occupations were collapsed into categories recognized by the respective industry.

[12] O*NET is a database of information describing all U.S. occupations. See http://online.onetcenter.org/

[13] The method used to link the O*NET data and the NAAL literacy measures is described in Appendix A.

Table 4: Literacy and educational requirements of demand occupations *continued*

Occupation	Industry	Prose	Quantitative	Difference in prose score	Difference in quant score	Percent of workers 25–44 years of age, by educational attainment		
						H.S. or less	Some college	Bachelor's degree or higher
Police, fire, and ambulance dispatchers	Homeland security	263	309	3.07	36.22	44	45.1	10.9
Physical therapy assistants	Health care	267	289	7.58	16.56	11.7	65.4	22.9
Electrical and electronics repairers, commercial and industrial equipment	Energy	270	283	10.05	10.54	46.4	46.0	–
Radiological technicians	Health care	270	293	10.27	20.25	7.2	67.9	24.9
Bill and account collectors	Financial services	270	290	10.27	17.34	38.4	48.2	13.3
Electrical power–line installers and repairers	Energy	270	276	10.66	3.40	55.9	38.2	6
Customer service representatives	Retail	271	291	11.24	18.07	33.8	44.2	22
Aircraft structure, surfaces, rigging, systems and assemblers	Aerospace	271	280	11.53	6.88	58.7	35.3	–
Aircraft mechanics and services technicians	Aerospace	273	296	13.46	23.37	32.9	56.6	10.5
Plumbers	Construction	274	294	14.00	21.69	67.6	28.5	3.9
Industrial machinery mechanics	Advanced manufacturing	274	294	14.68	20.99	55.9	38.8	5.3
Rough carpenters (carpenters)	Construction	275	278	15.59	4.83	72.8	21.6	5.5
Municipal fire fighters (fire fighters)	Homeland security	275	292	15.98	18.79	22.9	58.8	18.3
Computer, automated teller and office machine repairers	Information technology	277	305	17.29	31.90	22.5	52.7	24.7
Food service managers	Hospitality	277	298	17.89	25.24	40.0	35.8	24.2
Police patrol officers (police and sheriff patrol officers*)	Homeland security	279	305	19.05	32.27	15.5	51.7	32.8
Brokerage clerks	Financial services	281	295	21.48	22.61	24.4	44.6	31
Bookkeeping, accounting, and auditing clerks	Financial services	281	299	21.72	25.77	33.7	50.3	16
Payroll and timekeeping clerks	Financial services	282	294	22.51	21.66	32.9	49.6	17.5

Table 4: Literacy and educational requirements of demand occupations *continued*

Occupation	Industry	Prose	Quantitative	Difference in prose score	Difference in quant score	Percent of workers 25–44 years of age, by educational attainment		
						H.S. or less	Some college	Bachelor's degree or higher
Food science technicians	Emerging industries	282	296	22.92	23.57	42.7	25.6	31.6
Medical equipment repairers	Health care	286	314	26.44	41.55	28.3	57.0	14.7
Surveying technicians	Energy	287	298	27.19	25.06	42.2	51.0	6.8
Mapping technicians	Emerging industries	290	318	30.33	45.07	42.2	51.0	6.8
Electricians	Construction	290	292	30.71	19.45	50.7	42.4	6.8
Insurance adjusters, examiners, and investigators	Financial services	290	307	30.82	34.30	18.3	35.1	46.7
Registered nurses	Health care	290	297	30.92	23.77	1.0	42.7	56.2
Electronic drafters	Aerospace	294	306	34.75	33.59	13.0	62.4	24.6
Licensed practical nurses	Health care	296	314	36.39	40.96	20.6	72.4	7
Construction managers	Construction	297	308	37.12	35.01	39.5	31.1	29.4
Statistical assistants	Emerging industries	299	324	39.20	51.62	23.7	46.5	29.8
Electrical and electronic engineering technicians	Advanced manufacturing	299	317	39.21	43.92	27.2	54.4	18.4
Chemical technicians	Advanced manufacturing	301	314	41.90	41.42	30.3	32.5	37.2

The prose literacy requirements across the 50 occupations range from a low of 235 to a high of 308. The quantitative literacy scores range from a low of 251 to a high of 326. Generally, the workers in declining industries have lower literacy scores than those required for the representative high-growth occupations. The more surprising finding, however, is the lack of correlation between educational requirements and literacy requirements of high-growth occupations. In other words, high-growth occupations may have higher literacy requirements but not necessarily require education beyond high school. For this analysis, the 50 occupations were selected to exclude occupations in which most or all the workers had 4-year degrees as incremental to an effective transition strategy that was most feasible for the target group. Only 2 of the 50 occupations show a high distribution of workers with 4-year degrees—registered nurses (56.2 %) and insurance adjusters (46.7 %). The prose literacy score for both occupations is 290, and the quantitative literacy scores are 297 and 307, respectively. The occupations with the highest literacy scores are mechanical and technical occupations common to the advanced manufacturing industry, for example, industrial engineering technicians, mechanical drafters, technical engineering and chemical technicians. None of these positions requires a 4-year degree, but all do require some college. According to responses to the NAAL, a significant portion of workers in these occupations only have a high school diploma.

The lack of correlation between educational attainment and literacy may result from the ability of people with higher literacy proficiency but not necessarily education beyond high school to master the technical training for some occupations through on-the-job coaching and employer in-house special training. Advanced manufacturing typically relies on customized training that is driven by the unique requirements of its production equipment and processes. By contrast, registered nurses are schooled to state credentialing requirements implemented by degree-granting institutions.

Occupational training that is governed by standardized requirements generally falls into the domain of postsecondary educational institutions. These institutions typically have educational prerequisites, for example, high

school graduation, for entry. However, where employers train workers in occupational skills specific to their equipment and processes, educational prerequisites are not typical. Workers with the literacy skills needed to learn on the job but who lack formal education are more likely to advance their careers in high-demand occupations that are learned on the job. Postsecondary institutions that must meet credentialing standards may be unable to admit workers from declining industries who have not graduated from high school.

Table 5 compares the average prose and quantitative literacy scores of workers in declining occupations with prose and quantitative requirements in the high-growth or high-demand occupations. "Higher" means that the occupations' requirements are higher than the average literacy proficiency of workers in declining occupations. "Lower" is similarly defined. The majority of high-growth occupations (62%) in the sample require higher prose and quantitative literacy proficiency than the average for workers in declining occupations. Only four occupations (8%) require lower or similar literacy skills—railroad conductors/yardmasters; ship, boat, and barge mates; painters of transportation equipment; and operating engineers and other construction equipment operators. Only 6 high-growth occupations required the same literacy skills—dental hygienists, truck drivers, freight and cargo inspectors, railroad conductors and yardmasters, and ship, boat, and barge mates.

The lack of prose literacy skills is less a barrier to high-growth occupations than is the lack of quantitative literacy skills. A deficiency in quantitative skills was an obstacle to 74% of the high-growth occupations for workers in declining occupations, while a deficiency in prose literacy was an obstacle to only 62%.

Table 5: Comparison of working poor average literacy level with that required by selected high-growth occupations

		Quantitative		
		Higher	**Same**	**Lower**
Prose	**Higher**	Physical therapy assistants Electrical and electronics repairers, commercial and industrial equipment Radiological technicians Bill and account collectors Customer service representatives Aircraft mechanics and services technicians Plumbers Industrial machinery mechanics Municipal fire fighters (fire fighters*) Computer, automated teller and office machine repairers Food service managers Police patrol officers (police and sheriff patrol officers) Brokerage clerks Bookkeeping, accounting, and auditing clerks Payroll and timekeeping clerks Food science technicians Medical equipment repairers Surveying technicians Registered nurses Construction managers Statistical assistants Chemical technicians Mechanical engineering technicians Mechanical drafters Industrial engineering technicians	Electrical power-line installers and repairers Rough carpenters (carpenters) Aircraft structure, surfaces, rigging, systems and assemblers	
	Same	Chefs and head cooks	Dental hygienists	Pipelayers
	Lower	Medical transcriptionists	Railroad conductors and yardmasters	Painters, transportation equipment

Literacy's Role in Structural Unemployment

Structural unemployment is an industry issue rather than an individual worker issue. When an industry can no longer thrive, it shuts down and all its associated employees are unemployed—the managers, the highly skilled technicians, and the less skilled line workers—regardless of their education or skills. Individual differences among workers do not provide any protection from job loss; however, workers with skills that are transferrable to other employment can adapt to new jobs more readily and find new jobs more quickly. The NAAL research shows that workers' prose and quantitative literacy skills are critical to their transition to high-growth occupations. In terms of developing a strategy that can facilitate the shift of workers from declining industries to thriving industries, deficiencies in literacy is a barrier that is easier and more cost-effective to address than are lack of educational and training credentials.

Table 6 compares the average prose and quantitative literacy scores of workers holding declining occupations to various industries associated with high-growth occupations. Energy, transportation, construction, homeland security, and health care industries appear to provide the best reemployment options for the average displaced worker in a declining occupation for the smallest investment in literacy training. Financial services, retail, aerospace advanced manufacturing, information technology, hospitality, and emerging industries would require a greater investment in literacy training. If a geographic region faces a loss of a declining industry, the best opportunities for large-scale reemployment of the displaced workers will be in industries in which literacy skills are most similar to the industry lost. Therefore, for areas of the country suffering high structural unemployment, economic development that targets industries matching the literacy levels of the displaced workers can offer a compatible pool of employees as a strong inducement to attract new employers.

Table 6: Comparison of working poor average literacy level with that required by selected high-growth occupations

		Quantitative		
		Higher	**Same**	**Lower**
Prose	**Higher**	Health care Energy Financial services Retail Aerospace Construction Advanced manufacturing Homeland security Information technology Emerging industries Hospitality	Energy Construction Aerospace	
	Same	Hospitality Automotive Homeland security	Health care Transportation Homeland security	Energy Transportation
	Lower	Health care	Transportation	Transportation Construction

NOTE. "Higher" indicates that the required literacy proficiency of the industry is higher than the existing average literacy scores of workers in declining occupations. In the same manner, "lower" indicates that the required literacy proficiency of the industry is lower than the existing average literacy scores of workers in declining occupations.

By using O*NET data to compare the literacy skills required for each of the declining occupations with the literacy requirements of high-growth occupations listed in Table 4, literacy-training investments can be estimated for reemployment training. This type of comparison addresses the following questions:

- What high-growth occupation and corresponding industries are most compatible with the local displaced workers' prose and quantitative literacy proficiencies?
- What are the skill and literacy gaps between declining and prospective new industries?
- What should be the content for retraining programs that facilitate reemployment for dislocated workers?
- Which industries offer the best jobs compared to the training costs?

To demonstrate, Table 7 lists some of the same high-growth occupations found in Table 4 but also adds other O*NET data that will be useful to planning a reemployment strategy.

Table 7: Reemployment options for displaced workers on the basis of literacy and education requirements, median wage, training methods, and projected occupation demand in 2016

Occupation	Industry	Prose	Quantitative	Projected need (in 1,000s)	BLS hourly median wage (50th)	Post-secondary education or training category	Educational attainment cluster*
Painters, transportation equipment	Transportation	235	251	15	17.31	Moderate-term on-the-job training	HS/SC
Railroad conductors and yardmasters	Transportation	244	272	19	28.2	Moderate-term on-the-job training	HS/SC
Operating engineers and other construction equipment operators	Construction	245	255	118	18.33	Moderate-term on-the-job training	HS
Medical transcriptionists	Health care	248	293	26	15.02	Postsecondary vocational award	HS/SC
Mates—ship, boat, and barge	Transportation	252	276	15	27.5	Work experience in a related occupation	HS/SC/C
Dental assistants	Health care	252	282	280	15.17	Moderate-term on-the-job training	HS/SC
Dental hygienists	Health care	252	276	82	31.12	Associate's degree	SC/C
Pipelayers	Energy	255	256	20	15.04	Moderate-term on-the-job training	HS/SC
Bus and truck mechanics and diesel engine specialists	Transportation	256	266	91	18.58	Postsecondary vocational award	HS/SC
Truck drivers, heavy and tractor-trailer	Transportation	256	270	523	17.41	Moderate-term on-the-job training	HS/ SC
Excavating and loading machine and dragline operators	Energy	257	263	19	16.37	Moderate-term on-the-job training	HS
Chefs and head cooks	Hospitality	258	285	23	17.87	Work experience in a related occupation	HS/SC
Automotive body and related repairers	Automotive	260	281	64	17.16	Long-term on-the-job training	HS/SC
Security and fire alarm systems installers	Homeland security	262	288	19	17.02	Postsecondary vocational award	HS/SC
Freight and cargo inspectors	Homeland security	262	273	13	24.73	Moderate-term on-the-job training	HS/SC
Police, fire, and ambulance dispatchers	Homeland security	263	309	38	15.7	Moderate-term on-the-job training	HS/SC
Physical therapy assistants	Health care	267	289	27	21.22	Short-term on-the-job training	SC/ C
Electrical and electronics repairers, commercial and industrial equipment	Energy	270	283	33	22.65	Postsecondary vocational award	HS/SC
Radiological technicians	Health care	270	293	56	24.16	Associate's degree	SC/C
Bill and account collectors	Financial services	270	290	165	14.42	Short-term on-the-job training	HS/SC
Electrical power-line installers and repairers	Energy	270	276	43	25.27	Long-term on-the-job training	HS/SC

Table 7: Reemployment options for displaced workers on the basis of literacy and education requirements, median wage, training methods, and projected occupation demand in 2016 *continued*

Occupation	Industry	Prose	Quantitative	Projected need (in 1,000s)	BLS hourly median wage (50th)	Post-secondary education or training category	Educational attainment cluster
Customer service representatives	Retail	271	291	1158	13.96	Moderate-term on-the-job training	HS/SC/C
Aircraft structure, surfaces, rigging, systems, and assemblers	Aerospace	271	280	9	21.84	Moderate-term on-the-job training	HS/SC
Aircraft mechanics and services technicians	Aerospace	273	296	25	23.56	Postsecondary vocational award	HS/SC
Plumbers	Construction	274	294	157	21.2	Long-term on-the-job training	HS/SC
Industrial machinery mechanics	Advanced manufacturing	274	294	67	20.36	Long-term on-the-job training	HS/SC
Rough carpenters (carpenters)	Construction	275	278	348	18.11	Long-term on-the-job training	HS/SC
Municipal fire fighters (fire fighters)	Homeland security	275	292	142	20.75	Long-term on-the-job training	HS/SC
Computer, automated teller, and office machine repairers	IT	277	305	26	17.84	Postsecondary vocational award	HS/SC/C
Food service managers	Hospitality	277	298	100	21.43	Work experience in a related occupation	HS/SC/C
Police patrol officers (police and sheriff patrol officers)	Homeland security	279	305	243	23.86	Long-term on-the-job training	SC/C
Brokerage clerks	Financial services	281	295	38	17.96	Moderate-term on-the-job training	HS/SC/C
Bookkeeping, accounting, and auditing clerks	Financial services	281	299	594	15.17	Moderate-term on-the-job training	HS/SC
Payroll and timekeeping clerks	Financial services	282	294	61	16.26	Moderate-term on-the-job training	HS/SC
Food science technicians	Emerging industries	282	296	6	16.17	Associate's degree	HS/SC/C
Medical equipment repairers	Health care	286	314	38	19.38	Associate's degree	HS/SC
Surveying technicians	Energy	287	298	29	16.17	Moderate-term on-the-job training	HS/SC
Mapping technicians	Emerging industries	290	318	29	16.17	Moderate-term on-the-job training	HS/SC
Electricians	Construction	290	292	234	21.53	Long-term on-the-job training	HS/SC
Insurance adjusters, examiners, and investigators	Financial services	290	307	105	25.75	Long-term on-the-job training	SC/C
Registered nurses	Health care	290	297	1001	28.85	Associate's degree	SC/C
Electronic drafters	Aerospace	294	306	11	23.68	Postsecondary vocational award	SC/C

Table 7: Reemployment options for displaced workers on the basis of literacy and education requirements, median wage, training methods, and projected occupation demand in 2016 *continued*

Occupation	Industry	Prose	Quantitative	Projected need (in 1,000s)	BLS hourly median wage (50th)	Post-secondary education or training category	Educational attainment cluster
Licensed practical nurses	Health care	296	314	309	18.24	Postsecondary vocational award	HS/SC
Construction managers	Construction	297	308	152	36.65	Bachelor's degree	HS/SC/C
Statistical assistants	Emerging industries	299	324	12	15.64	Moderate-term on-the-job training	HS/SC/C
Electrical and electronic engineering technicians	Advanced manufacturing	299	317	39	25.07	Associate's degree	HS/SC
Chemical technicians	Advanced manufacturing	301	314	24	19.58	Associate's degree	HS/SC/C
Mechanical engineering technicians	Aerospace	304	320	12	22.73	Associate's degree	HS/SC
Mechanical drafters	Advanced manufacturing	304	323	26	21.51	Postsecondary vocational award	SC/C
Industrial engineering technicians	Advanced manufacturing	308	326	22	22.83	Associate's degree	HS/SC

*Key: HS = high school; SC = some college; c = college

To demonstrate the usefulness of O*NET data for the purposes of planning economic development or providing individual counseling at One-Stop Career Centers, the strategies or processes described above can be applied to a scenario involving major layoffs of team assemblers, for example, a job held by a large number of autoworkers. For this example, the estimated prose literacy score required of team assemblers is 250 and the quantitative score is 257. These scores represent the minimum literacy proficiency for this occupation. Obviously, team assemblers can function at higher levels, and this could be determined with a literacy assessment tool that correlates to O*NET occupations.[14] By comparing this assumption of minimum literacy levels, one can identify from O*NET data a variety of high-growth occupations that fall within or close to these scores. For discussion purposes, Table 8, below, presents a comparison with four high-growth occupations.

Table 8: Using O*NET to plan re-employment of dislocated team assemblers

High-growth occupation industry	Prose and quantitative literacy requirements		Training content	Median hourly wage	Level of demand
	Prose	Quantitative			
Medical transcriptionists—health	248	293	Some quantitative literacy/brief skill training—SC	$15.02	Medium
Heavy excavation—energy	256	270	Some quantitative literacy—on-the-job training	$17.41	High
Radiological technician—health	270	293	Some prose and quantitative literacy—2 to 4 years college	$24.16	High
Mechanical drafters—advanced manufacturing	304	323	Extensive prose and quantitative literacy—2 to 4 years college	$21.51	Low

[14] There are many literacy tests available, but AIR's research failed to find any that specifically correlated to O*NET occupation descriptions.

Each choice above poses tradeoffs, and none of these options considers individual preferences, but in terms of local economic development planning to address regional structural unemployment, this tool provides important information for planning responses to anticipated industry decline. Specifically, the tool can assist the workforce investment system to

- Identify industries and jobs that match the literacy levels of workers in declining occupations to guide industry recruitment and economic development
- Inform One-Stop Career Centers and training institutions about potential training needs of workers in transition from one industry to another
- Tailor job placement options to fit individual workers' needs and interests

Summary

Structural unemployment requires a response that can address large numbers of workers who typically represent occupations in a declining industry. The impact of large-scale worker displacement has degrading effects on local economies. To combat these events, regional economic development strategies should compare the capabilities and skills of workers in declining industries with the requirements of expanding industries and high-growth occupations.

Workers in declining occupations do not differ from workers in the general population except in the area of functioning literacy levels and college degrees. NAAL data show that literacy deficiencies, perhaps more than educational attainment, is the critical barrier that prevents workers in declining occupations from adapting to the demands of high-growth occupations.

By using O*NET data organized around literacy requirements of both declining and high-growth occupations, local area planners can affect the structural causes for unemployment by attracting industries that minimize the retraining needed by the pool of workers dislocated from declining industries. Efficiencies at this important planning stage of economic development reduce the duration of unemployment and the overall adverse effects of layoffs on the local economy.

References

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Kutner, M., Greenberg, E., Jin, Y., Boyle, B., Hsu, Y., & Dunleavy, E. (2007). *Literacy in everyday life: Results from the 2003 National Assessment of Adult Literacy (*NCES 2007-480). Washington, DC: U.S. Department of Education, National Center for Education Statistics.

LaPolice, C. C., Carter, G. W., & Johnson, J. W. (2008). Linking O*NET descriptors to occupational literacy requirement using job component validation. *Personnel Psychology*, *61*, 405–441.

Stowe, P. (1998). *Adult education participation decisions and barriers: Review of conceptual frameworks and empirical studies* (Working Paper No. 98-10). Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics.

U.S. Census Bureau. (2000). *2000 census industry and occupational codes*. Washington, DC: Author.

Appendix A: Methodology and Technical Notes

This appendix provides additional information about the methodology and research that are referenced in this report, starting with an overview of the 2003 National Assessment of Adult Literacy (NAAL). This section also describes the background variables and statistical procedures used in this report. A final section discusses the methods used to link the Occupational Information Network (O*NET) occupation descriptors to the NAAL literacy scales, in order to determine the literacy gaps between selected high-growth/demand occupations and workers in declining occupations.

The 2003 NAAL Assessment

The 2003 NAAL assessed the English literacy of adults (16 years of age or older) in the United States for the first time since the 1992 National Adult Literacy Survey. NAAL provided information on the literacy proficiencies of a nationally representative sample of approximately 18,000 adults living in households and 1,200 prison inmates. In addition to assessing the literacy skills of respondents, NAAL gathered extensive background information on their demographic and socioeconomic characteristics (e.g., their age, gender, nativity status, schooling, labor force status, and household income), as well as on the way the respondents obtained information.

NAAL measured respondents' proficiencies on three literacy scales:

- **Prose literacy**—the knowledge and skills needed to search, comprehend, and use information from continuous texts. Prose examples include editorials, news stories, brochures, and instructional materials.
- **Document literacy**—the knowledge and skills needed to search, comprehend, and use information from noncontinuous texts. Document examples include job applications, payroll forms, transportation schedules, maps, tables, and drug and food labels.
- **Quantitative literacy**—the knowledge and skills needed to identify and perform computations using numbers that are embedded in printed materials. Examples include balancing a checkbook, figuring out a tip, completing an order form, and determining the amount of interest on a loan from an advertisement.

For each of the literacy skills, proficiency was measured on a scale that ranged from 0 to 500. Scores on each of the literacy scales were characterized in terms of four literacy proficiency levels: *Below Basic*, *Basic*, *Intermediate*, and *Proficient*. For more information on the methodology and findings from the NAAL assessment, see *Literacy in Everyday Life: Results from the 2003 National Assessment of Adult Literacy* (Kutner et al., 2007; http://nces.ed.gov/Pubs2007/2007480.pdf).

Descriptions of Background Variables

Race/Ethnicity

In 2003, all respondents were asked two questions about their race/ethnicity. The first question asked them to indicate whether they were Hispanic or Latino. Then, all respondents, including those who indicated they were Hispanic or Latino, were asked to choose one or more of the following groups to describe themselves:

- White
- Black or African American
- Asian
- American Indian or Alaska Native
- Native Hawaiian or other Pacific Islander

Individuals who responded "Yes" to the first question were coded as Hispanic, regardless of their answer to the second question. Individuals who identified more than one group on the second question were coded as Multiracial. Respondents of Native Hawaiian or Pacific Islander origin were grouped with those of Asian origin.

Highest Educational Attainment

All respondents were asked to indicate the highest level of education that they had completed. The following options were provided:

- Still in high school
- Less than high school
- Some high school
- General Education Development (GED) or high school equivalency
- High school graduate
- Vocational, trade, or business school after high school
- College: less than 2 years
- College: Associate's degree (A.A.)
- College: 2 or more years, no degree
- College graduate (B.A. or B.S.)
- Postgraduate, no degree
- Postgraduate degree (M.S., M.A., Ph.D., M.D., etc.)

Respondents who reported less than high school or some high school were asked how many years of education they had completed. For certain analyses, some of these groups were collapsed.

Occupation

Respondents who had held a job within the past 3 years were asked to provide the title of their occupation and its most important activities and duties. This information was used to assign each occupation a 2000 Census Bureau code. The occupations were then collapsed into eight major occupational groups:

- Management, business, and financial
- Professional and related
- Service
- Sales and related
- Office and administrative support
- Construction and extraction
- Installation, maintenance, and repair
- Production

Statistical Procedures

Tests of Statistical Significance

All comparisons discussed in this report have been tested for statistical significance using the *t* statistic. Statistical significance was determined by calculating a *t* value for the difference between a pair of means, or proportions, and comparing this value with published tables of values at a certain level of significance, called the alpha level. The alpha level is an a priori statement of the probability of inferring that a difference exists when, in fact, it does not. The alpha level used in this report is .05, based on a two-tailed test. Differences in the means and proportions between subgroups were calculated using the following *t* statistic:

$$t = \frac{(p_1 - p_2)}{\sqrt{(se_1^2 + se_2^2)}}$$

where p_1 and p_2 are the estimates to be compared and se_1 and se_2 are their corresponding standard errors. When a subgroup was compared to a total group, a modification of the standard error of difference was made to adjust for group dependence. The formula for the adjusted standard error of difference was as follows:

$$SE_{Total-subgroup} = \sqrt{SE^2_{Total} + SE^2_{Subgroup} - 2pSE^2_{Subgroup}}$$

where *p* is the proportion of the total group contained in the subgroup.

Minimum Sample Sizes for Reporting Subgroup Results

- In the NAAL reports, the sample sizes were not always large enough to permit accurate estimates of proficiency and/or background results for one or more categories of variables. For results to be reported for any subgroup, a minimum sample size of 45 was required. This number was arrived at by determining the sample size needed to detect an effect size of 0.5 with a probability of 0.8 or greater, using a design effect of 1.5. This design effect implies a sample design-based variance 1.5 times that of a simple random sample. The effect size of 0.5 pertains to the true difference in a given mean estimate (e.g., mean proficiency) between the subgroup in question and the total population, divided by the standard deviation of that estimate in the total population. An effect size of 0.5 was chosen following Cohen (1988), who classifies effect size of this magnitude as "medium," and to be consistent with what was done in the 1992 National Adult Literacy Survey (NALS).

Linking O*NET Occupation Descriptors to NAAL Literacy Scales

Several studies support the use of the Occupational Information Network (O*NET) data to determine job requirement levels of employee aptitudes (LaPolice, Carter, & Johnson, 2008). To identify the literacy requirements of the selected high-growth occupations that could potentially offer economic independence for the working poor, occupation data related to job analysis ratings of knowledge, skills, and abilities were collected through the O*NET database. However, the ratings of the O*NET occupation descriptors are not on the same scale as the NAAL literacy measures. Therefore, linkage needs to be established between the two measures, so that the average literacy scores of workers in declining occupations can be compared with the literacy requirements of those selected occupations. This section describes the method used to link the O*NET occupation descriptors to the NAAL literacy scales.

Following the approach taken by LaPolice and colleagues (2008) in their study "Linking O*NET Descriptors to Occupational Literacy Requirements Using Job Component Validation," AIR used multiple regression models to estimate the literacy requirement for the 50 selected occupations on the NAAL 2003 literacy scale. The LaPolice study used a job component validity approach to relate O*NET knowledge, skill, ability, and generalized work activity descriptor data to literacy test scores on NALS, conducted in 1992. The study estimated mean NALS 1992 literacy scores for 902 O*NET Standard Occupational Classifications (SOCs) (http://www.bls.gov/soc/) using multiple regression models. The study also showed that the NALS literacy scores were highly predictable from the O*NET descriptors.

Specifically, for the purpose of this report, the prose, document, and quantitative literacy scores for 100 occupations were first estimated on the basis of the NAAL database. More than 400 occupations were available through that database, but these 100 occupations had sufficient sample sizes to allow reliable estimates. These literacy scores were used as the dependent variable in the multiple regression models for each of the prose, document, and quantitative scales, respectively.

The NAAL occupations were classified according to the 2000 Census Industry and Occupational Codes (U.S. Census Bureau, 2000). The O*NET descriptor data were at the level of O*NET–SOC code. The Census Industry and Occupational Codes were matched to the O*NET–SOC codes before the multiple regression analyses were conducted.

To select the potential predictor variables for the multiple regression models, a team of AIR experts first identified the O*NET descriptors that were conceptually relevant to prose, document, and quantitative literacy. Correlations of the selected predictors and literacy scores were checked, and those predictors with negative or zero correlations were deleted. Then several models were compared in terms of the ways in which the descriptors could be further combined. The final set of predictors was determined on the basis of the published O*NET factor model is presented in Table A.1.

Table A.1: O*NET descriptors identified to predict NAAL literacy scores

Prose	Document	Quantitative
Basic skills	Basic skills	Complex problem solving
English language	English language	English language
Getting information	Getting information	Computers and electronics
Interacting with others	Performing administrative activities	Cognitive abilities
Cognitive abilities	Cognitive abilities	

The results of the multiple regression analyses are presented in Table A.2. Two coefficients in the models are negative, which is contrary to what would be expected. This does not mean that those two variables are negatively related to the criterion; rather, the negative coefficients are very likely due to the effect of multicollinearity[15] (LaPolice et al., 2008). The regression coefficients were then applied to the models described above in estimating the literacy scores of the 50 selected occupations.

Table A.2: Regression coefficients for each regression models

Literacy scale	Predictors	Regression coefficients		Standardized regression coefficients			Adjusted R square
		B	Standard error	Beta	*t*	p	
Prose	(Constant)	170	6.2		27.5	0	0.8
	Basic skills P	12.5	2.7	0.4	4.7	0	
	English language	6.7	2.0	0.2	3.4	0	
	Getting information	–4.9	2.2	–0.1	–2.2	0	
	Interacting with others	7.6	2.2	0.2	3.5	0	
	Cognitive abilities P	9.5	3.3	0.2	2.9	0	
Document	(Constant)	184.9	5.7		32.6	0	0.7
	Basic skills D	7.5	2.2	0.3	3.4	0	
	English language	8.8	1.7	0.4	5.3	0	
	Getting information	–4.3	2.0	–0.2	–2.2	0	
	Performing administrative activities	5.0	1.4	0.2	3.5	0	
	Cognitive abilities D	10.0	3.0	0.2	3.4	0	
Quantitative	(Constant)	185.1	5.3		34.9	0	0.8
	Complex problem solving	5.9	1.4	0.2	4.2	0	
	English language	9.1	1.5	0.3	6.1	0	
	Computers and electronics	3.6	1.3	0.1	2.8	0	

[15] Multicollinearity is a problem in multiple regression that occurs when variables are so highly correlated with one another that it is difficult to separate the effects of two or more variables on an outcome variable and produce reliable estimates of their individual regression coefficients.