

Optimizing and Designing for an Aging Population in the Workplace

**Winnie Ip, CPE
Director of Consulting
Humantech, Inc.
Ann Arbor, MI**

Introduction

The maturing workforce is often seen as an issue to be dealt with instead of an asset to leverage. Although we often document how our organizations run, there are frequently knowledge gaps that are “filled in” by the tribal knowledge of our experienced workforce. It is this asset that needs to be leveraged.

By and large, experienced workers have a lifetime of knowledge. Because many of their child-care responsibilities are behind them, they may take fewer days off from work. Their long tenure with companies leads to increased loyalty (and retention), as they often have a personal interest in the success of the organization. They are typically more motivated than their younger counterparts, and tend to focus on quality. And over the long term, they have mastered the mechanisms of the workplace, resulting in fewer workplace injuries. The real effects of retaining the experienced worker are all positive.

The Forces at Work on Work

A topic under discussion for some time has been the fact that manufacturing organizations are faced with the challenge of not having enough older workers. In reality, the issue is not a shortage of older workers, but rather, a shortage of skilled workers in general, due to a large number of baby boomers approaching retirement. As the U.S. economy continues to grow at 3% per year (the average since 1948), the workforce will have to increase by 58 million employees over the next three decades in order to maintain the current rates of productivity. However, with fewer younger workers entering the workforce, the total number of workers will increase by only 23 million. U.S. industry will have a labor shortage approaching 35 million workers. Most of these projected shortages are expected to involve workers with specific skills. Even more imminent is a shortfall of 7.4 million baccalaureate degree holders by 2012. The particular shortage in math and science degree holders makes it unlikely that we will be able to engineer our way out of this problem.

The U.S. is not alone in this predicament; the graying of the workforce is a global phenomenon. Japan’s median age is 28% higher than that of the U.S. In the European Union, there is already a shortage of workers approaching 1 million per year. These regions offer a

glimpse of where the U.S. is headed. A logical answer to this dilemma is to tap an asset that already exists: an aging, but experienced, workforce.

The odds are in the favor of the employer because the current economic climate favors older employees keeping their jobs, more so than at any other point since World War II. The economic downturn that began in 2001 diminished the lifelong savings of many people through the loss of stock values in their retirement portfolios. When combined with recent devaluation of real estate and the subsequent stock market crash, the U.S. nest egg has been hit hard. Most surveys estimate that seven out of ten employees over the age of 45 plan to continue working past 65. A 2002 Gallup poll reported that 47% of working adults expect to retire later than planned, due to their diminished savings. According to the AARP, 65% of workers over 45 cited health insurance and prescription drug coverage as key reasons for remaining employed. Because most workers are motivated to stay employed, it is up to policies and workplace conditions to nurture that motivation.

So, we will clearly have a need for skilled workers in the years to come. We have economic considerations providing impetus for older workers to stay on the job longer. Demographics suggest that the supply will be there as well. The proportion of employees aged 55 to 64 is currently growing at a faster pace than any other age group. By 2006, this group made up 20% of the workforce. In a few years, 75 million baby boomers will begin to retire. The concept of an active, older workforce is also supported by the insurance industry. Actuaries anticipate that due to increased longevity, the eventual retirement age will reach 74 years. It appears that the 65- to 74-year-old age group will be the next growth market.

Unique Requirements of the Older Worker

What do engineers and managers need to know about employing a cadre of older workers? When we analyze how the work environment affects the workforce, we need to examine both “above-the-shoulders” factors and “below-the-shoulders” factors.

Above the Shoulders

“Above-the-shoulders” factors affect things like vision, hearing, and cognitive ability.

Vision

Starting above the shoulders, vision is a key concern. Eighty percent of the information we process is completed visually and, therefore, a high degree of acuity is required when addressing the manufacturing environment. Visual acuity typically declines 26% by age 60. We need significantly more light as we age. If a 20-year-old were to require “X” amount of light, a 40-year-old would need twice that amount (2X) and a 60-year-old would need 5 to 6 times as much (5X or 6X). We find that while 20% of 19-year-olds need glasses, 80% of 60-year-olds need them.

Vision includes not only what we can see but how we process that information. Contrast sensitivity decreases with age. Older workers take more time to achieve accuracy. When compared with a 20-year-old worker:

- A 40-year-old requires 120% as much time,
- A 50-year-old requires 160% as much time, and
- A 60-year-old requires 270% as much time.

Field of view, motion perception, and depth perception all decline with age. How far away from the eyes something must be in order to be readable changes from 4" at age 20 to 8.5" at age 40.



Figure 1: Loss of transmission of blue light (460nm) through the lens of the eye due to aging (Source: Meale, 1973)

While many people claim that their favorite color is blue, the ability to perceive color declines precipitously starting around the age of 40. This is especially true for the colors blue and yellow.

Hearing

Most manufacturing environments are loud, and in order to compensate, we speak louder and more rapidly. As a culture, our bias is to push more information both visually and aurally. Unfortunately, as workers age, speech intelligibility becomes more difficult. Each year we lose about 2% to 3.5% of our hearing ability, and this is more pronounced in men than women. By age 50, the average hearing loss at 3,000 hertz is 10 decibels; at age, 60 it is 25 decibels; and at age 70, it is 35 decibels. Eventual hearing loss is made more pronounced by other health factors affecting our population, such as disease. For example, diabetes currently affects nearly 17 million Americans, and another 6 million may be unaware that they have the disease. Current research estimates suggest that this number will increase to more than 28 million people in the next 50 years. Hearing loss is twice as common in adults with diabetes.

Cognitive Ability

Our ability to find, see, and discern information declines with age. While information-processing capability does not appear to decrease until after age 65, studies suggest that cognitive ability declines with age. There is a distinct degradation in the ability to attend to two or more tasks at once (some would argue that "multi-tasking" is an ability that we all struggle with, regardless of age), and the ability to pull information from long-term memory declines as well, although most daily information needs are satisfied by short-term memory.

Below the Shoulders

While it is clear that there are several "above-the-shoulders" issues that will affect the workforce, the "below-the-shoulders" issues will require the most attention. These issues include strength,

physiology, heat stress, shift work, connective tissue, musculoskeletal disorders (MSDs), and slips, trips, and falls.

A common fear is that as the workforce ages, people become more susceptible to injury. However, according to recent research (2001), rates of non-fatal occupational injuries and illnesses in the U.S. are actually higher for younger workers.

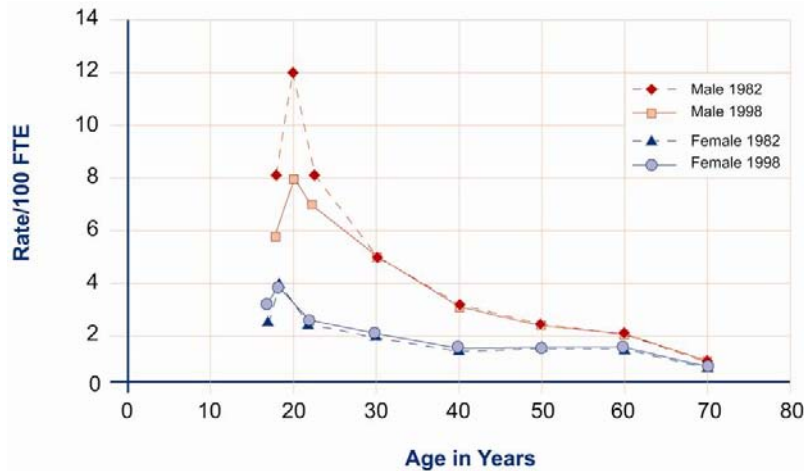


Figure 2: Rates per 100 full-time equivalent (FTE) workers by age and gender for injuries/illnesses treated in an emergency department (1982, 1998)

In addition, a review of research literature published since 1940 (a total of 63 studies across 18 countries) revealed the following:

- 56% of studies showed younger workers have higher non-fatal occupational injury rates.
- 27% of studies showed younger and older workers have similar non-fatal occupational injury rates.
- Only 17% of studies showed older adults have higher non-fatal occupational injury rates.

Despite what appears to be clear evidence that injuries do not increase with age, we are not yet confident that this is truly the case. There is quite a bit of “social Darwinism” at work here. The worst jobs (the most physically demanding) tend to be transitioned to the newer, younger workers. As our workforce ages, it will be interesting to see how the more experienced worker fares in a more punishing workplace role. The more relevant issue may be that the workplace continues to injure workers, both young and old, and whether the aging workforce will be more apt to injury should be considered a moot point. Improving workplace conditions will affect all workers (and companies) favorably.

Strength and Movement

There is a tremendous amount of literature pointing to the fact that, as we age, our ability to move decreases and, to a lesser extent, our strength decreases:

- Ability to grasp and reach slows down:
 - Ages 51 to 60 have a 15% reduction in grip capability
 - Ages 61 to 70 have a 18% reduction in grip capability
- Precision of movement decreases
- Range of motion declines
- Muscle strength (pushing, pulling, and gripping) erodes

- Ability to both control and perceive our grip force deteriorates
- Muscle endurance declines

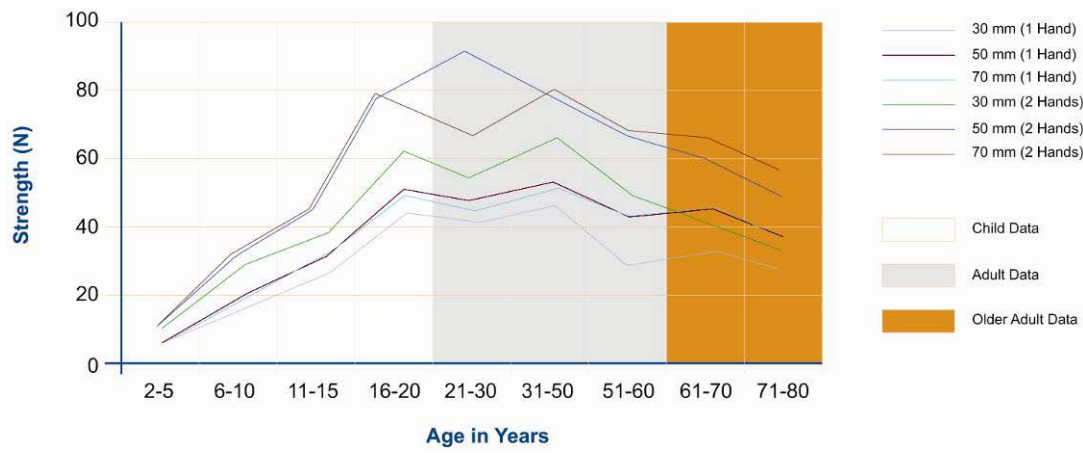


Figure 3: Mean maximum hand grip strength (males)

The following figure shows that strength peaks at or near 25 years of age and begins to fall precipitously after age 40. In other words, strength for most of our current and future workforce will be fleeting. The future of manufacturing is not one in which workers will be asked to exert extreme forces; it will require more brain, less muscle. The ability to process information and solve problems is where value resides, especially in organizations that embrace lean manufacturing.

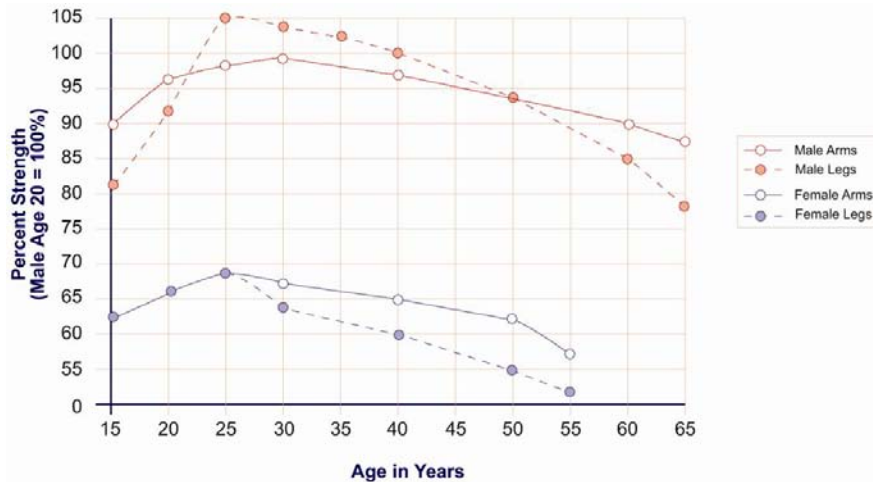


Figure 4: Male and female arm and leg strength

Connective Tissue

What we will find with our workforce as they age is that there will be issues related to skeletal decrements in force, power, and endurance. The biggest challenge will be a reduced capacity to recover from injury. We will see a shift in the stress-strain curve as older workers will be less able to tolerate external stress on a variety of tissues. Furthermore, aging skeletal muscle is more

vulnerable to injury, and older muscles have a reduced capacity to regenerate after tissue injury from overexertion.

Physiology and Shift Work

Our cardiovascular system also changes. A worker's maximum aerobic power is 70% of what it was at age 25. Every year we live after 30 years of age, we lose a beat from our maximum heart rate capacity. When combined with a more sluggish response of the sweat glands and less total body water, thermal regulation is negatively affected. Consequently, men over age 40 are ten times more likely to suffer from heat stroke as men under age 25. As our workforce ages, one of the most significant risks we will find is not the risk of issues like carpal tunnel syndrome, but the risks associated with cardiac infarction.

As people age (past 45), they often show a reduced tolerance to shift and night work, women more so than men. Although long-term prospective studies on aging are few, shift workers over 45 reported sleeping less soundly after night shifts, but not after morning shifts. Due to the scarcity of data, one can only extrapolate from the physiological trends of the younger workforce and make suppositions as to the older workforce. The preferred shift schedule that optimizes physiological and social factors for the aging worker is an extended rotation (4 to 8 weeks long), phase forward (adjusts from morning, to afternoon, to night), with work periods no longer than 8 hours.

Slips, Trips, and Falls

When we combine a reduced capacity to see, slower reaction times, and a more brittle infrastructure inside the human, the risk of a fall is heightened and the resulting injury may be more serious. Why do older workers fall more often?

- Reaction time: a 40-year-old needs 25% more time, a 60-year old 150% more time.
- Trips are more common because of age-related changes in gait.
- Loss of balance in older people is due to deterioration of somatic feedback from the stretch reflexes in the muscle spindles.

Workplace housekeeping becomes essential in an era when slips, trips, and falls can become serious sources of everyday injury.

Key Workplace Design Guidelines

We can take a proactive approach to address some of the particular challenges older workers face by keeping in mind the following design guidelines:

- Ensure regular health checks for shift workers over 40
- Ensure annual eye exams for inspectors, and current eye exams and correct vision prescription for all workers
- Increase illumination by 20%
- Improve illumination for walking surfaces and stairs
- Use task lighting to make low-contrast targets (defects) more visible
- Avoid using small print in instructions, orders, or on equipment
- Use 11-point font or larger
- Slow the rate of information presentation
- Avoid using small laptop screens; connect the laptop to an external monitor
- Use LCD displays for reduced glare
- Use 17" monitors or larger, if possible
- Increase monitor brightness and contrast

- Increase screen zoom in software applications
- Place document holders and monitors at the same distance from the eyes
- Ensure a higher coefficient of friction between the operator's fingers and the tool surface when precision tools are used
- Use a foot pedal from a sitting rather than standing position
- Lower top shelves and raise lowest shelves 3"
- Provide both visual and audio signals to machine operators when emergency situations arise

Consequences for the Future of manufacturing

In traditional ergonomics programs, the primary goal is to adapt the workplace and tools to the capabilities of people. This goal does not change when considering an aging workforce. You need only make a slight shift in the density of what you are doing to accommodate strength, vision, and hearing. Do exactly what you are doing today, just do it better, with more knowledge of the key performance differentiators within your workforce.

Aging, as measured by decay in performance, occurs much earlier than the lauded 65 mark. Brace yourself—because the wheels start to come off at 45. That's right, 45 years young and you begin to lose irretrievable amounts of aerobic capacity, strength, vision, hearing, mental agility—the works. The popular discussions of “65 is the new 55” have been behind schedule. It would seem that, to be accurate, “45 is the new 35.”

How do we keep older people in the workforce? The answer is similar to how you keep any person interested in his or her work. The key to keeping motivation alive and healthy is to treat people with respect in your designs and policies, and to engage their brains in solving problems; build a safe, healthy, and stimulating workplace and employee loyalty and retention will follow.

Long-term loyalty can be gained, or maintained, through a dedicated approach to the ongoing development of people and the humanization of their workplace.

Bibliography

All Business (2006, August 21). Central Europe copes with worker shortage: Labor pool trails boom; industry raises pay, trains... Retrieved January 20, 2010, from All Business website: <http://www.allbusiness.com/labor-employment/human-resources-personnel-management/8684315-1.html>

ANSI, American National Standard. ANSI S3.44, *Determination of Occupational Noise Exposure and Estimation of Noise-Induced Hearing Impairment*. 1996.

Automotive News Europe (2006, August) Central Europe copes with worker shortage: Labor pool trails boom; industry raises pay, trains, recruits. Retrieved January 13, 2010 from Find Articles website: http://www.findarticles.com/p/articles/mi_hb4893/is_200608/ai_n17951769

Berman, J., Industry output and employment projections to 2010, *Monthly Labor Review*, Vol. 124, No. 11, November 2001. pp. 39-56.

Bureau of Labor Statistics (2009, December) Household Data Annual Averages. Retrieved February 20, 2010 from BLS website: <http://www.bls.gov/cps/cpsaat3.pdf>

- CIA World Factbook (2009, December) Japan Median Age. Retrieved January 13, 2010 from IndexMundi website: http://www.indexmundi.com/japan/median_age.html
- Clemson University (2009, August) A Literature Review on Reaction Time. Retrieved March 3, 2010, from Clemson website: <http://biology.clemson.edu/bpc/bp/Lab/110/reaction.htm#Age>
- Costa, G., Some considerations about aging, shift work and work ability, International Congress Series, Vol. 1280, June 2005, pp. 67-72.
- EurActive (2007, June 5) The EU's labour shortage 'time-bomb'. Retrieved February 1, 2010, from EurActive website: <http://www.euractiv.com/en/social/europe/eu-labour-shortage-time-bomb/article-164261>.
- Issues in Science and Technology (2007) Where the Engineers Are. Retrieved January 15, 2010 from Issues in Science and Technology website: <http://www.issues.org/23.3/wadhwa.html>
- Jackson, A., Beard, E., Wier, L., Ross, R., Stuteville, J., and Blair, S., Changes in aerobic power of men, ages 25-70 yr., *Medicine & Science in Sports & Exercise*, Vol. 27, No. 1, January 1995, pp. 113-120.
- Jackson, A., Beard, E., Wier, L., Ross, R., Stuteville, J., and Blair, S., Changes in aerobic power of women, ages 20-64 yr., *Medicine & Science in Sports & Exercise*, Vol. 28, No. 7, July 1996, pp. 884-891.
- Menz, H. B., Morris, M. E., Lord, S. R., Foot and ankle characteristics associated with impaired balance and functional-ability in older people, *The Journals of gerontology. Series A, Biological sciences and medical sciences*, Vol. 60, No. 12, 2005, pp. 1546-1552.
- MetLife Mature Market Group & National Alliance for Caregiving (NAC), *The MetLife Study of Employer Costs for Working Caregivers*, Metropolitan Life Insurance Company, New York, 1997.
- PhysOrg.com (2007, April 5) Study: There is No Shortage of U.S. Engineers. Retrieved March 1, 2010 from Physorg.com website: <http://www.physorg.com/news94979949.html>
- Sanderson, Warren C. and Scherbov, Sergei, Average remaining lifetimes can increase as human populations age, *Nature*, Vol. 435, June 2005, pp. 811-813.
- Smith, S., Norris, B., and Peebles, L., *Older Adultdata: The handbook of measurements and capabilities of the older adult—data for design safety*. Dept of Trade and Industry, London, 2000.
- Talty, J., *Industrial Hygiene Engineering: Recognition, Measurement, Evaluation and Control*, 2nd. ed., William Andrew Publishing, Norwich, NY, 1988.
- The Sloan Center on Aging & Work (2006, February) How Old Are Today's Older Workers? Retrieved March 2, 2010, from The Sloan Center on Aging & Work website: http://agingandwork.bc.edu/documents/IB04_HowOldAreWrkrs.pdf.
- The Sloan Center on Aging & Work (2007, August) Today's Multi-Generational Workforce: A Proposition of Value. Retrieved March 2, 2010, from The Sloan Center on Aging & Work website: http://agingandwork.bc.edu/documents/IB10_MultiGenValue.pdf.
- United States Department of Labor (2008, February). Report of the Taskforce on the Aging of the American Workforce. Retrieved March 1, 2010, from U.S. Department of Labor website: http://www.doleta.gov/reports/FINAL_Taskforce_Report_2-11-08.pdf

U.S. Census Bureau (2008) Age and Sex (2008 American Community Survey 1-Year Estimates).
Retrieved March 3, 2010 from U.S. Census Bureau website:
http://www.factfinder.census.gov/servlet/STTable?_bm=y&-qr_name=ACS_2008_1YR_G00_S0101&-geo_id=01000US&-ds_name=ACS_2008_1YR_G00_&-_lang=en&-redoLog=false