

Aging Baby Boomers: Workforce Challenges and Ergonomic Solutions for Order Picking Operations©

Debjit Roy

PhD Candidate

Department of Industrial and Systems Engineering

University of Wisconsin-Madison

Madison, Wisconsin, USA

Email: debzitt@gmail.com

Executive Summary:

Population aging has emerged as a major demographic trend worldwide. Today, one out of every nine Americans is 65 years or older. Baby Boomers, born between 1946 and 1964 are progressing towards retirement. Distribution centers and manufacturing companies, which employ a majority of Americans, have already signaled the shortage of skilled workforce. Therefore, today, the common theme among these companies is to retain and grow older workforce, implement ergonomic workplace design principles, and adopt innovative technologies, which would enable older workforce to maximize their efficiencies. By focusing on order picking operations at distribution centers, this paper studies the workplace challenges faced by older workforce and provides ergonomic design solutions to improve the safety and efficiency of order picking operations. Further, an ergonomic innovation by Vanderlande industries, PICK@EASE order picking solution, which not only reduces picker's travel time but also improves picker's motivation and performance, is described.

Introduction

Aging is inevitable. However, population aging is unprecedented, and it is believed that the twenty-first century will witness even more rapid aging than the past century (World Population Aging, 2002). Today, more than 500 million people worldwide are 65 years and older, which outnumbers the children under age 5 (Demographics of aging, 2011). This trend is emerging around the globe and the age distribution of the nation is leaning towards the older age group, especially within more developed countries (Figure 1). Baby boomers, the largest generation in the America's history, which includes nearly 80 million Americans born between 1946 and 1964, have now individuals aged 65 years (U.S. Census Bureau, 2010).

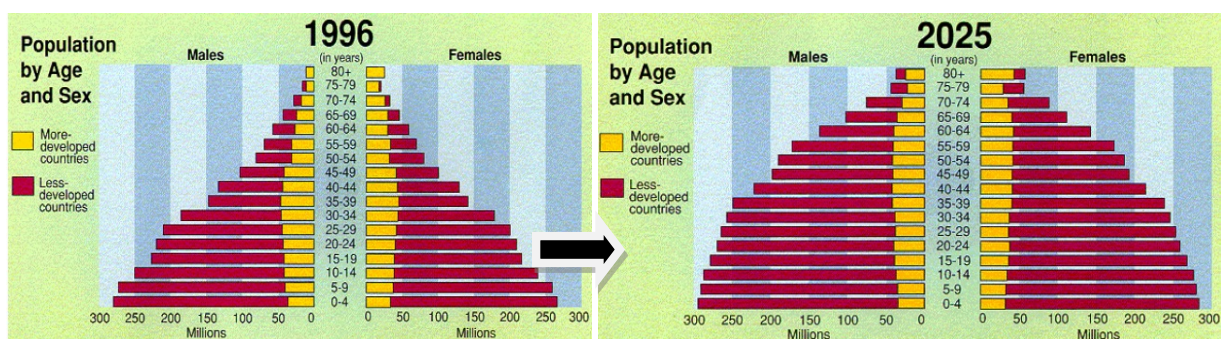


Figure 1: Shift in distribution of population by age and sex for both developing and developed countries (Lapide, 2010)

Because of the baby boomers, all industrial sectors including distribution and manufacturing in America have enjoyed a well-educated, seemingly endless supply of workers for the past 40 years. However, unlike their parents, the boomers had fewer children. Today, America is witnessing a shortfall of workforce supply in both distribution and manufacturing sector. In a study conducted for the American Trucking Association (ATA), it was reported that there is a current shortage of nearly 20,000 truck drivers. In only seven years, the ATA estimates that demand for drivers will exceed supply by more than five times – a shortfall of nearly

110,000 employees (Global Insight, 2005). Employers, in nearly all industry sectors, will be required to retain and seek older workers to maintain their expertise and in some cases simply to get the work done. The U.S. Bureau of Labor Statistics (BLS) estimates that while the overall workforce will continue to grow through 2016, the oldest groups, workers 65-74 and 75 and up, will each grow the most dramatically increasing by more than 80 percent (Figure 2).

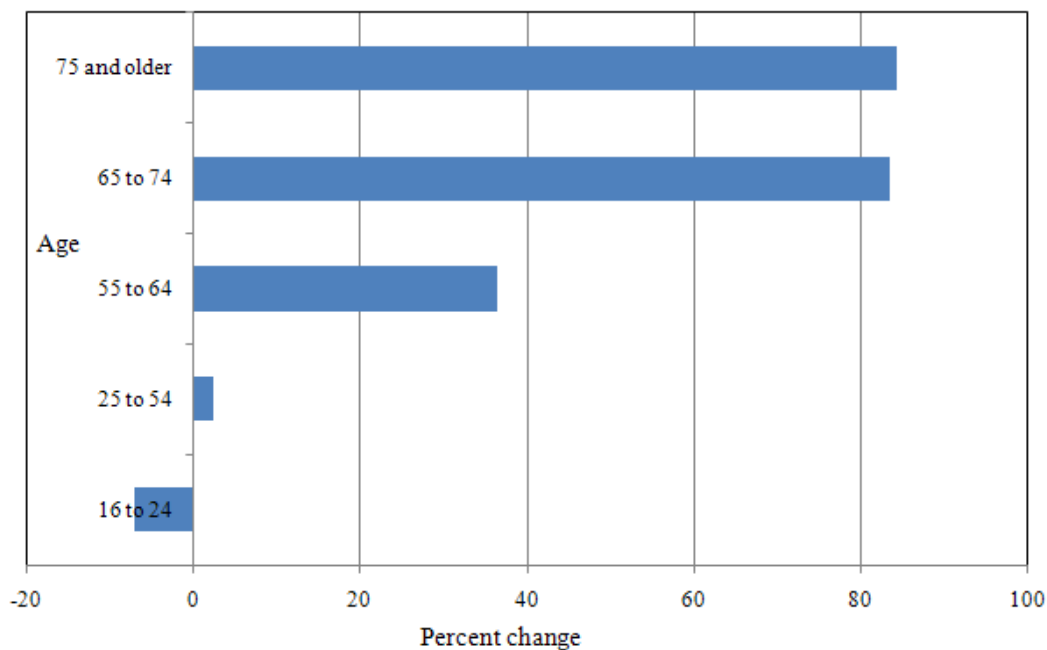


Figure 2: Projected percent change in labor force by age, 2006-2016 (Toossi, 2007)

Not only did the percentage of older workforce increase in the recent years but there has also been a dramatic shift in the distribution of part-time versus full-time status of the older workforce (Figure 3). The number of older workers on full-time work schedules nearly doubled between 1995 and 2007. However, the number working part-time increased by only 19 percent. As a result, full-timers now account for a majority among older workers: 56 percent in 2007, up

from 44 percent in 1995. This statistic suggests that older workers are significantly contributing to organizations' output and growth.

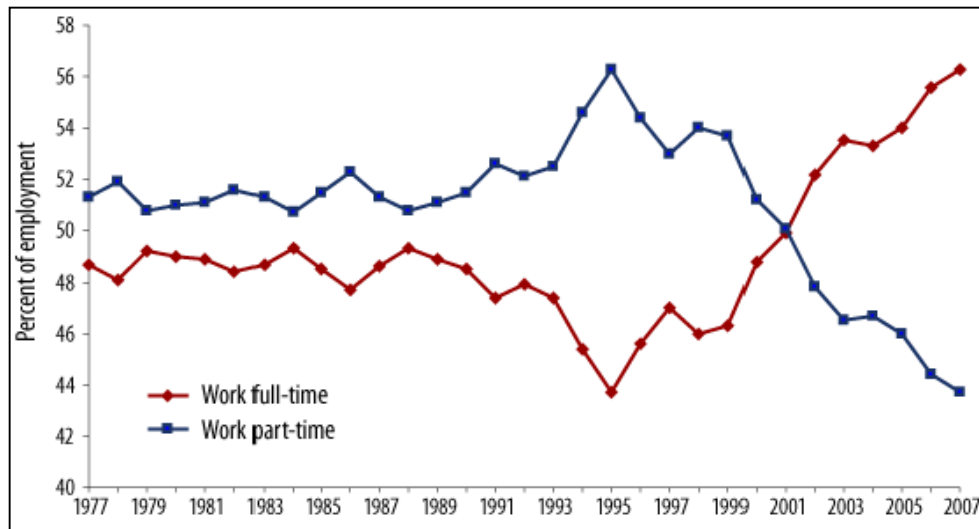


Figure 3: Workers 65 and over by work schedule 1977-2007 (US bureau of labor statistics, 2008)

Today, older workforce form critical portion of most organizations' talent pool. Among them, the material handling industry employs about 16 million people (11.6% of the employed persons in the nation), who are occupied in production, transportation, and material moving jobs (US Census Bureau, 2011). Due to global pressures in cost reduction and productivity improvements, the performance expectations from this workforce group are also immense. Therefore, today, the focus of these companies is to retain and grow older workforce, implement ergonomic workplace design principles, and adopt innovative technologies, which would enable older workforce to maximize their efficiencies.

Workforce operating pressures are particularly high in the order picking processes (the process of retrieving products from storage (or buffer areas) in response to a specific customer request) at distribution centers, which is typically the most labor-intensive operation and also

considered as the highest-priority area for productivity improvements (Goetschalckx and Ashayeri, 1989; Drury, 1988; Tompkins et al., 2003). Therefore, this paper studies employer concerns, retention, and performance improvement strategies for an older workforce in the context of order (item) picking process at distribution centers.

Workforce aging introduces a host of employment concerns due to changes in physical, psychological, and social aspect of individuals. For instance, the load bearing capability and reaction time of the workers decrease with age. Since the average life expectancy of an individual is ~79 years, the baby boomers have at least another 10 years to contribute towards their workplace. Therefore, the employment concerns with older workforce need to be identified and procedures should be implemented to retain and improve the performance of employees. The

purpose and organization of this paper are explained as follows:

- 1) Understand the role of a picker in order picking process (Section 1),
- 2) Study the challenges faced by older workforce in order picking process (Section 2),
- 3) Describe the ergonomic solutions to improve workforce well-being and order picking efficiencies (Section 3),
- 4) Explain the features of PICK@EASE technology developed to specifically address ergonomic and safety concerns in order picking (Section 4), and
- 5) Summarize the findings of this paper (Section 5).

1. Understanding the Role of a Picker in Order Picking Process

Typical warehouse flows include several functions such as receiving, pallet picking, case picking, broken case picking, accumulation, sortation, packing, and shipping (Figure 4). The

Reserve storage & pallet picking
 receiving activities include unloading of products from the transport carrier, updating the inventory record, and inspecting the records to identify any quantity or quality inconsistency.

Case picking
 Direct put away
 Transfer and put away involves the transfer of incoming products to storage locations. Order picking involves the process of obtaining a right amount of the right products for a set of customer orders.

Broken case picking
 Accumulation, sortation, and packing
 Shipping
 The accumulation/sortation of picked products into individual orders is necessary if the orders have been picked in batches. In such a case, the picked units have to be grouped by customer order, upon completion of the pick process. After picking, orders often have to be unitized, packed, and stacked on the right unit load (e.g. a pallet). Cross-docking is performed when the received products are transferred directly to the shipping docks.

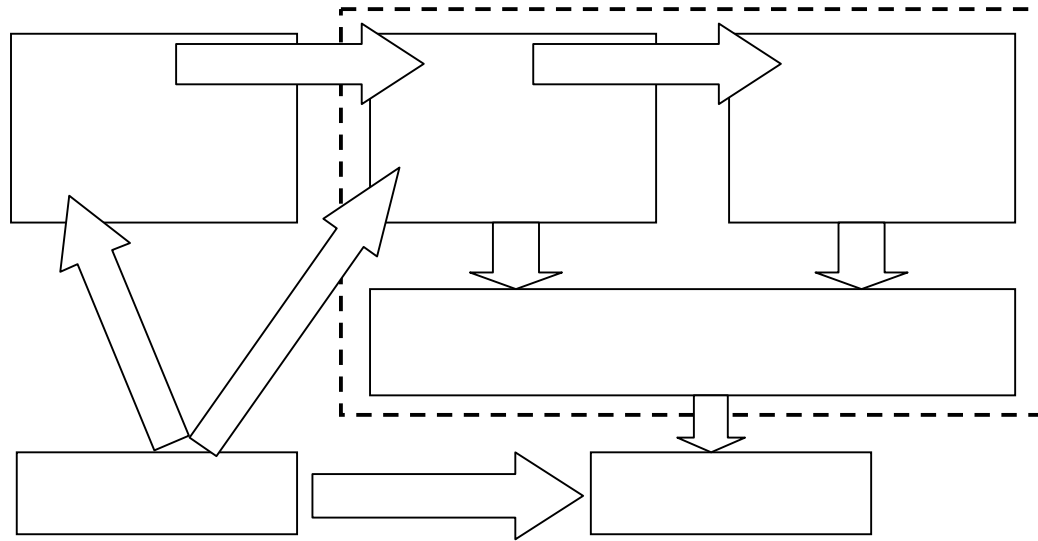


Figure 4: Typical warehouse functions and flows (Tompkins et al. 2003)

Order picking, which is the major activity in most distribution centers, involves the process of clustering and scheduling the customer orders, splitting orders into individual items, releasing orders to the floor, picking the items from storage locations, and the disposal of the picked items. Many different order picking system types can be found in warehouses. Order

picking systems differ according to whether manual labor or automated machines are used. Order picking systems that use manual labor are called picker-to-parts systems, where the order picker walks or drives along the aisles to pick items. In automated order picking systems, automated machines bring the items to the pickers, who are located at the pick stations. Automated systems are also called parts-to-picker systems. About 80% of the order picking systems employs *picker-to-parts or manual order picking* systems (De Koster, 2004).

In picker-to-parts order picking system, the storage locations are segmented into multiple picking zones and pickers are assigned to each zone. Zoning is usually implemented to increase the productivity of workers by reducing the picker travel time. Consider a scenario in which the storage area is divided into two zones and one picker is assigned to each zone (Figure 5). For instance, order 1 consists of three items (a, b, and e) and order 2 consists of three items (c, d, and f). When orders arrive, it would be inefficient for the retailer to send pickers out into the warehouse to fetch the items for one order. Instead, they may queue up several hours worth of orders and compute the best way to batch work in the warehouse. Often, multi-line orders are split across different pickers because the elements of the order are stored in distant locations. Each picker in a zone of the warehouse fills a tote with items that are part of several different customers' orders. In this example, items a, c, and d are batched and fetched in one pick cycle. Similarly, items b, e, and f are batched and fetched in one pick cycle. When the pack operator has received all of the items for one order, he/she consolidates them together into a box, inserts the packing slip, attaches the shipping label, and sends the completed box to the shipping dock.

To process an order, the picker typically picks items using a fork-lift truck. The pick travel activities include replenishing case-picking area from the reserve storage area by breaking full pallets to cases, replenishing broken-case picking area from the case-picking area by

breaking cases into individual items, and physical movements (from the receiving docks to different functional areas, between these areas, from these areas to the shipping docks), and travel to the pick locations to retrieve items. Figure 5 illustrates the long travel pick paths for retrieving items from a zone. Apart from the travel, manual effort is also necessary for lifting items on a few occasions (loading unitized items onto vehicles for shipment), consolidating the items and unitizing the items into an order. In spite of automating a few activities in the order picking process, the physical effort put by a picker is considerable. Therefore, the age of a picker and the work procedures significantly affects the cycle time of the picking process.

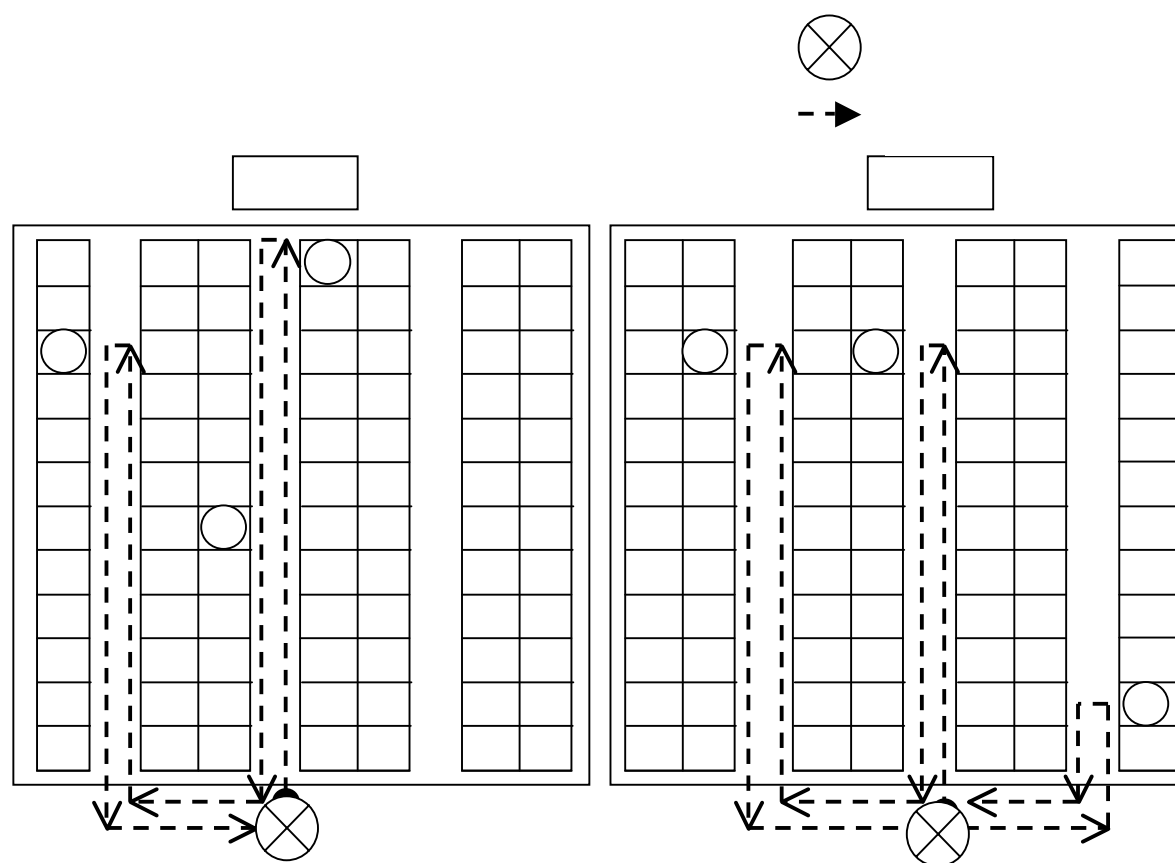


Figure 5: Illustrating travel paths in an order picking process (top view of storage area)

2. Identifying Challenges with Older Workforce

It is well known that the functional capability of human body deteriorates with time. With aging, the changes within a human body occur at three levels: physical, physiological, and psychosocial (Perry, 2010). The physical changes are associated with the functional strength, movement flexibility, vision, and balance. These changes not only limit the load bearing capacity of a worker but also affect the worker's range of motion. To ensure worker safety, the organization should monitor worker discomfort and implement ergonomic solutions (OSHA guidelines, 2010).

Further, with aging, the human body witnesses multiple physiological changes such as decrease in oxygen exchange, and increase in systemic blood pressure. Also, the body becomes more sensitive to extreme temperatures. This development can be especially challenging, if the worker is assigned to process orders in a refrigerated section of the distribution warehouse that stocks perishable and dairy items.

With age, there is an adverse effect on the psychosocial aspect of the human nature. Because the workers get accustomed and comfortable with the daily process and technology, they also form the pillars of change resistance within the company. Not only their acceptance towards newer technologies reduces but also their interest towards learning and training on new tools and techniques deteriorates. Research interviews conducted by Gue (2009) indicate that warehouse employees appreciated technology once it was in place, but found the initial process of technology implementation stressful. The interviews also revealed that the employees enjoyed the automation and work autonomy that technology provided, but raised concerns about their

ability to assimilate the training required to use the new technology. Table 1 summarizes these challenges faced by an older workforce.

Table 1: Challenges faced by an aging workforce

Physical	Physiological	Psychosocial
<ul style="list-style-type: none"> • <i>Strength</i>: 25-30 percent decrease at 65 years • <i>Flexibility</i>: 18-20 percent decrease at 65 years • <i>Balance</i>: One-third of 65 years or older fall each year • <i>Sight</i>: All aspects deteriorate • <i>Reaction time and speed</i>: Decreases • <i>Hearing</i>: One-third of 65-74 year olds have problems • <i>Manual dexterity and tactile feedback</i>: Motor skills deteriorate • <i>Body fat</i>: Increases • <i>Injury</i>: More likely to occur and long time to recover 	<ul style="list-style-type: none"> • <i>Oxygen exchange</i>: 40 percent decrease at 65 years • <i>Respiratory system</i>: 25 percent less at 65 years, 50 percent less at 70 years • <i>Cardiovascular system</i>: 15-20 percent less at 65 years • <i>Systemic blood pressure</i>: Increases • <i>Fatigue</i>: Occurs more rapidly • <i>Extreme temperatures</i>: More challenging 	<ul style="list-style-type: none"> • <i>Shift preferences</i>: Mornings, less shift work • <i>Training and learning</i>: Need structured training and education • <i>Disenfranchisement and disengagement</i>: More likely • <i>Technology acceptance</i>: Low

3. Solutions to Improve Order Picking Performance with Older Workforce

While the employer may find it challenging to reverse the adverse physical, physiological, and psychosocial transformation of the employees with aging, the employer can maximize the performance of old-age employees by re-designing the work procedures and by adopting ergonomic innovations in workplace. This section discusses the methods to maximize order

picking performance with an older workforce by addressing the challenges at physical, physiological, and psychosocial levels (Grocery warehousing ergonomics, 2010; Occupational Safety and Health Administration (OSHA) regulatory guidelines, 2010).

3.1 Physical Solutions

- a. Order picking using fork-lifts:* Fork-lifts are the most commonly used vehicle in distribution centers to store and retrieve items in the order picking area. The seating and navigational features of a fork-lift are crucial because the picker spends a substantial amount of time while traveling on a fork-lift.

Potential hazards: Because older employees suffer from poor vision and require greater reaction time, they may find it difficult to navigate fork-lift with conventional speed-dial features. This issue may lead to workplace accidents.

Possible solutions: To improve the efficiency and safety of the storage and retrieval operations performed by an older workforce, material handling industry should design fork-lift trucks with improved design features. An analogy for improved fork-lift design features can be drawn from the car industry. In majority of the markets, the average new-car buyer is 40 years old. By 2015, that age is expected to increase by four years. Developing cars for this target group does not mean building “old-age cars.” It means equipping cars with design and handling features that the target group will find useful, exciting, and desirable, without sacrificing the model’s overall statement. Similarly, the design features for the fork-lifts should include easy-to-use functions even for complicated options, dashboard design with easy to see speed dials, and special attention recommendation displays to alert the picker of the obstacles in the path. Further, the

seating should be ergonomically designed to minimize chances of back injuries and visual aids such as fluorescent pathways should be available for better path guidance during night hours. Note that highways in high density areas use fluorescent pathways for better traffic guidance.

- b. **Transport techniques:** Employees usually move materials through the warehouse on pallet jacks. A pallet is placed on the pallet jack and item is removed from a storage area called a slot or pick bin, then placed on the pallet. Many of these loads, especially in refrigerated or freezer warehouses, are extremely heavy. Weights upwards of 80 to 100 pounds are not uncommon.

Potential hazards: Employees repeatedly bend forward at the waist to place boxes on the lowest level of pallets (Figure 6a). The heaviest units are placed on the bottom layer for stability. This work process requires employees to lift the heaviest loads using the worst body posture.

Possible solutions: To keep the load close to the body of the employees, the height of the bottom level of the pallet should be raised (Figure 6b). This increase in height will minimize bending of the torso. Further, to minimize bending at the waist, height-adjustable picking equipment should be provided. Pallet jack can raise the height up to 10 inches (Figure 6c). Further, the employees should be educated about the hazards of bending while moving heavy loads and proper lifting techniques should be adopted at work.



Figure 6(a) Bending required to reach boxes, (b) use of a forklift raises the height of the boxes,

and (c) pallet jack with higher than normal fork elevation.

- c. **Storage:** Most goods in the warehouse are stored for a period of time. Racking is used to expand the amount of storage that is possible. Metal racks are used for storage and the area created within the racking is called a pick bin or slot. Slots range in size, depending on the products stored.

Potential hazards: Palletized product is stored in pick bins. Typically pallets are placed on the floor, which requires employees to bend at the waist to access palletized loads that come to the warehouse stacked only a few feet high, or may be unloaded to the point where they are only a few feet high. Even when these pallets are stored in taller slots, employees must bend at the waist to access product (Figure 7a). This is a significant problem since the heaviest product is usually in the shortest stacks. Low racking can force employees to bend at the waist to access loads. Loads in the bottom bins will require forward torso bending to reach under the rack, even when the top levels of the stack are at waist height or higher (Figure 7b).

Possible solutions: Whenever possible, the pallets should be elevated within a slot bin. The best technique is to place a palletizer into a tall bin (Figure 7c). A palletizer will lower in height under the weight of a full pallet, then will raise the load as items are removed.



Figure 7(a) Bending required to reach boxes under racking, (b) low racking, and (c) palletizer with turntable

- d. **Aisle width:** Aisle width may be insufficient for access to faster-moving product.

Potential hazards: Insufficient aisle space may create congestion that forces pickers to stop farther from the pick slot and carry product longer distances to the pallet jack.

Pickers may be tempted to carry multiple items at the same time to save trips.

Possible solutions: Increase the width of aisles where fast-moving product is located.

This will allow more pallet jacks to get closer and will reduce the distance that loads must be carried. Further, staggering the start times for the pickers at the beginning of the day will ensure fewer pickers hitting the same slots at the same time.

3.2 Physiological Solutions:

With aging, the mechanical, physical, and biochemical functions of the human body become more sensitive to workplace conditions such as poor workstation design and extreme temperatures.

Potential hazards: Due to poor workstation design, workers may develop musculoskeletal disorders (MSDs). With reduced awareness of MSDs, symptoms may go undetected until they become disabling injuries. If proper medical management is not in place, injured employees are less likely to get timely and appropriate care and restricted duty hours may not be established or utilized.

Possible solutions: A medical management program should be introduced to the order pickers. The picker should consult with a medical specialist who has experience in and is familiar with work-related musculoskeletal disorders (MSDs). This person may be a physician, a nurse, or other healthcare provider that is familiar with causes of musculoskeletal injuries. Symptoms should be reported as soon as they start to develop. Early reporting can help address potential problems before they become serious and costly lost-time injuries.

3.3 Psychosocial Solutions:

Older employees are difficult to be trained on new work procedures and technologies.

Potential hazard: The workforce may not recognize ergonomic hazards or understand the effective techniques used to minimize these hazards.

Possible solutions: The older workforce is more receptive to structured training programs. Further, appropriate video tapes of proper work practice for employees should be provided to employees to review on a regular basis. In addition to regularly scheduled refresher training, injured employees should be retrained regarding ergonomic risks pertinent to their injuries. Also, a mentor should be provided to each older employee with whom he/she can discuss the work-related issues. The mentor can also provide insights

on the proper and most efficient methods to perform their tasks. During new technology implementation, the employees should be given more hands-on assignments and demos before the roll-out.

4. Ergonomic Innovations for Order Picking

In picker-to-parts order picking system, the picker travels to the pick locations and retrieves the items. This method involves substantial picker travel and item lifting and putting away activities (Stanfords, 2011). As described in the Section 3, the putting away activities involve reaching, bending, stooping, climbing, and twisting that are required for picking the right inventory items from racks or shelves. Further, pulling the items from the shelves and stacking them on the floor could create a tripping hazard, clutter or cause back strain from bending.

To improve the safety as well as efficiency of order-picking operations, a few distribution centers are investing in parts-to-picker order picking system, where the items in warehouse storage are delivered to stations close to the order picker using conveyor or mobile racking technology. In this system, there is minimal reaching and carrying, and no climbing, which is more ergonomically sound. The pickers are stationed at modular workstations, which are developed using ergonomic considerations and mobility features.

Vanderlande Industries, headquartered in Veghel (the Netherlands), is a worldwide leader in automated material handling systems for distribution centers, parcel and postal sortation facilities, as well as baggage handling at airports. They developed parts-to-picker order picking system, where the items requested for an order are brought in totes to the picker's workstation using conveyor technology. Thereby, the travel time associated with order picking is

substantially reduced. Since the picker is always stationed at his/her workstation, the design of the workstation (height, lift angle) plays a crucial role in order picking performance. To maximize picker's well-being and improve performance, Vanderlande designed the workstation that strictly follows ergonomic design principles. This workstation is referred as PICK@EASE (Vanderlande Industries Press Release, 2010).

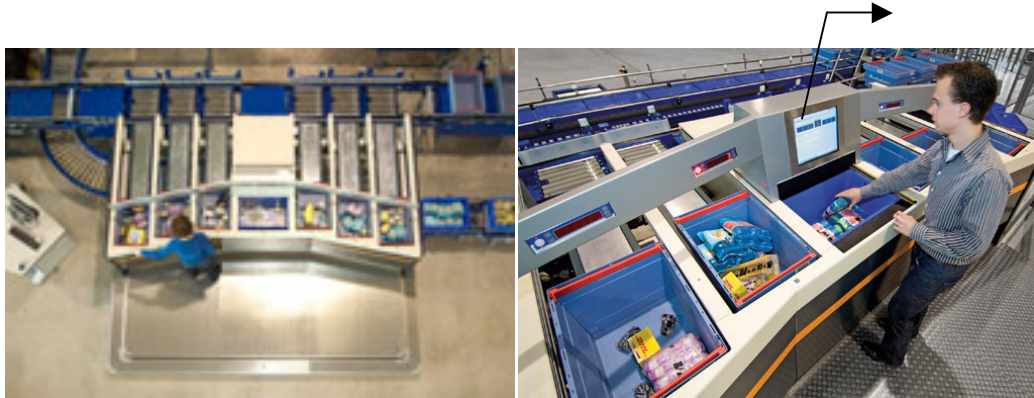


Figure 8: Picker stationed at a PICK@EASE workstation: top-view (left), side-view (right)

(Source: Vanderlande Industries Press Release, 2010).

PICK@EASE is developed under a successful partnership with TNO (Europe's largest institute for technological and strategic research and consultancy with expertise in ergonomics) to design high performance workstations, which meet strict ergonomic requirements. The workstation is designed in a single level "cockpit type" layout to minimize vertical arm and shoulder movement. Operators also tend to be more productive when they can influence their own work environment. With PICK@EASE, the operator can adjust the workstation platform automatically to his or her ideal height. An anti-fatigue floor mat improves operator satisfaction. Further, Vanderlande partnered with Philips to bring the dynamics of daylight into the work environment, which enables the operator to control his/her own environment and it improves well-being.

The PICK@EASE workstation is designed to improve efficiency and picking accuracy, contributing to better customer service. Orders are picked directly into a shipping carton (pick/pack) minimizing product handling. Based on the products which need to be picked, the workstation automatically indicates which order carton the operator should use. Picking accuracy is enhanced by light grids over the order totes. A 'pick pointer' indicates from which specific tote compartment the operator should pick the required products. The new PICK@EASE workstation enables operators to pick between 200-550 order lines per hour, while fulfilling all the required value-added service tasks.

5. Conclusions:

Today, the older population forms a significant portion of the America's material handling workforce. To retain and grow older workforce in the organization, the distribution centers should place higher importance on ergonomic equipment and processes, and employee-friendly work place design features. Ergonomic solutions should focus on minimizing the bending, reaching, and pulling associated with the tasks in item picking. New technology such as modular workstations and parts-to-picker PICK@EASE technology has made it possible for workers to work more efficiently and safely while assembling or picking orders. Implementation of parts-to-picker technology solution in distribution centers will ensure workforce longevity and substantial improvement in pick efficiencies.

References

de Koster, R. (2004). *How to assess a warehouse operation in a single tour, Report*, RSM Erasmus University, the Netherlands.

Demographic of Aging (n.d.), Retrieved January 10, 2011 from website:

<http://www.transgenerational.org/aging/demographics.htm>

Drury, J., (1988). *Towards more efficient order picking*, IMM Monograph No. 1, Report, The Institute of Materials Management, Cranfield, U.K.

Gue, K.R. (2009), *The worker-centric warehouse: A manifesto*, Working paper, Department of Industrial & Systems Engineering, Auburn University. Retrieved January 31, 2011 from http://web.mac.com/kgue/Kevin_Gue/WCW_files/manifesto.pdf

Goetschalckx, M. and Ashayeri, J., (1989). *Classification and design of order picking systems*. Logistics World, 99-106.

Grocery warehousing ergonomics, (2010). OSHA United States Department of Labor, Retrieved January 31, 2011 from Website: http://www.osha.gov/SLTC/etools/grocerywarehousing/work_practice.html

Global Insight (2005). *The US Truck Driver Shortage: Analysis and Forecast*. Report prepared for the American Trucking Association.

Lapide, L. (2010). *Outlook on Supply Chain 2020*, Supply Chain Summit, NA 2010, Cleveland, OH.

Occupational Safety and Health Administration (OSHA) regulatory guidelines, (2010). Retrieved January 31, 2011 from website: www.osha.gov.

Perry, L.S. (2010), *Designing the workplace for the aging workforce*, White paper, Zurich in North America, Retrieved December 20, 2010 from website

<http://www.zurichna.com/internet/zna/SiteCollectionDocuments/en/home/Designingtheworkplacefortheagingworkforce.pdf>

PICK@EASE ergonomic order picking workstation (2010), Retrieved January 31, 2011 from website <http://www.vanderlande.com/News-Events/News/PICKEASE-ergonomic-order-picking-workstation.htm>

Spotlight on Statistics (2008), *Workers 65 and over by work schedule*, Retrieved January 20, 2011 from website, http://www.bls.gov/spotlight/2008/older_workers/

Stanfords, J.P., *Ergonomic Innovations Make Order Picking Safer, Easier* (n.d.), Retrieved January 31, 2011 from website:

<http://ezinearticles.com/?Ergonomic-Innovations-Make-Order-Picking-Safer,-Easier&id=459420>

4

Tompkins, J.A., White, J.A., Bozer, Y.A., Frazelle, E.H., Tanchoco, J.M.A. (2003). *Facilities Planning*, NJ: John Wiley & Sons.

Toossi, M. (2007). *Labor Force Projections to 2016: More Workers in their Golden Years, Employment Outlook: 2006–16*, U.S. Bureau of Labor Statistics, Retrieved January 11, 2011 from website, <http://www.bls.gov/opub/mlr/2007/11/art3full.pdf>

The *2011 Statistical Abstract, Labor Force, Employment, & Earnings*, The National Data Book,

Retrieved January 31, 2011, from US Census Bureau website:

http://www.census.gov/compendia/statab/cats/labor_force_employment_earnings.html

United States Census Bureau (2010), Retrieved January 25, 2010, from website,

<http://www.census.gov/>

World Population Aging: 1950-2050 (n.d.), Retrieved January 11, 2011, from United Nations

website, <http://www.un.org/esa/population/publications/worldaging19502050/>