Ergonomic Redesign For Checkout Stations Part I

Presentation created by the Students of

DEA 470/670: Applied Ergonomic Methods

Cornell University

Under the Direction of

Professor Alan Hedge

Summary of Typical Checkout Routine for Cashier

TASKS	ISSUES
Check-in with Register	Downward Bending
• Place cash box lid into storage area.	Factor: Posture
Preparation of Bag	
• Locate bag from rear platform.	180º Torso Rotation
• Set bag on pedestal.	180º Return Rotation
• Open mouth of bag.	Downward Bending
	Factor: # Bags

Summary of Typical Checkout Routine for Cashier

TASKS	ISSUES
Access & Register Items	Forward Bending
• Remove divider.	Wrist Twisting
• Reach and swipe items into scanner.	Factor: # and Load of Items
Bag Groceries	Downward Bending
• Place items onto bottom of bag.	Factor: # and Load of Items

Summary of Typical Checkout Routine for Cashier

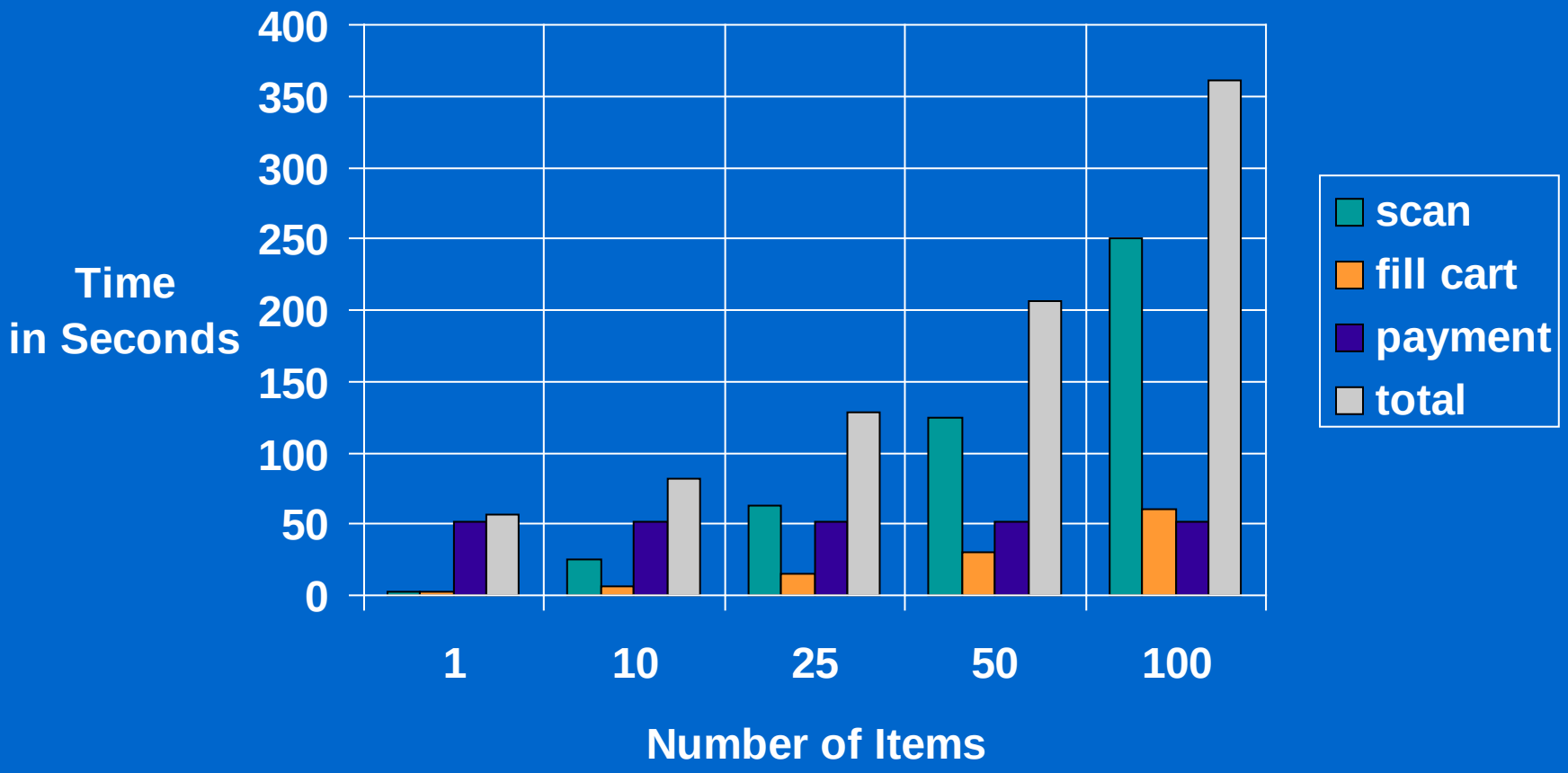
TASKS	ISSUES
Input Transaction Codes • Type codes into keyboard.	Wrist Bending Factor: Posture
Place Bag into Cart/Platform • Lift bag from pedestal. • Place bag into cart. • Place bag onto platform.	Forward/Backward Bending 180º Torso Rotation Factor: Load of Bag

Checkout Stand Task Times

ITEMS **TASKS**	1	10	25	50	100
SCAN ITEMS & BAG	2.5 sec.	25 sec.	62.5 sec.	125 sec.	250 sec.
FULL BAG TO CART	3 sec.	6 sec.	15 sec.	30 sec.	60 sec.
PAYMENT TRANSACT	51 sec.	51 sec.	51 sec.	51 sec.	51 sec.
TOTAL TRANSACT	56.5 sec.	82 sec. 1min. 22 sec.	128 sec. 2min. 8 sec.	206 sec. 3min. 26 sec.	361 sec. 6min. 1 sec.

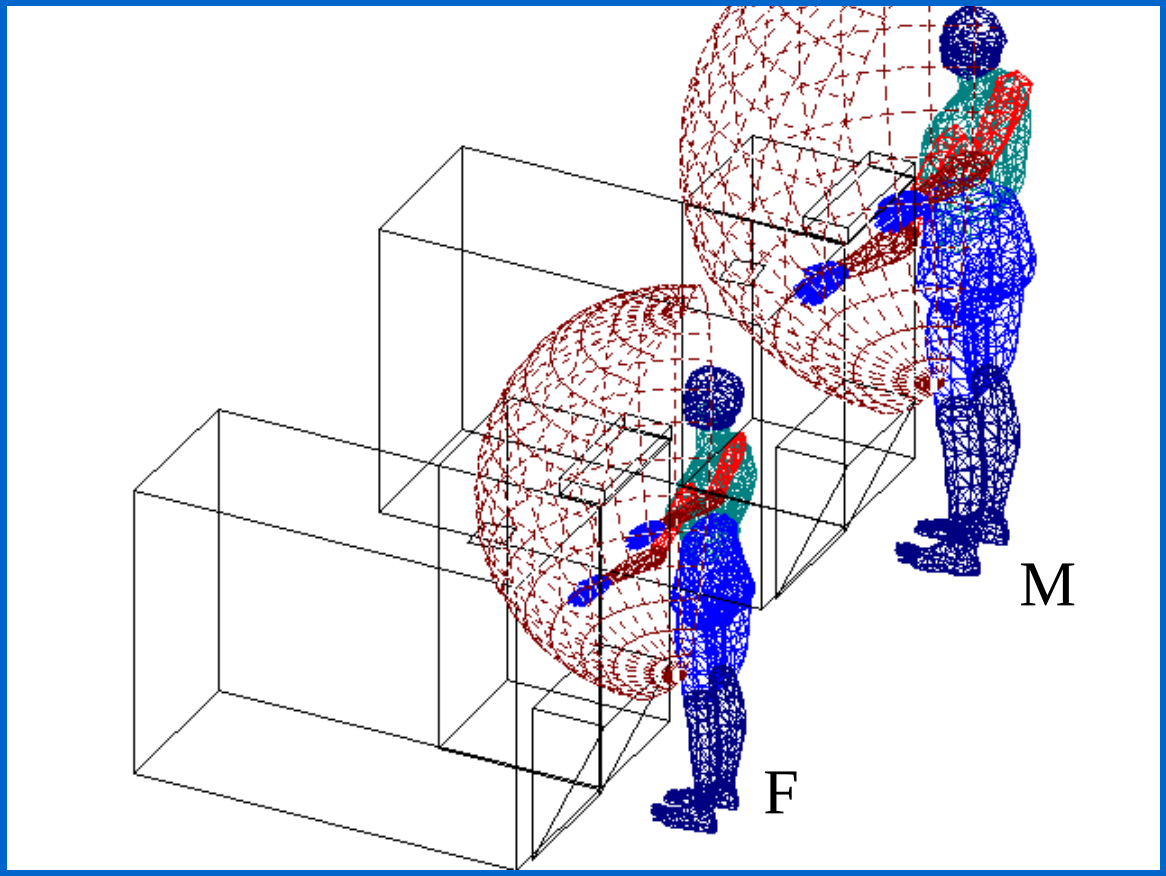
* All times represent averages.

Checkstand Task Times Graph

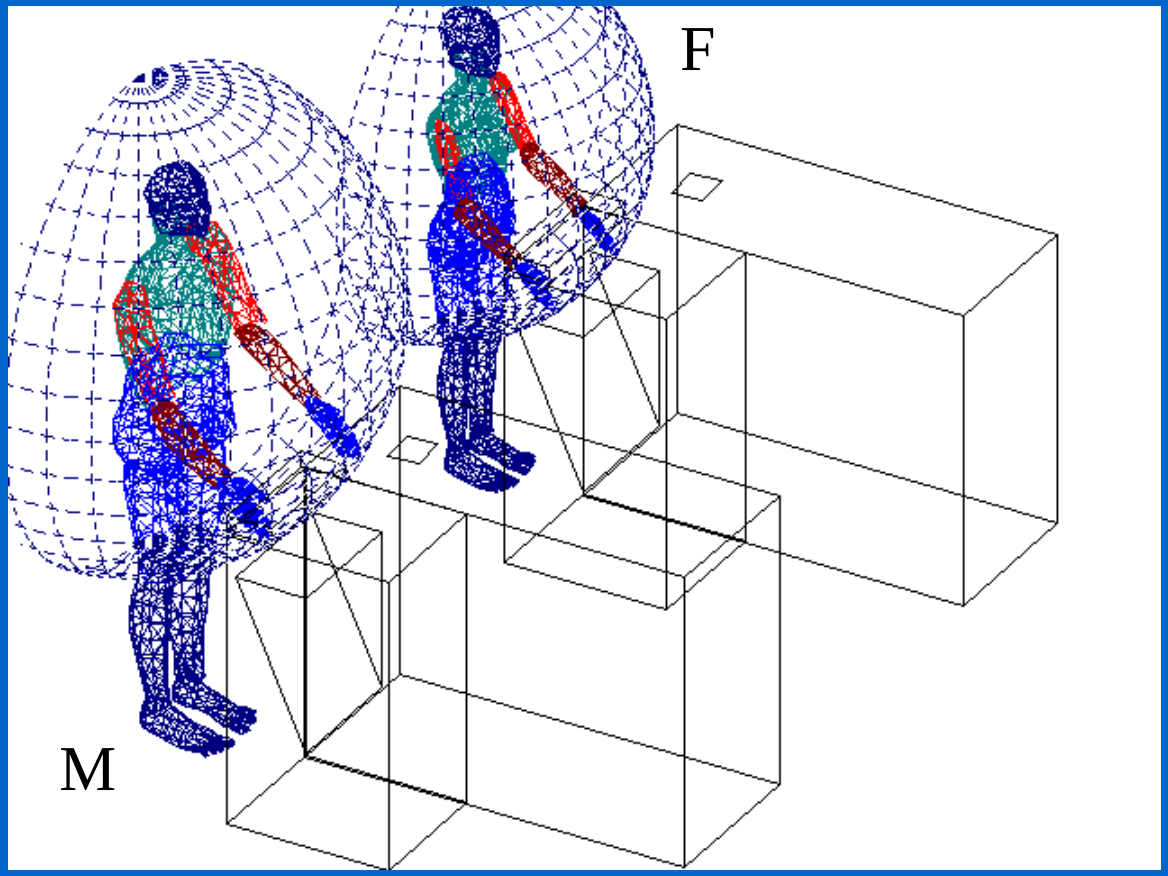


Left Arm Range:

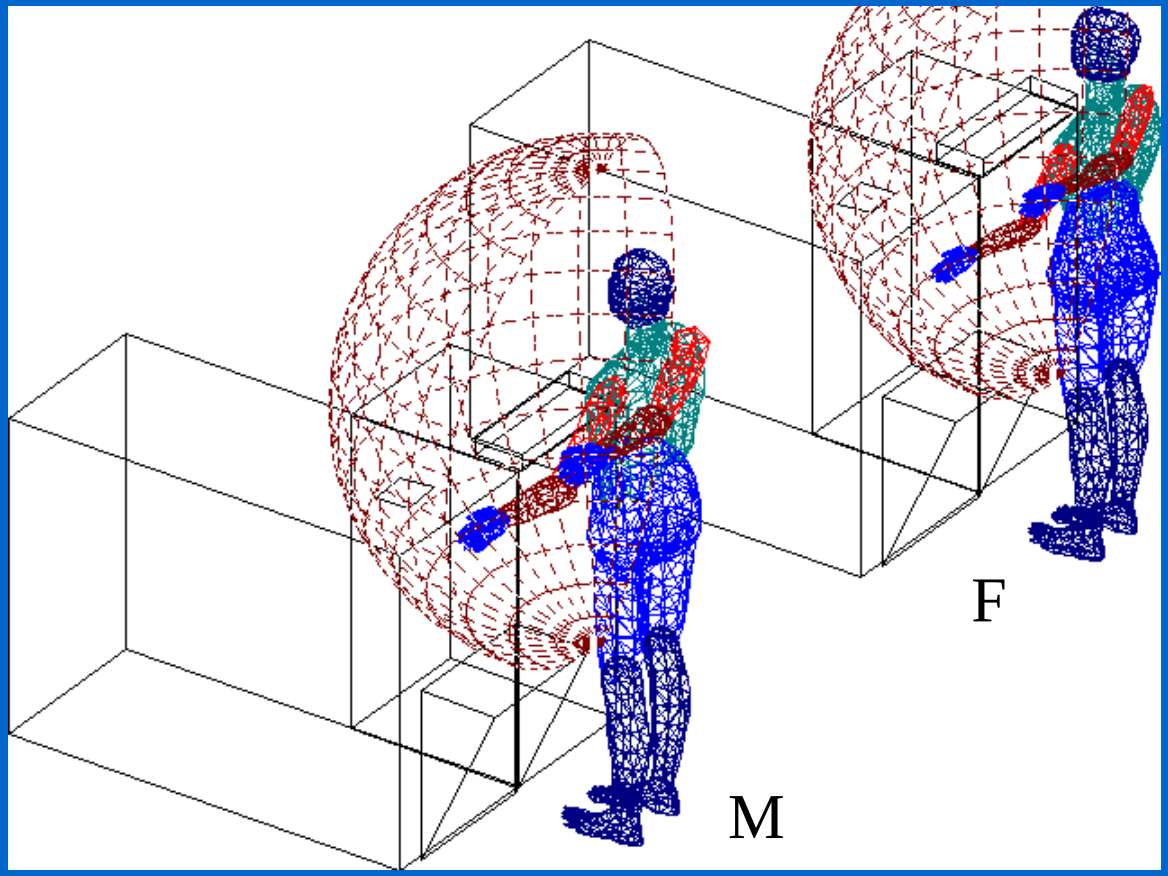
5th Percentile Female & 95th Percentile Male



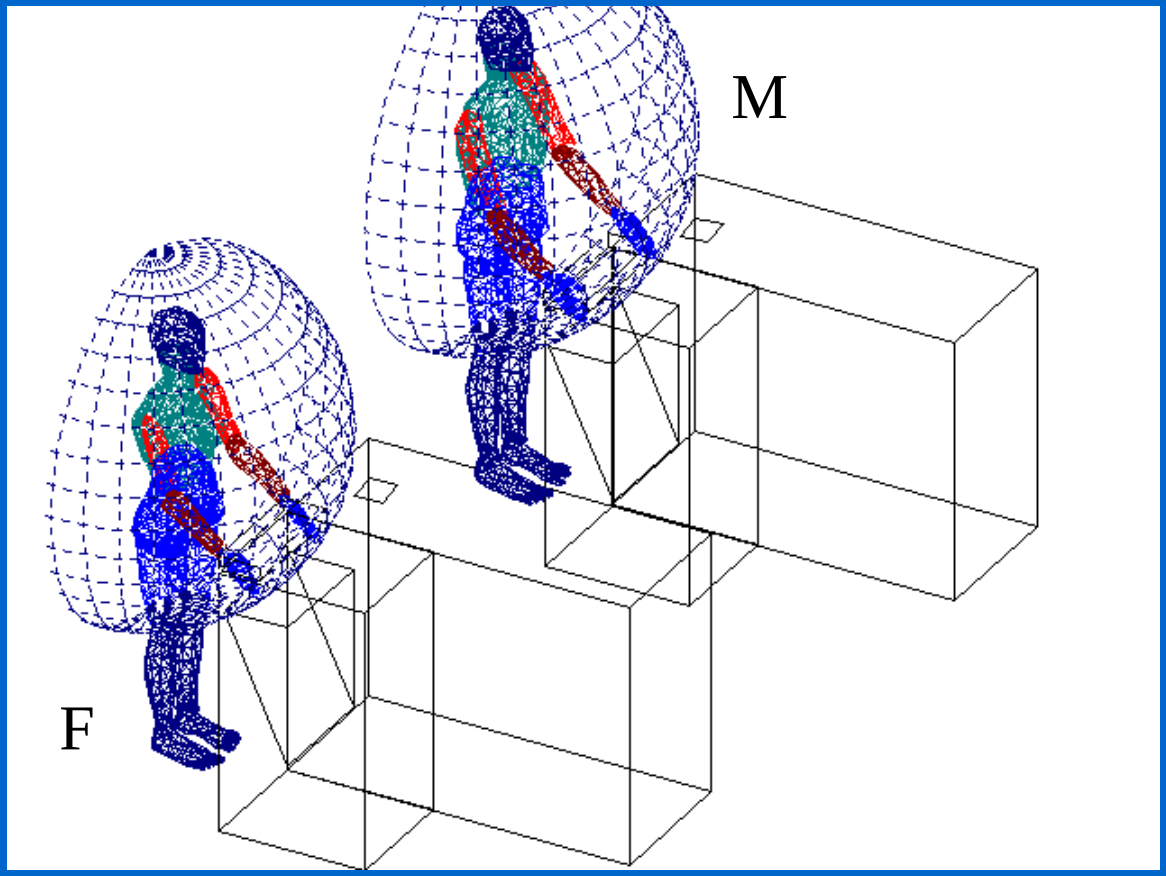
Right Hand Range:
95th Percentile Male & 5th Percentile Female



Left Arm Range:
50th Percentile Male & Female



Right Hand Range:
50th Percentile Male & Female



Ergonomic Problems Apparent From Computer Modeling

- Bottom of the bagging ledge is below arm's reach of well over 95% of the population.
- In order to place an object into the bag, cashiers must bend at the waist.
- Smaller women may have difficulty grasping heavy objects at the end of the conveyor belt, as this is about the extent of their reach. To compensate they will probably bend forward at the waist.

Summary of Dimension Data

- 4 types of check-out stations:
  - standard
  - tall
  - handicap
  - express
- Random arrangement of check-out stations
- Handicap stations are of a lowered height, have wider aisles, and lowered credit swipe machines.
- Tall stations are of a higher height and have taller credit swipe machines.
- 2 shopping cart sizes (small and large).

Ergonomic Analysis of Front-end Checkout Design

Use & Misuse of Checkout Stands

- Inconsistency of Stance
- Keyboard Placement
- Bag Handling
- Placement of Accessories
- Physical limitation of Stands
- Scanner Positioning
- Awkward Card Swiping System
- Employee Assignment

Comparative Analysis: Scanning Task

Scanner Type:

- Combination Vertical and Horizontal Scanner

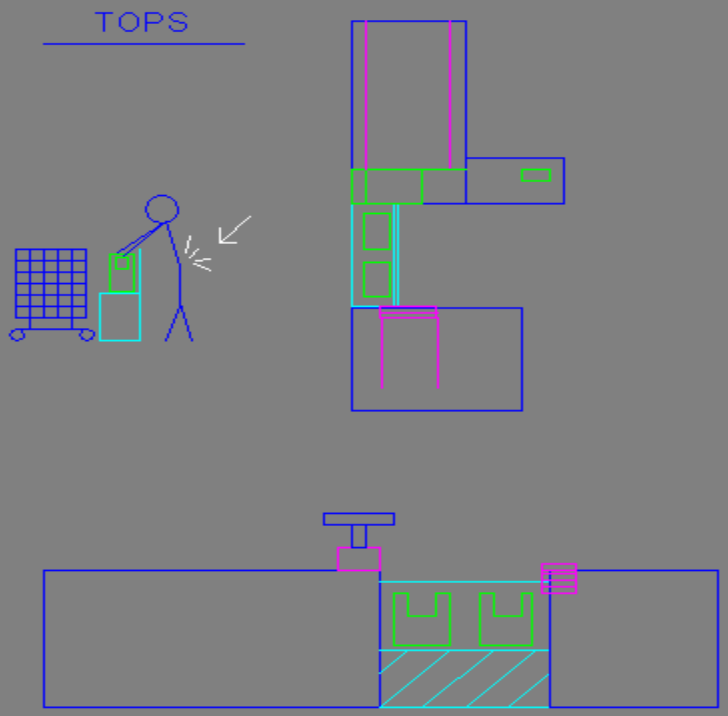
Keypad Location:

- Parallel to conveyor belt

Monitor Location:

- Varied (Parallel and/or Side)

Diagram of Side Stance Design



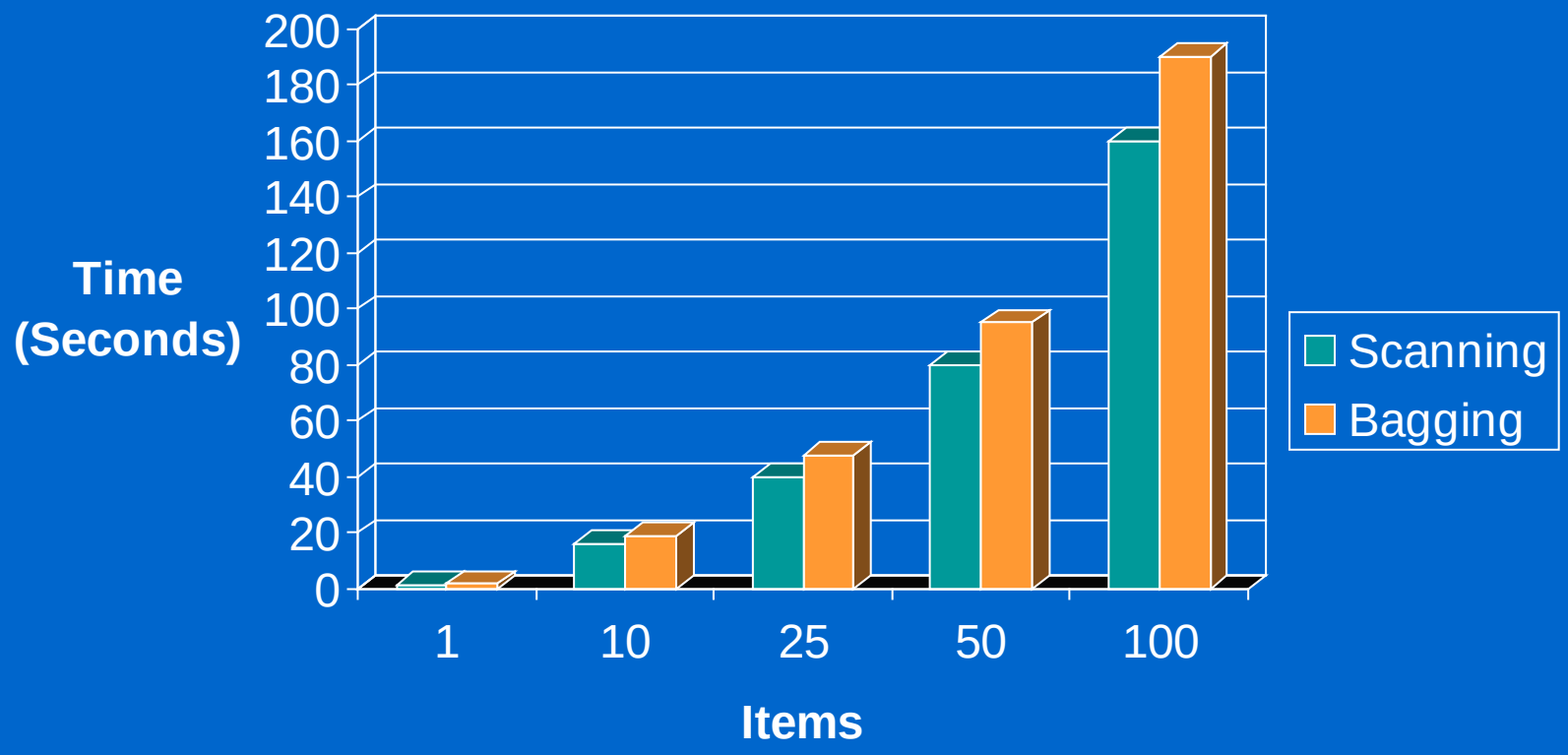
Comparative Analysis: Cashier Bagging

- Fold-down Bag Holder
- Posture Issues:
  - Bending:
    - Putting Items into Bag
    - Putting Bags Into Cart
- Customers had to lift bag into cart (OR) Cashier leaned over to put bag in cart
- Bags are parallel and adjacent to conveyor belt

Comparative Analysis: Bagger Bagging

- Second Conveyor Belt
- Bag Height: Adjustable (Around Thigh Height)
- Bagging Station: Pull-Out Bag Tray

Graph of Task Times



Ergonomic Redesign For Checkout Stations Part II

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Topics

- Scanning
- Keyboard
- Bagging
- Card Swipe
- Peripherals

Scanning

Posture Issues In Current Scanner Design

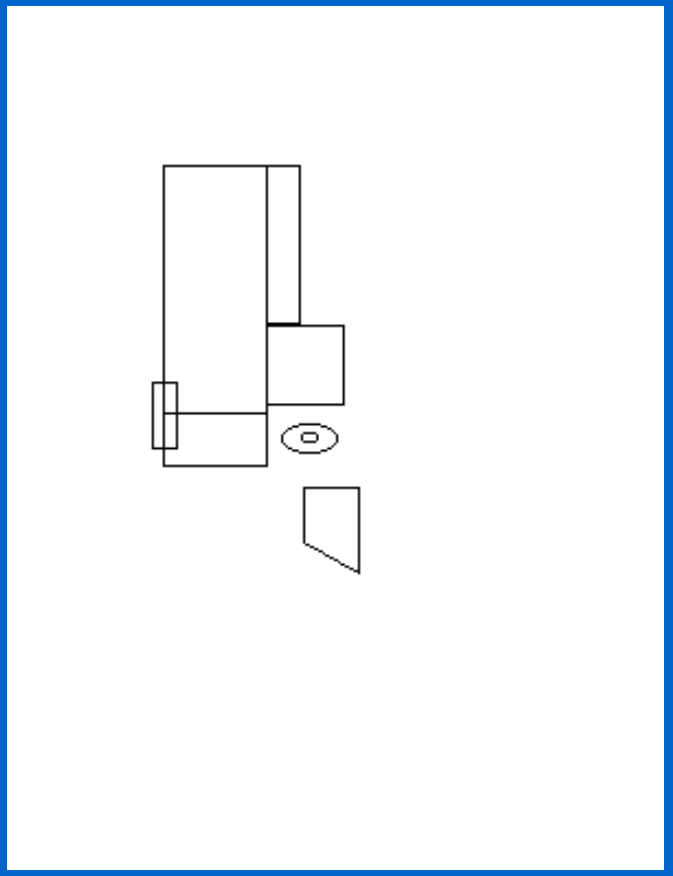
Back	• End of scanner bed outside reach envelope • Toggle switch for belt outside reach envelope
Wrist	• Twisting of items for repeated scanning • Shape of hand scanner
Neck	• Looking down at belt and scanner bed causes neck flexion

Redesign Options for Current Footprints

- Back
  - Narrow scanner
  - Relocate toggle switch for belt within reach envelope
- Wrist
  - Bi-optic scanner for decrease in reading errors
  - Different shaped hand scanners:
    - Pen
    - Palm-grip (like a computer mouse)
- Neck
  - Height of transport 100-75mm below average elbow height
  - More accurate scanner would reduce neck flexion

3/4 Stance Design Layout

- Register moved back: 90 degree angle to scanner bed
- Auxiliary table altered to allow for cart mobility
- Allows for a variety of bagging options



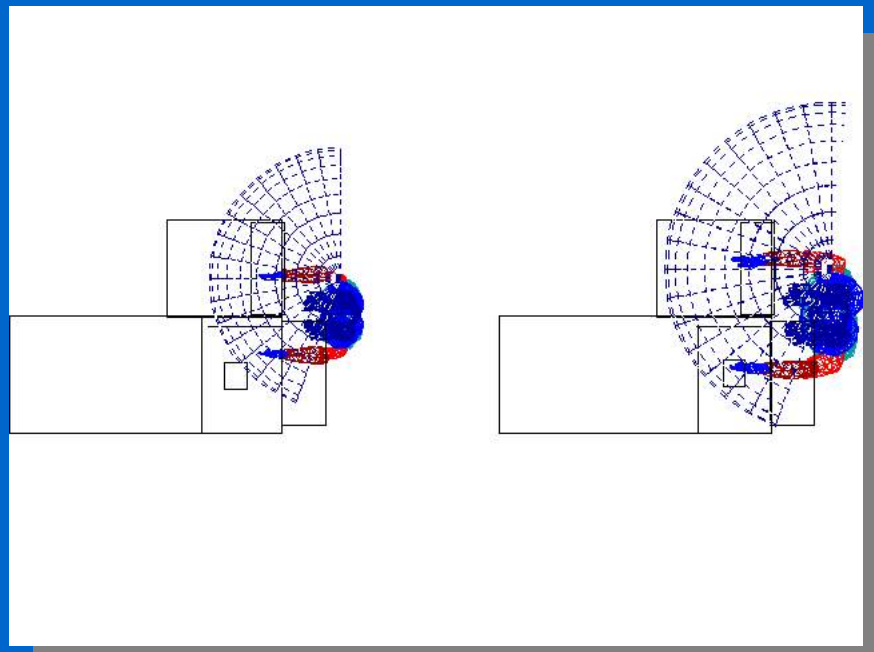
Key Ring Scan Tags

- May require cashier to take entire set of keys
- Wear caused by repeated scraping of metal on scanner bed
- Awkward grip on key ring causes wrist flexion

Keyboard

Advantages With Current Design

- The current keyboard location is within the right hand reach envelope of most of the U.S. population.
  - a 5ft tall woman and a 6ft 1in male
  - Approximately 97% of males and 97% of females

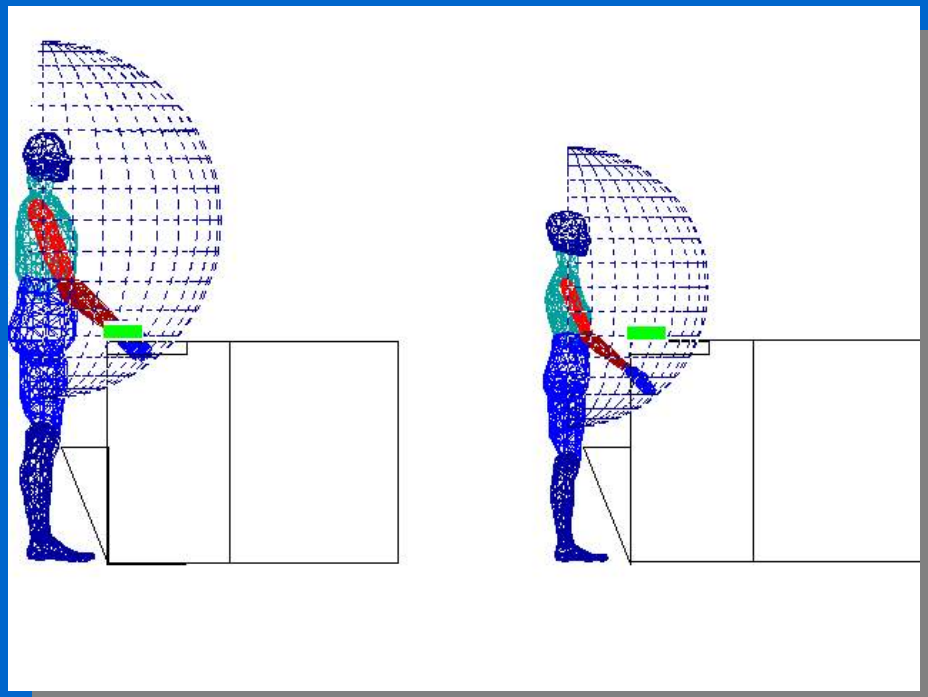


Avantages With Current Design

- Keyboard has functional coding of keys through color and tactile coding, grouping, and auditory feedback
- Free-standing keyboard

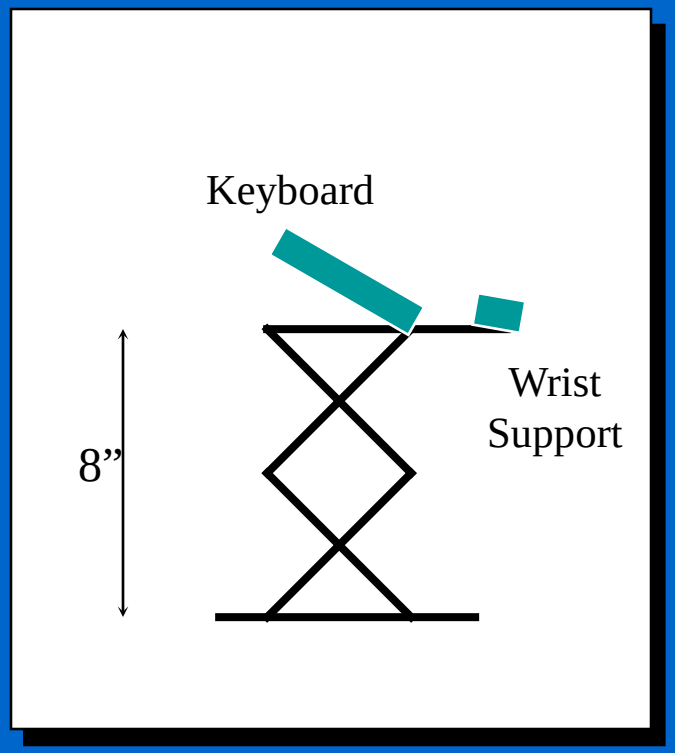
Problems with Current Keyboard Placement

- Placement of current keyboard causes various degrees of wrist extension in people of varying heights
- Not height adjustable
  - current height is 40 inches off floor (standard check-stand)
- Lack of wrist support



Suggested Improvements

- Minimize consistent wrist flexion and extension which over time may cause cumulative trauma disorders.
- Adjustable keyboard tray
  - Height (38-46 in. range)
  - Angle (0-30 degrees range)
  - Pictogram showing adjustment capability and neutral hand positioning
- Adjustable and retractable wrist supports
  - Cushioning should minimize the pressure on the medial nerve
- Training



Bagging

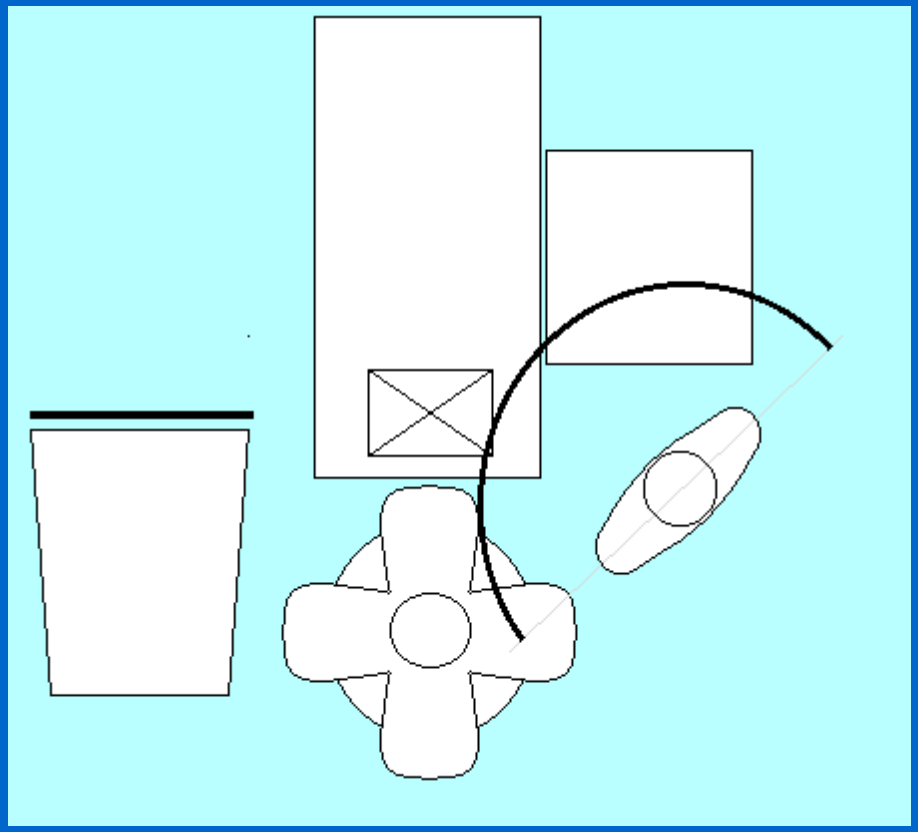
Bagging: Problems

- Bagger repeatedly bends forward from waist to fully open bags; can cause lower back strain.
- Variation in bagger's height can compound bending problem.
- Bags must be pulled apart each time due to static between plastic.
- Location of paper bags causes cashier to bend and/or rotate for access and retrieval.
- Paper bags do not have an ideal packaging placement.

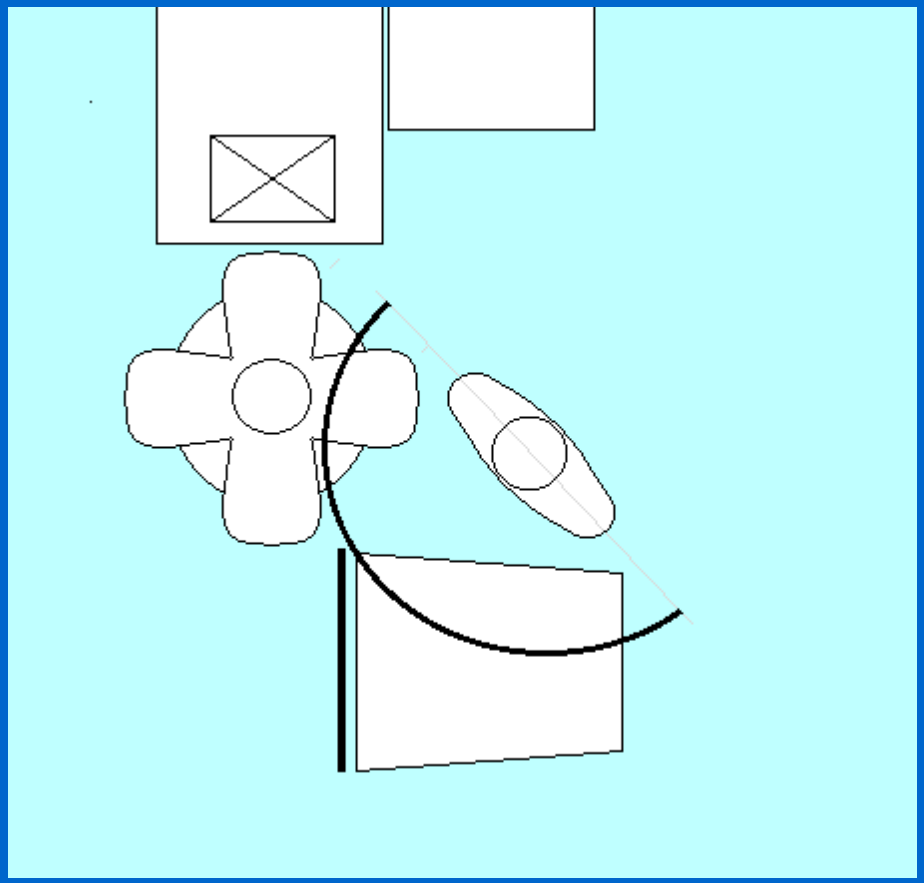
Bagging: Solutions

- Height-Adjustable/ Weight-Sensitive Platform
- Rotational Multi-Bag Platform

Rotational Multi-Bag Platform



Rotational Multi-Bag Platform



Bagging: Solutions

- Height-Adjustable/ Weight-Sensitive Platform
- Rotational Multi-Bag Platform
- Retractable Sliding Cart Doors
- Perforated Bag Dispenser System

Bagging: Solution Evaluation

ADVANTAGES

- eliminates forward flexion required for placing objects into bag and cart.
- accommodates various heights
- transfers worker's load to rotational device
- allows simultaneous bagging
- eliminates side bending and flexion
- facilitates in opening of bags--thereby, lessening transaction time and manual strain

DISADVANTAGES

- requires a greater amount of space
- necessitates change in footprint design
- implies the need for re-training of employees

Card Swiping

Card-swipe Problems

- Problems:
  - Cashier
    - Cashier must twist spine to help customer.
    - Cashier must overextend to reach around card machine.
  - Customer
    - Customer must turn wrist in awkward posture when swiping card.
    - Awkward body posture/position.
    - Non-ambidextrous design

Card-swipe Goals

- Goals:
  - Enhance usability of design so that customer doesn't need to ask cashier for help.
  - Lessen ergonomic issues for customer & cashier (i.e. wrist posture, arm reach)
  - Lessen time needed to pay cashier.
- Design Suggestions:
  - Place card-swipe machine at functional height.
  - Adjustable check-writing surface.
  - Lettered or color-coded buttons
  - Pictogram on buttons (i.e. MasterCard)

Card-swipe Design Suggestions

- If card-swipe machine faces customer:
  - Locate keyboard on back & front (or swivel).
  - Locate card swipe vertically on the right side.
- If card-swipe machine is placed flat on table:
  - Vertical swipe on table to avoid wrist flexion.
  - Color coding on the keypad for cashier.
- Other possibilities:
  - Instead of swipe, slide card in and out of machine.
  - Place Wegman's sticker on credit cards to avoid having to swipe two cards (i.e. Visa & Wegman's).

Peripherals and Stance

Peripherals and Stance

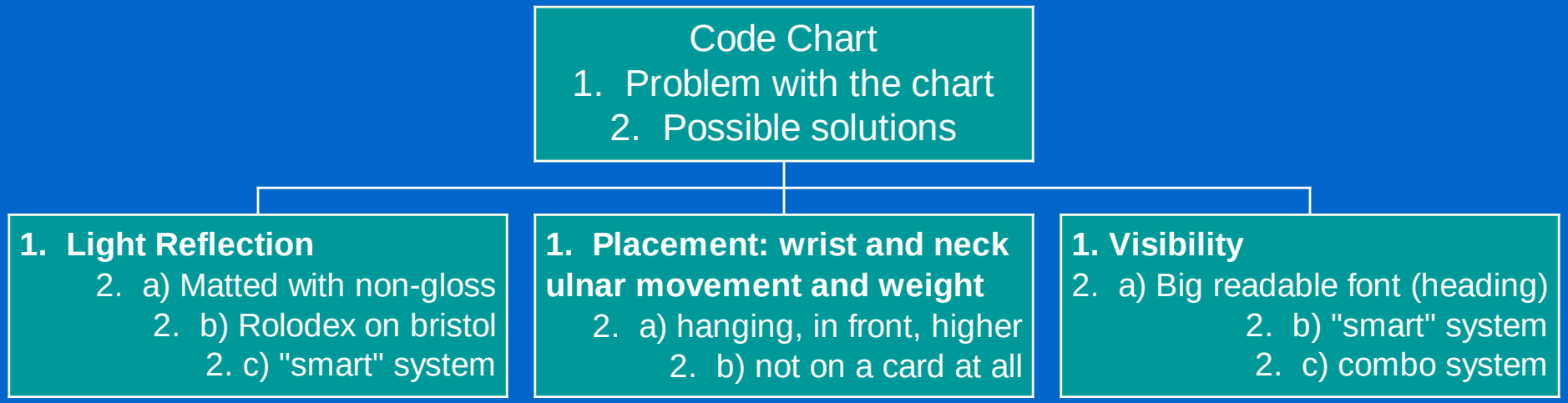
- **Ergonomic issues of standing work**
  - Rest Schedules
  - If the work surface needs constant visual attention, neck pain can result.
- **Position of peripheral objects**
  - Garbage Cans (3 of them)
  - Paper Towels
  - Back-Up Bags (both paper and plastic)
  - Chart with Produce Codes
- **Better possible use of vertical space**
- **Allocation of storage by weight and frequency of use**
- **Working with/around the bagging station**
  - Access to station requires 180 degree turning.
  - Station makes access to storage below the register difficult.

Getting to the Back-Up Bags and Paper Bags

- Access of paper bags requires body twisting. This could possibly be changed by placing the stack of bags upright, just in front of and below the cash register.
- Back up paper bags can be stored upright behind this, and back-up plastics can be stored next to it.
- This would greatly decrease, and possibly eliminate, the distance between the storage space and the open space of the heavy paper bags.
- Benefits:
  - Less chance of injury/pain.
  - Cashier can offer quicker paper-bagging service.

Stance: Code Chart

Stance



Conclusion: Next Steps

- Solutions range from inexpensive, quick-fix options to more extensive, ground-zero redesigns
- Future Endeavors:
  - Trial implementation of solution(s)
    - Evaluate organizational impact of proposed changes
  - Follow-up post-evaluation

Thank You!

- To Wegmans for giving us a real-life situation to investigate
- To Alan Hedge for providing us with the knowledge to conduct this project

We hope to work with you again in the future!