MIS
MAKE IT SAFE

Reframing Task Analysis:

An Important First Step in Musculoskeletal Injury (MSI) Prevention

Overview

Definitions

- Task analysis
- Ergonomics
- Musculoskeletal injury (MSI)

Physical demands-related MSI risk factors

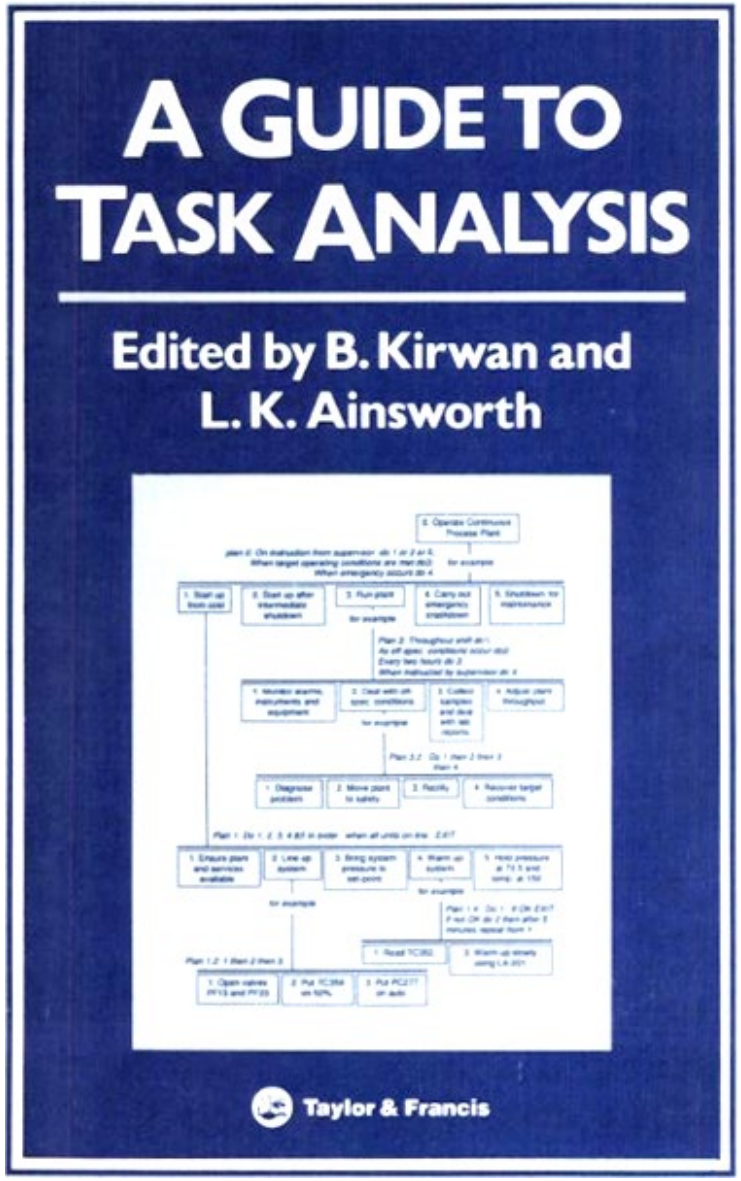
Task Analysis

- Different uses and context
- Historical perspectives
- MSI risk factor identification and assessment

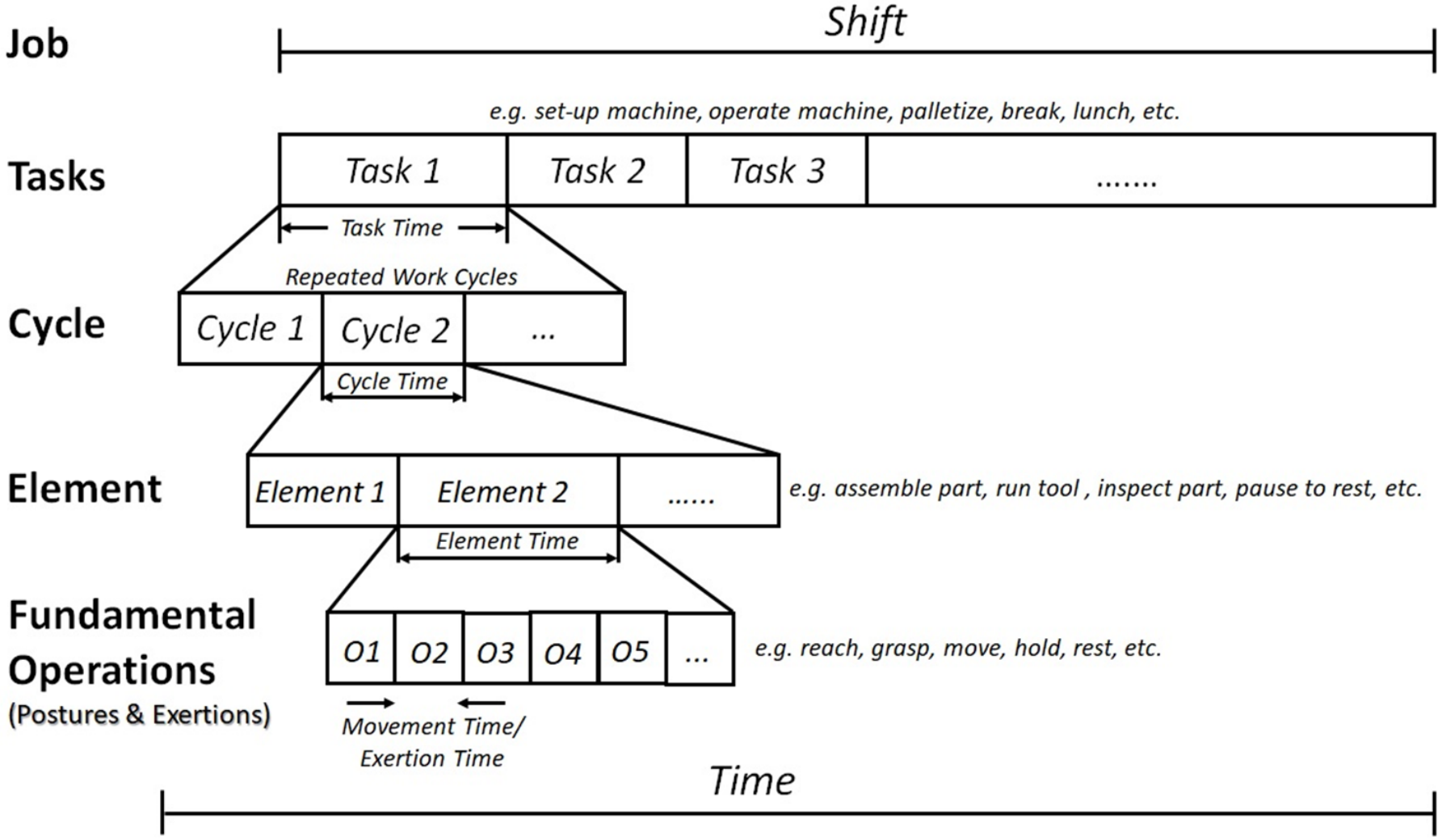
Task Analysis *Defined*

The study of what an operator (or team of operators) is required to do, in terms of actions and/or cognitive processes, to achieve a system goal.

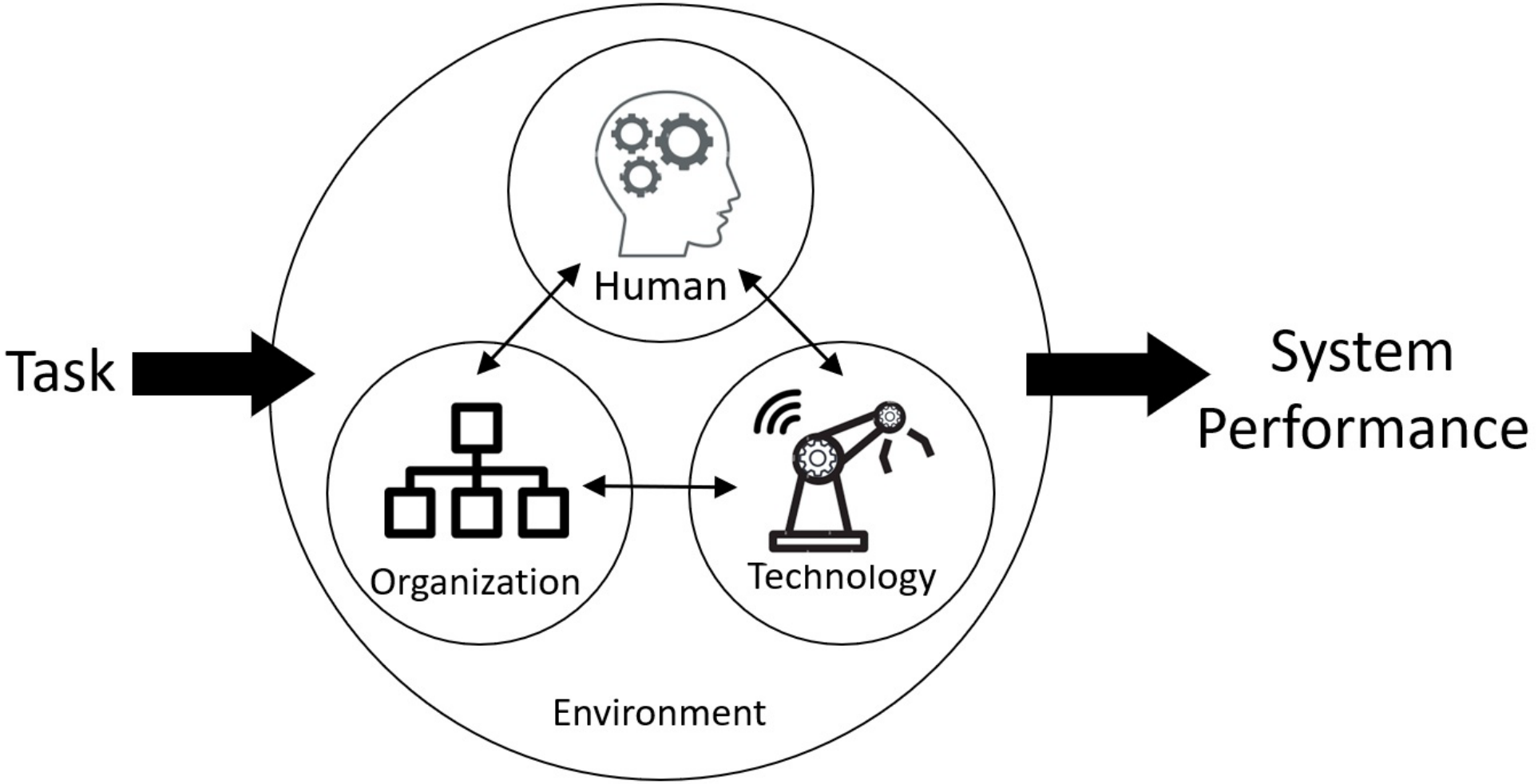
Kirwan and Ainsworth, 1992



Task Analysis
Overview



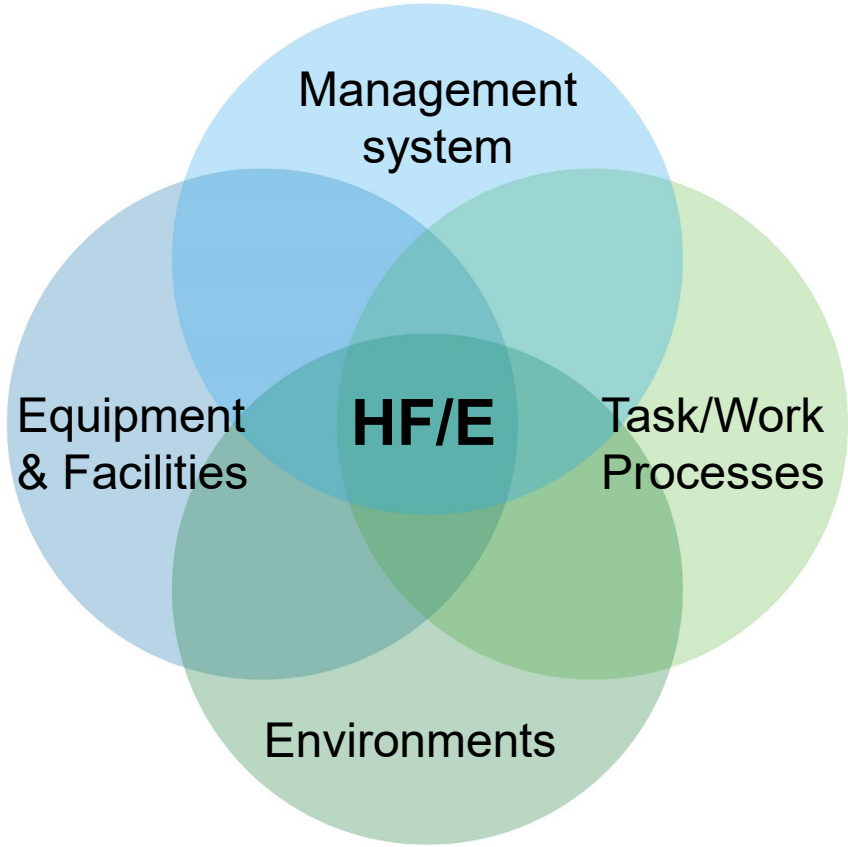
Task and System Performance



Ergonomics Definition – *IEA*

The scientific discipline concerned with the understanding of interactions among humans and other elements of a **system**, and the profession that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance.

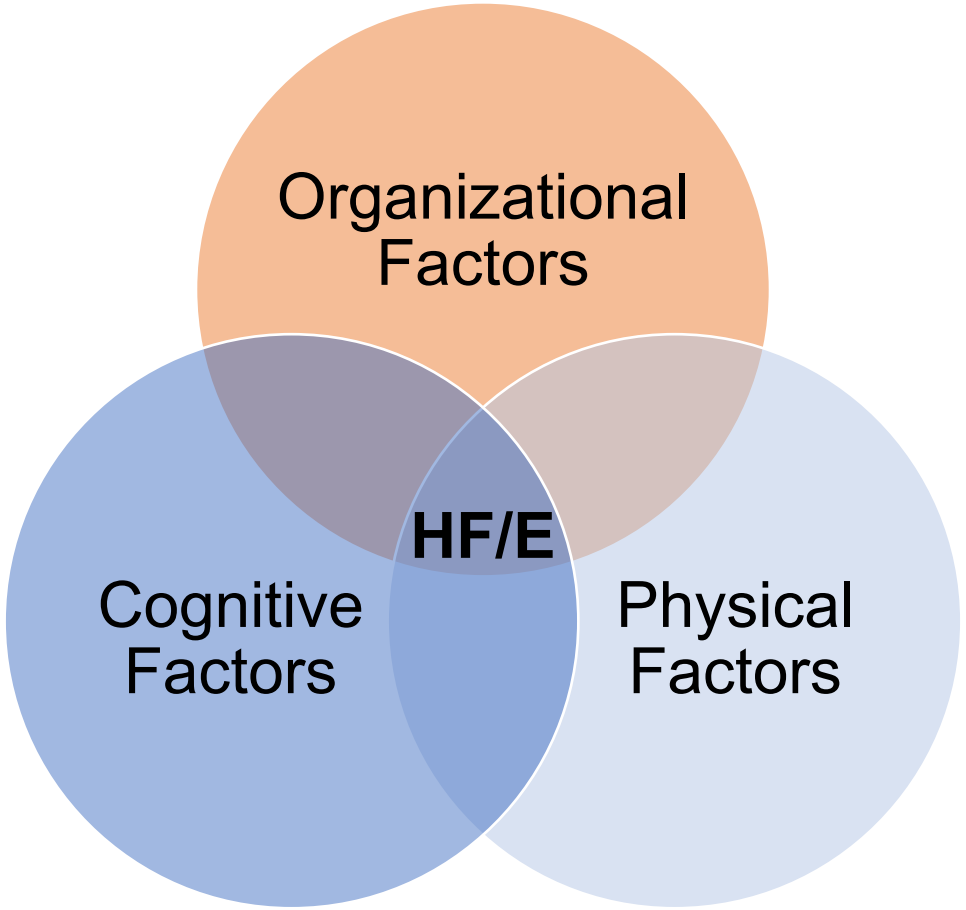
International Ergonomics Association (IEA), 2000



Human Factors/ Ergonomics (HF/E)

Ergonomics – *Defined*

- Ergon -> work (Greek)
- Nomos -> laws
- The science of work
- Fitting the workplace, facility, equipment, task, and processes to the physical and cognitive capabilities and limitations of **humans**



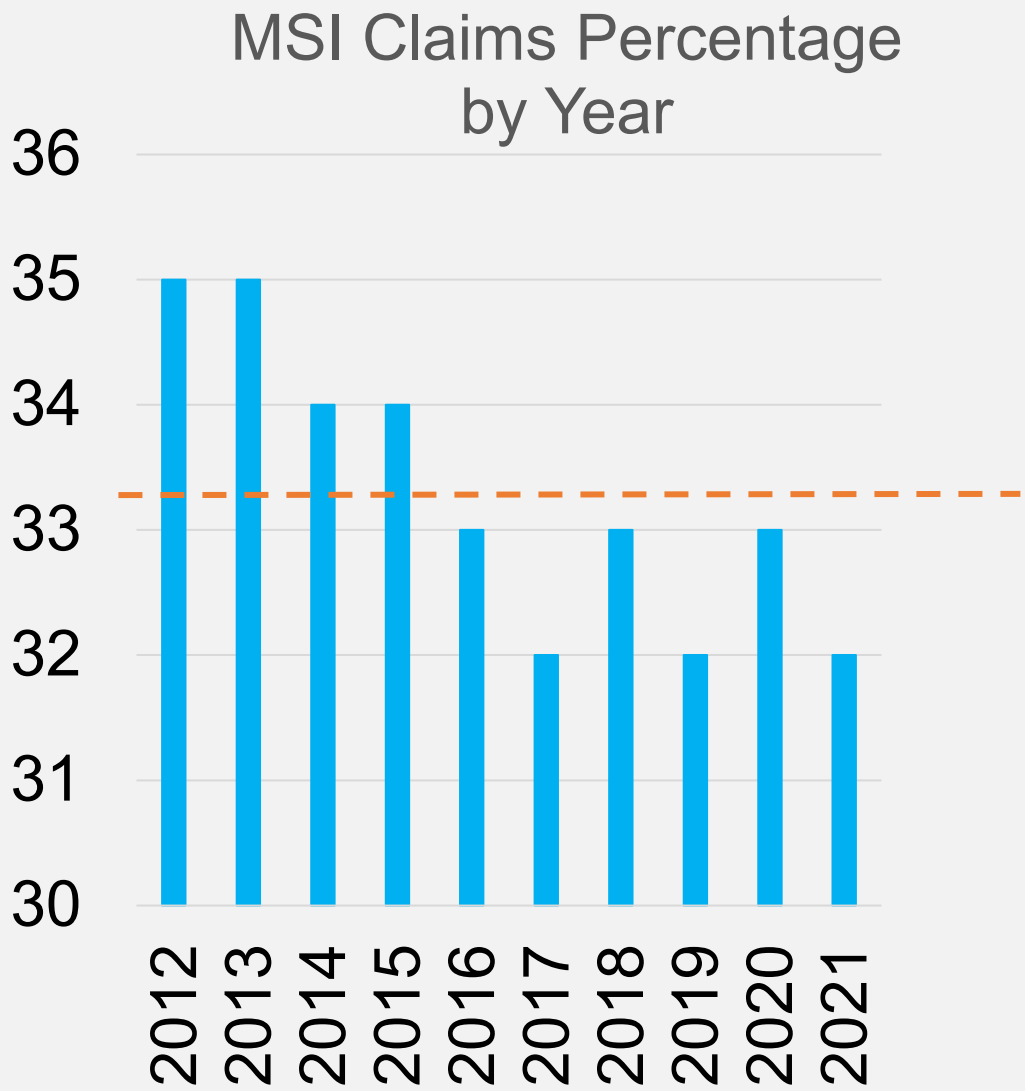
Human Factors/ Ergonomics (HF/E)

MSI: *CLC Definition*

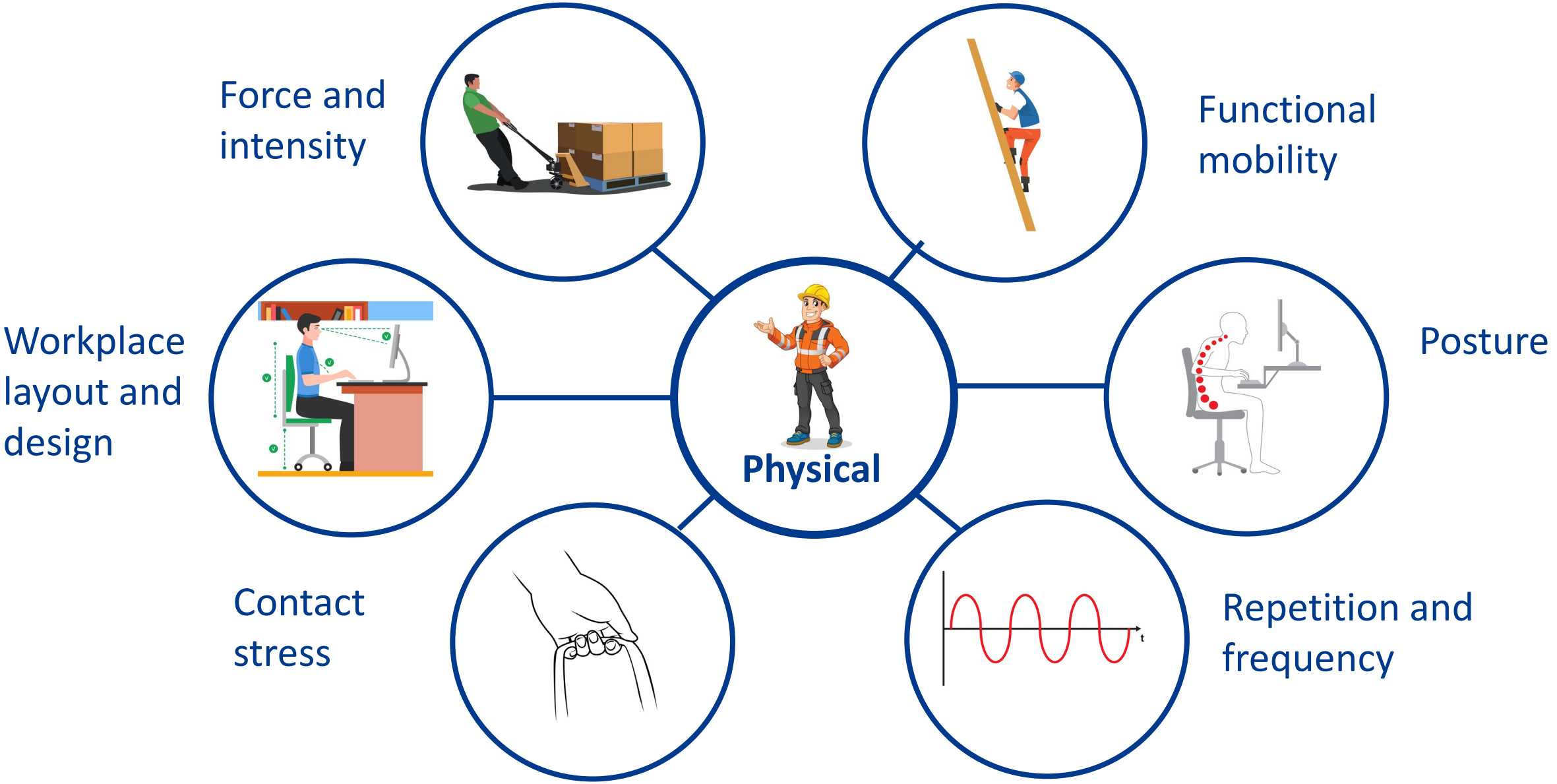
An injury or disorder of the musculoskeletal system, which includes muscles, tendons, blood vessels, ligaments, nerves, joints, spinal discs, and related soft tissue

Canada Labour Code, Part II

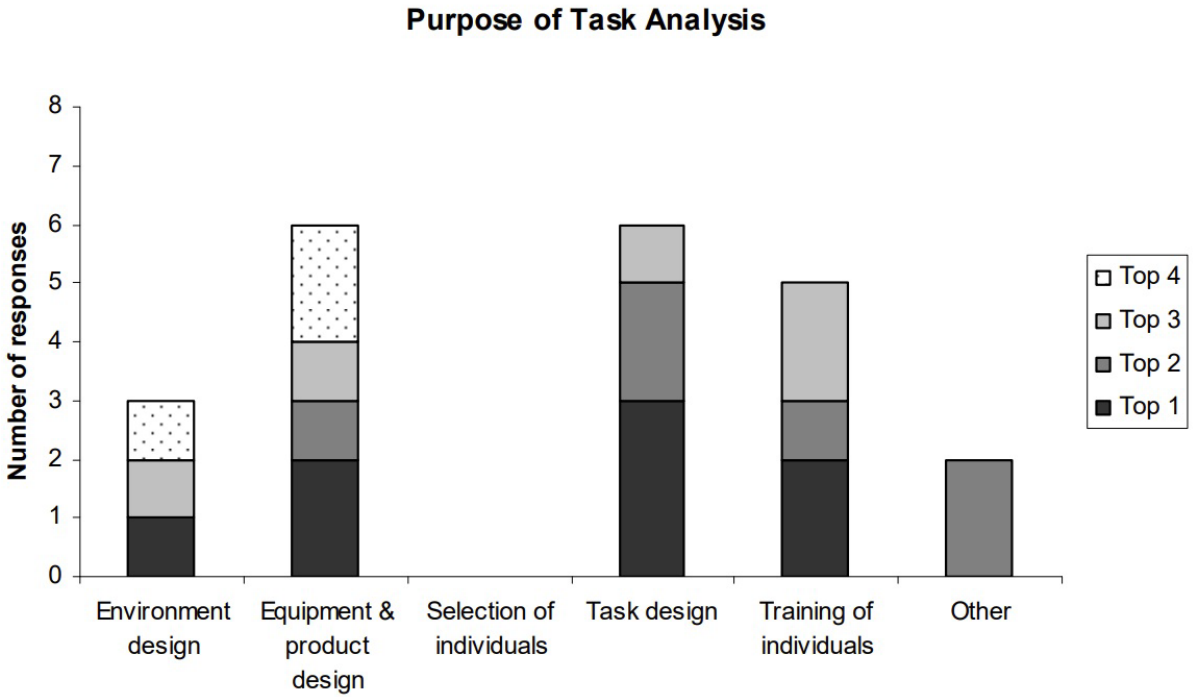
WorkSafeBC Statistics



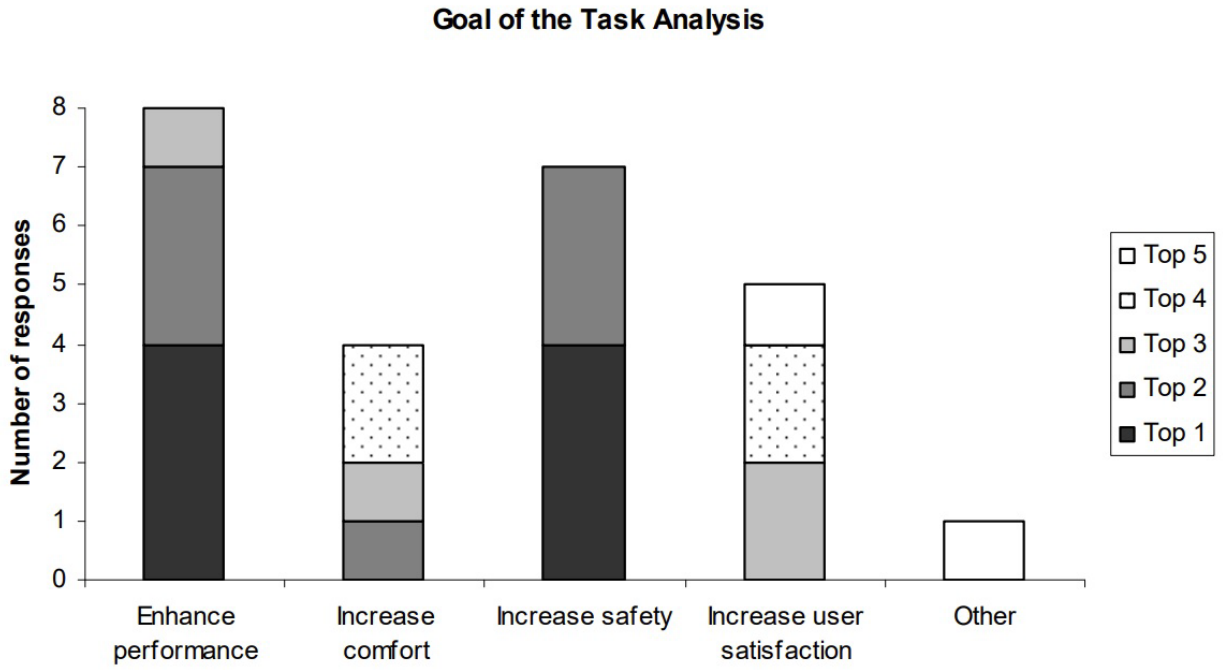
MSI Risk Factors –*Physical Demands Analysis*



Task Analysis in Different Context

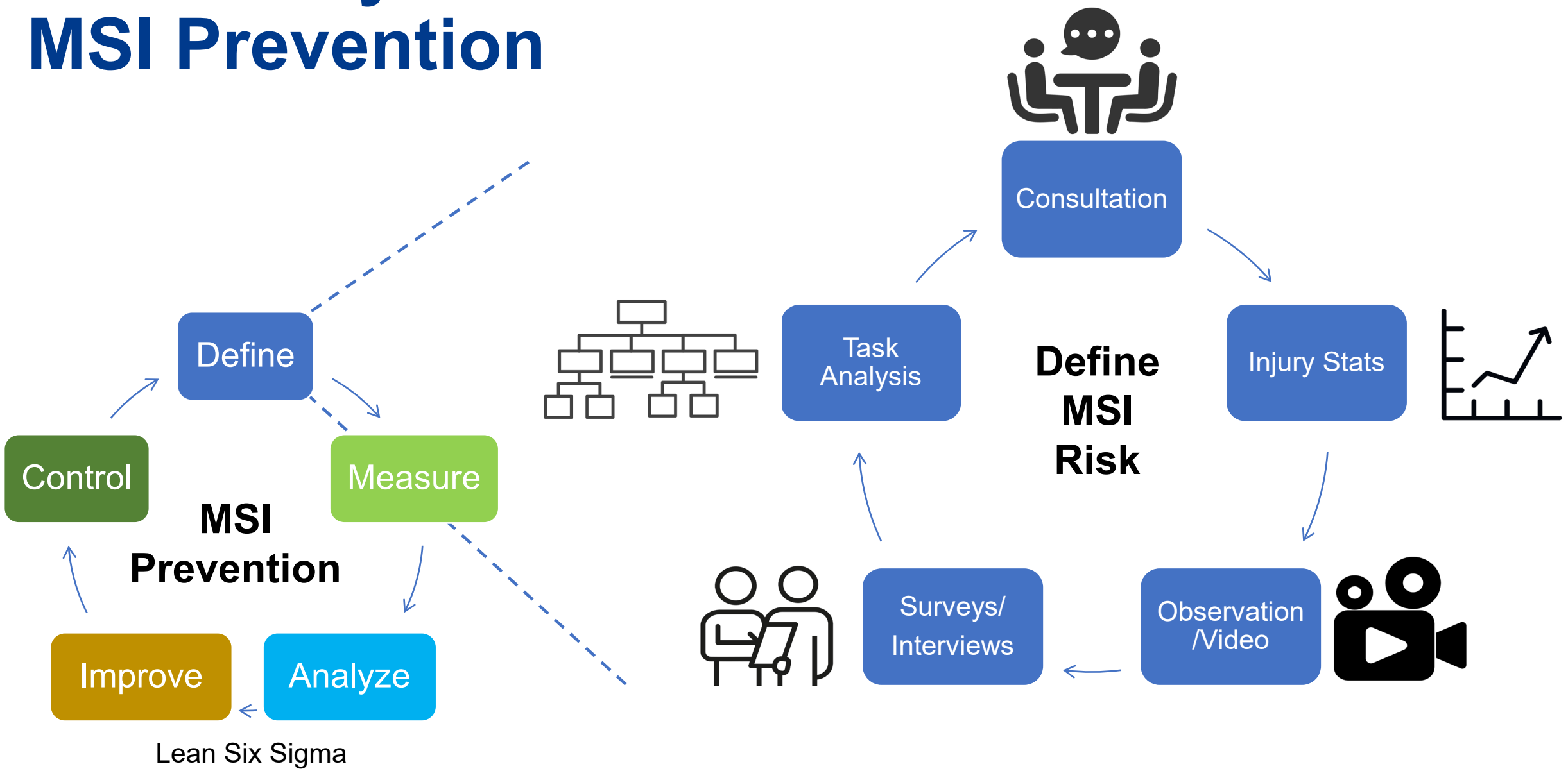


Source: Anne Edith Adams, PhD Dissertation, 2010 *Figure 5.1, (N=8)*



Source: Anne Edith Adams, PhD Dissertation, 2010 *Figure 5.2, (N=8)*

Task Analysis for MSI Prevention

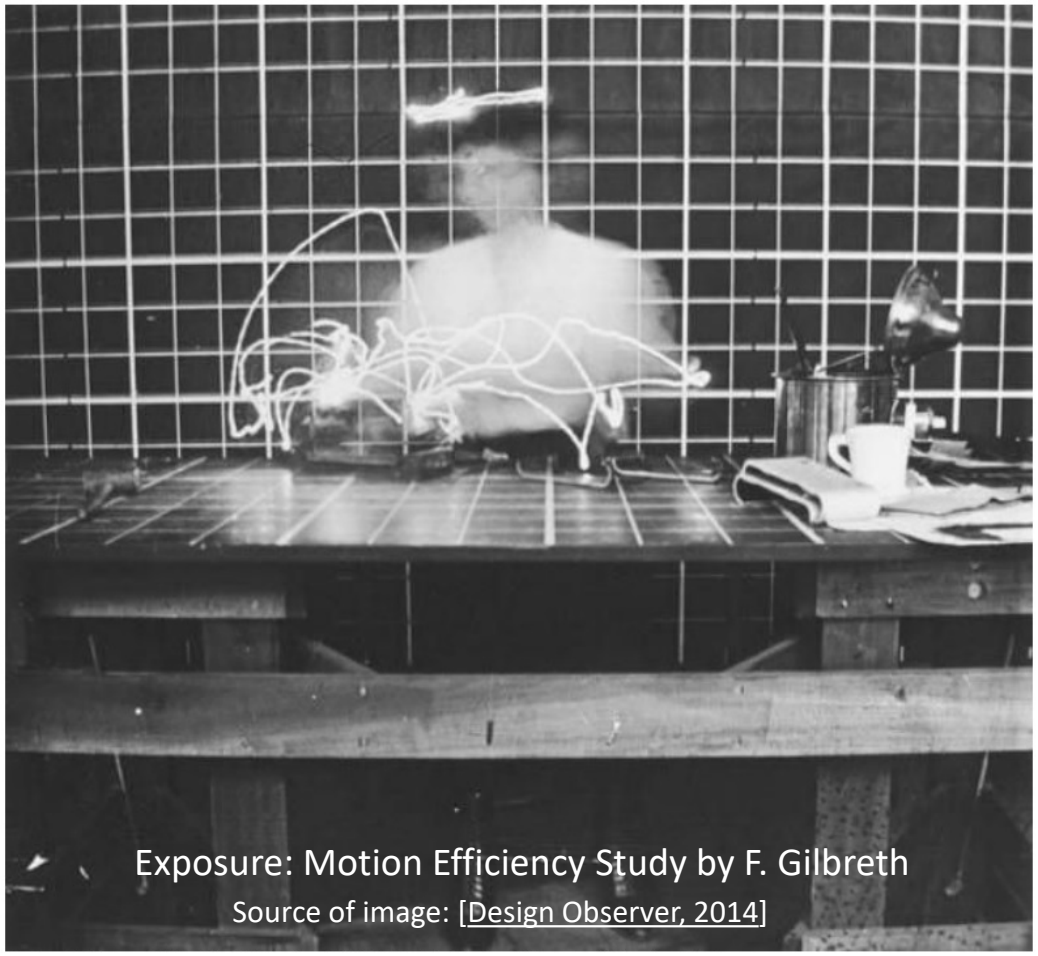


Historical Perspectives

Chronocyclographs and physical movements (1914)

Motion efficiency facilitates:

- Increased productivity
- Decreased waste
- Cost savings
- Good design
- Good ergonomics
- Improved safety
- …



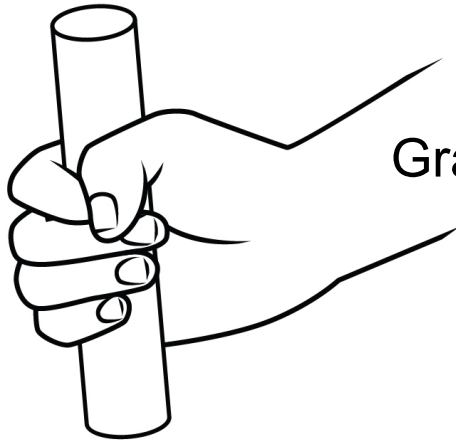
Exposure: Motion Efficiency Study by F. Gilbreth

Source of image: [Design Observer, 2014]

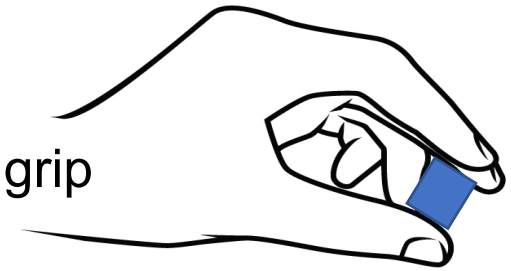
Historical Perspectives - *Physical motions*

Frank Gilbreth (1919): 17 Types of Motion (*Therbligs*)

- search
- select
- grasp
- reach
- move
- hold
- release
- position
- pre-position
- inspect
- assemble
- disassemble
- use
- unavoidable delay
- wait (avoidable delay)
- plan, and
- rest (overcome fatigue)



Grasp – power grip



Grasp – pinch grip

Historical Perspectives - *Motion Time Studies*

1 MOD = 0.129s

M1 = 0.129S
M7 : 0.129s x 7 = 0.903s

MODAPTS®: MODular **A**rrangement of **P**redetermined **T**ime **S**tandards

Image source: TPT website

Historical Perspectives

Process Control and Cognitive Functions

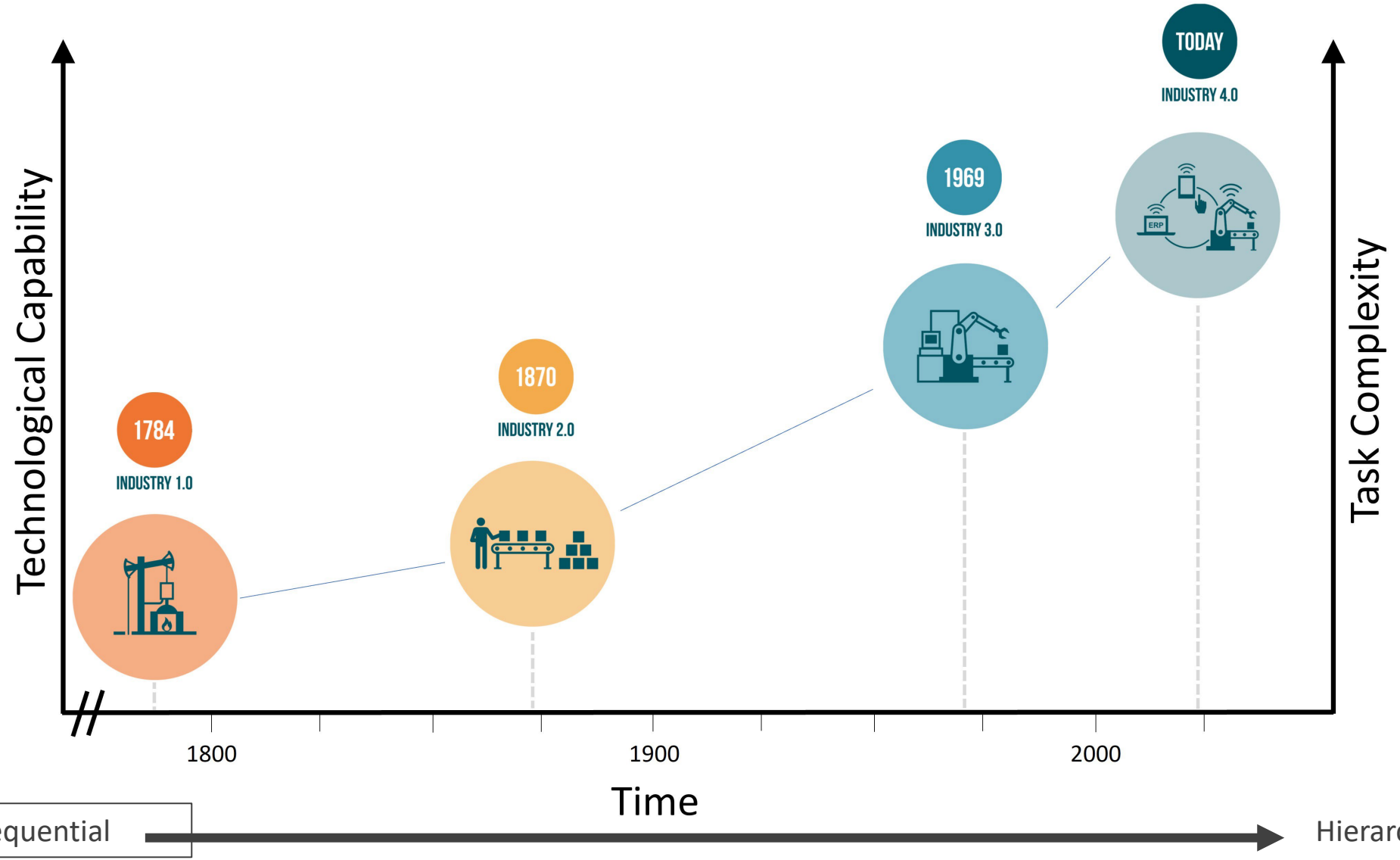
Rouse (1982) identified 11 process control functions.

- communicating
- coordinating tasks
- executing procedures
- maintaining
- planning
- problem solving
- recognizing
- recording
- regulating
- scanning, and
- steering

Higher level of abstraction than *Therbligs.*
Referred to as cognitive functions or tasks.

Source of image: CNSC, 2023-03-06

Evolving Types of Task Analysis



Hierarchical Task Analysis (HTA) - *Example*

- 0. Withdraw cash
  - 1. Check machine status
    - 1.1. Look at status indicator
    - 1.2. Look for card logo
  - 2. Insert bank card
  - 3. Enter PIN number
  - 4. Initiate withdrawl transaction
    - 4.1. Select withdrawl
    - 4.2. Input withdrawl amount
  - 5. Complete transaction
    - 5.1. Take cash
    - 5.2. Take card
    - 5.3. Take receipt

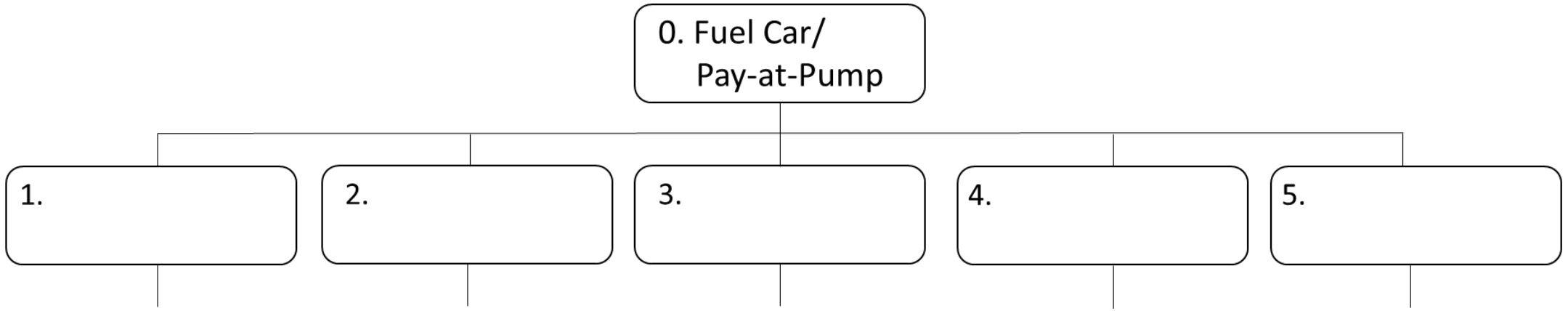
HTA – *Do it Yourself (DIY)*
10-minute activity

Goal

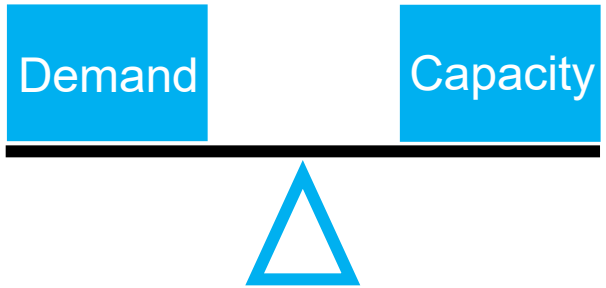
Sub-goal

Action/ Motion

Action/ Motion



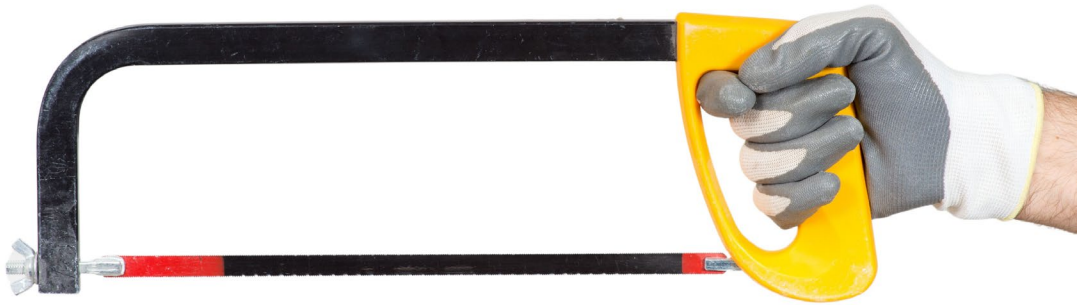
Demand vs. Capacity



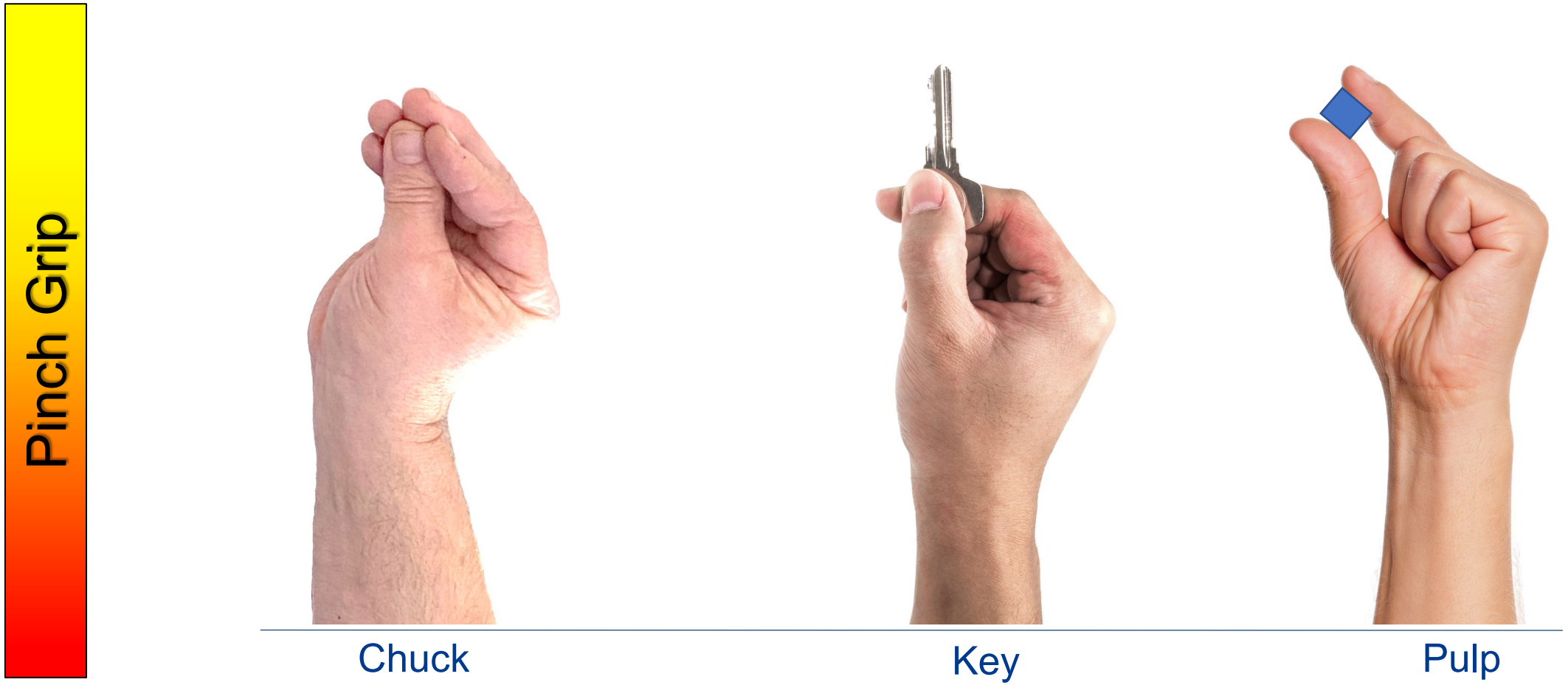
MSI Risk Level	Demand vs. Capacity
Low	Demand < Capacity
Moderate	Demand = Capacity
High	Demand > Capacity

Hand Intensive Task - *Gripping*

Power Grip



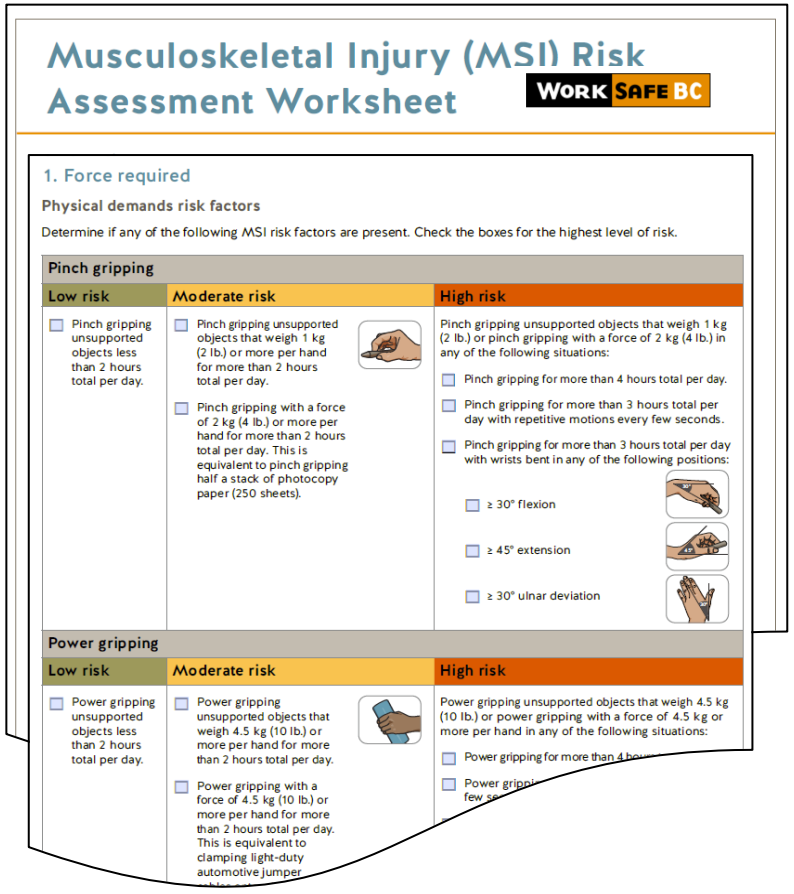
Hand Intensive Task – *Pinch Grip*



Force Requirements

Risk Assessment Tool for Hand Intensive Work

Risk Identification



Musculoskeletal Injury (MSI) Risk Assessment Worksheet

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1. Force required

Physical demands risk factors

Determine if any of the following MSI risk factors are present. Check the boxes for the highest level of risk.

Pinch gripping

Low risk	Moderate risk	High risk
☐ Pinch gripping unsupported objects less than 2 hours total per day.	☐ Pinch gripping unsupported objects that weigh 1 kg (2 lb.) or more per hand for more than 2 hours total per day. ☐ Pinch gripping with a force of 2 kg (4 lb.) or more per hand for more than 2 hours total per day. This is equivalent to pinch gripping half a stack of photocopy paper (250 sheets).	Pinch gripping unsupported objects that weigh 1 kg (2 lb.) or pinch gripping with a force of 2 kg (4 lb.) in any of the following situations: ☐ Pinch gripping for more than 4 hours total per day. ☐ Pinch gripping for more than 3 hours total per day with repetitive motions every few seconds. ☐ Pinch gripping for more than 3 hours total per day with wrists bent in any of the following positions: ☐ ≥ 30° flexion ☐ ≥ 45° extension ☐ ≥ 30° ulnar deviation

Power gripping

Low risk	Moderate risk	High risk
☐ Power gripping unsupported objects less than 2 hours total per day.	☐ Power gripping unsupported objects that weigh 4.5 kg (10 lb.) or more per hand for more than 2 hours total per day. ☐ Power gripping with a force of 4.5 kg (10 lb.) or more per hand for more than 2 hours total per day. This is equivalent to clamping light-duty automotive jumper	Power gripping unsupported objects that weigh 4.5 kg (10 lb.) or power gripping with a force of 4.5 kg or more per hand in any of the following situations: ☐ Power gripping for more than 4 hou ☐ Power grippi few se

Risk Assessment

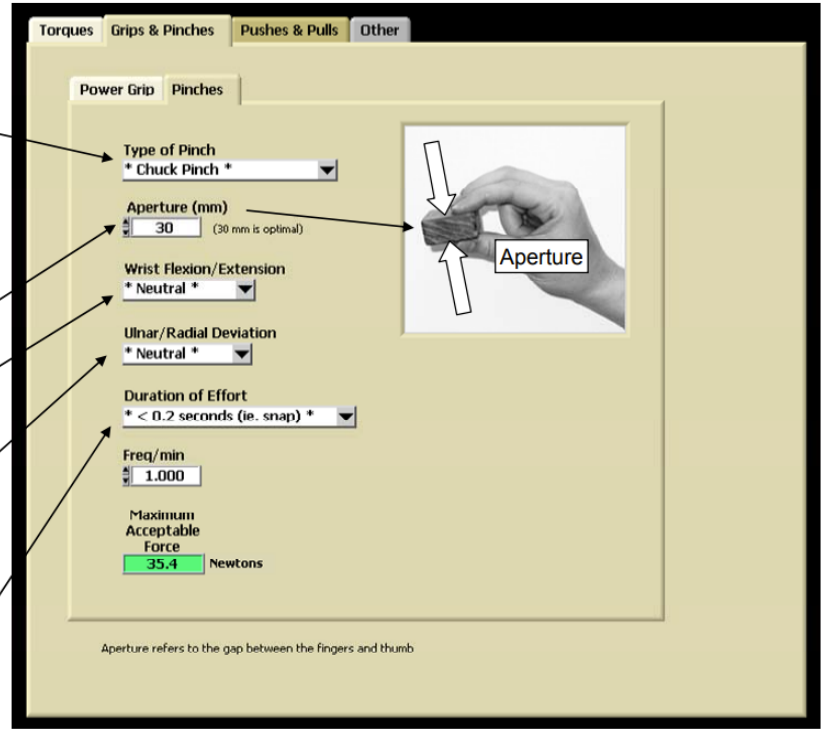
Type of Pinch Grip
- Chuck (Thumb vs Index & 2nd Finger)
- Lateral (Thumb vs Side of Index Finger)
- Tip (Thumb vs Index Finger Tip)
- Pulp Pinch - Thumb vs Pad of:
  - Index finger
  - Middle finger
  - Ring finger
  - Little finger
  - One Hand

Aperture (see photo)
- this is the distance between the fingers and the specific value can be entered (mm)

- Wrist Flexion or Extension
- Neutral
- Extended
- Flexed

- Ulnar or Radial Deviation
- Neutral
- Radial Deviation
- Ulnar Deviation

Duration of Effort
This indicates how long it took to perform the pinch effort
- less than 0.20 seconds or 200 ms
- between 0.2 and 0.6 seconds
- greater than 0.6 seconds or 600 ms



HANDPAK

Ergonomics Software

Force Requirements

Manual Material Handling

Lift

Lower

Two Person Lift

Carry

Push

Pull

Force Requirements

Manual Material Handling Assessment Tools

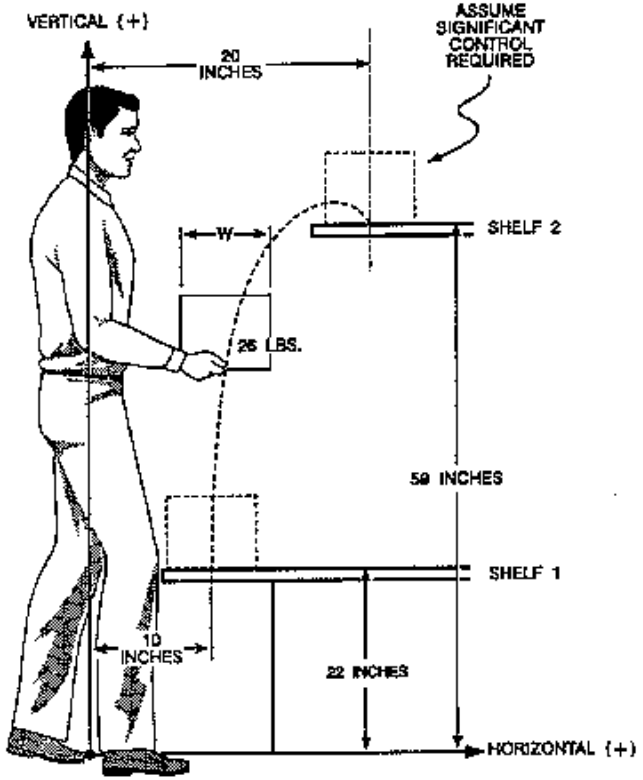
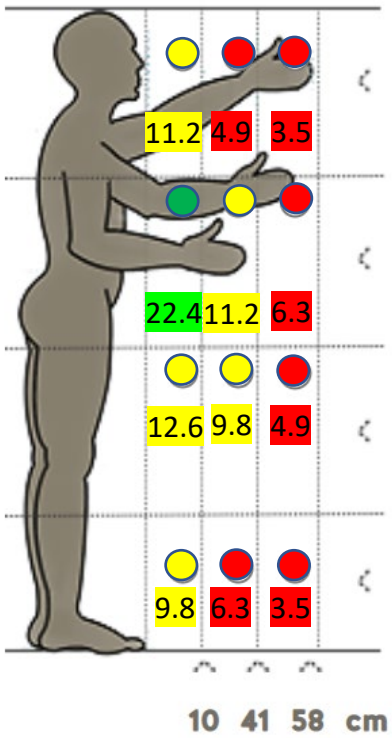
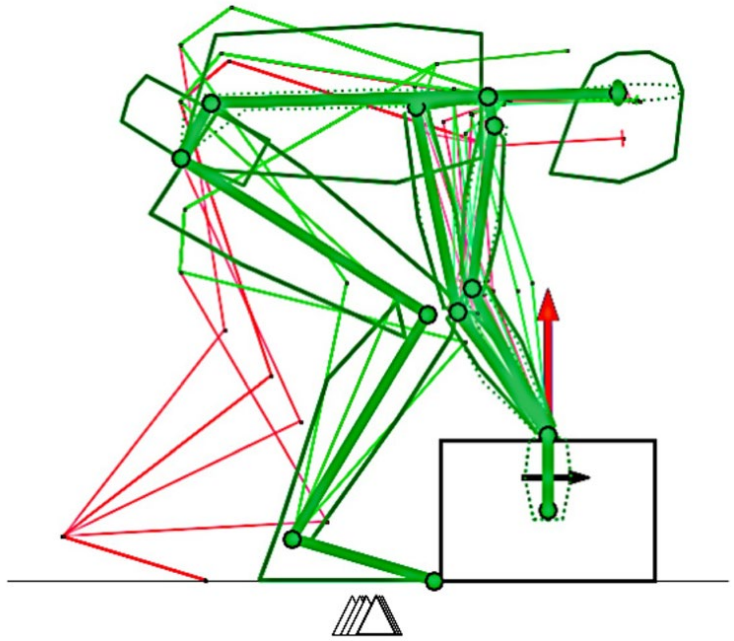


Figure 13 Package Inspection, Example 4

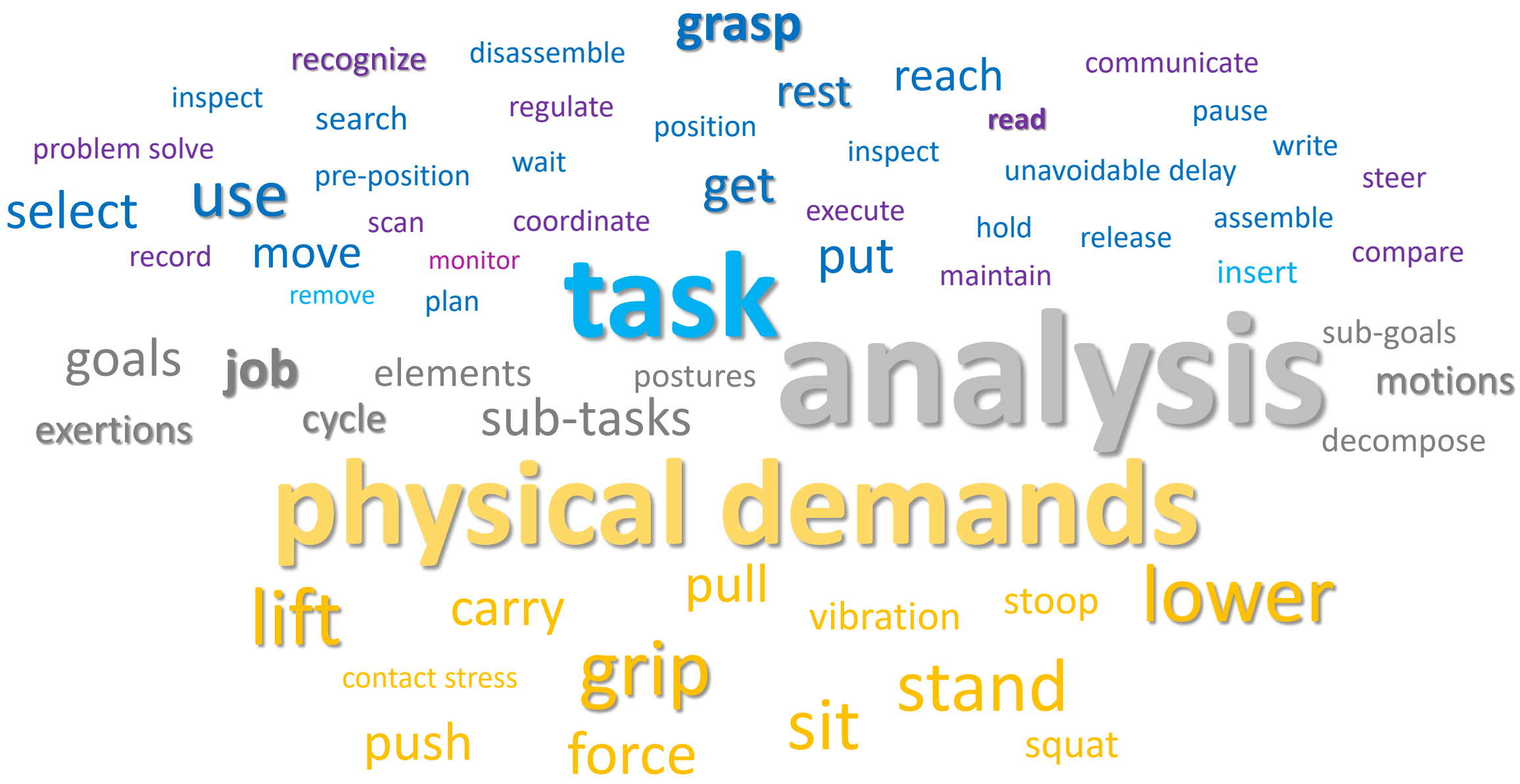
[NIOSH Lifting Equation, 1994]



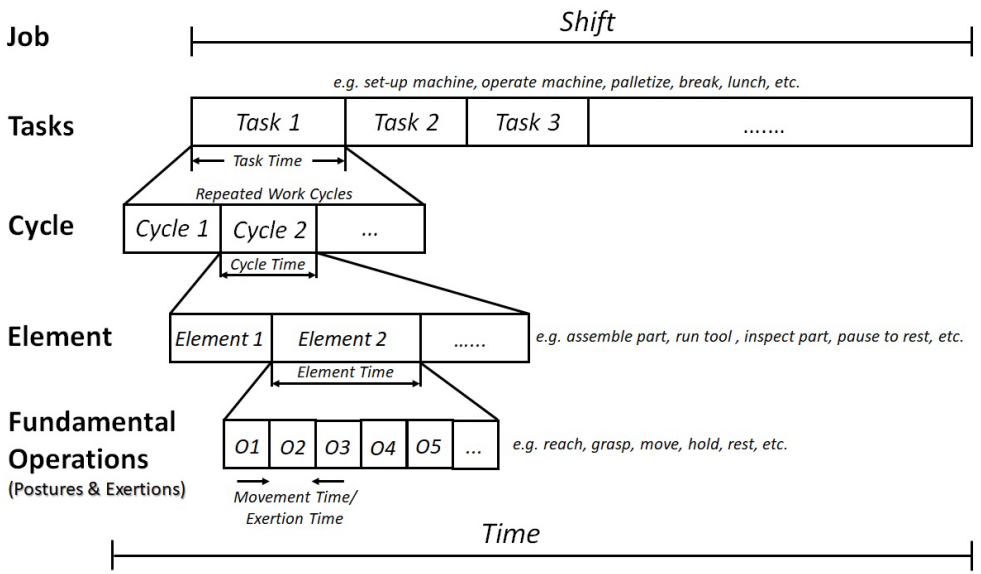
[WSBC Lift/Lower Calculator]

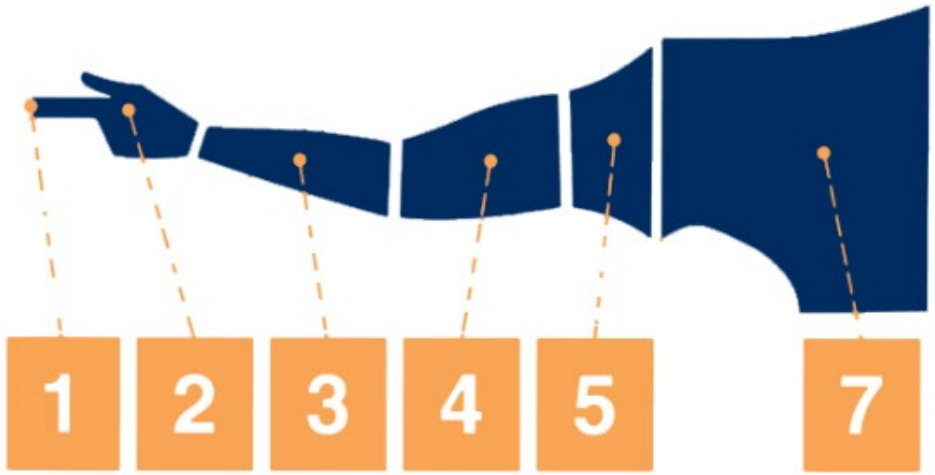


[Work(s) Ergo]


grasp
recognize
disassemble
rest
reach
communicate
inspect
search
regulate
position
read
pause
problem solve
wait
inspect
write
pre-position
unavoidable delay
steer
select
use
get
execute
assemble
scan
coordinate
hold
release
record
move
monitor
put
compare
maintain
insert
remove
plan
task
sub-goals
goals
job
elements
postures
analysis
motions
exertions
cycle
sub-tasks
decompose
physical demands
lift
carry
pull
vibration
stoop
lower
contact stress
grip
stand
sit
push
force
squat

Task Analysis – *Takeaways*





1. Depth of the task analysis should match the task complexity and the degree of risk identified in survey data, injury reports, observations, etc.

2. Physical actions with longer movement times (i.e., M5, M7) should be eliminated or minimized.

Q&A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THANK YOU
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