The role of the Ergonomist
The opportunities within Industry 4.0

Allison Stephens M.Sc, CPE, CCPE
The Role of the Ergonomist

The opportunities within Industry 4.0

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Prof Advanced Ergonomics Studies

Fanshawe College, London, Canada
Trailer to the Master Track
Ergonomics is the scientific discipline concerned with the interactions between humans and other elements of a system (environment, people and objects) with the goal of optimizing human well being and overall system performance.
https://www.youtube.com/watch?v=wbx8ios3vd4

Ford ergo lab
Traditional Ergonomics

- Analyse the operation on the plant floor.
- Operator input
- Apply analytical tools
New Side Airbag Analysis

Prototype Evaluation
Injury Driven Process

- Reacting to injury
- Operator concerns or discomfort
Ergo FTOV Rate for 3-Months After Re-Balance Compared to Prior Year

Edison Assembly: Trim & Chassis only

**REACTIVE**

$27\%$ Increase!

- **Jan-March 1997**
  - Ergo FTOVs per 200,000 Hours
  - 64.3

- **Aug 18, 1997**
  - Launch

- **Jan-March 1998**
  - 81.8

Ergo FTOV Rate for 3-Month Period Cases per 200,000hrs
Move from a Traditional Ergonomics Program

Business Case:
* Safety/Injuries
* Quality
* Cost
* Moral

Don’t have to justify each ergo fix with a cost benefit analysis.
Total Cost

TOTAL COST = 4 x Direct Cost

$26 Million is only the...

TIP of the ICEBERG

Direct Cost
Workers Compensation

Indirect Cost

Absenteism
Training Costs
Double Ups

Production Loss
Facility Changes

Total Cost is at least $104 M

U.S. Only
Safety

• Ergonomic Injury Rates *
  – 50% of Employees go to Medical
  – 2,146 lost time cases/year
  – 39,711 days away due to ergo injuries
  – 20,000 employees injured (FTOV) in 2000!

Equivalent to an ASSEMBLY PLANT being shutdown for 3 WEEKS!

* U.S. Assembly Plants
Weatherstrip Installation

Windnoise/water leak TGW's

269 TGW on 2000 Explorer
Morale

- Low Job Satisfaction
- Poor Quality of Life (Pain and Suffering)
- Absenteeism
- We continue to repeat known Ergonomic Issues
Move from a Traditional Ergonomics Program

WHY?

• More than injury costs
• Impact on
  * Safety
  * Quality
  * Cost
  * Moral
  * Productivity

HOW?

Virtual Manufacturing tools and new technology enable ergonomists to perform ergonomic assessments on the jobs of the future Before the injury!

The Future of Manufacturing 2000
Ergo FTOV Rate for 3-Months After Re-Balance Compared to Prior Year
Wayne Assembly: Trim & Chassis only

DESIGN + PROCESS + REACTIVE

46% Reduction!

Ergo FTOVs per 200,000 Hours

160
140
120
100
80
60
40
20
0
Dec 1998-Feb 1999
July 19, 1999 Launch
Dec 1999-Feb 2000

Major Launch

4 Month Re-Balance

65.6
Statistically Significantly Lower p<0.05

Source: HDA  Prepared by: Reeve & Stout, HCM Epidemiology 12/01/00
Ongoing implementation of Ergo process and virtual analysis tools

Number of Issues Raised

Design phase <finalize designs>

<PROTO TYPES>

Minor redesign

Build phase

Ergonomic Issues – Reduction Objective

Vision - Objective

Current Process
Proactive Ergonomics – upfront Engineering
# Motion Capture Studies - Leveraging Technology

<table>
<thead>
<tr>
<th>Hose</th>
<th>Hose Location</th>
<th>Program</th>
<th>Ergonomist</th>
<th>Insertion Target (lbs)</th>
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<td>2011 FA73</td>
<td>Ali Houston</td>
<td>25</td>
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</tbody>
</table>

![Image](image2.png)

![Image](image3.png)
Upfront involvement in Expedition launch

Michigan Truck
Ergonomic Lost Time Case Rate

89% Reduction

Ergo Visits per 200,000 Hours

Month

Jan-01  Mar-01  May-01  Jul-01  Sep-01  Nov-01  Jan-02  Mar-02  May-02  Jul-02  Sep-02
Injury Rates at an ALL TIME LOW

Proactive Ergonomics works.

Where do we go from here?
• How does the Ergonomist, the science of Ergonomics and Injury Prevention fit into Industry 4.0?
Quick Review: What is Industry 4.0

- **Late 18th Century**
  - **INDUSTRY 1.0**
    - Mechanization, steam power, weaving loom

- **1970’s-2000’s**
  - **INDUSTRY 2.0**
    - Mass production, assembly line, electrical energy

- **2010 Onwards**
  - **INDUSTRY 3.0**
    - Automation, computers and electronics
  - **INDUSTRY 4.0**
    - Cyber Physical Systems, internet of things, networks
Pillars of Industry 4.0

- Autonomous Robots
- Big Data
- Augmented Reality
- Additive Manufacturing
- Simulation
- System Integration
- Internet of Things
- Cloud Computing
- Cybersecurity

**FANSHAWE**
Disruptive Innovation

https://www.youtube.com/watch?v=Kxryv2XrnqM&t=683s
Disruptive Innovations in Transportation
Simulation

• Broadly defined as the simulation of physical assets and processes

The Big idea: The Digital Twin
A digital representation and dynamic software model of a physical object or system. The twin is constructed so that it can receive input from sensors gathering data from a real-world counterpart.

This allows the twin to simulate the physical object in real time, in the process offering insights into performance and potential problems.
The Ergonomist’s Role

Simulation

Currently large visionary companies only – That will change!

Opportunities

• Perfecting virtual assessments: better software, visuals and making it easier

• Opportunities
  • to expand applications i.e. assessments for maintenance and serviceability
  • More tools and deep knowledge needed

• Digital twin is the ideal platform to demonstrate human physical *and* cognitive limits
Ergonomic analysis

Maximal acceptable load for each hand is 27 N or 6 lbs.

Limiting Joint: Left Shoulder
Digital human models as part of the Engineering process
The advantage the IIoT refers to is that machines can operate semi-independently or with very minimal human intervention. Intelligently respond and even change their course of action based on the information received through the feedback loops established within the framework.
The Ergonomist’s Role

Industrial Internet of Things (IIoT) Opportunities

• Connecting the relevant data from HUMAN assets?
  • A need to collect and interpret accurate data quickly. Do you have the right tools?
• Integration of human data systems (ergonomic, medical, HR etc.) to a unified platform?
Additive Manufacturing

• Proactive

Hand Clearance Issue Identified

3D Printed Hand Clearance Model for P552 MCA

Rigid Nylon

NEW: Rigid & Flexible Parts
Robots and Cobots

Human interaction with a robot

https://www.youtube.com/watch?v=ghmmYQIFNbo

https://www.youtube.com/watch?v=WHWcilixNK2c&t=23s
Ergonomists Role

Opportunities

- Prevailing belief that robots are here to replace human workers but this doesn’t have to be the case
- Leadership is interested… but don’t have ideas on where a cobot would be useful and when a HUMAN is needed
- Workers have difficulty collaborating for psychosocial reasons
- Safety Standards needed.
Human factor specialists will be defining the role between the worker and the robot.
Exoskeleton - strength augmentation

https://www.youtube.com/watch?v=ZshA7Q37iws
What new ergonomic risks are there?
Ergonomists role

Understanding of Human response
Understanding of interactions
Studying the evolution of autonomous vehicles and human acceptance
Ethical decisions

(https://www.youtube.com/watch?v=nBfeyx6wNVg)
Augmented and Virtual Reality

- **Virtual reality (VR):** technology that immerses users in a fully artificial digital environment.
- **Augmented reality (AR):** technology that overlays virtual objects on the real-world environment.

How it’s being used now:
- Sales, displaying new equipment/products
- Training of employees
- Error proofing assemblies or kitting tasks
- Remote assistance for service workers
Ergonomists’ Role

Opportunities
• Maintenance & service teams
  • Choosing the technology that is the easiest to use
  • Assistance should include safe work practices
• AR for assembly workers
  • Aid in complex and variable work
  • Transforming monotonous work into a motivational and enjoyable experience
  • Pick and kitting stations
  • Error proofing
• Early Assessment of ergonomic risk
  • Are our tools ready?
  • Postural Assessments
  • Community needs to be thinking critically about how we use new data
Ergonomics is part of everything you do

Since the world is constantly evolving there will always be Ergonomic challenges. There will be new Technology.
Industry 4.0

To build the Assembly lines of the future
Ergonomists

• Be a Leader
• Be a Facilitator
• Be a Champion
• Be a Critical thinker
• Be an Innovator
• Be a life long learner