The Role of Ergonomics in Design

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Disclosures

- **Positions**
  - President Elect – Human Factors and Ergonomics Society
  - Deputy Editor – *Spine*
  - Principal - Biodynamics Solutions, LLC

- **Non-government funding**
  - Ford
  - Toyota
  - Focal Upright
  - Faurecia
  - Steelcase
What are the Challenges to Ergonomics?
Challenges For Ergonomics # 1

- Limited public recognition by main stream corporations
- Limited awareness of the ergonomics value proposition
Challenges For Ergonomics #2

- Limited scope, sub-optimal solutions
Challenges For Ergonomics #3

- Very small field
- Often incorporated in other fields

100,000,000 managers
50,000,000 engineers
15,000,000 M.D.s
500,000 psychologists
25,000 ergonomists (3 per 1 million people)
Challenges For Ergonomics #4

Diversity of views, topics, and quality
What is Ergonomics?
What Is Human Factors/ Ergonomics (HFE)?

Ergonomics defined by the IEA (2000)

“Ergonomics (& human factors) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design in order to optimize human well-being and overall system performance.”
What Is (High-Quality) HFE?

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- not only a multidisciplinary approach
- Is and **interdisciplinary** approach
What Is (High-Quality) HFE?

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- Work system
- product/service system
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- Work system design
- Product/service system design
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- balancing both, which may require trade-off decisions
Objectives of Ergonomics Design

Performance  Well Being
What Is High-Quality HFE?

Core Characteristics:

- Systems approach
- Design-driven
- Dual outcomes: well-being and performance
What Is High-quality HFE?

Systems approach:

- Interacting components
- Human with different capacities and aspirations: physical, psychological, emotional, social, etc.
- Environment with different aspects: other humans, technical, organizational
Systems Approach

(Marras and Hancock, 2013)
Systems Approach
Systems Approach
Systems Approach
Systems Approach

- Designed in USA
- Made in China
- Customer service in Europe

The Ohio State University Biodynamics Laboratories
Systems Approach: Consider the Context

Performance

Well Being

CONTEXT
Decision Making and Risk Exposure Interpretation

LIFELONG SMOKERS HAVE A ONE-IN-TWO CHANCE OF DYING FROM SMOKING-RELATED DISEASE.

IT'LL NEVER HAPPEN TO ME.

THE ODDS OF WINNING THE POWERBALL LOTTERY ARE 80 MILLION TO ONE.

THIS COULD BE MY LUCKY DAY!
What Is High-Quality HFE?

Design driven:

- Recommendations for, or actions applied to the (human-made/designed) environment
- Human-centered focus
- Universal design considerations
- Specialist role or process role in design
systems design: accommodate the right factors
What Is High-Quality HFE?

Balanced dual outcomes:

- **Performance** (productivity, efficiency, effectiveness, quality, innovativeness, flexibility, (systems) safety and security, reliability, sustainability, etc.)

- **Well-being** (health and safety, satisfaction, pleasure, learning, personal development, etc.)
What Is High-Quality HFE?

HFE design
Fitting the environment to the human

Performance

Well-being
What Is High-Quality HFE?

System design

Performance

Well-being
Five Core Interconnected Dimensions of Well-being

- **Career Wellbeing**: How do you occupy your time?
- **Social Wellbeing**: Strong relationships and love
- **Financial Wellbeing**: Managing your economic life to reduce stress and increase security
- **Physical Wellbeing**: Good health and enough energy
- **Community Wellbeing**: Sense of engagement and involvement where you live

(Rath, T. and Harter, J., 2010)
Health Care Costs are Directly Related to the Number of Thriving Dimensions

(Annual Health-Related Cost to Employer (Disease Burden and Unhealthy Days))

- Total
- Age: 44 and younger
- Age: 45 and older

Number of Elements Thriving at Baseline (Time 1)

<table>
<thead>
<tr>
<th>Number of Thriving Elements</th>
<th>Total</th>
<th>Age: 44 and younger</th>
<th>Age: 45 and older</th>
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<tbody>
<tr>
<td>None</td>
<td>$9,370</td>
<td>$9,370</td>
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<tr>
<td>One</td>
<td>$7,457</td>
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<tr>
<td>Two</td>
<td>$6,361</td>
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<tr>
<td>Three</td>
<td>$5,387</td>
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<tr>
<td>Four</td>
<td>$4,570</td>
<td>$4,570</td>
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<tr>
<td>Five</td>
<td>$3,539</td>
<td>$3,539</td>
<td>$3,539</td>
</tr>
</tbody>
</table>

(Rath and Harter, 2010)
Turnover Costs: 35-52% Lower for Thriving Employees

(Rath and Harter, 2010)
What Is High-quality HFE?

The combination of three core characteristics is unique for HFE:

<table>
<thead>
<tr>
<th></th>
<th>HFE</th>
<th>Engineering</th>
<th>Medicine</th>
<th>Psychology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems approach</td>
<td>YES</td>
<td>NO/YES</td>
<td>NO/YES</td>
<td>NO/YES</td>
</tr>
<tr>
<td>Design driven</td>
<td>YES</td>
<td>YES</td>
<td>NO/YES</td>
<td>NO/YES</td>
</tr>
<tr>
<td>Performance AND well-being</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO/YES</td>
</tr>
</tbody>
</table>

NO/YES = generally: NO, but for some specialized branches: YES
How Do We Expand our Influence?
Application of high-quality HFE

Demand for high-quality HFE

Awareness of need for high-quality HFE

Communicate with stakeholders
Build partnerships with stakeholders
Educate stakeholders

HFE community
- IEA
- HFE societies
- HFE individuals

Promote education of HFE specialists
Ensure high-quality standards of HFE
Promote HFE research excellence

Application of high-quality HFE
Conclusions

- Ergonomics is a very small field
- Challenges include recognition of value proposition
- Must push for high-quality approach to ergonomics through both supply (education) and demand
  - Systems approach
  - Design oriented
  - Balance productivity and well-being
A strategy for human factors/ergonomics: developing the discipline and profession

Jan Dul, Ralph Bruder, Peter Buckle, Pascale Carayon, Pierre Falzon, William S. Marras, John R. Wilson and Bas van der Doelen

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(Received 7 December 2011; final version received 22 January 2012)

Human factors/ergonomics (HFE) has great potential to contribute to the design of all kinds of systems with people (work systems, product/service systems), but faces challenges in the readiness of its market and in the supply of high-quality applications. HFE has a unique combination of three fundamental characteristics: (1) it takes a systems approach (2) it is design driven and (3) it focuses on two closely related outcomes: performance and well-being. In order to contribute to future system design, HFE must demonstrate its value more successfully to the main stakeholders of system design. HFE already has a strong value proposition (mainly well-being) and interactivity with the stakeholder group of ’system actors’ (employees and product/service users). However, the value proposition (mainly performance) and relationships with the stakeholder groups of ’system experts’ (experts from technical and social sciences involved in system design), and ’system decision makers’ (managers and other decision makers involved in system design, purchase, implementation and use), who have a strong power to influence system design, need to be developed. Therefore, the first main strategic direction is to strengthen the demand for high-quality HFE by increasing awareness among powerful stakeholders of the value of high-quality HFE by communicating with stakeholders, by building partnerships and by educating stakeholders. The second main strategic direction is to strengthen the application of high-quality HFE by promoting the education of HFE specialists, by ensuring high-quality standards of HFE applications and HFE specialists, and by promoting HFE research excellence at universities.
Thank You!

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A Two-Way Street: Mind controls the body and the body can influence the mind
Mind – Body Interactions

René Descartes
1596 - 1650
Pain

- Pain is not just about the tissues of the body
- Pain is a construct of the brain

(Lorimer Moseley)