# Connecting Human Factors to Corporate Strategies for Better Implementation

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## Linking Ergonomics and Corporate Strategy

Patrick Neumann
Jan Dul

**HAAMAHA2005**
**NES2005**
**IEA-2006**
**ACE2006**

RSM Erasmus University



## Session AIMS

**to help close the gap between corporate strategic development and the application of human factors for better organisational performance and better working life.**



## Workshop Structure

Open forum: Dialog-Roundtable

- Introductions
- A Conceptual Model is proposed
- Reaction, discussion, debate



## Key Questions

1. **How can firm strategies affect HF? (examples)**
2. **How can HF contribute to firm strategy? (examples)**
3. **How to integrate/apply ergonomics? (tactics)**
4. **What are the research priorities? (questions)**



## STRATEGY - A Primer

## STRATEGY is a slippery term

**Strategy as:**

1. Plan (*design, forward looking*)
2. Pattern (*emergent, development*)
3. Position (*market position*)
4. Pose (*"fake" position*)
5. Philosophy (*moral position*)

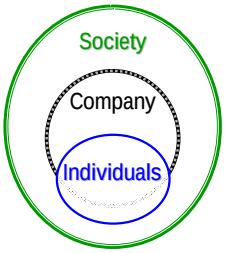
(Mintzberg)



## Strategy



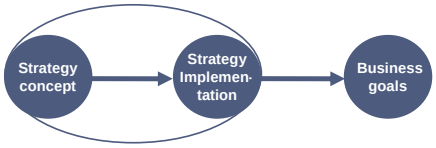

## Strategy




**Corporate strategy lies a the interface between the firm and its environment**



## Strategy process




From Dul & Neumann 2005 HAAMAHAA



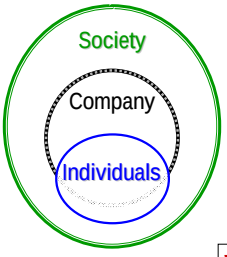
## Strategic arenas

1. Corporate strategies
   (e.g. cost leader)
2. Business function strategies
   (e.g. Production, HRM, logistics)
3. Cross-functional strategies
   (e.g. TQM, Lean Production)

Different:
- actors
- approaches
- performance criteria



## System Contexts




- **Globalization**
- **'Hyper-Competition'** (D'aveni 1994)
- **Consumer Power** (Klein)

**Where to intervene?**

## Social Factors

- Globalization of business competition
  - Speculation in Stocks (e-trading)
  - $ accountability down to 1/4erly
  - more power with investor
  - shift to 'sympathetic' locations
  - low wage low environments
- Reduced workforce
  - via automation
  - via outsourcing

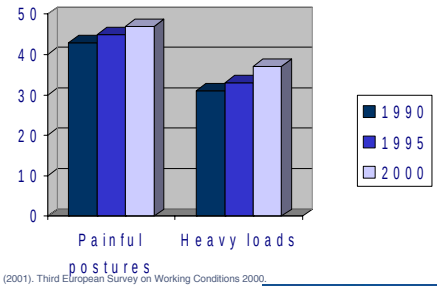


## Social Factors

- Increased self-employment
  - outsourcing related
- Increased part time work, Temp. workers
  - increased & reduced control
  - see outsourcing
- More small & medium sized businesses
  - less resources for ergonomics
  - shallower knowledge/talent pool
- Better (over?) educated workforce
  - north / south differences
  - shift from manual to tech work
    - (eg robot maintenance work)



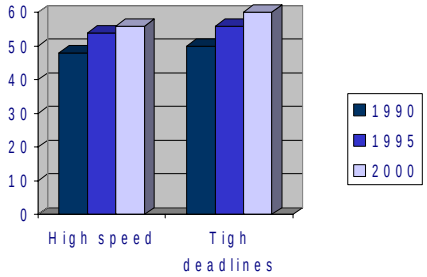
## Physical workload in Europe (1990-2000)




Paoli and Merllié (2001). Third European Survey on Working Conditions 2000. European Foundation for Improvement of Living and Working Conditions



## Stress in Europe (1990-2000)




Paoli and Merllié (2001).



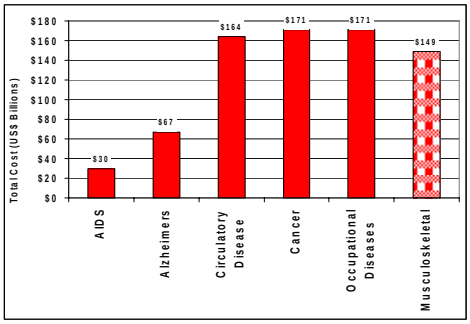
## The Problem of (with?) ERGONOMICS

## Scope of Problem

- Work Days Lost
  - 125 Mil. (USA)
  - 600 Mil. (EU) (ill health)
- 4% Gross World Product in ill health (WHO:ILO 1998)
  - ~40% Musculoskeletal Disorders

➢ 1.1 Million work-related DEATHS /year

## Occupational Health Costs (US 1992)




(Leigh & Markowitz 1997)



## Health Costs

TOTAL (indirect +direct) 1992 US Costs:

- AIDS = $30 B
- Alzheimers = $67 B
- Circulatory Disease = $164 B
- Cancer = $170.7 B
- **Occupational Disease = $171 B**
  - Musculoskeletal = $149 B

**(Leigh & Markowitz 1997)**



## Definition: ergonomics

**"Ergonomics (or human factors) is the scientific discipline concerned with understanding the interaction 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"**

(IEA 2000)



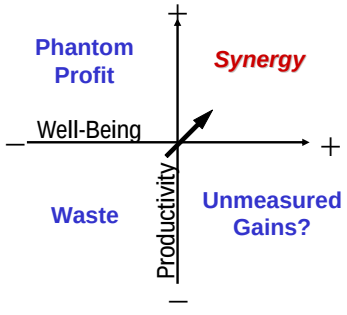
## ERGONOMICS is…

**a MEANS not an END**

**a TOOL not an GOAL**



## The Dual-Objective: win-win

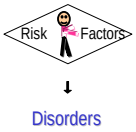



OK



## HF in DESIGN Perspective

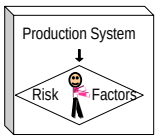
## Ergonomics Focus?




Disorders



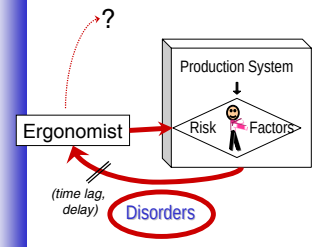
## Ergonomics Focus?




Disorders

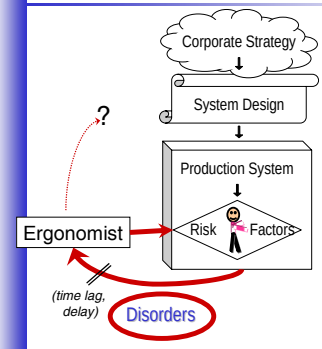


## Common Solution Approach



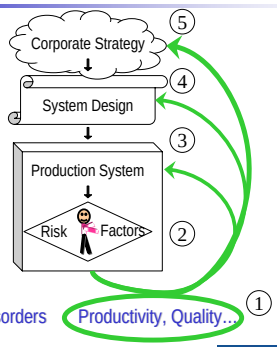



## Traditional Solution Approach






## System Feedback



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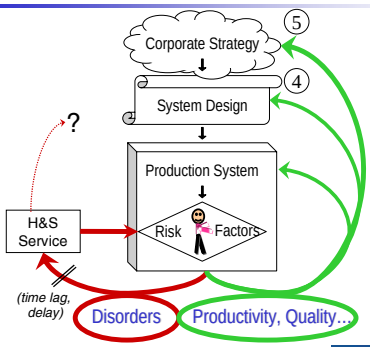
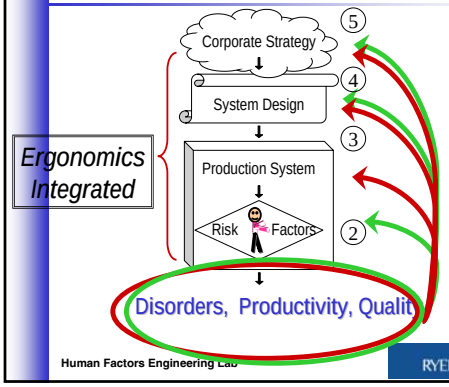
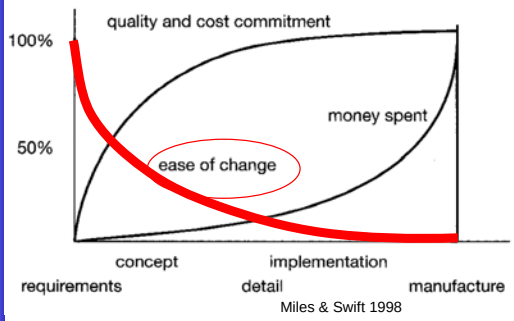


## Integrate Ergonomics into Concept Phase






## Influence in Design




Miles & Swift 1998



## Ergonomists have not enough influence

Perrow (1983):

- small number of ergonomists
- lack of control over budgets and people
- ergonomists are seen as protectors of workers

Perrow, C.(1983). The organizational context of human factors engineering. *Administrative Science Quarterly* 28 (4) 521-541



## Others don't see the importance of ergonomics

Hendrick (1996):

- ergonomists presume that others are convinced of the importance of ergonomics
- the benefits of ergonomics are not well documented
- too many examples of bad ergonomics

Hendrick, H.W. (1996) Good ergonomics is good economics. Proceedings of the Human Factors and Ergonomics Society 40th Annual Meeting, Santa Monica



## Ergonomics is Misunderstood

Helander (1999):

- First design, then consider ergonomics (3.7)
- Ergonomics is about chairs (3.1)
- Ergonomics is common sense (3.1)
- Ergonomics experiments take took long (3.1)
- Ergonomics is too abstract (2.7)
- Ergononics information not useful (2.6)
- People can adapt to systems (2.6)

1= never, 2= seldom, 3= sometimes, 4= regularly, 5= always

Helander, M.G. (1999). Seven common reasons not to implement ergonomics. *International Journal of Industrial Ergonomics* 25, 97-101
Breedveld (2005). The position of European Ergonomists in European Organizations. Master thesis, RSM Erasmus University



## CORPORATE STRATEGY

## Management recognizes the importance of people

- "Our most important asset" (Annual reports)
- "Success Factor People in Distribution Centres" (Eur. Logistics Association, 2004)
- "We shouldn't forget it's about people" (vice CEO, Unilever, 2004)



## People are important….

**Resource Based View of the firm (RBV)**



## Management finds it difficult to manage people

"We hired a worker, but a human being came instead"



## People are not important in most management-models

- People are not a major factor
- People are deterministic and predictable
- People are independent of other people
- People are stationary
- People are emotionless

Bourdreau et.al (2003). On the interface between Operations and Human Resource Management *Manufacturing & Service Operations Management* 5(3), 179-202, 2003

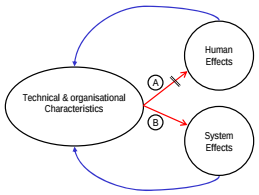


## Manufacturing Strategies…

| | | |
|---|---|---|
| 1. | TQM | Total quality management |
| 2. | JIT | Jut in time production |
| 3. | MC | Manufacturing cells |
| 4. | ICBT | Integrated computer based technology |
| 5. | CE | Concurrent engineering |
| 6. | TPM | Total productive maintenance |
| 7. | TBW | Team-based working |
| 8. | EMP | Empowerment |
| 9. | LC | learning culture |
| 10 | OS | Outsourcing |
| 11 | SCP | Supply-chain partnering |
| 12. | BPR | Business process reengineering |



## Human Factors Engineering…




**…embedding human factors into engineering design for improved performance and human well-being**

# Corporate Strategy

# stratégie d'entreprise



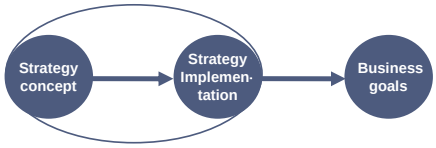
## Corporate strategies: theory

**Porter**

**- differentiation strategy**
**- cost strategy**



## Strategy process




From Dul & Neumann 2005 HAAMAHAA



## STRATEGY – Different forms

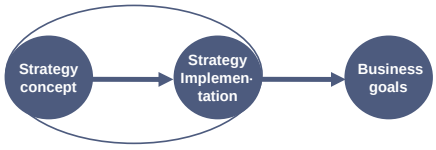
**Strategy as:**

1. Plan (*design, forward looking*)
2. Pattern (*emergent, development*)
3. Position (*market position*)
4. Pose (*"fake" position, ruse*)
5. Philosophy (*moral position*)

- Mintzberg



## Strategy process

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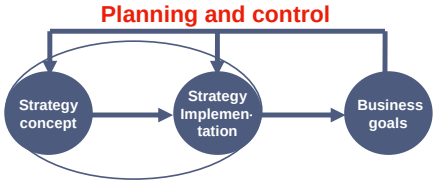
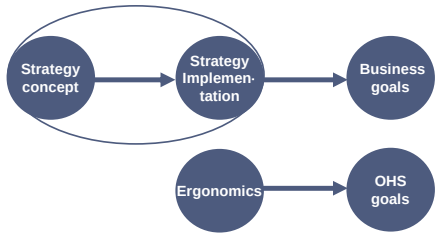



**Planning and control cycles**
**(business plan, targets, evaluation, incentives, …)**

## Ergonomics' current Position

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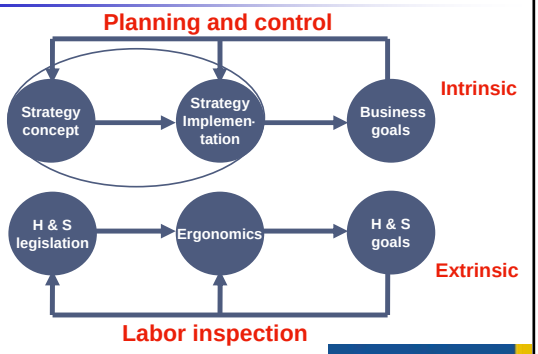
"Health & Safety Side-Car"

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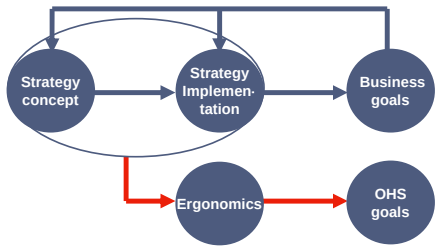
## 'Dream ergonomics'

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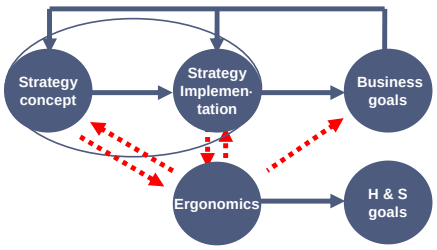
## Step 1: building relationships




"Health & Safety Side-Car"?

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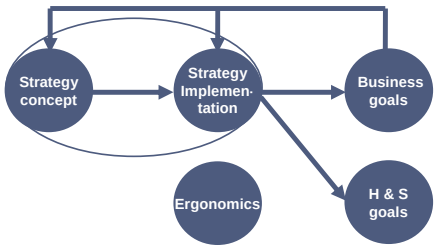
## Relationships?

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## Integration of ergonomics


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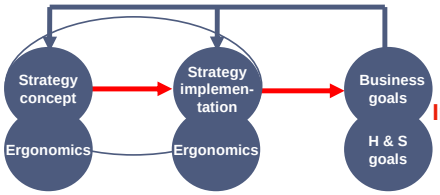
## Step 2: Embedding




Intrinsic

Ergonomics:
- Not a sideline based on OHS legislation
- Not in itself a strategy
- But an important feature of strategy…
  that help managers reach their goals



## Business goals are not always financial

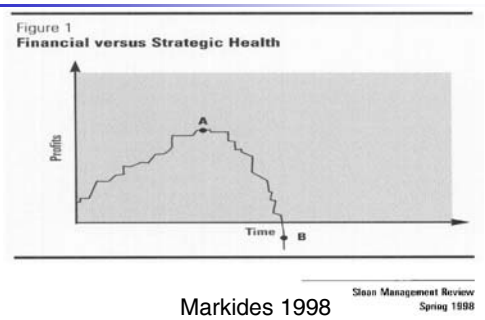
Management decision making is NOT rational!

Intermediate business goals | Ultimate business goal

Ergonomics Programme → Believed profit drivers → Profit

Quality
Productivity
Flexibility
Innovativeness
Customer satisfaction
Worker satisfaction
Worker motivation
etc.






Markides 1998



## LEGISLATION



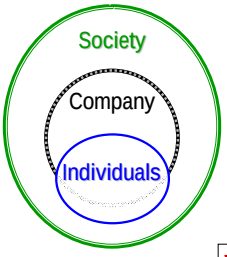
## How to stimulate ergonomics?

**Via OHS legislation?**

**(like OSHA "ergonomics rule', or European directives)**



## System Contexts




- **Globalization**
- **'Hyper-Competition'** (D'aveni 1994)
- **Consumer Power** (Klein)

**Where to intervene?**

## Social Trends

- More women in the workforce
- Older workforce
- Sensitivity to rights of disabled
- More legislation (enforcement?)
- Increased attention to values



## OHS legislation

'command-control'



## OHS legislation in Europe (4 Directives)

1. *Safety of machinery (1998)*
   - Minimum health and safety requirements
   - Exposure limits in CEN standards
   - Economic: internal market
2. *Use of work equipment (1989)*
3. *Manual Handling (1990)*
4. *Work with display screen equipment (1990)*
   - Optimal health and safety
   - No reference to CEN standards
   - Social: protection of workers



## New approaches for OHS legislation (1)

From: 'command-control'
To: 'self regulation'

"If people can agree about something, then they are more likely to actually do it then when it is imposed on them"




## How to stimulate ergonomics in business?

**Not:**

- Relying on command/control legislation

(business does not like this)

**But:**

- showing the business interest of ergonomics

(business will like this)



## LEAN STRATEGIES

## The Birth of Lean

- Smith (1776) – *The Wealth of nations*
- Taylor (1911) – *Scientific management*
- **FORD** (1920's)
- Demming (1950) – *Continuous Improvement*
- **TOYOTA** (1970 +)
- Womack (1994) – *Lean Production*



## Toyota Production System

1. Base your management decisions on a long-term philosophy (sacrifice short-term goals)
2. Create Continuous process flow to bring problems to the surface.
3. Use "pull" systems to avoid overproduction.
4. Level out the workload
5. Build a culture of stopping to fix problems, to get quality right the firs time.
6. Standardized tasks for continuous improvement and employee empowerment.
7. Use visual control so no problems are hidden.
8. Use only reliable, thoroughly tested technology that serves your people and processes.
9. Grow leaders who understand the work, live the philosophy and teach it to others.
10. Develop exceptional people and teams who follow your company's philosophy.
11. Respect your extended network of partners and suppliers by challenging them and helping them improve.
12. Go and see for your self to thoroughly understand the situation.
13. Make decisions slowly by consensus thoroughly considering all options.
14. Become a learning organization through relentless reflection and continuous improvement.

(Liker 2004):



## 5 Lean elements

(1) the devolution of responsibilities to front-line workers;
(2) their organization in work teams;
(3) employee involvement in continuous improvement;
(4) the use of visual factory controls; and
(5) the use of just-in-time to eliminate in-process buffers and eliminate waste.



## The Lean Chimera

- Lean vs Fat? (no alternatives)
- Lean as the end of history? (Berggren 1993)
- There is no perfect 'Lean'
  - Many production forms in may different contexts (Boyer & Freyssenet 2002)
- IMVP as flawed analysis: "The legend of lean production and the reality of Japan" (williams et al 1992)
- Toyota's real advantage – the product?



## 3. Level out workload

- **Eliminate waste**
  - Overproduction
  - Waiting
  - Unnecessary transports
  - Overprocessing
  - Excess inventory
  - Unnecessary movements
  - Defects
  - Unused employee creativity



## Toyota Production System

- ***Heijunka –Work like the tortoise not like the hare.***

(Source Mr. Cho President Toyota, from the Toyota Way Document 2001)

"Eliminating waste is just one third of the equation of making production successful. Eliminating overburden to people and equipment is just as important – yet (this is) generally misunderstood by companies attempting to implement TPS principles."

## Lean Problems

"Employees in all lean production groups were negatively affected, but those in assembly lines fared the worst, with reduced organizational commitment and role breadth self-efficacy and increased job depression. "

- Parker 2003 (A longitudinal study)



## Lean Problems

introduction of JIT led to a reduction in control over work timing, an increase in production pressure, and a drop in job satisfaction

- Jackson & Martin 1996



## Lean Risks

- After implementation of a Lean initiative in a Fortune 10 company, without concern for the ergonomic elements of the workplace improvements, lost time incidents tripled between 1996 and 1997.



## Lean Risks

- Anorexia
  - Lean but weak
  - Loss of responsiveness
- Lean-Fragile
  - Vulnerable to disturbance
  - Whiplash losses effect
- Lean & Mean



## Ergonomics & Design

***ergonomie et conception***



## Arenas of Design

- **Product Design**
  - Defines Assembly Task
  - Defines Market Position
- **Production System Design**
  - Technology
  - Work Organisation
- **Organisational Design**
  - Structure, Strategy, & Processes
  - Accountability, Rewards, Culture

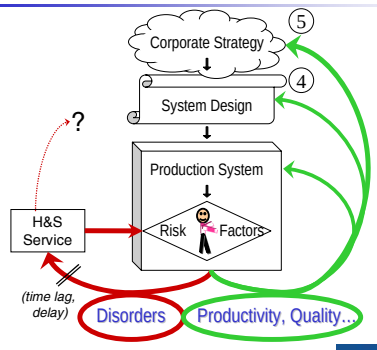
## Time Control

- (post) Taylorist rationalization strategies
- Removal of NVA time is 1 strategy
- Increase work time, reduced recovery time
- Sustained low level loading leads to tissue damage starting a sub-cell level
- "Ergonomic Pitfall" – fix peaks leave motor unit monotony
- 1st world affected first? (higher wages->more pressure)
- Dentist story



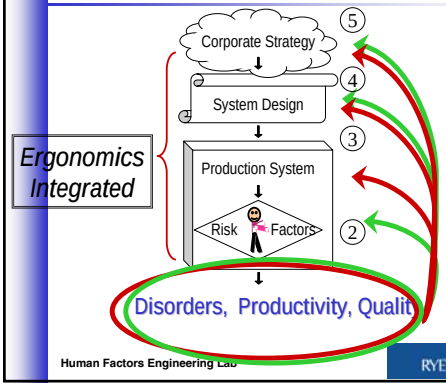
## VOLVO POWERTRAIN EXAMPLE

## System Feedback






## Integrate Ergonomics into Concept Phase






## Volvo Powertrain

**OLD**

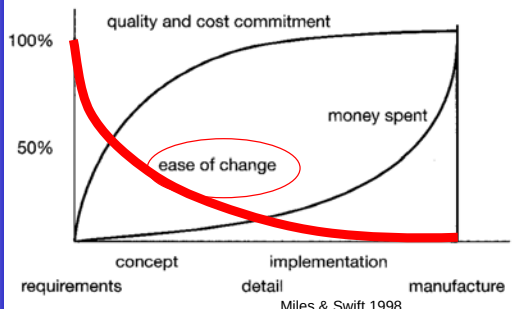
**'CELL' Station**

**NEW**

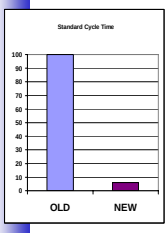
**'LINE' System**

Neumann et al. (in press) IJOPM

## Influence in Design




Miles & Swift 1998




**NEW Cycle Time is 6% of OLD**

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## Business function strategy:

## Production strategy

new vs. old:

- Social support + 25%
- (very) short cycles - 93%
- Influence over work - 10%

- Production volume + 12%
- Total cost/motor + 32%

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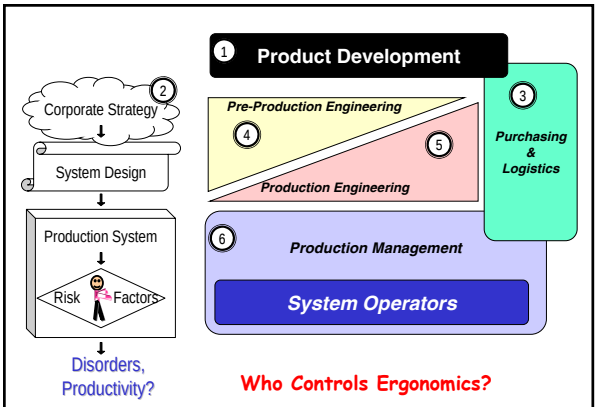
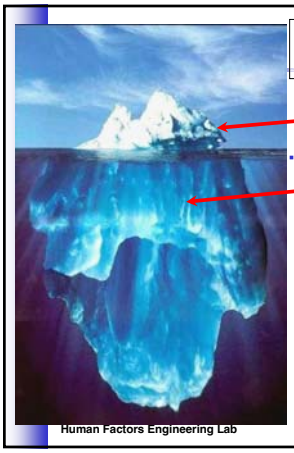
Ergonomics and effective production systems
– moving from reactive to proactive development

**Booklet available free on request or for download from: www.niwl.se**




# EXAMPLES



Modéle de l'isberg :

- **Problème de Santé**

- Productivity
- Lead Time
- Delivery Precision
- Quality
- Flexibility
- more…

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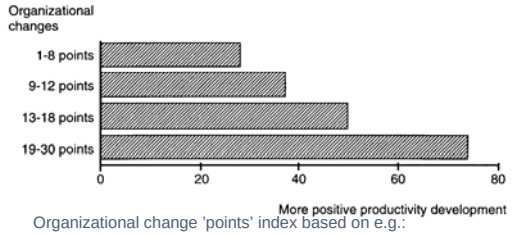
## Productivity improvement in general
## Analysis of 1,139 projects




Organizational change 'points' index based on e.g.:
- Job rotation
- Operator participation in development

Gustavsen, B., Ekman Philips, M., Wikman, A. and Hofmaier, B. (1996) *Concept-driven development and the organization of the process of change: an evaluation of the Swedish working life fund*, Benjamins, Amsterdam. 96-272-1773-4.



## Cost Benefit of IBM Improvements

- Payback about 1 week
- Productivity >> health



## T 2.2 IBM Improvements & Cost Reductions

| | Improvement (%) | | Cost Reduction ($) | |
|---|---|---|---|---|
| | Projected | Actual | Projected | Actual |
| Yield improvement | 20 | 18 | 2,268,800 | 2,094,000 |
| Operator productivity | 25 | 23 | 5,647,500 | 5,213,000 |
| Injury reduction | 20 | 19 | 73,400 | 68,000 |
| Total | | | 7,989,700 | 7,375,000 |

- **Payback about 1 week**
- **Productivity >> health**

Helander 2006



TEST RESULTS SUMMARY: GROUND

GROUND, FAULT T-G
3 TERMINAL DC RESISTANCE
> 3500.00 K OHMS T-R
= 14.21 K OHMS T-G
> 3500.00 K OHMS R-G
3 TERMINAL DC VOLTAGE
= 0.00 VOLTS T-G
= 0.00 VOLTS R-G
VALID AC SIGNATURE
3 TERMINAL AC RESISTANCE
= 8.82 K OHMS T-R
= 14.17 K OHMS T-G
= 628.52 K OHMS R-G
LOGITUDINAL BALANCE POOR
= 39 DB
COULD NOT COUNT RINGERS DUE TO LOW RESISTANCE
VALID LINE CKT CONFIGURATION
CAN DRAW AND BREAK DIAL TONE

******************************
* *
* TIP GROUND 14 K *
* *
******************************

| DC RESISTANCE | DC VOLTAGE | AC SIGNATURE |
|---|---|---|
| 3500 K T-R | | 9 K T-R |
| 14 K T-G | 0 V T-G | 14 K T-G |
| 3500 K R-G | 0 V R-G | 629 K R-G |
| BALANCE | | CENTRAL OFFICE |
| 39 DB | | VALID LINE CKT DIAL TONE OK |

- Recognition time decreased from 8.3 s to 5 s with new layout. (40 improvement %)

Helander 2006



## Examples: linking ergonomics to strategies

**Corporate strategies:**
- differentiation strategy
- cost strategy

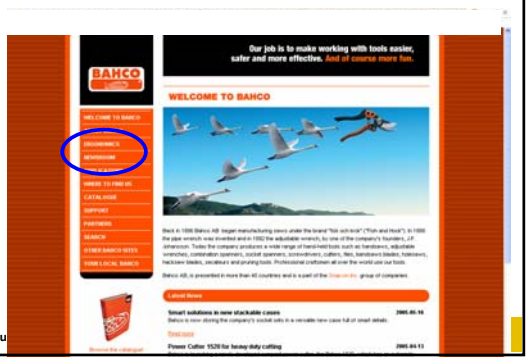
**Business function strategies:**
- Product strategy: Design for Assembly/Manufacturing
- Production strategy: parallel-serial
- HRM strategy: High Perfomance Work Systems
- Marketing strategy: reputation

**Cross-functional strategies:**
- Service Profit Chain
- TQM

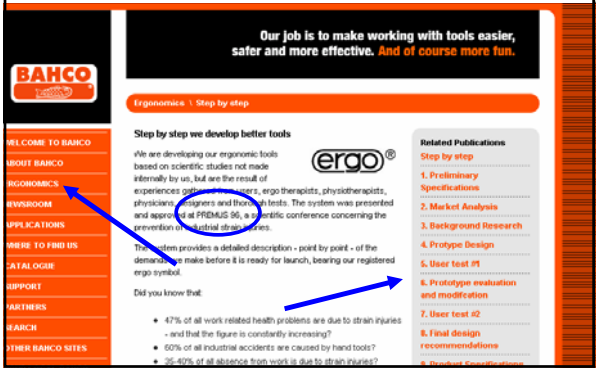


## Corporate strategy:
## Differentiation strategy

Better market position with 'ergo-tools'



## Corporate strategy:
## Differentiation strategy




## Corporate strategy:
## Differentiation strategy

- "improvement of market position by introduction of ergonomic products" (Annual report 2001, Snap-On)
- "ergonomic innovative competence is a competitive advantage" (Annual report 2002)
- "growing attention to ergonomics is a growth driver" (Annual report 2003)
- corporate value: "Our tools are designed with exceptional ergonomics" (Annual report 2004)
- distinctive competency: "demonstated innovation in ergonomics and efficiency" (Annual report 2005)

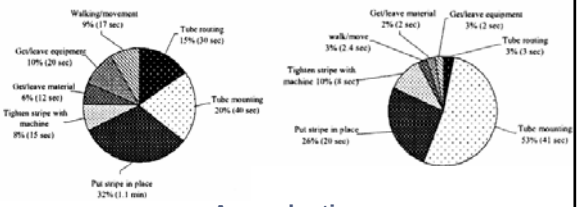


## Business function strategy:
## Product design and engineering
### Design for Assembly/ Manufacturing

**Improved posture**
(better access, less visual obstacles)

Sundin et al. (2004).

## Business function strategy:
### Design for Assembly/ Manufacturing




**Assemby time**

**Old (3.3 min.)** **New (1.3 min.)**

Sundin et al. (2004).

## HOW TO ACT?

## Roles for the Ergonomist

1. EXPERT
2. PROCESS Consultant
3. Project Manager
4. Other?

## Ergonomist as a "political reflective navigator"

- Broberg & Hermund 2004

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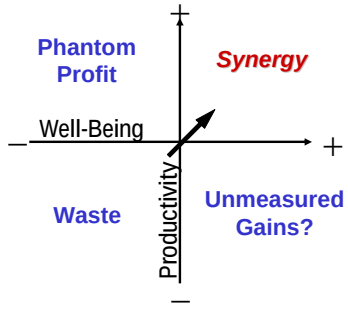
## The Dual-Objective: win-win

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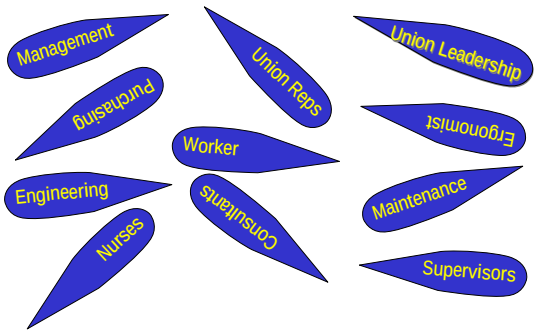
## Actor Networks in Ergonomics




*Neumann et al. (ACE - 1999) Roles and Relationships…*

## Organisational Goals & Ergonomics

- Company support will depend on alignment with existing goals:
  - Quality
  - Health & Safety
  - Production efficiency
  - Early Return to Work
  - Continuous Improvement
  - Adaptability
  - Internal Power and political objectives
  - Fiscal Responsibility

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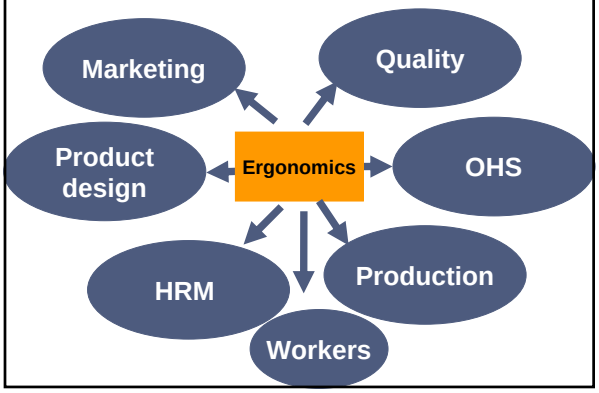
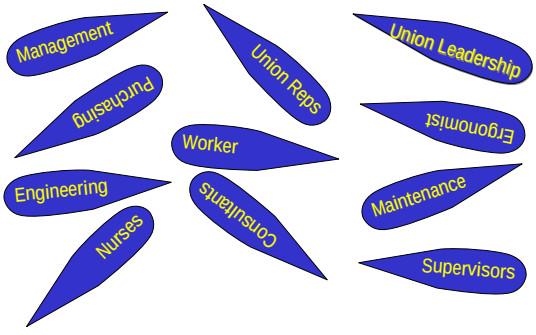
## Involve stakeholders

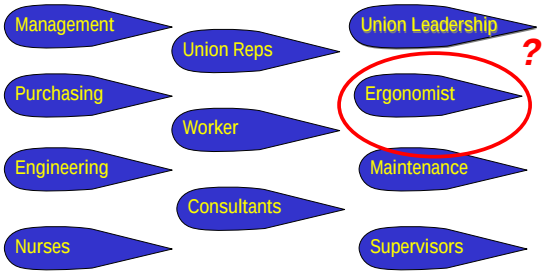



## Roles / Goals in Ergonomics




*Neumann et al. (ACE - 1999) Roles and Relationships…*

## Roles in Ergonomics




*Neumann et al. (ACE - 1999) Roles and Relationships…*

## Link ergonomics to business strategies and goals

- reading annual reports
- speaking to senior management
- reading management literature
- visiting non-ergonomics conferences
- co-operating with non-ergonomics professionals
- net-work



## Cooperate with others

1 = no .... 5 = very intensive co-operation

- engineer (3.8)
- safety expert (3.5)
- designer (3.3)
- professor (3.0)
- occupational physician (2.7)
- computer expert (2.7)
- organisational specialist (2.6)
- occupational psychologist (2.5)
- quality expert (2.4)
- environmental specialist (2.4)
- occupational hygienist (2.7)
- occuptional heath nurse (2.2)
- physiotherapist (2.2)
- occupational therapist (1.7)

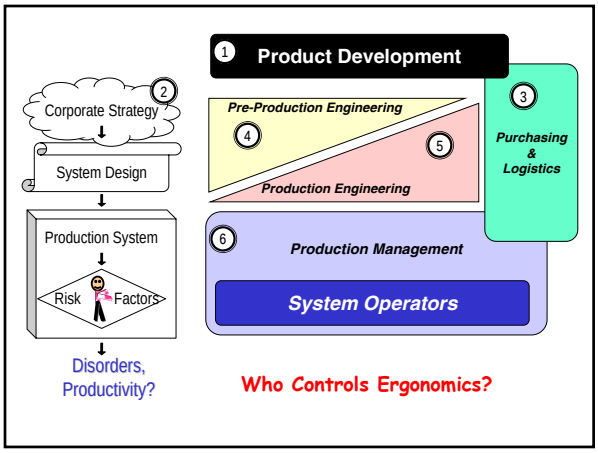
Breedveld (2005). The position of European Ergonomists in European Organizations

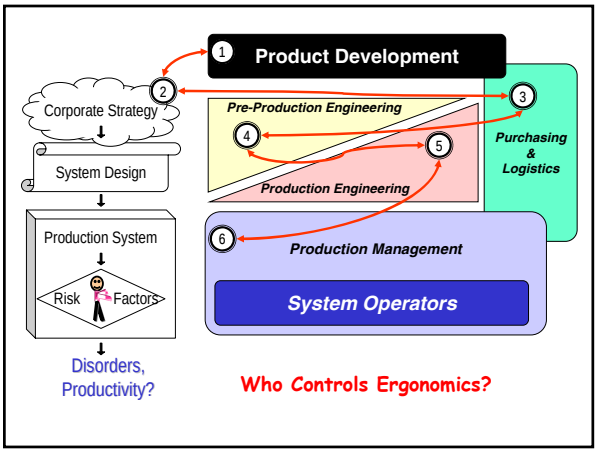


## How to sell worker participation?

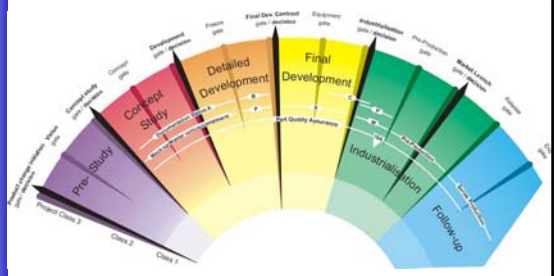
**"A worker knows more and is much cheaper than a consultant"**





## Tactic 2: Volvo Global Development Process





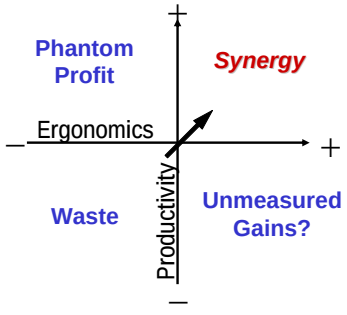

## Volvo chief ergonomist:

**"The ergonomics work is not a separate entity, but is based on the strategy. It was much easier to get the managers and other employees to understand, realize, accept and become involved in ergonomics work when they saw the link with the (….) strategy"**

Munck-Ulfsfält, U., A. Falck, A. Forsberg, C. Dahlin, and A. Eriksson, Corporate ergonomics program at Volvo Car Corporation. Applied Ergonomics, 2003. 34: p. 17-22.



## Navigational Objective

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## Conclusions

- Ergonomics can contribute to strategic goals – but it must be a deliberate tactic
- Most people see ergonomics as only a health issue... … but it is also a question of **performance**
- Attend to Ergonomics (Intervention) EARLY in design (conception) phases

Have we been TOO successful in selling ergonomics as a way to improve health?

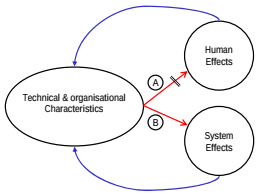


## Key Questions

1. **How can firm strategies affect ergonomics? (examples)**
2. **How can ergo contribute to firm strategy? (examples)**
3. **How to integrate/apply ergonomics? (tactics)**
4. **What are the research priorities? (questions)**



## Human Factors Engineering…




**…embedding human factors into engineering design for improved performance and human well-being**