



The Role of Automation & Control in Manufacturing Energy Reduction

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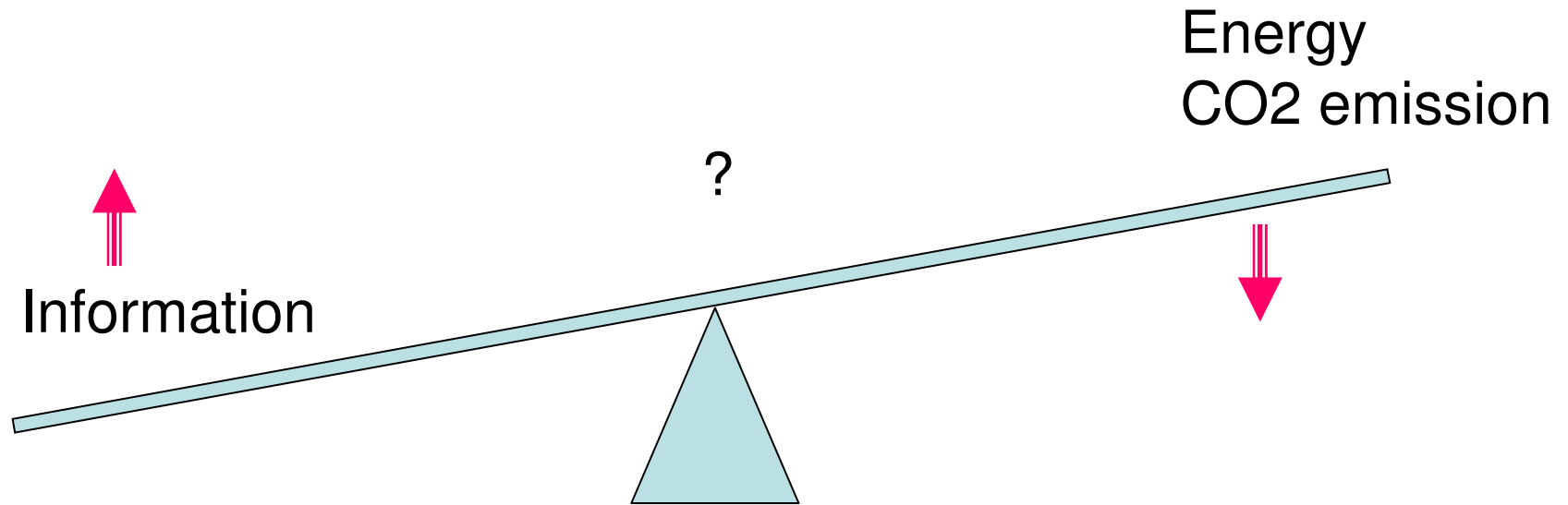
DIAL Mission & Activities

Investigating advanced information systems and automated technologies and their interface with advanced processing systems

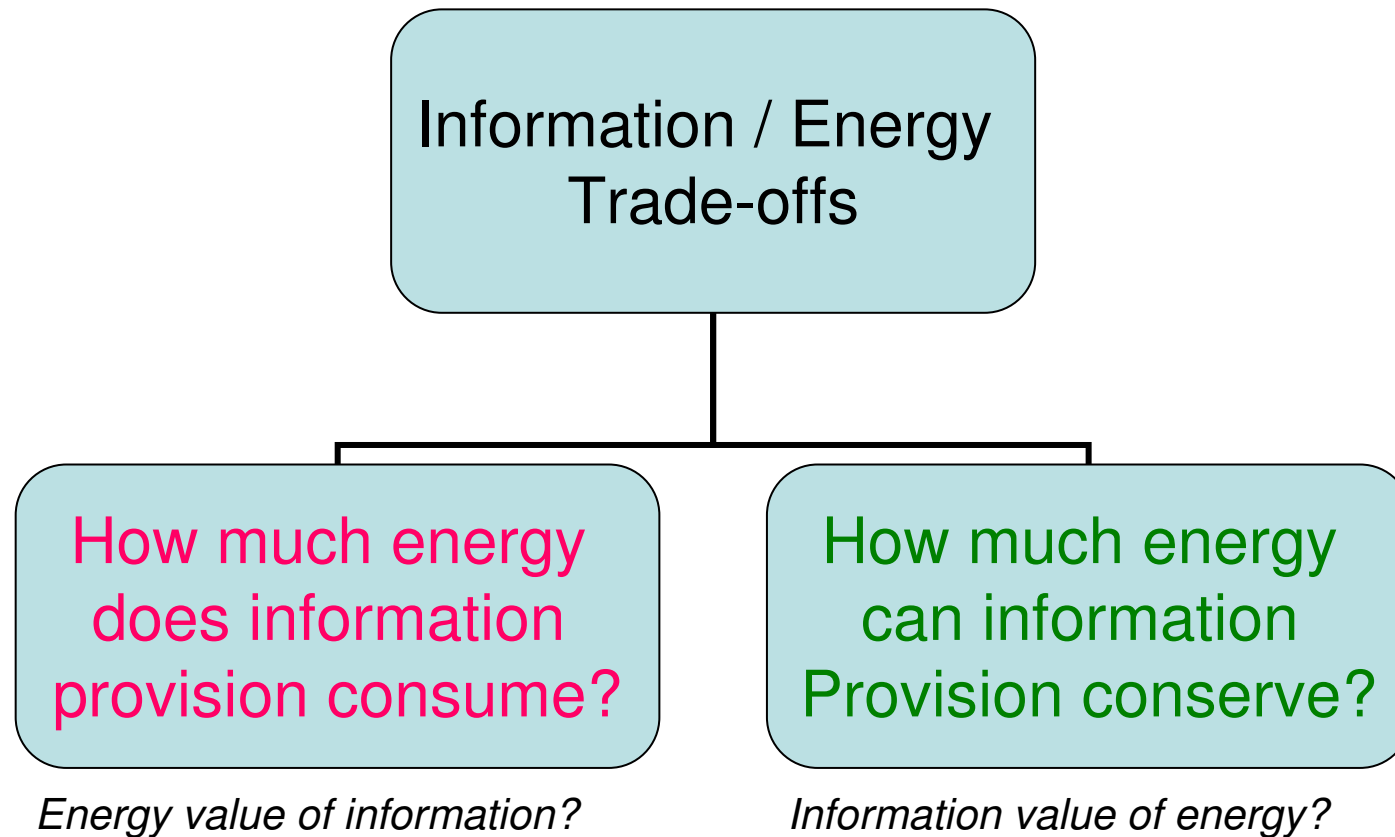
Creating and deploying smart products, flexible, reconfigurable operations and innovative services.

- Distributed Automation
- Reconfigurability Analysis
- Disruption Management
- Service, Maintenance
- Asset Management
- RFID for Tracking & Tracing
- Value of Industrial Information
- *Information & Energy*

The Information and Energy Issue



The Information and Energy Issue



Overview

- Manufacturing & Energy?
- Linking Automation & Control to Energy Consumption
- Industrial Efforts in Energy Management
- Issues

To live well – but within our means – experts predict that we must be able to deliver the ‘stuff of life’ using less than a quarter of current bio-capacity. For our industrial systems that means reductions of 75-90% in the use of carbon based Energy and similar scale reductions in resource use and material flows, while delivering the same value.

*Sustainability White Paper,
UK International Manufacturing Professors Forum, 2008*

Industrial Energy Consumption

Energy Consumption in Industry?

- 28-38% of global energy consumption
 - UK 20%
 - USA 31%
 - China 68%

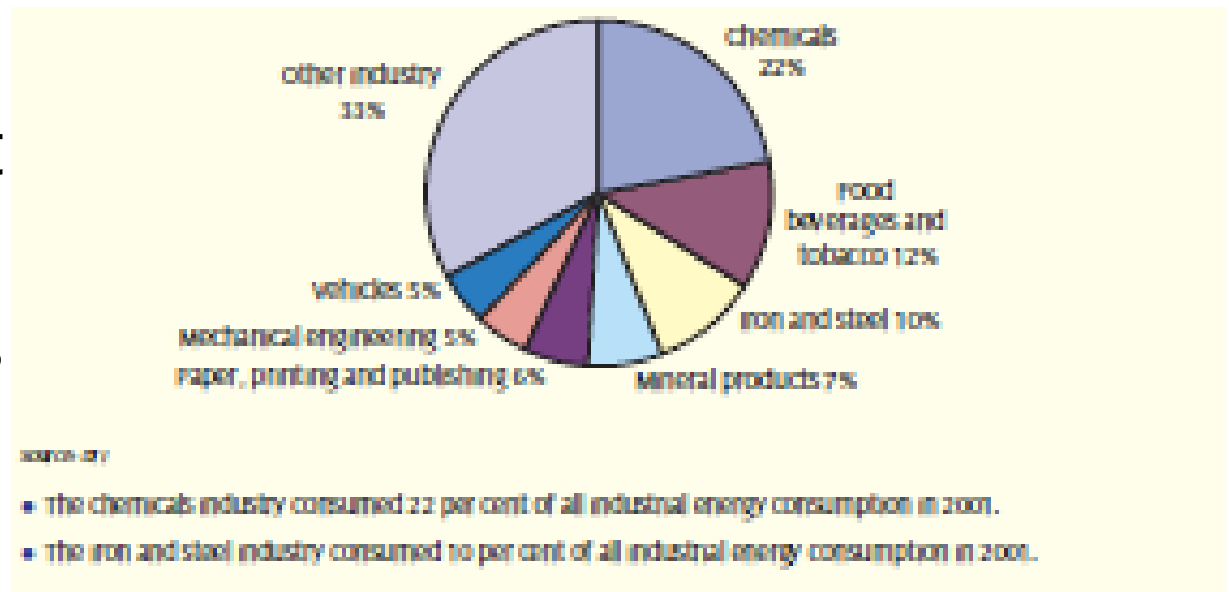
CO2 emission in Industry?

- *20-25% of direct CO2 emission*
- *37-40% of indirect CO2 emission with elec & heat*

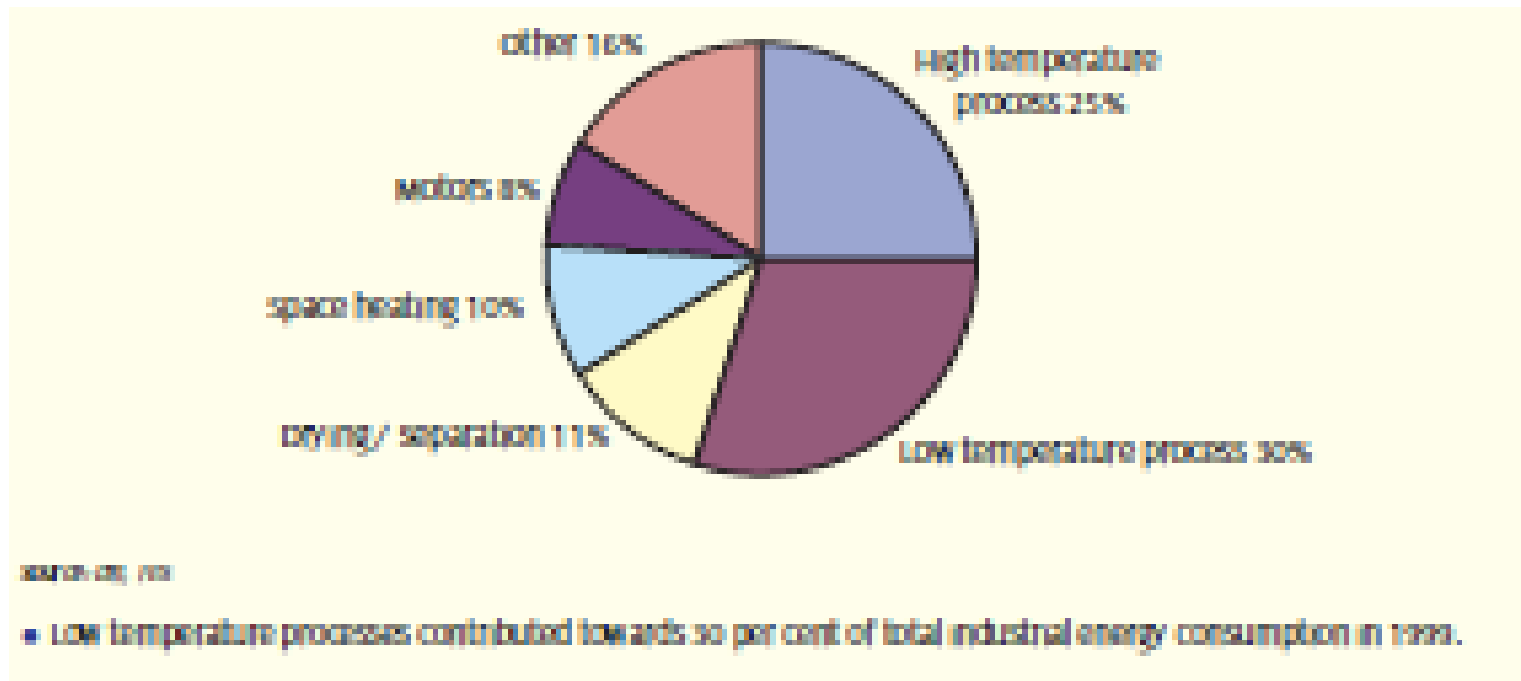
http://www.iea.org/textbase/nppdf/free/2010/key_stats_2010.pdf

Energy Distribution Across Sectors

- Distribution of consumption across different sectors
- Big Consumers
 - Chemicals
 - Steel (and iron)
 - Minerals
 - Food
 - Paper



Energy Consumers

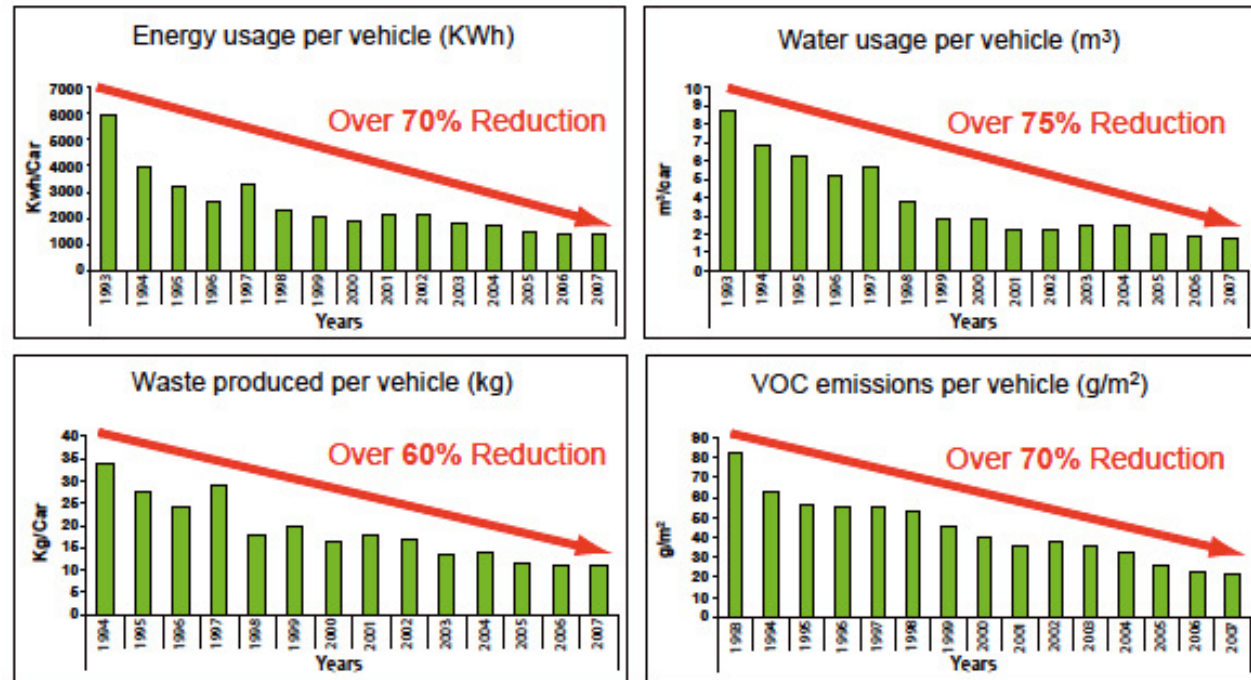


What Manufacturers Are Seeking

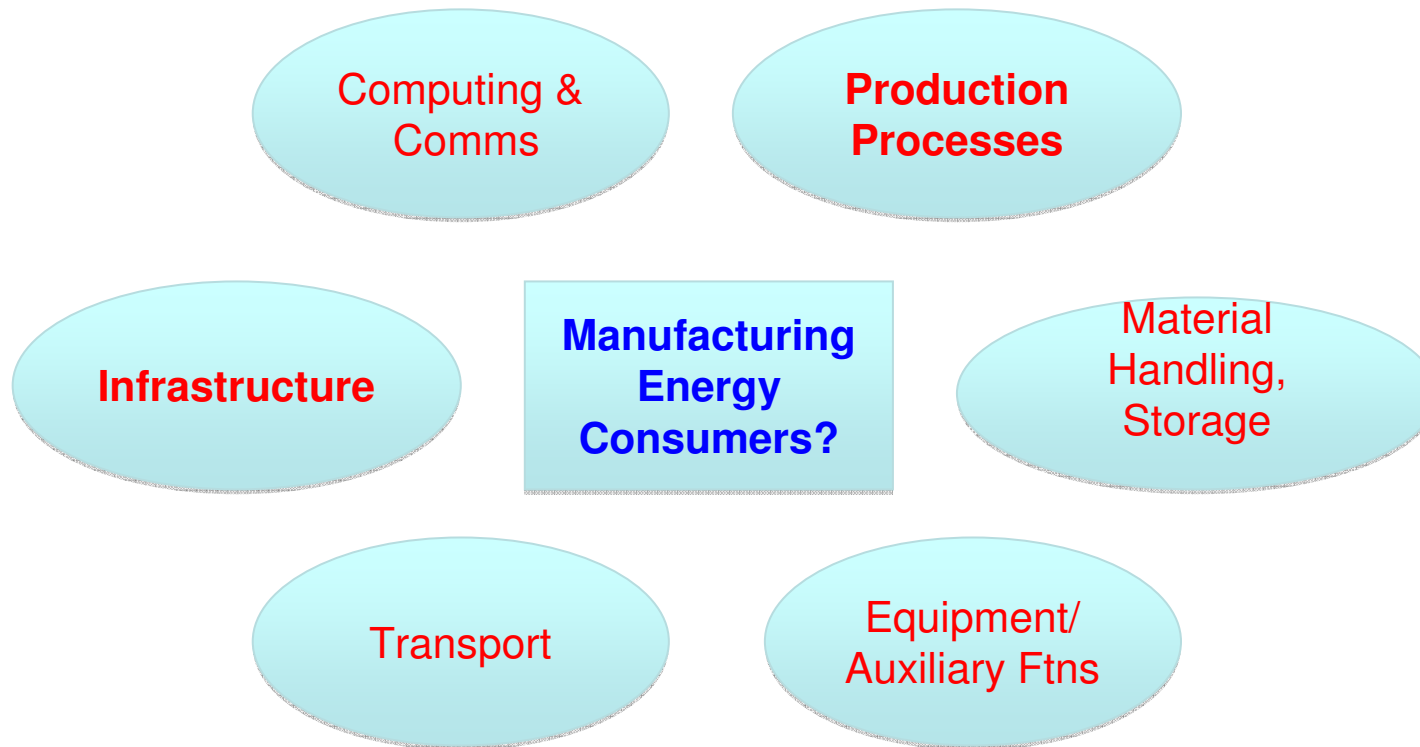
Environmental impact – KPIs

Example:
Toyota
Europe 1993-
2007

Source: *Sustainability White Paper, UK International Manufacturing Professors Forum, 2008*



Energy Consuming Mechanisms in Manufacturing

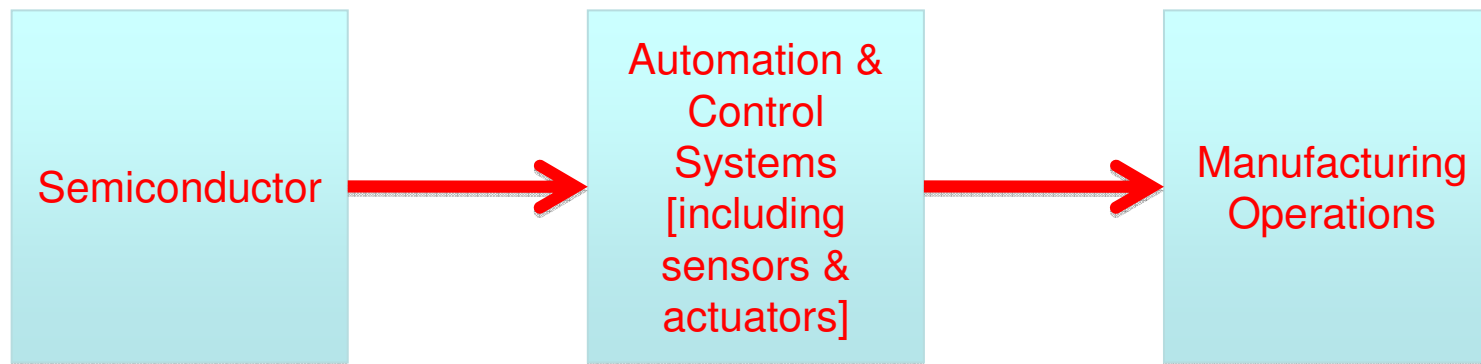


+ Products!!!

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Linking Automation & Control to Energy Consumption



1. **Direct Impact:** Semiconductor enabling energy savings in A&C
2. **Indirect Impact:** Semiconductor enabling A&C to achieve energy savings in Manufacturing Operations

Automation & Control

Automation

= *Performing Manual Task Automatically*

REPEATABLE
EXECUTIONS

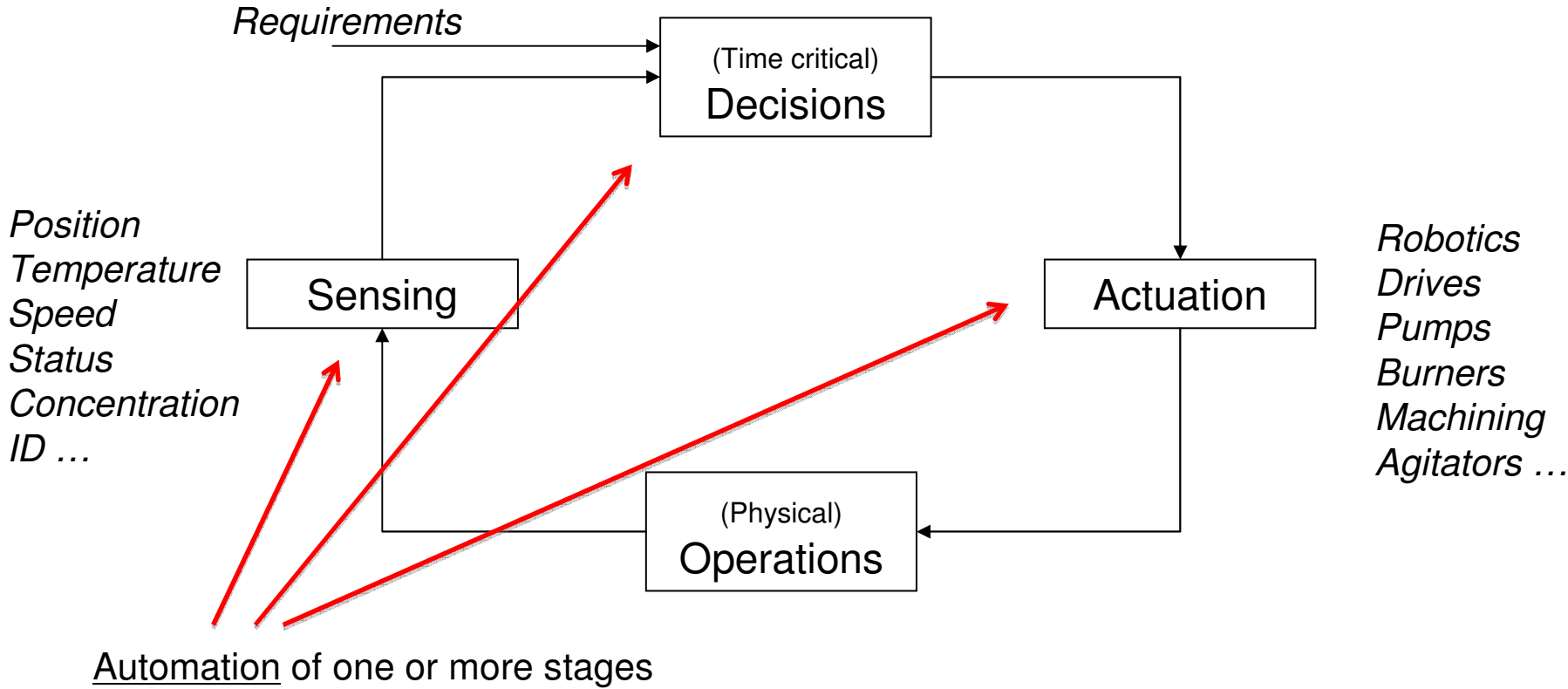
Automatic Control

EFFECTIVE
DECISIONS

Control

= *Effective Regulation of Process*

Industrial Control Loop

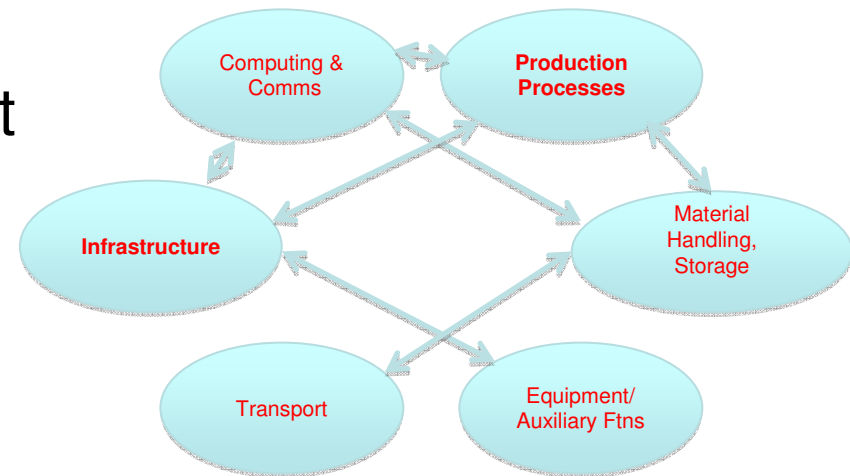


Impact of A&C on Energy Consuming Mechanisms in Manufacturing

- | | |
|--|---|
| 1. Production Processes | A: Efficient drives, pumps, m/c tools
C: accurate heating, control of waste |
| 2. Non production processes
[matl handling, store, transport] | A: Efficient drives,
C: Optimal mat'l handling, |
| 3. Asset Management | A: Low energy idling, switch off
C: Minimum time changeover, start up, shut down
A: n/a ?
C: Lighting & heating/cooling levels |
| 4. Infrastructure | A: Low energy sensing, computing & comms
C: Minimise computing & comms, energy sensing |
| 5. Computer Control Systems | |

Need for An Integrated View

- Manufacturing energy performance cannot be viewed in isolation
- Energy interactions important
 - E.g. more energy efficient processes requiring greater asset downtime
- ... and can be beneficial
 - E.g. production waste heat for infrastructure



Process Integration

Big issues

- Energy conservation via process integration

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- **Industrial Efforts in Energy Management**
- Issues

Industrial Energy Management Approaches

3 major areas identified [with overlaps]

- Sensing & monitoring
- Energy Management
- Actuation Systems

Energy Sensing and Monitoring Systems

Key features

1. Energy monitoring / wireless comms
2. Analysis / visualisation
3. Alarming / event detection

Examples

- SAP – Carbon Impact [2]
- Crossbow – EcoWizard [1,2]
- Optimal Monitoring – ISX System [1?, 2,3]
- Stark – Clarity and M&T programme (monitoring and targeting) [1,2]
- ITS – RiTA Utilities and Monitoring System [1,2]
- Honeywell – Energy Dashboard [1,2,3?]



Energy Management Systems

- Integrate monitoring but focus on reduction
- Take overall control of energy performance
- Buildings, infrastructure EMS: Energy reduction
- Process EMS: Balancing of energy demand/supply / often part of A&C system
- NB: EMS EN 16001 CERTIFICATION [audit]
- **Examples Process EMS**
 - ABB: Industrial IT PMS
 - Rockwell: Power & Energy Management
- **Examples: Buildings/Infra EMS**
 - British Gas: Energy 360
 - EnerNOC – EfficiencySMART [esp grid]
 - EMS: HVAC and Lighting Control



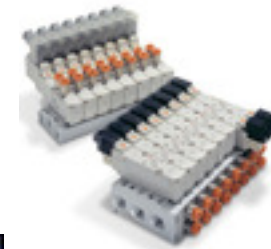
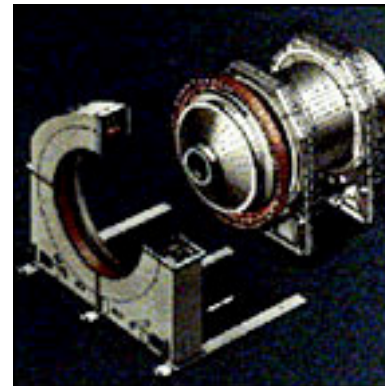
Energy Efficient Actuation Systems

Key Features

- Energy reduction built into actuation
- Reduces energy of actuator and system being manipulated
- Supported by additional control loop

Examples:

- OMRON: E7 Frequency Inverter with Energy Saving
- SMC: Energy saving solenoid valves
- Siemens: Gearless Drive System
- Toshiba: Semi Conductor Fab House



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Issues

- Analysis
 - Balancing energy cost of information vs information savings for energy
 - Energy accounting: factory v order accountability, product responsibility
- Approaches
 - Carbon neutral factory v carbon “neutralised” factories
 - Extending factory automation & control to include factory infrastructure
 - Flexibility & energy: Steady state vs transition energy consumptions