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Fit Manufacturing

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- ❑ ***MEC***
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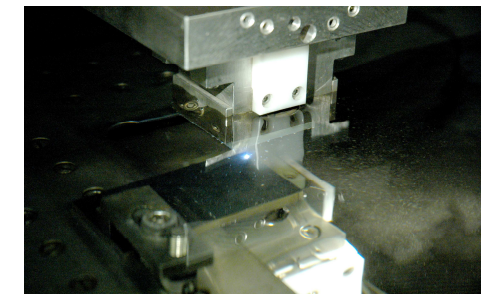
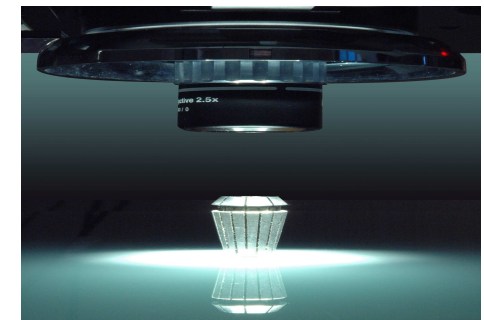
MEC



- **Mission:** To conduct world-class research and development in key areas of Advanced Manufacturing and use the output to assist industry
- R&D, PhD training, and ISO 9001:2000 accredited industrial consultancy and technology transfer
- **WAG** Centre of Excellence in Technology and Industrial Collaboration
- Founding partner in the **EPSRC** Innovative Manufacturing Research Centre at Cardiff University
- The Queen's Anniversary Prize and the Secretary of State's First Prize

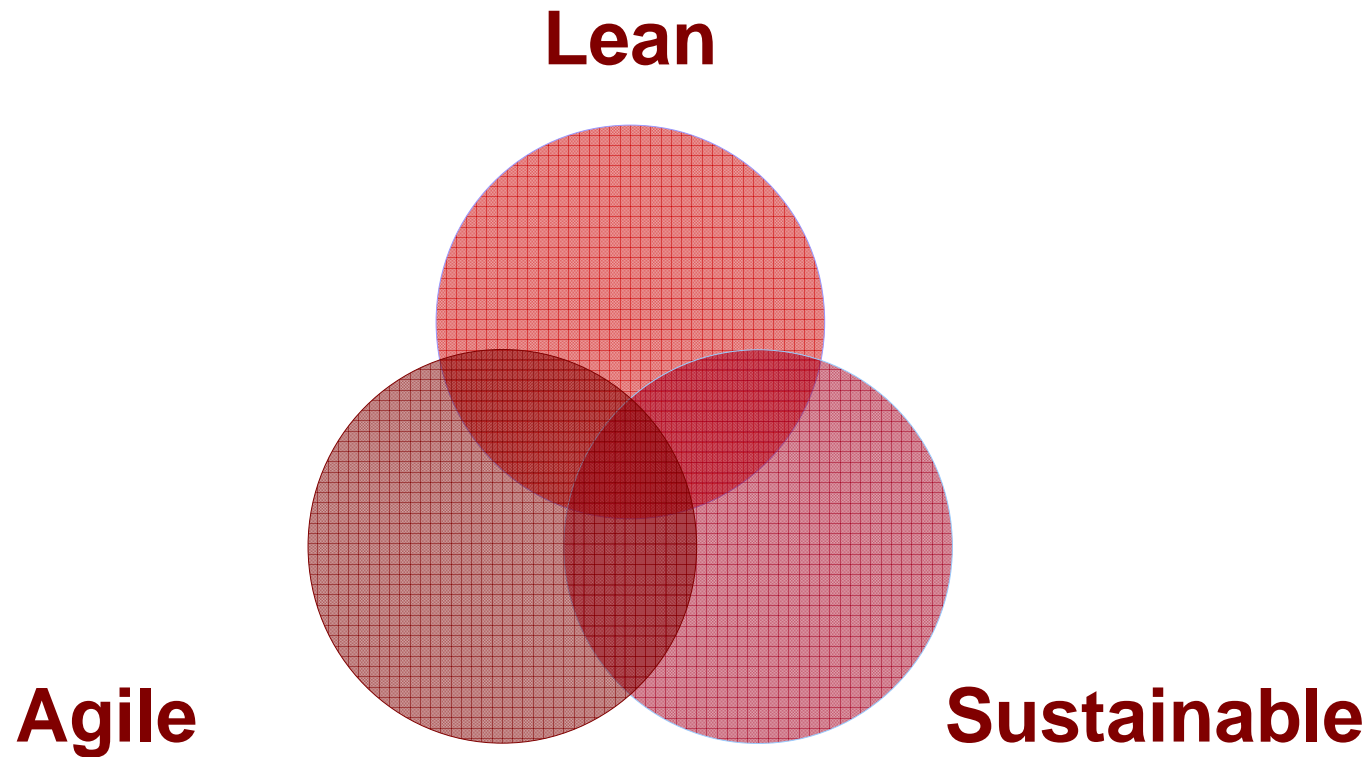


- 70 full-time engineers and researchers
- Active customer base of over **3000 companies**
 - 5000 projects undertaken since 1996
 - Partnership with 8 multinational corporations
- Income > £60M
 - Research grants £35M (55 projects)
 - Industrial Matched funding £15M
 - Commercial income £10M



- The smallest electrode (0.006 mm diameter) – Guinness world record
- The smallest haiku carved onto the point of a needle
- The high pressure laboratory for maintaining the life of bacteria and other creatures from 1500 m below the ocean bed in the Gulf of Mexico (1000 atmospheres)
- The moth-eye lens
- The thinnest metal casting (0.22 mm)
- The 'Beyond Lean' ('Fit Manufacturing') paradigm

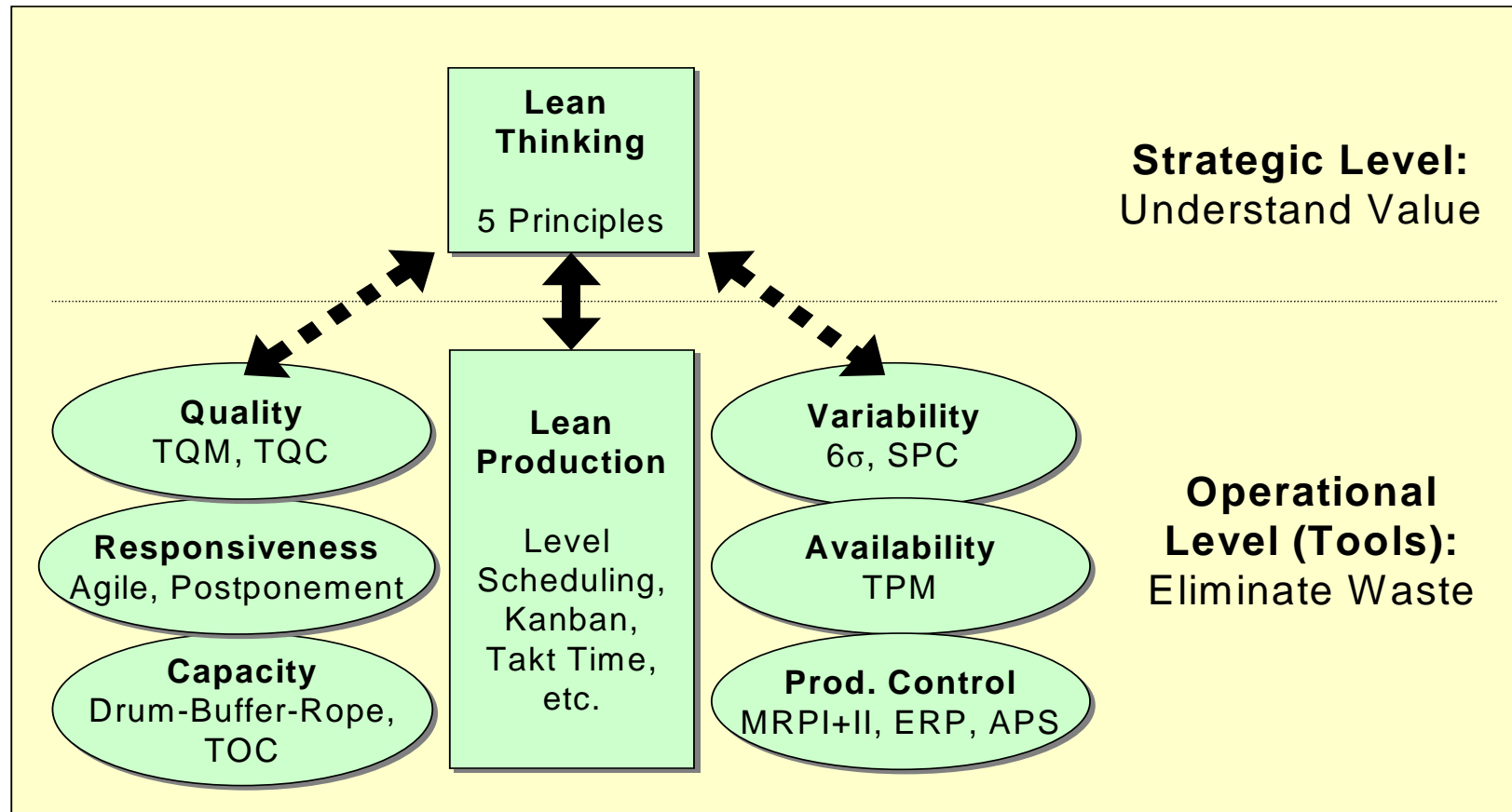




Lean Manufacturing – Concepts

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- Achieve more with less
- Focus on value & waste



Source: Professor Peter Hines, Lean Enterprise Research Centre, Cardiff University



More with Less?

It is possible to cut

**Throughput
time & defects**

Inventories

**Space & unit
costs**

*At very little capital cost ... with flexibility to meet
customer needs....*

**So increasing
output & profits**



...with the same head count



Lean

Potential Problem

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Too lean?





**Power
through
Speed**

Grand Master Kwang J. Lee, 9th Dan, demonstrating a flying side kick
<http://www.eagletaekwondo.org/taekwondo/index.html>



- ❑ **Agility** - ability to **respond rapidly** to changes in customer demand and the market environment
- ❑ Agile manufacturing exploits a **fundamental resource - knowledge**
- ❑ A necessary condition for **global competitiveness**

Sources:

1. P. T. Kidd, Cheshire Henbury, September 2000.
2. Y. Y. Yusuf, M. Sarhadi and A. Gunasekarann
International Journal of Production Economics,
Vol. 62 (1-2), 20 May 1999, pp 33-43



A **strategy for being competitive by becoming responsive to customer requirements:**

- improving speed of response **to customer requirements**
- continuously **upgrading products**
- **bringing** products to the market quickly **and cost effectively**
- **applying** appropriate **knowledge-based technology** and **systems methodology**
- **adopting** continuous improvement **philosophy**



□ Time to Customer Reduction

Fast Flexible Flow

Flow Production

Production Efficiency

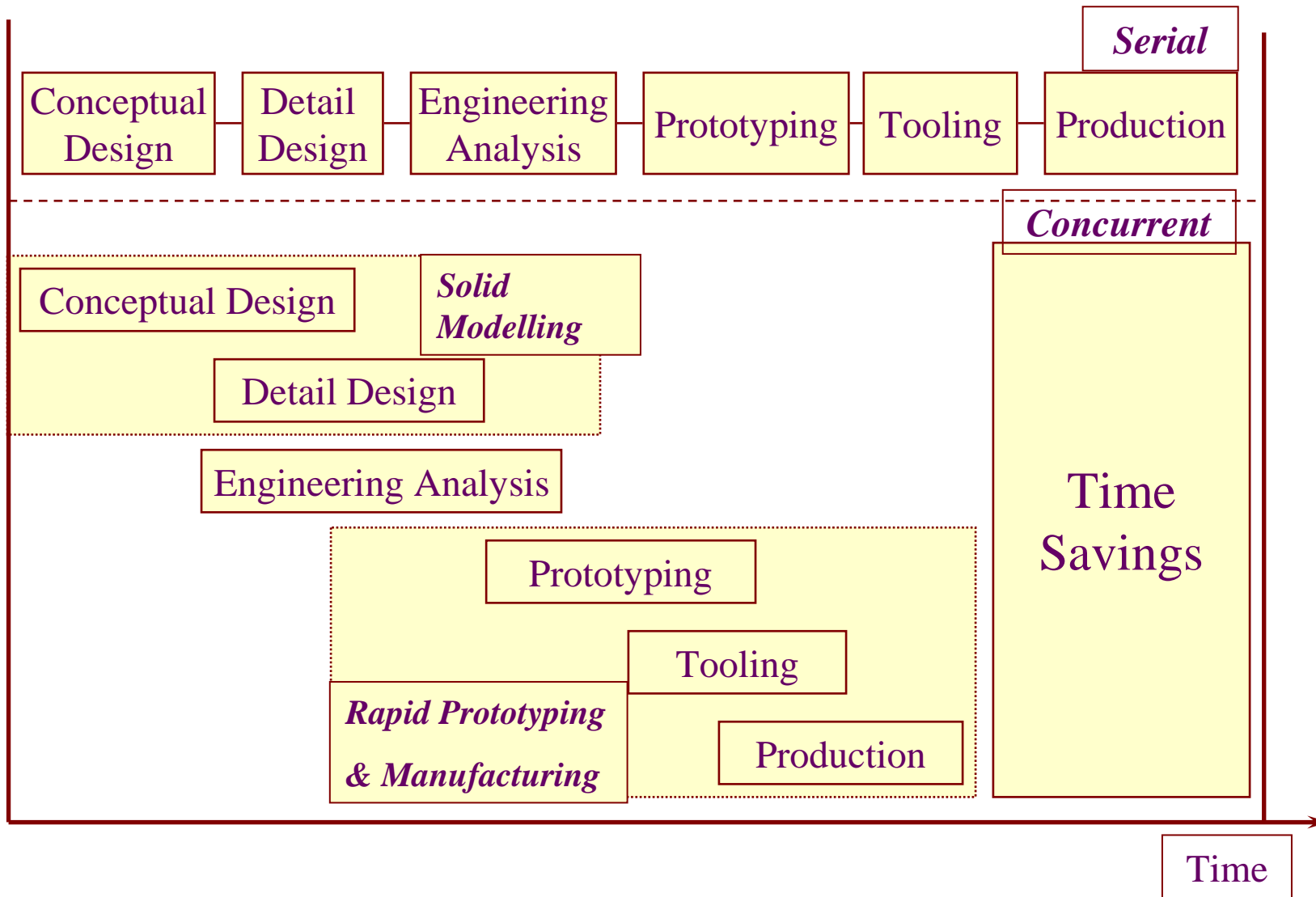
Quality as Standard

□ Time to Market Reduction

Concurrent Design and Manufacture

- ❑ **Product modularisation**
- ❑ **CAD / CAE enhancement and development**
- ❑ **Value stream analysis**
- ❑ **Equipment reliability**
- ❑ **Rapid prototyping**
- ❑ **Virtual prototyping**
- ❑ **E-Manufacturing**
- ❑ **Technology development**

Agility in NPD Process



Source:
Pham and Dimov



1. Satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development.
3. Deliver working software frequently.
4. Ensure business people and developers work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
6. Adopt face-to-face conversation for communication with and within a development team.

<http://agilemanifesto.org/principles.html>



7. Measure progress primarily by the amount of working software produced.
8. Promote sustainable development through agile processes to maintain a constant pace indefinitely.
9. Pay continuous attention to technical excellence and good design to enhance agility.
10. Maximise the amount of work not done.
11. Encourage team self-organisation to facilitate the creation of the best architectures and designs.
12. Regularly reflect on how to become more effective and then tune and adjust behaviours accordingly.

<http://agilemanifesto.org/principles.html>



- ❑ Over reactive -- unstable
- ❑ Over flexible -- inefficient
- ❑ Over engineered -- complex
- ❑ Over expensive -- unsustainable



Agility or Fragility?

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<http://www.dance.net/topic/6064684/1/Ballet-Photos-Misc/REQUEST-Alina-Cojocaru-ignore-photo.html&replies=16>



Sustainability

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<http://en.wikipedia.org/wiki/Marathon>



sus•tain•able /s^ə'steɪ nəbl/ adj.

1 involving the use of **natural products** and **energy** in a way

that does not harm the **environment**

2 that can continue or be continued for **a long time**

© Oxford University Press, 2005



Not only concerned with:

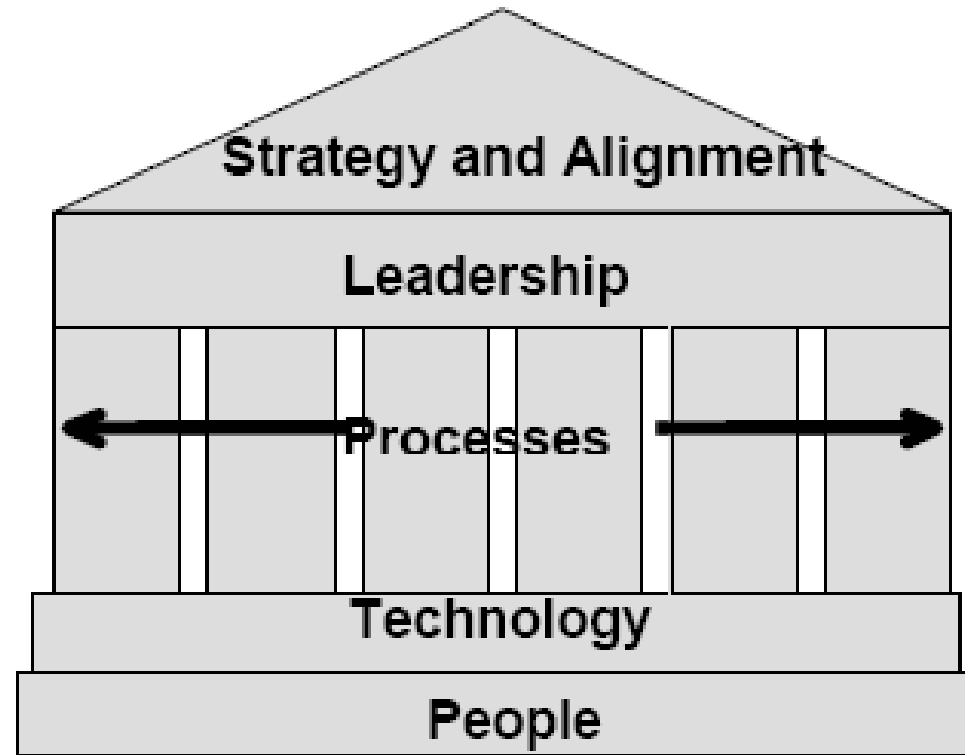
- *ecological or environmental* issues
- *energy or other natural resource* issues
- *socio-political* issues

i.e. not only concerned with manufacturing *environmentally friendly products* or using *natural products and energy* in a way that does not harm the *environment*

=> **Not** just **Green** Manufacturing



Source:
P Found, J Beale, P Hines *et al.* (2006) *A Theoretical Framework for Economic Sustainability of Manufacturing*, Cardiff Logistics & Operations Management Working Paper L/06/023, Cardiff Business School, Cardiff University, UK



The House of Sustainability

Economically sustainable manufacturing

... that can continue or be continued for a long time

The World's Oldest Companies

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Year	Company	Country	Field
578	Kongo-Gumi	Japan	Construction
885	Tanaka-Iga	Japan	Religious Goods
1000	Goulaine	France	Wine
1000	Marinelli	Italy	Foundry
1040	Weihenstephan	Germany	Brewery
1044	Wieliczka	Poland	Salt
1288	Stora Enso	Sweden	Paper
1295	Barovier & Toso	Italy	Glass
1328	Kremnica	Slovakia	Mint

http://en.wikipedia.org/wiki/List_of_oldest_companies



The World's Oldest Companies

28/47

Year	Company	Country	Field
1329	Kanbukuro	Japan	Confectionery
1346	Takata	Japan	Textile
1350	Schmidberger	Austria	Blacksmith
1366	Stella Artois	Belgium	Brewery
1369	Torrini	Italy	Jewellery
1426	Muehle Sting	Germany	Mill
1570	Whitechapel	UK	Bell foundry
1580	Elsevier	Netherlands	Publisher
1599	Mulliner (Bentley)	UK	Coach builder

The ability constantly to *innovate* is their secret to sustainability



- ❑ **Clock builders, not timekeepers**
- ❑ **Core preservation (values and ideology); Progress stimulation**
- ❑ ***BHAG***
- ❑ **Cult-like cultures**
- ❑ **Opportunistic experimentation**
- ❑ **Home-grown management**
- ❑ **Continuous improvement and innovation**
- ❑ **Clear vision with practised values and ideology**
- ❑ **Constant alignment**

'In Search of Excellence'

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1. Get on with it.
2. Learn from the customer.
3. Foster innovation and nurture champions.
4. Treat employees as the main source of productivity gains.
5. Practise a hands-on, value-driven management philosophy.
6. Stay with the business that you know.
7. Have few administrative layers and few people at the top.
8. Maintain core values but allow individual autonomy.

Source: T Peters and R H Waterman Jr (1982) *In Search of Excellence: Lessons from America's Best-Run Companies*, Harper & Row, San Francisco, CA.



In Search of Excellence - McKinsey 7-S model 31/47

- ❑ structure
- ❑ strategy
- ❑ systems
- ❑ style of management
- ❑ skills - corporate strengths
- ❑ staff
- ❑ shared values

Source: T Peters and R H Waterman Jr (1982) *In Search of Excellence: Lessons from America's Best-Run Companies*, Harper & Row, San Francisco, CA.





- ❑ **Low labour cost economies place increasing pressure on EU industries.**
- ❑ **Mass customisation forces companies into low volume manufacture of products to be sold at mass production prices.**
- ❑ **Lean and agile manufacturing approaches have limitations.**

'a company's ability to compete and prosper in a ***sustainable*** manner through making **high quality products** using an ***integrated***, **robust**, highly ***responsive*** and **reconfigurable *lean*** manufacturing system **that returns** high product quality and **reduced** internal and external **manufacturing costs**'



A *Fit Manufacturing* company must:

- ❑ operate **efficiently** and **flexibly**
- ❑ be able to **respond rapidly** and **effectively** to change
- ❑ constantly **innovate**
- ❑ continually **explore** and **exploit**
- ❑ **evolve** or **periodically renew** itself
- ❑ focus firmly on market **needs** (existing and future)
- ❑ be **robust** against disturbances
- ❑ continually seek to **improve** itself



Fit Manufacturing Axioms (2)

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- ❑ know its **balance/unbalance** points to resist/promote change
- ❑ make use of **power leverage**
- ❑ **control growth** to limit inertias
- ❑ **control damping** to achieve stability
- ❑ strive to operate in **steady state**
- ❑ possess a capability for **accurate prediction**
- ❑ **minimise entropy**
- ❑ **maximise simplicity**



'Fit' *integrates*

business process strategies

with a company's **existing and future technology platform and support systems**

to provide a manufacturing system that **optimally combines the capabilities of a range of business process concepts**



A 'Fit' manufacturing enterprise requires:

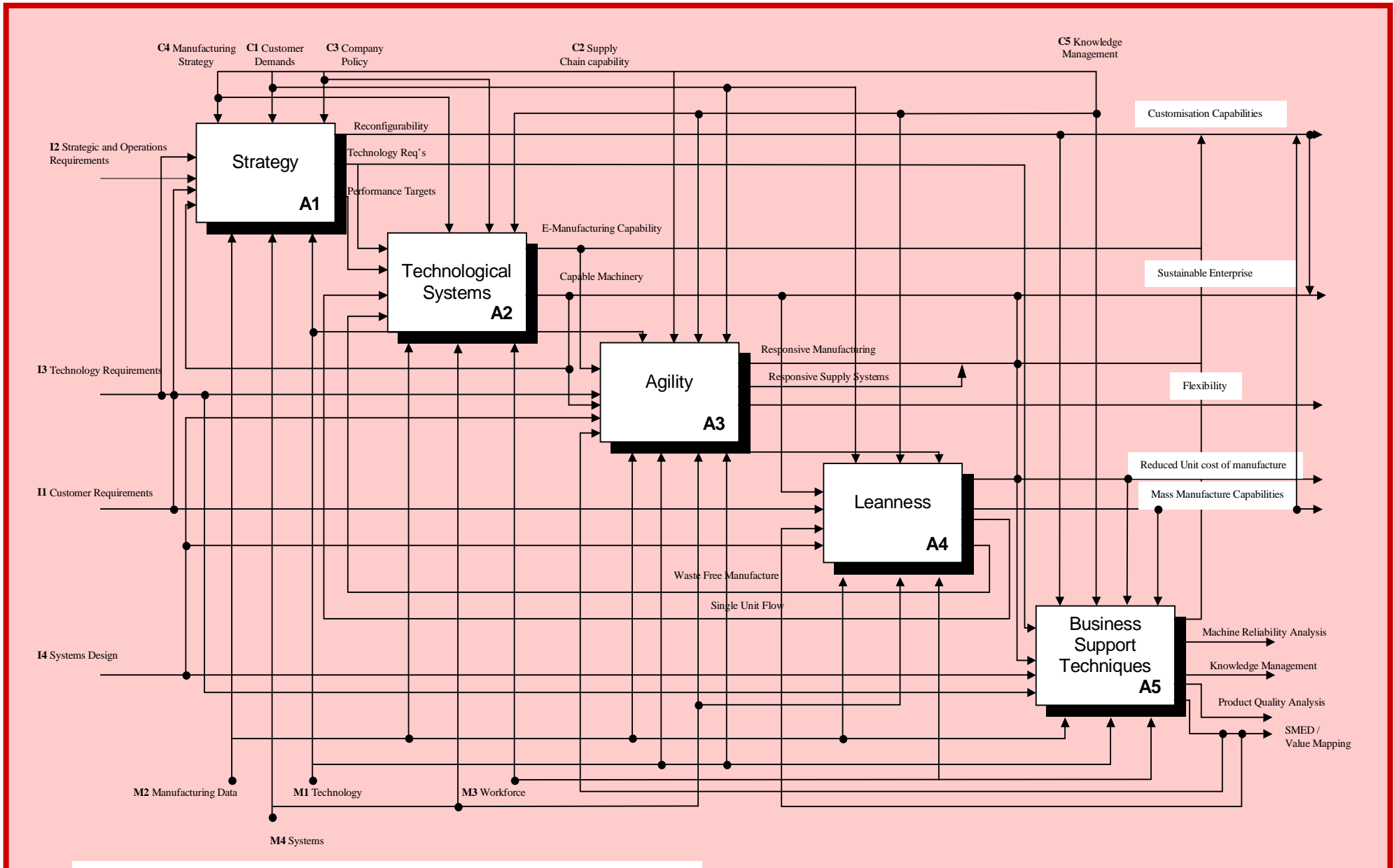
- ❑ an **integrated** supply chain **to ensure** high quality, **highly responsive and dependable supply of raw material and sub-contracted products**
- ❑ a lean, *technologically driven* and **highly** agile production system **designed to convert customer requirements to finished products quickly and efficiently**
- ❑ a support system **that enhances** sustainability **by fostering the performance of both logistics and manufacturing**

- 5 major elements used to develop manufacturing fitness in a company:
 - *Manufacturing Strategy*
 - *Manufacturing Technology*
 - *Agility*
 - *Leanness*
 - *Business Support Systems*

- The balance between agility and leanness will vary depending on a company's strategic and technological systems and capabilities



The 'Fit' Approach



□ Health Indicators

- **Body Mass Index:** $weight (kg)/height (m)*height (m)$
- **Waist Circumference**
- **Waist-Hip Ratio**

□ Manufacturing Key Performance Indicators

- **Quality, Cost, Delivery**
- **Leanness measures (*Soriano-Meier and Forrester*):**
waste elimination, continuous improvement, zero defects, JIT deliveries, pull of materials, multifunctional teams, decentralisation, integration of functions, vertical information systems and managerial commitment to lean production



□ Input measures

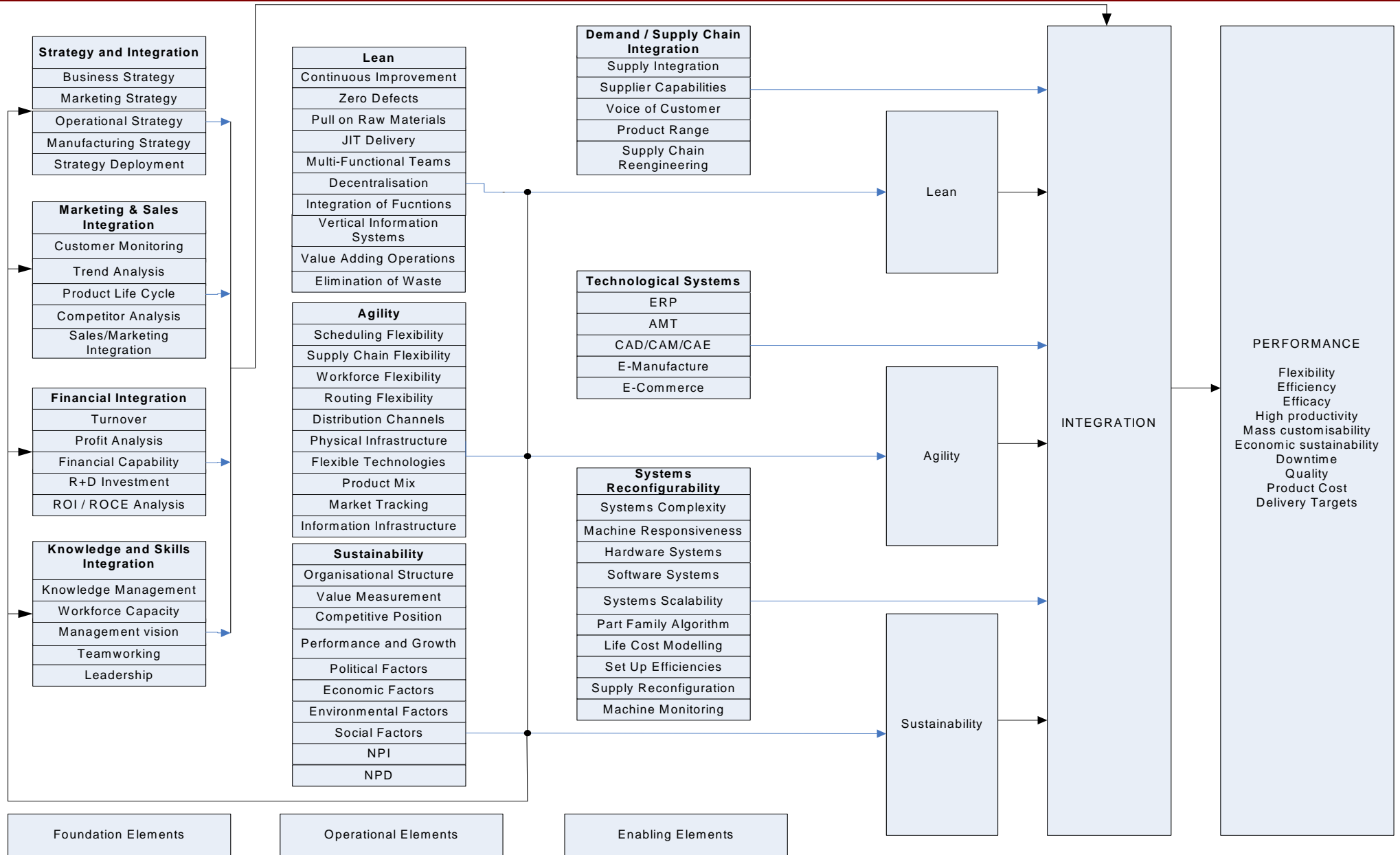
- **Foundation:** *knowledge, strategy, marketing, finance*
- **Operation:** *leanness, agility, sustainability*
- **Enabling:** *reconfigurability, demand/supply chain, innovation*

□ Output measures

- *Flexibility*
- *Efficiency*
- *Efficacy*
- *High productivity*
- *Mass customisability*
- *Economic sustainability*
- *Downtime*
- *Quality*
- *Product cost*
- *Delivery targets*



The Fit Manufacturing Structure



The elements of Fit Manufacturing

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Marketing / Sales Integration	Knowledge and Skills Integration	Lean	Agility	Sustainability	Performance
Customer Monitoring Trend analysis Product life cycle analysis Competitor analysis Integrating sales with manufacture to produce AWM Mark each element 0-1 Total = 5 Marks	Knowledge Management Workforce Technological capacity Management vision & capacity Leadership <u>Teamworking</u> , leadership, Culture etc Mark each element 0-1 Total = 5 Marks	Elimination of Waste Continuous Improvement Zero Defects Pull on raw materials Just in Time delivery Multi-functional Teams Decentralisation Integration of Functions Vertical Information Systems Value Adding Operations Mark each element 0-2 Total = 20 Marks	Workforce Flexibility Supply Chain Flexibility Flexible Technologies Scheduling Flexibility Product Mix Physical Infrastructure Information Infrastructure Market Tracking Distribution Channels Routing Flexibility Mark each element 0-2 Total = 20 Marks	Organisational Structure Value Measurement Competitive position Performance and Growth Political Factors Economic Factors Environmental Factors Social Factors New Product introduction New Product development Mark each element 0-2 Total = 20 Marks	Flexibility Efficiency Efficacy High productivity Mass customisability Economic sustainability Downtime Quality Product Cost Delivery Targets Mark each element 0-10 Total = 100 Marks
Strategy and Integration	Financial Integration	<u>Systems Reconfigurability</u>	Demand / Supply Chain Integration	Technological Systems	
Business Marketing Operational Manufacturing Deployment Mark each element 0-1 Total = 5 Marks	Turnover Profit Analysis Financial Capacity Expenditure on R+D ROCE / ROI Analysis Mark each element 0-1 Total = 5 Marks	Systems complexity Responsive machinery Hardware systems Software systems System Scalability Part Family Algorithm Life cost modelling Set-up Efficiencies <u>Supply Reconfigurability</u> Machine monitoring Mark each element 0-1 Total = 10Marks	Supplier Integration Supplier capabilities Voice of Customer Product range Supply chain reengineering Mark each element 0-1 Total = 5 Marks	CAD / CAM / CAE ERP E-commerce E-manufacture AMT Mark each element 0-1 Total = 5 Marks	

Fitness Profiling

Manufacturing Fitness Profile							
Company: xxx							
Elements	Scoring System					Weight	Mark
	0-2	3-4	5-6	7-8	9-10		
Marketing Integration	○					1	0.5
Strategic Development	○					1	1.5
Knowledge and Skills	○					1	2
Financial Analysis	○					1	2
Leanness		○				1	7
Agility			○			1	10
Sustainability			○			1	10
Reconfigurability	○					1	1
Technological Innovation	○					1	1
Demand / Supply	○					1	1.5
						Total	36.5
Results	Scoring System					Weight	Mark
	0-2	3-4	5-6	7-8	9-10		
Manufacturing Flexibility	○					1	3
Manufacturing Efficiency		○				1	4
Operational Effectiveness	○					1	3
Productivity			○			1	5
Mass Customisation	○					1	2
Sustainability			○			1	6
Downtime	○					1	2
Quality			○			1	6
Product Cost		○				1	4
Delivery Targets			○			1	6
						Total	41

Before TPM

Manufacturing Fitness Profile							
Company: xxx							
Elements	Scoring System					Weight	Mark
	0-2	3-4	5-6	7-8	9-10		
Marketing Integration	○					1	0.5
Strategic Development		○				1	1.5
Knowledge and Skills		○				1	2
Financial Analysis			○			1	2.5
Leanness			○			1	8
Agility			○			1	10
Sustainability			○			1	10
Reconfigurability	○					1	1
Technological Innovation		○				1	2
Demand / Supply		○				1	1.5
						Total	39.0
Results	Scoring System					Weight	Mark
	0-2	3-4	5-6	7-8	9-10		
Manufacturing Flexibility		○				1	3
Manufacturing Efficiency			○			1	5
Operational Effectiveness		○				1	4
Productivity			○			1	5
Mass Customisation	○					1	2
Sustainability				○		1	7
Downtime				○		1	5
Quality				○		1	6
Product Cost		○				1	4
Delivery Targets			○			1	6
						Total	47

After TPM

- ❑ **Ensures that a company has the optimum balance of leanness and agility to meet its strategic needs.**
- ❑ **Provides the ability for a company to reconfigure its manufacturing operations in response to future customer requirements.**
- ❑ **Encourages a culture of continuous innovation, technology development and product quality enhancement.**



- ❑ Fit Manufacturing is a philosophy integrating Lean, Agile and **Sustainable** approaches
- ❑ Lean is *mean*
- ❑ Agile can be *fragile*
- ❑ Fit delivers *sustainable benefits*



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ERROR: syntaxerror
OFFENDING COMMAND: --nostringval--

STACK:

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