Road 4 FAME

Business Modelling
Haydn Thompson
Approach of Road4FAME

**Push Perspective**
- Screening for novel concepts
- Identification of R&D Challenges
- Identification of Enablers
- Validation step

**Pull Perspective**
- Socio-economic Analysis
- Identification of Needs and Requirements
- Translation into ICT/architecture requirements
- Validation step

**Core Roadmapping Process**
- Roadmapping Workshops
- Roadmap for IT Architectures and Services in Manufacturing
- R&I Strategy Documents
- Business Models
How it used to be .....
Manufacturing companies need to evolve and adapt to meet competitive challenges and support world megatrends. The adoption of suitable architectures and services may provide a manufacturing company with substantial competitive advantage, however, successful implementation may strongly depend on the ecosystem of business services supporting them.

The objectives are to:

1. Study existing business models and services employed by European manufacturing enterprises
2. Determine business models and services which become possible or even necessary to support future architectures, services and manufacturing megatrends as identified in the roadmapping process.
3. Develop recommendations for new business opportunities tied to future architectures and services in manufacturing.

The output will be a Catalogue of Future Business Opportunities, Business Models and Services as a strategic document for manufacturing and service sector companies.
Mapping against 100 business models and identified business opportunities
- CyPhERS, Cyber-Physical European Roadmap & Strategy - PF7- Project, Deliverable D3.2 Market and innovation potential of CPS, August 2014.
- Road4FAME - Orientation Paper, August 2014.
- Smart Industry, Dutch Industry Fit For The Future, April 2014.
- “Recommendations for implementing the strategic initiative INDUSTRIE 4.0”, Final report of the Industrie 4.0 Working Group, Forschungsunion & acatech, April 2013
Trend Towards Services
Business Model Categorisations
(100 models in 10 categories)

Conventional
- Manufacturer Model - Selling Direct
- Merchant Model
- Advertising Model
- Information Model
- Brokerage Model
- Premium branding or limited availability
- Licensing, franchising
- Open innovation (platforms)
- Hire & leasing
- Razor and Blades Model
- Cutting out the Middlemen
- Bricks and Clicks
- Subscription Business Model
- Value Added Reseller
- Fee in, free out – charge first client only
- All in one business model
- Loyalty business model
- Monopolistic business model
- Premium business model
- Professional Open Source Business Model
- Machine supplier

Green/Sustainable
- Repair, the Circular Economy, and Collaborative Consumption
- Sustainability and value
- Low carbon manufacturing or solutions
- Cradle-to-cradle
- Reuse, recycle, re-manufacture
- Take back management
- Move from non-renewable to renewable sources
- Green chemistry
- Solar and wind-power based energy innovations
- Chemical Management Services (CMS)
- Dematerialised services
- Collaborative consumption
- Incentivised return & re-use
- Collection of used products
- Blue economy
- Choice editing by retailers

Networking
- The ‘Density Principle’
- Acting as a network entity
- Interaction and indirect capabilities
- Trans-sector collaboration
- Network Architecture Business Model
- Sharing assets (shared ownership and collaborative consumption)
- Crowd sourcing or funding
- Collaborative approaches (sourcing, production, lobbying)
- Collective Business Model
- Online Auction Business Model
- Network Effects Business Model
- Organisational form

Socially Aware
- Ethical trade (fair trade)
- Resource stewardship
- Biodiversity protection
- Responsible product distribution or promotion
- Slow fashion
- Slow Manufacturing
- Product longevity
- Long life
- Radical transparency about eco or societal impacts
- Consumer care - promote consumer health and well-being
- Not for profit
- Social and biodiversity regeneration initiatives (‘net positive’)
- Hybrid businesses, social enterprise (for profit)
- Alternative ownership: cooperative, mutual, (farmers) collectives
- Home based, flexible working
- Extended producer responsibility
- Frugal business (products for low income markets)
- Localisation
- Bring your own device

Customisation
- Made to order
- Personalisation, Identity, Provenance
- Mass customization
- Design and Innovation Service
- Fabless manufacturing
- Frugal innovation

Efficient Manufacturing
- Lean manufacturing
- De-materialisation (of products or packaging)
- Use excess capacity
- Industrial symbiosis

Economic
- Build-operate-transfer (BOT)
- "Patient or slow capital" collaborations

Knowledge
- Continuous innovation
- Creating value through information
- Incubators and entrepreneur support models
- Consumer education (models); communication and awareness
- Solution provider

Aftermarket/Product Service
- Asset management
- Product Service System
- Product-oriented PSS - maintenance, extended warrantee
- Use oriented PSS - rental, lease, shared
- Result oriented - pay per use
- Online Services Model
- Demand management (including cap & trade)
- Maintenance partner
- Performance partner
- Value partner

Technology Based
- Additive manufacturing
- Information Technology (IT) - Infinite Bandwidth/Zero Latency
- General-purpose technologies
- Increased functionality
- Biomimicry
### Business Model Characterisations

#### Product Service/Aftermarket

<table>
<thead>
<tr>
<th>To Achieve This</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delegate to employees who are close to the customer</td>
<td>Foster client dependency without dominating the relationship</td>
</tr>
<tr>
<td>Foster carefully selected and nurtured customers</td>
<td>Welcome responsibility for achieving results</td>
</tr>
<tr>
<td>Value and build relationships</td>
<td>Continuously learn from clients</td>
</tr>
<tr>
<td>Have special insights into clients and organisations</td>
<td>Look for specific solutions, not general or standardised ones</td>
</tr>
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</table>

#### Green/Sustainable

<table>
<thead>
<tr>
<th>To Achieve This</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop eco-conscious workforce</td>
<td>Environmentally aware</td>
</tr>
<tr>
<td>Monitoring of energy, raw materials usage across enterprise and supply chain</td>
<td>Understand value of resources and impact of enterprise on environment</td>
</tr>
<tr>
<td>Develop understanding of cradle-to-grave impact of product on environment</td>
<td>Rewards reduction in energy/CO2 and materials usage</td>
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#### Networking

<table>
<thead>
<tr>
<th>To Achieve This</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly connected business systems to allow exchange of information</td>
<td>Working collaboratively in partnership</td>
</tr>
<tr>
<td>Focus on monitoring to track product through network</td>
<td>High level of teamwork and trust between organisations</td>
</tr>
<tr>
<td>Standardisation of information exchange</td>
<td>Driven by desire to meet schedules</td>
</tr>
<tr>
<td>Flexibility to adjust and change network members</td>
<td>Respect for intellectual property</td>
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#### Technology Based

<table>
<thead>
<tr>
<th>To Achieve This</th>
<th>Culture</th>
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</thead>
<tbody>
<tr>
<td>Skilled workforce that can engage with new technologies</td>
<td>Exploitation of latest technologies (e.g. 3D printing) to gain commercial advantage</td>
</tr>
<tr>
<td>Strong and open minded leadership to drive through change</td>
<td>Open to new ideas/technologies</td>
</tr>
<tr>
<td>Capital investment to take on board latest technologies</td>
<td>Tolerate high installation/setup costs with a view to future gain</td>
</tr>
</tbody>
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#### Efficient Manufacturing

<table>
<thead>
<tr>
<th>To Achieve This</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardised and simplified</td>
<td>Absorbs waste</td>
</tr>
<tr>
<td>Efficient in effort and co-ordination</td>
<td>Obsessed with cost</td>
</tr>
<tr>
<td>Avoid variety, avoid niches</td>
<td>Rewards efficiency</td>
</tr>
<tr>
<td>Occupy middle of the market where demand is huge</td>
<td></td>
</tr>
</tbody>
</table>

#### Customisation

<table>
<thead>
<tr>
<th>To Achieve This</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible manufacturing processes and equipment to allow easy modification/change of base product</td>
<td>Encourages customer choice and input</td>
</tr>
<tr>
<td>Low cost tailoring support for product re-design</td>
<td>Encourages variety in market place</td>
</tr>
<tr>
<td>Strong communication links with customers to allow their direct input</td>
<td>Willingness to interact closely with customers</td>
</tr>
</tbody>
</table>

#### Knowledge

<table>
<thead>
<tr>
<th>To Achieve This</th>
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</thead>
<tbody>
<tr>
<td>Flexible structure to allow new ideas</td>
<td>Encourage individual imagination/ideas</td>
</tr>
<tr>
<td>Effective management of talented people</td>
<td>Results driven</td>
</tr>
<tr>
<td>Robust processes that can accommodate change</td>
<td>Reward new product/process success</td>
</tr>
<tr>
<td>Tolerate experimentation (even when not always successful)</td>
<td></td>
</tr>
</tbody>
</table>

#### Socially Aware

<table>
<thead>
<tr>
<th>To Achieve This</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company will have clear social values which are written down and universally understood</td>
<td>Managers and employees adhere personally to a set of values</td>
</tr>
<tr>
<td>Failure to conform to specified standards will not be tolerated from employees or suppliers</td>
<td>Treatment of employees reflect company core values</td>
</tr>
<tr>
<td>The firm will seek to supply customers who share their values</td>
<td>Relationships with customers and local community and charities reflect company values</td>
</tr>
</tbody>
</table>

#### Economic (Investor Supported)

<table>
<thead>
<tr>
<th>To Achieve This</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term vision</td>
<td>Reliant on external investors</td>
</tr>
<tr>
<td>Flexibility to meet the needs of investors</td>
<td>Driven by long term return</td>
</tr>
<tr>
<td>Concentrates on needs of end customers</td>
<td>High risk</td>
</tr>
<tr>
<td>Provides accountability to shareholders</td>
<td></td>
</tr>
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*Road 4 FAME*
Interviews

- **Coverage**
  - Manufacturers and Service Providers - large and small, across sectors
  - Questionnaire circulated to Road4FAME experts (92 people)
  - Face-to-face or telephone interviews with 23 companies

- **Attended events where can gather information/opinions**
  - Advanced Engineering Show (UK)
  - Sheffield BIN Event (Exhibition Stand)
  - IoT- A Deeper Dive (Brussels)
  - Manufacturing Service Ecosystem workshop (Brussels)
Manufacturers

- Customised solutions common - Configure to order or adapt a product to specifications before it is built
- Keep design and IPR in-house contract out
  H/W manufacture to China, software to Romania or India
- High reliance on supply chain but only work with trusted suppliers
- Sourcing raw materials a big concern (these can be the largest costs to a company)
- Need to balance price, quality and on-time delivery of these materials
  - Sourcing globally and quite often from competitors
  - In car industry may have to produce 40% locally in country where selling to, e.g. Brazil, which is challenging – get problems of counterfeit parts
- Need to balance CO₂ emissions – would prefer to manufacture close to assembly
- Traceability
  - Not sourcing from conflict areas. Where does molten metal come from?
  - Sustainability how much CO₂ associated with manufacture/transport?
Both large or small companies want to contract software development out
- SME’s do not have experienced staff
- Large companies want experienced staff to work on added value software for customer
- Problem is preventing engineers from doing “internal” software, e.g. Excel Macros, which are not maintainable once a person leaves
- Culture change from doing everything in-house to buy in services to free up people who have expertise

More opportunities for SMEs to provide services as creating custom solutions or adjusting existing ones is expensive for large companies who tend to produce “bloated” solutions

Cloud computing – Attractive, already being used by large and small companies, e.g. simulation, accounting, BPM
- Many companies believe that data in the cloud is not secure
- Belief that IP issues will be resolved
- Security of data talked a lot about but belief is that future will be “access all for free”
- Security by design needed
- Encryption is available and affordable (even to SMEs) but lack of awareness

Buy in
- Quality Auditing Service, e.g. ISO 9000
- Design, simulation and accounting tools
- CRM and ERP
- ICT maintenance support
- etc.
ICT may have more impact for SME’s in Future

- Sub-assemblers who support Tier 2’s
- Tier 1’s and Tier 2’s only want to talk to one person. Do not want to manage the whole supply chain.
- ICT is allowing companies to work together to produce one product or a range of products that attack one particular sector
- Challenge is vertical integration of data flow – cradle to grave traceability is important – where does metal come from, CO₂, safety-critical, etc.
Business Opportunities

<table>
<thead>
<tr>
<th>Business Opportunities</th>
<th>Service</th>
<th>Status of Uptake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>R&amp;D</td>
<td>Current</td>
</tr>
<tr>
<td></td>
<td>Technology Consulting</td>
<td>Current</td>
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<tr>
<td></td>
<td>Innovation</td>
<td>Current</td>
</tr>
<tr>
<td></td>
<td>Retired Engineer Service</td>
<td>New</td>
</tr>
<tr>
<td>Design</td>
<td>Product Customisation</td>
<td>New</td>
</tr>
<tr>
<td>Integration</td>
<td>ICT Tailoring</td>
<td>Current</td>
</tr>
<tr>
<td></td>
<td>ICT Integration</td>
<td>Current Increasing</td>
</tr>
<tr>
<td>ICT Maintenance</td>
<td>ICT Support</td>
<td>Current</td>
</tr>
<tr>
<td>Supply Chain</td>
<td>Management &amp; Optimisation</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Sourcing Raw Materials</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Traceability/Tracking of components</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>CO2 Calculation</td>
<td>New</td>
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<tr>
<td></td>
<td>Data broker between stakeholders</td>
<td>New</td>
</tr>
<tr>
<td>Simulation</td>
<td>Factory</td>
<td>Current Increasing</td>
</tr>
<tr>
<td></td>
<td>Product</td>
<td>Current Increasing</td>
</tr>
<tr>
<td>Financial</td>
<td>Accounting</td>
<td>Current</td>
</tr>
<tr>
<td></td>
<td>Product Costing</td>
<td>Current</td>
</tr>
<tr>
<td>Customer Focus</td>
<td>CRM</td>
<td>Current</td>
</tr>
<tr>
<td>External Computing</td>
<td>Data Centre</td>
<td>New Increasing</td>
</tr>
<tr>
<td></td>
<td>Cloud Computing</td>
<td>New Increasing</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Wireless Sensors</td>
<td>New Increasing</td>
</tr>
<tr>
<td></td>
<td>Big Data Management</td>
<td>New Increasing</td>
</tr>
<tr>
<td></td>
<td>Data Mining</td>
<td>New Increasing</td>
</tr>
<tr>
<td></td>
<td>Visualisation</td>
<td>Current Increasing</td>
</tr>
<tr>
<td></td>
<td>Decision Support</td>
<td>Current Increasing</td>
</tr>
<tr>
<td></td>
<td>Energy Management/Broking</td>
<td>New Increasing</td>
</tr>
<tr>
<td>Product Services</td>
<td>Servitization Support</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Aftermarket Support</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Available Hours Contracts</td>
<td>New Increasing</td>
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<tr>
<td></td>
<td>&quot;Photocopier&quot; Contracts</td>
<td>New Increasing</td>
</tr>
<tr>
<td></td>
<td>Monitoring Own Equipment - maintenance</td>
<td>New</td>
</tr>
<tr>
<td></td>
<td>Providing process optimisation</td>
<td>New</td>
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<tr>
<td></td>
<td>(based on own machine monitoring)</td>
<td>New</td>
</tr>
<tr>
<td>Sales</td>
<td>Marketing</td>
<td>Current</td>
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<tr>
<td></td>
<td>Demand Prediction</td>
<td>Current</td>
</tr>
<tr>
<td></td>
<td>Customer Polling</td>
<td>Current</td>
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<tr>
<td></td>
<td>Renting Showcase Products</td>
<td>New</td>
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<tr>
<td></td>
<td>Security</td>
<td>New</td>
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<tr>
<td></td>
<td>Providing guaranteed security</td>
<td>New</td>
</tr>
<tr>
<td>Insurance</td>
<td>Mitigate risks for SMEs</td>
<td>New</td>
</tr>
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Difficulty in moving up the food chain, e.g.

- Pay per weld - If a company offers a welding solution for an OEM or 1-tier supplier, the level of responsibility for production downtime is significantly higher - in many cases SMEs are reluctant to offer complete solutions

- The solution in this case could be a business model of an insurance company, which takes the risk
Megatrends
Knowledge as an Enabler 1
Innovation and New Technologies 2
Resource Stress and Scarcity 3
Globalisation/Economic 4
Interconnectedness 5
Sustainability (Environmental, societal, economic) 6
Climate Change 7

Top manufacturing related trends:
Increasing complexity of products, processes, and supply networks 8
Increasing demand for personalised products and high quality 9
Extension of ICT perspective to production site/company associations 10
Companies are increasingly focussing on their core business 11
Environmental sustainability / green manufacturing 12
Demand by customers for individualized/highly configurable products 13

Push Pull Themes
Cyber physical (production) systems/intelligent components 14
Plug and Produce 15
Autonomous manufacturing system components 16
Factory knowledge base 17
Data analysis 18
Decision making / Factory optimisation / Emergent behaviour 19
User Interfaces / Improved Usability 20
Man-Machine Interaction 21
Manufacturing-IT as a Service 22
New factory level manufacturing IT features 23
Knowledge transfer between manufacturing and engineering 24
Cloud manufacturing 25
Total Customisation / Ad-hoc establishment of production settings 26
Horizontal integration and optimisation of value chains 27
Analysis

Driven by Trend

- Networking
- Technology Based
- Green/Sustainable
- Customisation
- Knowledge
- Efficient Manufacturing
- Aftermarket/Product Service
- Socially Aware
- Economic
- Conventional

Driven by ICT Solution
Mapping against 100 business models and identified business opportunities
Business Modelling Workshop

- Over 50 business opportunities were identified. The most fertile areas were in networking, efficient manufacturing and customisation.
- A surprising number of socially aware business opportunities were also identified (11 in total), however, it was noted that it was difficult in practice to monetize these.
- The most difficult business model category to address was the economic category. Well known ways of funding manufacturing enterprises exist, but the current rigid legal framework would prohibit new approaches to financing.
- A key notable feature of the outcomes of the business modelling workshop was that many of the proposed approaches rely on increased interconnectivity.
- To support this there is a need for legal support for contract law to allow networking and collaborations to occur flexibly and on the fly. In some cases insurance is needed in order to offset risk. It was also highlighted that the big business opportunity is for SMEs providing manufacturing and software services rather than larger companies.
Concluding Remarks

- Identified 100 business models and 90 business opportunities
- Ownership is likely to become more and more decoupled from use of products. This opens up a number of new ways for sharing products, providing value and generating revenue. Here IT has an important role to play in tracking, measuring and billing.
- The trend towards green thinking (also backed up by regulation) is driving the circular economy which requires an ecosystem that supports recycling and re-manufacture. This may also link with products being used rather than being owned by consumers.
- The ability to associate information with (and within) products allows much greater levels of tracking from cradle to grave. This information can be used in a variety of ways such as for gathering data on sustainability, providing personalised products, giving guarantees of provenance.
- The business models that were identified were either market driven or dependent on policy / regulations. A key example of this is green / sustainable manufacturing which is driving the development of circular economy and collaborative consumption infrastructures both at a business level and also in partnership with consumers. Market drivers towards customised products requires new levels of connection between the customer and manufacturing and also flexibility within the manufacturing supply chain.
Concluding Remarks (Continued)

- When analysing the literature and key reports produced by the manufacturing sector a number of future business models are identified. A common feature of these is a move towards servitization in manufacturing.

- From the mapping analysis of the business models to the Road4FAME inputs, and via confirmation by experts, this move towards product services and the aftermarket is much less prominent. Here it is believed that the aerospace companies who are leading the way in product services and aftermarket provision are key contributors to many of the documents. This may well have resulted in some bias and not a true representation of the manufacturing industry as a whole.

- The interviews with a cross section of industry including large and small companies both from manufacturing and the service sector has indicated a number of key issues. These include both technological issues and also issues that can only be addressed at a policy level.
Road 4 FAME

Thank you for your attention.