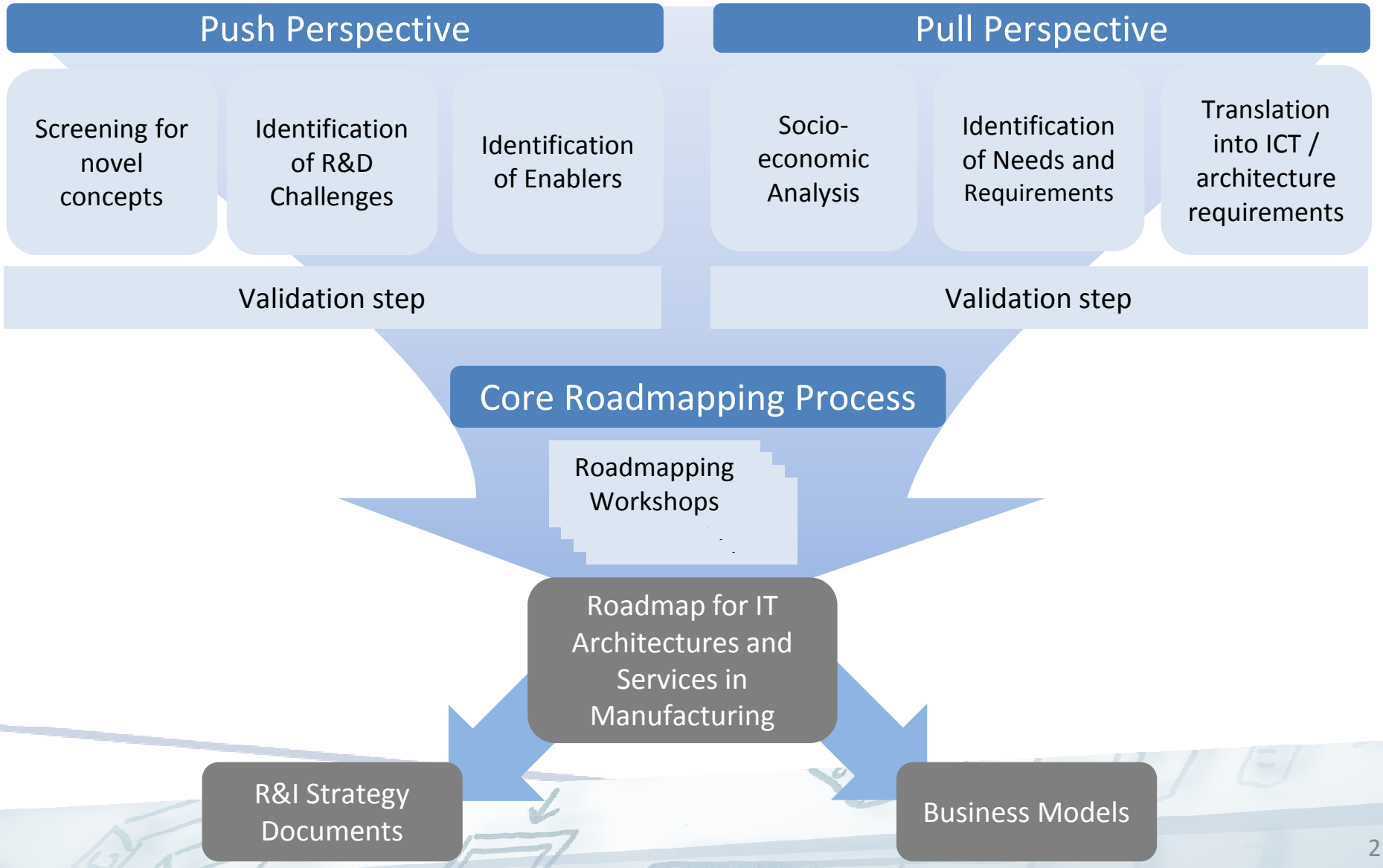
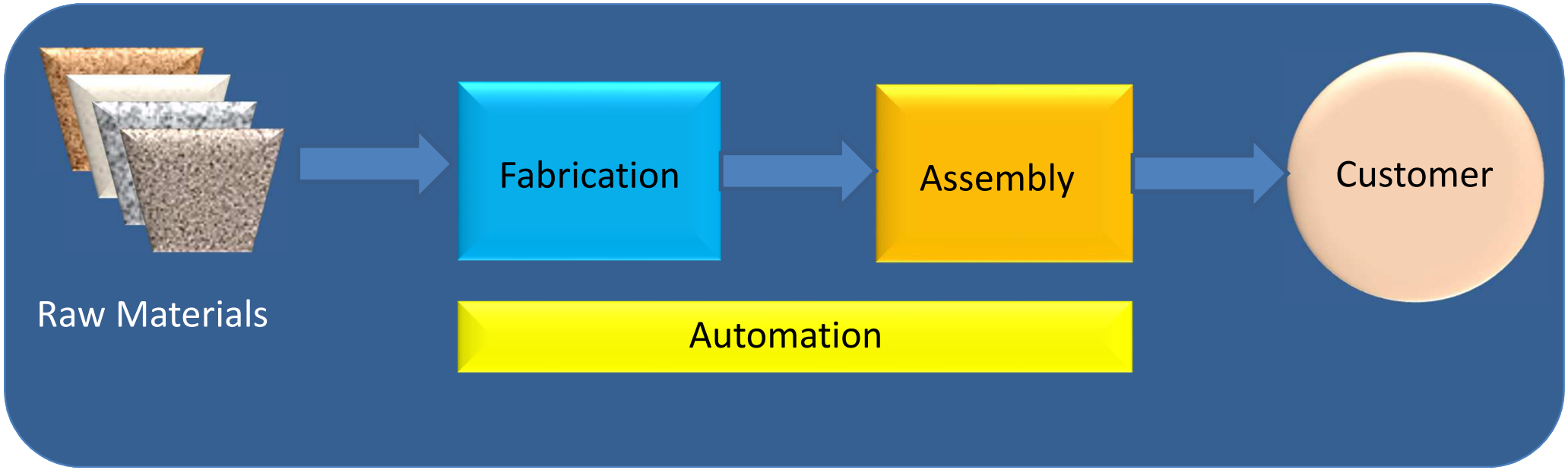
Road 4 FAME

Business Modelling
Haydn Thompson

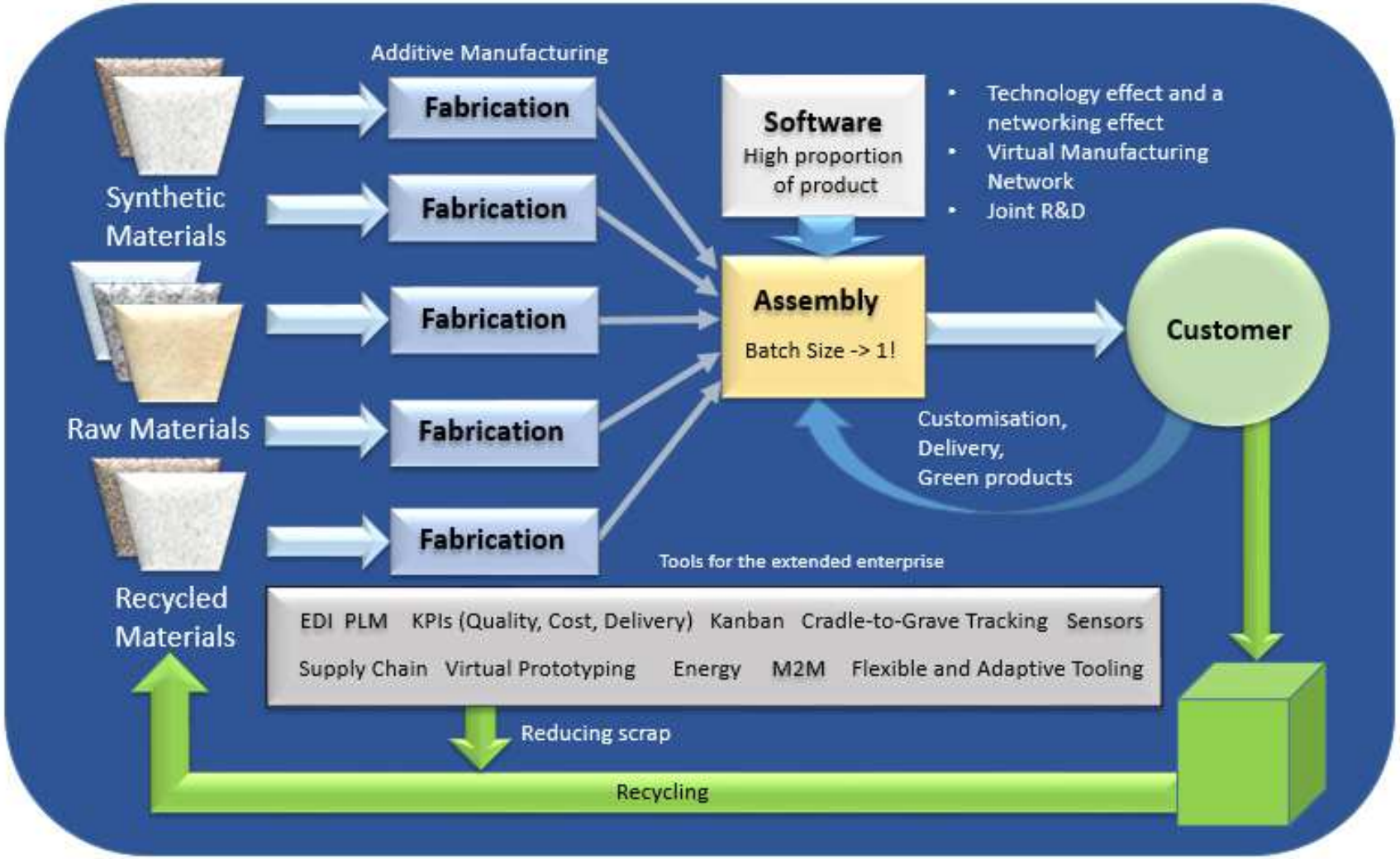
Approach of Road4FAME



How it used to be …..



Today


Additive Manufacturing
Synthetic Materials
Raw Materials
Recycled Materials
Fabrication
Fabrication
Fabrication
Fabrication
Fabrication
Software
High proportion of product
Technology effect and a networking effect
Virtual Manufacturing Network
Joint R&D
Assembly
Batch Size -> 1!
Customer
Customisation, Delivery, Green products
Tools for the extended enterprise
EDI PLM KPIs (Quality, Cost, Delivery) Kanban Cradle-to-Grave Tracking Sensors
Supply Chain Virtual Prototyping Energy M2M Flexible and Adaptive Tooling
Reducing scrap
Recycling

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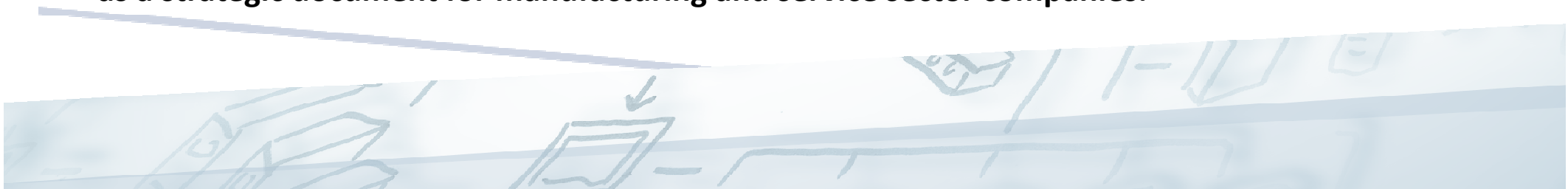
Objectives

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.



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Analyst Reports

Interviews

State-of-the Art in Business Models

14 Push/Pull Themes

Megatrends and Trends

ICT Priorities

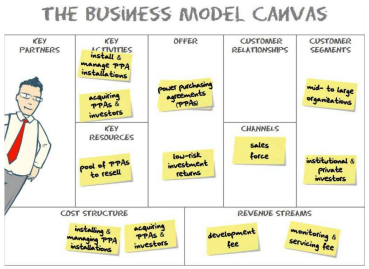
Road4FAME Recommendations

Interviews

Road4FAME Scenarios

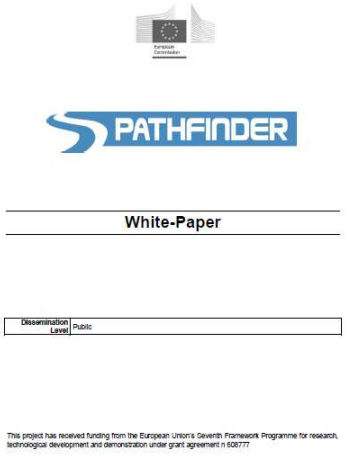
Analyse Against Business Models

Identify New Business Models/ Opportunities



Mapping against 100 business models and identified business opportunities

Documents



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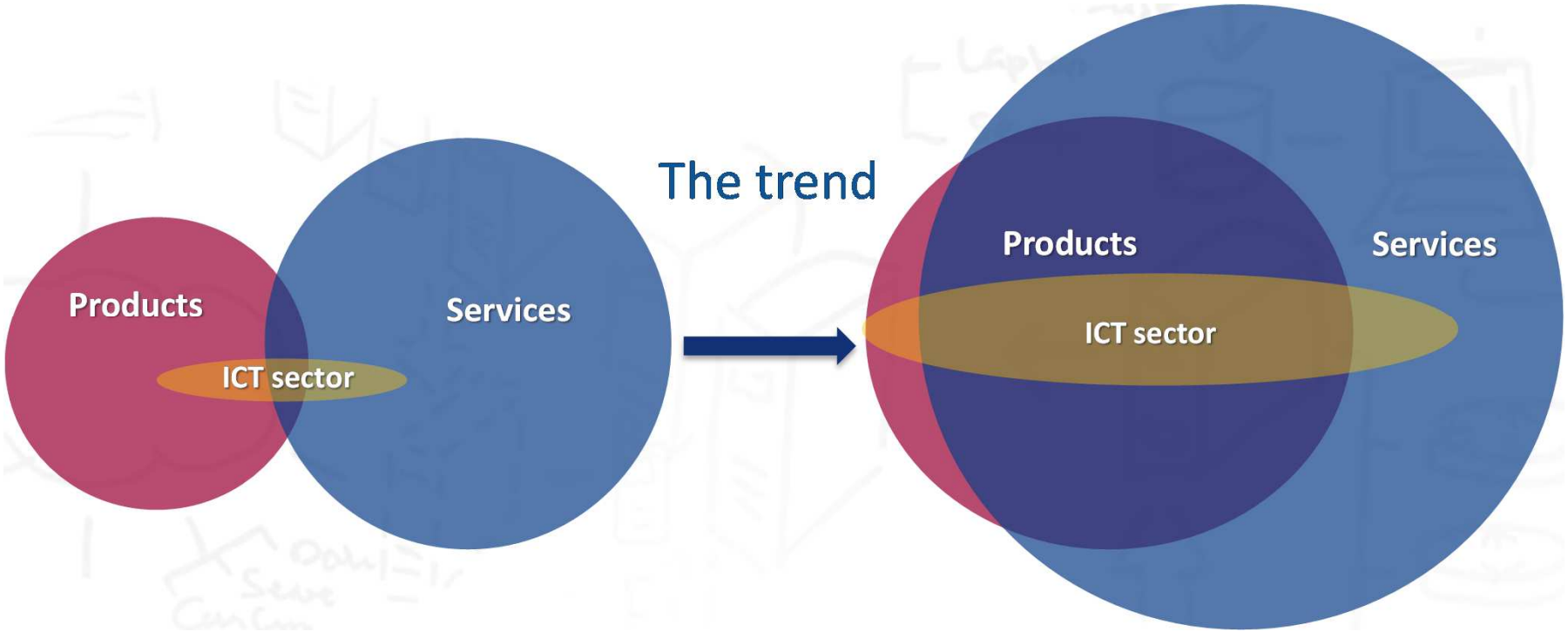
Trend Towards Services



Business Model Categorisations (100 models in 10 categories)

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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

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

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

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

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

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

Business Model Characterisations

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Product Service/Aftermarket

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

Green/Sustainable

To Achieve This	Culture
• Develop eco-conscious workforce • Monitoring of energy, raw materials usage across enterprise and supply chain • Develop understanding of cradle-to-grave impact of product on environment	• Environmentally aware • Understand value of resources and impact of enterprise on environment • Rewards reduction in energy/CO2 and materials usage

Networking

To Achieve This	Culture
• Highly connected business systems to allow exchange of information • Focus on monitoring to track product through network • Standardisation of information exchange • Flexibility to adjust and change network members	• Working collaboratively in partnership • High level of teamwork and trust between organisations • Driven by desire to meet schedules • Respect for intellectual property

Technology Based

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

Efficient Manufacturing

To Achieve This	Culture
• Standardised and simplified • Efficient in effort and co-ordination • Avoid variety, avoid niches • Occupy middle of the market where demand is huge	• Abhors waste • Obsessed with cost • Rewards efficiency

Customisation

To Achieve This	Culture
• Flexible manufacturing processes and equipment to allow easy modification/change of base product • Lost cost tailoring support for product re-design • Strong communication links with customers to allow their direct input	• Encourages customer choice and input • Encourages variety in market place • Willingness to interact closely with customers

Knowledge

To Achieve This	Culture
• Flexible structure to allow new ideas • Effective management of talented people • Robust processes that can accommodate change	• Encourage individual imagination/ideas • Results driven • Reward new product/process success • Tolerate experimentation (even when not always successful)

Socially Aware

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

Economic (Investor Supported)

To Achieve This	Culture
• Long term vision • Flexibility to meet the needs of investors • Concentrates on needs of end customers • Provides accountability to shareholders	• Reliant on external investors • Driven by long term return • High risk

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

Driven by Global Supply

- 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 CO_2 emissions – would prefer to manufacture close to assembly
- Traceability
  - Not sourcing from conflict areas. Where does molten metal come from?
  - Sustainability how much CO_2 associated with manufacture/transport?

Manufacturer's Buying in Service

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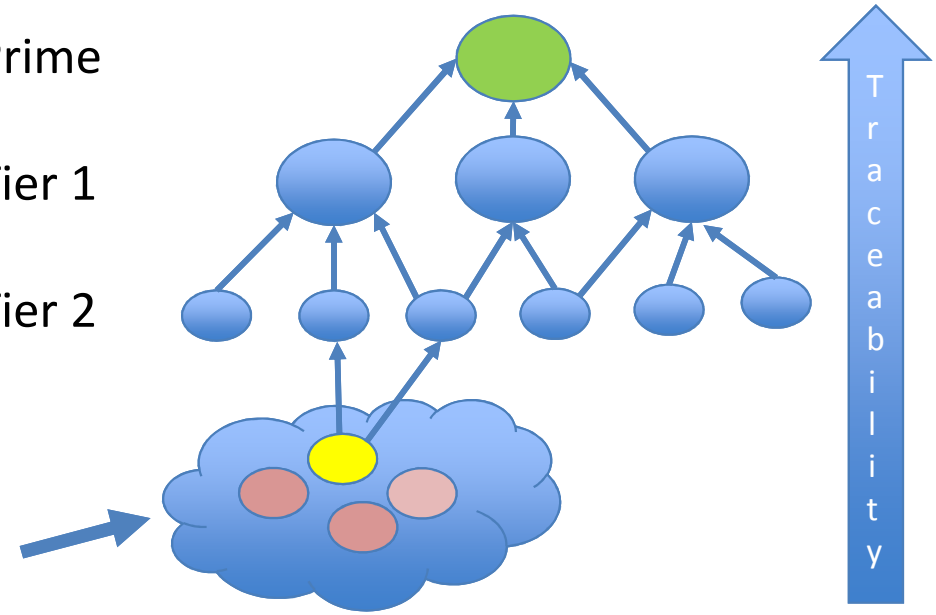
- Both large or small companies want to contract software development out
  - SME's do not have experienced staff
  - Large companies want experienced staff to work on added value software for customer
  - Problem is preventing engineers from doing "internal" software, e.g. Excel Macros, which are not 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, CO_2, safety-critical, etc.

Business Opportunities

Business Opportunities	Service	Status of Uptake
Knowledge	R&D	Current
	Technology Consulting	Current
	Innovation	Current
	Retired Engineer Service	New
Design	Product Customisation	New
Integration	ICT Tailoring	Current Increasing
	ICT Integration	Current Increasing
ICT Maintenance	ICT Support	Current
Supply Chain	Management & Optimisation	New
	Sourcing Raw Materials	New
	Traceability/Tracking of components	New
	CO2 Calculation	New
	Data broker between stakeholders	New
Simulation	Factory	Current Increasing
	Product	Current Increasing
Financial	Accounting	Current
	Product Costing	Current
Customer Focus	CRM	Current
External Computing	Data Centre	New Increasing
	Cloud Computing	New Increasing
Monitoring	Wireless Sensors	New Increasing
	Big Data Management	New Increasing
	Data Mining	New Increasing
	Visualisation	Current Increasing
	Decision Support	Current Increasing
	Energy Management/Brokering	New Increasing
Product Services	Servitization Support	New
	Aftermarket Support	New
	Available Hours Contracts	New Increasing
	"Photocopier" Contracts	New Increasing
	Monitoring Own Equipment -maintenance	New
	Providing process optimisation (based on own machine monitoring)	New
Sales	Marketing	Current
	Demand Prediction	Current
	Customer Polling	Current
	Renting Showcase Products	New
Spare Capacity	Renting Machinery	New
Security	Providing guaranteed security	New
Insurance	Mitigate risks for SMEs	New

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

Mapping

Mapping

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

Scenarios

MaaS 22	Virtual Enterprise 4,10,27
High Volume Production	Green Enterprise 3,6,7

Business Models

- Conventional
- Green/Sustainable 3,6,7,12
- Socially Aware 7
- Customisation 9,13,26
- Networking 4,5,10,15,27
- Efficient Manufacturing 3,19
- Technology Based 2,14,16,25
- Knowledge 1,17,24
- Aftermarket/Product Service 22
- Economic

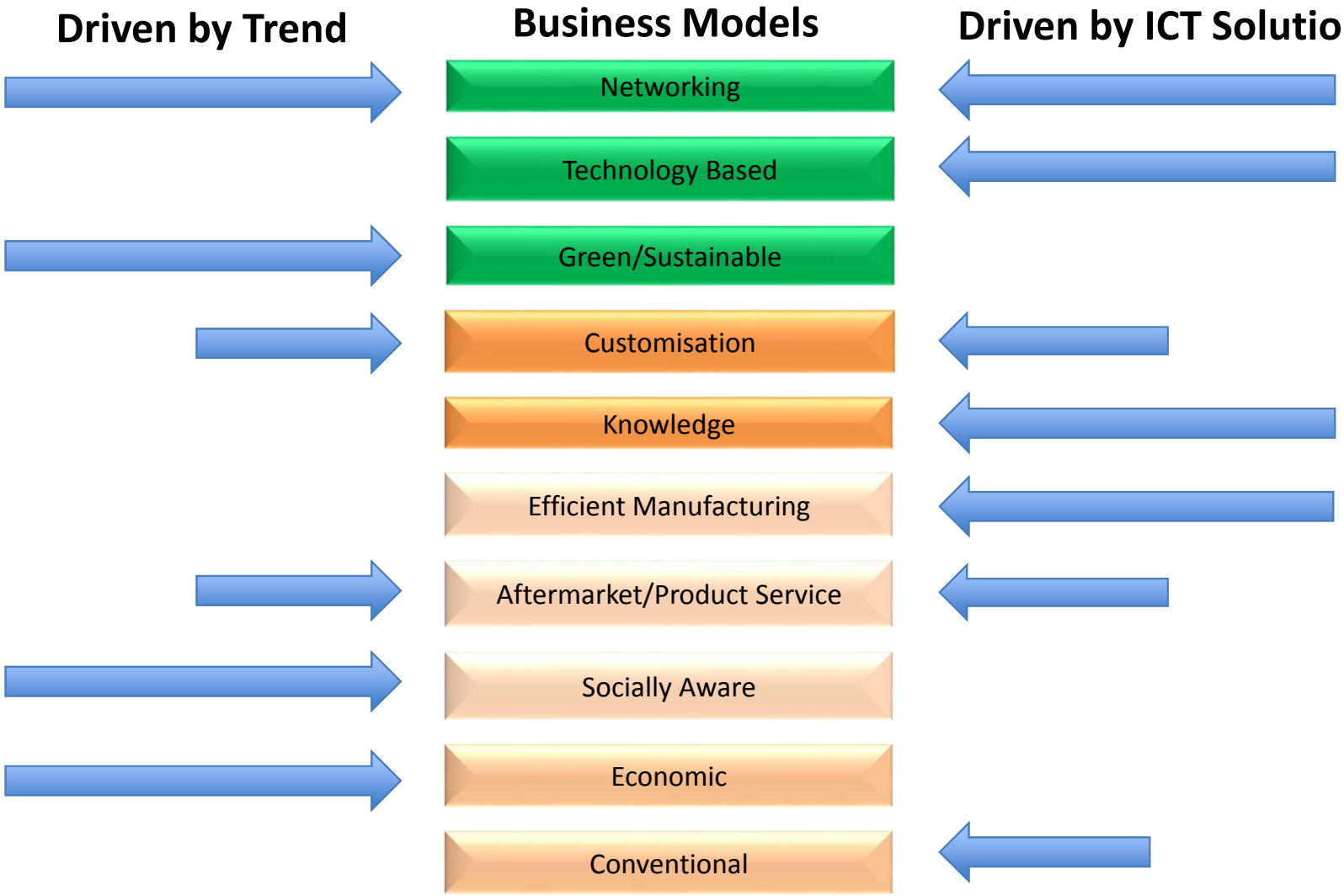
Business Opportunities

- Knowledge 1,17,24
- Design
- Integration 14,15
- ICT Maintenance
- Supply Chain 4,5,27
- Simulation
- Financial
- Customer Focus
- External Computing 10,18,22,25
- Monitoring 18
- Product Services 22
- Spare Capacity
- Security
- Insurance

Recommendations

- Integration (Efficiency) 14, 15
- Data and Information (Efficiency) 18
- Machine Learning & Flexible Manufacturing (Customisation) 9,13,,16,26
- Multidisciplinary Modelling (Complexity) 8
- Security (Networking)
- Privacy (Networking)
- Demonstrators and Education

Analysis


Driven by Trend
Business Models
Driven by ICT Solution
Networking
Technology Based
Green/Sustainable
Customisation
Knowledge
Efficient Manufacturing
Aftermarket/Product Service
Socially Aware
Economic
Conventional

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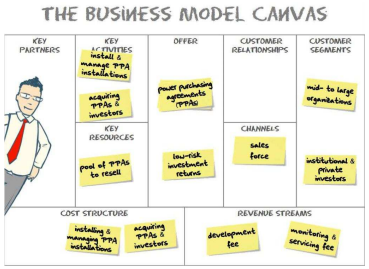

Mapping against 100 business models and identified business opportunities

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.

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Thank you for your attention.