Digital Manufacturing

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The DMDII Consortium: A partnership of leading manufacturing companies, universities, and government

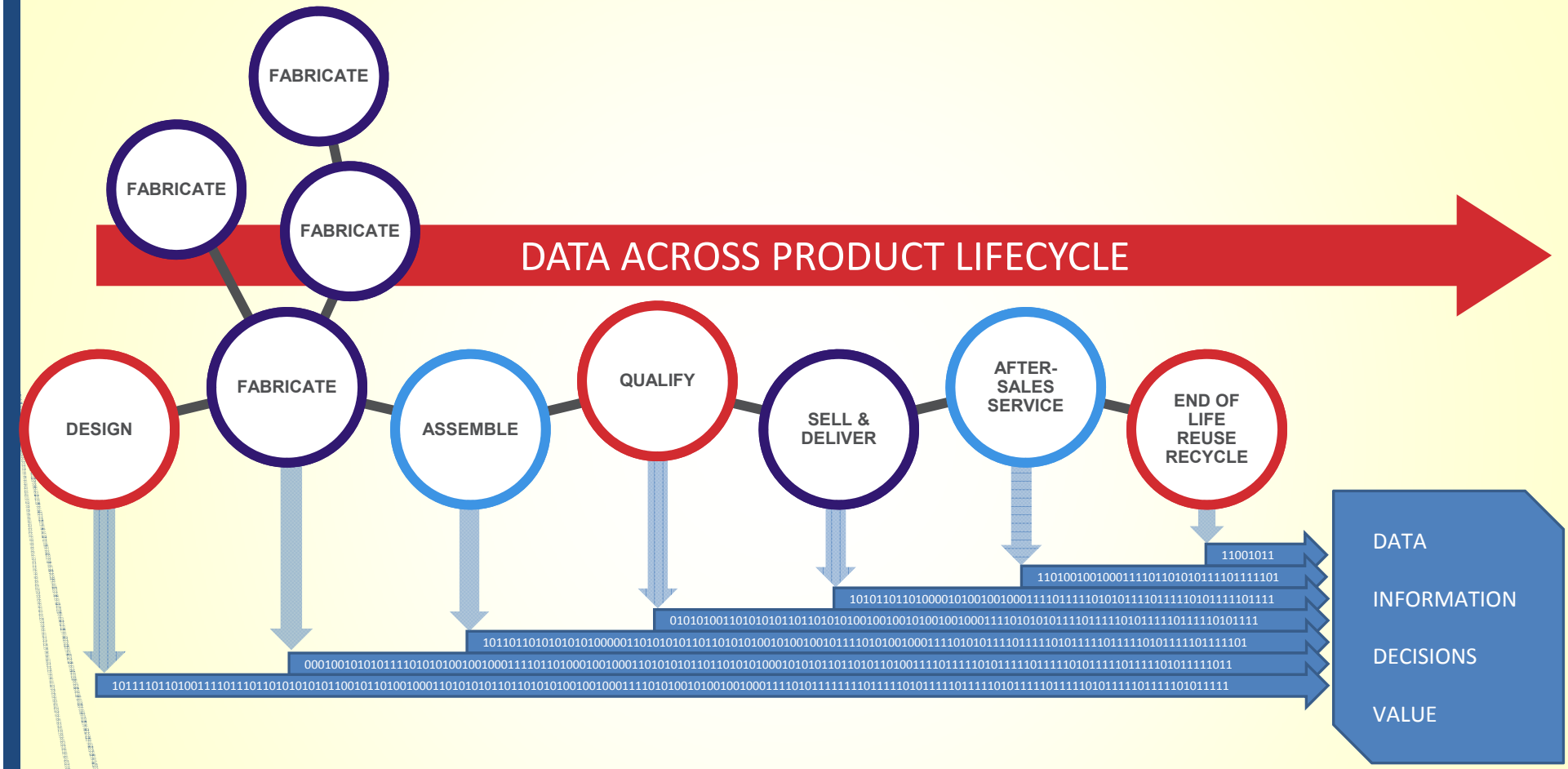
A partnership of world-class companies including:

Top universities including:

Proven talent from numerous state, educational, and vocational institutions:

Hundreds of **Small and Medium Sized Manufacturing Enterprises (SMEs)** seeking to improve competitiveness:

DMDII Vision for Digital Manufacturing



Manufacturing: Historical Perspective

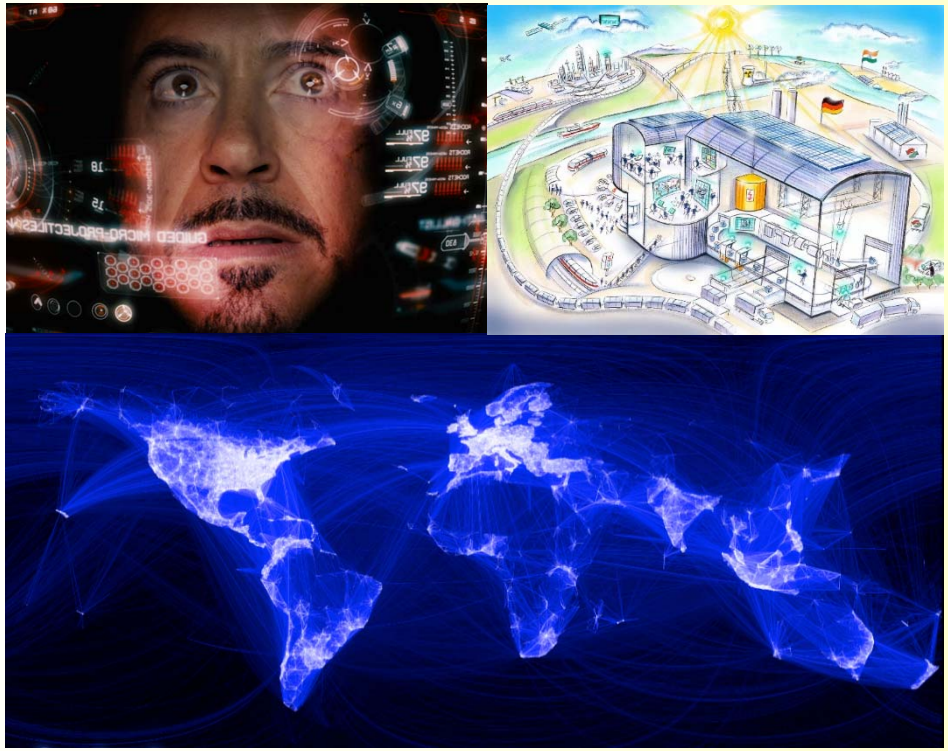
- **Linear process** through design, make, and deliver
- **Commoditization** of labor

Manufacturing: The Landscape Today

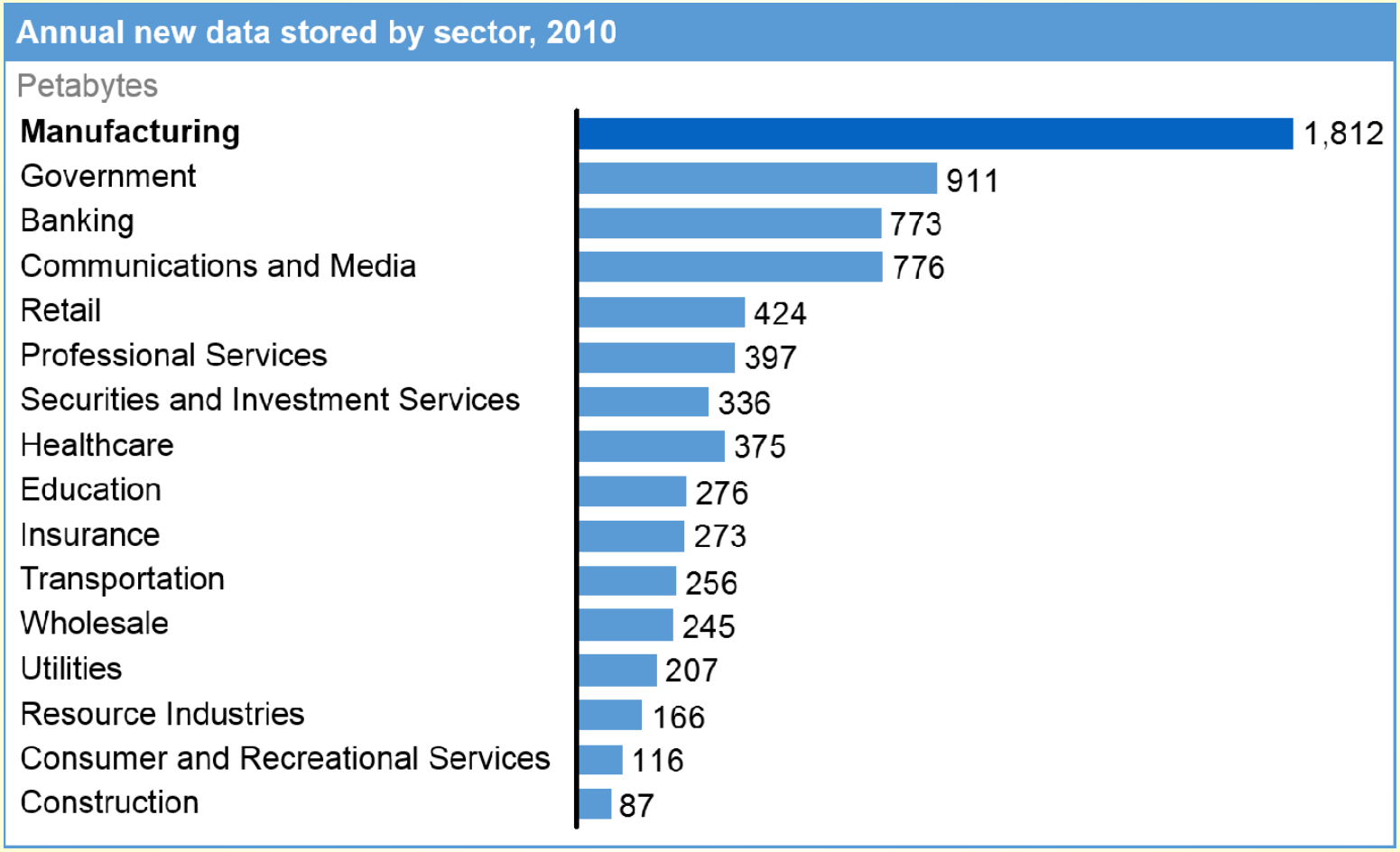
- **Materials**: Rising costs and supply constraints
- **Production Overcapacity**: reduced profitability
- **Labor**: Increasing costs globally, skills gap
- **Outsourcing**: separation of designers and makers has slowed innovation
- **Barriers for Sharing Data and Information**: technology, skills, incentives, security, trust, IP, standards

Manufacturing: The Future

- **Digital link** between design and fabrication
- **Connected** machines, factories, and supply chains
- **Transparency** into supplier factories
- **Data aggregation, analysis, and action** across the product lifecycle
- **Leverage the power of data analytics and networks** to do more with existing resources



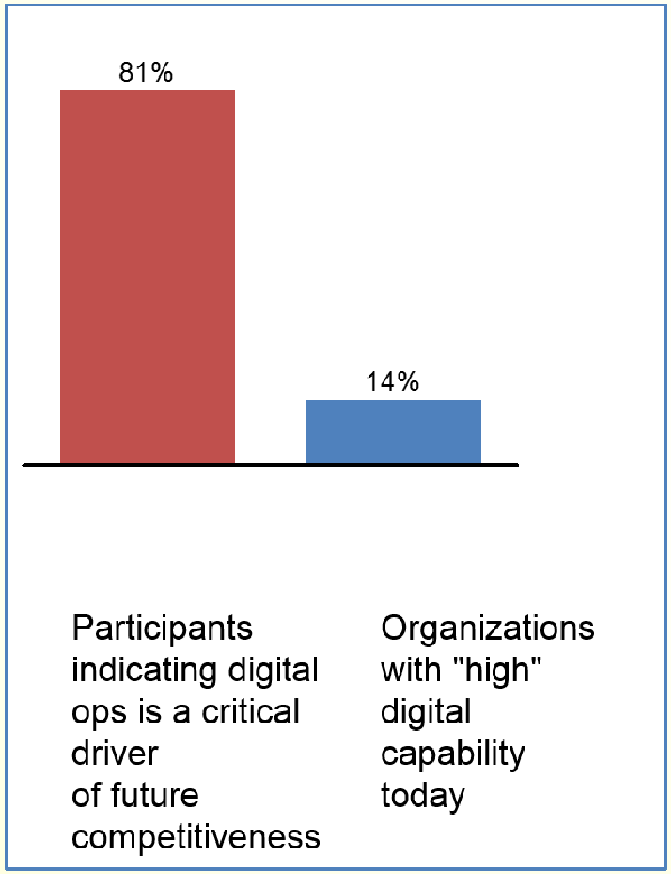
Manufacturing already generates more data than any other sector



1 Discrete manufacturing constitutes 1072 petabytes; Process manufacturing 740 petabytes

SOURCE: IDC; McKinsey Global Institute analysis

Despite the recognition of importance for digital manufacturing, most organizations feel they lack the necessary capabilities

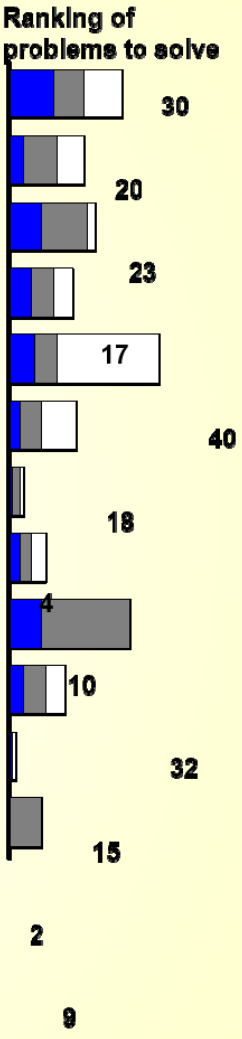


DMDII Technology Roadmap Guiding Principles

- **Start with the business need:** Entire strategy is focused on how the application of advanced manufacturing technologies can solve specific business problems (i.e., “market pull” versus “technology-push”)
- **Build and cultivate a diverse, distinctive, industry-led team**: Assembled collaborative & committed team of advanced manufacturing firms across sectors, large & small, public and private
- **Co-create the value proposition & strategy:** Enlist the industry partners to define the strategy, operating model, project approach to build buy-in along the way
- **Build an aligned industry roadmap:** identifying a common set of problems across partnership, and aligning on an industry technology and project roadmap
- **Bias to action… and creating demand:** place a premium on speed and efficiency in launch and operation, getting to tangible impact soon through demonstration projects, which show what is possible and create demand for broader adoption
- **Self-sufficiency through impact:** doing the above will yield a high-value institute, that will create value – not just from membership fees, but from value it creates

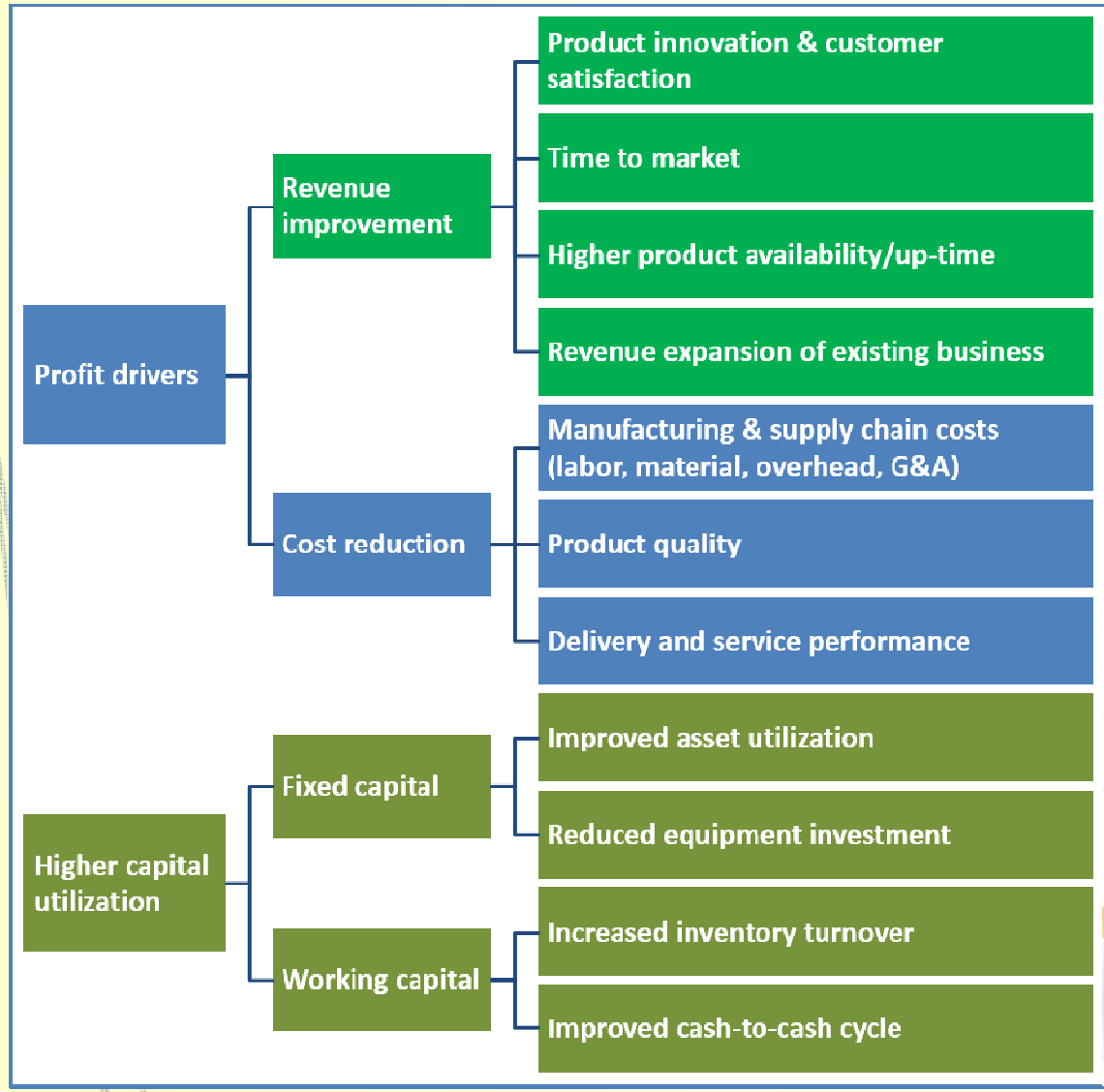
Broad alignment exists for the top problems for DMDII to solve

Theme	Sub-theme	Description of theme from interviews (paraphrased)
Integration of the digital thread	Optimization across value chain	• "Integration of digital tools, hardware, & standards across the value chain, enabling information sharing and optimization at a macro level"
	Big data	• "What data to collect, what subset to analyze, how to analyze it, and how to implement insights"
	Standard data format & machine communication	• "Interoperation between different platforms (e.g. SAP vs. ABB)" • "Standard machine communication platform for intelligent machines"
	Cyber-Security	• "Cyber-security for CAD/CAM/CAE tools and for "Internet of things"" • "Data-rights management, balancing security vs. information sharing"
	Make-design link	• "Process improvement/safety knowledge set embedded into the design environment" and "virtual qualification testing"
	Tracking product performance in the field	• "Integration of product usage/performance data into product design"
	"Real time" supplier visibility	• "Production performance visibility, allowing for adaptability to system perturbations"
Leadership/ organization capabilities	Commercialization of lab technologies	• "Collaboration with end-users to enable rapid iteration (e.g. "fail often, fail fast")"
	Articulation of business case for digital	• "Clear business case for adoption of digital technologies (e.g. through example use cases) "
	Workforce training/availability	• "Shortage of analytic, IT skill-sets"
Other	Enabling of mass-customization	• "Enabled by manufacturing agility, collaborative, customized design, and cheaper validation"
	Barriers to user adoption	• "Accessibility/ease of tool use for a range of user demographics and skill sets"



SOURCE: DMDII workshop, May 2014

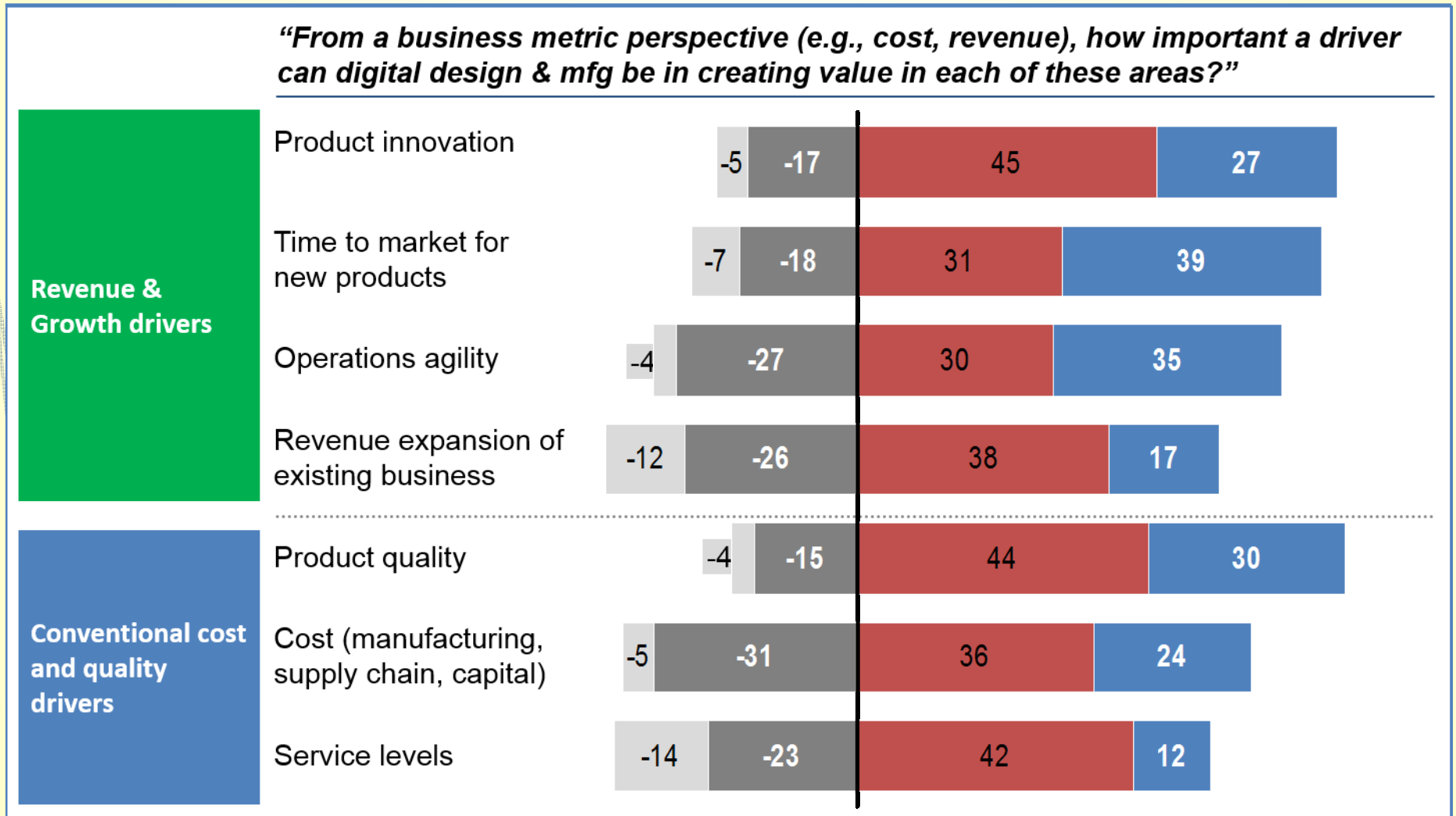
Digital manufacturing is driven by clear sources of value – and new opportunities driven by growth



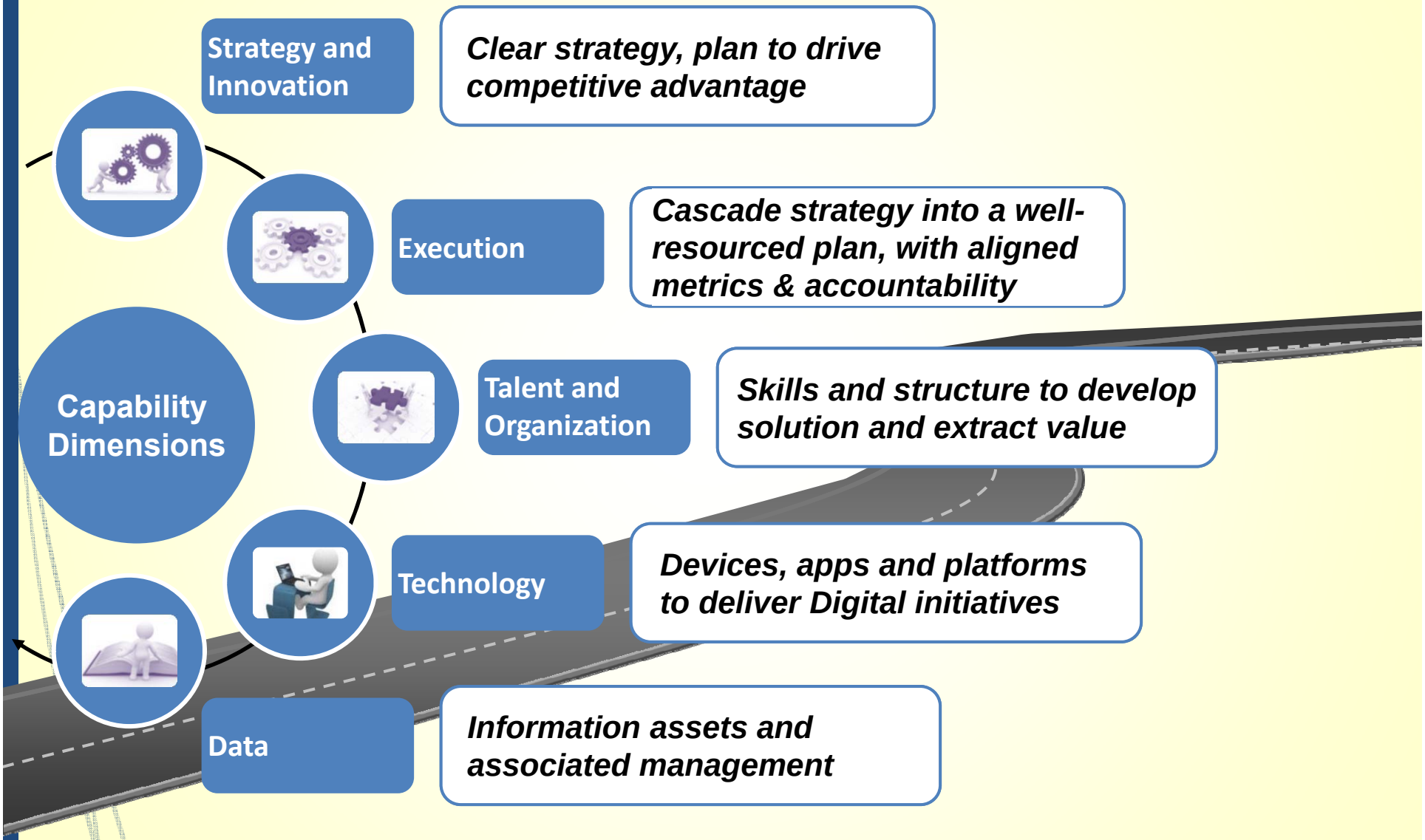
For the processes and capabilities that drive each branch, measures of improvement include:

- Efficiency
- Effectiveness
- Speed
- Agility (ability to change for upside benefit or downside protection)
- Risk profile

Digital is starting a paradigm shift: from operations as a cost & execution vehicle… to also an engine for innovation & growth



Organizations realize that technology creates no value…on its own



DMDII Strategic Investment Plan December 2014

Advanced Manufacturing Enterprise

Information systems integration throughout the product lifecycle.

Digital links between design and fabrication.

Smart factory and supply chain management.

1. **Design for "illity" tradeoffs including design for manufacturability**
2. **Real-time optimization of the digital factory**
3. **End to end supply network integration**
4. **Full system integration of the digital fabric**
5. **Completing the model based definition**
6. **Gap in SME engagement in digital manufacturing**

Intelligent Machines

Integration of smart sensors and controls to enable equipment to automatically sense and understand current production environment in order to conduct "self-aware manufacturing".

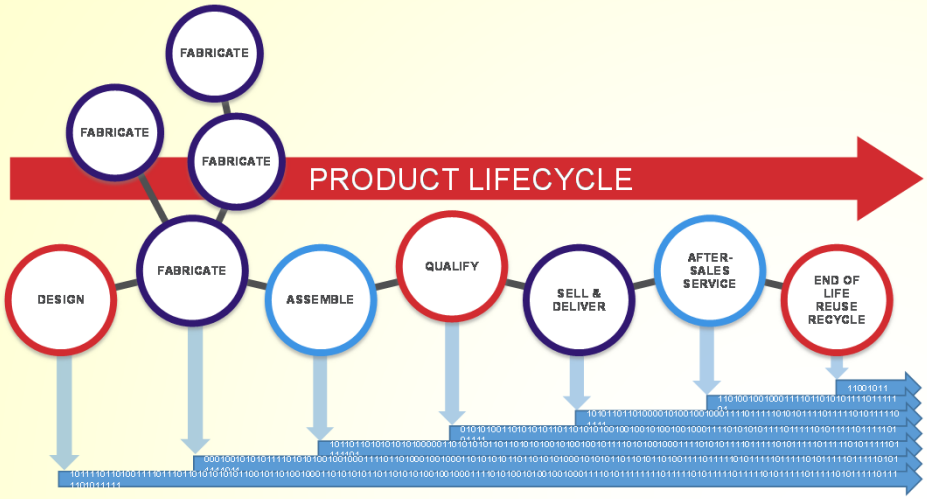
1. **Plug-and-play networking for intelligent machines**
2. **Operating system for cyberphysical manufacturing**
3. **Cyber security for intelligent machines**
4. **Intelligent machine toolkit**

Advanced Analysis

Computing to model materials, products and processes to enable "design with manufacturing in mind".

1. **Agile manufacturing to compensate for production variability**
2. **Model-based source-agnostic product design**
3. **Factory floor wearable computing and augmented reality**

Digital Manufacturing: Key Takeaways



Manufacturing is on the brink of a digital disruption, which will transform the sector over the next 10 years.

Manufacturing will become more productive, more agile, and will be a source of new business growth.

http://www.dmdii.uilabs.org/