AME CHICAGO INTERNATIONAL CONFERENCE 2019

NOV. 4-7 Leading ON THE Edge

Designing for the Environment and the Bottom Line

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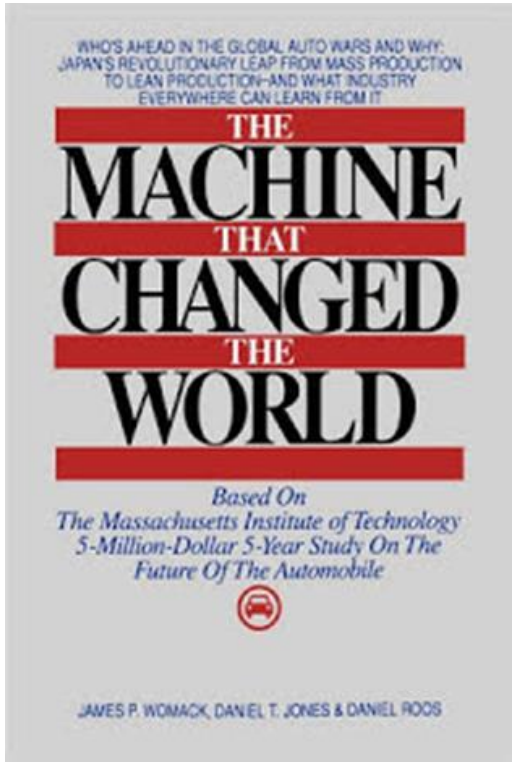
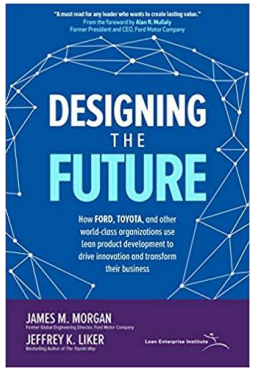


A system that achieves higher quality while utilizing

- Half the human effort in the factory
- Half the manufacturing space
- Half the tooling investment
- Half the engineering hours
- Half the product development time compared to mass production

Concurrently developing the product and process to create products and value streams using half the resources

Lean Product and Process Development



UNDERSTAND CUSTOMERS

- Creating the Right Product

PROCESS EXCELLENCE

- Deliver with Speed & Precision
- Fixed & Flexible

DOCUMENTED KNOW-HOW

- Creating & Applying Knowledge

EXCEPTIONAL PEOPLE

- Build High Performance Teams & Members
- Leading Development

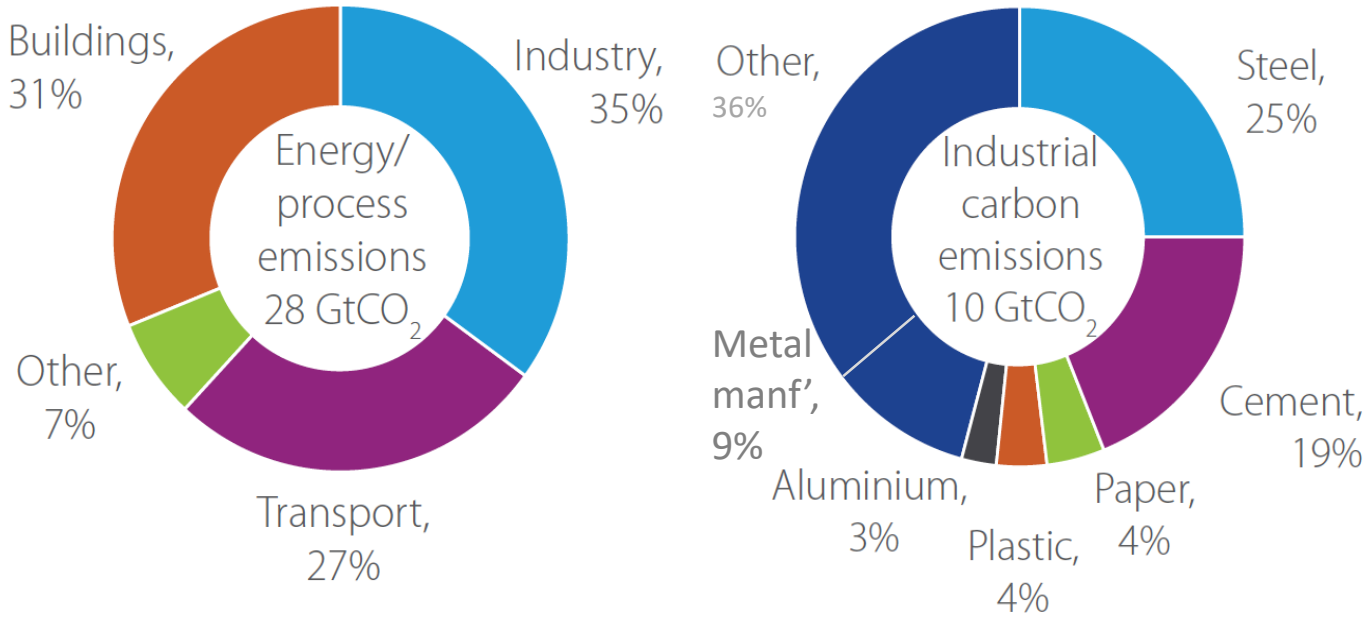
Pursue Product Perfection

Study / Concept Phase: Understand What Your Product Must Be

Execution: Detailed Design

Execution: Industrialization

Why Sustainable Design?
Global Emissions

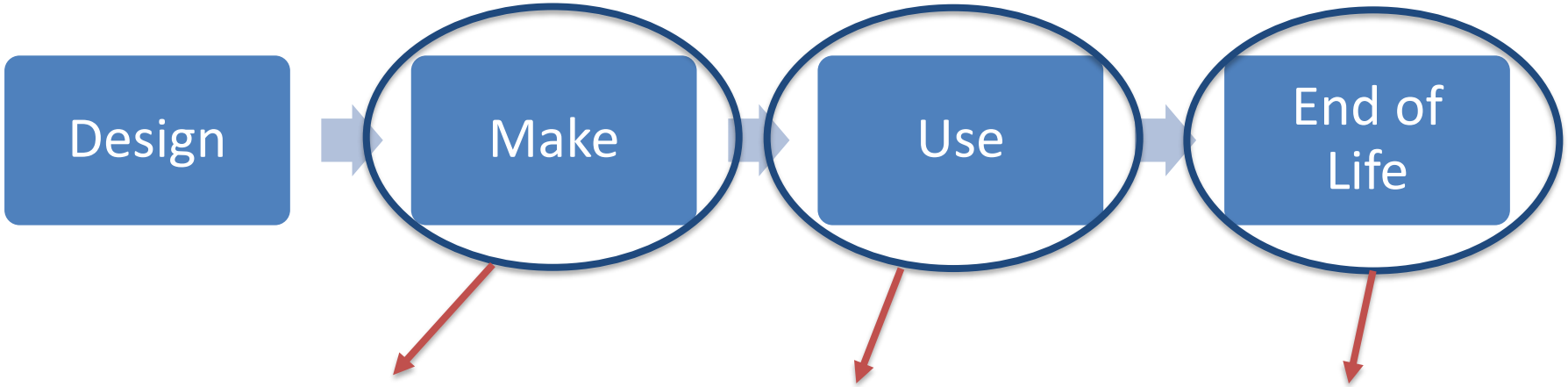


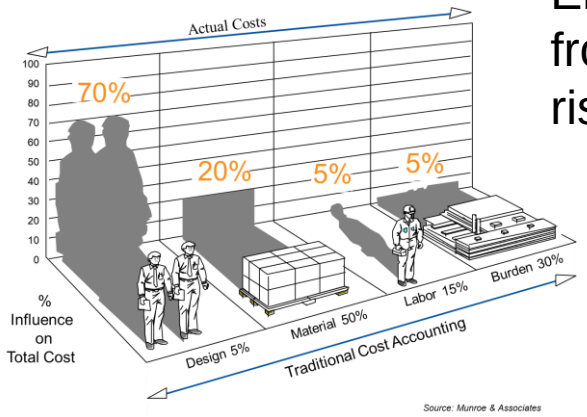
Opportunities in manufacturing: Resource efficiency

- **Material efficiency.** E.g., 25% of steel & 40% of aluminum is scrapped along the supply chain
- **Energy efficiency.** E.g., Efficient motors, hydraulic & compressed air systems

Why focus on minimizing emissions in the design phase?

Product Life Cycle





Environmental impacts from production are rising

Often where most environmental impacts occur but has been decreasing in recent years

Design determines potential for component reuse, remanufacturing and material recycling

Sustainable and Efficient Design

Make

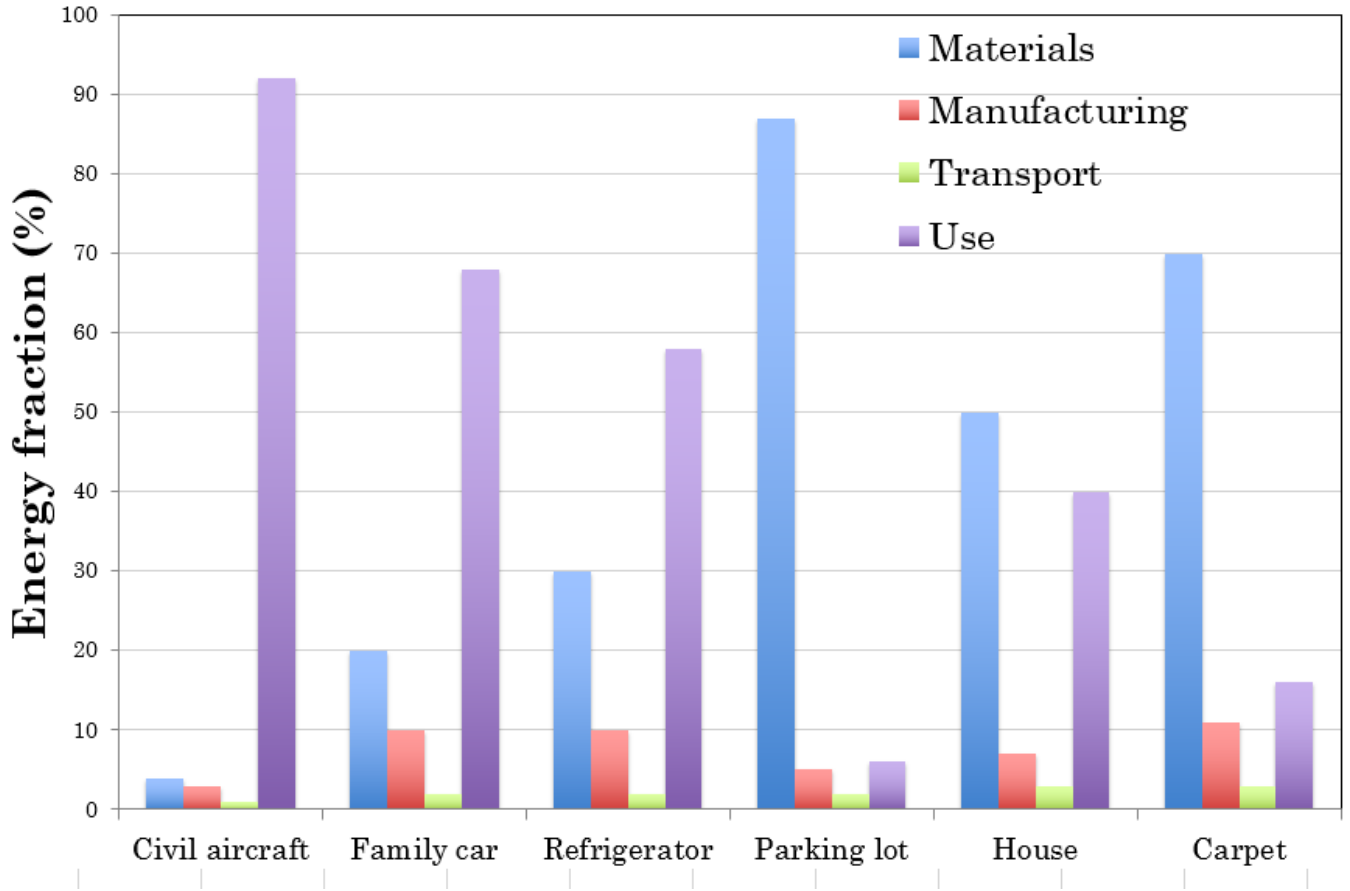
- Energy utilization
- Material utilization

The factors that impact the environmental impact of design are also efficient for the cost of production

– minimizing energy and material usage

Tools for identifying opportunities

Life cycle assessment (LCA)



Mike Ashby. 2012. Materials and the Environment: Eco-informed Material Choice

Tools for identifying opportunities

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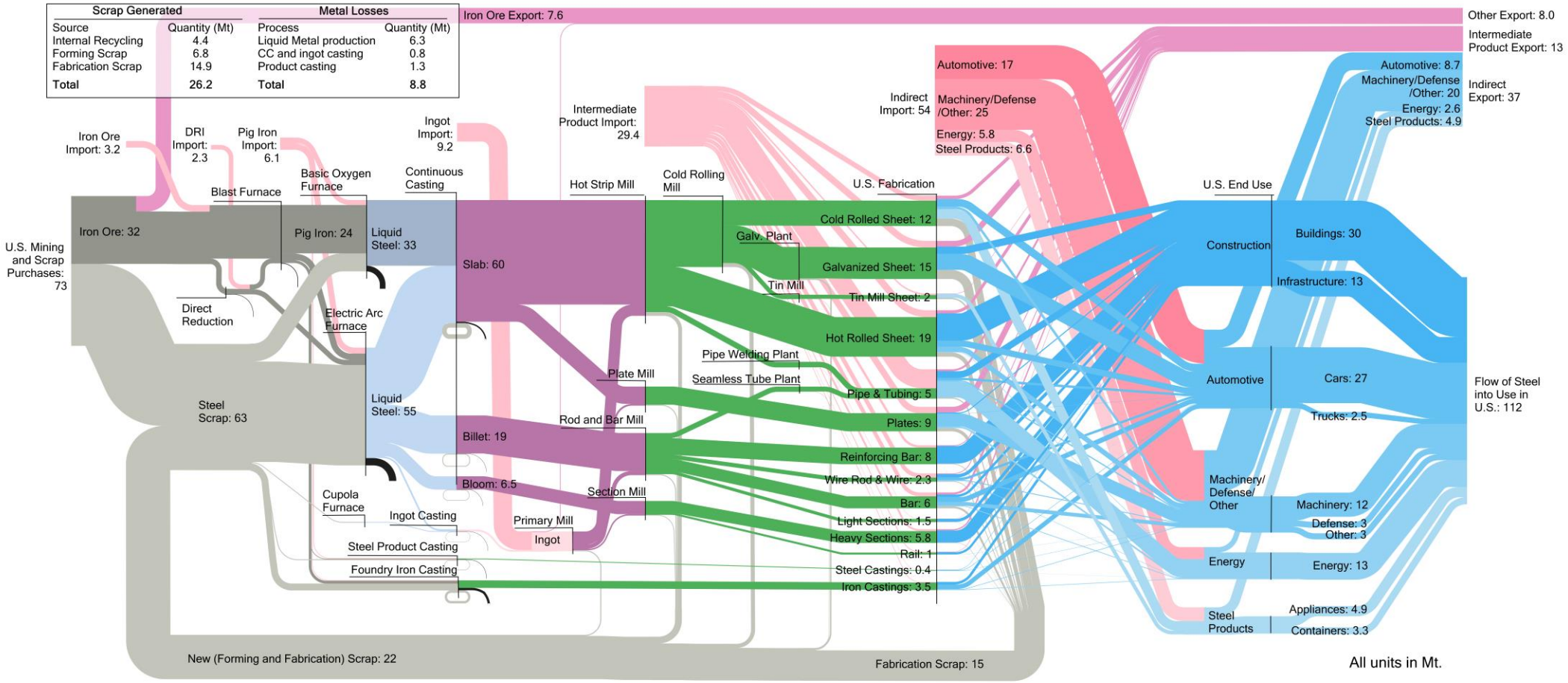
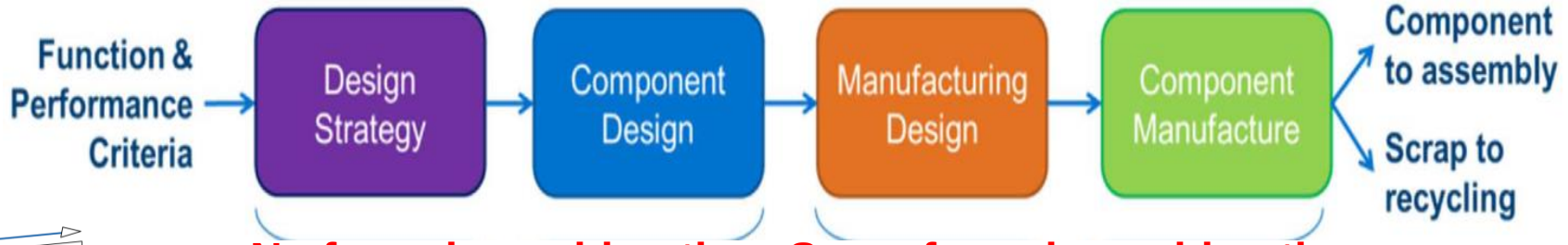
Material flow analysis (MFA)

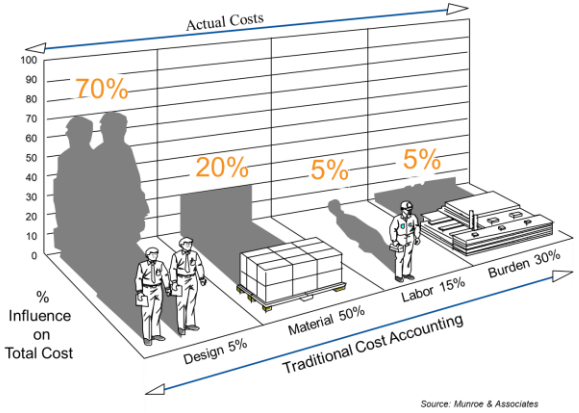


Zhu, Y., Syndergaard, K., and Cooper, D. (2019) Mapping the Annual Flow of Steel in the United States. Environmental Science and Technology.

Why Lean Product and Process Development?

Decisions that impact the sustainability and efficiency of designs are often made without understanding the impact





(Horton & Allwood, 2017)

"Designers need to consider *material and energy utilization.*"
- Easy to say, but for it to happen it needs to be built into the development system

Building it into the Development System (Study Phase)

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Understand Customers: Creating the right product

- Understand what the product needs to be and get alignment across the organization using a concept paper

Use

- Deeply understand how the product is used
  - Observation (Chief Engineer Immersion, High Tech Anthropology)

Make

- Understand production processes and design impacts.
- Set material and energy utilization targets at the start of the program, so they can be actively managed to achieve.
  - Bring cross-functional knowledge and objectives into the early phases of development.

Building it into the Development System (Execution Phase)

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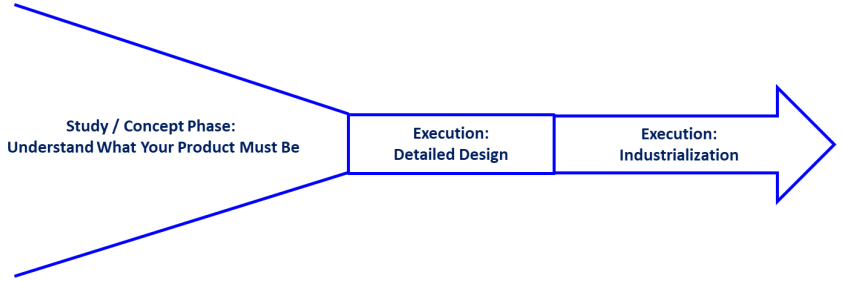
Process Excellence: Deliver with speed and precision

- Actively manage to meet targets / Create actionable plans
  - Milestones w/ quality of event criteria
  - Glide paths
- Effectively collaborating to meet the targets
  - Compatibility before completion
  - Obeya

Documented Know-How: Capturing & Applying Knowledge

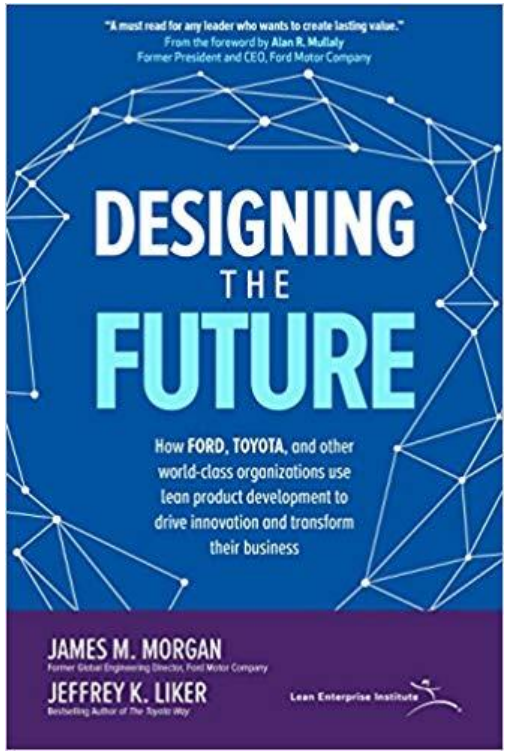
- Building the knowledge into the development system
  - Design guides



Ford: F-150

Lighter product, less scrap in production, maximized value of scrap

- Lighter product (use-phase)
- Less scrap in production (make-phase)
- Maximized value of remaining scrap (make-phase)



Ford: F-150

Lighter product, less scrap in production, maximized value of scrap

- Lighter product (use-phase)
- Less scrap in production (make-phase)
- Maximized value of remaining scrap (make-phase)

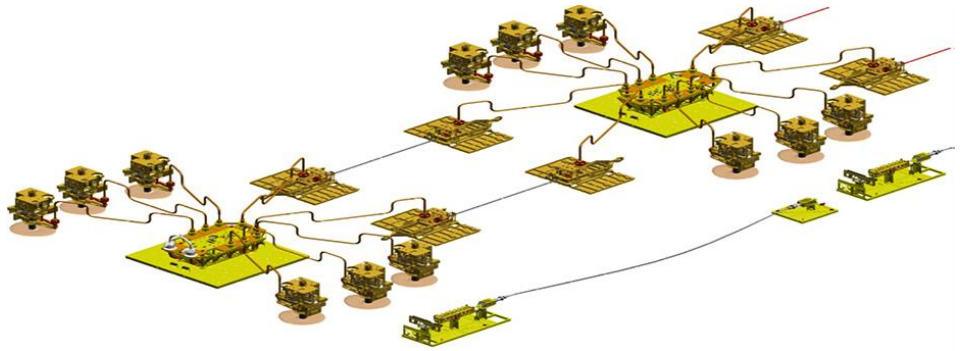
Delivered through:

- New KPIs
- Design & manufacturing collaboration
- Relentless collaboration with suppliers

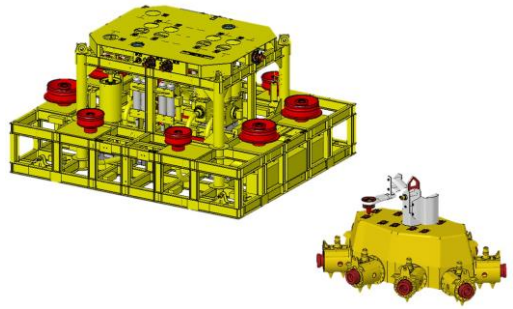
TechnipFMC: Subsea 2.0

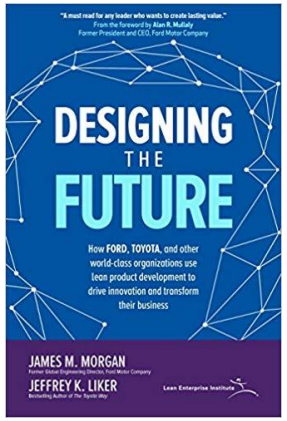
Seafloor production system (Oil & Gas)

- Program targets
  - Half size
  - Half part count
  - Half weight
  - Half cost



- Benefits (For the environment and bottom line)
  - Reduced production cost (make phase)
  - Reduced material environmental impact (make phase)
  - Reduced installation cost (make phase)
  - Reduced carbon foot-print 40-50%
  - Dramatic reduction in cost including the lowest total cost of ownership

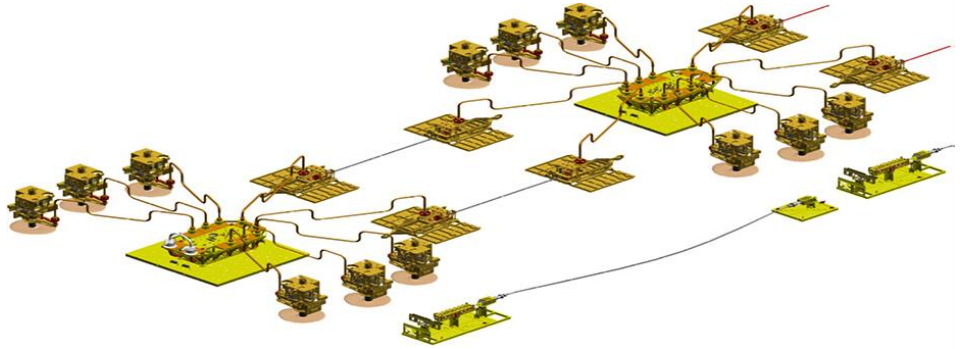


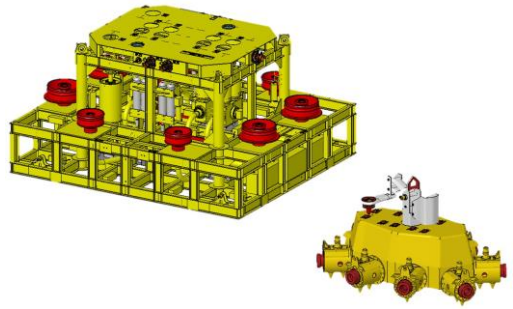


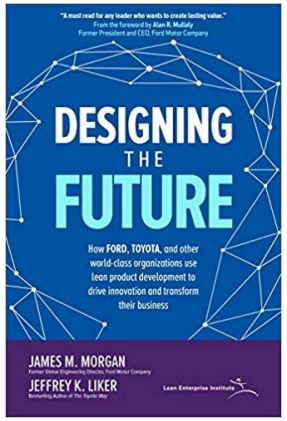
TechnipFMC: Subsea 2.0

Seafloor production system (Oil & Gas)

- LPPD was used to meet targets
  - Concept paper
  - Chief engineer
  - Obeya
  - Whole enterprise involved early in development
  - Set-based design – keep alternatives open longer
    - Trade-off curves







How does this impact your organization?

Opportunity to participate in on-going research on this topic.

- We are looking to pull out themes (opportunities and barriers) from this session.
- We will not use any specific examples without approval.

Discussion topics

- Where are the environmental impacts in your manufacturing operations? (5 mins)
- What are the opportunities to reduce the environmental impacts and improve your bottom line? (5 mins)
- How can lean product and process development principles and tools deliver these benefits? (5 mins)

Where are the environmental impacts in your manufacturing operations?

- Guidance:
  - In the materials you purchase
  - Components from suppliers
  - Running the factory: HVAC, lighting, air exchanges for clean room environments
  - In the by-products and wastes; e.g., hydraulic oil, material scrap
  - The manufacturing processes used to convert materials to components
  - Scrap from defect products
  - Anticipated scrap from manufacturing processes (e.g., stamping offal)

What are the opportunities to reduce the environmental impacts and improve your bottom line?

- Potential ideas:
  - Standardize components to prevent unnecessary rework and encourage reuse and repair
  - Optimize to reduce weight & improve performance
  - Eco-informed material selection
  - Reduce part rejects
  - Reduce scrap from manufacturing processes
  - Increase product lifespans and charge for servicing instead

How can lean product and process development principles and tools deliver these benefits?

- Potential ideas:
  - Concept Paper
  - Chief Engineer
  - Obeya
  - Getting the cross-functional organization engaged earlier in development
  - Milestones w/ quality of event criteria
  - Glide paths
  - Compatibility before completion
  - Design guides

Where else can these ideas work?

- Are you interested in exploring this further and / or participating in the research? Contact us:
  - appell@umich.edu
  - drcooper@umich.edu