PLM Road Map™ & PDT North America 2024

Value Drivers for Digitalization of the Product Lifecycle

Insights for the PLM Professional—Why the investment, what are the returns, and how are they achieved?

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DESIGN FOR SUSTAINABILITY

DEVELOPING A DESIGN OPTIMIZATION CULTURE

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DESIGN FOR SUSTAINABILITY RECIPE

- We **know WHY** we need to act.
- We **know WHAT** we need to do.
- Yet, we **don't know HOW** to do it.

We must act collectively to maximize and expedite our impact on the planet.

> Climate change is the existential crisis of our time, and we must act **TODAY** to solve it.

- From diesel engine company to **power solutions provider**
- Produce 1.5M+ engine systems annually
- Strong advocate of stringent emissions, GHG regulations
- **Provide decarbonized solutions**
  - Alternative fuel ICE systems
  - Hybrid powertrains
  - PEM fuel cell hybrid systems
  - Battery electric powertrains
  - (Green-H2) PEM electrolyzer systems

WHY...FOCUS ON SUSTAINABILITY?

> 90%

World's children breath toxic air every day.

205 million

Lives affected annually by weather related events.

4 billion

Experience water scarcity at least one month of the year.

WHAT…TO DO ABOUT IT (BY 2030)?

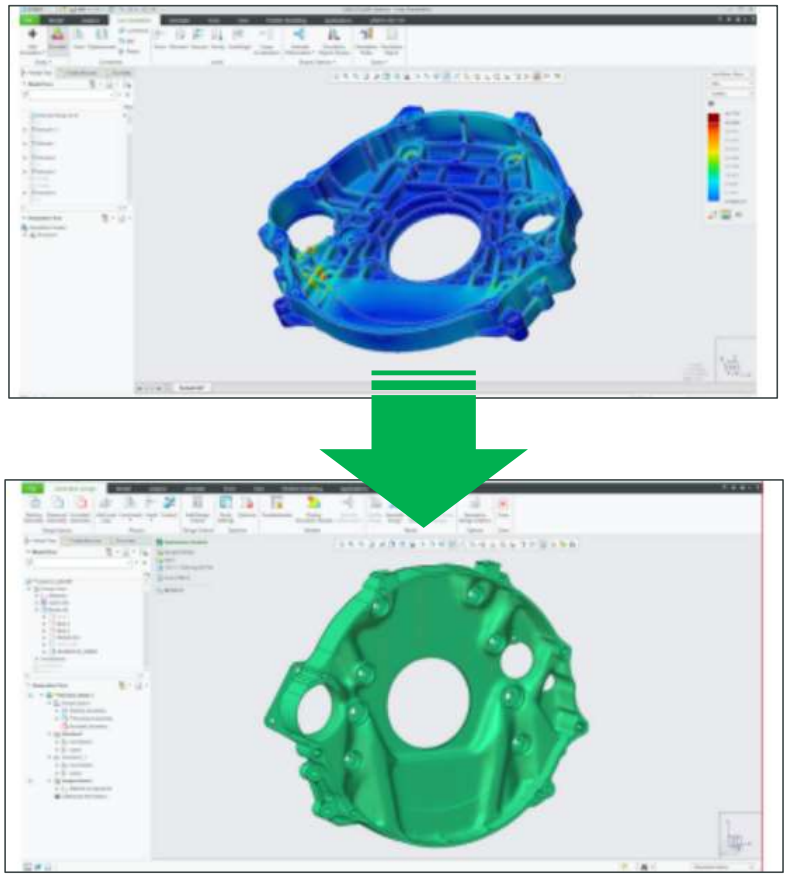
- Facilities and Operations
  - ↓ GHG emissions by 50%
  - ↓ Water by 30%
  - ↓ Waste by 25%
  - ↓ Organic compound emissions by 50%
- New product Scope 3 emissions by 25%
- Scope 3 emissions by 55M metric tons
- **Circular lifecycle plan for <u>every</u> new part – use less, use better, use again**

Design for Sustainability

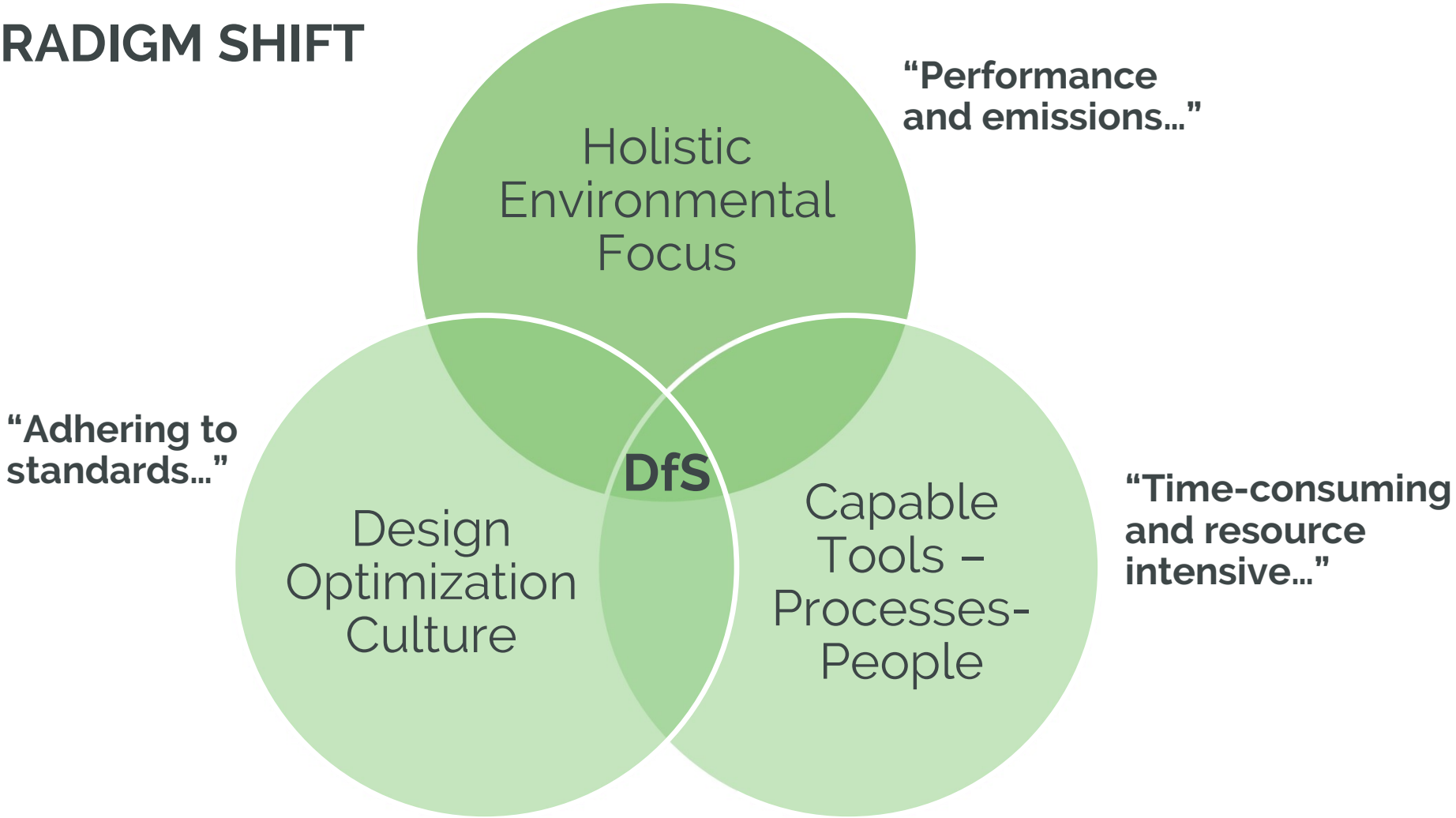
HOW…TO ACHIEVE DFS?

- **5 Steps to Practical Implementation including other impactful benefits:**
  - Reduction in product cost / waste
  - Minimizes product weight and its CO2 effects
  - Leverages engineering resources
  - Improves resource efficiency

So…why haven't we always been doing this?



PARADIGM SHIFT



5 STEPS TO PRACTICAL IMPLEMENTATION

1. Drive DfS expectations from **top-down**
2. Utilize **Design Optimization SMEs**
3. Update **Design Standards** to reflect DfS expectations
4. Improve **Design Engineer proficiency**
5. Roll-out effective **Designer tools and training**

1 CEO ENGAGEMENT

- PLANET 2050 team **met regularly with CEO** for several years
- Provided **forum to highlight implementation challenges**
  - Approval received to **roll DfS "expectations" into Corporate Design Standards**
  - Approval received to hire 2X dedicated Design Optimization SMEs
- Environmentally-focused **initiatives given corporate priority**
  - Quantifiable commitments established for 2030 / 2050

2 UTILIZE DESIGN OPTIMIZATION SMEs

- New **Design Optimization** engineering role
- Design Optimization SMEs (free! ☺) to support completion of DfS Scorecard
- Enabled DfS **results achievement without prolonging design process**.
- Provided **real-time opportunity to train/expose** Designers to DfS techniques
- Enabled their dedicated efforts to be quantified:
  - **10-15% material savings** reduction determined as typical
  - Cost savings generated paid for SME resources by 5X factor
  - **Minimized need for future redesign** due to early SME engagement
  - Scorecards received **100% cross-functional adherence** (lifecycle CO2 minimized)

3 UPDATED CORPORATE STANDARDS

- **Design Review Standards** define **"minimum expectations"**
  - Establishes DfS requirements
  - Drives consistency across BUs
  - Considers DfS early in design process to minimize lifecycle CO2
  - Enables objective DfS performance assessment
- Corporate database to document Design Reviews / Scorecards

Design for Sustainability Scorecard

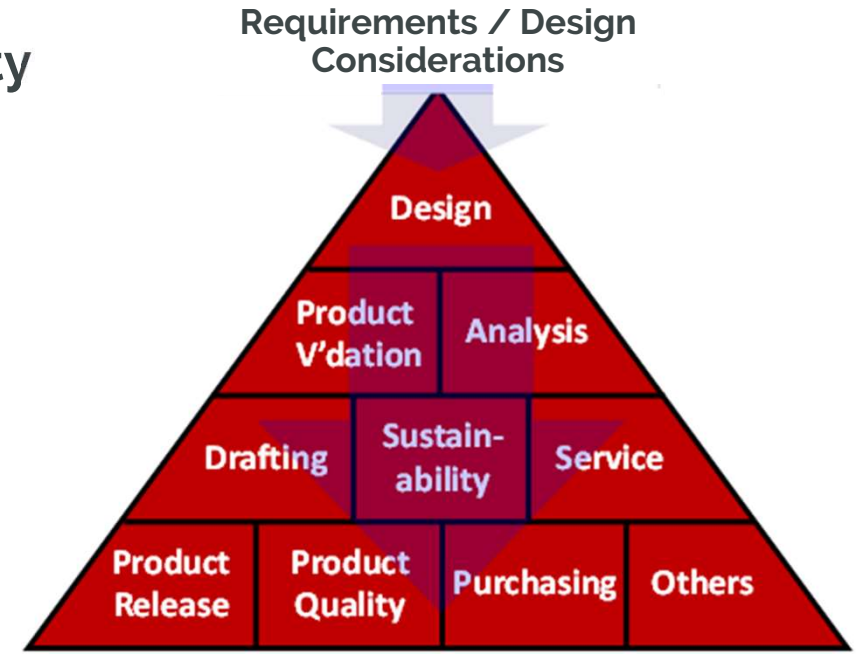
*When complete, submit scores using **this form** for tracking against PLANET 2050 goals.*

Fill out cells with blue shading.

Item Description / Part Number(s):		
Design for Sustainability Criteria	**Ranking (0, 3, 9)**	**Design for Sustainability - Ranking Criteria**
Material / Process Specification (Material approved by Material Science & Engineering Functional Excellence)	*9*	**0** = Approval NOT received by Material Science FE. **9** = Material and process specification approved by Material Science FE representative.
Material-Use Optimized (Material-use optimized to obtain required strength and stiffness)	*9*	**0** = NO EVIDENCE minimizing material-use. **3** = Material-use minimized using "design experience" ONLY. **9** = Material-use minimized using optimization-based methods such as topology optimization, Generative Design, MDO, etc.
"Near-Net" Principles Applied (Manufacturing post-processing minimized)	*9*	**0** = NO EVIDENCE of using "near-net" principles. **3** = Manufacturing processing minimized using "design experience" ONLY. **9** = Post-processing / machining stock minimized using supplier engagement and approved by manufacturing specialist.
Lifecycle Plan - "Closing the Loop" (Reuse, Reman, Recycle)	*9*	**0** = Evidence does NOT exist for a remanufacturing, reuse, or recycling plan. **9** = Aftermarket plan approved by New and Recon parts representative.
	100	**> 80** - Strong Design for Sustainability Plan Exists **70-80** - Moderate Design for Sustainability Plan Exists **< 70** - Weak Design for Sustainability Plan Exists

4 IMPROVE DESIGN ENGINEER PROFICIENCY

- **DfS requirements** / "design considerations" **firmly established**
- Importance of initial **design concept maturity and efficiency recognized**
- **"Design for X" capabilities and CAD-based proficiency** essential for weaving DfS tasks into design workflow



5 ROLL OUT EFFECTIVE TRAINING

- Collaborated with CAD supplier to provide **dedicated license-based training to improve overall CAD user proficiency**
- Dedicated training found to provide:
  - **Significant growth opportunity** for users at all experience-levels
  - High-quality instructor-led training **incentivizing participation**
  - **Awareness of underutilized CAD package capabilities** (modeling and analytical)
  - Incentive to **stray from (inefficient) legacy modeling practices**
  - A way to objectively **highlight an individual's CAD-use ability**
  - A means of identifying **individuals hungry for professional growth**

ANALYSIS WORK MUST "MOVE TO THE LEFT"

SUMMARY

- A **commitment to optimizing new product designs** for lifecycle material-use is necessary to minimizing its environmental impact.
- In addition to achieving environmental stewardship, **DfS techniques also enable other important bottom-line savings**.
- Methods and **Designer-based tools exist to practically enable DfS** techniques to become a standard part of the design process.
- Placing priority on **improving Design Engineer proficiency** is a critical step to achieving DfS goals – analysis work must "move to the left".
- DfS **provides Design Engineers with a tangible means of assessing their "value"** to a company.

PARTING THOUGHT

Addressing climate change is daunting, **but designing for sustainability is not.** It's our responsibility to follow this recipe to reap the environmental benefits.

THERE IS NO DOWN-SIDE!!!

- Better for **our environment**.
- Better for **your business**.
- **You NOW have the recipe** to implement DfS, so don't wait.

We must act NOW to leverage our unique opportunity to protect our planet!!!

QUESTIONS?

Thank you! You can find me at:

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David Genter

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With a 37-year tenure at Cummins Inc., David Genter has held pivotal roles, showcasing his leadership and technical expertise. His significant contributions to the field lie in his specialization in designing various internal combustion (IC) engine and electrified drivetrain systems.

He has been a driving force in setting and maintaining high industry standards, extending to sustainability where he led a pilot team, quantifying bottom-line savings potential and emphasizing a commitment to environmentally conscious design practices and standards.

In the dynamic field of Systems and Design Engineering, David introduced groundbreaking methodologies, better known as Systems Design Engineering (SDE), creating tools that revolutionize the approaches to requirements-development and system-level design. David is actively working with SAE International as an instructor and Subject Matter Expert to teach and promote his methodologies, while serving at Cummins leading Systems Design Engineering for a hydrogen generator program. His practical expertise is evident in the successful application of SDE in real-world, high-profile New Product Design, new technology development, and complex problem-solving scenarios.

With an impressive portfolio of over 80 patents, David continues to make significant and lasting contributions to the engineering landscape. His unwavering commitment to excellence and innovation is evident, coupled with his wealth of product and process-based experience, positions him as an invaluable asset for those seeking a profound understanding of engineering principles.

THANK YOU