

## **Aerospace Sustainable Manufacturing Workshop: Breakout Discussion: Life Cycle Tools for Value Creation**

*Life Cycle Assessment (LCA) is a valuable methodology for evaluating the potential environmental and energy impacts of a product or service. LCA, however, is generally limited to making relative comparisons between alternatives. In addition, it may not be well integrated with product and process development for economic and societal benefits. Moreover, LCA is generally not capable of providing guidance into manufacturing-related decisions (processes, systems, process planning, etc.). There is a great opportunity to develop and compile a toolset that enables the real-time evaluation of product and process alternatives, the quantification of costs and impacts, and the optimization of decision process. Areas of particular focus include the selection, use, and substitution of materials (especially materials and chemicals that support manufacturing), the evaluation of processing alternatives, the definition of, and planning for, manufacturing operations, and the management of life-cycle operation, including end-of-life (EOL).*

*The participants in this small group session will survey the full scope of the development of a life-cycle toolset for value creation. Through the understanding the broad scope of the challenge, they will prioritize the critical elements of the toolset, and will select focus areas for which they will flesh out the needed capabilities, and will begin the process of project definition. The deliverable from this topic area will be the definition of a project, or set of projects, that will develop both the architecture and the toolset for life cycle value creation.*

### **Session 1 – Brainstorm - Definition of Needs and Gaps**

- There is a disconnect between enterprise level need and current practices
  - “Where do you draw the control volume?”
    - Where does consideration begin for a company?
    - Company itself first, then pass on to suppliers
      - Consistency is key. Cant compare apples to oranges
- Industry-wide hot spot analysis to identify specific needs
  - Need both the policy level and the plant level
  - Business unit snapshot, country wide snapshot
  - Generic tools that can be easily customized
  - Green purchasing vs. Green Manufacturing
- Need for narrow/nimble tools for plant level
  - LCA is not as flexible as needed
  - Data intensiveness low
- TRL and MRL tools do not consider sustainability
  - Modify these or create new ones?
  - Range of tools in detail?
  - **SusRL? Identify gaps**
- Operationalizing life-cycle thinking with basic decisions
  - “Life-Cycle Thinking Guide” - EPA
  - also need deeper analysis - SusRL
- Tools today are based on historical data

- Need real time consideration
- Current focus is on a longer time span at a company wide level
- Need real time, shop floor level
- Need a tool to benchmark today and be able to measure relative changes from that baseline tomorrow
  - Database that can measure relative change of kg of a certain material
  - Need an easy way to measure
  - Aerospace is heavily burdened by “use” phase
- Little information is known about supply chain
  - Figure out a way to cascade throughout supply chain
- Energy/Water per volume measurement tool?
  - Document the general manufacturing processes and formulate a general database per unit of various materials to come up with a general baseline
  - Predictive analytics based on collected and historical data
  - Segue into optimization tool
    - Ex. Tool path optimization converted into energy/environmental impact savings
- Supplier Selection tool
  - Comprehensive assessment of waste streams, consumption.
  - Industrial symbiosis/ecology
- How do you assess suppliers information is truthful and/or correct?
  - Avoid green washing by standardizing scope 1,2,3.
  - Basic physics check – simplified to what is physically possible
- Proactive/Predictive Service and Asset Management
  - Already exists to some degree but there is a need to convert cost reductions in to environmental impact reductions
  - Conversion of products into services
    - Ex. Leasing engines
    - Allows for the ownership of the engine throughout total life cycle
    - Customers credit environmental savings
    - Must be a standardized lca methodologies for scope 1,2,3 emissions
- Need for standards and clarity on who owns them (customer, supplier, OEM, etc?)
  - Unit mfg. process standards
- CDP to assess supply chain
  - IAEG (Intl Aerospace Env Group)
  - Executive Order “13X”
  - Being able to know specific information on supply chain
    - Difficult to harmonize standards across a global supply chain
      - Can you assume that in X amount of time that footprint will be the same?

- Things to capture /metrics
  - Water
  - Energy
    - Greenhouse gas emissions
  - Land use footprint?
  - Sq footage footprint?
  - Emissions
  - Excess material
    - What level recycling
  - Buy to Fly
  - Hazardous Materials
    - Regulatory - REACH, EPA TSCA
  - Social metrics?
  - A lot depends on who bears the cost
- Rare Earth assessment
  - Conflict Minerals
  - Geopolitical concerns
- Environmental Impacts may have the ability to also identify economic impacts
  - Total cost of ownership from cradle to grave
  - Just looking at economy, environmental impacts may have been missed
- List based approach is a good place to start
  - Need to move towards total disclosure
  - Does industry want that?
    - Concerns with IP going to competitors
- Life cycle tool will have to protect IP
  - Pre-competitive
  - Protect competitive IP from going to competitors
- Lease system throughout supply chain?
- Simplified LCA-like tool
  - Mass balance
  - Conversions to assess impacts
- Where is a basic model needed as opposed to higher granularity?

### ***Session 2/3 - Project Approach – Define Steps***

- Capabilities of Toolkit
  - Assessment of current state relative to a baseline
    - Component Level?
    - “State” being metrics, or different spatial scales of the manufacturing enterprise (product, process, system)
      - Water
      - Energy
        - Greenhouse gas emissions

- Land use footprint?
  - Sq footage footprint?
  - Emissions
  - Excess material
  - What level recycling
  - Buy to Fly
  - Hazardous Materials
    - Regulatory - REACH, EPA TSCA
  - Social metrics?
  - Resiliency and Adaptability
  - A lot depends on who bears the cost
- Improvement of current state
  - What ifs? at all stages of life cycle cradle to gate
  - What Ifs? specifically at the early design stages
  - Make Buy
  - Evaluation of alternatives
  - Process planning decisions
  - Supplier selection decisions
  - Technology improvements and disruptors
- Manufacturing trade-off studies at the early design phase – product concept design – in production process changes
  - Process decisions
  - Material selection
  - Etc.
- Needs to be integrated into current design and assesment tools
- Approach to Metric Creation
  -
- Approach to Toolkit Creation
  - Understand who would use the tool and what tools currently exists
    - Identify gaps in capabilities of existing tools
    - Identify data gaps
  - Understand end-user requirements
    - Identifying KPIs and articulating those
  - Break down into simple components
- People
  - GE can contribute components and KPIs for assessment
  - Andrew Rak- Noblis
  - Sutherland -Purdue
  - Todd Rockstroh-GE
  - Todd Skowron-CTC
  - Brian Schmidt -NCDMM
  - Harry Zahn - Honeywell
  - Allan Hartong – Air Force
  - Jawa – UK, ISM