Aerospace Sustainable Manufacturing Workshop Template

OBJECTIVE: 3 teams that will continue on going collaboration around defined project

DELIVERABLE: One project definition and template information that the team is willing to invest time and effort into pursuing. Identify potential funding sources and best plan of approaching that source. ID a team leader that will pull the team together on regular bases to continue collaboration on the project toward a White paper / Proposal and ultimate funding and execution.

End-of-Life Value Management

The exercise of the best alternatives for product life-cycle management is imperative as we seek improvements in the total life-cycle product value, including value placed on the externalities. The best choices during the operational life in repair, remanufacture and rebuild extends the useful life of the product. The choices made at end-of-life for alternative uses involve recovery, reuse, recycle and remanufacturing including sustainable materials management, and approved process innovations in exercising these choices, have the potential to maximize the total life-cycle product value, including environmental responsibility.

There are gaps in the culture, businesses processes, and the technology toolsets. The most stringent end-of-life activities are enforced by regulatory statues. While they may be effective, a compelling business case as a driver is preferable. Business processes need to be changed to embrace end-of-life responsibility. Tools are needed to support the full evaluation of life-cycle management and end-of-life alternatives, and the selection of, and planning for, the most effective alternatives. New and improved processes for more efficient processing and maximum value in reuse need to be developed.

This group will address the issues in managing a product across its entire life-cycle including end-of-life stage. The key needs will be defined, and a project slate will be developed. The following strategies may be explored for sustainable manufacturing opportunities to strengthen a product's life-cycle:

PROJECT TEMPLATE

Project Title	***Develop Advanced Design Tools to Maximize Product Life-cycle Value***
Project Objective	Overall Objective(s) in Project Definition and Selection: • What projects will have the most impact on industry, and likely be supported by government and/or private funding? • What projects have clearly defined deliverables that could be met with tangible results? Metrics for measuring success? Project Focal Points • **Crosscutting** areas that reach each of the 3Rs listed (Recycling, Remanufacture, Reuse) Project Ideas • **Advanced Design Tools**: Add-on to Existing tools o Life-cycle consideration ▪ Material selection, etc. o Design for Disassembly and services o Design for remanufacturing o EOL Planning consideration o Modeling and Simulation o **Trade-offs when processing via Additive Manufacturing** ▪ i.e., how do you remove/repair embedded components? o **Standards for Product Data** ▪ Standard product support/service data • Need to know Material, Function, Critical Dimensions, replaceable parts ▪ Standardized configuration control ▪ Module Input/ Output data (needed for rebuild) • **Advanced Sensors** o Used for condition monitoring ▪ Energy, electricity, vibrations, etc. o Incorporate algorithm development into project deliverable o Validation technology

	▪ i.e. determine whether equipment meets spec and validate configuration before/after remanufacturing
The Need (Gap) **(What is the business case for doing this project?)**	<u>Opening Discussion</u> • From an industry perspective, there are other solutions • Need – ability to sustain industrial enterprise • How do we disrupt the "EOL" connotation and push it upstream? We have a whole infrastructure built on EOL management • 2 worlds in remanufacturing – spares/ systems – How do we extend the life cycle of the product? • Possibly a negative connotation with "remanufacture" – consumers are inclined to say "fix" • Is replacement done with remanufactured units in Aerospace industry? o Quick turnaround on parts but the part that is removed is not typically remanufactured <u>Current Gaps</u> • Complex materials – Sorting technology – how to? o How do you know if the material is homogenous? How do you identify and separate it? • End of "Life" (or end of "use") management broken out into 3 focal points: o **Recycling, Remanufacturing, Reuse** (repair, refurbish) • Circular economy model that we currently have is limited: o Focused on ability to extend lifecycle of a product o 3R's above take place but are very limited • **Recycle** (Typically called "last resort" – when you can't reuse or remanufacture) o ***Definition:*** *bring material back to its original form* o Sorting Technology o Infrastructure o Increase efficiency of processes o Material Recovery technologies o Scarcity of material is not reflected in the price • **Remanufacture** o ***Definition:*** *Industrial processes by which end-of-service product is brought into "like new" condition* ▪ ***rebuild*** o Standards needed (e.g. drawings, critical dimensions) o Product Data ▪ 75% of cost can be in figuring out material (collecting data) – e.g. when using additive manufacturing, the original material(s) needs to be determined

	▪ **Drawings, critical dimensions might not exist** o Process technologies o Reverse Logistics ▪ Products are deemed "defective" by consumer, and therefore cannot be resold • 1/3 of the time there is no actual defect • Companies (e.g. Walmart) have processes to remanufacture these items • **Reuse** o ***Definition:*** Bring non-functional product back into working condition ▪ **Repair/Refurbish** • Repair Technologies o Quoting a part, something damaged in the field, e.g. • Replacement Part Technologies (additive manufacturing, reverse engineering) • Qualification technologies • **Cross-Cutting** o Market o Design o Economic factors involved (cost)- Many materials are so cheap but don't have economic value to drive solutions o Collection System ▪ Unless you really are able to bring a product back into "like new" condition for resale, you are negatively impacting the environment o Advanced Sensors
Project Deliverable(s)	• Customer Needs Assessment • Design specifications for the desired tools • Tangible tools to be used for advanced design* which meet the objective of maximizing product life-cycle • Training Plan for Deployment of Tools at the Point of Use *Refer to project description
Project Workflow Steps and duration of each step	(1) Validate Project Concept • Clearly define the ***scope*** of the problem • Pre-Project Deliverable: Literature Review o Research Report on advanced design tools* currently in use ▪ Compose **WHITE PAPER** • Gauge current level of interest

	(2) Identify Stakeholders
	• Project Team Members
	  o **Project Champion**
	• Potential Funding Sources
	  o DLA (Defense Logistics Agency)
	  o DOD Manufacturing Technology Program (ManTech)
	(3) Project Proposal Development
	• In collaboration with related projects aimed at Consortium partnership development

"Best Guess" Cost	Determine based upon Project Validation (Workflow Step 1)
Team Members that are willing to continue working this project toward a funding source.	<u>Suggested Participants</u>: • Aerospace OEM • Tier 1 Suppliers • University Research Institutes • Engineering Affiliated Organizations (ASME, e.g.) • 3rd Party Recycler/ Remanufacturer
Project Approach/ Guidelines	**See Project Workflow**
Participant Names and contact info	TBD
Capable Technology Providers	• Independent Software Vendors (ISV)