

## **Product Lifecycle Management and the Quest for Sustainable Space Exploration Solutions**

Pamela W. Caruso, Manager, Technical Management Office  
Daniel L. Dumbacher, Director  
Engineering Directorate  
NASA Marshall Space Flight Center

### **Abstract**

Product Lifecycle Management (PLM) is an outcome of “lean” thinking to eliminate waste and increase productivity. PLM is inextricably tied to the systems engineering business philosophy, coupled with a methodology by which personnel, processes and practices, and information technology combine to form an architecture platform for product design, development, manufacturing, operations, and decommissioning. In this model, which is being implemented by the Engineering Directorate at the National Aeronautics and Space Administration’s (NASA’s) Marshall Space Flight Center, total lifecycle costs are important variables for critical decision-making. With the ultimate goal to deliver quality products that meet or exceed requirements on time and within budget, PLM is a powerful tool to shape everything from engineering trade studies and testing goals, to integrated vehicle operations and retirement scenarios. This paper will demonstrate how the Engineering Directorate is implementing PLM as part of an overall strategy to deliver safe, reliable, and affordable space exploration solutions.

It has been 30 years since the United States fielded the Space Shuttle. The next generation space transportation system requires a paradigm shift such that digital tools and knowledge management, which are central elements of PLM, are used consistently to maximum effect. The outcome is a better use of scarce resources, along with more focus on stakeholder and customer requirements, as a new portfolio of enabling tools becomes second nature to the workforce. This paper will use the design and manufacturing processes, which have transitioned to digital-based activities, to show how PLM supports the comprehensive systems engineering and integration function. It also will go through a launch countdown scenario where an anomaly is detected to show how the virtual vehicle created from paperless processes will help solve technical challenges and improve the likelihood of launching on schedule, with less hands-on labor needed for processing and troubleshooting.

Sustainable space exploration solutions demand that all lifecycle phases be optimized. Adopting PLM, which has been used by the automotive industry for many years, for aerospace applications provides a foundation for strong, disciplined systems engineering and accountable return on investment by making lifecycle considerations variables in an iterative decision-making process. This paper combines the perspectives of the founding father of PLM, along with the experience of Engineering leaders who are implementing these processes and practices real-time. As the nation moves from an industrial-based society to one where information is a valued commodity, future NASA programs and projects will benefit from the experience being gained today for the exploration missions of tomorrow.