B. Rapid, Low-Cost Tooling Development

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Objectives

- Assess status and need for low-cost tooling technologies for lightweighting materials.
- Evaluate state-of-the-art capabilities for rapid, low-cost tooling approaches.
- Determine the socioeconomic factors that are likely to significantly impact the development and implementation of advanced tooling technology.
- Recommend Department of Energy (DOE) course of action with respect to investments in tooling technology development.

Approach

- Engage industrial tool die and mold manufacturers (TDMs) and tool users to evaluate socioeconomic drivers affecting implementation of new tooling technology.
- Identify and engage or develop other stakeholders that will address socioeconomics factors.
- Evaluate potential tooling technologies that are most likely to be fielded and impact fuel efficiency.

Accomplishments

- Met with a small group of leading North American TDMs and the Center for Automotive Research (CAR).
- Initiated tool sourcing analysis by CAR to determine effects of tool sourcing models on health of tool mfg industry, and its ability to incorporate new technology.

Future Direction

- Work with industry to foster communication and collaboration, and to develop an "industry-owned" roadmap.
- Engage other interested government parties to co-sponsor research and development (R&D).
- Commence performing selected R&D.

Introduction

The introduction of advanced polymer-based composites and lightweight material manufacturing processes to commercial vehicle manufacturers and their supplier base is thought to be severely impacted by the high cost of tooling and long tooling development time. Often the use of lower-cost materials and less efficient structural designs is dictated by the fact that tooling for the manufacture of advanced composites and other lightweight materials cannot be justified from a cost-per-part basis, and from the long development times or procurement lead times that are required. In addition, the unique production volumes associated with commercial vehicles—which are significantly lower than automotive production volumes, yet well above aerospace production numbers—make current tooling design and development methods unsuitable.

An example of the cost and schedule challenges faced by commercial vehicle manufacturers is that a fully tooled door system for a Class 8 tractor can cost upward of $20 million and require over 24 months to fabricate and qualify the tooling. When advanced materials such as carbon fiber composites or lightweight metals such as aluminum or magnesium are considered, tooling design, material forming characteristics and surface finish requirements make today's manufacturing approaches very high-risk. The result is often that manufacturers fall back on less efficient structures that use conventional steel and fabricated structural designs.

The purpose of this project is to assess current tooling technologies to identify key deficiencies in cost, prototype and fabrication methods, and design and modeling tools that prevent the increased use of lightweight metals and composites structures in low- and medium-volume commercial vehicles. Data have been gathered from government–industry workshops, published data sources, and numerous follow-up interviews with workshop participants and other key industry experts. The team is working with industry to develop a roadmap that will guide the development and implementation of advanced tooling technology that reduces the risk of using advanced lightweight materials in commercial vehicle applications.

Project Deliverables

The project team has delivered to DOE a report containing findings from an industry workshop conducted in FY2004, follow-up interviews, energy analysis, and socioeconomics review. The primary future deliverables are a joint government-industry roadmap for tooling technology development and implementation, and a list of co-sponsors that will share the R&D costs with DOE.

Technical Approach

The technical approach for this project is largely based on gathering and analyzing information to enable informed decision-making regarding future R&D investments. A key part of the project has been to plan and conduct a workshop that served as a forum for soliciting information from industry experts and for networking among industry peers. The workshop was followed by interviews with selected key industry contacts, most of whom were attendees at one or more workshop sessions, to validate the workshop findings. Additionally, potential energy and socioeconomic impacts were analyzed.

TDM Roundtables

In December 2004 and June 2005, the project leaders met with a select group of leading TDMs. The purpose of these meetings was to create a small leadership group of individuals who can help to create an industry strategy to establish the conditions under which new technology can be infused into the industry.

The attendees represented a cross-section of both large and small North American TDMs, all of whom focus on large tools. The attendees were either the

presidents or vice presidents and owners or part-owners of their companies.

A key portion of the first TDM Roundtable was the presentation of the project team's findings from FY2004 workshops and analysis. The presentation provoked considerable discussion. The group generally concurred with the findings presented. The project team planned to commence roadmap development at this meeting, however it quickly became evident that the TDMs need the opportunity to address their business climate before they can objectively participate in developing a technical roadmap After much discussion, the group concluded that the TDMs need to make the case to the OEMs that through early collaboration the TDMs can bring value to the OEMs. This early collaboration will help the OEMs design product that can be manufactured at lower over-all cost. By so doing, they believe that the OEMs will derive value from the geographic proximity of a healthy TDM industry.

A second Roundtable was conducted in June 2005 at the CAR, with CAR participating. CAR was identified as a renowned and respected voice in the automotive industry that understands the business issues affecting TDMs. CAR was asked to conduct a "lifetime tool sourcing analysis" that would analyze how OEM tool sourcing practices affect OEM costs, TDM industry health, and the TDM industry's ability to incorporate new technology. This analysis has been initiated. After this analysis is completed and disseminated, we expect the tool manufacturing community to work with us to develop an "industry-owned" tooling technology roadmap. We have identified CAR as a renowned and respected organization that can address the critical business issues associated with tooling technology, freeing the DOE participants to focus on technology roadmapping and development.

Conclusions

Tooling is a major expense in manufacturing vehicles, especially at low production volumes, and therefore constitutes a major barrier to lightweight materials implementation on vehicles. There are opportunities to lower this barrier with properly planned and targeted tooling technology development and implementation. However, industry workshops and analysis conducted in FY2004 indicated that promising technology alone is not sufficient; rather economic barriers to new technology implementation need to be understood. In FY 2005, the project team engaged key TDMs and initiated analysis to investigate how tool sourcing practices affect OEM costs, TDM health, and new tooling technology incorporation. We plan to commence developing a roadmap in FY 2006.

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