Space Supplier Council Examines Affordability

By SUSAN HASTINGS
The Aerospace Corporation

The Space Supplier Council (SSC) addressed industrial base (IB) and quality concerns with an eye toward improved affordability and IB health when the SSC met April 8 in Colorado Springs, CO, coincident with the National Space Symposium.

In response to the imperative that Space and Missile Systems Center leader Lt. Gen. Ellen Pawlikowski expressed in her keynote speech at the Mission Assurance Summit in December, the group of suppliers discussed what can be done to increase the efficiency and effectiveness of testing while maintaining mission success.

One supplier explained how the company had rounded up test requirements for all customers with an intent to consolidate the effort. The common test was more expensive but would save money in the long run by amortizing the cost of qualification across numerous customers. Unfortunately, sharing of the qualification data was an impediment, and each customer wanted to have its own unique qualification test. This supplier identified a potential savings of $1M/year in testing if customer behavior were different.

Consistency in testing approaches seemed to resonate with the 15 suppliers present. Customers often desire special requirements, but when another user discovers a potentially common issue, all users wait for resolution despite the special requirements.

Another supplier offered that the test equipment and test protocols need to be verified before the test campaign begins. In this member’s experience, which includes multiple companies, the community sees many failures due to test equipment. She asserted that more attention applied prior to the test can increase efficiency and avoid unverified failures.

Mission assurance (MA) in a cost-constrained environment was the topic of a panel held on April 10 at the annual National Space Symposium in Colorado Springs, Colorado. Specifically, the panel focused on the co-existence of MA and affordability, with the assertion that both were needed. Members of the panel included Brig. Gen. Roger Teague, director of strategic plans, programs, and analyses, Air Force Space Command; Michael Gass, president and CEO, United Launch Alliance; Rob Strain, president, Ball Aerospace and Technologies Corporation; Gwynne Shotwell, president and COO, Space Exploration Technologies (SpaceX); and James Wade, vice president, corporate mission assurance, Raytheon. The panel was moderated by Aerospace President-CEO Dr. Wanda Austin, who opened the panel by explaining that the cost constraints we’re facing are here to stay and the user requests for greater space capability continue. She and the panel then detailed a number of ways to continue the U.S. record of success through mission assurance and using innovation to remain affordable.

Nat’l Space Symposium Focuses on Mission Assurance and Affordability

In this budget-constrained environment, it is easy to fall into the trap of seeing affordability and mission success as being opposed to one another. However, consider this: If a program is not affordable, it never gets the chance to deliver mission success, and the more affordably we deliver a mission, the more mission we can afford to deliver. I therefore view affordability as a mission enabler and accelerator. The key is to pursue smart affordability, not “cutting corners.”

In smart affordability, we enable cost reduction through innovation.

Innovating for capability, delivering more bang for the buck, is a clear way to do this. A key approach is to find ways to use deployed systems more efficiently and in new missions. I have been consistently amazed by the ability of the collective space workforce to drive big mission impacts through small software and CONOPS changes in deployed systems. As the SBIRS and AEHF

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LESIONS LEARNED:

Moisture Is Catastrophic for Processing of Polycyanurate Resin Composites

By RAFAEL ZALDIVAR
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Polycyanurates are a class of thermosetting resins that have become the material of choice in the fabrication of high-performance, resin-based, fiber-reinforced composites. Fiber-reinforced composites are composed of high-strength fiber and matrix material to bond the fibers together. The combination of fiber and matrix materials is specifically chosen to provide the desired material characteristics, such as high stiffness, low weight, low outgassing, and dimensional stability over temperature range of operation.

The manufacturing processes and mechanical properties of polycyanurate composite systems are similar to previously used composite chemistries, but they possess added benefits. After proper cure, polycyanurates have considerably lower moisture absorption and increased fracture toughness, plus they can withstand higher temperatures.

However, there are a number of factors that must be carefully monitored and controlled during the composite processing in order to achieve the expected high performance. In particular, the resin is highly sensitive to moisture during processing and cure, which may prevent thorough cross-linking in the resin structure.

Polycyanurate resins are typically synthesized by polymerization of cyanate ester monomers. In plain terms, monomers are building blocks that contain a cyanate [C≡N] linked to a neighboring cyanate bond (see Figure 1). With the addition of heat and/or a metal catalyst, the cyanate ester monomers form rings through a cyclotrimerization reaction.

There are many different backbone structures, but all of the polycyanurate resins contain the [C≡N] bond, which is responsible for linking the backbone structures together to form a network.

By changing or combining backbones, certain properties, like low dielectric constant or flexibility, can be optimized for the specific application for which the composite is being used. Fillers, which are mixed into the matrix but do not chemically react with the polycyanurate, can also be used to alter the overall matrix material properties.

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Smart Innovation

constellations come into their own and the enhanced capabilities of GPS III emerge, the field is ripe for this type of innovation.

On the face of it, innovation for capability is the most exciting type of innovation, but I am equally energized by innovation for affordability. Traditional affordability is about examining the government side, an enabler for standards, contracts, tooling, technology—all of these areas can play a role. In this regard, given the shift to fixed-price contracts and establishment of successful production lines in many core U.S. government space systems. This is the perfect platform to maximize the value of the government’s investment through learning curves and innovative process shifts from a development to a production mindset.

Innovation for affordability comes in as many forms as there are costs. Process, standards, contracts, tooling, technology—all of these areas can play a role. On the government side, an enabler for this is to optimize command processes to the essential, highest-value elements, creating room for innovation. On the contractor side, a key enabler is to understand that innovation is not improvisation. Process discipline is the ecosystem in which innovation can really flourish.

For example, if a test conductor discovers a better way to execute a test and brings that innovation through the right boards and instills it in the right command media, that innovation becomes a communal activity, where other process stakeholders can improve on and learn from the innovation. If that same idea is pursued in a stovepipe, it loses its power and has greatly increased risk.

The famous axiom “Change is the only constant” will certainly apply to our industry for the next few years. As we face that change, in partnership, the degree of our adaptability and innovation will largely determine the degree of our success.

Richard Ambrose is executive vice president of Lockheed Martin Space Systems Company and succeeded Joanne McGuire upon her retirement.
Did You Know…
GIDEP alerts and advisories are a best practice

The Government-Industry Data Exchange Program (GIDEP) is a cooperative activity between government and industry participants seeking to reduce or eliminate expenditures of resources by sharing technical information essential during research, design, development, production, and operational phases of the lifecycle of systems, facilities, and equipment. A GIDEP Alert provides the government with information concerning nonconforming items, supplies, and services or safety problems that have adversely impacted — or have potential to adversely impact — a government-funded program or programs.

The National Security Space Alert Forum (NSSAF) was implemented to supplement the existing GIDEP Alert System in order to accommodate the proprietary controls and timeliness required to identify and mitigate potentially systemic problems as early as possible in a space system’s development lifecycle. The NSSAF allows the space industry to share parts problems, test results and data, anomaly investigation results, and lessons learned in a limited participation environment, which enables the exchange of unvetted discoveries. A sample of data from 2009-2012 shows that approximately half of the NSSAF alerts did not transition to GIDEP alerts, partly due to “containment” of the impact of the alert. Coordination is ongoing among government, industry, and The Aerospace Corporation to improve the collective sharing of NSSAF and GIDEP data as a best practice.

**SSC continued from page 1**

The suppliers at one point divided into three small groups to discuss current, relevant topics they selected prior to the meeting.

One group discussed the recent counterfeit parts legislation and pending Defense Department Federal Acquisition Regulations (DFAR) revised language. The suppliers emphatically agreed the counterfeit parts needed to be mitigated, but they expressed at least two concerns to the government leaders at the outbrief:

1. The legal interpretation by many companies is that no safe harbor exists and that liability for rework or failure is unlimited, even when all possible mitigation avenues have been exhausted. Clarification of the government’s legal interpretation was requested.

2. Although the revised DFAR is not out, customers are implementing proposed requirements. As a result, there is inconsistency and churn surrounding the unknown content of the eventual finalized DFAR.

   The small group that discussed the diminishing space parts supply base had two key recommendations:

   1. Revisit the application of unique requirements which limit the sources for parts and components.

   2. When making Title III\(^1\) investments, consider the business case for sustainability and viability as part of the criteria.

The third group focused on developing a value model for improving the requirements flowdown process, noting that significant savings could be achieved by making requirements consistent.

Also at the SSC meeting, James Stein, program manager for the Government-Industry Data Exchange Program (GIDEP), provided an update on the program and a status update on GIDEP submittals. The GIDEP system is DOD’s official method for notifying the supply chain of parts and materials nonconformities. In addition, all counterfeit items are to be reported to GIDEP per the National Defense Authorization Act (NDAA) that became law at the start of this year.

Due to the travel restrictions associated with sequestration, government leadership received the outbrief at the end of the day through virtual means. Government seniors included Maj. Gen. Samuel Greaves of MDA, Gil Klinger of AT&L/SIO, Ted Bujewski of AT&L/MIBP, Brig. Gen. Terrence Feehan and Dave Madden of SMC, Maj. Gen. Susan Mashiko of the NRO, and Brian Hughitt and Rod Liesveld of NASA.

For additional information about the SSC, contact Susan Hastings, 571.307.5866, susan.e.hastings@aero.org.

ENDNOTES
[1] The Defense Production Act Title III program that sponsors manufacturing and industrial base projects has the mission of creating assured, affordable, and commercially viable production capabilities and capabilities for items essential for national defense. For more information, visit www.dpatile3.com/dpa_dlb.
Moisture
continued from page 2

produces CO₂ gas, which can
formation, the carbamate formation
desired properties. In addi-
trix will not have the highly
will not be formed. Without
the cyclotrimerized rings
the cyclotrimerization reac-
type and concentration, hu-
carbamate, as shown in Figure 2.

Exposure of cyanate esters to
moisture at slightly elevated
Exposure to moisture during
processing results in signifi-
cy degraded mechanical
and physical properties.
Exposure of cyanate esters to
moisture at slightly elevated
moisture at slightly elevated
temperatures causes the cy-
nate monomer to react with
the water to form a carba-
mate, as shown in Figure 2.
Carbamate formation is usu-
ally dependent on the catalyst
type and concentration, hu-
midity level, and temperature.
If the carbamate is formed,
the cyclotrimerization reac-
tion cannot occur, and there-
fore the cyclotrimerized rings
will not be formed. Without
the structure of rings, the ma-
trix will not have the highly
desired properties. In addi-
tion, the carbamate formation
produces CO₂ gas, which can
result in blisters and cracking
when exposed to temperature
(see Figure 3).

LESSONS LEARNED: Once
carbamates are formed dur-
ning processing of polycya-
urate resins, no amount of
heat treatment will reverse
the process to restore polycy-
ate monomers or transform
the structure into the desired
network of cyclotrimerized
cyanurates. Unfortunately, the
only solution is to scrap the
affected composite structure
and begin again. The most
effective risk-mitigation ap-
proach is to consciously take
steps to prevent formation of
carbamates.

A more complete explana-
tion is available in TR-
98(8565)-8 Lesson Learned
in the Processing of Polycya-
brate Resin Composites by
R.J. Zaldivar; 15 Feb. 2002
(public release).
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