Stimulating a Culture of Innovation at The Aerospace Corporation

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Abstract— **The aerospace industry is undergoing tremendous changes causing a shift in focus, methodology, and the speed of innovation. The "NewSpace" sector of the aerospace industry consists of almost 1,000 companies focused on creating different business models for accessing space. As a result, the role of The Aerospace Corporation (Aerospace) as a trusted advisor on space programs is taking on a new focus as our customers are working directly with the NewSpace sector. The speed and agility of NewSpace and an increasing focus on space security is pushing Aerospace to elevate our culture of innovation. In this paper, we describe the programs we created to stimulate this culture and engage our employees in more innovative practices.**

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1. INTRODUCTION

The Aerospace Corporation (Aerospace) is a non-profit company that operates a Federally Funded Research and Development Center, which provides independent technical and scientific research, development, and advisory services to national security space programs. While Aerospace has been in business for nearly 60 years, the space industry is undergoing tremendous changes with many NewSpace entrants building space and launch systems at an unprecedented pace using processes and practices that don't necessarily align with the traditional military standards (MIL-STDs). As a country, we need to innovate quickly to respond to the need for assured space capabilities and move at the speed of the new commercial space startups. At the same time, Aerospace has six decades of experience as a technical advisor on space missions, spanning the entire history of the Space Age. Given the high costs to getting assets into space, we must balance new innovative methodologies with "keeping the recipe" on achieving 100% mission success for our customers.

To respond to this challenge, Aerospace created iLab, or the Innovation Lab, with the goal of generating and sustaining a corporate culture of innovation that creates value for our customers and the company. While Aerospace has always been innovative, our corporate success as a risk-reducer for our customers' endeavors with national security space dominates our external perception. To respond to customer demands for increased innovation, we are redefining our company culture with one that encourages employees to take more risks and bring their creative ideas to management for consideration. Ultimately, we would like our customers to associate Aerospace with innovation and their trusted partner in assuring mission success with our national space systems.

The programs we have developed to lower the barriers to entry for employees to innovate include employee on-site sabbaticals; a "Lunchbox" innovation kit series; Angel Innovator Program (internal Angel investors); Angel Public Private Partnerships; a Test Kitchen for deep dives into an idea; Hack Sessions with customers and potential external partners; an intern venture program; an incubator for prototyping internally; an accelerator for working with external partners on prototyping; and physical makerspaces for exploring new technologies. Through these programs, our new collaboration workspaces, and an idea submission portal, we are creating an innovative culture focused on our customers.

We are still in our first year of rolling out these innovation programs and integrating them with our existing internal research and development program. While these programs are flourishing under the early adopters, we are working through the challenge of engaging all employees. The goal

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is not to create a small elite team that can operate in a Skunk Works business model but to transform the culture across all the staff so the whole company becomes part of an Innovation Laboratory. We are also aligning these programs with the corporation strategy, which is being defined concurrently. For a company rich in culture and history, introducing something where change is the only constant induces a series of challenges. We are always looking for new ways to motivate innovation to lead Aerospace and our customers into the future of space.

2. MOTIVATION

Aerospace has a long-storied history of innovation in the space industry. As an example, Aerospace played a significant role in the development of the Global Positioning System (GPS), serving as the principal adviser to the Air Force on space acquisitions. Aerospace provided proof-of-concept studies; constellation design and management studies; accuracy-improvement initiatives; independent assessments; and operational assistance to the satellite-based navigation system. But like much of the work performed at Aerospace, it was behind the scenes. The culture at Aerospace has been one where employees are encouraged not to talk about their work outside the company and oftentimes even within the company. Part of this is related to the classified nature of much of the work, but the culture extends to the unclassified work as well. That culture can stifle efforts to create innovation because it hinders collaboration. An important role that the Innovation Lab serves is to bridge the gap by bringing different departments together to solve hard problems.

An additional side effect of the culture of not talking about our work is that Aerospace is not known for innovation. One goal of our cultural shift is to effectively communicate our role as an innovation leader to our current and prospective customers.

Moore's law describes the rapid pace of technology development by stating that the number of devices on a piece of silicon doubles every 18 months. The rate of technology development has actually been accelerating beyond Moore's Law because each generation of technology builds upon the last. For example, consider the Uber ridesharing model that has completely disrupted both the taxi car industry and the idea of car ownership. This model was built upon multiple technologies including smartphones, the cloud, GPS, and fast cell phone data networks. The space industry is being similarly disrupted by the integration of advanced technology from many sectors. We now have access to less expensive launch capabilities, reusable launch vehicles, low-cost CubeSats and SmallSats, cheaper manufacturing methods for custom parts (e.g., 3D printing), and a several orders of magnitude increase in the speed of data processing using the cloud and machine learning analytics – all of which have enabled new business models for access to space.

Aerospace needs to play a part in the new and innovative commercial space industry to advise our customers on the future of space. Our customers are specifically asking us to be more innovative, adaptive, and responsive in support of their programs. *The commander of the U.S. Air Force Space and Missile Systems Center (SMC) forecasts a significant funding bump in the service's space budget for more prototyping, demonstration and experimentation programs. SMC Commander Lt. Gen. John Thompson, the service's program executive officer for space, says his organization will begin placing many more "small bets" on promising space technologies, and those that succeed could transition into programs of record for new on-orbit or ground segment capabilities. Thompson says the space enterprise is moving into an area where innovation and agility are mandatory for success, and the Air Force's space group "needs to go faster."* [1] These customer requirements necessitate a cultural shift to take our workforce to the next level of innovation.

The accelerating pace of innovation in the space industry is also creating an indirect risk to our space systems. Several commercial companies are planning to launch (or have already launched) constellations of hundreds of small satellites. The rapid increase in orbiting satellites creates a threat of impact between these systems and our national security space satellites. Aerospace is developing new innovative methods for space traffic management, such as detecting and mitigating impacts from these satellites and other orbital debris.

Lastly, the space industry is putting an increased focus on the security of operating satellites. Most commercial communications satellites and many government satellites are large expensive assets that are attractive targets for malfeasance. The risk of disruption to our space infrastructure has caused Aerospace to focus more attention on space security. The satellite industry is general is moving to smaller, distributed, and more resilient satellite systems.

3. INNOVATION LAB

Aerospace started the Innovation Lab as a Corporate Initiative to renew our employees' focus on innovation. The Innovation Lab charter is to foster an innovation ecosystem, energize our corporation's innovation culture, and accelerate the transfer of new technologies to our spacefaring, U.S. government customers. In a sense, we are working to bring the spirit of a startup company to a well-established organization. Through the exploration of innovative solutions that go beyond business as usual, we seek new approaches to improve space resiliency, develop new operating models to enable cost-effective innovation, and accelerate the utilization of the commercial sector for mission critical capabilities in space.

4. SABBATICAL PROGRAM

Throughout a work week, most of our technical staff support several programs in either long-term development or in response to customers' immediate needs. As a company, our R&D portfolio is organically driven by staff, both in being

forward thinking about our customers' needs and pushing the state-of-the-art within certain types of science and technology. Some of our employee's highest-risk, highest-reward proposals are rejected, due to the mere fact that it would take months (or even more) to perform enough to work to assess the feasibility of the concept due to the nature of our staff's piece-meal work week. To accelerate to proof-of-concept, we developed the sabbatical program, where any employee can apply to take a week off from daily tasking to spend a dedicated 40-hours on a single problem with the end goal of proving out a concept.

The recipe for a sabbatical itself is simple: staff members will have access to a location away from their desk to work; a modest budget to procure necessary equipment (software and/or hardware); and resources to bring in subject matter experts for support. While still in the early stages of deployment, the program has already proved to be a success both for the participants and for our corporate management team to determine when to fund (or not fund) further development. Because of this program, we have already seen a significant increase in patent submissions and teaming in our collaboration centers.

5. LUNCHBOX PROGRAM

What would you do with a motion sensor, temperature sensor, sound sensor, speakers, lights, and push button inputs? That's what we asked of our staff with the Lunchbox 1.0 kit. We created a lunchbox kit around the Adafruit Circuit Playground (See Fig. 1.) to provide our employees with the opportunity to experiment with Arduinos over lunchbreaks. [2] We asked a small team of engineers to design a kit with all the necessary components for beginner, intermediate, and advanced projects, along with tutorials and a blog for discussion amongst the corporate community. The lunchboxes immediately captured the attention of staff ranging from summer interns to senior staff members. We are developing additional lunchbox kits with other focuses, such as robotics, and plan to deploy them within the next year.

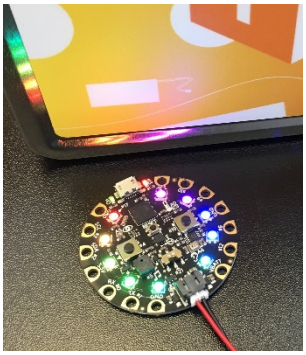

Figure 1. Aerospace Lunchbox

One employee, Adam Vore, used the lunchbox kit to capture the August 2017 solar eclipse. He used the Arduino to control his home-made "barn-door" tracker to move a camera at the proper speed to keep the sun and moon in the center of his camera's lens. He also used the Arduino to trigger the camera to take pictures every 30 seconds. On his own time, Adam designed and built the device, 3D printed several pieces, and then sat back and enjoyed a historic solar event as the lunchbox kit did the work to capture it. Photos of his set up and final product (both courtesy of Adam Vore) are shown in Fig 2 with the Adafruit circuit visible in the center of the device.

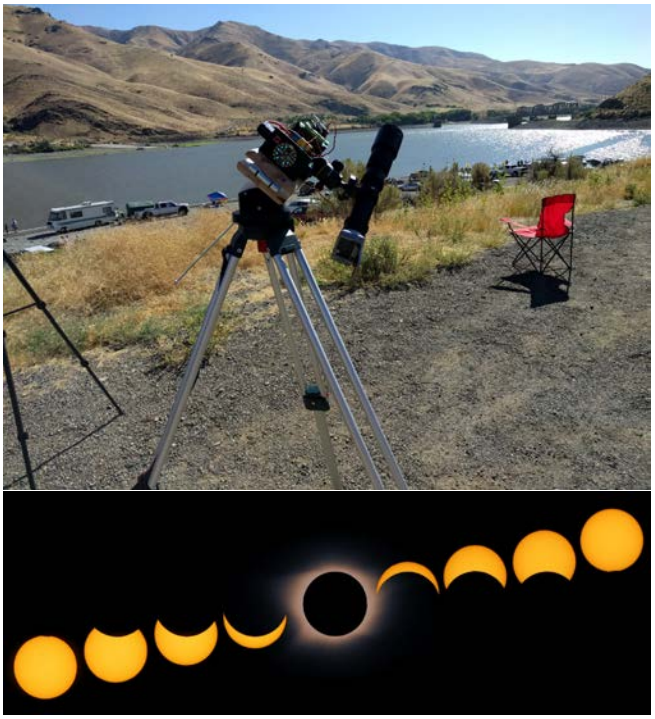

Figure 2. Lunchbox Eclipse Camera Project

6. WARPSPEED INNOVATION MODEL

A key goal of Aerospace is to deliver new technologies that bring utility to our core customers and serve the public good. We support that goal in two ways: internal technology development and transition and, where technology exists in the private sector, facilitating the transition to the government. Given the rapid pace of technology development and subsequent obsolescence, speed is paramount to our process along both paths. Therefore, we have developed "WarpSpeed", a process to assess demand signals, evaluate whether there is existing or emerging commercial technology that meets the need, and supports the transition of commercial market technologies to the government or, where appropriate, develops technology internally to satisfy those needs.

WarpSpeed Commercial

Through partnerships, we find and assist in maturing companies that have capabilities and products that can fit government needs. The process is simple, but implemented differently than our usual relationship with the commercial sector. We do not ask them to become a government contractor, and we do not tell them what to build. We do provide them with relevant data, and we do provide them with "proxy problems" that have been translated from government-speak into commercially known terminology. This solves the "lost in translation" problem that often leads to missed opportunities for the commercial sector to work on government problems. As a non-profit FFRDC, we are uniquely positioned to serve as a trusted advisor and broker

to be the government-need/commercial-solution interface.

WarpSpeed Internal

To help assess demand and scan for commercial supply, we employ a "Forage and Filter" process for tech sector capabilities and emerging technologies. This helps both internal and external WarpSpeed programs. Where technology does not exist commercially, Aerospace develops technical approaches, captures the intellectual property (IP), then focuses internal investment on rapidly developing capabilities and prototypes following a model of Sponsorship, Field Testing and Transition. In each step, we have developed an accelerated process. Regarding capturing IP, we focus on only what is minimally needed to ensure the next step. For example, a disclosure is sufficient for initial discussions, a provisional patent may be sufficient for discussions on collaboration with the private sector. Patent filings can then be flexible, based on demand signals and initial field testing. Next, we select partner companies based on capabilities and customers. What follows is a rapid pace of collaboration and field testing with technology transition as the final step.

In this way, whether from the commercial sector or internally developed, WarpSpeed quickly makes available to government customers new technologies that meet their emerging needs, that help speed development and deployment of government programs and that come with the commercial service and support required for long term deployment.

7. ANGEL PUBLIC PRIVATE PARTNERSHIPS

The Angel Public Private Partnerships (PPP) is a program we developed to address challenges in accessing commercial sector technologies for the government sector. Those challenges are varied, and often subtle, but the uneven record of success of PPP points to the need for a new way to think about the problem. The Angel PPP program addresses these challenges by translating government needs into opportunities that align with the business models of startup companies. To attract the best talent and innovation, the government will need to adapt to how start-up companies think and operate. This can prove challenging with government regulations and constraints. The Aerospace Angel PPP program has the advantage of not being directly based out of the government, but with the benefits of having a not-for-profit, trusted partner that is free from conflict-of-interest concerns.

The Angel PPP Program is based on two key elements: foraging and filtering tech sector innovations and translating government problems through Hack Sessions. This is often followed by "scrimmaging" internally with small competitions between teams of staff members.

Through this effort, we are now working with the entrepreneurial sector, such as the aerospace industry focused Starburst Accelerator. We have expanded our reach and can now access a larger pool of emerging tech companies that are also partnered with Starburst. [3] We hosted a Starburst event at Aerospace in March 2017. We have also developed strategic partnerships with universities including Georgia Tech, University of Southern California, The University of California, Los Angeles, and The University of Colorado, Boulder, among others. We also work closely with non-profit technology entities, such as the Institute for Creative Technologies and the Information Sciences Institute.

Hack Sessions

A Hack Session is an Aerospace-developed, brainstorming process that jumpstarts engagement with commercial companies of all sizes and types. Hack Sessions revolve around the premise that the right set of constraints spur creativity and innovation. The goal is to consistently produce out-of-the-box ideas to hard problems. Hack Sessions run from 3-4 hours and are designed around a set of questions that help assess a company's technology and business model. Another distinguishing feature of a hack session is that we look at both technical and business aspects of an idea. As an example, we may stipulate that any proposed solutions must have a commercially viable application to help offset the development costs or risks. After a hack session, one outcome could be to prototype the ideas in a Scrimmage (detailed in the next section), starting with a quick feasibility check all the way to a live demo, if warranted.

8. SCRIMMAGE SESSIONS

After a hack session, a next step can be to prototype the ideas in a Scrimmage (a set of iterative cycles akin to a sprint). If great ideas are born out of competition, they are brought to reality through collaboration. That's the underlying premise of an *innovation Scrimmage, a collaborative-competition process* developed by Aerospace to simultaneously challenge and encourage teams to take risks in creating breakthrough innovations.

Convention holds that teams who collaborate well produce the best solutions. Therein lies a contradiction, because working collaboratively can be harmful to the early, highly creative stages of the innovative process. The same qualities that drive good collaboration—consensus building, emphasis on coordination, and the desire for every decision to be the right one—stifles the creative process and dampens out new ideas. A Scrimmage solves this problem through a collaborative-competition approach. The result is an innovative solution unlike any other, with combinations of ideas that no one person would have conceived and would be too difficult for a team to develop on their own. The scrimmage is structured with the following steps:

1. **Formulate a Great Question**. The Scrimmage process starts by framing the problem as a Statement of Work (SOW). This is the key step because a well-framed problem will feed the creative process and inspire participants to explore and take-risk.
2. **Architect Teams.** While easy to overlook, forming the teams is only second to problem formulation in

ensuring the success of a Scrimmage. There isn't one recipe for forming teams but the general strategy is to pair staff who amplify or complement each other, while simultaneously generating a healthy tension between the teams.

3. **Compete.** With the problem formulated and the teams formed, a Scrimmage coach guides each of the teams, who are aware of the other teams but do not communicate with them. The goal is for each team to formulate a complete response that they think will win.
4. **Collaborate.** All the teams convene to pitch their solutions to each other in the second phase. After the pitches, the participants join to select which elements from each team to combine into a hybridized solution.

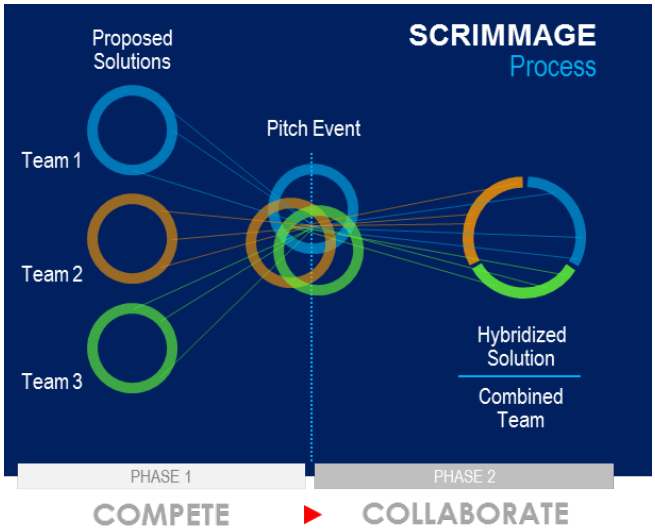

Figure 3. Scrimmage Process

Structured as a collaborative competition (*collab-petition*), teams initially compete to solve a common problem. At a critical juncture, we bring the teams together to form one team that collaborates on combining the best ideas pooled from each of their individual efforts. (See Fig. 3.) Customers (or Aerospace staff acting as proxies) work with the teams, anywhere from a few days to a few months, to flesh out their ideas and turn them into prototypes. Role playing creates a scrimmage-type atmosphere where developers and users work in teams to iterate and evaluate solutions. The outcome is a clear picture of what the solution entails, that is achieved in less time than analogous efforts, and with customer buy-in upfront.

A pilot Scrimmage was chartered to drive the development of a concept termed "forward engineering," a novel approach to extrapolate the future of key technologies, space systems, and mission concepts by introducing increased technical rigor and traceability into a forecasting process that is traditionally driven by Subject Matter Expert (SME) assessments. In this Scrimmage pilot, three two-person teams comprised of multi-disciplinary staff on both the east and west coasts sprinted for three months to design and develop high-level methodologies for a transformative forward engineering concept in a context of a test problem—anticipating what satellite servicing might look like in 2020, 2025, and 2030. The three teams competed independently of one another over the Scrimmage period, and reconvened in one location at its end to discuss their methods, talk about the pros and cons of each, and ultimately converge on a "final" solution that combined aspects of all three teams' methods to provide a target for follow-on IR&D investments.

9. Other Programs

Test Kitchen

The Test Kitchen is a key component to our innovation lifecycle. The Test Kitchen provides a failure-friendly business model wherein engineers and scientists are encouraged to look at new technologies that are not likely to be successful in the initial implementation. By encouraging our researchers to take on high risk but potentially high reward projects, they are enabled to investigate new approaches that would normally be avoided in a risk managed environment. It is important to have this type of flexibility in our innovation toolbox to stay at the edge of technology.

One example of the Test Kitchen is our exploration of the Blockchain technology. This is an exciting new technology using immutable ledger transactions that has led to the explosion of the BitCoin crypto-currency. Our researchers have been looking at different problems sets within our customer community to which such a technology could be applied. There have been many false starts in how Blockchain could be used in the National Security Space mission area, but one area that is looking promising is Digital Mission Assurance. The immutable ledger transactions provide a potential solution to having instant and traceable data on every part and subsystem on a satellite build, from the piece part supplier to the spacecraft integrator. While a full implementation of this approach has not been completed, the project is showing great promise and is ready to graduate into a prototype effort.

Intern Venture Program

Finding innovative ways to engage Aerospace's future workforce is also a goal for the Aerospace Innovation Lab. We have a Venture Internship Program that allows interns to propose project ideas to be funded and partnered with a staff mentor. This program is intended to fuse new ideas from the next generation workforce with the experience of our thought leaders in national security space. This fusion of new with experience helps transform the innovation culture at Aerospace for the entire company. As a side benefit, when interns are able to work on a dynamic engaging project of their choosing, they often return as full-time employees after graduation.

Incubator (Internal)

The Aerospace Innovation Lab is charged with accelerating new concepts and ideas from our staff into minimum viable

products to demonstrate their utility to our customer's missions. The Innovation Lab Incubator Program is designed to form cross-functional teams across our engineering matrix to develop rapid prototypes, leveraging the latest in commercial technologies and government research. Incubator projects usually range in duration from 6 to 18 months.

Makerspaces

Aerospace is experimenting with makerspaces as a creative space for employees to explore new ideas. Our concept for makerspaces is to create areas with a specific focus, and our first makerspace is focused on big data. With the exponential explosion of data in the last 20 years that has no signs of slowing, it is imperative that we find new ways to process, exploit, and comprehend this deluge of data. Our data makerspace will provide our scientists and engineers with the latest tools and necessary infrastructure to experiment with different data modalities and to look for new ways to visualize and process information. We believe a space with easily accessible data and an environment conducive to creative thought will help explore new frontiers in this field.

10. Seminars, Talks, Open Houses

There is a concerted effort to expose our staff to external sources of innovation. Those efforts include events and collaborations with universities, start-ups, incubators, speaking engagements, accelerators, other FFRDCs and recruitment to further strengthen our innovation brand and value to our primary customers. Our internal education department sponsored an innovation webinar series to feature employees and their stories of innovation. We have also hosted multiple open houses with hands-on demonstrations to showcase internal innovation and connect employees with one another.

11. Collaboration Spaces

The Innovation Lab Office officially unveiled its center for Exploration Prototyping Innovation & Collaboration (EPIC West) in El Segundo in June 2017. EPIC West serves as home to the Innovation Lab Office team, and offers unique collaborative spaces for all employees. (See Figs. 4 & 5.) These spaces are used for the Sabbatical Program, Hack Sessions, Innovation Lab-sponsored events, and day-to-day interactions among staff. In addition, the Innovation Lab Office team encourages customers to use EPIC West for collaboration with Aerospace employees and/or each other. EPIC West also provides private workspaces, mobile whiteboards, touch-screen monitors, a multi-screen display wall, computers, and virtual and augmented reality.

To build from the success and momentum of EPIC West, the Innovation Lab is preparing to create versions of EPIC in our Chantilly, VA location.

Figure 4. EPIC Meeting Area

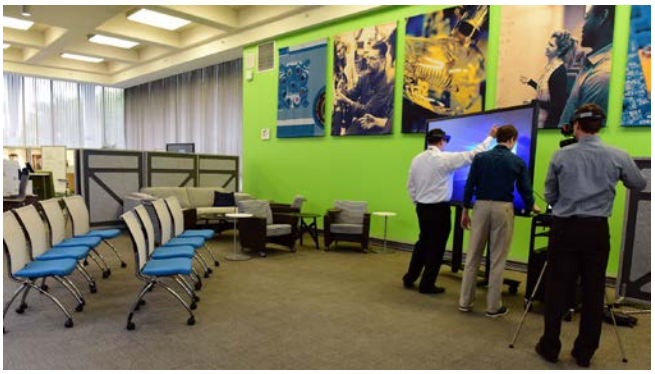

Figure 5. EPIC Presentation Area

12. Aerospace The Innovators

Another important component of our innovation culture is communicating our innovative work to our employees, current customers, future customers, and the public. We are engaging with our current and potential customers with articles, videos, hosted events, and tours with hands-on demonstrations to showcase our corporate achievements in innovation. We are also working with media to tell the story of Aerospace as an Innovator. We are actively applying for innovation awards and publicizing innovation wins, both internally and on social media.

Internally, we are taking several steps to transform the Aerospace culture. We are encouraging employees to publish their innovative work both internally and externally through conferences and journal articles. The Innovation Lab publishes regular communications highlighting and celebrating innovative work as well as spotlight that work in corporate all-hands meetings. We have an innovation award for outstanding contributors to our most impactful projects. We host a speaker series with both internal and external speakers on innovative topics. We also provide significant funding for employee innovation projects that are customer focused.

13. STANDARDS DEVELOPMENT INNOVATION

One example of Innovation at Aerospace involves developing standards to improve access to space for SmallSats. For developers of mid-sized smallsats, the biggest hurdle is not creating the satellite itself, but launching these devices into space. Launch is expensive, so compact satellites often need to hitch a ride on a larger payload that could be sponsored by any combination of government, civil, and commercial entities. This requires an extensive time commitment for both negotiation of the placement and resolving any integration issues with the larger payload.

Ridesharing on a payload adapter that can accommodate multiple satellites from a centralized ring has helped to make better use of cargo space on launch vehicles. However, integration issues remain, as each individual small payload has its own size and engineering requirements. Developing a standard Launch Unit, or Launch-U, for mid-sized SmallSats—ranging in size between a toaster and a small refrigerator—will enable rideshares to be configured more quickly and efficiently, resulting in more launch opportunities at a lower cost. Aerospace is leading development of the Launch-U standard by assembling representatives from industry, academia, and government.

14. SUMMARY

Innovation is a core value for Aerospace because it underpins assuring mission success in space. As technology accelerates, we continue to set the innovative bar as customers look to us to innovate in existing and new market areas. The aerospace industry has undergone a shift to a startup culture with many new small companies developing space systems quickly and with significant innovation. Our adversaries are applying these same innovation principles to rapidly develop new technologies that threaten National Security Space systems. Aerospace is adapting by elevating our innovation culture using new programs that encourage our employees to experiment, try new ideas and methods, and learn lessons by failing early and often. We are not even one year into the new program, but we have already seen a significant increase in employee developed innovation and an uptick in patent applications. We are also seeing substantial employee participation in our innovation programs, beyond the entrepreneurial early adopter employees. It's too early to measure a traditional Return on Investment (ROI) for our innovation programs, but we will be focusing on that next year. We will also continue to adapt our programs as we learn what works and, just as importantly, what does not.

ACKNOWLEDGEMENTS

The authors thank our many collaborators and partners across the government, commercial, and academic sectors.

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BIOGRAPHY

Rob Sherwood *is the Deputy Executive Director of Innovation at The Aerospace Corporation. He is responsible for defining and developing the company-wide innovation program, including creating a corporate culture that supports and champions innovation and advances strategic solutions. Mr. Sherwood's responsibilities include management of The Aerospace Corporation's $40M R&D program, as well as identifying and analyzing emerging technological trends and opportunities that could be impactful to Aerospace customers. Prior to Aerospace, he spent 5 years at DreamWorks Animation and 19 years at JPL.*

Dr. Randy Villahermosa *is the Executive Director of Innovation at The Aerospace Corporation. He is responsible for leading innovation programs, culture transformation initiatives, and the corporation's research and development portfolio. His responsibilities span a broad range of science, technology, and innovation areas related to space systems, remote sensing, data analytics, and autonomous systems.*

Dr. Lael Woods *is a Senior Project Leader at The Aerospace Corporation. She is responsible for developing and managing the portfolio of Innovation Programs to engage with staff early in the innovation development lifecycle. She has developed strategically aligned programs to encourage diversity and creativity in idea generation to match corporate objectives. These Innovation Programs have enabled staff from across the corporation to explore ideas at an unprecedented pace, with many moving on to further development and pre-patent status.*

Andre Doumitt *is the Director of Innovation Development in The Aerospace Corporation. Previously he served as President and founder of Digital AdopXion LLC, a consulting company focused on transitioning R&D technology in the airborne and space-based data collection and processing domain into new commercial and military programs. Previously, Mr. Doumitt served as President and CEO of Geosemble Technologies, an In-Q-Tel funded start-up spun-out of USC's Computer Science department. Geosemble developed and sold technology to automatically integrate open source text into satellite imagery and maps, and was acquired in 2012.*

Brad Hirasuna *is the Director of Innovation Operations in the Innovation Lab Office at The Aerospace Corporation. He is responsible for the execution of Innovation Lab special projects aimed at game-changing innovations leveraging the latest technologies in both the commercial and defense industries. In addition to overseeing the execution of the Innovation Lab special projects portfolio, Hirasuna is also responsible for the successful transition of these new innovations to transition partners.*

Dr. Paul V. Anderson *is a member of the Innovation Operations team at The Aerospace Corporation. He is responsible for guiding seedling and venture projects through the innovation lifecycle, coordinating innovation programs, and striving to foster a culture of innovation through improved multi-site communication, inter-disciplinary collaboration, and knowledge management. Anderson is based in Chantilly, VA, and serves as the point of contact for east coast innovation initiatives.*

Dr. Erica Deionno *is a Senior Scientist in the Innovation Lab at The Aerospace Corporation. Before her current position in the Innovation Lab, she conducted analysis of on-orbit solar cell and array degradation and degradation modeling, as well as radiation testing and modeling of advanced memory devices.*

Brandie Rhodes *is a Senior Member of the Technical Staff at The Aerospace Corporation where she is responsible for planning and executing special projects aimed at game-changing innovations. Brandie also leads a research program developing a novel small satellite propulsion system. Ms. Rhodes received her B.S. in Aerospace Engineering from the University of Kansas and her M.S. in Mechanical Engineering from Stanford University and is currently pursuing her PhD in Astronautical Engineering at the University of Southern California as an Aerospace Corporation Fellow.*

Mackenzie Puig-Hall *is a member of the Innovation Operations team at The Aerospace Corporation and a recent graduate in mechanical engineering from the University of California, Irvine. She is responsible for developing some of the Innovation Lab's special projects as well supporting the efforts of the other members of the Innovation Operations team.*