

APL's Systems Approach to Becoming a Strategy-Driven Organization

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ABSTRACT

The Johns Hopkins Applied Physics Laboratory (APL) developed an integrated systems approach to strategy beginning in 2011. The approach has resulted in a vision and strategy framework that is built for the long term and has proven itself in execution during a turbulent decade marked by changing national security priorities, economic uncertainty, and transformative technological advances in areas such as artificial intelligence, hypersonics, and cyber. This article describes how articulating a bold vision and strategy, coupled with an innovative and lasting implementation plan, enabled APL to achieve a new level of national impact by becoming truly and overtly strategy driven. It did so by introducing, in stages, a system composed of six strategic planning methods that are often implemented separately or partially: a classic vision framework; a one-page strategy articulation adapted from industry; a continuous decision-making process; a strict alignment of resources to strategic priorities; regular accountability reviews; and a genuine engagement of the entire staff in fostering innovation aligned with the vision and strategy. The narrative includes expository descriptions of each system element and hard-won lessons learned during implementation. This can give the practitioner confidence that vision and strategy need not end up sitting on the shelf, but rather can be successfully applied to drive the organization forward through turbulent times.

INTRODUCTION

Founded on March 10, 1942—just 3 months after the United States entered World War II—APL, sprung from a federal government effort to mobilize the nation's scientific resources to address wartime challenges. The effort was sponsored by the Office of Scientific Research

and Development, led by Dr. Vannevar Bush² and reporting to President Franklin Roosevelt.

Secretly tucked into an old used car garage in suburban Maryland, APL was tasked to find a better way for Allied ships to defend themselves against air attacks.

This article is an expanded and updated version of "Becoming a Strategy-Driven Technology Organization—A Case Study," previously published in *IEEE Engineering Management Review*.¹

The Laboratory designed, prototyped, and tested a radio proximity fuze (known as the VT fuze; VT stood for “variable time” to avoid the then-classified and more accurate “radio proximity” technology descriptor) that significantly improved the performance of anti-aircraft shells in the Pacific—and, later, ground artillery during the invasion of Europe. Historians later judged this product of APL’s intense work, along with the atomic bomb and radar, one of the three most valuable technology developments of the war.³

From that successful collaboration, the US Navy, Johns Hopkins University (JHU), and APL committed to continuing their strategic relationship after the war. The Laboratory quickly became a major contributor to advances in guided missiles and submarine technologies, and today, more than eight decades later, APL’s numerous and diverse achievements continue to strengthen our nation.⁴

APL’s work is sorted by 12 mission areas (i.e., thematic program portfolios), each of which taps the diverse skills and expertise of more than 8,000 staff members. Together, these mission areas encompass more than 1,500 ongoing research and development (R&D) projects for a variety of government sponsors, including all military services and agencies, NASA, and the Intelligence Community, with a total annual revenue of slightly more than \$2 billion.

Long evolved from the strict focus of its founding project, APL relentlessly pursues a core purpose: *to make critical contributions to critical challenges for our nation*. But as the 21st century dawned, it became clear that this core purpose and the Cold War—original culture that grew around it were not enough to maintain pace with rapid technology developments and emerging threats confronting the nation. Adapting the Laboratory to meet this acceleration and globalization of critical technical challenges required a strategy to achieve a new level of innovation that the entire staff could embrace and sustain.

That included a look back to identify a set of innovations that went well past the level of critical contributions to truly revolutionary advances that provided a game-changing advantage for the nation. Indeed, *defining innovations* (a term coined for APL’s 75th anniversary) such as the radio proximity fuze, surface-to-air guided missiles, satellite-based navigation, advanced sonar systems, ballistic missile defense from the sea, and planetary defense, among others, are evident throughout the Laboratory’s history and exemplify APL’s significance.⁵

The APL Executive Council (EC), which consists of the director, chief of staff, assistant directors, general counsel, and sector and department heads, also looked ahead, forging a vision and strategy that would inspire and engage all staff members in the pursuit of new defining innovations that would ensure the nation’s continued preeminence in the 21st century.

This case study demonstrates how articulating a bold vision and strategy, coupled with an innovative and lasting implementation plan, helped a historically successful organization achieve a new level of national impact by becoming truly and overtly strategy driven. It did not happen all at once, nor by adopting one particular best practice. Instead, APL wove a system composed of six strategic planning elements that are often implemented separately or partially: a classic vision framework; a one-page strategy articulation adapted from industry; a continuous decision-making process; a strict alignment of resources to strategic priorities; regular accountability reviews; and a genuinely inclusive engagement of the entire staff in fostering innovation aligned with planning, experimenting, and executing the strategy.

THE FIRST FIVE DECADES: WORLD WAR II THROUGH THE COLD WAR (1942–1991)

Over its first 50 years, APL enjoyed a relatively stable working and financial relationship with its primary sponsor, the US Navy, and focused to a great extent on the steadily advancing naval and strategic threat posed by the nation’s principal adversary, the Soviet Union.

As mentioned, APL was founded with the unitary mission to develop and operationalize an advanced munitions fuze to counter enemy air power in World War II. It was commonly understood that the Laboratory would be disestablished when the mission was achieved or the war ended, whichever came first. The first Lab director, Dr. Merle A. Tuve, clearly expressed that laser focus and urgency in his running orders to the staff: “I don’t want any damn fool in this laboratory to save money. I only want him to save time. We don’t want the best unit, we want the first one. . . . The *final* result is the only thing that counts, and the criterion is: Does it work *then*. . . . Don’t forget that the best job in the world is a total *failure* if it is too late.”⁶ Another culture-creating quote from Tuve doubled down on the entire organization’s foundational commitment to the operational effectiveness of the new radar proximity fuze: “Our moral responsibility goes all the way to the final battle use of this unit; its failure there is our failure regardless of who is technically responsible for the causes of the failure. It is our job to achieve the end result.”⁶

As the war ended, related and emergent threats in naval warfare motivated the Navy to continue to support R&D at APL, and the Lab responded with evolutionary and expansionary follow-on innovations that helped the nation build an unrivaled naval force. It was during this period that APL achieved six of its historical defining innovations: the radio proximity fuze, Navy surface-to-air missiles, the Transit satellite navigation system, Navy phased-array radar, advanced sonar arrays, SATRACK ballistic missile testing, and the Tomahawk cruise missile weapon system.

While some diversification beyond the Navy occurred during this era, it was limited by a long-standing policy decision to restrict the Laboratory to first 2,600 and later 2,800 employees to ensure that APL would remain an elite R&D organization, working on only the most critical challenges facing the Navy. In practice, diversification was implicitly initiated at the request of Navy officials who referred the Laboratory to other national security sponsors as a systems engineering and technology innovator that could not only develop solutions to clearly specified problems but also collaboratively match government needs to science and technology solutions, often through innovative applications of technologies that had first been developed for the Navy. New non-naval innovations during this era included taking the first photo of Earth from space; developing telemetering technology, a modulated molecular beam mass spectrometer, and attitude stabilization for satellite tracking; and conducting Army ballistic missile testing.

THE FIRST DISRUPTIVE DECADE: THE POST-COLD WAR “PEACE DIVIDEND” (1991–2001)

National defense spending reductions, popularly known as the “peace dividend,” had a disruptive effect on the Laboratory’s 50-year-old partnership with the Navy and forced APL to adapt its business model in response. Soon after the breakup of the Soviet Union in 1991, the Department of Defense aggressively cut operating forces and civilian headquarters staff, reduced procurement funding, and closed or consolidated many military bases. Even though R&D budgets were generally stable during this decade, the broad reduction in funding for national security naturally led to an increased sense of competition among commercial industry and national laboratories for opportunities in R&D to replace reductions in more traditional manufacturing and procurement, as well as opportunities to gain an edge for subsequent production of systems related to successful research programs.

Commercial firms advanced a position that continuing sole-source awards to national laboratories prevented them from demonstrating that they could conduct R&D as well as or better than some national laboratories, and they further argued that not only should new R&D be competed, but some existing, long-term national laboratory roles should be as well. Perhaps the most disturbing trend, observed by then director Carl Bostrom, was that the Laboratory was being treated more like a contractor than a partner, which could hurt its ability to continue to serve as an innovative national resource. The Lab was at its best when presented with something that did not work and then allowed to both find and fix the problem rather than be told what to do.⁷

When Gary Smith took over as director in 1992, working closely with APL leaders and armed with candid sponsor feedback, he initiated an APL improvement

initiative that included procedures that led to more timely responses to sponsors, more efficient teamwork, and streamlined processes to reduce costs.⁵ As well, it was necessary to increase sponsor engagement calls to familiarize traditional and new sponsors with APL capabilities because they had lost significant corporate memory as senior civilian staff levels were reduced and increasingly replaced with active-duty military officers for relatively short-term assignments. But by early 1995, it was apparent that these measures would not be enough to adapt to the reduced funding and dynamically competitive environment. Discouragingly, APL found that it needed to downsize by about 10% and resolved to diversify beyond its Navy sponsors.

This controversy over competition for R&D opportunities was partially resolved in 1995 when the Office of the Secretary of Defense for Acquisition, Technology, and Logistics, or OSD (ATL), established complementary University Affiliated Research Center (UARC) and Federally Funded Research and Development Center (FFRDC) management plans. These plans specified core competencies that each type of organization had to maintain. As those competencies were needed, the plans authorized government sponsors to award sole-source contracts to UARCs and FFRDCs as established national resources. While the plans validated sole-source contracting under certain conditions, especially to avoid conflicts of interest, they did not allocate funding, and therefore some of the work APL previously did migrated to industry. But this new identification of APL as a UARC partially offset those declines, enabling the Lab to establish new program areas such as transportation and command, control, and communications, which diversified its sponsor base, energized critical staff members, and provided exceptional value to new sponsors.

To better position the Laboratory long term, and to find new ways to apply existing staff expertise toward a more diverse set of emerging national challenges, Smith initiated the first centrally managed, wide-ranging strategic planning effort. The 1998 strategic plan identified 21st-century challenges that APL could undertake as a UARC and that would expand the sponsor base into new areas while allowing the Lab to continue to make critical contributions to critical challenges for legacy sponsors. Indeed, three of APL’s recognized defining innovations—the Cooperative Engagement Capability, ballistic missile defense from the sea, and low-cost planetary exploration—came to fruition during this decade.

The strategic planning effort resulted in new and accelerated program development, perhaps most notably in the areas of national ballistic missile defense and infocentric operations. Sponsor engagement efforts were bearing fruit such that the long-standing, now self-imposed limit of 2,800 staff members was set aside, and by 2001 the Laboratory’s staff numbered 3,400. However, growth and mission impact of the new programs

were not uniform across the Laboratory's several technical departments. Reflecting the current sponsor base and areas of deep expertise, strategies and business plans had been primarily developed by departmental organizational teams. While this strengthened the operating posture of the Laboratory in aggregate, APL could still be characterized as a loosely tied confederation of independent departments rather than a fully integrated organization responding to a unified vision and strategy.

In the fall of 1999, the Johns Hopkins board of trustees announced that Richard Roca, a vice president at AT&T Bell Laboratories, would become APL's director. Roca, who had been the director of strategic planning during the Bell Systems divestiture that created the "Baby Bell" regional phone service companies, knew well the value of vision and strategy. During his first three months, he met with APL leaders, staff members, and government sponsors to discern whether the Lab should focus on diversification beyond its traditional sponsor base, which deeply depended on the Laboratory. What he heard convinced him that APL should "stick to its knitting," which now included infocentric operations, but should also be sufficiently flexible and agile to accommodate new sponsor needs when critically necessary to the nation, with success always defined as whether APL was making "critical contributions to critical challenges." Picking up on the insights in the 1998 strategic plan regarding a global trend toward unconventional warfare, he also moved to support nascent programs to counter biological, chemical, and nuclear national security threats. And in response to the growing importance of IT infrastructure and cyber defense, he established a chief information officer, an information technology department, and a cyber-focused business area.⁵

The feedback that Roca received from the sponsor community was not all positive. While it was recognized that APL did amazing, impactful things, he heard that too often work was isolated in organizational silos. He thought that a sponsor should hear the best solution that *all* of APL could bring to a problem, not just one solution from one part of the Lab. To help the Lab think and work as a united entity, Roca decided that the role of a department should be to provide technical expertise and resources, and business areas—a new program-related matrix structure that he created—would assemble expertise from various departments to accomplish specific goals for each sponsor. An additional benefit of the business area construct was its potential to develop future Lab leadership.⁵ The concept of business areas, today known at the Lab as mission areas, has endured as a key organizational construct.

The recognition of APL as a UARC and the Lab's initial strategic plan, business practice modernization, and new focus on diversification and making critical contributions to critical challenges all positioned APL well for the future.

NEW STRATEGIES FOR NEW ADVERSARIES (2001–2010)

The horrific attacks on the Twin Towers and the Pentagon on 9/11 led to a national mobilization against terrorism, along with sharp increases in defense and intelligence agency funding for operations and rapid fielding of advanced technology. APL quickly formed cross-organizational teams to meet new and unexpected challenges; new sponsors fast-tracked many of the Lab's security-related programs; and over the next several years, the program portfolios in homeland protection, what became known as cyber operations, and special operations forces expanded in response to the growing importance of intelligence and networking capabilities.

Staffing levels grew quickly to meet critical mission needs, providing both opportunities and challenges for the Lab. With rigorous new business practices instituted by Roca, enterprise service expenditures were held flat to achieve economies of scale as the sponsored work grew. This enabled APL to allocate surplus funds to sorely needed new facility construction, advanced laboratory equipment, and greater investment in internal Independent Research and Development (IRAD) funding to explore emerging problems and technologies. A particular challenge was prioritizing among diverse sponsor needs in this era of advancing threats to homeland security and countering terrorism abroad—all of which were presented as urgently needed from the sponsors' point of view. The still-fresh memory of the funding challenges of the previous decade discouraged many APL managers from turning down new opportunities, which accelerated growth and put pressure on talent acquisition and infrastructure.

Roca led the development of a new 2004 strategic plan (later updated in 2008) to cope with the rapid growth and diversity of national challenges, requiring each of APL's 14 business areas to develop detailed business execution plans that sought to reconcile forecasts of programmatic growth with availability of staff expertise and necessary facilities. However, these attempts at rigorous planning and limiting staff growth were only partially successful in the face of incessant and emergent sponsor demands for advanced and rapidly fieldable technologies—which APL delivered again and again, often at a very highly classified level. While national security budgets increased by over 100% during this decade, the Laboratory's growth control efforts successfully limited its staff increase to about 50%, reaching 5,100, by 2010. This restraint to limit new work to critical challenge areas would mitigate the effects of the next storm, unlike for organizations that opportunistically rode the full force of the national security funding wave.

By early 2010, according to key measures, the Laboratory was in excellent shape from a business and technology perspective. Mission areas were providing

sponsors with expertise they could not find within the government or industry, the Laboratory was financially healthy, and its culture—with a focus on doing the right thing while solving problems of national interest—was admirable.

PREPARING FOR THE STORM: STRATEGY IN ACTION (2010–2012)

But storm clouds were forming. As the decade began, the economy had become volatile, and with pressure to reduce federal budgets, nontraditional organizations sought defense funding at the same time government agencies were in-sourcing work to avoid downsizing. The Department of Defense (DoD) began to look to Silicon Valley for cost-effective and innovative solutions, bypassing the long-established national laboratories that were now perceived to be inflexible and bound by requirements.

Ralph Semmel, selected that year as APL's director, was convinced that APL needed a bold strategy for thriving in a world where connectivity among nations, cultures, and adversaries was becoming seamless, and where the pace of science and technology was accelerating chaotically. APL would need to be even more agile and connected and would need to increase collaborations with commercial industry. Every staff member would need to be empowered to innovate and develop potentially disruptive solutions to critical challenges.⁵

APL leaders met to decide on a path forward and determined that this confluence of turbulent times for national security and federal budgets, the changing innovation landscape, and a new director offered a unique opportunity to strategically reset the Laboratory and prepare it for the coming storms—and beyond. As a result, the EC committed to developing a bold new strategy that the entire organization would follow.

The strategy and its implementation system comprised four interrelated elements, depicted in Figure 1 and described in more detail below.

Capturing Actionable Strategy in Cascading Vision, Strategic Focus, and Execution Priorities

While participating on a government advisory board, Semmel saw how the networking and telecommunications firm Cisco had expressed its strategy on a single page: the VSE, for vision, strategic focus, and execution priorities.⁸ A more mature version of the original Cisco VSE construct can be found online in *bmc's The Business of IT Blog*.⁹ He resolved to try it out at APL. Not only could the VSE be easily shared and followed by the staff, but its brevity would serve to focus the EC as it developed this first high-level strategy product. The guidance was straightforward:

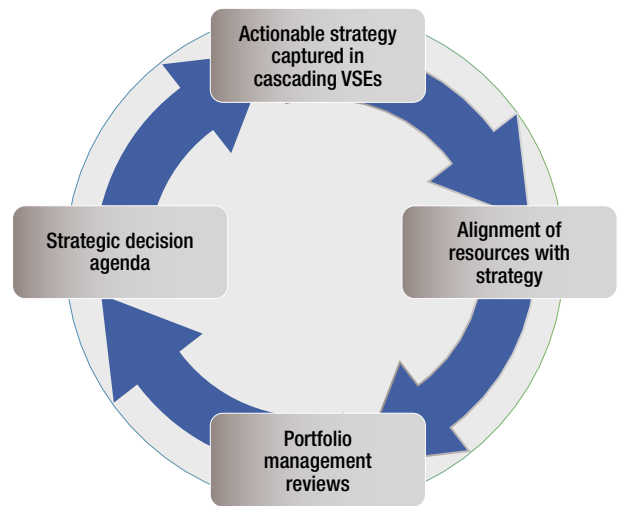


Figure 1. Strategy and its implementation system comprising four interrelated elements.

- The **vision** would be crisp, inspiring, and focused on the longer-term future and include the value proposition for the organization.
- The **strategic focus** areas, or SFs, would cover the next three years and include key decisions and directions that would guide fulfillment of the vision.
- The **execution priorities**, or EPs, would be measurable activities implemented over the next year to realize the SF areas; they could include actions as well as critical decisions.

The executive team adopted the first APL VSE, shown in Table 1, in 2011. The strategy did not stop at the highest levels; it cascaded into tailored VSEs for each sector, department, and mission area (formerly referred to as business areas). The entire Lab adopted the process and the broad discussions necessary to converge on strategic priorities, and while the format has been refined, this one-page capture of vision, SF areas, and EPs persists today.

One feature that became important to the success of the VSE process in formulating the Lab strategy was widespread participation in the developmental process. As the EC met to contemplate successive VSEs, it began considering inputs from APL's corporate Board of Managers, external experts, and organized groups within the Lab. These included the other executive forums and even individual staff members, as well as purposely selected issue teams. This latter approach became especially successful. That is, teams of staff members nominated for their executive potential were tasked with developing strategic ideas to shape the future of the Lab. These teams became known as the "X,Y,Z" teams, and the EC dedicated a day to hearing their inputs. As one example attributed to their inputs, a strategic thrust that evolved

Table 1. APL’s first VSE, adopted in 2011 for fiscal year (FY) 2012

Vision: As a premier nonprofit research and development institution trusted by government and industry, make highly innovative, affordable, and timely contributions to critical challenges in national security and space.

| Strategic Focus (FY2012–FY2014) | Execution Priorities (FY2012) |
|--|--|
| 1 Increase the impact of our contributions across all of our business areas | Enhance the technical excellence of our overall program portfolio through an increased emphasis on innovation, affordability, and timeliness |
| 2 Place special emphasis on highly visible and high-risk challenges that span our traditional sponsor and mission boundaries | Focus Lab resources to ensure success of PTSS [Precision Tracking Space System] and to develop concepts for solutions to the Navy’s anti-access challenges |
| 3 Establish enduring trusted technical agent roles in cyber operations and CBRNE [chemical, biological, radiological, nuclear, and high-yield explosives] defeat | Establish trusted Navy relationships for cyber, with a focus on 10th Fleet |
| 4 Identify and assess emerging national challenges for APL contributions | Create and ensure initial success of a Special Operations Business Area |
| 5 Adapt the enterprise to be robust and agile in the face of shifting national priorities | Transform the organization to increase flexibility, eliminate unnecessary process, and significantly reduce costs |
| 6 Foster a Laboratory-wide culture that embraces creativity and excellence | Create an innovation initiative in which business areas identify and tackle “challenges after next” |

from one session became the basis of APL’s National Health Mission Area.

A second critical feature of each VSE’s SF/EP pairs was that they include no objectives related to revenue or staff growth. Instead, the focus was always on impact toward the vision, with the underlying assumption that necessary resources would become available to compelling initiatives through the natural competition for ideas.

But how to score success? If the expectation was that 100% achievement of the set of EPs was the standard, then easily achievable EPs could be offered up to ensure

success. So, Semmel set a 50% success criteria threshold to encourage boldness and willingness to fail in trying.

However, simply having a strategy, communicating it, and measuring its execution were not enough; implementation had to have a bite for leaders and staff members to take it seriously and live by it. Semmel reasoned that the implementation had to have consequences for allocation of scarce resources, executive accountability, and decision-making. These additional three elements of the strategic framework were quickly added and implemented for 2012 and each subsequent annual cycle.

Table 2. APL’s VSE for FY2020

Vision: Create defining innovations that ensure our nation’s preeminence in the 21st century.

| Strategic Focus (FY2018–FY2020) | Execution Priorities (FY2020) |
|--|---|
| 1 Develop bold next-generation national security initiatives in each sector that have the potential for game-changing impact | Incorporate breakthrough ISR&T [intelligence, surveillance, reconnaissance, and targeting] concepts in a resilient and modular framework that enables military operations in contested environments |
| 2 Shape and lead disruptive opportunities in civil space that will result in new groundbreaking missions and national capabilities | Develop an APL-led mission model that enables a new paradigm for space exploration |
| 3 Develop and implement revolutionary cyber situational awareness and defense capabilities to enhance resilience in naval platforms | Demonstrate a capability to provide response options leveraging cyber situational awareness across multiple subsystems |
| 4 Become a transformative force in the biological sciences for solving national security and global health challenges | Create a framework for the government to identify, assess, and mitigate potential biological threats to national security and public health |
| 5 Establish APL as the recognized leader in critical emerging innovation ecosystems | Develop the analytical foundation for a war game to inform policy and programmatic decisions necessary for success in seabed warfare |
| 6 As part of One University [JHU initiative], become a trusted partner in new educational initiatives, research programs, and development pursuits | Design and deploy the delivery component of PMAP [Precision Medicine Analytics Platform], with a focus on providing data-driven insights into patient prognosis |
| 7 Be a model organization for innovation, inclusion, and empowerment | Establish a Lab-level innovation challenge that engages and fosters professional growth among our early-career staff |

While the basic framework has remained the same, the annual VSE has evolved over time, with improvements to clarity and succinctness, explicit alignment of EPs to SFs areas, and hierarchical VSE connection, as can be seen in the Laboratory VSE for fiscal year (FY) 2020 (Table 2).

Aligning Resources with Strategy: The Integrated Investment Plan

The spending of Laboratory contractual revenue is broken into two broad categories: “direct” expenses, which are directly associated with executing work for a sponsor, and “indirect” expenses, which support enterprise-wide activities, maintenance, or investments needed to sustain the organization in its core purpose. These indirect expenses are further broken down into routine overhead, program development (IRAD, bid and proposal, and sponsor engagement), and capital funds. When APL introduced the VSE, indirect expense budgets were managed in a distributed manner throughout the organization, and not explicitly aligned with strategic priorities. At the Laboratory level, overall budgetary planning of routine overhead and capital funds was the purview of the assistant director for operations, while the assistant director for programs handled allocation of program development funds.

To ensure that resources would be available to execute the VSE, Semmel established an investment strategy team (IST). This team is chaired by the chief strategy officer (later dual-hatted as the assistant director for programs) and includes the other assistant directors, the chief financial officer, and the chief of staff. It is charged with developing an annual integrated investment plan that—based on proposals from sector and department leadership teams—aligns the allocations of all indirect funds with the strategic priorities, emphasizing the EPs of the VSEs.

Each sector, department, and mission area’s budget allocation is fixed at the same level for three years. Reserves representing about 20% of available indirect funds are held back and allocated annually according to competing strategic needs. And to acknowledge the evolution of priorities among organizational elements within the Laboratory, in alternating three-year intervals, the baseline allocations for program development, capital, and overhead funds to each area are reduced by 10%, 10%, and 5%, respectively, and then reallocated among the areas in accordance with strategic priorities.

This fiscal and budgetary accountability has brought strategy to the forefront of decision-making while also providing a significant degree of agility to respond to emerging needs.

Reviewing Portfolios for Accountability

Semiannual portfolio management reviews (PMRs) hold the executive for each mission area accountable for

properly executing their strategy, being a good steward of the investment resources allocated by the IST, and most importantly, enhancing the impact and quality of their mission area’s direct-funded programs.

To provide uniform structure and efficiency to the PMRs, the outline for each session is clearly specified:

1. Sector and mission area VSEs
2. Quad-chart summary of mission area business status relative to strategy
3. Integrated investment plan–related accomplishments
4. Portfolio analysis
 - a. Strategic importance of the work
 - b. Alignment relative to the UARC mission
 - c. Transition plans for misaligned programs
5. Quality management
6. Sponsor/customer feedback
7. Progress toward VSE EPs
8. Issues

The heart of each PMR is the portfolio analysis, which has three key elements of accountability. Aligning the work portfolio with the mission area’s VSE provides insight into the strategic importance of new and ongoing sponsored work. Recognizing the Laboratory’s special status as a UARC, executives discuss disposition of any programs that no longer align with the intended role of DoD UARCs. And finally, in the interest of continually strengthening the mission area’s work portfolio, mission area executives are obligated to identify the least impactful 10% of their portfolios as candidate programs to be transitioned, either to commercial industry or government, or phased out. This directive was later revised to remove the characterization of “least impactful” to recognize that candidate programs may have been successful and were now mature enough for transition to programs of record. In practice, 2–5% of each mission area’s portfolio is transitioned annually through this process.

These PMRs close the loop between establishing and executing the strategy, thereby creating real and visible accountability throughout the organization.

Setting a Strategic Decision Agenda for Continuous Planning

While the EC performed well together in making operational decisions—that is, when making decisions on internally oriented tactical issues—it was still finding its way when tackling primarily externally oriented and strategic topics. It often took more time to arrive at strategic decisions. And some decisions were made without all members having a deep understanding of

the issue at hand, which inhibited full commitment and follow-through across the organization.

Semmel next leveraged a 2010 JHU deans' strategic planning retreat to help the EC refine its approach to strategic decisions. These discussions introduced an intriguing *Harvard Business Review* paper, "Stop Making Plans; Start Making Decisions."¹⁰ The authors, Michael Mankins and Richard Steele, had developed a powerful method for identifying strategic issues and making effective decisions in a collaborative environment (Figure 2).

Mankins and Steele observed that most strategic planning is an annual (or even aperiodic) process and most often focuses on individual business units—which is how previous APL strategic planning efforts had been implemented. However, they discovered that executives actually make important strategic decisions outside of the strategic planning process, unconstrained by the calendar or organizational boundaries. Their research found that companies with standard strategic planning processes and practices make just two to three strategic decisions per year, while those that follow a continuous strategic decision-making process make more than double the number. Acknowledging this finding, their approach provides a discipline for identifying strategic

issues and making strategic decisions in a timely, collaborative fashion.

While APL had adopted the VSE process, the challenges in identifying the strategic decisions that fed the VSE and focusing the EC consistently on strategically important issues remained. This continuous, decision-oriented planning approach had promise. Like the VSE, it was deceptively simple:

- Periodically identify a set of potentially strategic issues.
- Prioritize the issues relative to importance and timing for decisions.
- Consider each strategic issue over two sessions:
 1. Data and alternatives (D&A)
 2. Decision-making

In preparation for its October 2010 strategic planning meeting, the EC polled its members to identify the set of strategic issues the group should address during the coming year. Out of this poll came 37 candidate strategic issues, of which 11 were sufficiently time critical that they were decided in the first year.

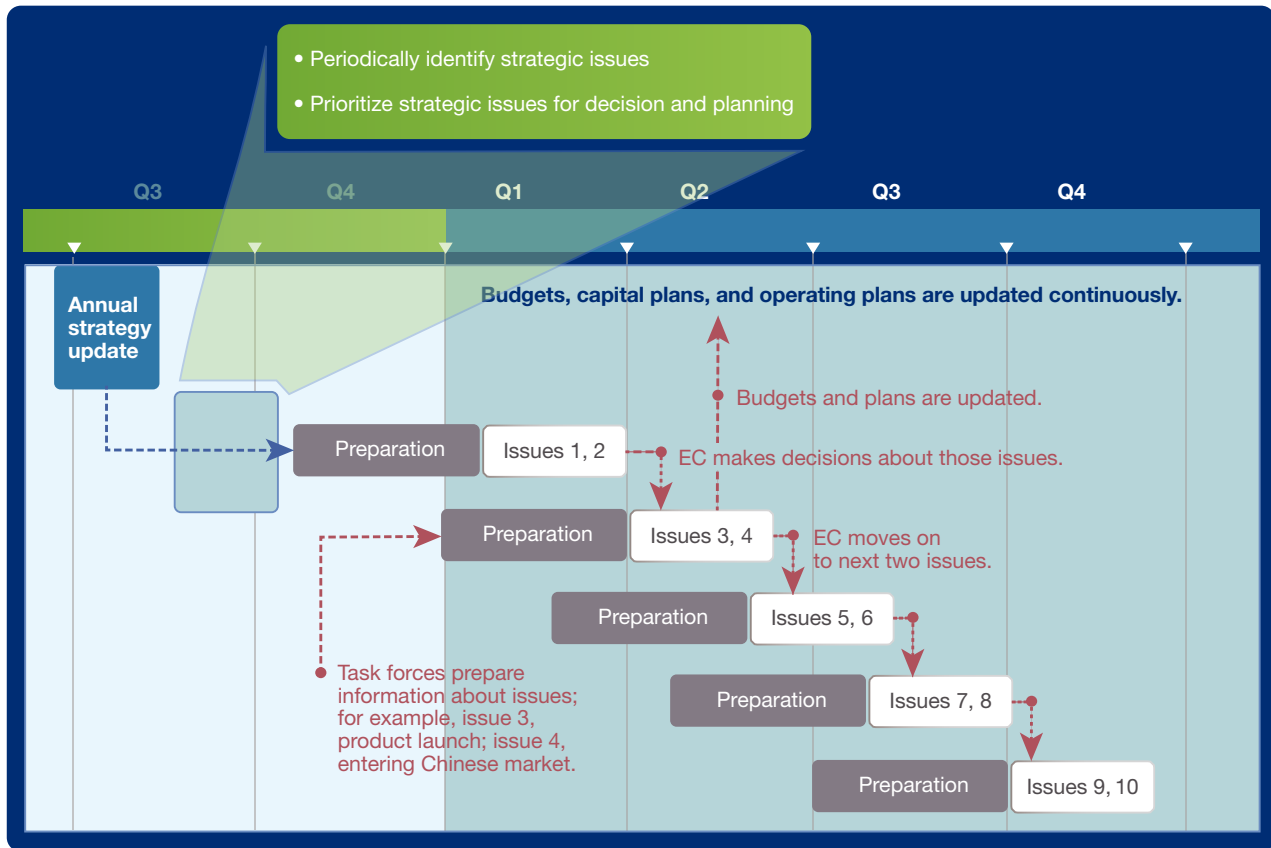


Figure 2. Mankins and Steele method for identifying strategic issues and making effective decisions in a collaborative environment. (Reprinted by permission of *Harvard Business Review*. Adapted from p. 83 from "Stop Making Plans; Start Making Decisions" by Michael C. Mankins and Richard Steele, January 2006. Copyright ©2006 by Harvard Business Publishing; all rights reserved.)

The fundamental insight embodied in the construct was the two-session consideration sequence. The purpose of the D&A session is to ensure that EC members are fully informed on the issue at hand and satisfied that a robust set of choices, spanning the full range of what is feasible, is offered. For complex topics, an expert team researches and presents the data, articulating a set of feasible alternatives and an accompanying analysis that identifies objective pros and cons for each alternative. During the D&A session, EC members may ask for more data, pose additional alternatives for the expert team to explore, and offer additional pros and cons to be analyzed.

In some instances, the decision is sufficiently obvious once the alternatives are presented that the second session, the decision session, can be waved off if all members consent. However, decisions are usually not permitted during the D&A session. During the decision session, the expert team addresses questions raised during the D&A session and is then usually dismissed so that the EC may openly debate and come to a decision that cannot be subsequently attributed to individual members.

One unexpected benefit of this two-session process became quickly apparent. The pause between the D&A session and the decision session enabled EC members to engage their own leadership teams in evaluating the decision alternatives. This often revealed diverse perspectives and, ultimately, more thoughtful decisions that were embraced by those deeper within the organization. But another unexpected pattern, this one concerning, also developed. Often, three alternatives were posed—status quo, mild change, and aggressive change—and it became tempting to just pick the middle alternative. To combat this tendency, the expert teams have since been charged with being bold in developing highly innovative alternatives, especially with particularly complex issues.

Overall, the Mankins and Steele framework oriented the EC toward truly strategic decision-making and resulted in robust decisions that stood the test of time as the Laboratory adapted within an uncertain environment. Since implementing this practice in late 2010, APL has made an average of nine strategic decisions per year through 2022, addressing diverse topics such as new mission areas, cost-control measures, IRAD investment posture, cybersecurity, business continuity planning, technology transfer and commercialization, strategic relationships, major reorganizations, campus development, growth control, and hybrid work environments.

In addition to adopting this planning construct, APL's "storm preparation" in 2011–2012 included some other initiatives. A steady stream of thought leaders was brought into the Laboratory to interact with the staff and explore diverse perspectives on emerging challenges, not yet fully apparent or understood, that the Lab would likely face. The most wide-ranging reorganization of the Laboratory's technical organizations and a

significant cost-control initiative positioned the Lab to better respond to the external environment and address evolved misalignments.

In the initiative most visible to the entire staff, Semmel in 2010 charged Jerry Krill, assistant director for science and technology, to launch an integrated set of innovation initiatives. These initiatives were based on a series of experiments involving interested staff members and supported ideas that might cross organizational boundaries in novel ways or be too forward-looking to find internal or government financial advocates.

While Semmel celebrated this tremendous progress, he also knew that a truly long-range vision—one that extended over 25 years to the Laboratory's 100th anniversary—was needed to inspire the organization to become fully strategy driven and to ensure that the commitment would take hold and last. But the long-expected storm was nigh, and the long-range vision and strategy would have to wait.

THE PERFECT STORM OF 2013

The storm arrived with a vengeance in three intersecting waves, all in 2013: mandatory indiscriminate federal budget cuts through a process known as sequestration, associated delays in renewing APL's foundational UARC contract with the Navy, and a federal government shutdown that suspended many government services and triggered widespread employee furloughs in government and the private sector alike.

When Congress failed to reach agreement for FY2013 on how to implement spending cuts mandated by the Budget Control Act of 2011, a trigger mechanism in the bill, known as sequestration, was activated to reduce the rate of increase in spending across the board.¹¹ The sequestration effects had been looming for over two years by then, as several temporary measures that delayed the spending cuts were passed. But with Congress at an impasse, the cuts were ultimately scheduled for implementation on 1 March 2013. At the same time, the Laboratory's principal omnibus contract with Naval Sea Systems Command (NAVSEA) was up for a ten-year renewal worth just over \$6 billion in potential, but not guaranteed, funding. But with the uncertainty of funding due to the impending sequestration, such a large, sole-source contract had increased visibility, and senior Navy officials were reluctant to approve it in that uncertain environment, even though the terms were nearly identical to the expiring NAVSEA contract. If the contract were not renewed, APL could face irrecoverable reductions in force starting in March and accelerating from that point on until alternative contracting mechanisms could be put in place to continue critical work for Navy sponsors.

Recognizing the seriousness of the sequestration and contract renewal confluence, the EC established

a strategic task force to examine the best ways to control costs while enhancing the Lab's value to the Navy. While difficult cost-reduction decisions were necessary in a number of areas, including retiree medical benefits, construction, and operational overhead, the EC knew it needed to continue to attract and retain a world-class workforce, so it made no changes to active staff members' benefits or compensation. Additionally, it made the strategic decision to protect investments in innovation. As a result, APL was able to meet its goal to reduce its cost to deliver by 5% relative to inflation. In fact, as the effects of long-term measures kicked in, APL reduced costs by over 10%, while holding voluntary staff turnover to the remarkably low level of less than 5% and preserving the innovation programs.

Finally, with strong support from all of APL's immediate Navy sponsors, the foundational UARC contract was awarded in mid-February 2013. However, because of the uncertain impacts of the underlying sequestration-related funding reductions, planning for the foreseeable future remained constrained.

The third wave emerged in the form of a "funding gap" between the two chambers of Congress on how to balance long-term appropriations and the federal debt limit. Ultimately, the impasse led to a federal government shutdown on October 1, 2013, for 16 days, the third longest in US history. The threat to APL's cash flow was significant, as approximately 800,000 federal employees were indefinitely furloughed and another 1.3 million were required to report to work without known payment dates¹²—including government fiscal offices that process payments for valid contract expenses to organizations like APL. In an extraordinary all-staff meeting two weeks into the shutdown, Semmel announced that the Laboratory would continue to keep all staff members working and paid through the shutdown for at least three months by using a large line of credit and additional loans as necessary. Staff members, expecting a furlough announcement, were greatly relieved, inspired, and energized by the Laboratory's full commitment to its staff and willingness to assume considerable financial risk in such a time of turmoil.

With existential threats averted, and as the storm abated, Semmel decided that it was time to complete the full long-term vision and strategy, the critical and capstone fifth element of the system.

BUILDING THE CENTENNIAL VISION

Semmel had a deep appreciation for the Collins and Porras method of building an organization's vision, as articulated in the 1994 landmark strategy book *Built to Last*,¹³ and had long planned to apply it rigorously to APL. During a six-year research project at Stanford, Collins and Porras studied 18 exceptional and long-lasting companies, comparing them not to the

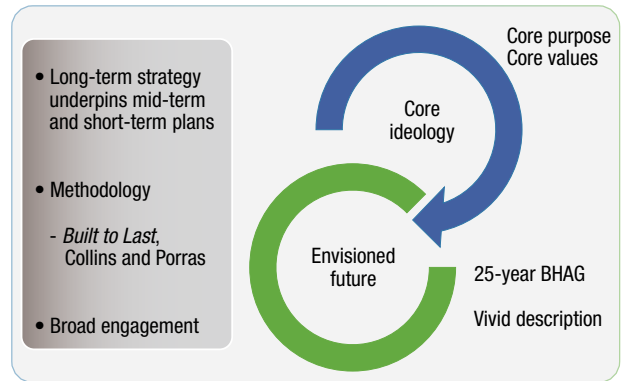


Figure 3. Collins and Porras vision framework. Reprinted by permission of *Harvard Business Review*. (Adapted from p. 4 of "Building Your Company's Vision" by James C. Collins and Jerry I. Porras, September–October 1996. Copyright ©1996 by Harvard Business Publishing; all rights reserved.)

average performance of their business sectors, but rather to their very top competitors to isolate what made them truly great and lasting. The principal finding was that "companies that enjoy enduring success have core values and a core purpose that remain fixed while their business strategies and practices endlessly adapt to a changing world. . . . This rare ability to manage continuity and change—requiring a consciously practiced discipline—is closely linked to the ability to develop a vision."¹⁴

Collins and Porras go on to describe how to discover an organization's *core ideology* and develop an *envisioned future*, which together form the vision framework (Figure 3). Each consists of two distinct elements. The core ideology consists of (1) *core values*, a set of guiding principles and tenets; and (2) the *core purpose*, the organization's most fundamental reason for existence. The envisioned future consists of (1) a 10- to 30-year *Big Hairy Audacious Goal (BHAG)*; and (2) a *vivid description*, or a narrative of what successful achievement of the BHAG would look like.

APL's effort to build these elements into its strategy process began in earnest during one of the EC's semi-annual 2.5-day planning meetings, this one in October 2014. Tim Galpin, assistant director for strategy and programs, had charged a strategy working group with critiquing APL's 2008 strategy relative to the Collins and Porras model and suggesting alternatives for the core ideology and envisioned future elements to formulate the vision framework. While the daylong discussions were a good introduction to building the vision, it was clear that intense and extended sessions would be required before significant progress could be made. Therefore, Galpin convened the EC for several lengthy and focused strategy working sessions over the next six months as preparation for spending the majority of the next planning meeting on fully developing the vision framework elements.

It would take until April 2016 to finalize the vision framework's four elements and to plan the rollout to the entire staff. Fortuitously, the Laboratory's 75th anniversary was just around the corner, on March 10, 2017, and the new strategy, which was extended to about 25 years, became known as the *Centennial Vision* since the time frame for achieving the BHAG aligned with the Laboratory's 100th anniversary. The four elements of the *Centennial Vision* and some interesting points about their development are discussed below to illustrate the journey and the challenges of APL's strategy development.

Core Purpose

Many candidate core purpose statements had been proposed by the strategy working group and EC members, and four had each gained a degree of traction. Reviewing these statements illustrates the progression of thought needed to produce a simple and compelling statement:

- Enhance the security of the nation through the application of science and technology.
- Overcoming national challenges through applied research and development.
- Securing the nation's well-being through science and technology.
- *Critical contributions to critical challenges.*

The fourth statement was a clear choice because of its familiarity and resonance with the staff. It had been in use for over a decade, the staff knew what it meant, and it was a statement that everyone could recognize in their own work. And it was short and easy to remember. The other three statements unnecessarily included the means by which the core purpose was to be achieved. To APL staff, a critical challenge is understood as a hard problem whose solution has an important bearing on national security, military readiness, space exploration, national health, or on the advancement of fundamental science or engineering. CC2CC, as it is sometimes known, also reflects the staff members' pride in being a part of an organization that exists to ensure that our nation has access to a dedicated and powerful team of technical experts who are prepared and unafraid to tackle the hardest problems of national importance.

Core Values

Developing crisp and inspirational statements of core values was more challenging. Keeping in mind the Collins and Porras enjoiner that core values must be discovered rather than aspirational, and that no more than five or six could be truly central values, the EC widely engaged extended focus groups. Terms and phrases that emerged included *integrity, excellence, technical excellence,*

innovation, service, impact, respect for people, challenging and supportive work environment, and serving the nation. After much deliberation, the EC synthesized the inputs into five short statements:

- Unquestionable integrity
- Trusted service to our nation
- World-class expertise
- Game-changing impact
- A highly collaborative, fulfilling (even fun!) environment

Interestingly, the first core value had been “unquestioned integrity” through many drafts until one executive observed that a recently disgraced public figure had been revered as having unquestioned integrity—and then some unsavory incidents came to light. Wouldn't we really want to have “unquestionable” integrity? This seemingly small distinction resonated deeply with the staff, and the story underlines how seriously the EC worked to discover this set of core values.

Another late change was the insertion of “even fun!” into the fifth core value. We were reminded that APL staff members have always had a good bit of fun—the fun of working in tightly knit teams that forge close and lasting friendships and the fun of successful accomplishments that make a difference to the nation. Once revealed, the simple “even fun!” phrase had the unexpected effect of unleashing a surge of excitement and creative activities throughout the Laboratory, often led by early-career staff.

Big Hairy Audacious Goal

The BHAG associated with the 2008 strategy was “Become the premier technological institution sought by government and valued by industry for providing practical solutions to the nation's critical challenges.” And the vision statement for the then-current FY2015 VSE was “Strengthen our nation through transformative innovation and trusted technical leadership in national security and space.” Neither statement cleanly met all the Collins and Porras criteria for a BHAG: that it be clear and compelling, have a clear “finish line,” drive a unified effort, be a stretch goal that should take a good 20 years to achieve, and of course be exciting. The 2008 BHAG focused on a subjective assessment of how we wished to be recognized as an organization, and the 2015 version was similarly flawed in that it provided a direction but not a goal that could be easily recognized as having been achieved.

A breakthrough occurred when the EC rallied around the concept of a *defining innovation* and expressed it as a BHAG: “*Create defining innovations that ensure our nation's preeminence in the 21st century.*” But what is a *defining innovation*?

The proximity fuze of APL's origin story precipitated an inflection point. This, in fact, is the paramount characteristic of all defining innovations. Innovations, in general, are novel capabilities built on new or existing science and technology, but a *defining innovation* is a dramatic advance that completely changes the way we live or operate. Defining innovations are so profound that returning to the way we lived before the achievement is unthinkable. For APL, a defining innovation is a critical contribution to a critical challenge that forever changes our understanding of what is normal. Like all innovations, a defining innovation might involve the invention of a new scientific idea or principle, or it might arise from the ingenious use of existing technologies.

Vivid Description of the Envisioned Future

Painstakingly, the EC prepared a vivid description of the envisioned future associated with achievement of the BHAG at the Laboratory's centennial, including the culture and environment that will need to exist to meet the goals:

When we celebrate our centennial, APL will be a treasured national resource, widely recognized for our technical leadership and bold, previously unimaginable technical solutions to the nation's most complex national security and space exploration challenges. Always anticipating the future, we will also be providing decisive advantage to the nation in complementary new areas. Never losing sight of why APL was created, we will be nurturing a culture of experimentation, embracing risk, and exemplifying what it means to be a trusted research and development laboratory. Furthermore, APL will be a magnet for the nation's top talent and a sought-after partner at the center of a vibrant innovation ecosystem. Finally, as an integral member of one of the world's finest universities, we will be sharing knowledge and technologies that benefit our society and the lives of people throughout the world.

Our Core Values
From the challenges we pursue to the way we overcome them, we are guided in our actions by the core values that have made APL strong.

- Unquestionable integrity
- World-class expertise
- A highly collaborative, fulfilling (even fun!) environment
- Trusted service to our nation
- Game-changing impact

Our Core Purpose
Critical contributions to critical challenges

Our Goal
Create defining innovations that ensure our nation's preeminence in the 21st century

Our Vision
When we celebrate our centennial, APL will be a treasured national resource, widely recognized for our technical leadership and bold, previously unimaginable solutions to the nation's most complex national security and space exploration challenges. Always anticipating the future, we will also be providing decisive advantage to the nation in complementary new areas. Never losing sight of why APL was created, we will be nurturing a culture of experimentation, embracing risk, and exemplifying what it means to be a trusted research and development laboratory. Furthermore, APL will be a magnet for the nation's top talent and a sought-after partner at the center of a vibrant innovation ecosystem. Finally, as an integral member of one of the world's finest universities, we will be sharing knowledge and technologies that benefit our society and improve the lives of people throughout the world.

Figure 4. APL's Centennial Vision in its entirety.

The first sentence describes defining innovations, their impact on the nation, and the primary application domains for the Laboratory, while the second sentence encourages exploration in critical yet complementary domains. The third sentence characterizes the culture that will be needed, and the fourth sentence sets a high bar for the talent and collaboration necessary for this level of innovation. The final sentence explains the benefits and responsibilities associated with being part of JHU as a nationally recognized UARC.

Table 3. Alignment of SFs to the vivid description

| Strategic Focus Area (FY2021–FY2023) | Vivid Description |
|--|--|
| 1 Develop bold next-generation initiatives in each sector that have the potential for game-changing impact | |
| 2 Shape and lead disruptive opportunities that leverage all dimensions of space to achieve groundbreaking national security capabilities | When we celebrate our centennial, APL will be a treasured national resource, widely recognized for our technical leadership and bold, previously unimaginable solutions to the nation's most complex national security and space exploration challenges. |
| 3 Create capabilities that will dramatically enhance national security by integrating demonstrated concepts and technologies from across APL | |
| 4 Create initiatives for sustainable contributions that address global challenges resulting from climate change | Never losing sight of why APL was created, we will be nurturing a culture of experimentation, embracing risk, and exemplifying what it means to be a trusted research and development laboratory. |
| 5 Become a national leader in biological security by anticipating and countering emerging biological threats | Always anticipating the future, we will also be providing decisive advantage to the nation in complementary new areas. |
| 6 As part of One University, serve as a trusted partner and leader in JHU's artificial intelligence initiative | Finally, as an integral member of one of the world's finest universities, we will be sharing knowledge and technologies that benefit our society and improve the lives of people throughout the world. |
| 7 Be a model organization for diversity, inclusion, and empowerment | Furthermore, APL will be a magnet for the nation's top talent and a sought-after partner at the center of a vibrant innovation ecosystem. |

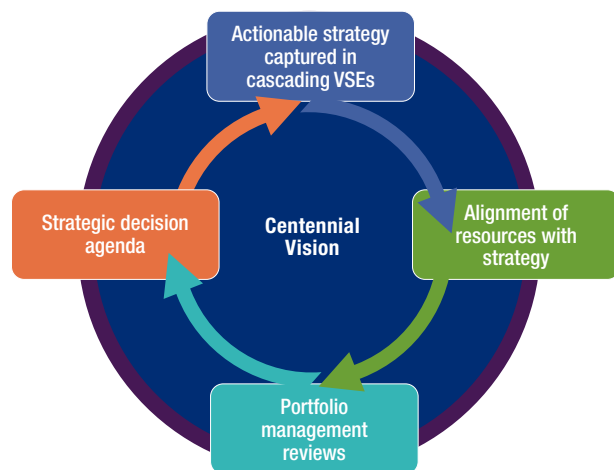


Figure 5. The fully integrated system including the annual strategy implementation cycle and the Centennial Vision.

As Semmel unveiled the Centennial Vision (Figure 4) at an all-staff gathering, he summarized the sense of it with a now oft-quoted slogan: “Be bold! Do great things! Make the world a better place!”

With the complete vision framework in place, the annual strategy implementation cycle now had a long-term strategic foundation as its guide star. Just as the sector, department, and mission area VSEs flowed logically from the Laboratory-level VSE, now the overall VSE could be pegged to the vision framework. In the 2022 VSE, each of the seven SF areas aligns with one of the five statements in the vivid description of the envisioned future (Table 3).

And so, the annual strategy implementation cycle and the Centennial Vision can be illustrated as a fully integrated system (Figure 5).

THE STRATEGY IN PLAY: INFUSING INNOVATION

The concept of innovation has been infused into all elements of APL’s strategy.¹⁵ The 2022 VSE, for example, includes such phrases as “Develop bold next-generation initiatives” and “Shape and lead disruptive opportunities.” As mentioned, alongside the work to refine the strategy creation process, APL launched an integrated set of innovation initiatives. One of the first strategic decisions in 2011 was to transform a workplace bound by highly regulated practices into one of empowerment and measured risk-taking by eliminating the hundreds of documented policies and procedures down to essentials—ultimately reduced by 75%. The first to go was one of the most unpopular: a rule against Frisbee playing on one of the Lab’s large outdoor gathering areas, the Central Green. Semmel announced the end of this policy while also unveiling the first major innovation initiative, Ignition Grants. At a town hall meeting, after describing the Ignition Grants program and the culture

shifts underlying it, he tossed out Frisbees branded to commemorate the new Ignition Grants initiative with Frisbee playing on the Green and adjourned the meeting by inviting everyone to take their Frisbees to the Central Green.

The Ignition Grants program of seedling funds was an experiment to encourage and stimulate innovative ideas and invite staff members to create game-changing concepts. The first Ignition Grants cycle proved popular, and staff members especially appreciated the trust implicit in the crowdsourced selection of winners. What began as an initial experiment has endured as one of the most popular innovation initiatives and led to the EC strategic decision to also establish a pair of much larger grants, Combustion Grants and Propulsion Grants, in 2015. These three levels of grants, known collectively as Project Catalyst, complement the traditional sponsor-oriented IRAD funds as a way to invite research into truly extraordinary ideas that are (perhaps yet) not in line with mission area strategies or sponsor timelines but just might yield a defining innovation.

Enhancing the Management Framework

The EC realized the need to establish a new forum. APL already had two executive forums reporting to the EC. The Mission Area Forum of mission area executives, led by the assistant director for programs, coordinates program portfolios, sponsor needs, and opportunities for multi-mission collaborations. The Operations Forum of operations executives, led at the time by the assistant director for operations and now led by the chief financial officer, ensures efficient and effective operations of business, information technology, and human resources systems. However, the “line side” of the executive leadership, the managing executives, were not members of either forum but had the responsibility for staff development and technical excellence, with the vast majority of the staff reporting to them, directly and via middle management. The EC therefore established the Management Forum in 2011, led by the assistant director for science and technology, for the managing executives to collaborate in shepherding innovation and staff development.

Expanding Space to Innovate and Collaborate

For one of the early Ignition Grant cycles the Management Forum suggested soliciting ideas for APL’s next innovation experiment. The result was two proposals selected by the staff to develop a “maker space” and a facility to exercise design thinking, both ideas gaining increasing national popularity. The winning teams applied their Ignition Grant funds to develop an encompassing concept for a collaborative innovation center. The result, Central Spark, was unveiled in 2014. It included a design thinking studio, modeling and simulation and software app prototyping tools, and a maker

area including modular electronics and 3-D printers. Central Spark has proved so popular that in 2020 it was moved to a location with three times more space and equipment.

Central Spark gave APL leadership experience with open collaboration space at a relatively low cost, and the leadership team applied the lessons learned to the design of the next collaboration space, the Intelligent Systems Center. The “ISC” was designed to encourage resident researchers in robotics, neuroscience, autonomy, and information systems to collaborate. The ISC cost about ten times more than the original Central Spark. Lessons learned from the ISC then motivated the design of a new building, known as Building 201. It cost 20 times more than the ISC, with 263,000 square feet including 90,000 square feet of labs and collaboration spaces. In fact, Building 201 now houses the expanded ISC as well as most of the strategically redesigned Research and Exploratory Development Department. For subsequent building and renovation programs, APL has applied a menu of design options incorporating collaboration features across the spectrum of programs, facilities, and staff spaces according to their needs and the degree of security required.

Rethinking Staff Performance Management

Another offshoot of the innovation strategy was a renewed look at the Lab’s performance management process, a time-consuming end-of-year retrospective evaluation of every professional staff member. Recent research had indicated that the value of such a traditional process was not necessarily commensurate with the effort required. Semmel wondered whether excellence and innovation would suffer if the documentation-heavy process were replaced with a zero-documentation coaching approach. The Management Forum concluded that the coaching-centered approach should be tried. The experiment led to full adoption, and in the half-decade since revamping the process, staff performance has not faltered, and satisfaction with reviews and coaching has increased according to staff surveys.

A DECADE OF RESULTS AND HARD LESSONS LEARNED

Since implementing the systems approach to strategy in 2010, robust innovation initiatives beginning in 2011, and the Centennial Vision in 2016, the Lab has enjoyed advances in measurable results and national recognition. Using the Mankins and Steele strategic

decision-making approach, the EC has made an average of nine strategic decisions annually, about three times that of companies that use standard strategic planning processes.⁸ Even while the Lab has actively shed its lowest-impact work and reduced costs by over 10% relative to inflation, it has grown its staff by 60%— to over 8,000 in 2023—and has accelerated the number of staff members named as fellows in prestigious national-level professional societies. Other tangible results are summarized in the sections below.

Direct Impact of Aligning Resources to VSE Priorities

The disciplined practice of aligning internal resources to strategic priorities as expressed in the VSE has resulted in new and accelerated innovations and high-impact contributions to the nation’s most complex national security, space exploration, and health challenges. Two such examples resulting from the FY2020 VSE illustrate how this integrated systems approach works in practice and the resulting impact that has been achieved.

Winning the Dragonfly NASA mission

In its 2015 Discovery Program selection process, NASA rated five APL proposals as selectable but did not select any of them to move forward. As a result, a precipitous drop in overall NASA funding to APL was looming. Therefore, in October 2016, Lab leadership created an out-of-cycle SF and EP pair (below) for FY2017 to evoke a strategy and corresponding resources to win a NASA mission competitively.

The charge to create a winning strategy included provision of program development funds to devise a winning proposal for a novel, affordable mission with acceptable risk. Resources were also allocated to ensure that the requisite development and testing facilities would be in place as a risk mitigation measure to strengthen the proposal. Recognizing NASA’s strategic commitment to pursue the discovery of life elsewhere in the solar system, in accordance with the National Academy of Science’s Decadal Survey, APL’s Civil Space Mission Area proposed a novel mission in response to the New Frontiers Program’s call for proposals. (New Frontiers is a consequence of APL’s defining innovation to develop affordable planetary missions.) The proposed mission, called Dragonfly, featured a nuclear-powered dual-quadcopter to be landed on Saturn’s moon Titan. It would fly through the thick Titanic methane atmosphere to high-interest surface locations where it would collect samples and test them for the presence of life. APL won funding for the proposal.¹⁶ Paul Voosen, a writer for *Science*, noted that

Vision: Create defining innovations that ensure our nation’s preeminence in the 21st century.

| Strategic Focus (FY2015–FY2017) | Execution Priorities (FY2017) |
|---|--|
| 2 Aggressively shape and pursue disruptive opportunities in civil space that will lead to at least one groundbreaking mission | Advocate and propose pioneering concepts for high-value planetary science and space weather monitoring |

Vision: Create defining innovations that ensure our nation's preeminence in the 21st century.

| Strategic Focus (FY2018–FY2020) | Execution Priorities (FY2020) |
|---|---|
| 4 Become a transformative force in the biological sciences for solving national security and global health challenges | Create a framework for the government to identify, assess, and mitigate potential biological threats to national security and public health |

the mission “represents a calculated risk for the agency, embracing a new paradigm of robotic exploration to be used on a distant moon.”¹⁷

Strategy Anticipating the Need for COVID-19 Situational Awareness

The FY2018–2020 SF and EPs for biological sciences (refer to Table 2; the relevant portion is repeated above) turned out to be prescient when the COVID-19 pandemic struck.

APL already had a decades-long history of collecting and curating medical data from both US state and international jurisdictions through the ESSENCE (Electronic Surveillance System for the Early Notification of Community-based Epidemics) and SAGES (Suite for Automated Global Electronic bioSurveillance) programs.¹⁸ So, given the VSE-related provision of strategic resources and exploration of potential new roles, when Whiting School of Engineering faculty member Dr. Lauren Gardner began building the JHU COVID-19 Dashboard (which also became known as the JHU Coronavirus Resource Center), APL was equipped to step in, upon request, to validate, curate, and classify the data needed to scale the dashboard to the worldwide level as *the* trusted source of COVID's status. Further, APL began to develop algorithms to mine the data to identify resource needs, especially hospital beds, equipment, and consumables such as masks. APL was asked

to ramp up to support the technical team of the White House COVID Working Group with over 40 staff members. The JHU Coronavirus Resource Center data and APL-developed algorithms were leveraged, along with other government information, to prepare regular briefings for the president on the status of COVID (Figure 6) and became instrumental in the United States' ability to allocate resources to the counties across the country where they were most needed. The JHU Coronavirus Resource Center was identified by *Time* magazine as one of the best inventions of 2020.¹⁹ As of this writing, the center's function has transitioned to the CDC and is being disestablished, having served the nation and world well during the emergency status of COVID-19.

New Defining Innovations

As mentioned earlier, as APL celebrated its 75th anniversary, nine defining innovations were identified as the exemplars of contributions so significant that they changed the nature of their operational domain. They are the proximity fuze, Navy guided missiles, satellite navigation, Advanced Multifunction Array Radar, towed sonar arrays, satellite-based precision tracking of submarine-launched ballistic missiles, Tomahawk, the Cooperative Engagement Capability, and affordable planetary exploration.²⁰ These selections were each based on the retrospective conclusion that they, in fact, truly changed warfare and space exploration. For APL's

80th anniversary in 2022, the EC decided that it was time again to look back at game-changing innovations to determine whether any had by then risen to similar stature. Two additional defining innovations were identified and announced to the entire staff in early 2023 by Director Semmel, bringing the total number of defining innovations to 11.

Ballistic Missile Defense from the Sea

Beginning in the early 1990s, APL responded to the critical challenge of proliferating ballistic missile threats by leading the development of the transformational technologies and experiments needed to demonstrate ballistic missile defense (BMD) from ships at sea. The resulting

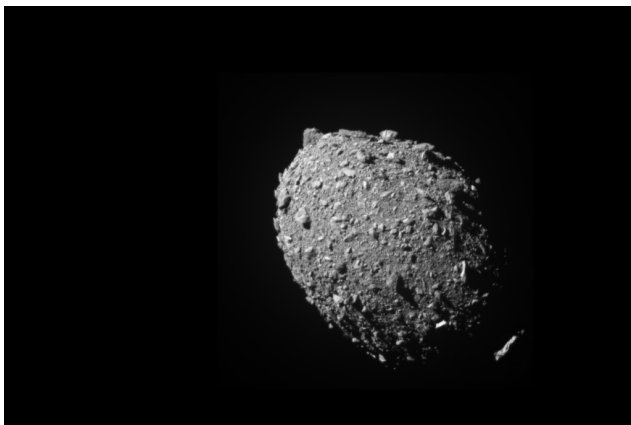


Figure 6. Members of the White House COVID Working Group, including President Biden, meeting in the Oval Office to review a COVID briefing book.



Figure 7. USS Lake Erie (CG 70) launching the Standard Missile-3, which intercepted the satellite during the Burnt Frost mission. The missile struck a nonfunctioning US satellite as it traveled in space at more than 17,000 miles per hour over the Pacific Ocean. The nation called on APL, with its long experience with Aegis and Standard Missile, to make vital contributions to this critical operation. (US Navy image.)

Terrier Lightweight Exoatmospheric Projectile (LEAP) experiments proved that BMD technology could be integrated with the Navy's Aegis weapon system to "hit a bullet with a bullet" in space from the sea. APL's critical contributions opened the door for the Navy's central national role in BMD. The resulting impact is felt far beyond our nation's shores as BMD now provides enduring defenses at sea and ashore across the globe,



defending our allies and even engaging an errant satellite, during what was called Operation Burnt Frost (Figure 7), before it could deorbit and potentially cause civilian casualties.

Planetary Defense

For more than a decade, APL engineers and scientists developed game-changing concepts and technologies to ultimately prove that it was possible to defend our planet from an asteroid on a potentially catastrophic Earth-impact trajectory. APL established the technological basis for planetary defense; solidified the domain as a research and development area at the federal level; played key roles in defining and exercising intra-agency and international coordination responsibilities; and captured worldwide attention by successfully completing the Double Asteroid Redirection Test (DART) mission in September 2022 (Figure 8), the first in-space demonstration of planetary defense technology.²¹ In contrast with the other defining innovations, this one was solidified as a defining innovation in short order because of the national and global response to affirm that planetary defense was attainable.

Innovations That Cannot Be Discussed

The EC also recognized and honored the fact that some classified projects, if they could be disclosed, would surely be identified as APL defining innovations as well. In addition to Director Semmel's recognition of these achievements during the 2023 strategy gathering of APL staff members, one blank poster accompanies those celebrating the 11 defining innovations in the hallway leading to the director's wing on APL's campus. It is a silent tribute to the family of special innovations that remain classified.



Figure 8. Left, the asteroid moonlet Dimorphos as seen by the DART spacecraft 11 seconds before impact. DART's onboard DRACO imager captured this image from a distance of 42 miles (68 kilometers). This image was the last to contain all of Dimorphos in the field of view. Right, members of the DART team celebrate in the mission operations center at APL on September 26, 2022. Along with viewers all over the world, they watched images livestreamed from the spacecraft showing that it successfully impacted the asteroid Dimorphos, completing the world's first planetary defense test mission.

External Recognition

During 2020 through early 2023 alone, the Lab earned several national accolades for its innovation and desirability as an employer:

- For five consecutive years, APL has been named to Fast Company's Best Workplaces for Innovators, including the inaugural list in 2019²² and one year at number 3.²³
- APL has been named one of *Insider Pro* and *Computerworld's* top twenty "Best Places to Work in IT" for five years in a row, including being named in two categories in 2021²⁴ and three categories in 2023.²⁵
- The APL team managing NASA's Parker Solar Probe mission was recognized by the American Institute of Aeronautics and Astronautics (AIAA) with the von Braun Award for Excellence in Space Program Management²⁶ in 2020.
- JHU Whiting School of Engineering and APL researchers behind the Johns Hopkins Coronavirus Resource Center (CRC) were honored as Fast Company's Innovative Team of the Year for 2021.²⁷ The CRC was also named a *Time* Best Invention of 2020.¹⁹
- The Lab was named number 3 on Fast Company's 2022 World's Most Innovative Space Companies²⁸ list for building and managing NASA's DART spacecraft.²⁹
- For two consecutive years, APL has won a Glassdoor Employees' Choice Award, ranking in the top 50 out of 100 US large companies on the Best Places to Work on the 2022³⁰ and 2023³¹ lists. This award is based solely on feedback from employees, who anonymously complete company reviews about their jobs, work environments, and employers.
- APL researchers earned two R&D 100 Awards in 2022³² and one in 2023.³³

Lessons Learned

The journey to becoming a fully strategy-driven organization with an exciting vision and systems implementation took about five years. Periodically stepping back and looking at lessons learned has been helpful in refining the process and in sharing insights with other organizations that have similarly sought to become strategy driven. APL learned ten hard-won lessons:

1. The CEO's ruthless commitment to aligning decisions with the vision and strategy is key to building a strategy-driven organization with a fully participative staff.
2. Strategy for innovation can and should be an exciting and substantive journey and must involve the

staff members themselves in experimentation to determine what works for the organization.

- Strategic thinkers are scattered throughout most organizations, and many of them yearn for the fun and excitement of strategy development and the inclusivity that comes when they have a say in what the organization does and how it does it.
 - While concentrating strategy at the executive level feels efficient and timely, doing so can ignore valuable insights from other sources.
3. Without appropriate engagement, strategy has little value, impact, or relevance.
 - Participation and concurrence are important; otherwise, the strategy ends up as leadership's priorities, having to be explained repeatedly to rise above "normal" work priorities.
 - All staff members should (and deserve to) understand where the organization is heading.
 - Strive for the right balance between long-term goals and explicit actions tied to those goals.
 - Routinely discuss strategy with the staff, provide opportunities for input, align resource allocation to strategy, and hold the staff accountable for strategy execution to make strategy relevant.
 4. Leaders focused on innovation must spend time interacting with the staff and explaining the nuances of their ideas and plans.
 - Run experiments with clear objectives and involving staff members to inform strategic decisions.
 - Encourage and provide plenty of opportunities for the staff to engage on strategy.
 - Schedule face-to-face time with executive teams.
 - Present strategy regularly. At APL, the director presents strategy twice per year to the entire staff.
 - Ensure that stakeholders regularly update leadership. Each APL mission area presents strategy updates and highlights to the Lab's Executive Leadership Team twice per year.
 5. Executives want to focus on strategic issues but are sometimes hesitant to give up tactical control.
 - It is the responsibility of the executive team to tackle critical problems.
 - The executive team should identify potentially strategic issues, decide which ones are truly strategic, and explicitly delegate (most) others.
 6. Managers can be more averse to losing resources than motivated by an opportunity to gain.
 - Promote enterprise behavior while ensuring that the best ideas are supported; avoid introducing unhealthy competition.

- Allocate funding for exploration of new ideas. APL uses set-aside allocations and director's reserve annually for this purpose.
 - Reset baselines often. APL's resource baselines are reset every three years rather than annually to promote focus and progress on long-term goals.
7. There often is a reluctance to transition out of relatively lower-impact work to pursue potentially higher-impact opportunities.
 - Strategically, it is important for organizations to remain at the leading edge, but commitments to existing sponsors and comfort with existing work can lead to reluctance to embrace higher-impact opportunities.
 - Regularly review work portfolios and encourage tough decisions. APL actively phases out work by requiring executives to identify and explain their lowest-impact projects to the investment strategy team (IST) and develop their own transition paths or justification for retaining existing work.
 8. Strategy should underpin resource allocation and performance assessment.
 - The first was a given, but the second had to be learned.
 - Both are needed to maintain strategic focus of the executive team.
 - A portion of each executive's above-base compensation is tied to achievement of at least 50% of the EPs in their organization's VSE (or VSEs if they have cognizance over one or more mission areas).
 9. Embracing diverse perspectives and inclusion leads to new and novel ideas and approaches.
 - Leverage many different groups to develop a better, more inclusive, and accepted strategy. APL uses a participative process in which we iterate extensively and gather information from focus groups, but we do not get paralyzed by process or indecision.
 - To emphasize the strategic commitment to diversity, equity, and inclusion, a seventh SF/EP pair was added to the VSE in 2018 (see Tables 2 and 3).
 10. A chief strategy officer who guides implementation is critical to success.
 - Someone has to ensure that the organization follows through. APL elevated the role of chief strategy officer to an assistant director who has control and oversight of critical investment resources.

CONCLUSION

APL's integrated systems approach to strategy has resulted in a vision and strategy framework that is built to last and has proven itself in execution, even during a turbulent decade marked by changing national security priorities, economic uncertainty, and transformative technological advances in areas such as artificial intelligence, hypersonics, and cyber. Finally, as with other successful APL innovations, we have sought to widely share this systems approach to strategy in the conviction that it can be useful to any organization committed to becoming strategy driven as a basis for thriving in an uncertain world.¹

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