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Managing Innovative Ideas for Problems of National Importance

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Introduction

Organizations use innovation programs to develop new products and services for their customers. In MITRE's case, our customers are government agencies that sponsor the seven federally funded research and development centers (FFRDCs) that MITRE operates. Our sponsors depend on MITRE to provide innovative solutions to some of our nation's most critical challenges in defense and intelligence, aviation, system modernization, homeland security, cybersecurity, and healthcare.

We tackle many of these challenges through the MITRE Innovation Program (MIP), our independent research and development (R&D) program, which supports researchers from across the MITRE-operated FFRDCs. Our researchers look at the government's problems in fundamentally new ways, and apply advanced and emerging technologies to innovative solutions. The Patient Toolkit, an iPad application, is an example of a new healthcare idea that progressed through the MIP to a licensable product administered by our Technology Transfer Office.

Idea generation and portfolio management are keys to the success of our R&D program. We use an online idea management system, called the Idea Market, to select and develop research proposals that reflect the needs of our sponsors. The ideas for projects come from all over the company and represent MITRE's wide range of expertise. Any employee can submit an idea to the Idea Market, which is just the beginning of the process. Using the online Idea Market, other staff members can easily give feedback on the ideas by adding technical ability or sharing information about specific sponsors' problems that could be solved through R&D. This collaboration functionality improves and refines ideas throughout the review process.

The MIP is organized into portfolios or "Innovation Areas," such as Cybersecurity, Aviation & Transportation, and Health. Each Innovation Area is led by an Innovation Area Leader (IAL) who reviews the ideas submitted to his or her area and chooses a portfolio of projects for the year ahead that support his or her research strategy. Each year, employees submit 1,000 research proposals; approximately 200 of these proposals are chosen to be funded projects.

Child's Lyme Disease Leads to Patient Toolkit

One of these research proposals was submitted by Kristina Sheridan, who was desperate to find a cure for her daughter Kate, who was painfully deteriorating from Lyme disease.

Sheridan researched and developed a "Patient Toolkit" to help people with chronic illness. This set of tools, available through a mobile application, enables chronically ill patients to apply data to better manage their conditions by engaging in successful partnerships with their care teams. The toolkit includes simple, easy-to-use interfaces built upon patient-centered, daily workflows to maximize patients' engagement and to help them develop habits that improve their health outcomes.

Kristina Sheridan's daughter Kate got sick from Lyme disease in 2006 (Figure 1). Kate was treated, but she didn't get better; rather, three years into her illness, her health degraded severely. She developed multiple comorbid, or secondary, conditions to the Lyme disease. Consequently, Kate went from a straight-A student to a special-needs student—from reading three books at a time to not being able to read a single page. She also went into a wheel chair. Her constant, 18-month-long pain level ran from 7-9 out of 10, in every joint in her body. Kate was totally dysfunctional and declining.

Over the three years, Kate saw 30 different doctors, had 5 hospitalizations, received 15 diagnoses, and was prescribed multiple treatments and medications. The 30 doctors each had a piece of the story, only in their medical specialty field, but not the comprehensive story. With no view of the big picture, the doctors didn't understand the impact of the chronic disease as comorbid conditions to the underlying infection.



Figure 1. Kate Sheridan sick with Lyme disease (left), and fully recovered with her mother, Kristina (right), at HIMSS-17, Orlando, FL, where she spoke about her recovery.

Kristina Sheridan, Kate's mother, was a MITRE Department Head, who had previously worked in a commercial satellite control center. She had no background in health but knew how to use data to make decisions. She merged years of data from Kate's illness, including the diagnoses from the 30 doctors, into spreadsheets. She mined the data to track trends such as how her daughter's white blood count fluctuated over time, how and when different doctors tried different treatments, and so forth. Kristina identified other problems as well, such as when Kate didn't mention some symptoms, such as foot numbness, to a specialist because she was so used to the symptom. Kate had never mentioned more than 10 symptoms at any one appointment, but her mother identified a full set of 26.

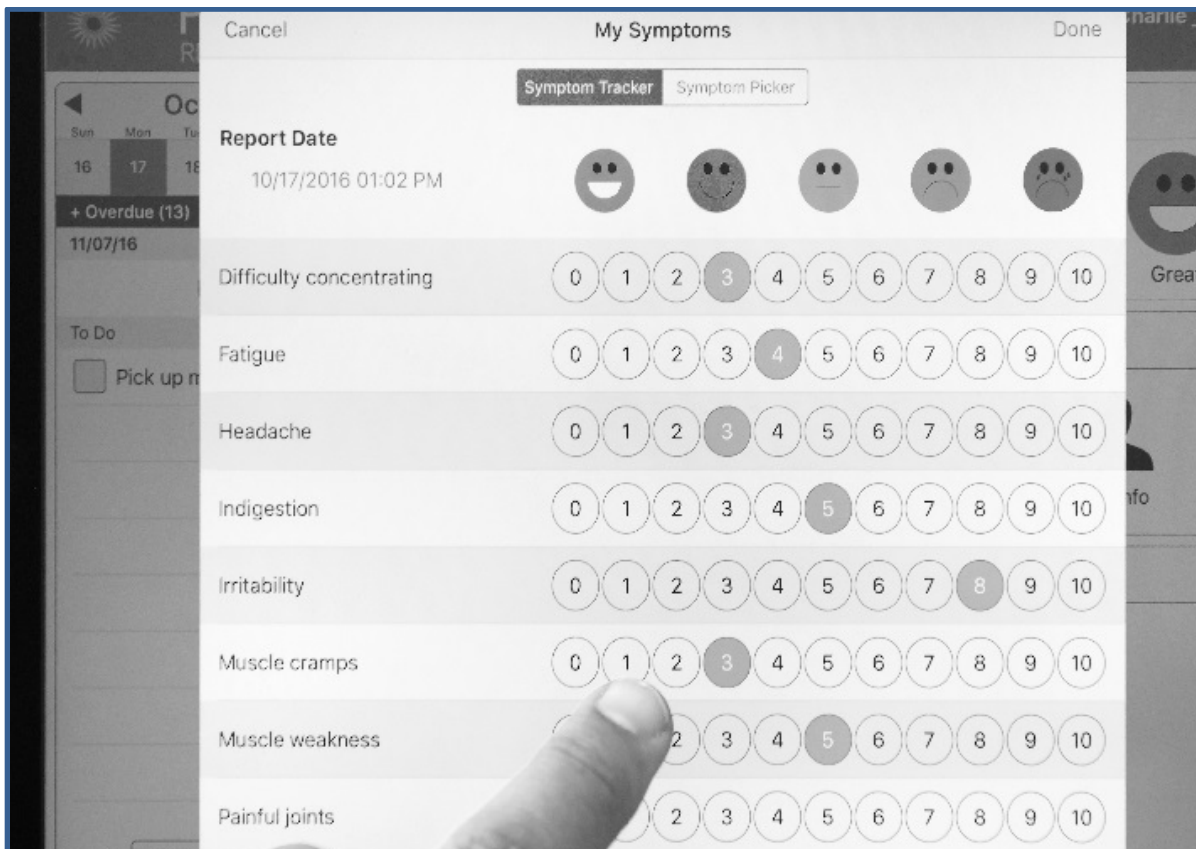


Figure 2. “My Symptoms” Tracker in Patient Toolkit

Sheridan used the data to develop visualizations to plot out Kate’s pain and symptoms (Figure 2 and Figure 3). That data, in combination with clinical data, finally unraveled the comprehensive story for a new set of doctors in New York City. As a result, the doctors developed a new course of treatment, and after 18 months, Kate was back in school part-time. Today, Kate is a thriving college student. She spoke about her recovery at the Healthcare Information and Management Systems Society 2017 conference, Orlando, FL (Figure 1).

Kristina Sheridan notes that more than half of Americans deal with one or more chronic condition, either as a patient or as a relative, friend, or caregiver. “This is a national challenge,” says Sheridan. “In the U.S., we’ve got 117 million people with one or more chronic conditions. In addition, we have between 34 and 52 million caregivers. Four out of five healthcare dollars are spent on their behalf, which is nearly \$2.1 trillion annually.”



Figure 3. “My Charts” Module in Patient Toolkit

Choosing the Best Ideas

Central to the MIP is the Idea Market Life Cycle, a four-phase process (Figure 4). The time required by MITRE for each phase is noted in parenthesis; however, depending on your company’s requirements, the time required may differ. The process is governed by a team of leaders representing the research program and direct work for our sponsors.

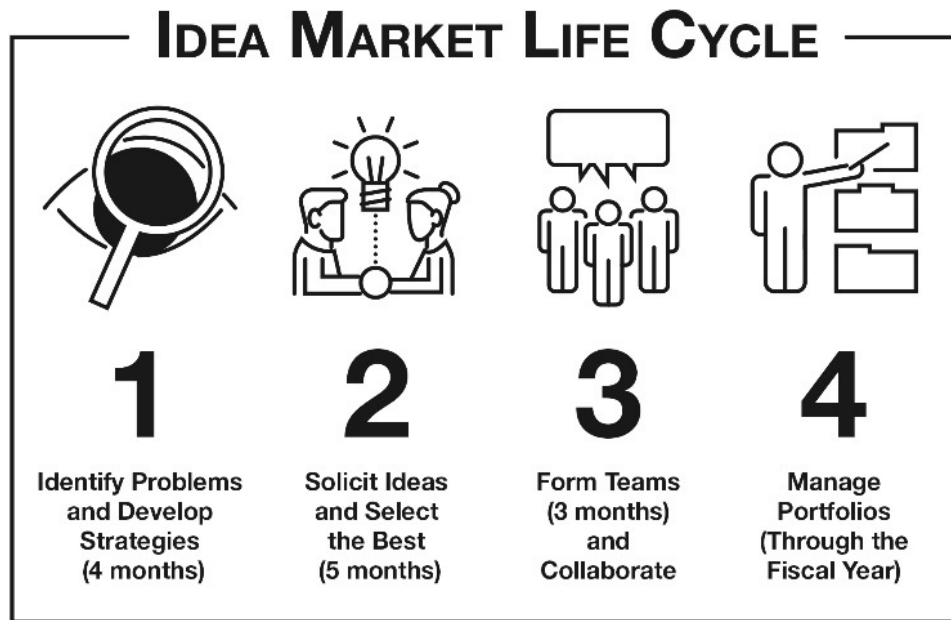


Figure 4. Four Phases of Idea Market Life Cycle

Phase 1: Identifying Problems and Developing Strategies (4 months)

The Idea Market Life Cycle starts with identifying our sponsors' problems that could be solved through R&D. The IALs meet with sponsor-facing project directors, who work closely with our sponsors to understand their domains and missions. The two groups discuss government agency problems in the near-, mid-, and far-term, and think about how to reframe the problems as research proposals.

The IALs also look across the technical environment, in their respective Innovation Areas, and create global R&D landscapes that show where the pockets of innovation are around the world and where industry and academia are focusing their R&D investments. The landscapes allow us to see the gaps that no one is addressing and helps us identify partner organizations with which we'd like to collaborate to accelerate innovative solutions.

All of this information is reflected in the R&D strategy for each Innovation Area. The IALs hold meetings to discuss their strategies with interested staff across the corporation, and idea proposers use the strategies to develop their ideas. It should be noted that the Patient Toolkit relies on patient engagement, which is an important focus for the Centers for Medicare & Medicaid Services (CMS), the Department of Veterans Affairs (VA), and the Department of Defense (DoD).

Phase 2: Soliciting Ideas & Selecting the Best (5 months)

This phase is the most resource-intensive time of the Idea Market Life Cycle. We kick off this phase with a presentation by the Chief Technology Officer on what kinds of ideas we are looking for and how to navigate the Idea Market. MITRE staff enter their research proposals into the Idea Market, which is open to new ideas for 30 days. Proposers are encouraged to discuss their ideas with their own management, as well as with IALs,

division Chief Engineers, and division Technology Integrators, who help researchers both understand sponsor research needs and develop targeted proposals.

After the Idea Market is closed to new ideas, it remains open for feedback. Within the Idea Market, the IALs review the ideas by using criteria aligned with their strategies. They make a first round of down-selects around mid-April to reduce the idea pool by at least 50 percent. Next, they ask the proposers who made the first cut to present their ideas in more detail to a group of subject matter experts. The final down-select occurs in June, and the winners are notified in July. The winning proposers then become Principal Investigators (PIs) and get ready to begin their research projects on October 1, the beginning of our fiscal year.

Kristina Sheridan proposed her idea for the Patient Toolkit in the Idea Market under the category “Healthcare Transformation.” While developing her idea, she talked to several MITRE colleagues in the healthcare area, as well as to clinical professionals, to make sure that her idea made sense outside her own world view. She received positive feedback from healthcare specialists. “I posted my idea and was very active in asking people for comments and suggestions,” says Sheridan. “Every time I got a suggestion, I would refine the idea to incorporate it, as long as it made sense with the end goals.”

Phase 3: Forming Teams (3 months) and Collaborating

As soon as the new year starts, PIs form project teams and begin documenting their project-related information (i.e., budget, staffing plan, milestones, etc.) online. They also begin networking with subject matter experts in relevant technical areas, some of whom will supply a fresh perspective, and some of whom will work with the team off and on during the life of the research project. The PIs are also strongly encouraged to connect and collaborate with external scientists and engineers in industry, academia, and government organizations. In addition, the PIs are advised to identify the end users for their research and think about how to transition their new solutions if they are successful.

Sheridan’s Patient Toolkit team consisted of 13 researchers with a range of specialties, from healthcare management to application development. To collect evidence to support the development of the Patient Toolkit, team members collaborated with the University of Virginia on a study to show doctors that data collected by patients at home can be trusted. They also collaborated with Carnegie Mellon University to find out what patient-generated data doctors wanted the Patient Toolkit to collect. Sheridan collected data for longitudinal trends of symptoms and longitudinal trends in medication compliance that would help them with clinical decisions. “I also brought in a Co-PI who specializes in healthcare policy so we could research how policies incentivize or hinder the use of patient-facing tools.”

Phase 4: Managing Portfolios (Through the Fiscal Year)

While each PI manages his or her own project, the IALs manage the portfolio of projects within their Innovation Areas. The IALs regularly review each project and advise the PIs on where to find the experts or the data that the PIs need. The IALs also communicate results to sponsor-facing directors throughout the corporation, and help PIs connect with end users who could benefit from the results of their research.

Our goal is to get all of MITRE’s successful technology into the hands of end users (e.g., government staff, as well as pilots, air traffic controllers, soldiers, data analysts, doctors, patients). Thus, IALs advise their PIs on the best way to share and/or transfer their technology. The IALs and PIs work closely with MITRE’s Technology Transfer Office to analyze markets and to discuss and negotiate various kinds of licenses. For example, a commercial license is designed to transfer MITRE-developed technology to companies that can turn the technology into affordable products for government and commercial use.

MITRE’s Technology Transfer Office helped Kristina Sheridan create a commercial license for the Patient Toolkit so that the tools will be available to patients and their care teams to improve long-term health and potentially save costs. While Kristina also considered an open-source license, MITRE’s Technology Transfer Office felt that a commercial company would be more likely to continue to develop and maintain the technology in the future. One of the first licenses went to Gastro Girl, which has a telehealth platform for dietitians and health coaches who treat patients with chronic gastrointestinal (GI) symptoms and disorders. Gastro Girl is the first patient-centric digital health platform for individuals living with GI symptoms and conditions. Gastro Girl brings key support elements together in one place to help patients comply with treatment plans. It also gives ongoing support between doctor visits.

This is one example of an idea that made it through the idea generation and portfolio management process, step by step, to reach what we consider a successful outcome—availability to the end users who need the technology to improve lives.

Other commercial licensees for the Patient Toolkit include those listed below.

- Applied Medical Information, Inc.
- Patdat, LLC
- Blue Laurel, Inc.

Lessons Learned

If your company is considering an innovation management system, consider six lessons that MITRE has learned over the past few years:

1. **Know your problem space.** An effective high-level strategy begins with understanding sponsors’ (customers’) needs. This understanding helps you anticipate future conditions, assess gaps, and identify opportunities for shaping your research program. Determine what research has been conducted; identify opportunities that match your R&D competencies, as well as potential external partnerships; and assess what domains to address.
2. **Establish and maintain the process and infrastructure.** Effective innovation offices require robust management processes with supporting tools to gather, evaluate, and select ideas. There should be a strategic rhythm, as well as a clear process for ideation, refinement, and portfolio management. It is important to track and report on the results of your program so that it can be improved as needed or as situations evolve.

3. **Define a governance process that commits and prioritizes resources.** A dedicated governance team, including your Chief Technology Officer, provides the framework for allocating strategic research funds aligned with a corporate strategy. The team includes representatives from the business units who understand sponsors' research needs, an Innovation Manager to lead the day-to-day efforts, and staff to maintain the process and infrastructure. A staffing plan with a multi-year commitment is important to guarantee the resource support and to provide consistency to the overall program.
4. **Communicate with employees throughout the innovation life cycle.** There is no such thing as over-communicating. An enterprise-level innovation management program has several stages: plan, execute, review, selection, and award. Together these stages span many months, and you must keep stakeholders informed during each stage. Failing to communicate the status of the program leads to frustration and confusion.
5. **Measure the results and impact.** This includes tracking products and services brought to market. At MITRE, we track technology that is licensed to sponsors and industry; patents received; as well as results shared through publication, standards bodies, and open-source avenues. We also ask PIs to apply Technical Readiness Assessments, which include Technical Readiness Levels and Transition Commitment Levels for performance measurement and technology transition. Both of these levels define the current performance and the future desired states of the R&D effort at hand, resulting in an "as-is" baseline and a "to-be" performance characterization.
6. **Capture and disseminate the lessons learned.** Documenting lessons learned is a powerful method of sharing ideas for improving work processes, day-to-day operations, and cost-effectiveness. This data helps improve management decision making and supports team performance through every stage of the process. Lessons learned also help organizations anticipate and solve problems that occur during the innovation management life cycle.

Conclusion

An innovation management program that is conducted openly and that attracts participation from across the corporation will lead to innovations—from products or new policies—that provide the most benefit for your customers. Our innovation management methodology and tools produce a repeatable, structured process that helps identify solutions to problems that have a national scope and importance. The same methods and tools could help other organizations achieve similar benefits and results.

Abbreviations and Acronyms

CMS	Centers for Medicare & Medicaid Services
DoD	Department of Defense
FFRDC	Federally Funded Research and Development Center
GI	Gastrointestinal
IAL	Innovation Area Leader
IT	Information Technology
MIP	MITRE's Innovation Program
PI	Principal Investigator
R&D	Research and Development
VA	Department of Veterans Affairs