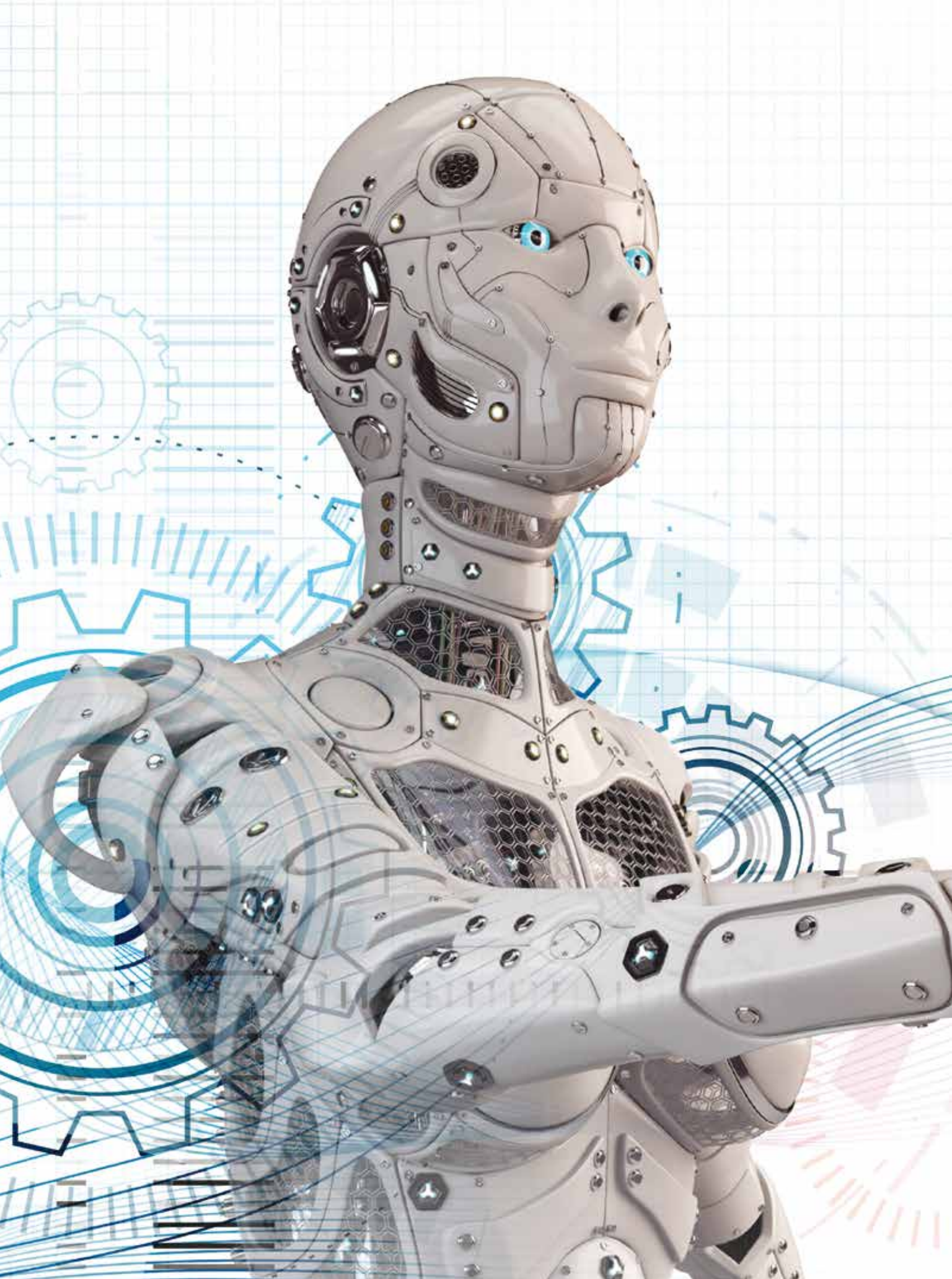

If Your Technology Works, Will It Matter?

Ryan Umstattd, Ph.D.

The foundational question above is asked and then answered by our program directors before they launch any new focused initiative at the U.S. Department of Energy's Advanced Research Projects Agency (ARPA-E).

It's simply not good enough to perform groundbreaking applied research if we haven't also developed a credible path toward the commercial market for our technologies. While the U.S. Department of Defense (DoD) Research, Development, Test and Evaluation construct is not geared toward placing products in the broad commercial marketplace, many lessons learned from asking that foundational question remain valuable in managing the DoD's science and technology investments.

Managing More Than Technology Development

Our mission at ARPA-E is to catalyze and support the development of transformational, high-impact energy technologies. That said, a technological breakthrough by itself may not be sufficient to drive a transformation that becomes truly disruptive (see Figure 1). Bringing a new technology to the tipping point of disruption involves success on several fronts, including science and technology development, a viable business model and value proposition, favorable market

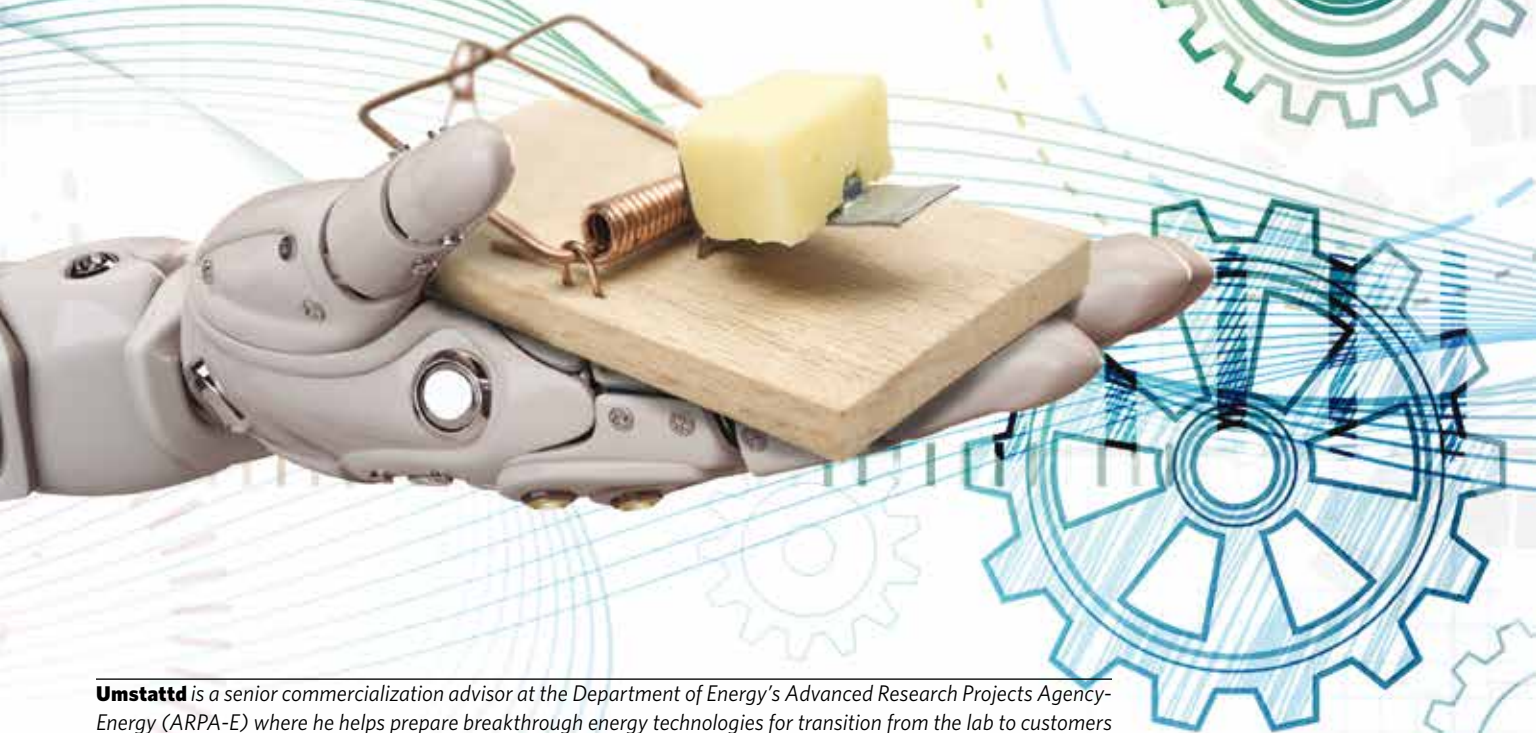

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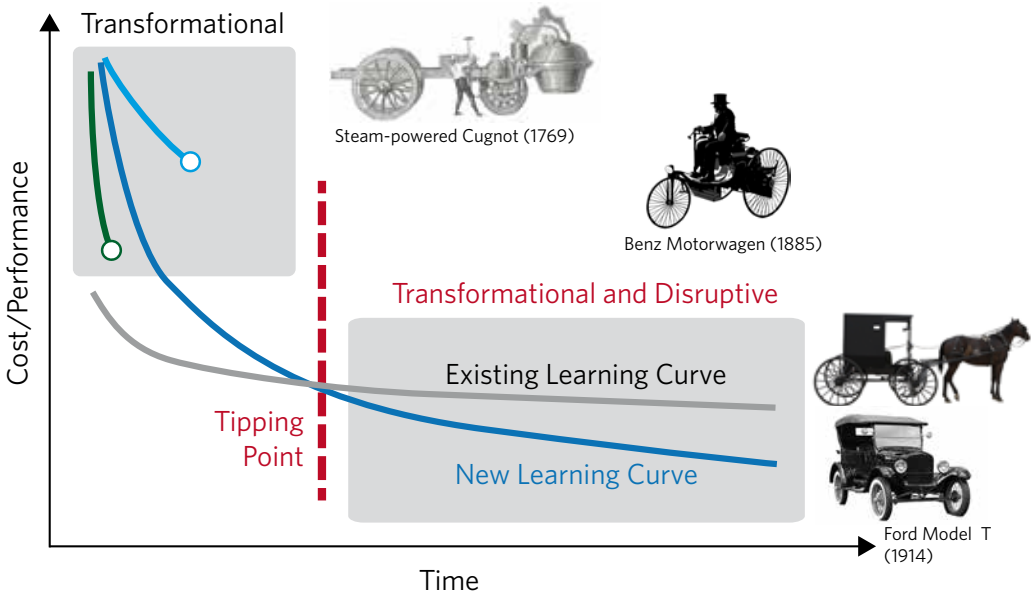
Figure 1. Technology Transformation and Disruption



conditions, and financial support for scale-up and production. As a government agency that provides funding, we have the role of developing technologies until they are ready for market decisions; to prepare for that stage, we manage and guide our awardees in both technical and commercial development. We employ both program directors who manage the technology development of various projects as well as project-specific, dedicated technology-to-market advisors. Our tech-to-market advisors help our awardees plan and execute the many aspects of commercialization that go beyond successful technology development. As shown in Figure 2, the tech-to-market team provides a foundation that supports the program director's advanced technology effort as part of our strategy to increase the yield of good ideas that become impactful products. Our program directors and tech-to-market advisors work together to build a community of advocates ranging from the laboratory to the marketplace so that successfully demonstrated, transformative technologies have a better chance of being embraced by potential users.

There can be a natural, healthy tug-of-war between our program directors and our tech-to-market team over technical risk. While the program directors are asked to identify and fund high-risk, potentially game-changing research, the tech-to-market advisors will need to demonstrate that the associated technical risk has been driven low enough to capture the interest of potential commercialization partners. At the end of the day, because our program directors and tech-to-market advisors are both in hot pursuit of a positive response to our mantra, "If it works, will it matter?," they appreciate each other's perspective and remain unified by that common goal.

Supplementing Awardees' Skill Mix

Because our goal is to enable the project teams to manage their own paths to commercialization, our tech-to-market efforts must extend beyond the ARPA-E program and tech-to-market team. As part of an ARPA-E award, each awardee is asked to assign a tech-to-market lead person who establishes the project's commercialization goals that drive the technology along the path to market. In fact, a portion of the award funding must be designated for performing technology transfer and outreach. A skilled tech-to-market lead on the awardee team can make the difference between a transformational idea that withers on the vine and a disruptive new technology that overtakes the competition and dominates the market (as per Figure 1). An effective tech-to-market lead must be intimately familiar with the technology landscape and the technical details of the project, so sometimes the tech-to-market lead also is the project's lead scientist or principal investigator. The skill set needed for performing bread-and-butter commercialization tasks is quite different, however, from that needed for performing world-class applied research. Thus, a principal investigator is encouraged to seek out a tech-to-market lead with a strong background in not just the technical area of the project but also in preparing business cases, value propositions and intellectual property protection strategies.

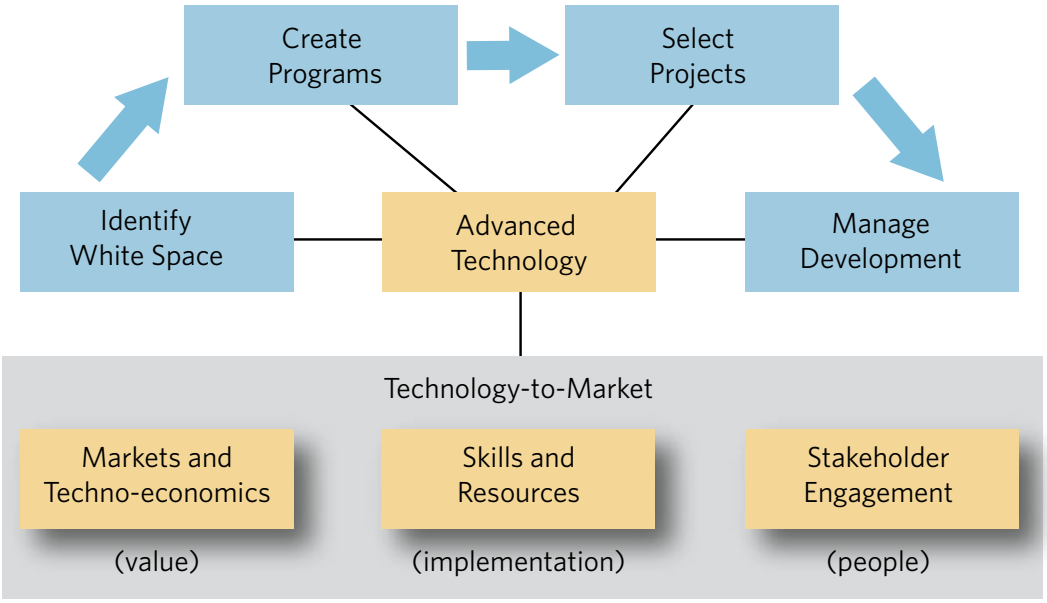
At each quarterly project review, the ARPA-E program director and tech-to-market lead actively engage with the awardee team to understand, direct and advise both technical and tech-to-market efforts. This government-awardee-combined team becomes a powerful force when each group is committed to making the technology matter.

Transitioning Technology

Each awardee's progress is monitored against carefully designed technical and tech transfer milestones—but meeting those milestones alone does not necessarily mean their technology will be commercialized. The government and awardee teams should work together throughout the project term to identify and connect with potential transition partners. As each of our projects come to a close, we aim to keep the successful technologies moving toward commercialization via several available paths, including:

- New company formation
- Strategic partnership with an existing company

Figure 2. Bringing Technology to Market



- Private investment
- Public development

When the awardee's team has a strong technical success, the right personnel and supportive market conditions, a new business may be spun off at the conclusion of the project as the path to commercialization. Another route leverages the experience and size of an existing company by attracting its interest in the new technology. If the technical risk remains too high for either of these two paths, the project team might seek out follow-on funding from private investors or another government agency in order to further mature the technology. Regular and open communication between the government and awardee teams is crucial to understanding the successes and stumbling blocks along a transition path. To date, projects funded by ARPA-E have resulted in the formation of at least 30 new companies, attracted more than $850 million of private sector follow-on funding and led to more than 37 projects funded via partnership with other parts of federal, state or local government.

It also is important during transition to find the right partners who can add skills and resources beyond those of the original project team. Many ARPA-E projects focus on breakthrough, building-block technologies that will need to be incorporated into a larger system in order to fully commercialize, such as actuators for sun-tracking solar panels, cell-level battery diagnostics to improve energy management or higher current density superconducting wire. Thus, once a project team has identified that crucial first market, an important next step may be to find a transition partner who can help the team plan and execute the effort that takes the project beyond a lab prototype of a component to a full-blown system demonstration.

For the subset of ARPA-E projects that also have clear defense-specific applications, we encourage the awardees to forge partnerships with a defense customer—ideally by affordably addressing a formal requirement. It also is beneficial for the project team to consider a partnership with a commercial firm that has a proven track record of being able to contract with, manufacture for and deliver systems to the DoD.

Finally, as you have likely seen in your acquisition careers, the technologies with the greatest likelihood of making it through the defense acquisition system are supported by a combination of both technology push and requirements pull. While ARPA-E does not have formally documented user requirements, our tech-to-market program includes activities designed to help awardees understand the current market needs, generate customer pull and increase their odds at having their new technologies matter.

Parting Thoughts

While we apply the tips above in managing, executing and partnering across our entire ARPA-E project portfolio, note that these insights are much more readily applied in defense science and technology development for applied research and beyond. The fundamental science research performed cannot benefit nearly as much, given that a market cannot be defined when the end-goal technology is still in flux. For each office that funds, manages or performs applied research, we encourage you to find your most natural and effective transition partners and keep them informed and engaged often!

For ARPA-E, success lies in having effective partnerships not just internally between our program directors and tech-to-market advisors, but also externally with our counterparts on the awardee teams and potential transition partners. Of course, if achieving successful technology transition were as simple as following the guidelines above, there would be a straightforward checklist resulting in higher yields from lab to market. From what we have seen here at ARPA-E, these guidelines are executed by top-notch personnel attracted by an organizational environment that is transparent and eager to experiment with new approaches to developing and delivering energy technology that matters.

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