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ABSTRACT: This article identifies the key components of an innovation ecosystem that can assist in developing nontraditional defense resources to cope with rapidly evolving technology threats. These components include organizational culture, an awareness of emerging technologies, a capacity for leveraging resources, and a strategy for absorbing external information.

For more than three years, the US Department of Defense (DoD) has been improving how it innovates in the face of rapid technological change. Dozens of departmental, service, and agency initiatives have emerged to address different aspects of the innovation problem. Significant energy has gone into linking these diverse efforts more comprehensively and collaboratively beyond the traditional defense community. But more thought must be given to the institutional competencies the DoD needs to become a focal point for creative and entrepreneurial problem solving.

The First and Second Offsets, for example, addressed a specific military-strategic calculus, namely overcoming the Soviet military's numerical superiority. In contrast, the Third Offset has taken this focus one step further by attempting to reinvent "the process of harnessing innovation to meet new enemies wherever and whenever they arise."[1] Accordingly, the top-down approach to capability development that characterized the Cold War is ill-suited for the present era.

Instead, the DoD needs a more dynamic model—one in which tacit knowledge encoded in networks of practitioners across the military enterprise drives new capabilities. Such a strategy means creating the capacity to innovate by aligning demand (from technology operators) with supply (the providers of global technologies). Building this capacity within the DoD can enhance its organizational culture, processes, and workforce—namely, enabling entrepreneurial competencies prevalent in the most competitive innovation ecosystems, such as Silicon Valley.

As part of the Third Offset, the Army established a Futures Command that will consolidate core modernization functions into a single organization. This command must place a premium on entrepreneurial competencies to capitalize on new sources of talent,

1 Damon V. Coletta, "Navigating the Third Offset Strategy," *Parameters* 47, no. 7 (Winter 2017–18): 50.

ideas, and resources.[2] This article outlines those competencies and discusses each of them in terms of the value it brings to the Army.

Innovation Ecosystem

We can trace the contemporary idea of innovation to Joseph A. Schumpeter's *Theory of Economic Development* (*Theorie de Wirtschaftlichen Entwicklung*), which appeared in 1934.[3] Schumpeter argued economic and social change came about when technology and business innovators recognized gaps and opportunities within the chaos of a competitive environment and reacted to it by offering new products and services. An innovation ecosystem, in effect, is the collective environment consisting of economic, networking, and physical assets as well as Schumpeter's technology and business innovators (change agents) that facilitate the transfer and application of knowledge and associated technological value creation.[4]

Within an innovation ecosystem, one can find diverse, interconnected participants and resources. These components include the human capital (students, faculty, staff, industry researchers, and industry representatives) and the material resources (financial resources, equipment, and facilities) that make up institutions (universities, colleges of engineering, business schools, business firms, venture capitalists, industry-university research institutes, federal or industry-supported centers, state or local economic development, business assistance organizations, funding agencies, and policy makers).[5]

The Army can develop a network among such stakeholders to promote value-maximizing behaviors associated with the efficient transfer and utilization of tacit knowledge as well as to improve organizational flexibility and openness that are critical for innovation. A number of barriers stand in the way of achieving such outcomes in traditional military organizations, however. Among these impediments are the rigid formalisms governing complex decision-making in the military that are manifested in the hierarchical organizational structure, strict job specializations, distinct divisions of labor, and highly authoritarian culture.[6] Another is the Army's lack of a true innovation culture.[7]

Innovative organizations implement an open strategy based upon the principle that "not all the smart people work for us." With this approach, the Army must learn to connect more effectively with smart people outside its organization to create a multiplicative network.

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2 Helene Cooper, "Army, Struggling To Get Technology in Soldiers' Hands, Tries the Unconventional," *New York Times*, March 18, 2018.

3 Joseph A. Schumpeter, *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle* (New Brunswick, NJ: Transaction Publishers, 1934).

4 Bruce Katz and Julie Wagner, *The Rise of Innovation Districts: A New Geography of Innovation in America* (Washington, DC: Brookings Institution, 2014).

5 Deborah H. Jackson, "What Is an Innovation Ecosystem," Engineering Research Center, March 15, 2011.

6 Edwin Hutchins, *Cognition in the Wild* (Cambridge, MA: MIT Press, 1995).

7 COL Eric E. Aslakson, "The Army Is Falling Short in Developing Creative Leaders," *Association of the United States Army*, May 4, 2016.

Embracing the ideas in these external links will, in turn, amplify the advantage of internal efforts.[8] Similarly, the Army needs to consider how to leverage the theory of lead-user innovation, which entails identifying sophisticated consumers who typically modify or invent products to satisfy their own needs as an important source of innovation outside the firm. Lead users can help the Army by becoming a source of new ideas capable of augmenting traditional product development within an organization.[9]

Admittedly, successful implementation of these innovation strategies presents challenges for the military services. Factors such as cultural idiosyncrasies, security, and policy constraints impede free-flowing interaction between the Army and important segments of high-tech industry. While firms operating in nondefense markets are a potential source of new, competitively differentiated technologies and business approaches, the Defense Business Board indicated the defense market is generally not attractive to commercial firms. This fact is due in part to the complex regulatory, policy, and process provisions governing defense acquisition, which represent a significant barrier to entry for firms pursuing mainly higher margin commercial markets.[10]

Nonetheless, the Army still needs an approach to technological innovation that enables it to create options across a diverse spectrum of potential solutions, such as cybersecurity, autonomy, and artificial intelligence, necessary for maintaining military advantage.[11] The Defense Innovation Initiative was launched in 2014 to begin addressing this need.[12] Since then, numerous internal initiatives have developed to connect the Defense Department to the participants and the resources necessary for a more flexible, resilient innovation posture.

Two prominent examples are the Defense Innovation Unit, which provides a channel for procuring commercial products that address military needs, and the MD5 National Security Technology Accelerator, which catalyzes the creation of startups that solve significant defense and security problems. The conceptual basis framing these initiatives also informs the Army's effort to internalize a set of competencies associated with innovating organizations—opportunity development,

8 Henry Chesbrough, "Managing Open Innovation," *Research Technology Management* 47, no. 1 (2004): 23–26.

9 Eric Von Hippel, "Lead Users: A Source of Novel Product Concepts," *Management Science* 32, no. 7 (1986): 791–805.

10 Defense Business Board, *Innovation: Attracting and Retaining the Best of the Private Sector* (Washington, DC: Defense Business Board, 2014).

11 Andrew P. Hunter and Ryan A. Crotty, *Keeping the Technological Edge: Leveraging outside Innovation To Sustain the Department of Defense's Technological Advantage* (Lanham, MD: Rowman and Littlefield, 2015).

12 Richard M. Jones, *Defense Secretary Hagel Launches Defense Innovative Initiative*, American Institute of Physics, November 18, 2014; and Chuck Hagel to the deputy secretaries of defense, memorandum, OSD013411-14, "The Defense Innovation Initiative," November, 15, 2014, Secretary of Defense, Washington, DC.

championing, resource leveraging, and location leveraging—that will enable the full advantages of an expanded innovation ecosystem.[13]

Supporting Interviews

To confirm the key components of an innovation ecosystem, we conducted 11 interviews in person, via telephone, by questionnaire, and through direct observation in formal and informal settings between January 2017 and October 2017. This qualitative method provided a rich understanding of the context of innovation within the DoD community in general and the Army in particular. We collected additional data through primary and secondary historical research and analysis based on news and industry reports and social media coverage. Using these inductive methods, we built on existing concepts in research on innovation ecosystems while exploring new strategies, processes, and relationships.

The interview data was initially analyzed to confirm the centrality of four previously identified competencies in the Army and the Department of Defense.[14] Respondents mentioned the word "champion" a total of 62 times; "resources," 53 times; "location," 51 times; and "opportunity," 42 times. Based on the confirmatory evidence, we organized the respondent data according to these four themes. Several other words such as "bureaucracy," "ideas," "trust," "participative," and "incentive," were also prevalent. We determined these keywords correlated to one or more of the underlying themes and decided against separating them.

Due to the relatively small sample size limiting the impact of biases, we do not claim the findings can be broadly generalized. Such qualitative approaches, however, can "close in on real-life situations and test views directly in relation to phenomena as they unfold in practice" even for small sample sizes.[15] In order to minimize the potential of verification bias, we asked open-ended, nondirectional questions. This approach, as well as an interview protocol appropriate for the participants' depth and breadth of experience, allowed us to gain richer, more holistic perspectives.

Implications

Several areas immediately challenge the Army's efforts to activate an ecosystem that increases its innovation capacity. Interviewees perceived risk aversion as endemic to the Army bureaucracy and deeply embedded in the organizational culture. This risk aversion and the stigma associated with perceptions of failure in the institutional Army were contrasted with

13 Adam Jay Harrison, Bharat Rao, and Bala Mulloth, *Developing an Innovation-Based Ecosystem at the U.S. Department of Defense: Challenges and Opportunities*, Defense Horizons 81 (Washington, DC: National Defense University, 2017); and Bharat Rao and Bala Mulloth, "The Role of Universities in Encouraging Growth of Technology-Based New Ventures," *International Journal of Innovation and Technology Management* 14, no. 4 (2016).

14 Harrison, Rao, and Mulloth, *Developing an Innovation-Based Ecosystem.*

15 Bent Flyvbjerg, "Five Misunderstandings of Case Study Research," *Qualitative Inquiry* 12, no. 2 (2006): 219–45.

the spirit of ingenuity and adaptation exhibited by the tactical military. Moreover, respondents suggested that not constructively acknowledging failure constrains organizational learning normally associated with iterative problem-solving approaches. Such a culture of risk avoidance also impacts professional development, whereby individuals electing to pursue career paths outside the norm do so at the expense of future choice assignments and promotion. Here, the check-the-box mentality of advancement limits the personal and professional diversity of the Army workforce necessary for innovation.

Several of our interviewees highlighted that mindset and systemic conservatism lead individuals to resist innovative approaches that might challenge existing organizational and behavioral norms. There is a tendency, according to Stam, to "not care about getting it right but rather care about delivering the product on time."[16] Respondents generally painted a picture of an Army bureaucracy that takes innovation for granted as a natural output of a more or less static process rather than as a living system of experimenting and learning. Such a mindset fails to emphasize opportunities for continuous improvement and causes military organizations to be, as Porkolab noted, "reactionary instead of proactive."[17]

While recent progress was acknowledged with respect to the Department of Defense accessing new sources of innovation, respondents agreed such activity suffers from a lack of resources and institutional buy-in necessary to implement innovation successfully. Several subjects highlighted the failure to reconcile newer innovation approaches, such as crowdsourcing, hackathons, and innovation challenges that are currently in vogue in defense circles, with the core roles, missions, and functions of the military. In effect, this contrast creates an environment in which bottom-up innovation takes place without being internalized by the institution in meaningful ways.

Recommendations

With the creation of the Futures Command, a number of tangible, near-term opportunities, ranging from training and education programs to partnership and organizational models, provide the Army with a mechanism for internalizing the innovation competencies explored above. Though incomplete, the following recommendations represent respondents' feedback that can be pursued as part of or as adjuncts to the Futures Command construct.

Training and education. A competencies-based approach to the development of in-depth innovation capacity starts with people. Therefore, the Army should deploy training and education resources supporting the self-initiated, discovery-based problem solving.

16 Allan Stam (dean, Frank Batten School of Leadership and Public Policy, University of Virginia), interview by the authors, March 31, 2017.

17 BG Imre Porkolab (Hungarian Ministry of Defense and former Supreme Allied Commander Transformation's Representative to the Pentagon), interview by the authors, June 19, 2017.

Innovation training and education programs should be structured to attract talent external to the Army's traditional technology development efforts, including those who would not otherwise be aware of the opportunities to work on military and civil-military issues.

One option to address this objective involves expanding Army engagement with programs like Hacking for Defense, a university-based experiential education program that aligns Army-sponsored challenges with student teams. Now offered at more than 18 universities around the United States, this program reinforces the opportunity development competency for students and Army problem sponsors. Hacking for Defense also promotes the creation of networks between the Army and student-innovators in key innovation geographies around the country to build the resource and the location leveraging competencies simultaneously.

Additional opportunities for training and education involve the deployment of professional military education and skills-based training for the internal Army workforce to develop a cadre of personnel able to navigate bureaucratic obstacles to technological change and innovation. Training and education should cover topics like entrepreneurial leadership, leading change, problem framing, design thinking, social networking, innovation culture, organizational design, talent and risk management, and strategic technology literacy. Classes should augment the Army's current education in science, technology, engineering, mathematics, and management as per the 2014 recommendations of the National Research Council.[18] A recent example of this approach has been successfully demonstrated by the Office of the Secretary of Defense in a program called the MD5 Boot Camp, a one-week curriculum that focuses on innovation skills development.

Distributed networks. Our respondents emphasized the importance of human-centered networks as a basis for opportunity development and as a means to organize resources and location-based benefits. The Army should activate extended networks of entrepreneurs, technologists, and other partners through a portfolio of programs that promote information exchanges required to connect the tangible and intangible assets—such as people, technology, capital, and infrastructure as well as the problems, customers, intellectual property, technical expertise, market information, partnership vehicles, and sales channels—necessary to conceptualize, build, and validate innovative solutions for Army problems.

Human-centered networking programs should first and foremost facilitate knowledge sharing between Army stakeholders and collaborators across government, academia, and industry. The Open Campus initiative, for example, offers academic and industry researchers opportunities to work alongside their counterparts at Army Research Laboratory facilities. Open Campus also includes a handful of extended sites where the Army researchers from these facilities are forward

18 Jacques S. Gansler et al., *Review of Specialized Degree-Granting Graduate Programs of the Department of Defense in STEM and Management* (Washington, DC: National Academies Press, 2014).

deployed into university communities to capitalize on their unique attributes.[19] This model has successfully demonstrated how the Army can position its physical and knowledge-based assets in a research and development context to attract new collaborators. This model could be replicated in a search for opportunities that support nonresearch objectives. Uniformed personnel with firsthand knowledge of the warfighting domain, for example, could be placed at select universities to stimulate academic thinking on revolutionary warfighting applications of emerging technology.

Architecture. In addition to developing a human link that can rapidly deliver private sector innovation for military applications, former Undersecretary of Defense for Acquisition, Technology, and Logistics Frank Kendall called for a new architecture to capitalize on high-tech ideas that are also required to instantiate in-depth innovation capacity in the Army.[20] Standing up the Futures Command provides the Army with a unique opportunity to deploy a business system that aligns externally derived ideas, products, partners, resources, and expertise with the Army's concept and capability development to enable high-potential opportunities to be internalized, scaled, and sustained.

With this objective in mind, the Army should frame the knowledge and materiel-based outputs of innovation efforts like technology demonstrations and experiments, crowdsourcing, and collaborative research and development with key decision points across the capability-development enterprise. An example of this approach involves leveraging entrepreneur-based prototyping associated with activities like hackathons, crowdsourcing, and challenge prizes to investigate systematically the implications of emerging technology in application areas relevant to the Army. Correctly documented, such efforts would provide evidence-based support for concept and requirements development. In the area of contracting, entrepreneurial networks can provide new insights into the technological art of the possible that are relevant to acquisition strategy development and preacquisition market surveys.

Conclusion

Since the end of the Cold War, the United States has built a decisive military-technological edge as the cornerstone of its national defense strategy. In an effort to maintain that edge, the Army will spend more than $10 billion on research and development in fiscal year 2019. While significant, the Army investment is a small fraction of escalating global outlays on research and technology. At the same time, the proliferation of knowledge and creative technologies are displacing traditional, capital-intensive approaches to advanced product development. The fusion of new physical, digital, and biological technologies characteristic of the Fourth Industrial Revolution is amplifying the dynamics of creative destruction with new technology-driven business models that are upending legacy

19 "ARL Open Campus," Army Research Laboratory, accessed June 30, 2018.

20 Coletta, "Navigating the Third Offset."

modes of competition at increasing rates. The hallmarks of organizations that successfully innovate in the age of disruption include characteristics like openness, connectedness, decentralization, and scalability. Taken together, the transformation of the R&D landscape from a centralized, capital-intensive model to a networked, democratic model represents a significant challenge to many traditional organizations in fast-moving markets. For the Army, the implications of this change are the impetus, at least in part, for forming the new Futures Command.

Successfully competing in the new innovation environment requires more than adjustments to organizations and processes. It demands a commitment to developing an in-depth innovation capacity—a whole new set of competencies required for the dynamic organization of people, problems, technologies, and resources in an innovation ecosystem. Once established, such an ecosystem, consisting of elements internal and external to the traditional defense industrial base, will provide a resilient source of competitively differentiated ideas as well as a means for discovering unexpected new applications of technology with the potential to impact Army equities positively.

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