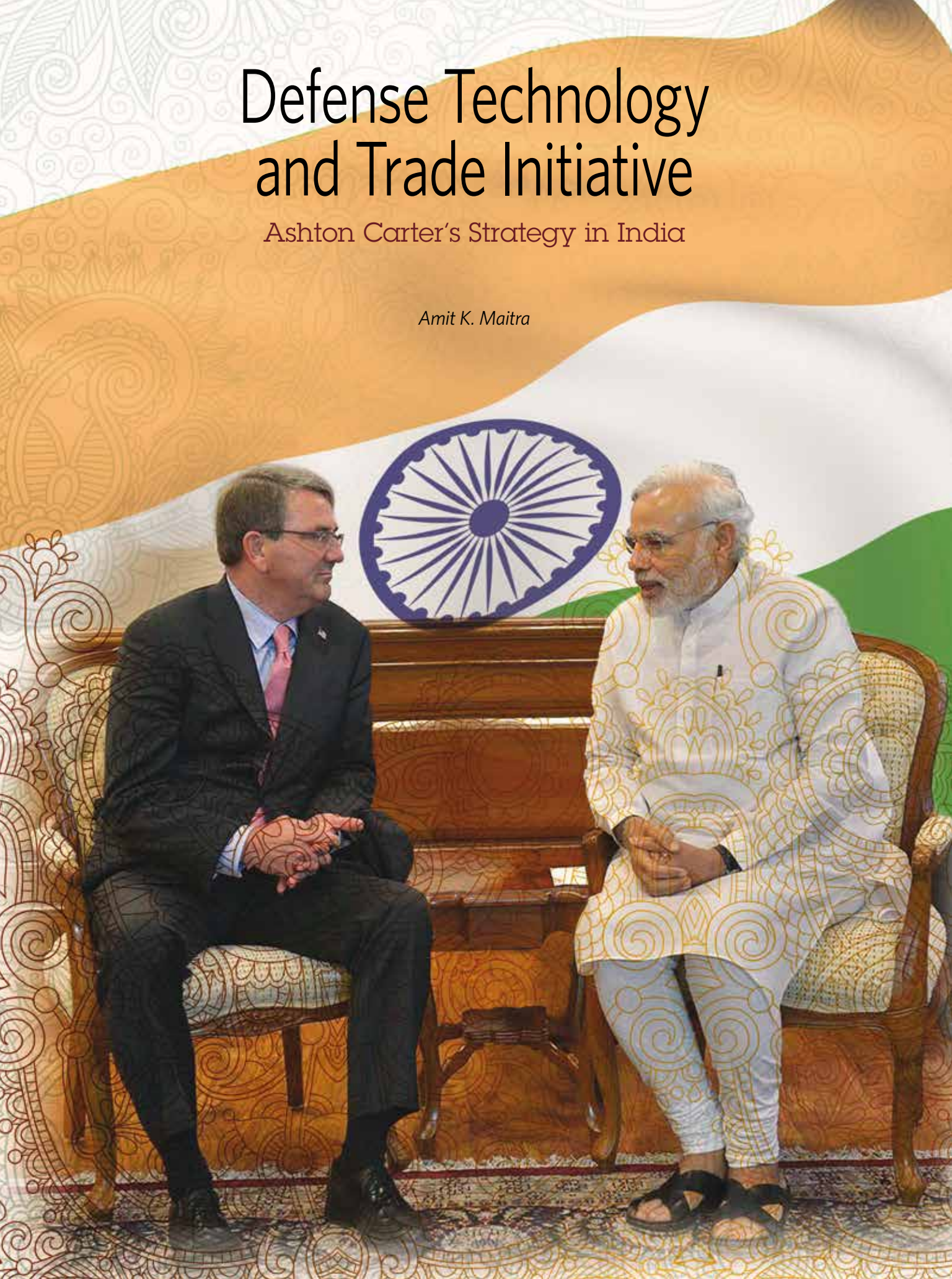
Defense Technology and Trade Initiative

Ashton Carter's Strategy in India

Amit K. Maitra



In early June 2015, Defense Secretary Ashton B. Carter met with senior Indian officials to work on initiatives that were set in motion during President Obama's January 2015 visit to India. During that visit, Obama and Indian Prime Minister Narendra Modi focused on shared concerns ranging from maritime security and cooperation and joint training on aircraft carrier and jet engine technology.

Modi, who has a broad vision of India as a global power, has a noticeably great affinity for the United States. Also, in the wake of China's efforts to project power into the Indian Ocean and beyond, both the United States and India share an interest in building closer ties, especially on defense matters.

Modi has given priority to domestic manufacturing, including production of military hardware. Sanjeev Shrivastav, an analyst at the Institute for Defense Studies and Analyses in New Delhi, argues that the Modi administration views an extensive co-production deal with the United States as "a significant move forward."

Carter visits India frequently. However, his June arrival as the U.S. defense secretary heralded a new beginning. He landed in the southeastern city of Visakhapatnam and toured the Indian Navy's eastern command headquarters. This first visit by an American defense secretary to an Indian military operations command highlighted the importance of maritime defense and manufacturing ties between the two nations. After a briefing from the Indian commander, Carter visited a frigate designed and built in India, with its engines supplied by General Electric and many of its systems and subsystems also acquired from abroad.

U.S. and Indian defense officials have been discussing the exchange of technology on major military items, such as jet engines and launch catapults for aircraft carriers. Jet engines

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Maitra *is a founding member and president of the Foundation for Emerging Solutions, which was established to strengthen the capacity of people throughout the world to evaluate the challenges, operations, and solutions facing governments as they formulate national strategies to keep their defensive and offensive cyber capabilities current and in line with the international community.*

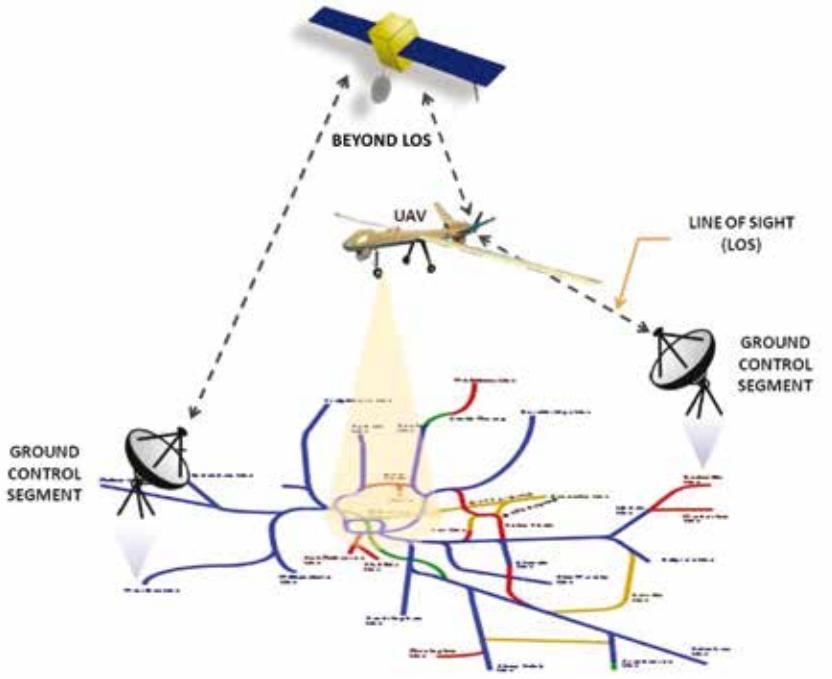
← **U.S. Defense Secretary Ashton B. Carter, left, meets with Indian Prime Minister Narendra Modi in New Delhi, India, June 3, 2015.**
Department of Defense photo by Glenn Fawcett

and aircraft carrier technology represent the larger projects that the Pentagon is considering for co-production with India.

As the main architect of the India-U.S. Defense Technology and Trade Initiative (DTTI), Carter staunchly advocates treating India like some of the closest U.S. partners in terms of the extent and level of technology transfer, co-development, co-production and collaborative ventures, and expedited approval process for licenses, among other activities. Under Carter's leadership, the Pentagon, with its special India team, is ready to help senior officials cut through their own bureaucratic barriers and red tape.

During the June 2015 visit to India, Carter completed the details of two small research projects that the U.S. and Indian militaries would conduct together. These projects are very small, but their importance could be significant, depending on the outcomes. The expectation, according to U.S. officials traveling with Carter, is that Washington and New Delhi would become accustomed to working with each other through these small-scale initial projects.

Figure 1. Unmanned Aerial Vehicle Line of Sight



Source: *Report on Unmanned Aircraft Systems: Perceptions & Potential,* Aerospace Industries Association, May 10, 2013.

Carter also signed the 2015 U.S.-India Defense Framework, the stated purpose of which is "to open up this relationship on everything from maritime security to aircraft carrier and jet engine technology cooperation." Before the visit last June, Carter had told delegates at the Shangri-La Dialogue plenary session in Singapore that the framework agreement with India was meant "to blaze a trail for things to come." What benefits accrue to whom as the U.S. and Indian industry partners undertake technology transfer, co-development, co-production and collaborative ventures?

The Unmanned Aerial Vehicle

The small portable, hand-launched and remote-controlled, electric-powered RQ-11 Raven is built by AeroVironment, Inc., in Monrovia, California, and has changed the way military ground forces operate. The design, development and manufacturing and market reach of this particular unmanned aerial vehicle provide a case study of technological advancements and joint venture co-production and co-development requirements.

In 1987, AeroVironment introduced the first true small unmanned aerial vehicle (UAV) for military use. Since then, the U.S. military's UAV market has witnessed meteoric growth, as UAVs have proven their value in operations around the world. Several industry reports project that U.S. military UAV manufacturing will generate $86.5 billion in revenue over 2013–2018. These forecasts provide the following breakdown of U.S. sales of UAVs:

- Research, development, tests, and evaluations
- UAV, as an assembly
- Payloads
- Ground control systems
- Service, support, and maintenance
- Training
- Data management
- Revenue by UAV groups (by vehicle airspeed, weight, and operating altitude)

Since the U.S. Department of Defense (DoD) is the single largest consumer of UAV technology, industry experts predict that the U.S. Government will continue investing in UAVs to keep its technological and pure force supremacy in the coming decades.

A market research study by the Teal Group Corporation predicted that the United States will account for 65 percent of total worldwide research, development, test and evaluation spending on UAV technology over the next decade and about 41 percent of the procurement. This study provides a comprehensive analysis of UAV system payloads and key UAV manufacturers. Philip Finnegan, the Teal Group's director of corporate analysis and study author, forecasts the UAV market at 89 percent military and 11 percent cumulative civilian uses for the decade. He foresees the mili-

tary market share decreasing to 86 percent and the civilian market rising to 14 percent by the end of the 10-year period covered by the forecast.

Thomas Nielsen, president of the Association for Unmanned Vehicle Systems International, reminds us that, in addition to the military use of UAVs, other applications should not be overlooked: fire safety, land safety, search and rescue, firefighting and other crime prevention—just to name a few such activities. Forecasts from market research firms indicate that UAV applications will continue evolving in all these domains. Today, UAVs are used to monitor national borders and pipeline utility assets, and protect civilians via search and rescue missions (e.g., find people who are lost and in distress). These missions are well served by small UAVs, as they can be launched easily, day or night, to provide precise situational awareness whenever and wherever they are needed.

According to several industry reports, UAV electronics will be the world's fastest-growing aerospace payload market, with new sensor programs for current and future air vehicles presenting surprising growth opportunities.

David Rockwell, author of the electronics portion of the Teal Group study report, identified and listed a few speculative new programs in the out-years that demonstrate how wise companies' managements will plan for future growth.

Varied Strategies of Small UAV Companies

The U.S. military and allied forces extensively use AeroVironment's UAVs, which deliver valuable capabilities to provide intelligence, surveillance and reconnaissance (ISR) superiority in today's combat zones.

AeroVironment's Raven is the most widely used unmanned aircraft system in the world today. It can be operated manually or programmed for autonomous operation with the system's advanced avionics and precise GPS navigation. The hand-launched Raven weighs 4.2 pounds. With its 4.5-foot wingspan, it provides aerial observation, day or night, at line-of-sight ranges of up to 10 kilometers (see Figure 1 on page 28).

When an optional stabilized gimbaled payload is added, Raven delivers real-time color or infrared imagery to ground control and remote viewing stations. AeroVironment's common Ground Control Station interfaces with all its tactical ISR air vehicles, thereby reducing the training required, as well as the time and cost involved. The company has won every DoD competition for programs of record involving small UAVs. Despite AeroVironment's market presence and the global UAV industry's growth forecast, the December 2013 DoD report, *Unmanned Systems Integrated Roadmap FY2013–2038*, points to the grim reality of defense funding. A comparison of DoD funding plans versus industry predictions shows DoD will not be the bulk user within that market. The Bipartisan Budget

Table 1. AeroVironment's Recent Developments

Date	Approach	Description	Importance
June 2014	New Product launch	AeroVironment Inc. and BP U.S. launched the first Federal Aviation Adminisration-approved, commercial UAVs to provide mapping. Geographic Information System (GIS), and other commercial information services to BP's Prudhoe Bay oil field.	
February 2014	Agreement	AeroVironment Inc. and Lockheed Martin Corp. (U.S.) signed an agreement to jointly pursue opportunities in UAV development.	
November 2013	Contract	The company was given a contract worth $2.3 million for the Defense Advanced Research Projects Agency's Concept Definition Tactically Exploited Reconnaissance Node (TERN) program for a Medium Altitude Long Endurance Unmanned Aircraft System.	
October 2013	Contract	The company was awarded a contract worth $13.5 million by the U.S. Army for RQ-11B Raven Unmanned Aircraft System Gimbaled Sensor Payloads.	
August 2013	Contract	The company received an order worth $13.8 million for the RQ-11B Raven Small Unmanned Aircraft Systems and Gimbaled Payloads.	

Source: Data compiled by author from AeroVironment published literature on the company website (www.avinc.com <http://www.avinc.com>), and several other Market Research Reports published through the Internet,including *U.S. Military Unmanned Aerial Vehicles (UAV) Market Forecast 2013-2018*, Jan. 9, 2014, Market Research Media, Ltd.; Teal Group's 2014 Market Study: *UAV Market Profile and Forecast*, July 17, 2014, Teal Group Corp. See http://www.marketsandmarkets.com/Market-Reports/commercial-drones-market-195137996.html.

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Control Act of 2013 imposed budget cuts on the DoD, thereby reducing the DoD's UAV procurement expenditures from $3.9 billion in 2013 to a requested $2.4 billion for 2015. Procurement contracts for the compact drone (as UAVs commonly are called) dropped from $30 million in 2013 to $13 million for 2015.

Two factors constrain U.S. companies from contributing to the UAV industry's growth independent of government contracts: commercial use of drones are subject to Federal Aviation Administration regulations, and companies also must overcome export license restrictions before they are allowed to make foreign sales of these drones. AeroVironment's "Hummingbird drone," ordered by the Pentagon and a favorite for combat operations in Iraq and Afghanistan, took an enormous hit in 2015. According to Chief Executive Officer Timothy Conver, revenue is expected to drop to $230 million in the coming fiscal year. Table 1 on page 29 provides a partial listing of the company's recent developments.

Given uncertainty in the U.S. domestic market, AeroVironment has ventured into international marketing opportunities. DTTI offered a fortuitous foundational opportunity to overcome bureaucratic obstacles, including export approvals, and arrange cooperation with an emerging economic power at the research, co-development and co-production stages for select defense systems. Today, the company is focused on a pathfinder project involving a mini-UAV initiative with Indian industry partners.

In discussing the Make in India initiative, U.S. officials note that it requires time and tenacity to create high-tech military defense sector industry. The mini-UAV projects will help develop deeper levels of cooperation and partnership between U.S.–Indian businesses, militaries, and American and Indian engineers, to produce cutting-edge designs. This understanding is warranted, because Make in India is not about transferring old technologies from the United States for final product assembly in India: Rather, it aims at joint development of new technologies through design, engineering, manufacturing, testing, production, deployment, operations and sustainment. Keith Webster, director of International Cooperation, Office of the U.S. Under Secretary of Defense for Acquisition, Technology, and Logistics (OUSD[AT&L]), notes that modest programs like mini-UAVs will allow both the U.S. and Indian participants to understand how they can work together more effectively, work out procedures, and learn from that experience.

Webster views AeroVironment's arrangement with the Indian counterpart as an excellent opportunity for lessons learned about the complexities of the transfer process. As mentioned earlier, a rapid reaction-cell has been instituted within OUSD(AT&L) specifically to move Indian transactions faster, and it has approved the export license for AeroVironment to proceed with the pathfinder project. Now, the company must

Table 2: Steps in Production and Handling of a Complete System of Technology Development and Transfer

Steps	Technology Transferred	Transfer Media
Research	Product Design	Documentation & Hardware
Laboratory Development		
Prototype	Manufacturing Technology	Documentation & Hardware
Manufacturing Process Development		
Pilot Production	Quality Analysis Techniques	Documentation & People
Engineering Support		
Product Management Techniques →	Product Management Techniques	Documentation & People

Source: Maitra, Amit K. *Transferring Technology Across Borders: Policies, Practices and Conditioning Factors*, GENERAL SYSTEMS, Vol. XXI, 1976.

Table 3. Audit Matrix

	Transfer Mechanisms						
	Documentation		Training		Seminars	Learning, Visits, and Exchanges	Equipment
Type of Technology	Manuals, Special Process Drawings	Regular Information	Formal	OJT	Formal	Formal	Formal
Planning and Proposal	X	X	X		X	X	
Design and Construction	X		X	X		X	X
Startup	X	X	X			X	X
Value Engineering	X	X				X	X
Research and Product Development	X		X	X	X	X	X
Environmental Support	X	X			X	X	X

Source: Maitra, Amit K. *Transferring Technology Across Borders: Policies, Practices and Conditioning Factors*, GENERAL SYSTEMS, Vol. XXI, 1976.

determine both the technology package and the transfer process. AeroVironment must assess its Indian partner's current industrial base to support the manufacture of the particular UAV model and the locally manufactured components that could be integrated into the UAV model. These questions are germane to the UAV pathfinder project, as they provide the highly sophisticated nuances related to electronic components and circuitry and the ability to develop a local capability for component integration.

The questions help identify and list the basic steps to produce a complex product like UAVs, including research, laboratory development, prototype development, manufacturing process development, pilot production, and engineering support. From these steps, elements of a technology transfer package evolve in the following manner (see Table 2, on page 30):

- A product design is achieved through laboratory development and prototype development. This element can be directly transferred through documentation and the hardware itself.
- Manufacturing techniques are established through the combination of manufacturing process development and pilot production steps. Again, these techniques can be transferred through documentation and hardware.
- Quality assurance techniques are developed from product testing in pilot production and data gathering entailed in engineering support. These two steps incorporate design refinement and continuous updating of the product; new state-of-the-art techniques also form part of the technology transfer package and are transferred through documentation and people.

Another very important element of transferrable technology is that of product management techniques. These techniques are not exactly product oriented, nor do they directly relate to the steps outlined above. They include the development and management skills to ensure sufficient and timely production of high-quality products at a predetermined cost. This element and that of quality assurance techniques constitute the most valuable ingredients that many overseas suppliers have to offer to Indian industry in a technology transfer package.

In April 2015, Prime Minster Modi announced plans to shelve the purchase of 126 Rafale warplanes from France's Dassault Aviation SA, a contract that would have seen 108 planes built in India. Talks stalled for several years over pricing and a requirement for Dassault to assume liability for the 108 jets to be built under license by Hindustan Aeronautics Ltd (HAL).

The state-run company has been plagued by quality problems: for instance, its indigenous Tejas fighter jet took more than 20 years to develop. India has several options, such as inviting private companies to either replace or complement HAL. Justin Bronk at London's Royal United Services Institute for Defence and Security Studies observed that finding an alternative to HAL for making one of the world's most advanced fighter jets may be difficult. Indian industry is not ready to produce a fighter jet of this complexity. Technical knowhow, coupled with human knowhow, is the winning combination for India.

As a first step toward more specific analysis and evaluation of all technology components required to establish a high-technology manufacturing facility, including that for the AeroVironment type of pathfinder project, a Total Technology System framework is warranted. A Total Technology System built in the form of an audit matrix is shown in Table 3 on page 31.

To fully enhance the concept of evaluating stages and mechanisms of technology transfer, pathfinder type of projects should use the audit matrix to identify which aspects of technology are critical to different types of industry. There is no one best means for technology development and transfer. For mass production technology, one element may be more important than another. For Indian industry, design, development, test, evaluation, integration, verification, validation and quality checks may bring more critical new technology than the start-up phase. These determinations depend not only on the type of technology being supplied, but also on the overall needs of the Indian industry and its environment. The AeroVironment pathfinder project offers an excellent vehicle for raising questions about the type of technology and its particular transfer mechanism, and the cost, quality and extent of its importance to the ongoing project and the Indian environment. To that end, Table 4 discusses the rationale and aim of asking questions, such as *what* and *when* and *how*: How best can the AeroVironment pathfinder project guide a potential Indian partner on tried and tested methods of sustainable product engineering design and development processes and tools?

The pathfinder project permits the company to initiate joint programs, by sharing development and production of a new UAV aimed at Indian domestic and export markets. The scope of the global market for UAV applications comprises Military, Civil and Commercial, and Homeland Security. Military involves ISR, Combat Operations, Battle Damage Assessment/Target Designation Mission. Civil and Commercial contain Agriculture, 3D Mapping, Film Industry, Photography, Oil and Gas, Product Delivery, Wildlife Research and Survey, and Climate and Pollution Monitoring. Homeland Security includes an array of applications, including Border Security, Fire Fighting, Traffic Monitoring, Disaster Management, Search and Rescue, Police Operations and Investigations, and Maritime Security.

A snapshot of the global market for UAV payloads points toward Electro-Optical/Infrared Sensor, Cameras, Synthetic Aperture Radar, Signals intelligence, Electronic Intelligence, Communications Intelligence, Maritime Patrol Radar, Inertial Navigation System, Laser Sensors, Electronic Warfare, Optronics, and others including Autopilot, Lidar, Weapons, Automatic Target Recognition.

The Indian market for Raven type of UAV is wide open and by virtue of its pathfinder project, AeroVironment has established a beachhead in South Asia and will be able to enjoy a comparative advantage over its licensee.

By participating in co-production and co-development of UAVs, Indian industry will acquire new product development, manufacturing, logistics, and marketing skills. It will co-develop products and co-produce technology for UAV markets

Table 4. Questions and Answers Readily Accessible Through the Pathfinder Project

Rationale	Given the wide scope and broad impact of DTTI's programs and policies, as well as the differing workflows and approaches of Make in India across the sectors, examples are needed of effective practice that are collaboratively developed but reflect institutional difference within a "real-world" environment.
Aim	The AeroVironment pathfinder project will aim to develop shareable models of good practice with regard to implementation of DTTI's requirements. In doing so, the project will enable their own and associated Indian industry partners to find out what works best in implementing DTTI projects, in a variety of institutions across sectors, and will share this knowledge openly thereby aiding other Indian industry partners in the wider sectors.
How will they achieve this?	The AeroVironment pathfinder project will produce guidance that will enable Indian industry partners to improve awareness and clarity of tried and tested sustainable product design and development principles, approaches, tools and resources. The project aim is to embed this new thinking into their product design and development "stage gate" (decision-making) processes and in key documents and guidance materials.

Table 5. Potential for UAV Market Growth

Region	Market Share	CAGR*
Americas	65.3%	111.93%
Europe	17.59%	102.11%
Asia-Pacific	11%	98.47%
Rest of the World	6.11%	98.47%

*Compound Annual Growth Rate percentage (2014-2020)

Source: *Commercial Drones Market*: GLOBAL FORECAST TO 2020, SE 3099-2015, Markets and Markets (http://www.marketsandmarkets.com/Market-Reports/commercial-drones-market-195137996.html).

in six main geographic regions: North America, Europe, Asia-Pacific, Latin America, Africa, and the Middle East.

The two joint-venture partners' challenge is to find concrete areas to step up product development, manufacturing, logistics, and export marketing cooperation so that only their strategic logic sets the pace of product development and penetration, persuasion and prosecution of their export marketing ventures. Until then, as Table 5 on page 32 shows, their individual shares remain visible targets to acquire from everywhere.

From this case material, it is possible to form a general observation about a particular firm's or industry's willingness to share front-end technology, impart sophisticated design and engineering capabilities, instruct foreign nationals in management skills, etc.: Foreign firms, facing narrowing opportunities to earn returns in their domestic markets, are eager to meet various conditions in a meaningful way so they can utilize their technology asset effectively. They prefer a U.S. Government policy that is flexible toward strategic trade and disclosure of technology products and information. DTTI allows defense systems, equipment, weapons and their subsystems to flow in both directions across the United States and India. AeroVironment pathfinder project illustrates, to paraphrase Carter, what can be achieved by opening the private sector, where companies are both eager and better prepared to assist both India and the United States.

Acknowledgments

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The author can be contacted at **amaitra@emerging-solutions.us**.