Translating Strategic Vision into Tactical Implementation

Interpretive vs. Analytical Thought in AFRL Technology Development

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In the past four years, senior leadership has demanded more responsive research and development organizations. On Sept. 10, 2001, Secretary of Defense Donald H. Rumsfeld directed the acquisition community to deliver quality technology to soldiers rapidly and efficiently. "We must recognize ... the revolution in management, technology and business practices," Rumsfeld said. "Successful modern businesses ... reward innovation and they share information. They have to be nimble in the face of rapid change or they die. Business enterprises die if they fail to adapt ... but governments can't die, so we need to find other incentives for bureaucracy to adapt and improve." Commander of Air Force Materiel Command, Gen. Gregory Martin, has called for on-time development of the right technologies. But how do working-level personnel translate these words into action?

Lt. Smith (left) and Capt. Sanders (center) meet with Michael Jiavaras (right) at NAVAIR Lakehurst and get experience lifting and placing existing AM-2 airfield matting.

In March 2003, an Air Force Research Laboratory (AFRL) team set out to transition a technology to the user. Our initial efforts yielded the next-generation airfield matting (AM-X) program, an initiative to replace AM-2 aluminum airfield matting, the heaviest system the Air Force deploys. From its inception two years ago, the AM-X program has grown into a $2.2 million tri-Service program with multiple investors. We have since identified and initiated development of five other potentially disruptive technologies. [*Coined by Harvard Business School professor Clayton M. Christensen, the term "disruptive" describes new technology that displaces established technology.*]

Identifying a Conceptual Framework

We found a conceptual framework that supported the strategic vision and our tactical development in *Innova-*

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 U.S. Air Force photograph.

tion: The Missing Dimension, in which MIT professors Richard Lester and Michael Piore attempt to understand American corporate success in the 1990s. They observed that a major aspect of growth was from innovation: leaps in biotechnology, computing, networking, and more. But why did America innovate more in the 1990s than in the preceding decades? How does the economy—and for our purposes, the AFRL—develop new technologies and enhance existing ones in a fast and efficient way? More fundamentally, how does innovation work?

Lester and Piore argue that innovation depends on two fundamental processes: interpretation and analysis. Analytical concepts are well known by AFRL personnel and provide the foundation for science, engineering, and economics. They help individuals solve problems. They assume perfect (or nearly perfect) information, clearly defined options and outcomes, and the ability to analyze risk and make informed trade-offs.

In contrast, interpretive concepts help individuals explore ambiguity. Interpretive interactions begin with a conversation in which people may have trouble comprehending each other. While these discussions are open-ended, unpredictable, and sometimes have no tangible outcome, they help individuals understand different perspectives and overcome organizational barriers.

Interpretive concepts are derived from Heideggerian philosophy (reviews of which are given in *Being-in-the-World* by Hubert L. Dreyfus and *The History of Political Philosophy* edited by Leo Strauss and Joseph Cropsey). Heidegger discusses a concept of being that has implications for the way humans exist and is unique from traditional western philosophers like Aristotle and Descartes. Individuals define themselves not by roles or categories (e.g., engineer, male, American, etc.), but by the context of their social activities. People can be one thing in association with one group of people yet interpret themselves differently in other groups. In effect, humans have no specific nature that can be categorized and independently studied since that nature is dependent upon social context.

For our purposes, awareness of Heideggerian concepts, translated to the business world by Lester and Piore, provides one framework for understanding strategic transformational concepts and implementing them at the tactical level. We can better comprehend individual views and organizational opinions because we have the ability to view them not as traditional categories (e.g., good, bad, right, wrong), but as valid beliefs shaped by the social context in which a person or an institution exists.

We have relied on this conceptual framework to develop technology more rapidly for the Department of Defense. Much of our work has been analytical: forming integrated product teams (IPTs), developing models, and recording user requirements. But we have also spent considerable time conversing with people, experiencing existing technologies, and learning about different perspectives and opinions.

Case Study: Next-Generation Airfield Matting Development

In March 2003, we identified a promising technology to develop. While in graduate school, author Sanders had invented a three-dimensional honeycomb structure. The idea seemed promising, so it was modeled and a rapid prototype produced.

With prototype in hand, we began building a network of contacts from which our IPT would emerge. We met with experienced managers, and it was suggested that we apply the technology to airfield matting. We spoke with Dr. Charles Browning, director of the Air Force Research Laboratory's Materials and Manufacturing Directorate (AFRL/ML), who subsequently offered us $60,000 to explore the concept further.

Knowing little about airfield matting, we also convened a team of knowledgeable users and airfield matting experts to discuss needs and expectations. Air Force and Marine Corps laboratory, acquisition, and user representatives convened at Wright-Patterson Air Force Base, Ohio, in August 2003. We discussed user requirements and field experiences. Integrated product and process development tools provided a framework to record quantitative information.

After gathering initial user requirements, we initiated face-to-face discussions with field users to gain experience with the current technology. We placed ourselves in our customers' shoes by visiting the Marine Corps NAVAIR Lakehurst, N.J., facility to set up AM-2 on a small scale. Author Smith also traveled to the Marine Corps Air Station in Yuma, Ariz., to interact with the Expeditionary Air Field teams. We met with the Air Force Civil Engineering Support Agency at Tyndall Air Force Base, Fla., to discuss their experiences. These activities not only increased our understanding of the problem, but also enabled us to build business relationships with the user community. Our growing competence and determination convinced the Marine Corps to invest $50,000 in support of development efforts.

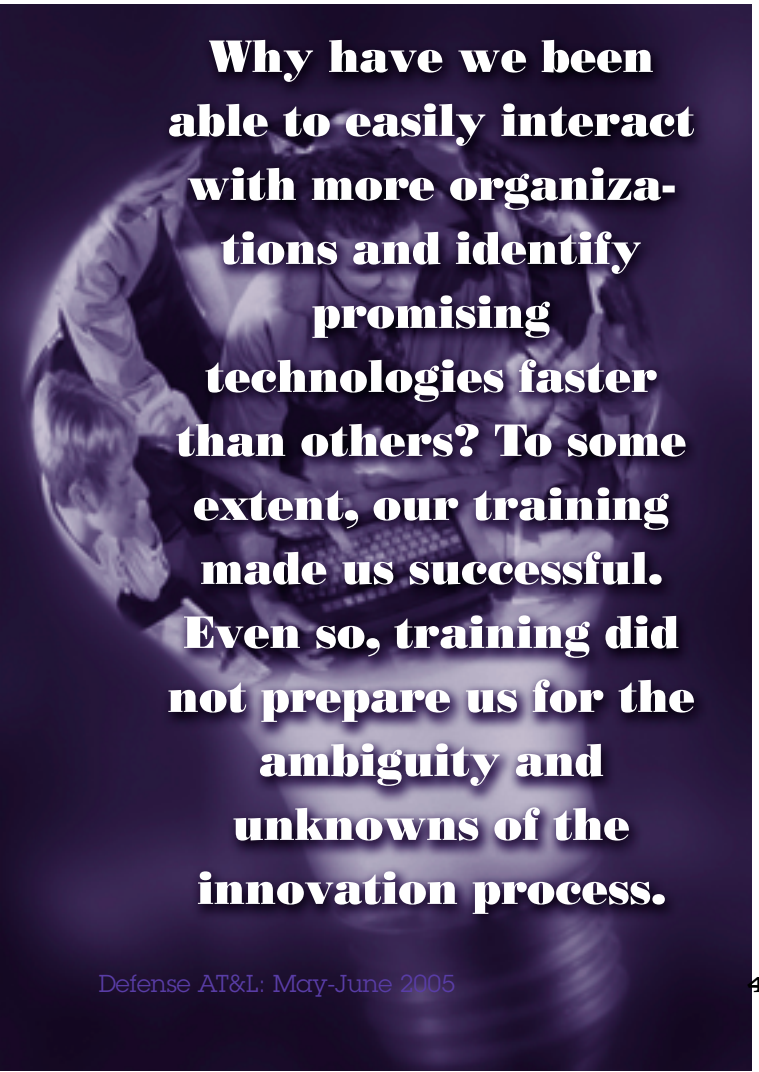
We eventually invested our seed money into promising commercial technologies. We developed an analytical model with the Naval Surface Warfare Center Carderock, Bethesda, Md., and the University of Dayton Research Institute that predicted the proposed solution could withstand the necessary operating conditions. We presented the findings and proposed future plans to representatives from the Marine Corps and AFRL/ML, which led to the investment of additional development funds.

Our strong network of advisors helped us quickly address the program unknowns. For example, we were uncertain how to ameliorate manufacturing issues and affordably produce the mat, and we were unsure of the accuracy of our models. With Army-provided data on the existing and previous matting and expert guidance, we narrowed our design options to a few promising solutions. We discussed various manufacturing processes with experts and devised ideas to meet our cost objectives. In summer 2004, we consolidated our empirical data to seek additional funding. We briefed the Air Warfare Battlelab, Mountain Home Air Force Base, Idaho, and secured funding to procure and evaluate panels.

The first panel was produced in November 2004 for coupon testing. A single-panel test with the Army took place March 2005, to be followed by a full eight-panel matting system test three months later.

Analysis versus Interpretation in AM-X Development

During AM-X development, we used many analytical concepts learned in acquisition courses. We formed an IPT and used it to make critical programmatic decisions. We gathered and recorded user requirements early in our program. We considered lean manufacturing concepts to minimize waste and rework.



Interpretive concepts were also essential to development efforts. Frequent conversations helped us understand the history of AM-2 from different vantage points. Our meetings helped us learn the diverse attitudes and nomenclatures of different organizational cultures: the Air Force civil engineers, the Marine Corps, the battlelabs, contracting, and different small businesses. Interactions helped us gauge the individuals or organizations that could contribute to accelerated development, and those that required more patience.

Understanding different attitudes and beliefs helped us continue an accelerated development schedule even when problems arose. In one situation, people thought we were telling companies that our development concept would be purchased and fielded by the Air Force without competition, so we modified our conversational style to avoid the misinterpretation. In another case, a trip we made caused individuals to perceive—wrongly—that the Marine Corps was not actively supporting Air Force development efforts. We worked together to overcome the misperceptions, which strengthened our team. Finally, some on the IPT decided the optimal path was to first develop a new, lighter-weight mat using the existing AM-2 connection method; others, however, wanted concurrent development of a new connection mechanism. Discussions are ongoing. For the moment, we have decided to use the existing AM-2 latch but have invested funding to investigate other latching concepts.

The conceptual framework also helped us manage situations where analytical decisions later required re-evaluation—what Lester and Piore call the "tension between analytical and interpretive thought." For example, in June 2004, we modeled a mat design and built a tool to manufacture prototypes. Only around September 2004, shortly before production, did we learn that our analysis of the model was not entirely accurate. Rather than halt production to modify the tooling, we decided to commence with prototype production to avoid a schedule slippage. We made analytical decisions based upon information we had at the time. Invariably, we learned more as we proceeded, forcing us to re-evaluate those initial analytical decisions. In this particular case, we decided that manufacturing and testing a sub-optimal panel to validate the new performance model was more important than a two- to four-month redesign. We relied upon our experts to help us make decisions, and then we communicated the reasoning and implications of our decisions to our investors and customers.

Replicating and Spreading the Interpretive-Analytical Framework in DoD

Through conversations with scientists and engineers, our technology portfolio continues to grow. In September 2004, Smith received development funding from Browning for a heat transfer technology to prevent airfields and

pavements from accumulating snow and ice. Smith has contacted a broad base of experts and customers. A prototype will be built and evaluated in 2005, and other technology applications will be investigated. In March 2005, for example, Smith and Lt. Allyson Schutzenhofer, USAF, researched and are commencing development of heated vest technology. We are evaluating funding for at least three other ideas and exploring, with some organizations, work requiring extremely short development cycles of 90 days from initiation to fielding.

Why have we been able to easily interact with more organizations and identify promising technologies faster than others? To some extent, our training made us successful. As acquisition officers, we were prepared to succeed in analytical situations. As university undergraduate students we had been taught to solve problems, make informed trade-offs, and analyze probabilities of success or failure. Upon entering the DoD acquisition community, we were trained to follow processes, listen and numerically record customer needs, minimize waste and rework, and develop technology capabilities.

Even so, training didn't prepare us for the ambiguity and unknowns of the innovation process. We were not equipped with concepts to help us overcome organizational barriers and individual biases. We were not prepared to address cultural roadblocks associated with joint innovation and development.

To address this deficiency, we suggest that the Defense Acquisition University equip acquisition personnel with an interpretive conceptual framework to complement the analytical lexicon. Ideas presented by Lester, Piore, and others should be researched and related to DoD acquisition and technology activities. Personnel should be taught how to build dynamic teams that explore ambiguity, gather requirements, and converse with users to question them about their needs and respond to questions about technology capabilities. Interpretive concepts should be taught at introductory acquisition courses and compared and contrasted with more analytical approaches.

To be sure, teaching a new conceptual framework is not a panacea, and our success was dependent upon other factors. Our management provided us active and flexible guidance, frequently meeting with us when issues arose and referring us to known experts. Browning quickly provided seed money when we approached him with a compelling concept that might have broad defense applications. Dozens of DoD personnel from every Service took time away from their busy schedules to provide us feedback and guidance on our development efforts. The small-business community consistently provided us dynamic new concepts, patiently answered our questions as we learned, and responded promptly to our needs.

Reforms are needed to help individuals rapidly develop technologies in answer to Rumsfeld's directive. Short-lead-time seed funding should be available to explore new, potentially disruptive, technology concepts. Contracting should operate an order of magnitude faster, allowing personnel to quickly invest small amounts of funding in unique technologies. Supervisors should allow scientists, engineers, and program managers to spend part of their time exploring unorthodox concepts outside traditional research programs. Small businesses must be funded to explore ideas faster, with smaller, more spontaneous venture funds.

A modified conceptual framework, coupled with the aforementioned reforms, will accelerate transformation within the DoD acquisition and technology community. It will energize the workforce—just as it has motivated us—to identify and develop new technologies. An energized DoD acquisition community can more quickly respond to new and unexpected threats. Greater speed and agility will contribute to future victories on the field of battle and will deter and protect against our nation's enemies.

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