SCIENCE POLICY

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Report on DoD Basic Research Seeks to Redress Imbalances in Unfettered Research Efforts

A recent report from the National Research Council recommends a new definition for basic research in the regulations of the Department of Defense (DoD), and calls on the department to redress the imbalances in its basic research portfolio. Titled *Assessment of Defense Basic Research*, the report concludes that there has been a reduced effort in unfettered exploratory research at DoD, historically a critical enabler of the most important breakthroughs in military capabilities.

The DoD's mission includes support for basic research in order to advance fundamental knowledge in targeted fields considered vital to national defense. However, over the last six years, many groups including researchers in academia and industry have expressed concern about whether the nature of DoD-funded basic research is changing. Most notably, there is concern that funds are being spent for research that does not fall under DoD's definition of basic research.

Congress directed DoD to request a study from the National Research Council to address these concerns. The task force was charged with assessing the basic research portfolio of the DoD to determine if its programs are consistent with the definition of basic research contained in the DoD's regulations. DoD's basic research portfolio includes the office of the Secretary of Defense, the three military departments, and the Defense Advanced Research Projects Agency.

Materials science accounts for ~8% of total DoD funding, on a par with funding levels in physics, chemistry, and the biological sciences (all of which also have a materials component). Research ranges from high-temperature superconductors and microelectronics to the behavior of materials at the nanoscale. The development of composite materials is a major focus, especially in regards to tailoring these materials for application-specific properties. This research has given rise to better armor, lighter equipment, and greater durability in materials for military applications. Many glass, carbon, and plastic composites have moved beyond the battlefield into such applications as artificial limbs, high-performance golf clubs, rechargeable batteries, and "smart" windows that can darken to absorb sunlight.

The report concluded that basic research funds (which DoD terms "6.1" programs) have not been used for applied research and development (6.2 and 6.3 categories). The group also found that DoD research managers are "well-motivated and generally successful" when it came to allocating 6.1 funds to the discovery of fundamental scientific knowledge.

Yet some changes were deemed necessary. The study group concluded that DoD's current definition of what constitutes basic research—which precludes having any specific applications in mind—is not a "useful criterion" for distinguishing it from applied research, according to the group's vice chair C.D. Mote Jr., president of the University of Maryland.

"The current concept in DoD [for R&D] is very much sequential," Mote said, moving from basic research to applied research and then systems development and deployment. "That's not the way things really work in practice."

In fact, the linear model has been discredited for decades from the perspective of industry.

"In industry the sequential linear model of information flows in R&D has long been replaced by more complex models involving multiple feedback loops between advanced development, product design, and basic research," said Charles Duke, vice president and senior research fellow in the Xerox Innovation Group and also a member of the study group.

In reality, the process is more circular than linear. The various phases often occur in parallel, with numerous supporting connections between them: The need for ongoing discovery from basic research is not limited to that first exploratory stage. Even at the applied research and practical development stages, scientists often find that some directed basic research is still required. This is especially important for materials issues, which can make or break an application.

"Perhaps a material is doing strange things, and you need to go back and figure out how it works before you can use it in a specific application," said Mote.

Nonetheless, the DoD has increasingly shifted its attention to more focused, short-term problems, at the expense of exploratory basic research, which has declined critically over the past decade. That trend should be reversed, the study found, with more funding going toward unfettered research, although some short-term problem-solving will still be required. Doing so will require clear communication from the top levels of leadership at the department.

"Changing the portfolio balance between next-step and high-risk, high-potential-payoff basic research is an executive decision that would have to be taken at the highest levels of the DoD and then promulgated through the ranks," said Duke. "Program managers at the working level will rarely if ever make such decisions in the current climate."

As to why DoD executives should do so, Duke points to the Sept. 11 attacks, and to the fact that terrorists are confounding U.S. military personnel in the Near East.

"In its R&D operations, the military is typically investing in tools to fight the last war," he said. "Any prudent senior manager would want his or her basic research investment focused on the next war," Duke said. In fact, he believes that war has already begun.

The initial response to the report from the scientific community was surprisingly negative, according to Mote. He attributes the reaction to a misunderstanding of the nature of the charge given to the task force.

"Our charge was very narrow," he said. The group was not asked to evaluate DoD's research program or set priorities, for example, or to make recommendations about funding levels. Instead, it was asked specifically to assess whether the funding set aside for basic research was, indeed, being used for basic research.

"That narrowed the focus quite a bit, [although] we deviated from the charge as much as we were able," he said. "Some people felt the right questions weren't asked."

Nonetheless, Mote believes strongly that the report's recommendations contain a great deal of substance.

"These are not lightweight recommendations," he said. "If all nine recommendations were followed, there would be a tremendous change in what we're doing in DoD's basic research program."

JENNIFER OUELLETTE

MATERA Brings Together Policymakers in European Materials Research

Tekes, the National Technology Agency of Finland, has reported on the progress of MATERA, a four-year European network project for organizations funding the field of materials science and technology. The network consists of 15 national funding organizations from 13 European countries, and the project is open to new partners. MATERA is one of the ERA-NET projects supported by funding under the 6th Framework Programme of the European Union. The MATERA project was launched in February 2005. The funding of €2.3 million is available until January 2009.

The main goal of MATERA is to strengthen the bases for durable European partnerships in research, technology, and development (RTD) planning and collaboration in materials science and technolo-

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gy. Its aim is to help national and regional science and technology authorities improve the dissemination of knowledge and skills in Europe. This effort includes launching joint activities in materials science and engineering.

"The project enables for the first time a real cooperation between the European funding organizations on materials science and engineering. Even though the road to joint and coordinated activities will be rocky and challenging, the final results will be worth it. Together we can achieve more," said the coordinator of the project, Sisko Sipilä, chief technology advisor for Tekes.

Tekes recognizes that the core of materials research has evolved from metallurgy and metals science to looking at functional materials, polymers, and materials for extreme conditions and with nanomaterials a common research subject at present. This kind of rapid transition within the discipline demands more knowledge and skills from researchers, according to Tekes. Intensive international collaboration, which MATERA is helping to create, is essential if materials science and technology are to evolve, according to the agency.

Sipilä said, "We look forward to building durable European RTD networks between the national materials research groups. These networks will also strengthen the national development."

MATERA will reach the main goals of the project by benchmarking program-like research and development procedures in use with national and regional policymakers; identifying the research, technical developments, and demonstration areas where program collaboration at the European level would be particularly beneficial; identifying the RTD areas in which to invest nationally or regionally; developing systematic working methodologies from general science and technology policy to practical operations; and intensifying policymaking.

Joint activities will be launched once the areas for such potential activities have been identified and the common planning, evaluation, and dissemination processes involved in joint calls between project partners have been tested. Much of MATERA's progress and achievements will be open to parties outside the network. This information will include best practices, benchmarking of procedures, research programs, and industrial and technical implementation methods. The cornerstone of MATERA's communications is be the project's Web site—www.matera.fi—which became available in May.

Others interested in participating in MATERA may join the project as a partner and receive funding from the European Commission (EC), join the project as an observer with no EC funding, or join the MATERA mailing list. More information can be obtained from Ms. Sisko Sipilä, Coordinator, Tekes, tel. +358-10-521-5845 or e-mail sisko.sipila@tekes.fi.

The participating organizations are Tekes (coordinator) and the Academy of Finland (AKA), Finland; the Institute for the Promotion of Innovation by Science and Technology of Flanders (IWT) and the Ministry of the Walloon Region (DGTRE), Belgium; the Ministry of Economic Affairs and Labour, North Rhine Westphalia (MWA-NRW), Germany; the Icelandic Centre for Research (RANNIS) and the Technological Institute of Iceland (IceTec), Iceland; Enterprise Ireland (EI), Ireland; Invest Northern Ireland (Invest NI), the United Kingdom (Northern Ireland); the Ministry for University, Education, and Science (MIUR) and Roma Tre University (the Department of Mechanical and Industrial Engineering), Italy; the Latvian Council of Science (LCS) and the University of Latvia (the Institute of Solid-State Physics), Latvia; the National Research Fund (FNR), Luxemburg; the Research Council of Norway (RCN), Norway; the Ministry of Scientific Research and Information Technology (MSRIT/ MNII) and Warsaw University of Technology (Materials Design), Poland; the Ministry of Higher Education, Science, and Technology (MHEST)/Previous Ministry of Education and Sport and the Slovenian Research Agency, Slovenia; and KTI/CTI Innovation Promotion Agency, Switzerland.

India, Singapore Sign Agreement for Joint University Degrees in Materials

India's Ministry of Human Resource Development has announced that the Indian Institute of Technology–Bombay (IIT-B) and the National University of Singapore (NUS) signed a memorandum of understanding in Singapore in March to establish a program leading to a joint master's and a joint PhD degree in advanced engineering materials for the purpose of training human resources relevant to a number of industrial sectors in both countries.

The program—covering nanostructures, hybrids and composites, microfabrication and microdevices, biomaterials, electronic materials, chemical engineering materials, and building materials—aims to increase the depth and breadth of engineering materials for future consumers and the environment. The program emphasizes three elements, namely, education, research, and industrial relevance.

With funding support from the Singapore Economic Development Board and the Ministry of Education, the partnership is expected to yield about 40 MS and eight PhD graduates annually. Under the program, IIT-B expects to further develop its "smart" classroom facilities for course delivery to Singapore, which can also be used for furthering the distance education program within India. The program is expected to attract students from top engineering schools in India and from top schools in China, Singapore, and other ASEAN countries.

The agreement was signed by Ashok Mishra, director of IIT-B, and Shih Choon Fong, president of NUS, in the presence of India's Minister for Human Resource Development, Arjun Singh, and the Minister of Education of Singapore, Tharman Shanmugaratnam.

Singh expressed the hope that the students of this pioneering program between India and Singapore will go out with a wide interdisciplinary technical background as well as an appreciation for working as part of a globally integrated workforce.

Shanmugaratnam said that the involvement of IIT-B in this joint master's program will further enhance Singapore's image as an education hub in the world. He said that the program will provide an enlarged campus of talent, promising greater innovation, stronger branding, and the creation of an environment that would attract some of the top talent in the region. □

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