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Project Hindsight*

The United States Department of Defense is the largest customer of many of the major companies engaged in advanced science and technology. The Department has an \$80-billion inventory of weapons systems and equipment. This inventory is continually being upgraded. In some instances succeeding generations of weapons systems have achieved a cost effectiveness greater by an order of magnitude than that of their predecessors.

In order to understand factors contributing to successful management of its research and development programs, DOD is conducting a retrospective study of the science and technology used in weapons systems. This effort, known as Project Hindsight, has been under way for 2½ years. About 20 proven weapons systems have been analyzed. Typically a team of five to ten expert scientists and engineers dissects the system into its subsystems and components and identifies contributions from recent science and technology important to improved cost or effectiveness. Such a contribution is called an Event. A typical Event is the development of a titanium-aluminum-vanadium alloy used in compressor blades of the turbo-fan engines in the C-141 transport aircraft (and in many civilian planes). The high and uniform strength-to-weight ratio and corrosion and erosion resistance, the notch toughness, and the creep resistance of this alloy substantially increase the performance and life of jet engines.

Once the Event has been recognized, its history is traced. It has been possible to identify the individuals who were principal contributors, their organizations, and the dates and circumstances under which the work was done. For the 20 systems, the principal contributors have included 1025 people. The Events were performed by about 300 organizations, sometimes jointly. All together, some 638 Events have been analyzed. Eight percent of the Events are categorized as science; 92 percent, as technology.

Of the science Events, the majority were applied research clearly oriented toward a DOD need. Most of the remainder were applied research with a commercial objective. Only two science Events were identified as arising from basic academic research. These were the early development of the shock tube, at Cornell University, and a project in statistical sampling, at Wayne University. Nine percent of all the Events, mostly in applied research and technology, were performed by universities.

About 90 percent of the federal funds for university research is furnished by mission-oriented agencies including the Department of Defense. Some of the conclusions from Project Hindsight are of relevance to such agencies. Some of the conclusions are these:

1) Contributions from recent (post-1945) undirected science to the systems studied appear to have been small.

2) The length of time to utilization of scientific findings is decreased when the scientist is working in areas related to the problems of his sponsor.

3) The efficient production of timely knowledge useful to a mission-oriented agency is most readily achieved when that agency funds and manages its own research programs.

Because of its unprecedented nature and impressive scope Project Hindsight is likely to be influential. The report implicitly raises questions concerning government support of academic research which university scientists will do well to consider.—PHILIP H. ABELSON

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Project Hindsight

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