

A brief narrative relevant to *Rescuing Prometheus*...

*Every other Friday in the last two years, a “coalition of the willing” group of military officers, lab scientists, university academicians, and a slew of other individuals from government agencies and industry converge in a medium-size meeting room on the 7<sup>th</sup> floor of Crystal City Mall 3, just across the Potomac river from the Capitol in Washington D.C. The topic of discussion is the GIG, otherwise known as the Global Information Grid – a project which meeting participants believe may be the most ambitious large systems engineering effort yet attempted by the Department of Defense (DoD). Loosely, the GIG can be defined as “all information processing assets within the DoD.” This means not just the computers and networks we may be familiar with in the Internet, for example, but all devices, all sensors, all communication lines, all satellite processing, all aircraft, all ships...basically anything and everything that is somehow connected to other things through an IP (Internet Protocol) compatible connection. The challenge is to somehow connect them all together in an interoperable and scalable way. Thus, the scientists from places such as CalTech, Carnegie Mellon, John Hopkins, MIT, Navy Research Lab, MITRE, RAND, Aerospace Corp, TRW, and other labs come together with senior government decision-makers and military leaders to look at technology, economic, organizational, and policy issues that must be orchestrated to start this endeavor.*

The GIG systems engineering effort described above has historical lineage traced back to the events described by Thomas Hughes in his historical account of the SAGE and Atlas ICBM development programs. In *Rescuing Prometheus*, Hughes presents selected views on the evolution of systems engineering in the United States and discusses the events that lead to the beginning of organizations such as MIT Lincoln Lab, MITRE, RAND, and TRW among others. Hughes' accounts of SAGE, Atlas, and the two additional accounts of Boston's Central Artery Tunnel project and the development of ARPANET all emphasize the interaction of military, government, university, and industrial elements on large projects. While missing specific recommendations on how to implement a large engineering project, I found immediate relevance and use of Hughes' four historical accounts for understanding issues we might otherwise inattentively repeat in building the GIG.

It shall be interesting to read the future historical accounts of systems engineering projects occurring in the millennium which began two years after *Rescuing Prometheus* was published and contrast them with Hughes' accounts from the “modern” and “post-modern” eras. At the end of the book, Hughes uses a list of twenty-two pairs of “modern” (pre-World War II) and “postmodern” (postwar) shorthand “polarities,” as he calls them, to compare approaches to technology, engineering, and management. In greater detail, on page 138, Hughes states that “the circumstances conditioning large-scale weapons projects today differ greatly, both Ramo and Schriever believe, from those that they experienced: It is ‘business as usual’ today in the government; it was ‘mission impossible’ then on the ICBM program in the decade from 1954-1964.” Some of the differences lie in the tools and technologies we have available now for collaboration and modeling. Alexander McKenzie believes differences in the regulatory environment “really make it very difficult for the government to get the same kind of power out of its research dollars these days as it was able to then.” Simon Ramo believes “with the passing of the Cold War commitment, the government will not be able again to setup “the tight, closely integrated systems management

that proved so effective on the ICBM program". Today, the pressing post-911 need for government funded technological innovation may not be as imperative as during the Cold War, but perhaps it is too early to tell.

In retrospect, it surprises me now to realize that when I was an inexperienced engineer and second lieutenant working in the Air Force's medium launch program office<sup>1</sup> in the late 80's, no mentor or project manager attempted to train me on the historical engineering background of the Atlas II program. Even since *Rescuing Prometheus* was published in 1998, I did not read Thomas Hughes' accounts as part of my training as a MITRE scientist working on SAGE descendent projects (nor receive similar historical background through other sources other than random conversations with colleagues). While not directly work-related, as a local resident and benefactor of Boston's Central Artery Tunnel ("Big Dig"), this book provides useful insights on systems engineering projects close to my own proverbial backyard. Furthermore, my connection to the book was fostered by professional interactions with several of the pioneers described in the book, such as Robert Everett and Lawrence Roberts.

One quote that struck me as much of a truth today as when Simon Ramo stated it in 1985 is:

*"In an advanced electrical engineering course, he also learned that problems from the field of practice could not be solved if one observed disciplinary boundaries – "the kind of thing that is, even today," Ramo observes, "usually not taught in universities."*<sup>2</sup>

This quote is relevant to the formation of MIT's ESD and has implications of needed change. My own recent experience in a computer science course at MIT would lead me to agree with Ramo. To illustrate another aspect of the need for interdisciplinary approaches in systems engineering, Hughes quotes Vice President Hubert Humphrey saying "The techniques that are going to put a man on the moon are going to be exactly the techniques that we are going to need to clean up our cities." Hughes showed how military research organizations like the RAND or defense contractors like TRW were enlisted in civil projects, and analyzes why such attempts ultimately failed. It is also interesting to see that where many historians have argued that the vast military expenditures which characterized the Cold War tended to distort and subvert industrial and academic science and technology to military needs, Hughes argued that his case studies illustrate the powerful controlling influences academic and industrial players exerted on the military agenda.<sup>3</sup>

Possible group discussion points:

- What have we learned from these historical accounts?
- Large scale systems engineering has become more commonplace since the start of the Atlas program. How do we measure how much better we have become at it?
- How do we know today when a complex systems project is a success?
- How does one approach to systems engineering compare to what might have been alternative approaches?

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<sup>1</sup>The Medium Launch Vehicle (MLV) program provides sustainment, procurement and launch of DoD's Atlas II and Delta II ELVs at Cape Canaveral AS, FL, and at Vandenberg AFB, CA. MLV launches Defense Satellite Communication System (DSCS) and Global Positioning System (GPS) satellites.

<sup>2</sup>Hughes, *Rescuing Prometheus*, Pantheon Books, 1998, p. 111

<sup>3</sup>David Jardini, "Cold War Systems Builders: Managing a Military-Industrial Complex", <http://www.cmu.edu/coldwar/hughes.htm> (September 18, 1998)

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Note: A curiosity I could not rid myself of while reading this book, was the title itself. Why “Rescuing Prometheus?” The Greek god Prometheus failed tricking Zeus and consequently suffered torment by being chained to a mountain and having Zeus’ eagle tear at his immortal flesh and devour his liver each day only to have the torn flesh mend overnight so the eagle could begin anew at the first touch of dawn. Thirteen generations later, Io’s descendent grandson Hercules rescued Prometheus.<sup>4</sup> Was this title chosen because of the Herculean task of engineering these large complex systems? Or because the name Prometheus means “forethought”, alluding to a comprehensive engineering approach Hap Arnold may have envisioned when he reminded General Schriever that “World War I had been won by brawn, World War II through superior logistics, but any future war would be won by brains.”<sup>5</sup> Conjecturing deeper meanings may incriminate us of over-thinking the matter, but perhaps a deeper meaning may be construed from the realization that Prometheus’ suffering is a consequence to his disagreement with Zeus’ one dimensional perspective of mankind as primitives to be left alone on earth until they died off.<sup>6</sup> Since Prometheus did interfere and complexity was unleashed on mankind, did Prometheus need rescuing by Hercules to resolve man’s need for coping with complexity?<sup>7</sup> The idea of exerting control on seemingly intractable matters was reflected more recently by Pope John Paul II’s 1995 encyclical letter on abortion, euthanasia, and the death penalty, where he lamented the existence in contemporary culture of “a certain Promethean attitude which leads people to think that they can control life and death by taking the decisions about them into their own hands.”<sup>8</sup> It is not entirely clear what Hughes alludes to with the provocative title, although it certainly does conjure up fascinating images.

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<sup>4</sup> Stewart, Michael. "Prometheus", *Greek Mythology: From the Iliad to the Fall of the Last Tyrant*. <http://messagenet.com/myths/bios/promethe.html> (September 19, 2005)

<sup>5</sup> Hughes, p. 94

<sup>6</sup> Zeus said that knowledge and divine gifts would only bring misery to the mortals and he insisted that Prometheus not interfere with his plans.

<sup>7</sup> Stewart

<sup>8</sup> Theodore Ziolkowski, *The Sin of Knowledge: Ancient Themes and Modern Variations*, Prelude, p. 5