ESD.83 Darian Unger
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Book Review:
Rescuing Prometheus, by Thomas Hughes
Pantheon Books, 1998

I chose to review *Rescuing Prometheus* because it was my favorite reading of the year alongside the Stephenson article in *Wired*. I originally picked up the book on a whim last year when I was browsing through a library, and was glad to see it on the class syllabus. This review gives a brief synopsis of the book and then puts it in the context of the various types of systems discussed in class. The review continues with some criticism of author regarding the examples and the lessons of the book.

Hughes presents a fascinating story of the rise of systems thinking in the "postmodern" (post World War II) world. His emphasis is on systems engineering, so he chooses four engineering management examples through which to tell his story. The first, SAGE, was a "learning experience" which led to development of systems thinking without leading to a particularly valuable or successful product. The second, Atlas, was another military program which tackled the enormous systems challenges of creating the first intercontinental ballistic missile. After a chapter on the spread of the systems approach, the third example deals with the Central Artery/Tunnel (CA/T or Big Dig) project that incorporates systems planning in a highly political environment not faced in the military. The final example returns to the military with a description of the development of ARPANET.

Hughes concentrates on system engineering and devotes considerable time and effort to persuade the reader of its importance and development. Midway through the book, he expands from systems engineering to systems approaches in general, so it is here that we can link several other systems concepts from class to his work. For example, our discussions and readings of complex systems mesh perfectly with Hughes' chapter on the Big Dig. Professor Sussman also used the same project as an example of a complex system – and for the same reasons. Like Hughes, we acknowledged that the true complexity laid with the variety of parties, political constituencies, and environmental factors involved in the engineering project.

Hughes' other examples deal with R&D projects. Indeed, the title of the book refers to the passing of new sparks of knowledge. Although he treats them as examples of engineering systems, they are also reflect new product development and can thus be analyzed through the lens of systems architecture, product development, and innovation systems. The system architectures in SAGE, Atlas, and ARPANET were all critical to their development, yet despite their necessity, the establishment of architectures can inhibit creativity later. Once an architecture is in place, it places limits on ideas allowed. Some architectures are designed to be flexible specifically to mitigate this problem. Given Hughes concerns of open or flexible systems, the matter of architecture can weigh heavily. However, even "architecture" can have several meanings. Although Hughes

does not dwell on the word, it can apply to the organizational structure of people in a system as well as to the product that the system is developing. The two architectures need not be identical: ARPANET apparently had a relatively open product architecture although the organizational architecture was closed. This contrast is not analyzed in detail, but could provide interesting insight.

Hughes' praise and description of creativity suggest that an innovation systems view, although not specifically mentioned, could lend a different perspective. Management of innovation systems, whether as part of companies' (and military agencies') technology strategies or as part of countries' national policies have also developed significantly over the last half-century. An entire field of management study has been developed in an effort to systemically foster creativity and convert it into useful innovations. Yet Hughes dismisses "simple" invention on the first page of his book and continues on to what he considers to be a more complex world. In doing so, he skips over a sophisticated systems field that examines how to foster that inventiveness. This field, if applied to the same examples as Hughes, would suggest that examining four government-sponsored projects might come at the cost. Other branches of engineering and systems development in the 1950s and 1960s surely did not have the same incentives (military discipline, genuine patriotic sense of defense, desire for reelection by those in charge of the project managers described) as the examples in the book.

Hughes' heavy emphasis on military examples and systems threatens to dilute the power of his book. Despite nods to swords-to-ploughshares efforts and one civilian example, the emphasis remains and Hughes recognizes the need to justify it by praising the military-industrial-research complex between 1950 and 1970. He suggests that it is difficult for people of my generation, those of us "influenced by counterculture values of the 1960s," to understand that that the military could lead to great creativity. I read this statement with considerable umbrage, given that this generation has come to acknowledge and value military spinoff technologies with the recognition that *of course* military development is impressive. However, this acknowledgement does not foster a sense of dependence on the military. Today's amassed "system of creativity" as we might call it, no longer rests on military R&D, but rather on a broad series of ventures by private enterprise. Furthermore, Hughes definition of counterculture is unclear. It could mean the attitude that "disparage[s] big systems, insisting simply that small [i]s beautiful." (p. 190) or it could imply a skepticism about the military (p. 10) These two ideas are not identical, yet he groups them together under one definition.

The book could also be improved with additional examples to include greater breadth. The four examples provided, of course, are different; Hughes categorizes them into several sorts of categories, including modern and postmodern (with the plethora of traits he assigns to each, such as integration vs. coordination, closed vs. open, etc.) but several categories of systems projects remain unrepresented. All of his systems examples are large, witnessed by the devotion of part of each chapter to explaining the size of the project, including how many tens or hundreds of thousands of people were involved. Although providing this data is an important part of project description, the book presents these figures in a way that attempts to make the reader fawn over the numbers, as if to

glorify systems even more by explaining how it can line up such extraordinarily large, disparate masses. In fact, part of systems thinking, as we have seen from the class, can involve considerably smaller groups. Complexity, as we have read in other books, can come from examples as simple as a three-body mechanics problem. (von Bertalanffy, 1969) Yet smaller systems, of the type we might see in a startup company's development efforts, are not represented in Hughes' examples. Further, the actual engineering of systems is rarely investigated because the stated purpose of the book is to examine engineering management. By ignoring engineering details, including resolving network systems, concurrent design, and iterative series that are part of almost any engineering design, the story leaves out some interesting additions to the development of systems thinking.

In conclusion, the book provides an interesting and well-substantiated story of the development of systems thinking. Although I bemoan the systems perspectives and examples not used, I have no doubt that Hughes could respond ably to my criticism by pointing out, for example, that my proposed examples of other systems projects (hardcore engineering systems analysis, complex systems thinking in small startups, etc.) and other fields (innovation systems, complexity, systems architecture, product development systems) could not have existed or would not be as developed as they are today were it not for the earlier and formative examples explained in his book.