

A review of
Systems Architecting of Organizations: Why Eagles Can't Swim
by Eberhardt Rechtin

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11/22/00
ESD.83 Research Seminar in Engineering Systems

Eberhardt Rechtin, drawing on his experience at CalTech's JPL, DARPA, the Office of the Secretary of Defense, NATO, Hewlett-Packard, and the University of Southern California, sets out some principles and heuristics of design and project management in *Systems Architecting of Organizations*. These principles and heuristics are being systematized into an area called systems architecture.

Systems architecture, as a formal discipline, is a new way of analyzing systems which is intrinsically based on the systems perspective. Rechtin defines a system as "a construct or collection of different elements that together produce results not obtainable by the elements alone. The elements, or parts, can include people, hardware, software, facilities, policies, and documents; that is, all things required to produce systems-level results. The results include systems-level qualities, properties, characteristics, functions, behavior, and/or performance. The value added by the system as a whole, beyond that contributed independently by the parts, is primarily created by the relationship among the parts; that is, how they are interconnected." Architecture is defined as "the structure - in terms of components, connections, and constraints - of a product, process, or element. Includes all elements of a system that determine its form and function. By definition, each system has an architecture, explicit or not, which can be viewed from many perspectives."

Rechtin provides several arguments and examples for why a systems approach

should be taken and how systems architecture specifically is useful. For example, the true worth of a car is not in the nuts and bolts of which it is composed but in how these parts are connected. Moreover, the transportation value comes through the use of the car in conjunction with roads, service stations, rules of the road, law enforcement, licenses, gasoline, oil, sales and service, maps, and automobile insurance. Once these elements of the system have been identified, their interrelationship can be mapped, and bottlenecks can be analyzed as arising from the elements and their interactions.

Rechtin builds on the insight of Womack, Jones, and Roos (1990) regarding lean production, as well. He notes that once the policy commitment to quality was made, the rest of the organization could follow. In this way, other companies could convert from mass production to lean production. Since product quality only arose after a top level organizational commitment, Rechtin labels quality an emergent property of the lean production system. In this way, Rechtin points to the difference between a systems approach and a non-systems approach while highlighting the need for a systems approach.

As a case study, Rechtin examines six companies' efforts to win a renewal of a satellite contract. This case study highlights some of the difficulty in maintaining excellence in a changing landscape. By extracting lessons from past technology development efforts, Rechtin points to several needs, such as the need for modularity and open communication. He also cites the need not to be encumbered by past successes. While these examples and instructions are illustrative and potentially useful, part of the challenge for the practitioner is to use the right tool at the right time. An open challenge for the academic is to communicate this experiential knowledge in the class room.

In discussing organizational strength, Rechtin is quick to point out that even excellent organizations are not strong in all situations. Therefore, when trying to maintain excellence over a long period of time, an awareness of the surrounding environment and a willingness to adapt is crucial. Rechtin notes that the systems architect has large challenges in times of seismic shifts since some of the best people may depart if change is not handled well. Rechtin rightly focuses on the importance of people since analytical models do not exist for the management of complex socio-technical systems, and the expertise which arises from lived experience is crucial for creating and maintaining excellence in an organization.

As a result of his experience, Rechtin is able to provide some insight into the role of the government from the perspective of a government servant and a business man. Rechtin highlights the role of the government in the delicate balancing of the U.S. economy. The Federal government achieves this balance between growth and inflation by regulation, by consuming goods and services, and by supporting adventure and exploration. Rechtin draws valuable distinctions between the organizations which focus on bureaucracy, profit seeking, and culture. These distinctions are useful in thinking about interactions between business and government.

I find systems architecture useful because it focuses on relationships. It also opens up more design possibilities by approaching design at the top level and by including legal, economic, and political technologies in the design space. As the Engineering Systems Division is setting out to understand the use of these technologies, Rechtin's work can be viewed as a kind of prehistory for ESD.