intro.it   The systems approach

1   Simon Ramo and Richard Booton, Jr.—the folks who brought us the intercontinental ballistic missile (ICBM) (thanks? …I mean thanks. But, thanks?)—defined systems engineering to be

systems engineering

> the design of the whole as distinguished from the design of the parts. (Richard C. Booton and Simon Ramo. ?The development of systems engineering? inIEEE Transactions on Aerospace and Electronic Systems: AES–20 [july 1984], pages 306–9)

Like the ICBM, many modern technologies require this systems engineering design approach.

2   A key aspect of the systems engineering design process is the mathematical modeling of the system—the development of a dynamic system representation.

mathematical modeling

3   Dynamic systems exhibit behavior that can be characterized through analysis and called the system's properties. A property of a dynamic system might be how long it takes for it to respond to a given input or which types of inputs would cause a damaging response. Clearly, such properties are of significant interest to the design process.

system properties

4   This Part of the text focuses on electromechanical systems: systems with an interface between electronics and mechanical subsystems. These are ubiquitous: manufacturing plants, power plants, vehicles, robots, consumer products, anything with a motor—all include electromechanical systems. In ?? , we will consider more types of systems (e.g. fluid and thermal) and their interactions.

electromechanical systems

5   Electromechanical systems analysis can proceed with initially separate modeling of the electronic and mechanical subsystems, then, through an unholy union, combining their equations and attempting a solution. This is fine for simple systems. However, many systems will require a systematic approach.

6   We adopt a systematic approach that draws linear graphs (á la graph theory) for electronic and mechanical systems that are intentionally analogous to electronic circuit diagrams. This allows us to use a single graphical diagram to express a system's composition and interconnections. Virtually every technique from electronic circuit analysis can be applied to these representations. Elemental equations, Kirchhoff's laws, impedance—each will be generalized. In ?? , this same graphical and electronic-analog technique will be extended to other energy domains.

linear graphs
graph theory