Integrated System Health Engineering and Management

Integrated System Health Engineering and Management (ISHEM) is both something old and something new. It is old in that it consists of a variety of methods, techniques, and ideas that have been used in theory and practice for decades. It is new in that the recognition of the relationships between these various methods, techniques and ideas is much more recent. We can in fact argue that this recognition is only occurring now, and that the conference on ISHEM in Aerospace in November 2005 is a critical step in that recognition, and will help crystallize this recognition into a discipline.

A synonym for ISHEM is "Dependable System Design and Operations." Both phrases (ISHEM and Dependable System Design and Operations) signify that the new discipline deals with ensuring the "health" of a technological system, or alternatively, to prevent its degradation and failure. We can define ISHEM as "the processes, techniques, and technologies used to design, analyze, build, verify, and operate a system to prevent faults and/or minimize their effects." This includes design and manufacturing techniques as well operational and managerial methods. ISHEM is not a "purely technical issue" as it also involves and must account for organizational, communicative, and cognitive features of humans as social beings and as individuals.

Thus the new discipline includes classical engineering issues such as advanced sensors, redundancy management, artificial intelligence for diagnostics, probabilistic reliability theory and formal validation methods. It also includes "quasi-technical" techniques and disciplines such as quality assurance, systems architecture and engineering, knowledge capture, and human factors. Finally, it includes social and cognitive issues of institutional design and processes, education and training for operations, and economics of systems integration. All of these disciplines and methods are important factors in designing and operating dependable, "healthy" systems of humans and machines.

The recognition that these different techniques and technologies must be brought together has been growing over time. This can be seen in a variety of ways:

- the creation of reliability theory, environmental and system testing and quality methods in the 1950s and 1960s
- the total quality management fad of the 1980s and early 1990s
- the development of redundancy management and fault tolerance methods from the 1960s to the present
- the formulation of Byzantine computer theory in the 1970s and 1980s
- the development of new standards such as integrated diagnostics and maintainability in the 1990s
- the emergence of vehicle and system health management as technology areas in both air and space applications in the 1990s and early 2000s
- the recognition of "culture problems" in NASA and the Department of Defense as crucial factors leading to system failure in the 2000s.

The ISHEM Forum intends to bring these issues and methods together so as to create the first textbook that crosses all relevant disciplines related to prevention and mitigation of faults. This will provide a concrete, cross-cutting, and accepted starting point for researchers and designers in the field.