One possible way of getting additional information about a system is by carrying out real system experiments. This concept proposes deliberate experimentation with the operating system itself, or a large segment of it. Its objective is that of any experiment, namely, to gain information otherwise not available, or to test a theory, which, if valid, has broader practical applications. Although real system experimentation has been - and continues to be - carried out by both industry and the Armed Forces, it has certain serious limitations. This approach cannot be used in many instances because of high costs both in money and in time; because of unacceptable consequences in the event of failure; or because the approach may be downright unfeasible.

There is, for example, only a limited amount of useful experiment taken that can be carried out on certain systems related to Civil Defense, or to tactical operations on a battlefield, since such systems only become fully operational in times of emergency or war. Perhaps the most serious limitation of real system experimentation is the fact that it cannot be conducted on proposed future systems that are still only tentative concepts or preliminary designs. This is an area in which improved understanding is especially needed, and which becomes increasingly important as the rate and cost of technological change increases.

The limitations of operating experience and real system experimentation that I have indicated cause systems designers and managers to look for other ways of getting the information they require. Their search has led them to extensive use of system models. The analysis of models, particularly those that are basically mathematical in design, has assumed a vital role as an aid to management in its decisions concerning the development, improvement and operation of major systems.

It is my purpose in this lecture to discuss some of the fundamental characteristics of such models, to indicate some of their advantages and limitations,