MAINTENANCE AND SUPPORT: A CRITICAL ELEMENT IN THE SYSTEM LIFE CYCLE

Blanchard, B.S
Virginia Polytechnic Institute & State University, USA

Keywords:maintenance and support, system life cycle, support infrastructure, system design

Contents

Summary

Many systems in use today are not performing as intended, nor are they cost-effective in terms of their operation and support. When addressing "cause-and-effect" relationships, experience has indicated that the problems often stem from the lack of an effective and efficient maintenance and support capability. In many cases, systems are in a "non-operational" state because of the unavailability of the proper level of support. In other cases, the support infrastructure that is available is very costly. In general, the activities associated with system maintenance and support have been addressed "after-the-fact" and somewhat "downstream" in the system life cycle, the results of which have often led to rather costly consequences.

With the objective of increasing the overall cost-effectiveness of systems, particularly as resources are dwindling and international competition is increasing worldwide, it is essential that we address systems in "total", and that the maintenance and support infrastructure be considered as a major subsystem and as an integral element within the overall configuration of the system in question. Further, the maintenance and support infrastructure must be considered from the beginning when the initial requirements for a system are first being established during conceptual design. Subsequently, these requirements must be properly addressed, through the systems engineering process, as system development evolves into production and distribution of the system for operational use. The objective herein is to view the "maintenance and support infrastructure" as a major element of the system in question and to present such in the context of the overall system life cycle.

1. Introduction

Recent trends indicate that, in general, systems are:

1. increasing in complexity with the on-going introduction of new technologies,
2. are not meeting customer expectations in terms of performance and effectiveness, and
3. are becoming more costly relative to their operation and maintenance support.

In the production of goods, manufacturing systems (in particular) are often operating at less than full capacity, productivity is low, and the costs of factory operations are high. This is happening at a time when resources are becoming scarce and international competition is increasing worldwide.

In dealing with the aspect of cost, experience has indicated that a large percentage of the total cost of doing business is due to the maintenance-related activities required in order to sustain system operation throughout the performance of its mission. For large defense systems, it has been determined that up to 60% to 75% of the life-cycle cost for a given system is due to the required maintenance and support of that system. In the manufacture of products in a typical commercial factory, there have been examples where up to 15% to 20% of the total product cost has been due to the maintenance and support of the factory equipment that is used to produce the product initially. Further, when determining the "cause-and-effect" relationships, much of these high costs can be attributed to the engineering and management decisions made during the early phases of the system life cycle; e.g., the selection of a given technology, the selection of materials, equipment packaging schemes, etc. In other words, many of the decisions made in the early stages of system design and development have a great impact on the "downstream" maintenance and support costs for that system which, in turn, often constitute a large percentage of the total.

Due to these and related experiences, the requirements associated with *maintenance and support*, and the impact of such on the ultimate profitability and effectiveness of systems, are being recognized more and more as being critical to the performance of systems in fulfilling their respective missions. The elements of maintenance and support constitute a significant and critical part of the "make-up" of a system, and these elements must be integrated and properly addressed from the beginning. Maintenance and support requirements must first be defined during the conceptual phase when system-level requirements are initially established, must be "designed-in" during the system development phase, and the ultimate maintenance and support infrastructure must be available and implemented in a timely and cost-effective manner when needed throughout the system utilization phase.

-
-
-

Bliography

Blanchard, B.S. (2004). *Logistics Engineering And Management.* 6th ed. Upper Saddle River, NJ: Prentice-Hall. [A classic work on this subject.]

Blanchard, B.S. and W.J. Fabrycky. (2006). *Systems Engineering And Analysis.* 4th ed. Upper Saddle River, NJ: Prentice-Hall. [This text contains an introduction to the subject of logistics and maintenance support within systems engineering.]

Lambert, D.M., J.R. Stock, and L.M. Ellram. (1998). *Fundamentals Of Logistics Management.* New York, NY: Irwin/McGraw-Hill. [An excellent work on this subject.]

Biographical Sketch

Benjamin S. Blanchard, is a Professor of Engineering-Emeritus at Virginia Polytechnic Institute & State University and a consultant in such fields as systems engineering, reliability and maintainability, maintenance, logistics, and life-cycle costing. He is also currently serving as an Adjunct Professor of Systems Engineering for Virginia Tech.. Prior to his current role, he served as Assistant Dean of Engineering for Public Service, College of Engineering (until June 1995), and as Chairman of the Systems Engineering Graduate Program, Virginia Tech (1979-1996). He has taught courses in systems engineering, reliability and maintainability, and logistics engineering. Before joining Virginia Tech in 1970, he was employed in industry for 17 years where he served in the capacity of design engineer, field service engineer, staff engineer, and engineering manager (Boeing Airplane Co., Sanders Associates, Bendix Corp., and General Dynamics Corp.). In conjunction, he also served as an Adjunct Professor for several years at the Rochester Institute of Technology (1966-1969). Prior to his industry career, he was an electronics maintenance officer in the U.S. Air Force.Professor Blanchard's academic background includes a BS degree in Civil Engineering, graduate course work in Electrical Engineering, and a MBA degree (through an Executive Development Program at the University of Rochester). He has authored four textbooks, and has co-authored five additional texts. He has published numerous journal articles and has lectured extensively throughout Africa, Asia, Australia, Europe, and North America. Professor Blanchard is a Charter member, Fellow, CPL, *SOLEtech* newsletter editor, member of the Board of Advisors, and past-president of the International Society of Logistics (SOLE); a Fellow of the International Council on Systems Engineering (INCOSE); and a member of several other professional organizations (ASEE, CSCMP,IIE, IEEE, and NDIA).