

### Answer for the Assignment of the Logistics Support Module

1. (15%) For one maintenance facility, one part is consumed at the constant rate of 1,000 units per year. Each order of this part incurs \$200 for processing and shipment no matter what the size of the order. Holding one unit of this part in the inventory incurs \$10 per year. Assume the replenishment lead time is negligible. Please calculate the Economic Order Quantity to minimize the total cost.

ANSWER:

From the question, we know

$D=1000$  units per year;  $K=\$200$  per order; and  $h=\$10$  per unit per year.

$$Q = EOQ = \sqrt{\frac{2KD}{h}} = \sqrt{\frac{2(200)(1000)}{10}} = 200 \text{ units per order.}$$

2. (15%) For a system with one operating unit and one spare (stand-by unit). The two units are identical with the same constant failure rate of 0.03 per day. Please calculate the overall system's reliability of the system for 30 days.

ANSWER:

From the question, we know the failure rate of each unit is  $\lambda=0.03$  failure per day.

$$R(T = 30 \text{ days}) = e^{-\lambda T} + \lambda T e^{-\lambda T} = e^{-(0.03)(30)} + (0.03)(30)e^{-(0.03)(30)} = 0.772$$

Therefore, the probability that the system will not fail during 30 days is 77.2%.

3. (10%) Please explain the relationship between logistics support with reliability and maintainability.

ANSWER:

Reliability and maintainability are closely related to logistics support. Reliability requirement decides the frequency of failure (i.e., the frequency of corrective maintenance), which requires logistics support. At the same time, spares could improve reliability. Maintainability requirement decides the frequency of preventive maintenance and the required time and resources for both corrective and preventives. The supportability will influence the time and cost of a maintenance task, therefore influencing maintainability. As shown in the figure in slide 25 in the Logistics Support lecture, both reliability analysis and maintainability provides design data to logistics supportability analysis. At the same time, the logistics support analysis will decide maintenance personnel, facility, equipment, and supplies.

### Group Assignment

- (a) Please read the document of *Space Flight Operations Contract between NASA and United Space Alliance* as the file of "Case\_ United Space Alliance.pdf" in the reading material.

- (b) Please prepare a report to discuss whether you think the contract was a good idea to define the relationship between NASA and its major contractors. Please discuss it from the viewpoint of supply chain management and supportability. Please also discuss why the contract was not fully implemented and your suggestions to NASA.

Some pointers expected in students' reports:

- In general, the contract serves a good mechanism to define a partnership between NASA and United Space Alliance. The partnership involves the life-cycle collaboration between two parties, including development, production, maintenance, and logistics support. Rather than a transactional relationship based on a "cost-plus" contract, a complex contract structure including performance-based and cost reduction incentives could foster the long term strategic partnership between them. Those performance measures could represent the requirements (about what are expected and how well to do) of NASA well compared to the traditional contracts in which NASA asked the contractor what to do and how to do.
- Logistics support issues are well addressed in the contract as "United Space Alliance also provide parts for the Orbiters, maintains Shuttle flight simulators, and provides tools and supplies, including consumables such as food, for Shuttle missions" and "operate and maintain Shuttle-specific facilities such as the Vehicle Assembly Building". Since United Space Alliance is also supposed to be responsible for mission design and planning and maintenance tasks such as inspecting and modifying the orbiters, we could expect United Space Alliance would consider logistics support from the early design phase and consider supportability and maintainability in a seamless way.
- A good supply chain relationship could save cost and reduce expense. The implementation of this contract, even not fully successful, realized a significant amount of cost saving.
- The contract was not fully implemented because of the resistance from several NASA units. This lesson tells us that in order to have good logistics support and supply chain management, all units in an enterprise or government agency need to understand its importance and support the initiative. In other words, a good integration with partners requires a good integration inside.