Welcome

Learning Objectives

Upon completion of this lesson, you should be able to:

- Identify the main categories of supply material
- Identify the types of supply costs included in estimates of depot-level repair costs
- Explain the factors that influence supply and depot maintenance costs

Closed Captioning

Upon completion of this lesson, you should be able to:

- Identify the main categories of supply material,
- Identify the types of supply costs included in estimates of depot-level repair costs, and
- Explain the factors that influence supply and depot maintenance costs.

Why Is This Important?

Once a system is deployed, much of the Product Support Manager's (PSM's) attention, and the PSM's team, will be focused on Supply. While reliability, maintainability, and therefore Maintenance, is largely design-driven, supply is process-driven. That process requires constant assessment and adjustment to ensure that needed spare and repair parts reach the warfighter in the most efficient and cost-effective ways. Supply chain planning and execution are a major part of a PSM's job. Estimating O&S costs for Supply is challenging, simply because there are so many variables that can't always be accurately predicted.

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Long Description

Helicopter landing on aircraft carrier deck, man looking inside equipment, military personnel studying.

Levels of Supply

To begin, it is imperative to understand key terminology as applied to Supply. Two key levels include wholesale supply and retail supply.

Wholesale Supply is the level of supply support including national inventory control points, depots, terminals, arsenals, central wholesale data banks, plants and factories associated with commodity command activities. Wholesale supply includes:

- Responsibility for the procurement of supplies for the military branches from commercial sources or from Government plants.
- Stock, regardless of funding sources, over which the Integrated Materiel Manager has asset knowledge and exercises unrestricted asset control to meet worldwide inventory responsibilities.

Support for wholesale supply is accomplished by distributing supplies to retail level for stockage or for issue to users.

Levels of Supply, Cont.

The other level of supply is retail supply.

Retail Supply is the level of support used particularly in terms of calculating cost and in terms of inventory management and its impact on availability.

We can, for example, position huge numbers of spare parts forward at the retail level to ensure a minimal logistics response time, but the cost might be staggering. On the other hand, if we deploy too few assets, we will incur additional costs in transportation and the shortage of retail, or field level, spares could very well lengthen our logistics response times, thereby negatively impacting operational availability.

The stockage for retail supply is held in the custody or on the records of a supply organization below the wholesale level.

Supply Material Classifications

At each level of supply we will have two basic types of material:

1. **Consumables** are any material that is discarded after or consumed during use. This type of material is managed by the Defense Logistics Agency (DLA).
2. **Repairable Items** include those surplus and repair parts that cannot be repaired at the field or retail level and must be sent to another activity for repair; usually to an intermediate maintenance activity or to a depot, also called Depot Level Repairables (DLRs)

Popup Text

Intermediate maintenance activity

Material that can be removed and repaired at levels above the organizational or field level.

Depot Level Repairables (DLRs)

A part that is returned to the depot (wholesale supply system) for repair.

Maintenance Consumables

To expand on "Consumables" we need to take a look at Maintenance Consumables.

For instance, a Maintenance Consumable is a maintenance item that is discarded after failure with no salvage value.

It's important to note that costs for consumables and repairables are calculated differently.

Consumables are parts that are discarded upon failure, generally without any salvage or rebuild value.

Maintenance Consumables, Cont.

Costing consumables is done in the same way as for DLRs except that Depot Level Repairables generally have a surcharge added to the price to account for overhead incurred in effecting repairs at the depot.

Consumable unit prices do not include repair cost and there is no credit for a return.

Therefore, the equation for costing will simply be Q x P, where Q is the quantity of consumables of certain price which fail over a specified time period and P is the standard price for a replacement.

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Long Description

Woman beside flipchart with Costing for Consumables formula written on chart.

Consumable Cost Estimating Methods

The cost estimating methods for the cost of consumables are generally the same as for calculating maintenance costs, covered earlier. The same caveats apply as well and include:

- **Analogy:** adjusted data from similar systems
  - Early in program
  - Design incomplete
- **Cost Estimating Relationship (CER):** prediction equation based on design and operational parameters
  - System level design "complete"
  - If available and verifiable
- **Direct:** prediction equation based on theory
  - Subsystem design "complete"
  - Testing begun
- **Actual Costs**
  - Fielded systems and reliable data collection
  - Predictable pattern

Note: When using historical analogies, it's important for the PSM to make sure that the proverbial "apples to apples" comparison is taking place. If not, he or she will need to assist the cost estimators in establishing factors that will account for differences.

Depot Level Repairables (DLRs)

Depot level repairables are often one of the most significant O&S cost elements of a weapon system.

Current DoD policy is to pay for such repairs through a stock or revolving fund, whereby a using command pays the fund for getting a replacement for a failed DLR and gets credit for turning in the DLR for repair.

For costing purposes, one can determine the current price for DLRs through military cost data systems.

Popup Text

Stock or Revolving Fund (aka Working Capital Fund)

- A working capital fund that covers the cost of stocking (purchase and repair) and providing replenishment DLRs.
- Military supply buys the DLRs out of the stock fund and "sells" them to operating units who pay out of O&M funds.
- The price paid includes a surcharge to cover the repair including personnel, transportation, storage and other associated costs. Surcharges are periodically updated.
- The operating unit gets a credit, or percentage of the item price, for each DLR turned in for repair based on repair and discard rates.
- The vast majority of wholesale inventory of DLRs is generated by the Depot Repair process.

Depot Level Repairables (DLRs), Cont.

It's important to note that some DLRs that are returned are found to be Beyond Economical Repair.

Similarly, some percentage of them will be rendered "Beyond Economical Repair" during the repair cycle. This is known as the "Attrition Rate."

The impact on O&S cost is somewhat convoluted, but real nevertheless.

Since the Working Capital Fund cannot by law lose money, the Fund managers have no choice but to raise the unit price to account for this attrition and that increased unit price becomes an increased O&S cost.

Knowledge Review

As the PSM, you know that you are going to need spare parts to support your program's maintenance concept. In communicating this to your team, you remind them that the planning associated with these parts will be different based on the two basic categories of supply material. What are the two basic categories?

- [x] Consumables and Repairables
- [ ] Wholesale and Retail
- [ ] Scheduled and Unscheduled
- [ ] Consumables and Retail

Check Answer

Consumables and repairables are the main categories of supply materials.

Types of Depot Maintenance Activities

Now that we've covered the categories of supply material, let's take a closer look at depot maintenance and its impacts on O&S cost.

There are two types of depot maintenance activities: **scheduled** and **unscheduled**. Select each box to learn more about each.

Scheduled Maintenance

Unscheduled Maintenance

Popup Text

Scheduled or Routine Depot Maintenance

- Work that can only be accomplished at major facilities by trained personnel with significant amounts of capital equipment

- Returns items to "like new" condition
    - Generally based on a workload forecast

Unscheduled Depot Maintenance

- Emergency repairs
- Repairs that may be needed based on: recalls, safety factors that may not be related to failure and a variety of other factors

Types of Depot Maintenance Activities, Cont.

Most depot work will fall into the scheduled category.

Making sure depots have a steady amount of work is a major concern.

As well, planners use a process, called "workloading," or "workload forecasting," to make sure that the considerable investment made in tooling, test equipment, training, and infrastructure is fully utilized.

If you find yourself in a poor stock position for a particular DLR, and there is a surge in failures, repairs may need to be done on an emergency basis.

DLR Cost Components

DLR Costs affect three factors including:

- **Demand**
  - Inventory and usage
  - Frequency of failure (reliability)
- **Proportion of failed items** discarded versus repaired (Condemnation Rate or "CR")
- **Costs**
  - Unit price of the item
  - Cost to repair
  - Credit for turning in a serviceable failed item
  - Surcharge

DLR Cost Components, Cont.

In calculating the cost of DLRs, the failure rate is critical, but also important is the percentage returned to the depot that are determined to be beyond economical repair.

A certain number will also be destroyed in the repair process. This is called the Condemnation Rate or Attrition Rate.

To encourage operators to return DLRs, a credit is applied to the replacement cost of a new DLR. This credit must also be taken into account when calculating DLR costs.

The amount of the credit, as well as the surcharge, is periodically updated to reflect real-world realities.

Knowledge Review

In estimating repair costs, you as the PSM need to be concerned with the items that are unserviceable as well as the items that are repairable. Among those that are sent for repair, some are damaged further and therefore not able to be repaired. What is the term for the number associated with discarded (failed) items?

- [ ] Emergency Repair Rate
- [ ] Reliability Rate
- [x] Condemnation Rate
- [ ] Stock Fund Credit Rate

Check Answer

The number of items destroyed in the repair process is usually referred to as the **condemnation rate.**

Depot Level Overhaul Cost

Depot costs may include those costs associated with maintenance performed at a depot, or under depot control, on a complete weapon system or major subsystems such as an engine.

It includes both scheduled or periodic maintenance such as teardown type inspections, program depot maintenance and overhauls, and may also include non-scheduled maintenance such as correcting a structural problem or restoring a system that has been in an accident.

Note: DLR costs are also costs incurred at the depot but they refer to lower level system costs and not to the system or major subsystems.

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Popup Text

Overhauls

Major repair or Overhaul requiring high value facilities and/or special skills

- Overhaul tasks
  - Conduct major inspections
  - Restore systems to baseline condition
- Either at an organic (government) depot or contractor facility

Long Description

Helicopter behind battleship, man working on equipment, hands pointing toward schematic.

Depot Level Overhaul Cost, Cont.

Depot cost is usually estimated as the annual depot cost per operating system or on an operating hour basis.

The former is calculated by dividing all depot cost in a year associated with the system by the number of such systems operating during the year.

The "operating hour" estimation uses the number of annual operating hours as the divisor.

Depot cost can also be calculated as cost per overhaul with an annual overhaul quantity.

Cost can be based on a forecasted demand, (e.g., overhaul after X miles or Y flying hours) or it can be based on calendar (e.g., ship overhauls every 5 years).

Depot Maintenance - General Approach

Depot maintenance estimates may differ when you are referring to DLRs or more specific items such as an entire aircraft. But, there are two areas in which the procedure is similar: estimating frequency and estimating cost per action.

To estimate frequency of depot maintenance:

- Account for changes in durability
- Use operating hours or equivalent if maintenance depends on usage
- Check overhaul/servicing schedule

To estimate cost per depot maintenance action, use:

- Analogy and expert opinion
- Direct estimation
- CER (if available and applicable)

Note: Failure rate or something equivalent may have to be used to estimate the number of events requiring unscheduled depot maintenance such as accidents.

Popup Text

Durability

"Durability" generally refers to the resistance to changes over time which can degrade the life of a system. The every-day definition is not easily worn out, long lasting, sturdy. One measure of durability is the service life.

CER

Cost Estimating Relationship – prediction equation based on design and operational parameters.

Durability and Service Life

While depot maintenance helps to avoid "wear out" or critical stage failures, understanding the durability and service life of objects/systems is very important.

For example, through depot maintenance, engineers can define the number of engine cycles to run before overhauling an engine through analysis of the three major modes of engine failure:

- High cycle fatigue
- Thermal fatigue
- Low cycle fatigue

Durability and Service Life, Cont.

The service life, a specific measure of durability, is the length of time or amount of usage a system has before it must be taken out of service or else a major program to extend its life must be implemented.

The latter is often called a SLEP, Service Life Extension Program, which we cover under Continuing System Improvements.



Knowledge Review

An engineer is tasked with purchasing a set of low maintenance engines for the aircraft your program is acquiring. You know that the aircraft is projected to have a high operating tempo (OPTEMPO). With which of the following factors should the engineer be most concerned regarding the engines?

- [x] Durability
- [ ] Workloading
- [ ] Maintenance Schedules
- [ ] Unit price

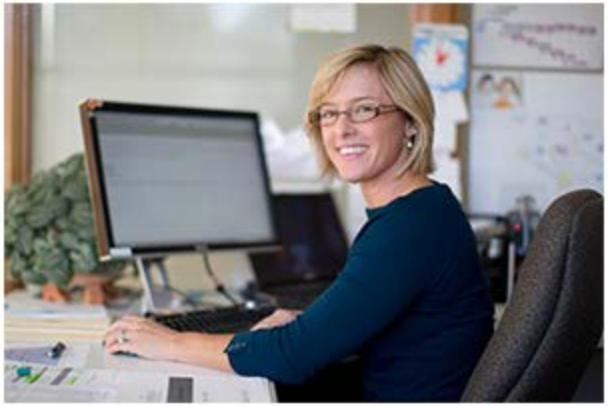
Check Answer

The engineer should be most concerned with **durability**. Low unit cost can end up being higher if more repairs or even replacement is needed.

Lesson Summary

To summarize, in this lesson you learned the following:

- Supply is process-driven and that process requires constant assessment and adjustment to ensure that needed spare and repair parts reach the warfighter in the most efficient and cost-effective ways. Supply chain planning and execution is a major part of a PSM's job.
- There are two levels of supply, wholesale and retail. Wholesale Supply is the level of supply support including national inventory control points, depots, terminals, arsenals, central wholesale data banks, plants and factories associated with commodity command activities while retail is the level used in calculating cost and in terms of inventory management and its impact on availability.
- Consumables and Repairables are the two main categories of supply materials.



Lesson Summary, Cont.

- Estimating repair costs is a critical action. In estimating cost for maintenance consumables, the equation for costing will simply be Q x P, where Q is the quantity of consumables of certain price which fail over a specified time period and P is the standard price for a replacement.
- Depot level repairables are often one of the most significant O&S cost elements of a weapon system. It is important for a PSM to know the cost components as well as how to cost DLR's.
- Depot maintenance estimates may differ when you are referring to DLRs or more specific items such as an entire aircraft. But, there are two areas in which the procedure is similar: estimating frequency and estimating cost per action.
- While depot maintenance helps to avoid "wear out" or critical stage failures, understanding the durability and service life of objects/systems is very important. This helps in the planning of repair or purchase cycles.

Lesson Summary, Cont.

Congratulations! Now that you have completed the Supply and Depot Maintenance lesson, you should be able to:

1. Identify the main categories of Supply material.
2. Identify the types of costs included in estimates of supply costs, particularly as they relate to depot-level repair.
3. Explain the factors that influence supply and depot maintenance costs.

Lesson Completion

You have completed the content for this lesson.

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