Equipment Management
Part 5

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Equipment Availability

- Equipment availability
  - This relies on good housekeeping
  - Forward planning
    - To make sure, it can be decontaminated and set up in time
    - Adequate consumables are ready
  - Availability of back-up equipment
    - This is impractical when equipment is expensive
    - Timely equipment replacement based on records of past reliability
  - Maintaining up-time
    - Effective maintenance of equipment
  - Equipment failure
    - Most causes (about 80%) are preventable
  - Simultaneous requirement by several departments

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Spare Parts Management

- Capital goods require maintenance.
- In general, maintenance may be defined as:
  - "the combination of all technical and associated administrative actions intended to retain an item in, or to restore it to, a state in which it can perform its required function"
    - (cf. the British Standard Institute).

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Spare Parts Management

- Spare parts are essential for maintaining and repairing medical equipment
- Capital goods require preventive and corrective maintenance.
- Preventive maintenance is scheduled in advance, and may require spare parts.
- Corrective maintenance is carried out upon failure of a system.

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Spare Parts Management

- In corrective maintenance, If the failure is caused by a failing part, then it is done on a repair-by-replacement basis:
  - The failed part is removed from the machine and replaced by a new or as good as new spare part.
- This avoids a too long and costly downtime.
- For this corrective maintenance, the proper spare part is needed
- The demand for spare parts is not known in advance
- An inventory of spare parts is needed to be kept

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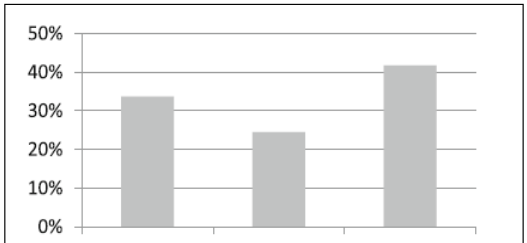

Fig. 1.2 Division of TCO for an engineer-to-order system

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Spare Part Classification

- According to their purpose, spare parts are classified into one of two categories:
  - that of maintenance and that of repair.
- The spare parts used for maintenance (maintenance parts) are classified into five groups according to the lifespan.
  - Less than one year
  - 1-3 years
  - 3-5 years
  - 5-7 years
  - As per manufacturer's instruction
- Spare parts used for repair (repair parts) are mainly used for random and wear-out failures,
  - They are divided into two groups;
    - those of long lifespan and those of semi-permanent lifespan.

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Spare Part Classification

- The maintenance parts are required to conform to particular specifications of the equipment.
- On the other hand, most semiconductor parts and electronic parts, which are used as repair parts, can be used on any equipment.
- However, advanced technique is often required in repair work that utilises semiconductor and electronic parts.

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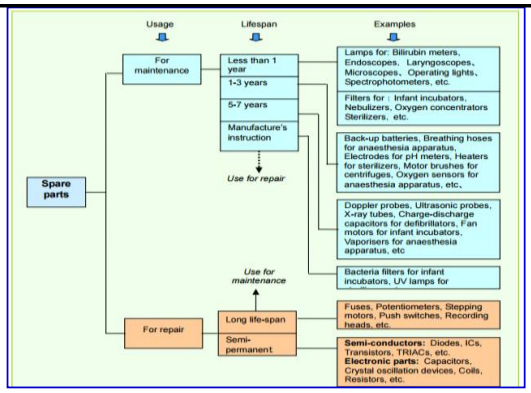

Classification of Spare Parts

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Inventory of Spare Parts

- Six Rs define complete optimization of the sourcing and delivery of spare parts.
- These are:
  - Right parts
  - Right quantity
  - Right quality
  - Right place
  - Right time
  - Right price
- To achieve this, a well-defined and executed inventory management and procurement process are required

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Inventory of Spare Parts

- Spare parts have to be kept on stock
  - This is required to facilitate preventive and corrective maintenance
- Sources of spare parts
  - device manufacturer
  - other manufacturers
  - responsible organisation
  - service provider
  - pre-used
- When obtaining replacement spare parts from sources other than the manufacturer, ensure
  - that all aspects of the technical specification are met

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Spare Parts

- **Reusing spare parts**
  - Under normal circumstances pre-used parts should not be used to repair a device.
  - They may be acceptable only in exceptional circumstances
  - A risk assessment to be done and fully documented
  - These spare parts may fail because of stress and strain these have undergone
  - The failure of a part can have severe consequences for the end user
    - The part should not be reused if its history is unknown

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Spare Parts

- Traceability of spare parts
  - Ensure that the maintenance service provider can:
    - Identify all spares replaced during the maintenance or repair of a particular device
    - Trace all critical parts back to the supplier
  - This will permit ready identification of those devices containing parts that need to be repaired or re-called
  - Only critical part needs to be identified and related to the original piece of equipment

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Replacement Planning

- **Replacement**
  - A device will not be considered serviceable if any of the following criteria apply:
    - Worn / damaged beyond economical repair
    - Unreliable (poor service history)
    - Clinically or technically obsolete
    - Spare parts no longer available
    - If because of design, wear and tear or damage the equipment cannot be cleaned effectively prior to disinfection / sterilisation

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Replacement Criteria

- Factors to consider include:
  - whether the device is damaged or worn out beyond economic repair
  - its reliability (check service history)
  - clinical or technical obsolescence
  - changes in local policies for device use
  - absence of manufacturer/supplier support
  - non-availability of correct replacement parts
  - non-availability of specialist repair knowledge
  - users' opinions
  - possible benefits of new model (features, usability, more clinically effective, lower running costs)
  - lifecycle of the medical device.

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Depreciation and Loss of Value

- All medical equipment has a definite life span
- After the useful life the equipment is not usable for providing patient care
- Concept of depreciation
  - A part of the fixed asset is consumed every year to earn revenue
  - So there is gradual reduction in its value
  - This happens because of wear and tear in the equipment
- Usually two methods are available to calculate depreciation:
  - Straight line method, and
  - Written down method

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Depreciation and Loss of Value

- Straight line method
  - Say, the catheterization Laboratory has 10 years life
  - So it looses 10% of its value every year
  - At the end of 10 years its value become zero
- Written down method
  - Say the Cath Lab's purchase price is Rs 6 crore and the rate of depreciation is 10%
  - So at the end of the first year its value becomes 6 crore minus i0%, i.e., 54000000
  - At the end of second year its value is 54000000-10%, i.e., 48600000
  - Unlike straight line method the book value will never become zero
- IT department provides rates of depreciation for critical medical equipment
- Estimated useful life of depreciable hospital assets has been given by American Hospital Association
- (https://ams.aha.org/eweb/DynamicPage.aspx?WebCode=ProdDetailAdd&ivd_prc_prd_key=3591a778-8a0a-4469-afcc-8dea7c9f0512)

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Economic Life

- What is 'Economic Life'
  - Economic life is the expected period of time during which an asset is useful to the average owner.
  - The economic life of an asset could be different than its actual physical life.
  - Estimating the economic life of an asset is important for businesses so that they can determine when it is worthwhile to invest in new equipment and
  - they can allocate appropriate funds to purchase replacements once the equipment has exceeded its useful life.

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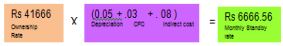
Cost of Standby

- Stanby refers to the situation where equipment is on the job and available for work
- But the equipment is not put into operation until needed
- No standard exists on how to calculate standby rates
- A method based on depreciation, cost of facilities capital, and indirect cost is as below:



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Biomedical Technology

- Biomedical technology is a broad term that combines engineering and technology
  - This is to solve biological or medical problems involving humans,
  - Deals basically with the design and use of medical equipment used to diagnose and treat various diseases.
  - Biomedical technology can also be broken down into smaller sub-fields, like biomedical informatics, engineering, science and research.

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Biomedical Technology

- Application in hospital environment
  - Any organisation delivering healthcare with modern medical technology relies to a greater or lesser extent on medical devices to benefit patients.
  - As technology in clinical care becomes more complex, so do demands on those managing the equipment which delivers it.
  - Clinical professionals rely on equipment to provide what it promises and not let them down.
  - Biomedical engineers who support them need to know how to keep patients safe and equipment working in the clinical environment

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Biomedical Technology

- Medical equipment management has three essential aims:
  - To ensure medical equipment in the clinical environment is appropriate to the needs of the clinical service,
  - That it functions effectively and safely, and
  - That it represents value for money
- Users need to be trained and equipment has to be maintained and supported.
- Attendant risks have to be managed, including
  - clinical risks from operator misuse and malfunction and safety risks to patients and staff
- These functions are collaboratively performed by the biomedical engineer
- The Clinicians, other user, managers, finance and other department also support the BMEs in their job

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Calibration Tests

- Regular user checks and calibration are needed to ensure that the output of these equipment is accurate
- Therapeutic equipment ranging from radiotherapy machines to syringe drivers need calibration periodically
- All measuring equipment and equipment which outputs energy are needed to be calibrated
- Calibration is required to be done by a registered laboratory is not acceptable

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Calibration Tests

- ISO 17025
  - This is a quality management standard that aims to demonstrate that test and calibration laboratories produce technically valid results
  - Biomedical engineering departments may seek accreditation to this standard when providing test and calibration service to equipment diagnostic and treatment
- In India, National Accreditation Board for Testing and Calibration laboratories accredits biomedical engineering department laboratory for calibration

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Maintenance Features

- Medical devices range from relatively simple to highly complex
- A maintenance programme need to consider
  - Equipment inventory
  - Identification of method by which maintenance will be provided
  - Resources requirement
    - The financial, physical, and human resources should be available
- The clinical engineering department should identify and select the devices to be included in the inventory
  - From this inventory the department should select the items to be put on maintenance programme

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Hazards from Equipment

- A **hazard** is any source of
  - potential damage,
  - Harm, or
  - adverse health effects
    - on something or someone under certain conditions at work.
- The terms hazard and risks are used interchangeably
- There are three main categories of hazards that challenge health care organisations

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Risk Categories

- Clinical risks
  - Typically relate to sub-optimal outcomes, such as
    - Misdiagnosis
    - Inappropriate treatment
    - Acquired infections, or
    - Adverse drug reactions
  - Most medical equipment incidents are minor
    - Some equipment related incidents may cause serious patient injury and death
    - Most recorded causes are human error

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Risk Categories

- Health and safety risks
  - These risks expose patients, staff and the public to potential injury from equipment, materials or the environment
  - National legislation and facility inspection are aimed at reducing such hazards
- Organisational risks
  - Risks are often linked to those from clinical or health and safety causes
  - These might lead to loss of business, waste of financial or other resources or damage to reputation

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Thank you

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