**Design for Machinability & Economy**

**Design for Machinability (DFM)** and **Design for Economy (DFE)** help optimize manufacturing efficiency by reducing machining time, tool wear, and production costs while improving product quality.

**1. Design for Machinability (DFM)**

DFM focuses on designing parts that are **easy, cost-effective, and efficient to machine**.

**A. Key Guidelines for Machinability**

✔ **Use Standard Features & Dimensions** → Reduces custom tooling and setup time.  
✔ **Minimize Sharp Corners** → Use **fillets (≥1 mm)** to reduce tool wear.  
✔ **Optimize Material Selection** → Use **machinable materials** like aluminum, free-cutting steel.  
✔ **Reduce Deep Cuts & Undercuts** → Avoid features that require special tooling.  
✔ **Maintain Uniform Wall Thickness** → Prevents distortion and improves stability.

**B. Recommended Material Choices for Machinability**

| **Material** | **Machinability** | **Notes** |
| --- | --- | --- |
| **Aluminum 6061** | ✅ Excellent | Soft, easy to cut |
| **Free-cutting Steel (12L14)** | ✅ High | Contains lead for improved machinability |
| **Brass (C36000)** | ✅ High | Low friction, easy to machine |
| **Titanium** | ❌ Poor | Harder to cut, requires cooling |

**2. Design for Economy (DFE)**

DFE ensures cost reduction while maintaining performance and quality.

**A. Cost-Saving Design Guidelines**

✔ **Reduce Unnecessary Features** → Avoid **complex shapes** that require extra machining.  
✔ **Use Standard Fasteners & Components** → Minimizes part customization costs.  
✔ **Minimize Setup & Tool Changes** → Design for **single-tool operations** where possible.  
✔ **Optimize Tolerances** → Avoid **overly tight tolerances** unless necessary.  
✔ **Choose the Right Manufacturing Process** → Use casting or forging for pre-shaped parts to minimize machining.

**B. Cost Comparison – Machining vs. Alternative Processes**

| **Process** | **Cost Efficiency** | **When to Use** |
| --- | --- | --- |
| **CNC Machining** | Moderate | Small to medium batches, high precision |
| **Casting + Minimal Machining** | High | Large batches, complex shapes |
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