**The Economics of Managing a Cleanroom**

A cleanroom, used in manufacturing or scientific research, is a controlled environment that has a low level of pollutants such as dust, airborne microbes, aerosol particles, and chemical vapors. The controlled level of contamination is specified by the number of particles per cubic meter at a specified size. Cleanrooms are used in semiconductor manufacturing, pharmaceuticals, biotech, medical device and life sciences, as well as critical process manufacturing common in aerospace, optics, the military, and energy where small particles can adversely affect the manufacturing process, particularly in nanotechnology research.

The GW state-of-the-art cleanroom currently has a number of scientific devices with capital costs listed in Table 1.

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| --- | --- |
| Tool | Cost |
| Raith Pioneer electron beam lithography tool (teaching cleanroom) | $700,000 |
| Raith Voyager electron beam lithography tool (research cleanroom): | $2,000,000 |
| Raith Voyager service contract per year | $30,000 |
| New evaporation tool | $80,000 |
| Spin coater | $5,000 |
| Lifetime | 15-20 years |
| Facility costs | 18-20% |

Note that the cost of providing the tools as facilities are about 18-20% of the cost of the tool. On average, tool lifetimes range between 15-20 years – though the tool may last longer, the technology becomes outdated, and new tools are purchased.

In addition to the costs above, consumables for tools in the cleanroom also contribute to the variation of the overall cost. They can be expensive (e.g. new lenses) or cheap but used often (e.g. gloves). Typical cleanrooms have a fee schedule where there is charge per hour to use a tool (e.g. $60 per hour to use the scanning electron microscope). There are also structures to allow unlimited use of the cleanroom for one month (e.g. Stanford's cleanroom was about $2000 per month).

Overhead costs and fees cover consumables, facilities, and staff. For instance, and cleanroom technologist’s salary is about $50k per year. A cleanroom staff member with BS or MS and some experience would start at about $60-65k per year.

**Tasks**

1. Prepare a Present Value analysis of GW’s cleanroom and estimate the annual lifecycle cost of the cleanroom facility;
2. Develop a sensitivity analysis on how the annual lifecycle cost varies over the range of 15-20 years in 1 year increment, facility cost ranging between 18-20% of installation cost in 1% increment;
3. Estimate the monthly equivalent cost of the GW’s cleanroom.

Assume a discount rate of 5% per annum. State all other assumptions.