

Risk Assessment and Reduction-I

ENG101 Engineering Professionalism

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How to assess risks?

Uncertainties in design

Risk-Benefit Analysis

Personal Risks

Public Risk and Public Acceptance

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Design Uncertainties

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Safety and Cost

Primary and secondary costs

Improved safety means increased primary cost

- Raw materials

- Labour

- Production delays

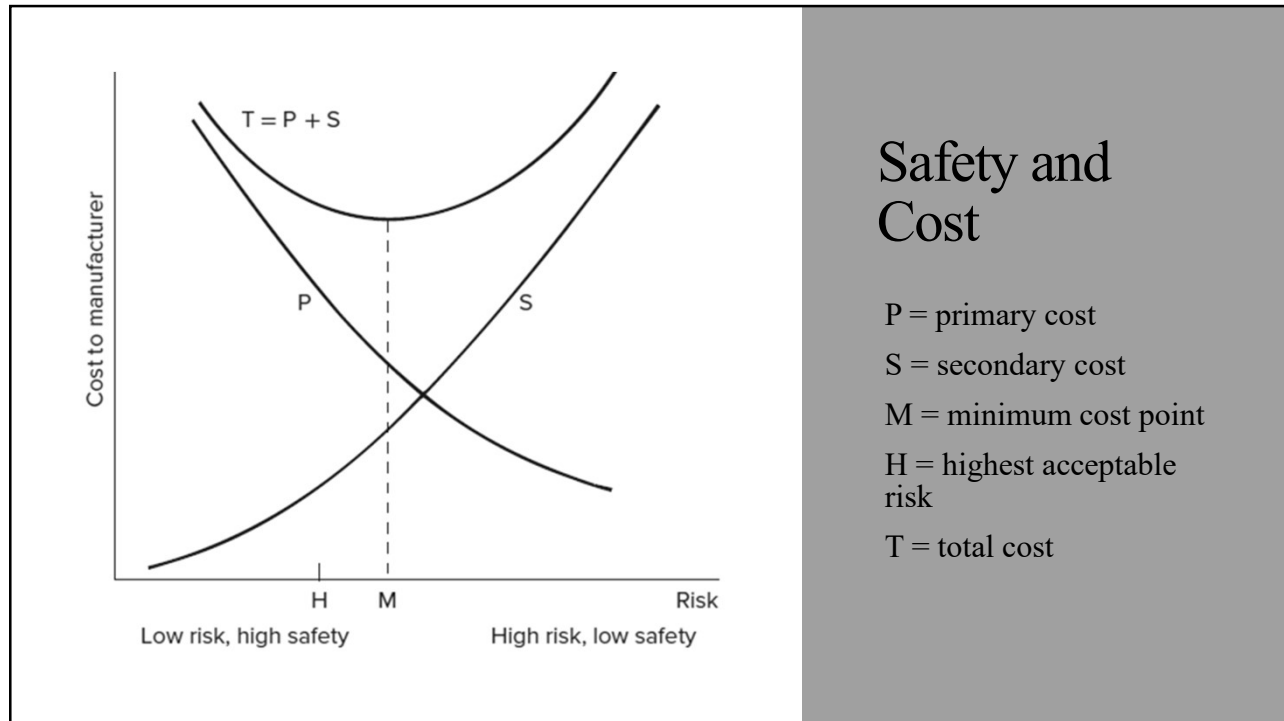
Low safety means secondary cost

- Warranty

- Loss of goodwill

- Loss of customers – injuries, litigation, production downtime, service downtime etc.

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Design Risk: Standard products?

Open or free sharing of information: cost of failure < cost of fixing

Legal settlements and non-disclosure agreements: problems and causes not revealed

Forward-compatible technologies, substitute materials and components: less usefulness of information

Built-in risks due to uncertainties: design, manufacturing, sales, applications

Profit vs ROI: a poorly designed autopilot system may provoke even the most competent pilot to make catastrophic mistakes (*Design*)

Static vs Dynamic loading: transmission cables under wind (*Application*)

Material and skill: standard or inappropriate material, skillset required to manufacture (*Design/Manufacturing*)

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Design Risk: Measuring Safety

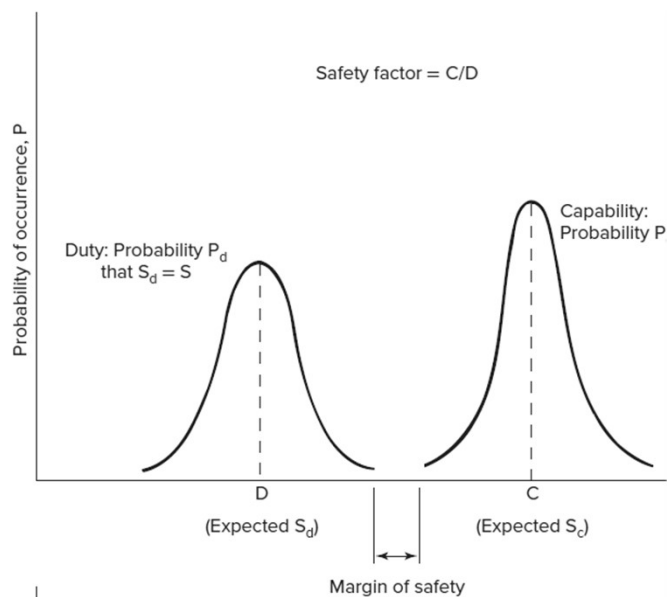
Safety factor

- Anticipated load (duty) vs ability to withstand deviation from expected value (strength or capability)
- Assembly capability vs component tolerance
- Ignores variability in the reliability

Safety Margin

- Safe distance between duty and capability probability densities
- Difficult to compute for dynamic loading

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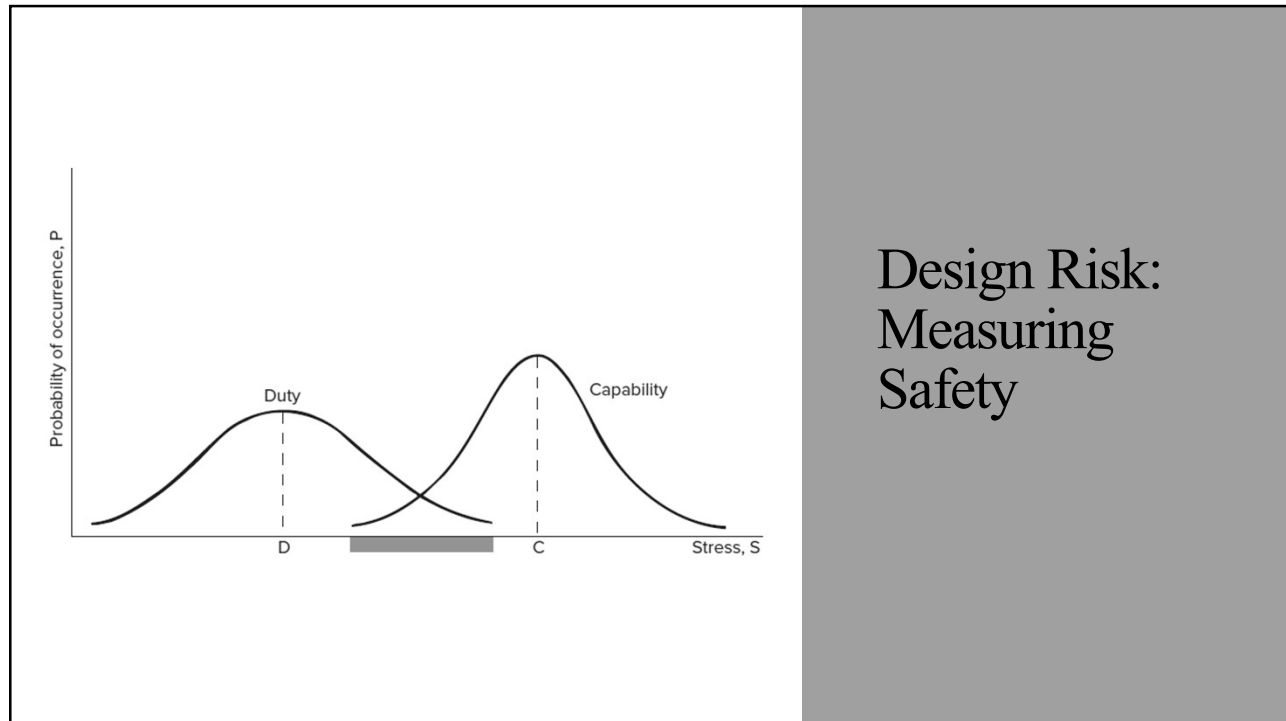


Design Risk: Measuring Safety

Safety factor for low
variability

Safety margin for high
variability

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References

1. Zhu, Q., Martin, M. W., & Schinzinger, R. (2022). *Ethics in engineering*.

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