

11376 Probabilistic Modeling in Civil Engineering

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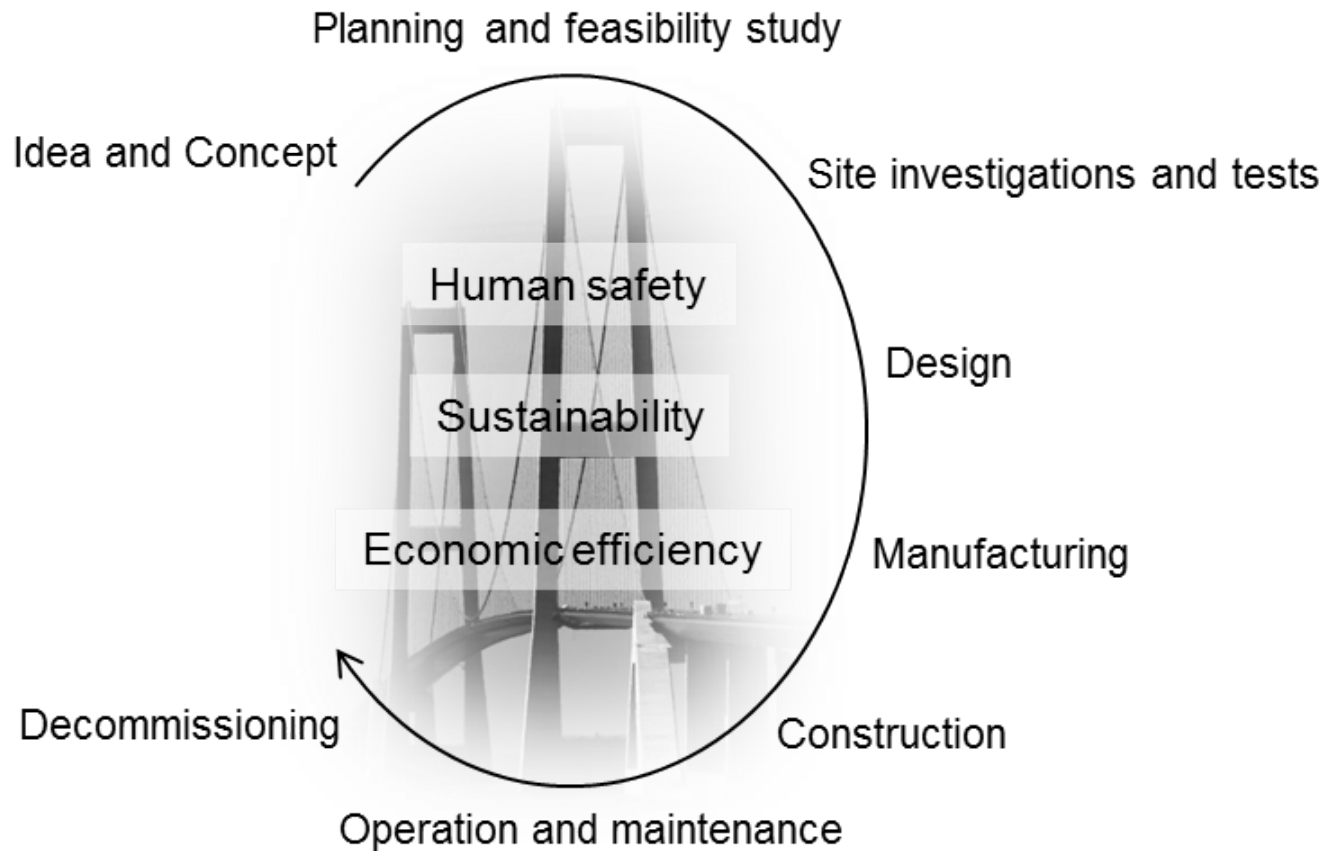
Associate Professor

ERDA: Engineering Risk and Decision Analysis

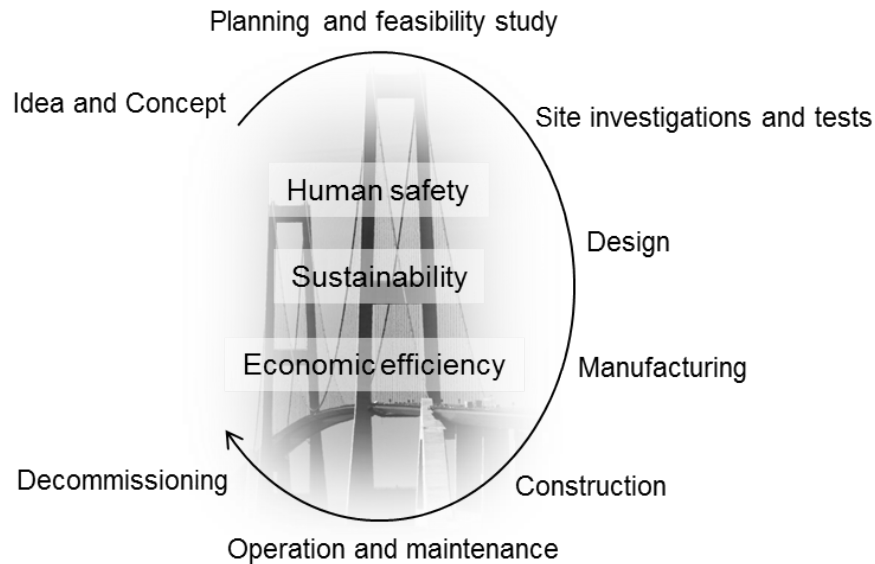
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What do Civil Engineers do?



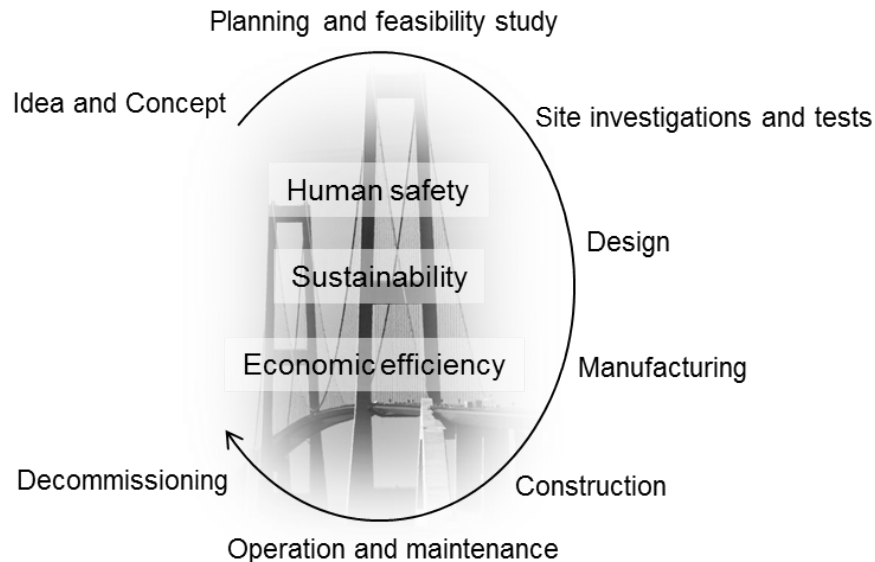
What do Civil Engineers do?



Utilizing models:

- Traffic volume
- Loads
- Resistances
- Degradation processes
- Service life
- Manufacturing costs
- Decommissioning cost

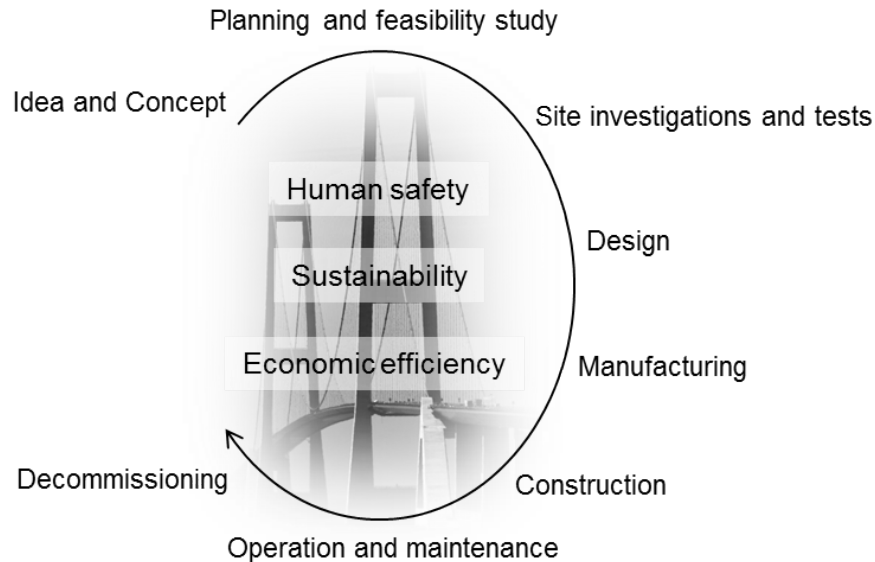
What do Civil Engineers do?



Decision making is essential for the objective to provide safe, long-lasting (sustainable and environmental friendly) and economic efficient built environment.

- Decision making is associated to every phase of the life cycle of a structure and to every action of a civil engineer
- Engineer is confronted with the real world

What do Civil Engineers do?



Examples for decisions

- Selection of steel profile for a girder
- Decision that a construction scheme works and is safe
- Decision that the structure can withstand a vehicle impact
- Choice of an appropriate load model for traffic on a bridge
- Selection of the structural system and material for a wide span roof
- Choice of an inspection and monitoring plan for a wind park to ensure safety throughout operation
- ...

Decisions in Civil Engineering

Attributes of a decision maybe:

- Human health and safety
- Functionality
- Human welfare
- Monetary value
- Sustainability
- Resilience

Utility is defined as an attribute of a decision which models the decision makers preferences.

Decisions in Civil Engineering

Decision are subjected to uncertainties.

- Decision build upon models to predict the future behaviour.
- Models can predict very accurately the behaviour of e.g. structural systems, but only under very controlled conditions (experiments). The application of models in the “real world” is subjected to uncertainties!

Decisions in Civil Engineering

Uncertainties can be categorised in:

- Aleatoric uncertainties due to randomness
- Epistemic uncertainties due to a lack of knowledge

Causes:

- Inherent variability
- Model uncertainty
- Statistical uncertainty
- Measurement uncertainty or error
- Human and organization error

Objectives

The objectives of the 11376 course are to provide

(1) the background and

(2) the basis

for structural design and assessment.

Objectives

The background for structural design and assessment comprises

- Probabilistic modelling
- Structural reliability analysis
- Safety and load combination factors
- Target reliabilities

Objectives

The basis for structural design and assessment are:

- Decision analysis
- Risk analysis
- Value of Information

Learning Objectives

The main learning objectives are that you will be able to

- (1) Analyse decisions,
- (2) Evaluate risks and expected benefits associated to engineering decisions and
- (3) Create engineering solutions with consideration of uncertainties.

Thank you for your attention.