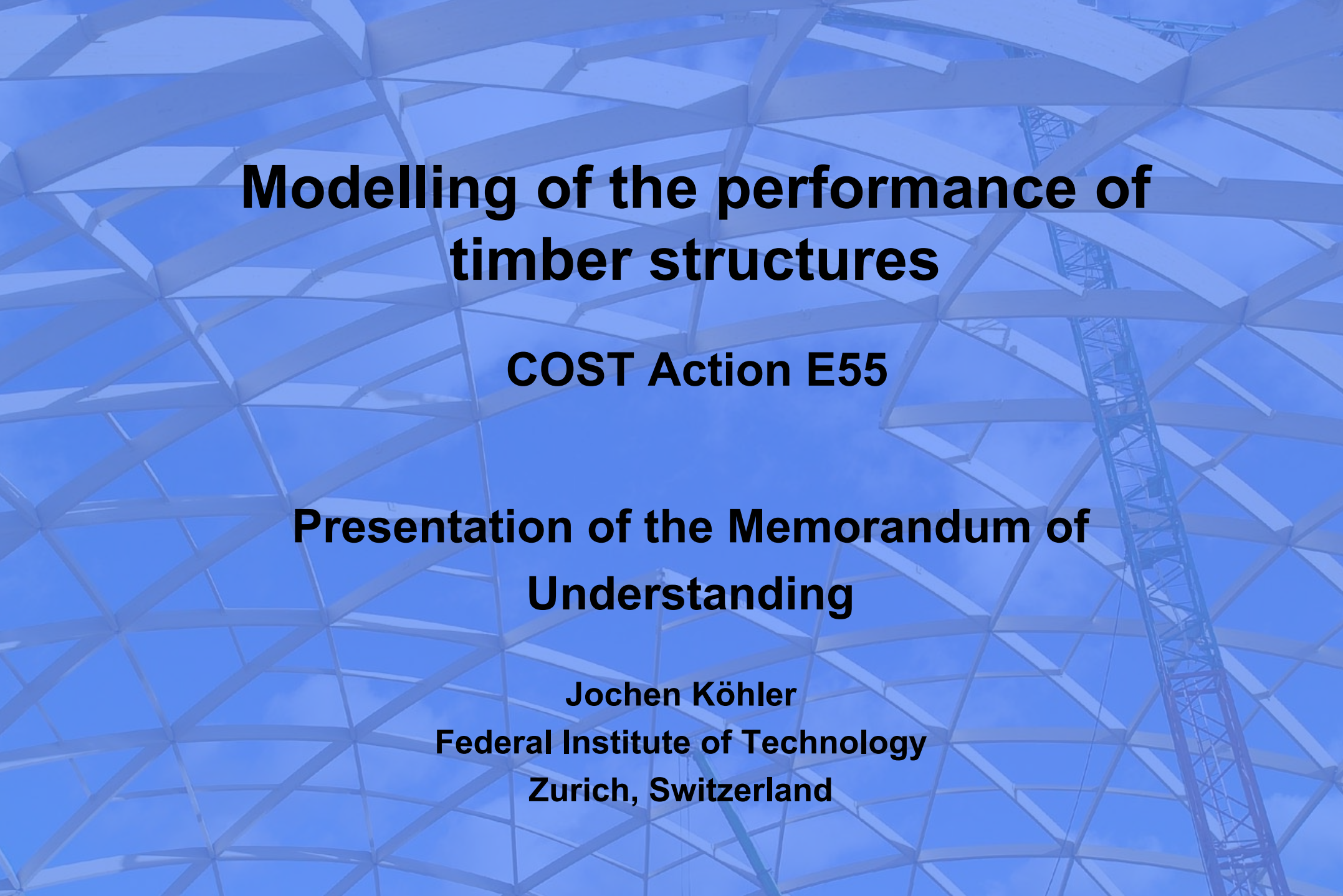
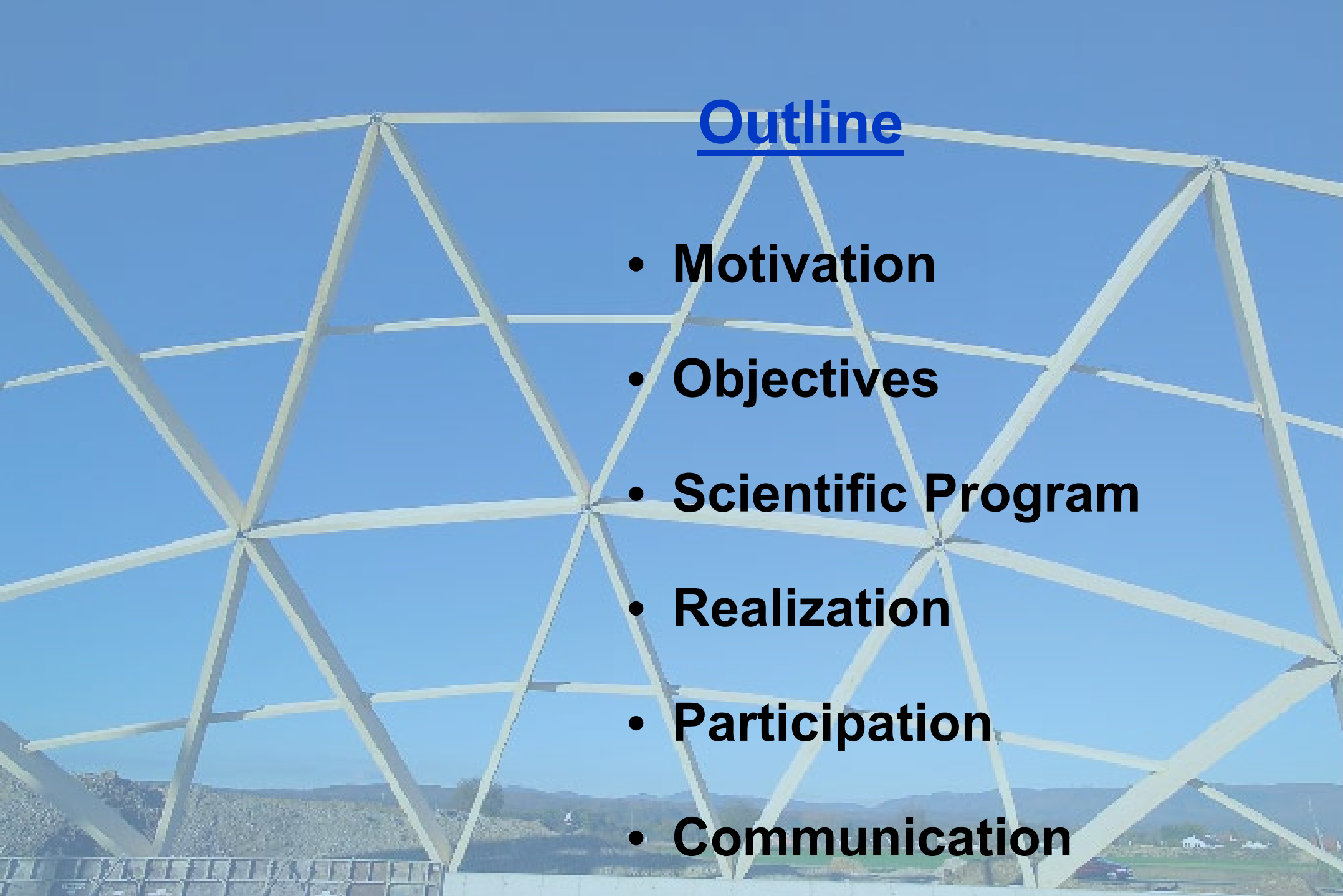


# Modelling of the performance of timber structures

## COST Action E55

## Presentation of the Memorandum of Understanding

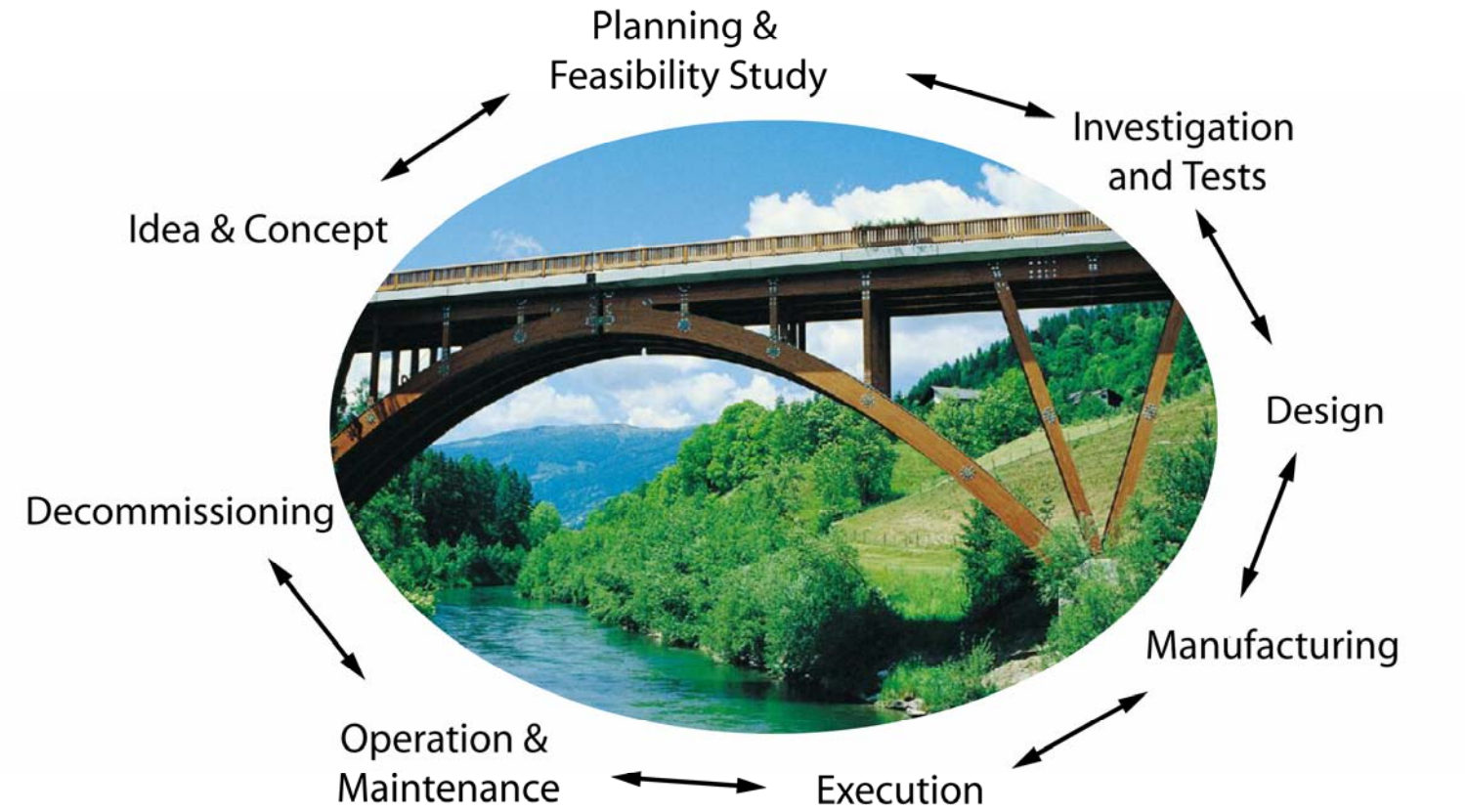
**Jochen Köhler**
**Federal Institute of Technology**
**Zurich, Switzerland**



# Outline

- Motivation
- Objectives
- Scientific Program
- Realization
- Participation
- Communication

# The Life-Cycle of Timber Structures



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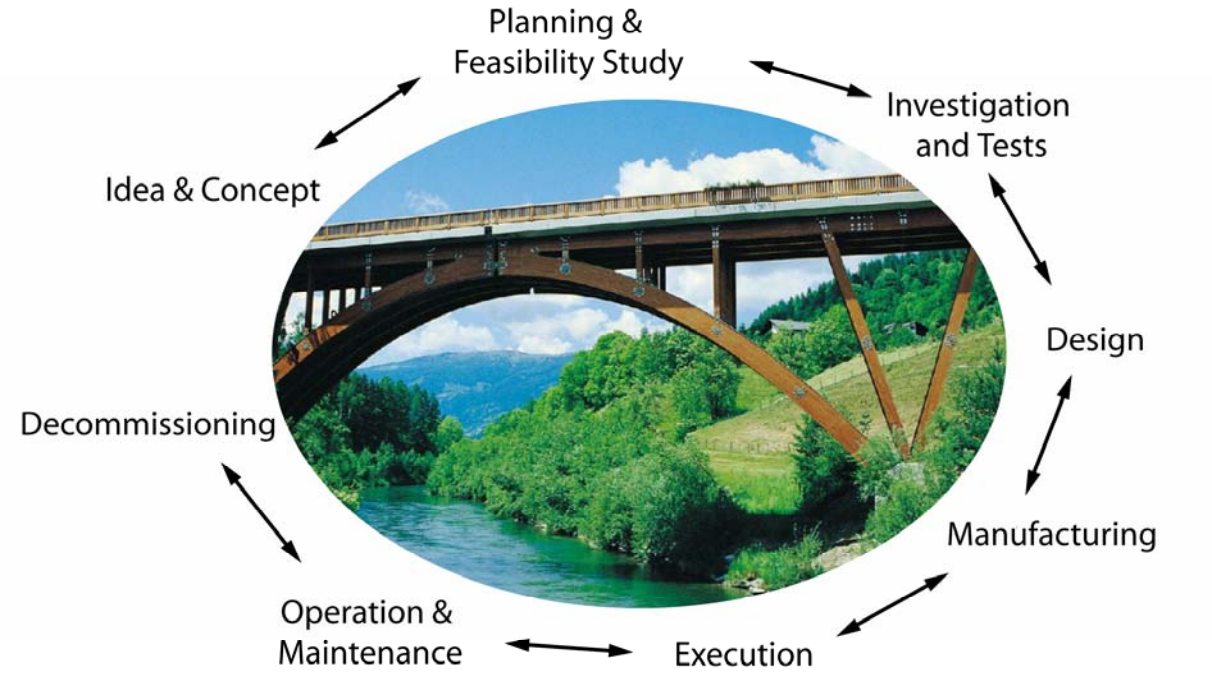
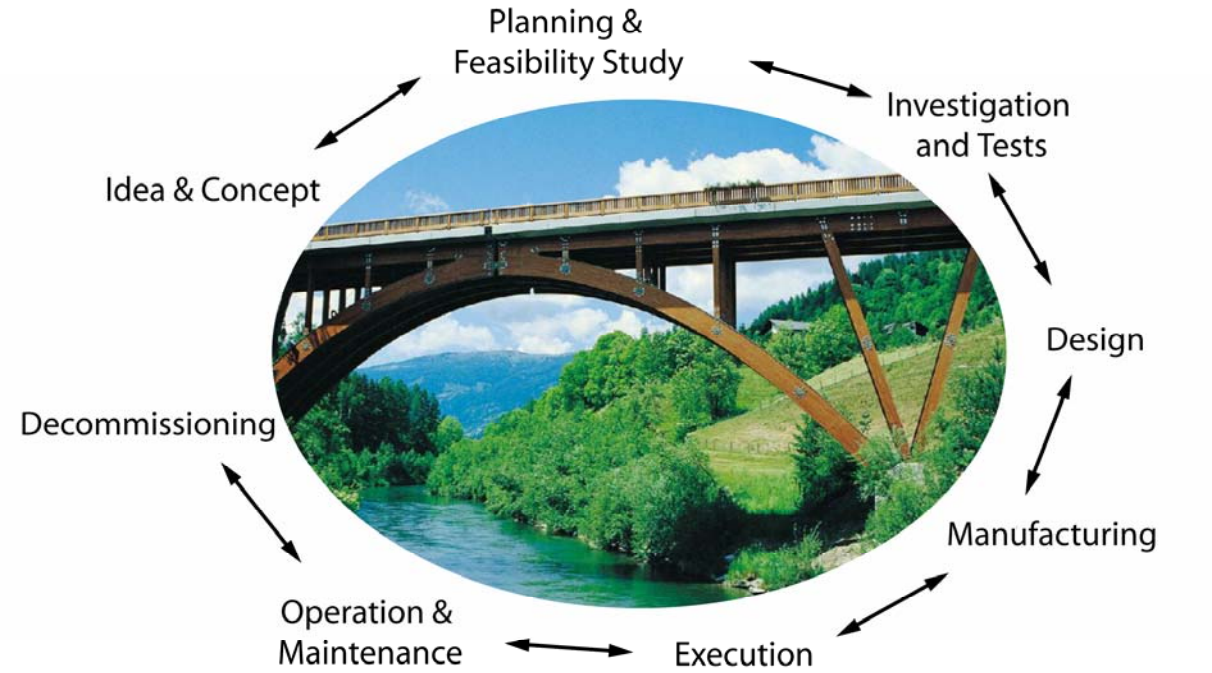



## Decisions under Uncertainty

**Uncertainties related to e.g.**

- **Traffic volume**
- **Loads**
- **Resistances (material, soil,..)**
- **Degradation processes**
- **Service life**
- **Manufacturing costs**
- **Execution costs**
- **Decommissioning costs**

# The Life-Cycle of Timber Structures

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- **Service life**
- **Manufacturing costs**
- **Execution costs**
- **Decommissioning costs**

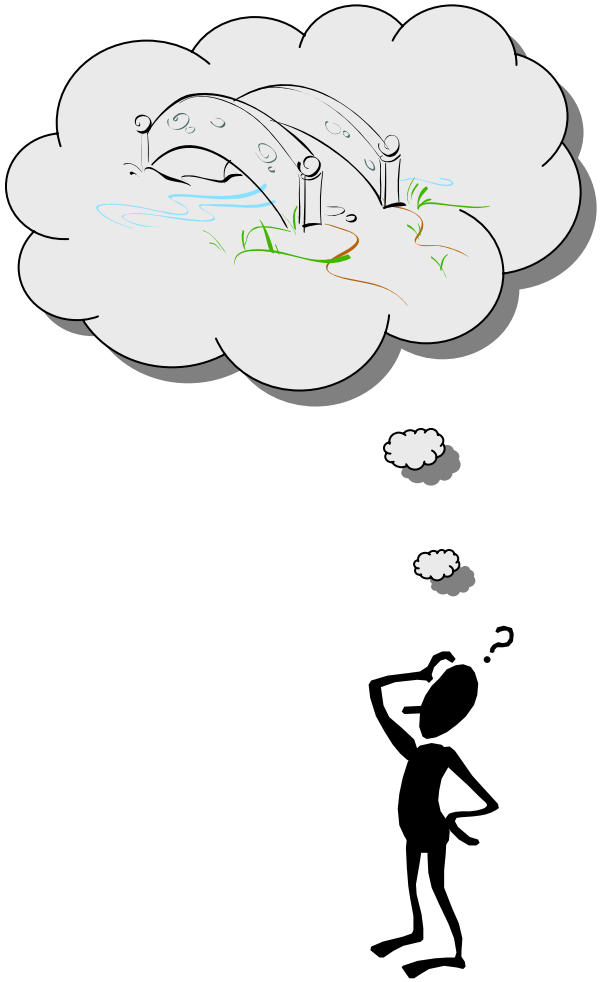
# The Performance of Timber Structures

**Derived from ‚End-User Requirements‘:**

- **Reliability**
- **Serviceability**
- **Durability**
- **Good Value for Money**
- **Good Appearance**

# The Performance of Timber Structures

Structural Engineering Decision Problem:



Design Process:

Risk Screening
(Assessment of Failures and Malfunctions)

↓

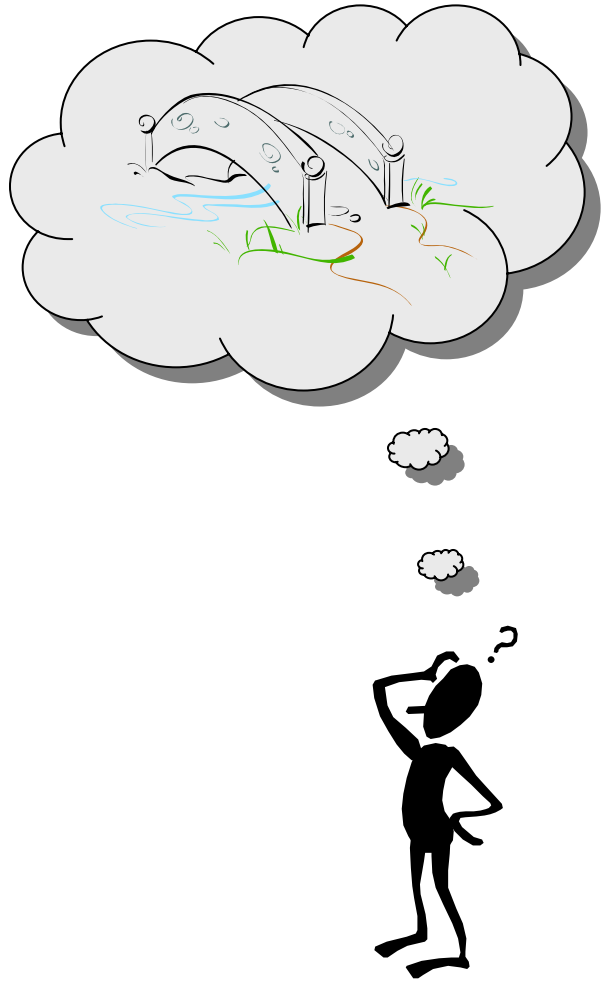
Identification of Design Situations

↓

Detailed Quantification of
Design Strategies

# The Performance of Timber Structures

Structural Engineering Decision Problem:



Design Process:

Risk Screening
(Assessment of Failures and Malfunctions)

↓

Identification of Design Situations

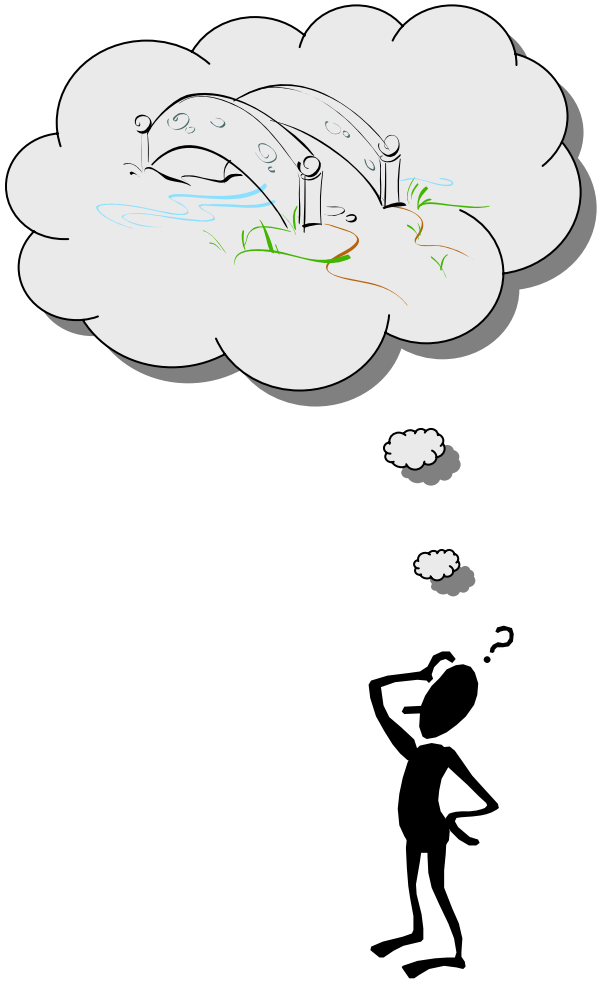
↓

Detailed Quantification of
Design Strategies

Efficient
in terms of the
Performance
(e.g. Expected cost)

# The Performance of Timber Structures

Structural Engineering Decision Problem:



Optimal Design:

Expected Benefit of the Structure

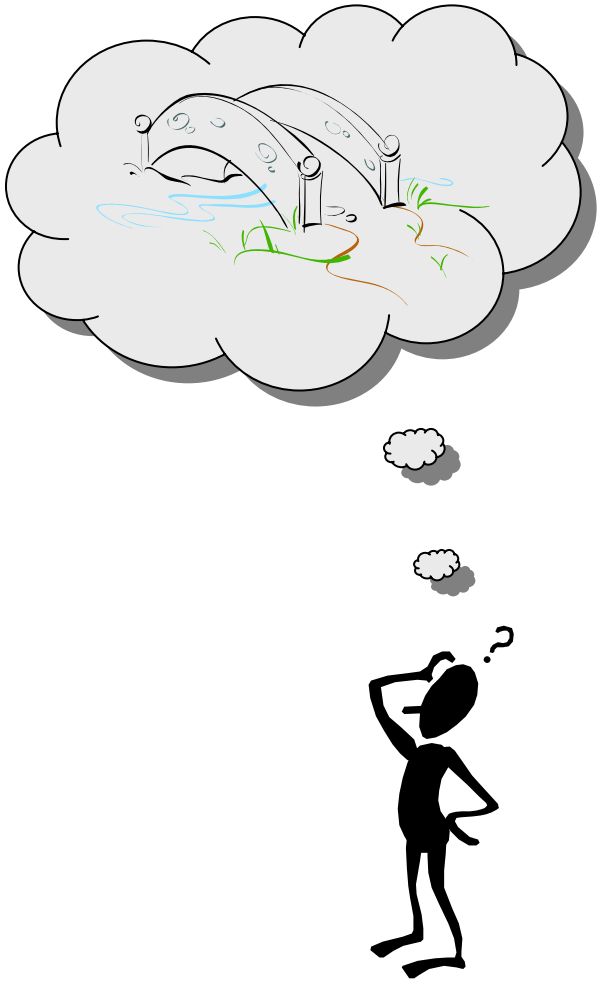
Benefit of the Structure in Service

Reliability Risk

$$E[B] = I\left(1 - P_F\left(C_D\right)\right) - C_D - C_F P_F\left(C_D\right) \Rightarrow \frac{\partial E[B]}{\partial C_D} = 0$$

# The Performance of Timber Structures

Structural Engineering Decision Problem:



Optimal Design:

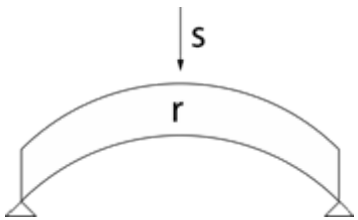
Expected Benefit of the Structure

Benefit of the Structure in Service

Reliability Risk

$$E[B] = I\left(1 - P_F\left(C_D\right)\right) - C_D - C_F P_F\left(C_D\right) \Rightarrow \frac{\partial E[B]}{\partial C_D} = 0$$

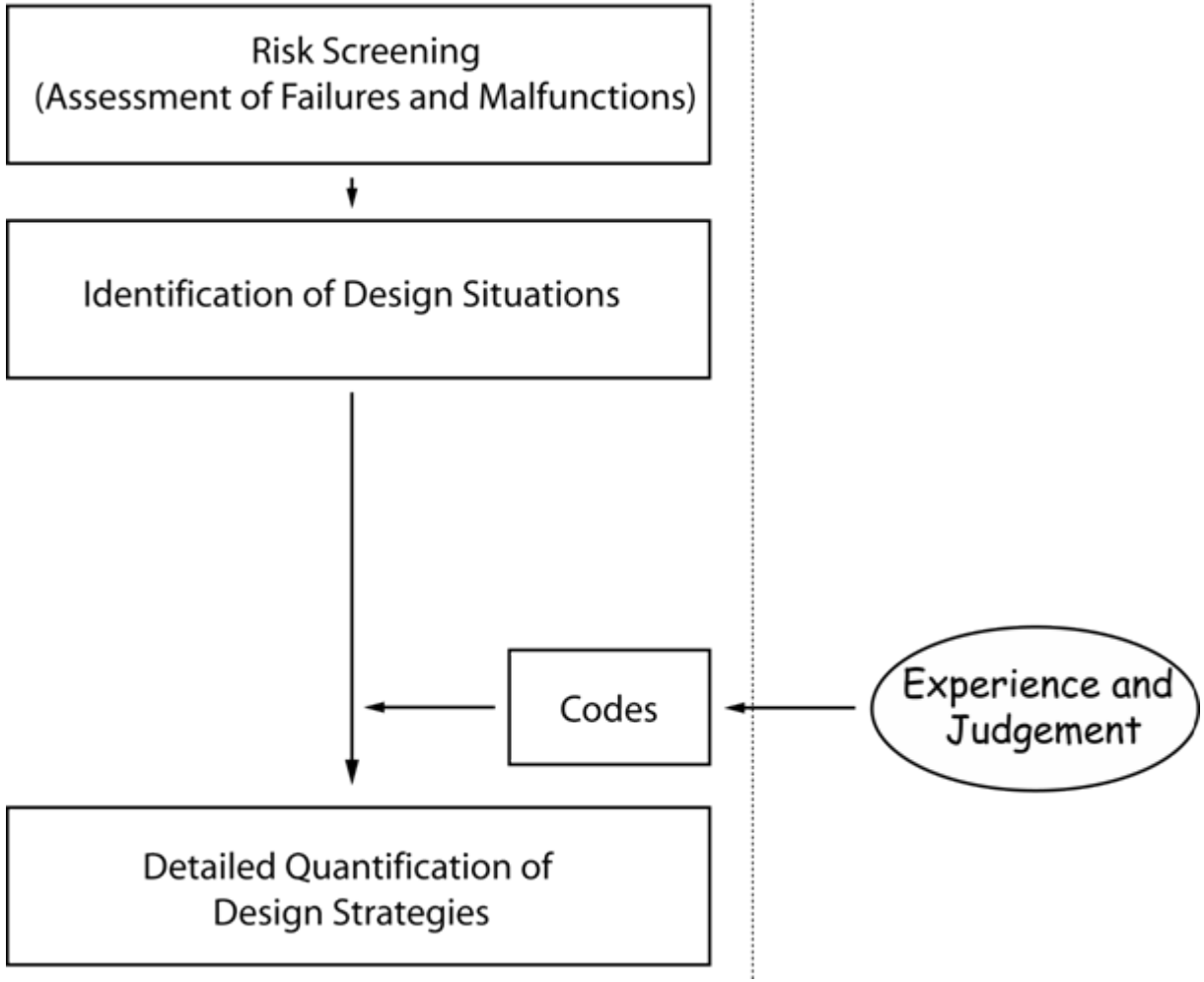
Probability of Failure:




$$P_f = P\left(R - S \le 0\right)$$

$$P_f = P\left(g\left(\mathbf{X}\right) \le 0\right) = \int_{g(\mathbf{x}) \le 0} f_{\mathbf{X}}\left(\mathbf{x}\right) d\mathbf{x}$$

# The Performance of Timber Structures




Codes and regulations:

-Deterministic limit state equations

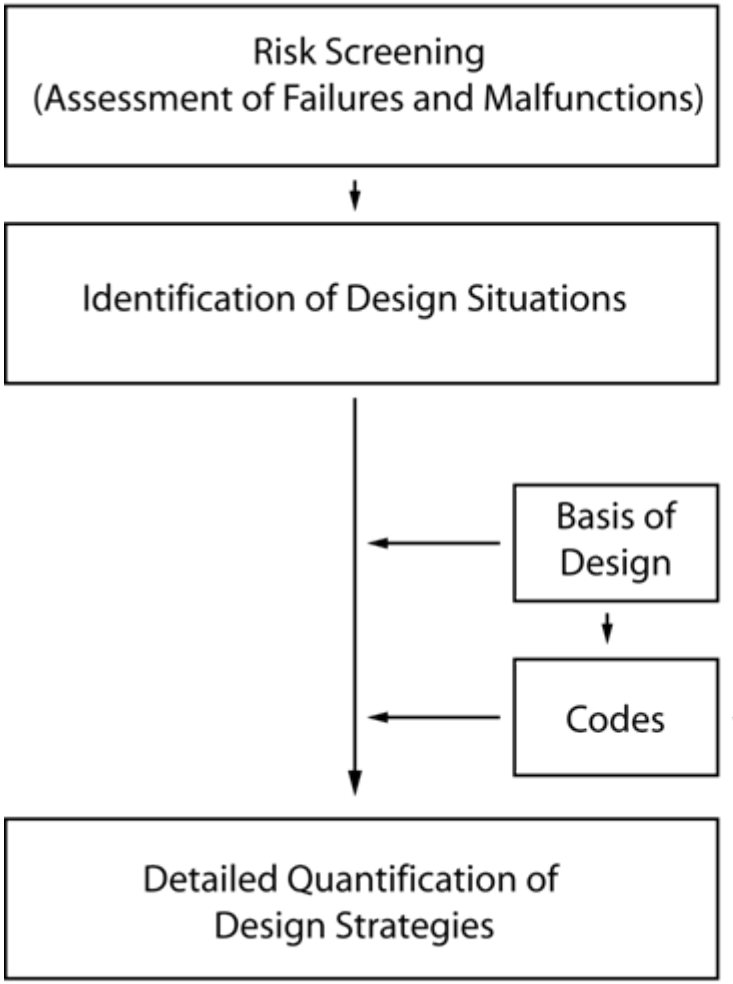
-Loads, resistance, safety factors

--> Decision support tool for engineers

Derived by code authorities

Traditionally based on experience and judgement

# The Performance of Timber Structures




Basis of Design:

-Toolbox for the formal treatment of uncertainties in design

-Probabilistic models for loads and resistances

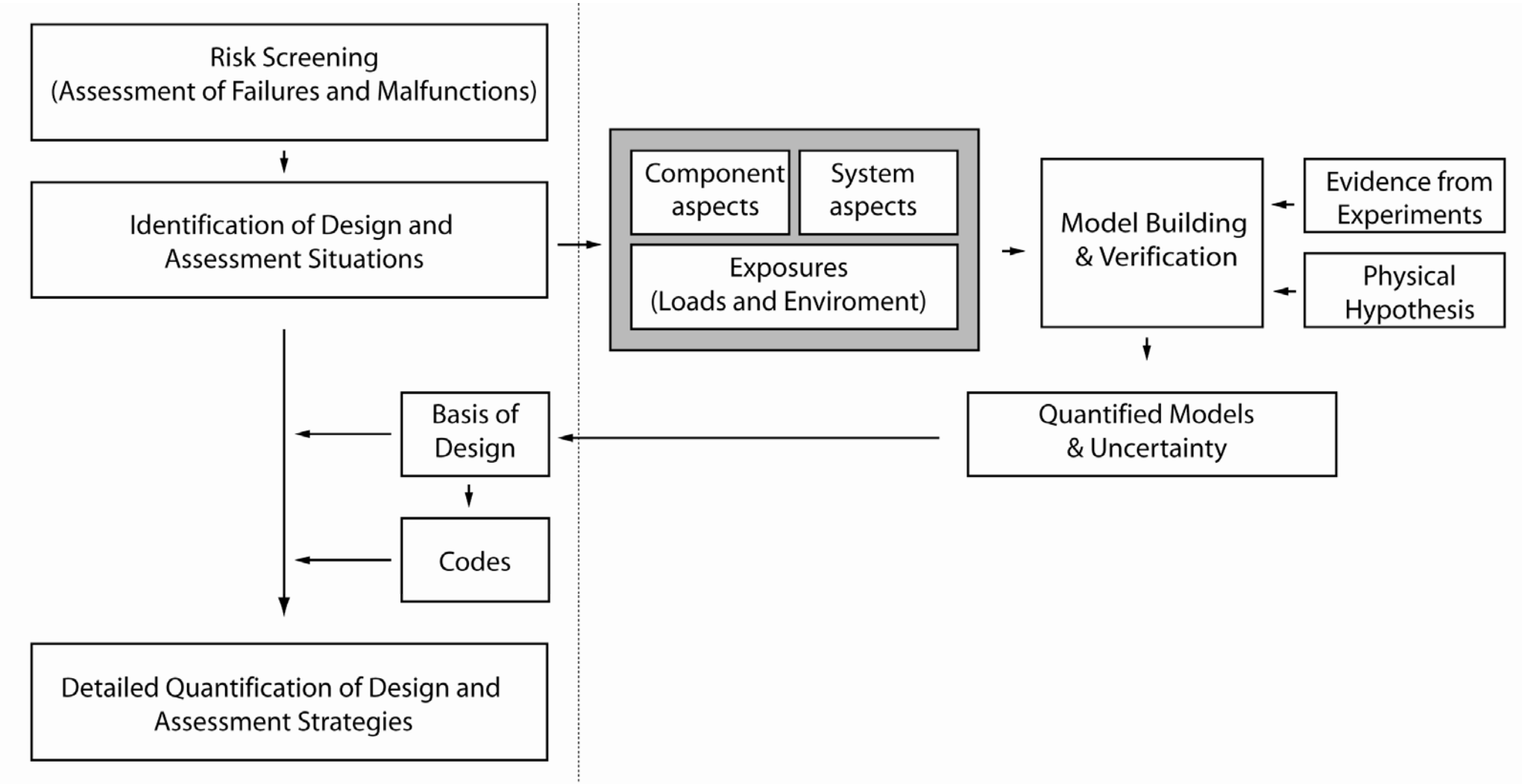
-Reliability methods, decision theory

-->Decision support tool for code authorities

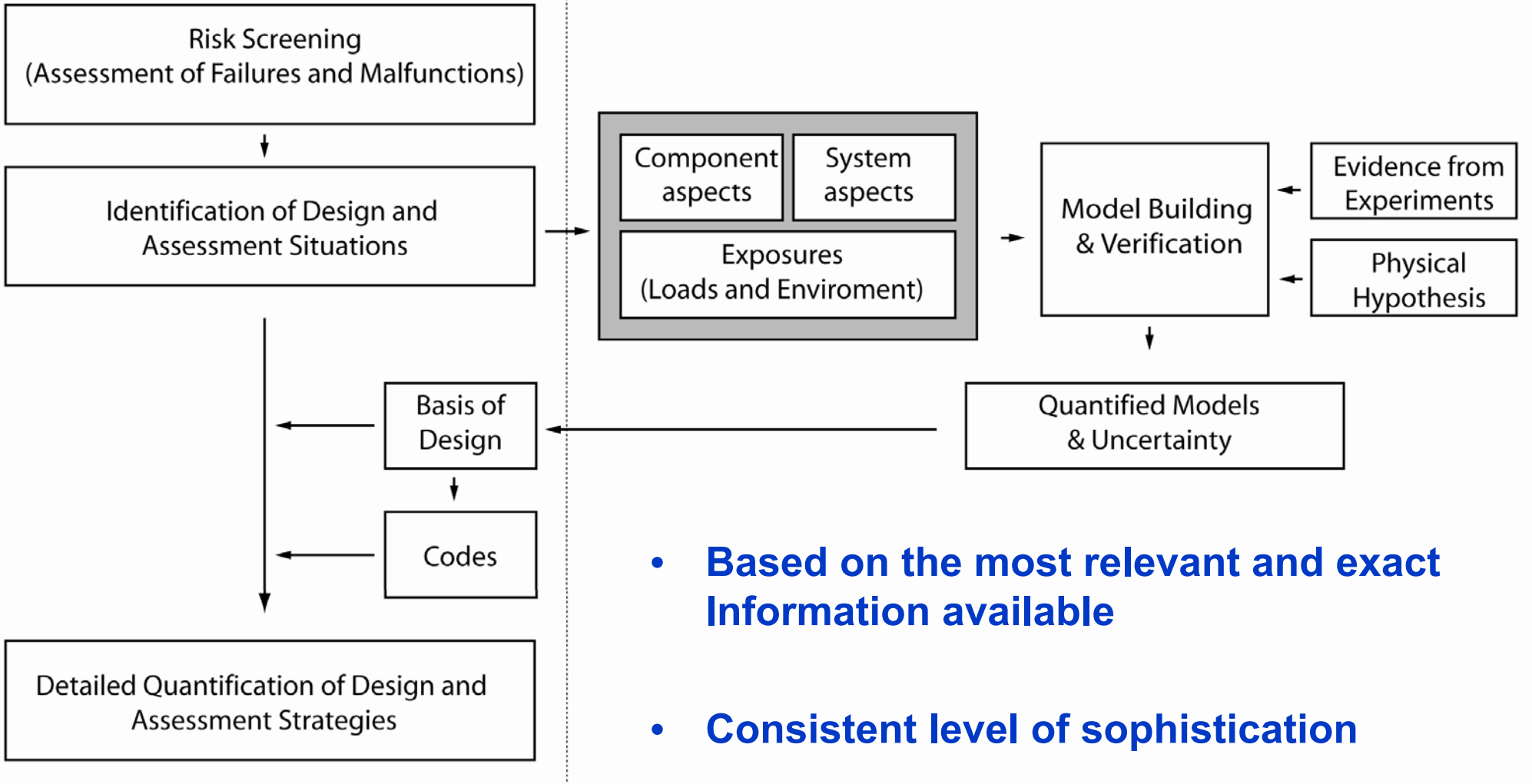
-->JCSS Probabilistic Model Code

+ Research findings (e.g. CIB W18)

# The Performance of Timber Structures

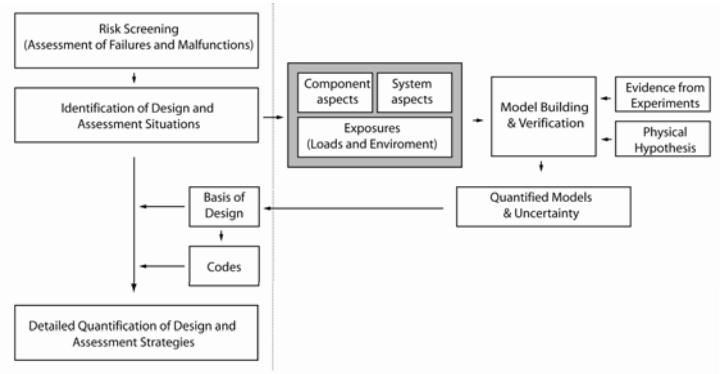


# The Performance of Timber Structures



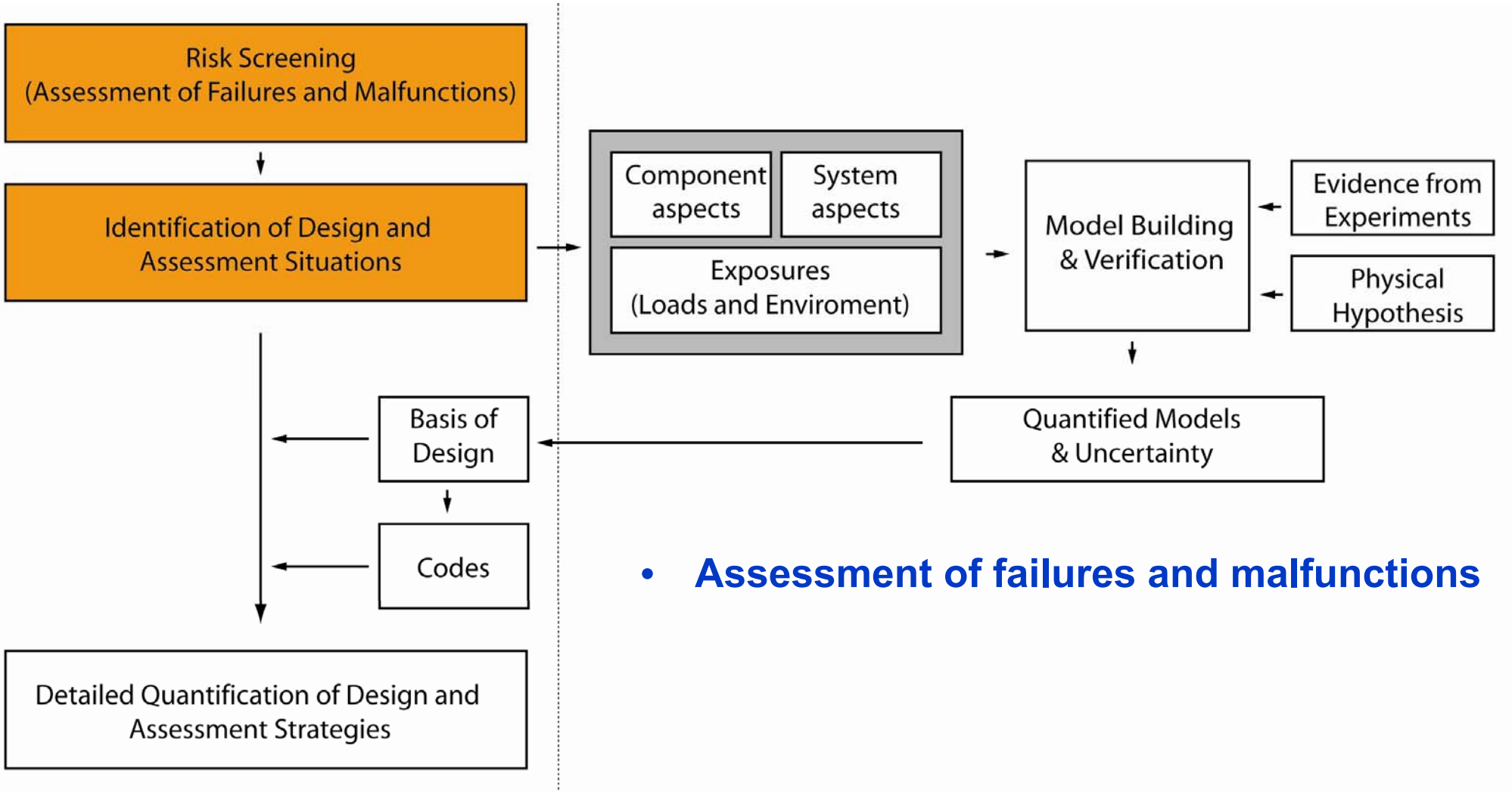

- **Based on the most relevant and exact Information available**
- **Consistent level of sophistication**

# What are the goals?



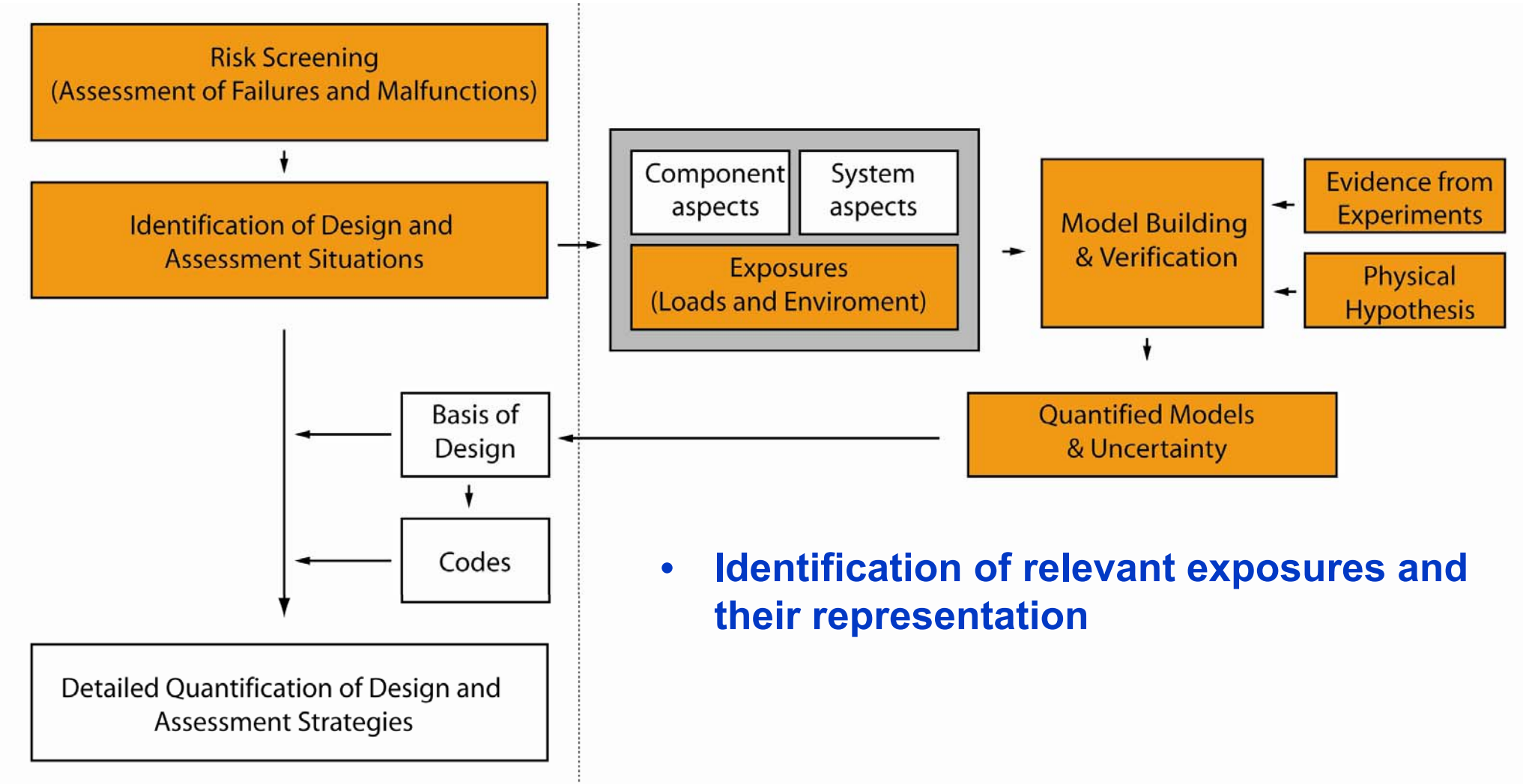

- **Identify what is really essential to research further**
- **Verify models for component and system performance for timber structures**
- **Extend the focus to the operation and maintenance phase of the structures' lifecycle**

# What are specific objectives?



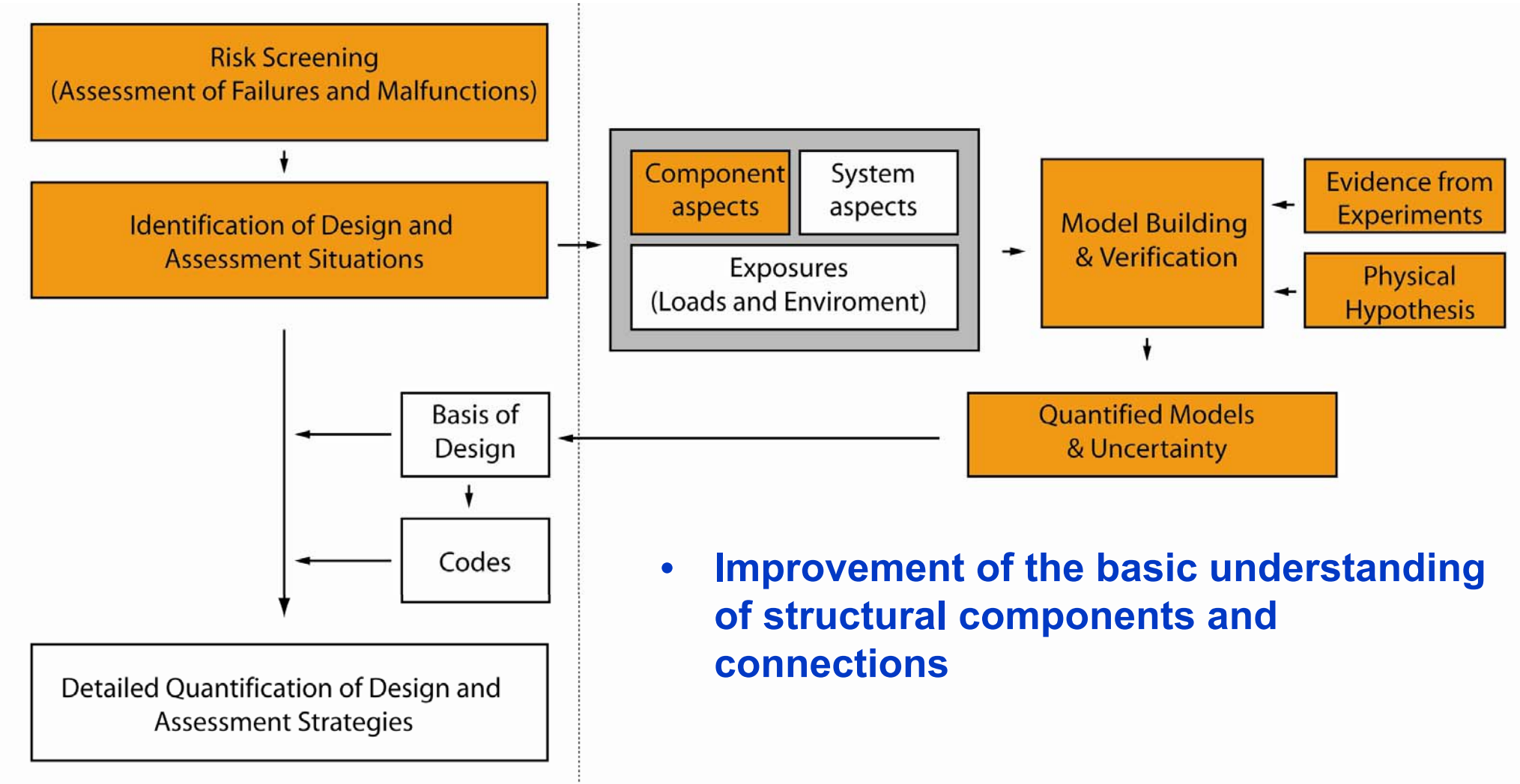

- **Assessment of failures and malfunctions**

# What are specific objectives?



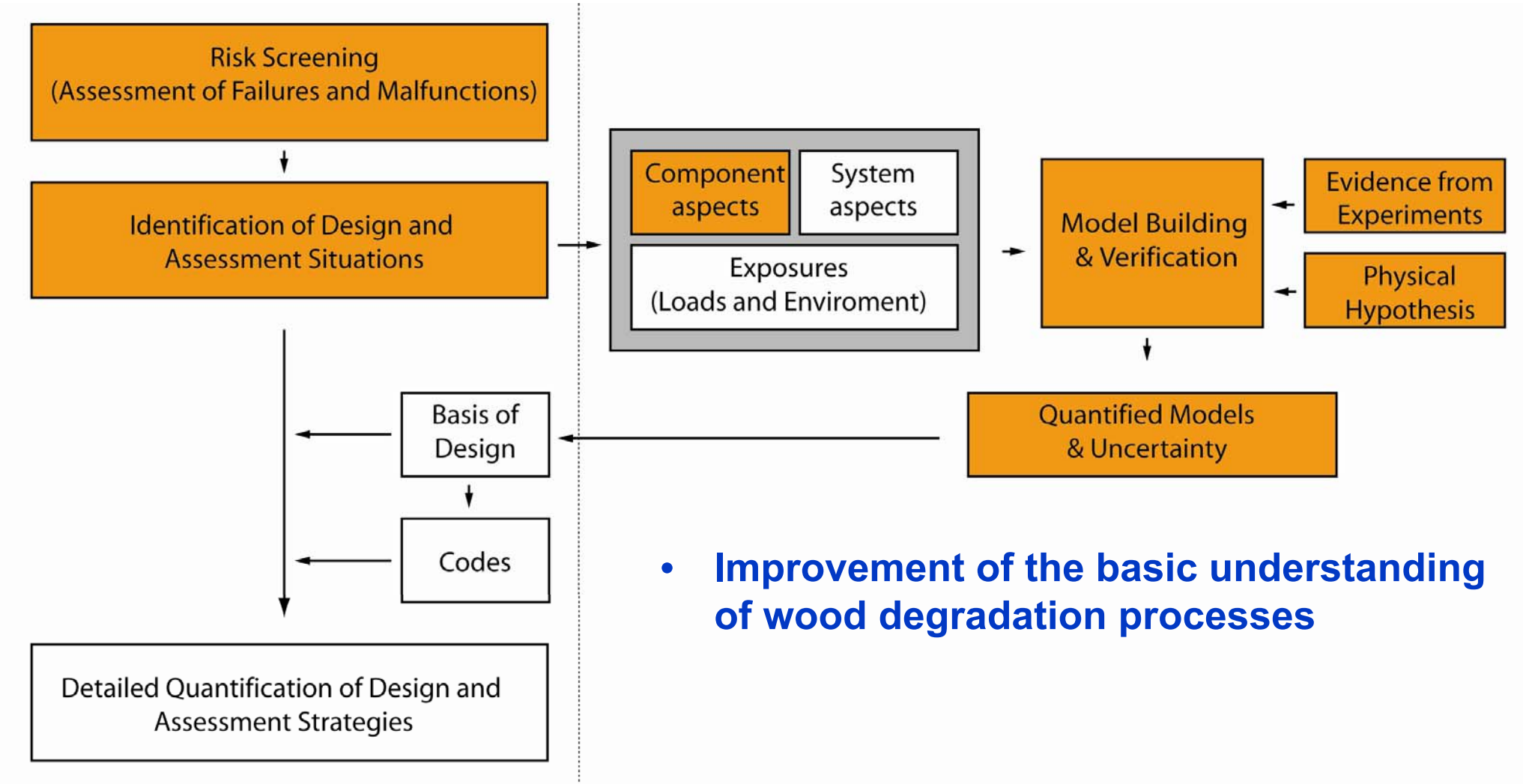

- **Identification of relevant exposures and their representation**

# What are specific objectives?



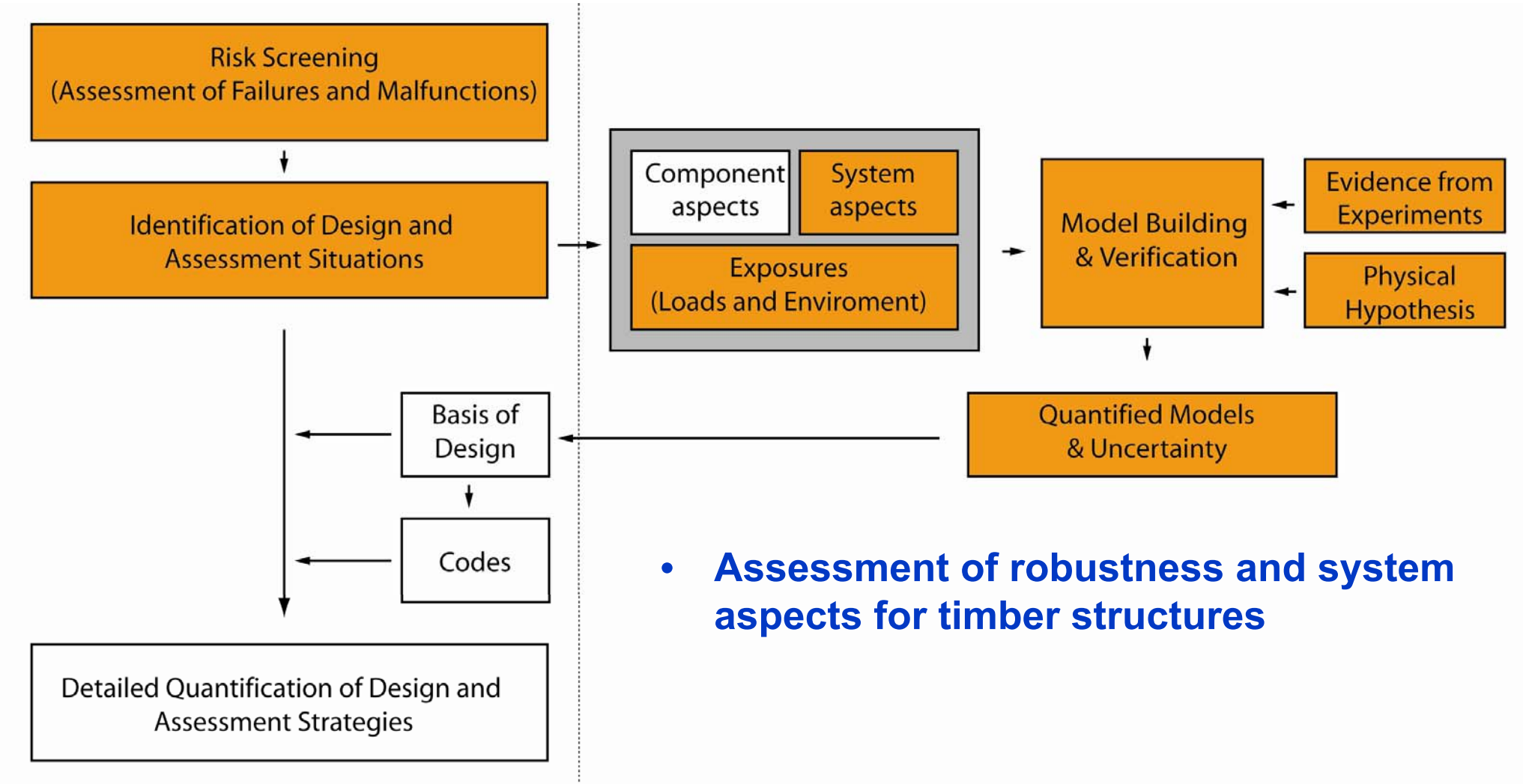

- **Improvement of the basic understanding of structural components and connections**

# What are specific objectives?



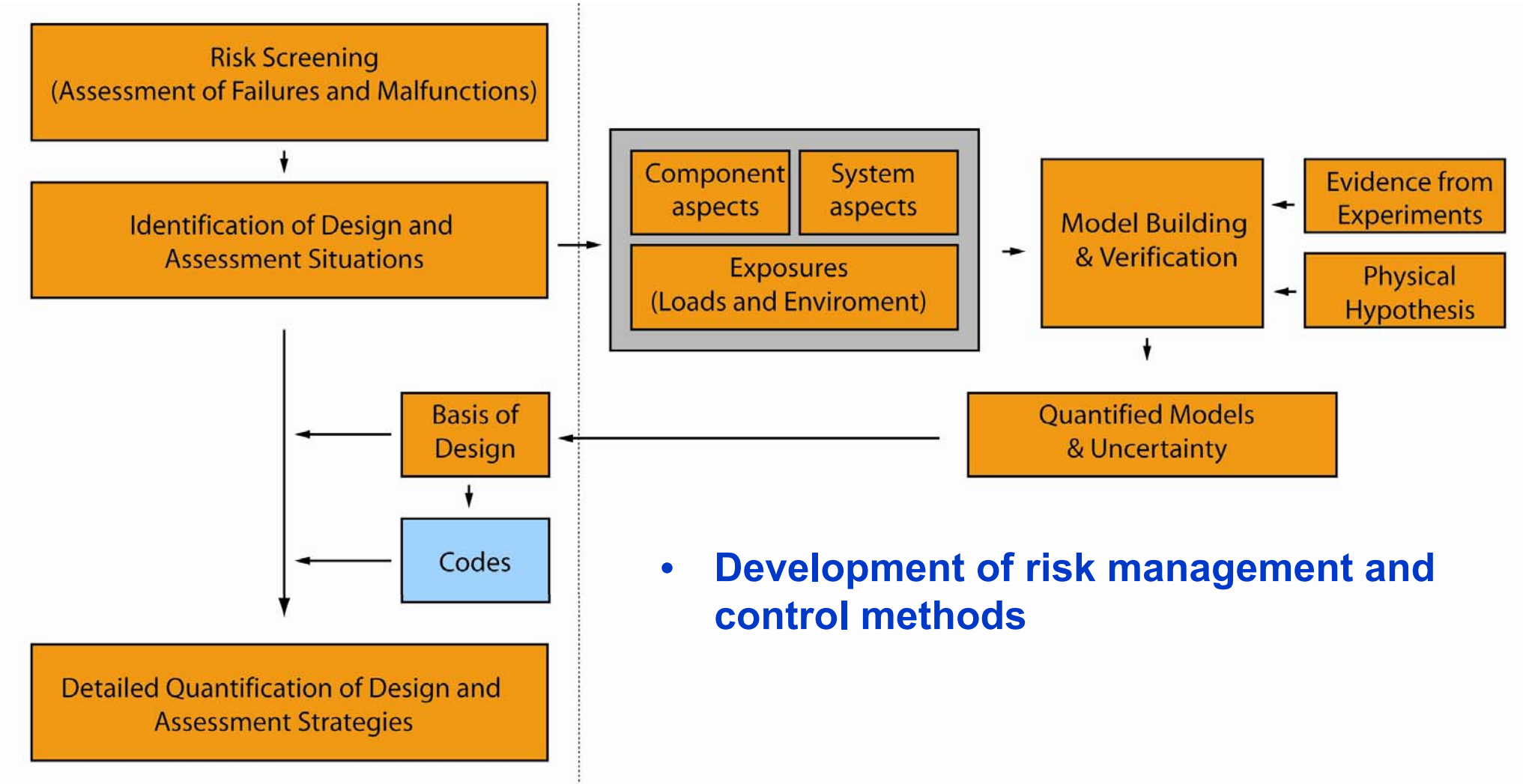

- **Improvement of the basic understanding of wood degradation processes**

# What are specific objectives?




- **Assessment of robustness and system aspects for timber structures**

# What are specific objectives?




- **Development of risk management and control methods**

# The Benefit

- **Improving design methods, assessment techniques and maintenance policies**

➢ **Tools which make engineers and planners more confident working with timber**

➢ **Structures which provide expected high performance**

# Scientific Program

- **Three main areas:** → **Three Working Groups:**

  - **Assessment of failures** → **WG1**
  - **Vulnerability of components** → **WG2**
  - **Robustness of systems** → **WG3**

# WG1 - Assessment of failures

- Collecting information about failed and malfunctioning timber structures and components
- Analysis of the failure and malfunctioning mechanism
- Identification of relevant design and assessment situations

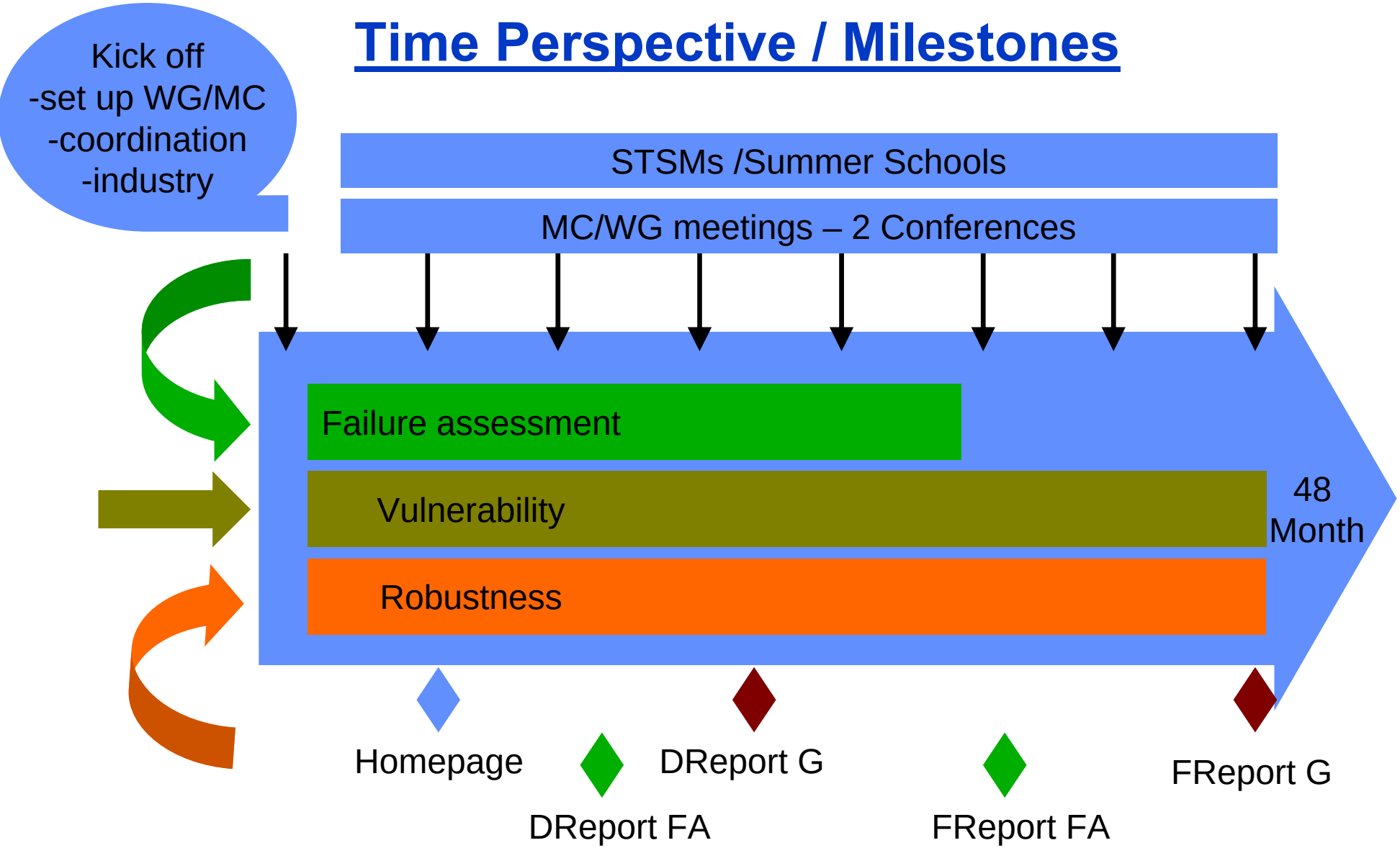
# WG2 - Vulnerability of components

- Basic strength and stiffness properties of graded timber material and engineered timber products
- Dependency of these properties on load and climate scenarios, size dependencies
- Strength and stiffness properties of connections
- Modeling of the durability of timber components and connections

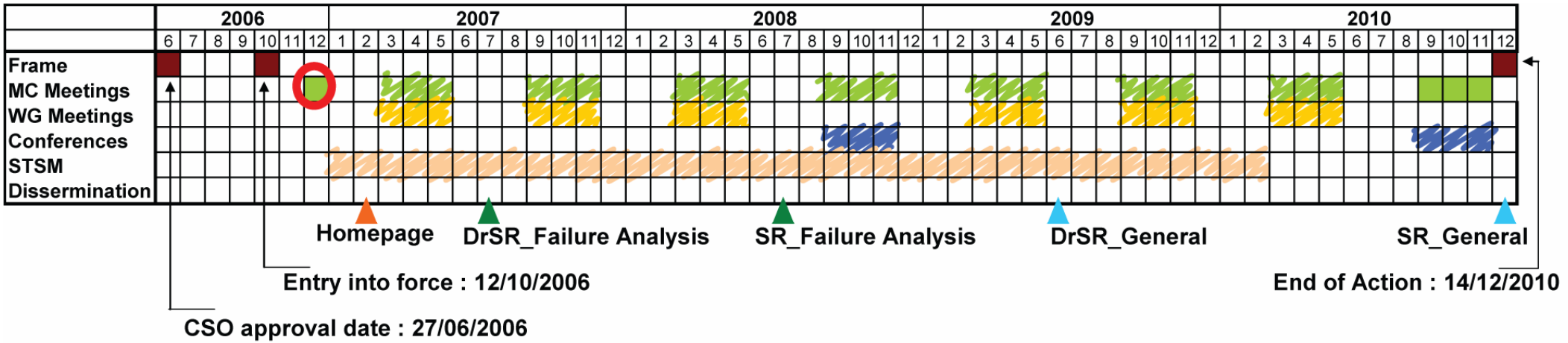
# WG3 - Robustness of systems

- Characterization of multi-scale variability in timber structures
- Analysis of system effects for several types of timber structures
- Qualification of robustness as a characteristic of timber structures
- Establishing a framework for reliability based design and assessment of timber structural systems based on these considerations

# Time Perspective / Milestones



# Time Perspective / Milestones




SR: Scientific Report
DrSR: Draft Scientific Report

# Related National Projects

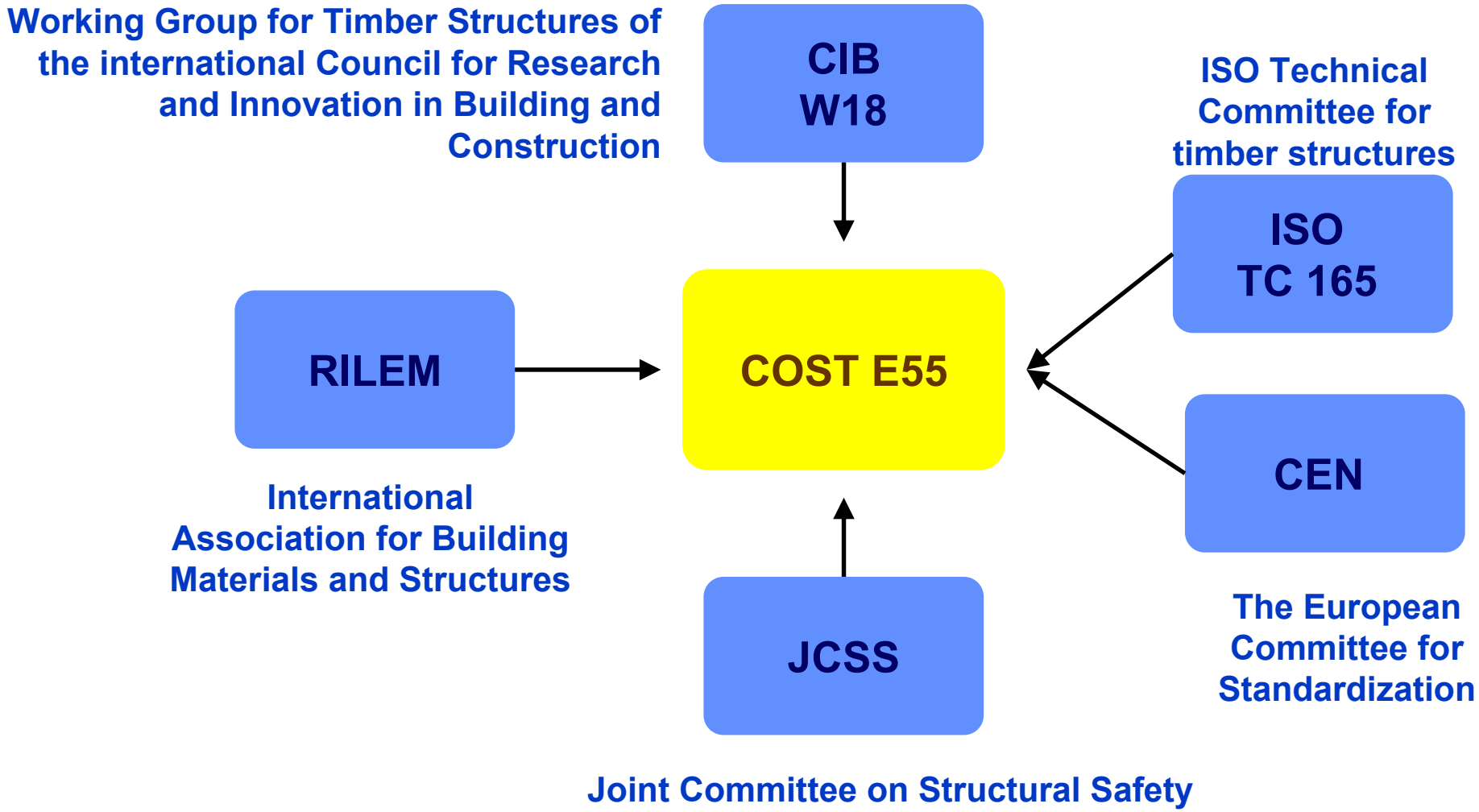
**COST E55**

**E.g.***

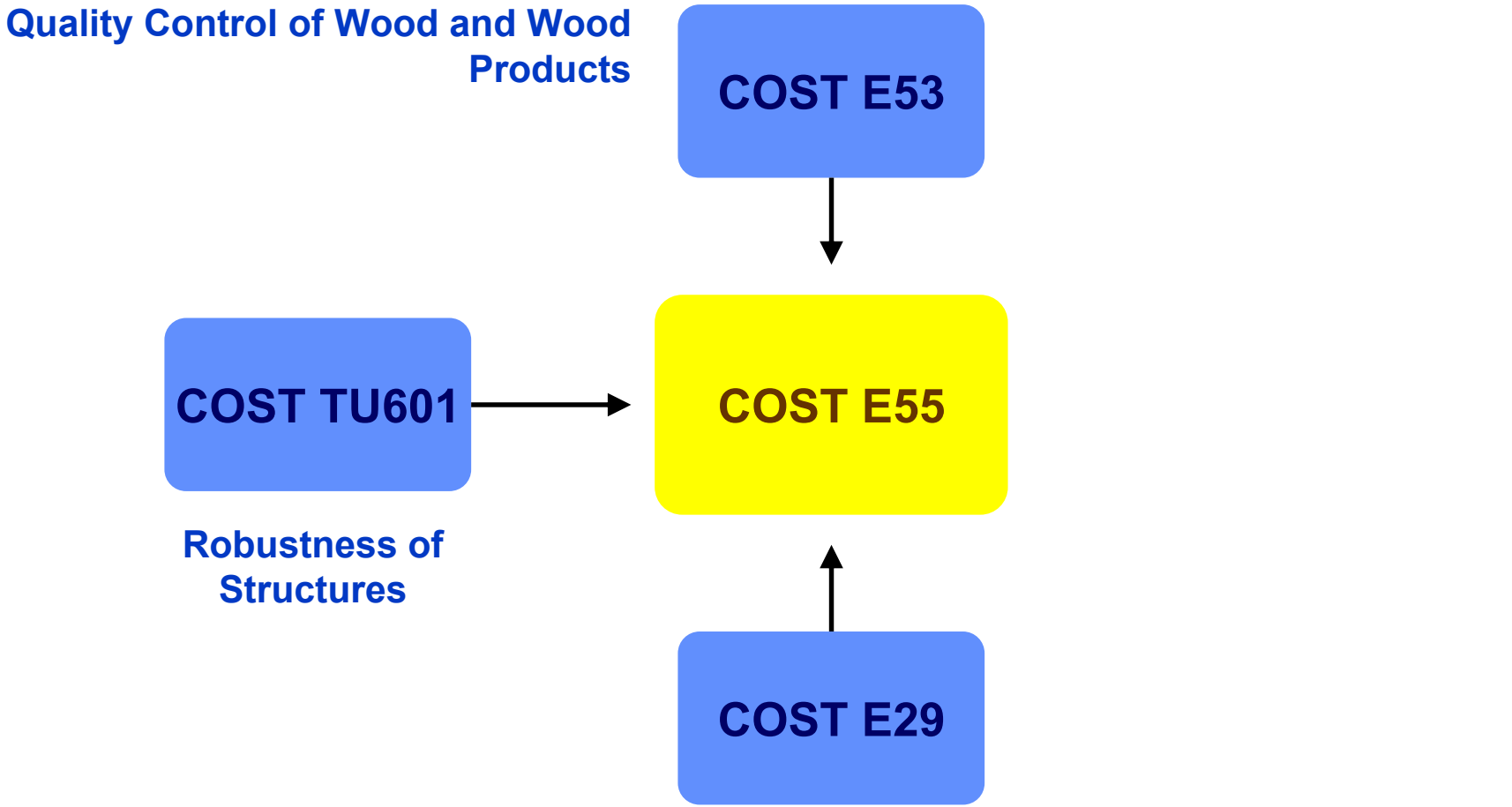
- **Sweden/Finland: Assessment of Failures**
- **France: Glued Laminated Timber, Repair, System effects**
- **Switzerland: Glued Laminated Timber, Reliability, Grading**
- **The Netherlands: Connections, Grading**
- **Denmark: Moisture/Time – Strength/Stiffness**
- **Sweden: Moisture/Time – Strength/Stiffness**
- **Germany: Size effects, Assessment of Failures**
- **…**

***(Information obtained during approval phase, needs to be updated)**

# Link to research communities and code authorities



# Link to other COST Actions



# Researchers from:

(14/12/06)

| Signatures | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Country | Date | Status | Country | Date | Status | Country | Date | Status |
| Belgium | 03/10/2006 | Confirmed | Denmark | 06/10/2006 | Confirmed | Finland | 13/10/2006 | Confirmed |
| France | 29/11/2006 | Confirmed | Germany | 13/10/2006 | Confirmed | Ireland | 12/12/2006 | Confirmed |
| Netherlands | 04/10/2006 | Confirmed | Norway | 02/10/2006 | Confirmed | Portugal | 05/12/2006 | Confirmed |
| Slovenia | 13/10/2006 | Confirmed | Spain | 03/11/2006 | Confirmed | Switzerland | 12/12/2006 | Confirmed |
| United Kingdom | 12/10/2006 | Confirmed | | | | | | |
| Total | 13 | | | | | | | |
| Intentions to sign | | | | | | | | |
| Austria | 22/08/2006 | Intention | Croatia | 17/11/2006 | Intention | Italy | 29/11/2006 | Intention |
| Total | 3 | | | | | | | |

# indicated their interest for participation

# Dissemination

- Promoting interdisciplinary, international research
- Participate in conferences organized by other relevant associations
- Publishing of co-authored papers
- Publishing information on the WWW
- Scientific Reports

# Summary of the MoU

- **The main objective of the Action is to provide the basic framework and knowledge required for the efficient and sustainable use of timber as a structural and building material.**
- **The scientific content will be developed by 3 working groups:**
  - **WG1: Assessment of Failures;**
  - **WG2: Vulnerability of Components**
  - **WG3: Robustness of Systems**
- **A lively interaction to other research communities and code authorities is crucial and will be actively developed / maintained.**

# Distribution of Tasks

- Working Group Leaders
- MC Reporting
- Grant Holder
- Homepage Responsible

- Core Group
- Coordinator – Research Associations / Code Authorities
- …

# Intermediate-Term Planning

## Tentative Proposal (Progressive):

| | |
|---|---|
| **National Promotion** | **Immediately** |
| **Core Group Meeting** | **January 07** |
| **Invitation Workshop** | **January 07** |
| **Homepage** | **February 07** |
| **Folder** | **February 07** |
| **Submission of Workshop Contributions** | **April 07** |
| **Workshop** | **April 07** |
| | |

# The Core Group Meeting

**Tentative Proposal:**

- **Organization of the Workshop**
- **Set up of a WS Program**
- **Creation Folder**
- **Review Homepage draft**

- **Where and when?**

# The Workshop

**Tentative Proposal:**

- **40 – 50 Participants approx. 3 per Country, evtl. Guest speakers.**
- **2 Full Days.**
- **Country wise brief presentations of the participating institutions (background, potential and expectations).**
- **4 lectures – General, Assessment of Failures, Components, Robustness.**
- **Plenum discussions.**
- **Presentation of (a) case stud(y)ies.**

- **MC meeting.**

# Long-Term Planning

## Tentative Proposal (Progressive):

| | |
|---|---|
| **Short Term Scientific Mission** | **Always** |
| **2. WS – Failure Analysis (open)** | **May 07**** |
| **Draft Research Report Failure Analysis** | **June 07** |
| **CIB W 18 Co Authored Contributions** | **August 07** |
| **3. WS** | **Autum** |

# Long-Term Planning

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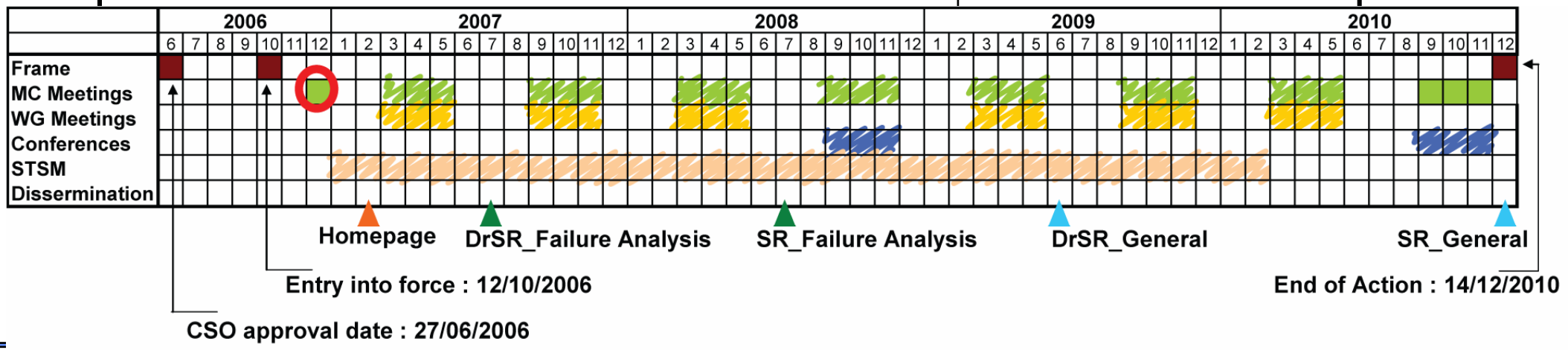


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Thank you for
your attention