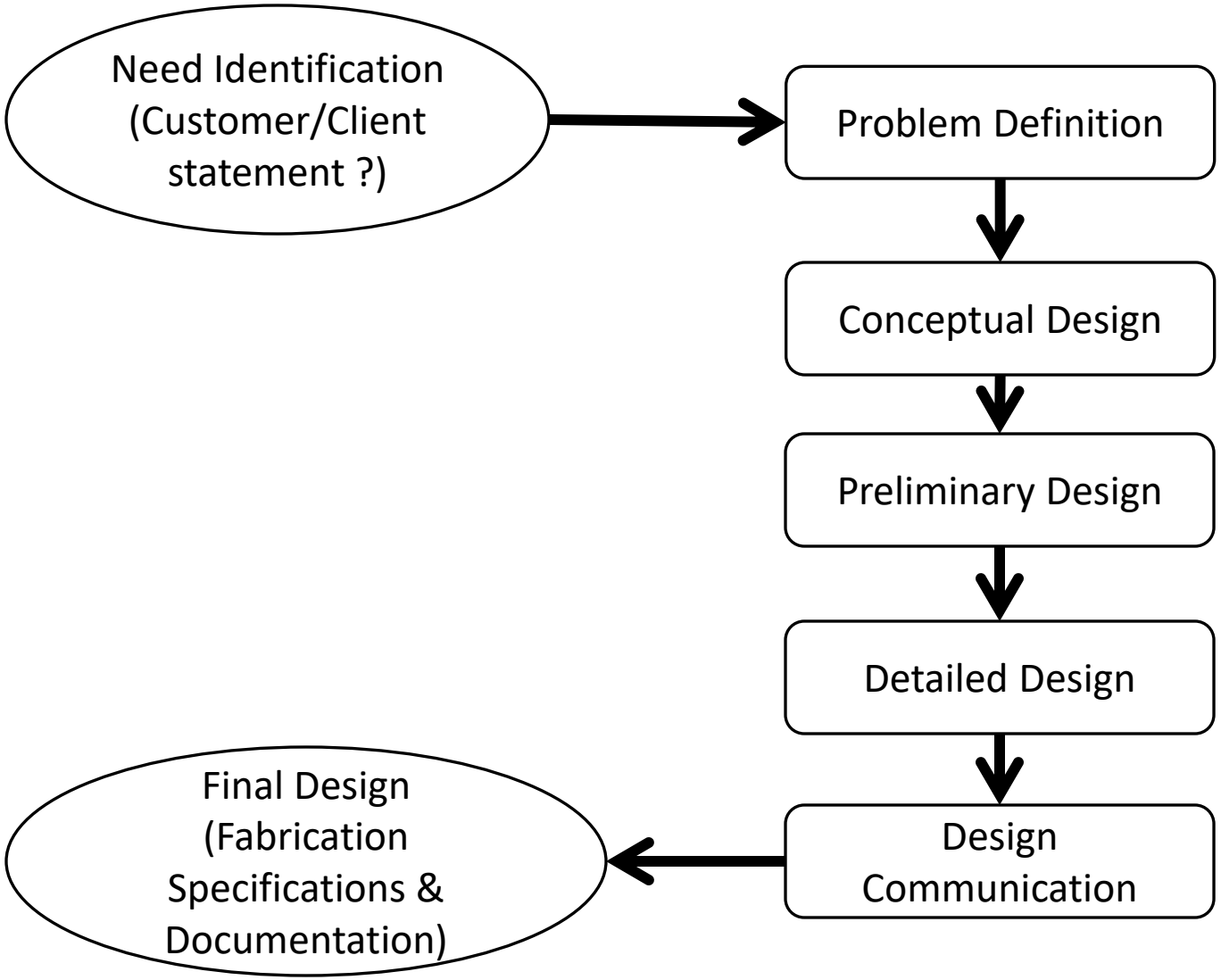
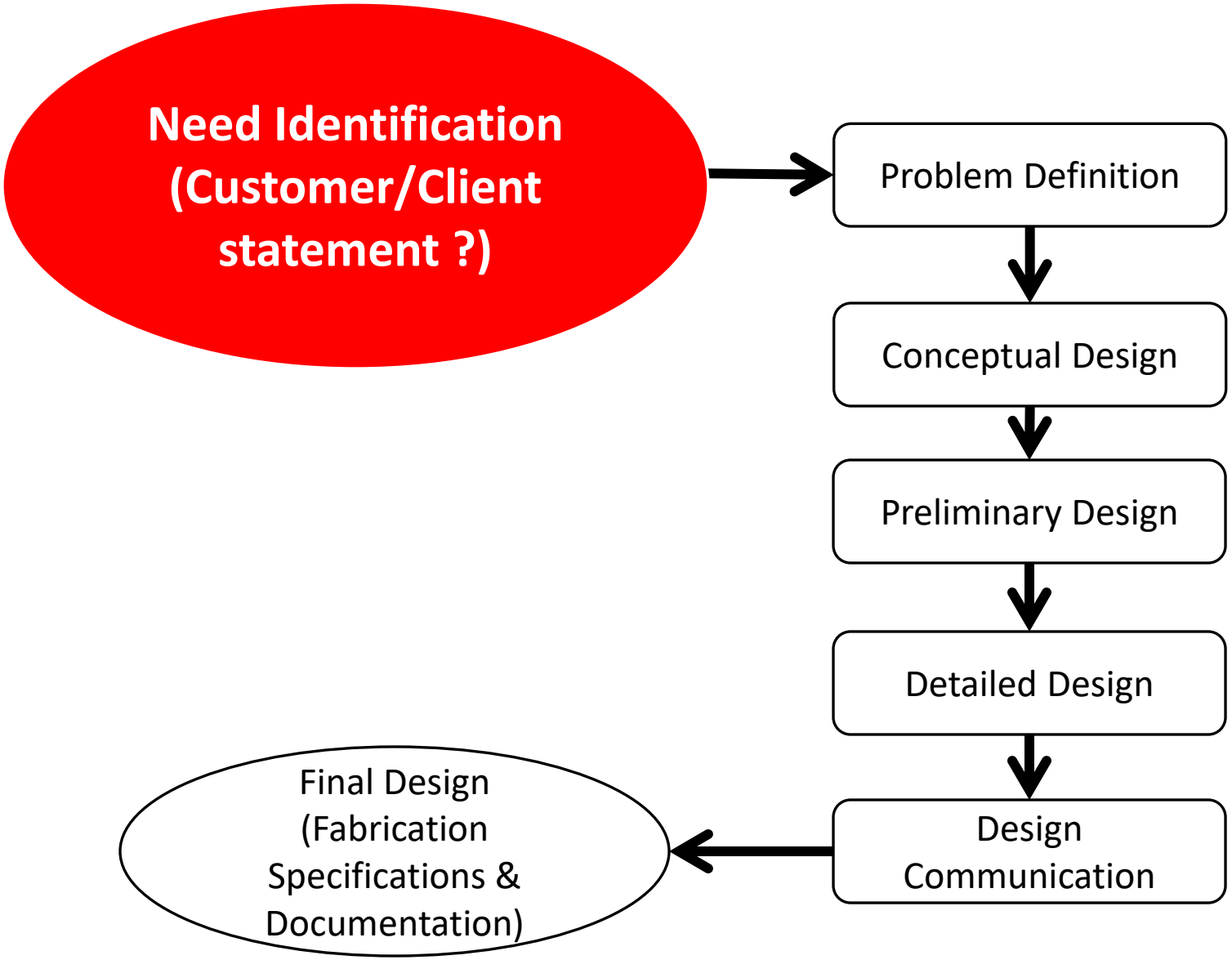
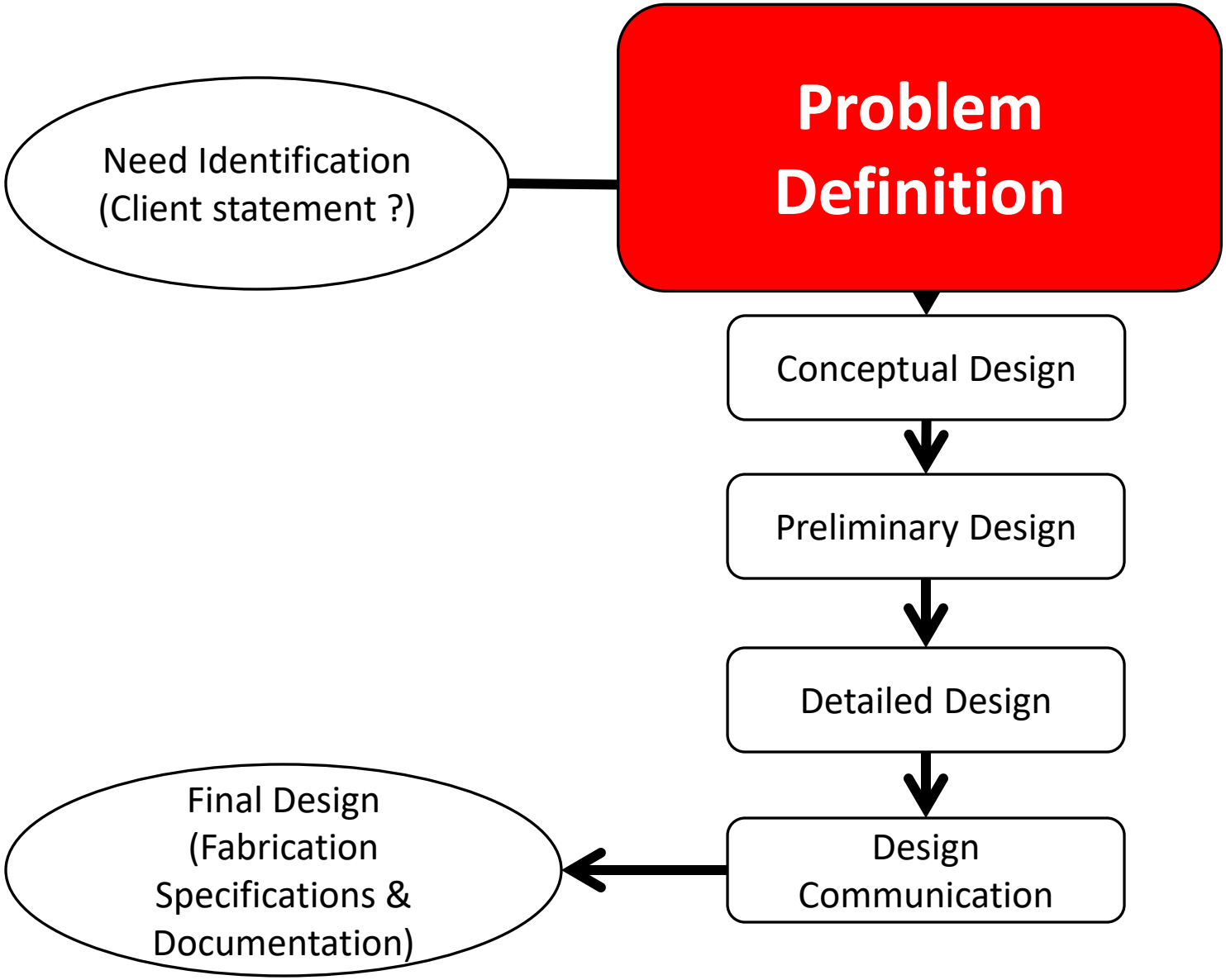


Engineering Design Process: Main Phases



Engineering Design Process: Main Phases



Engineering Design Process: Main Phases

Problem Definition

Input:
Client's statement

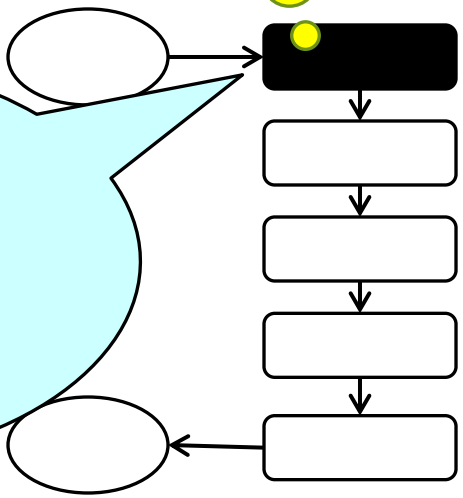
Tasks:
Clarify design objectives (1)
Establish user requirements (2)
Identify constraints (3)
Establish functions (4)

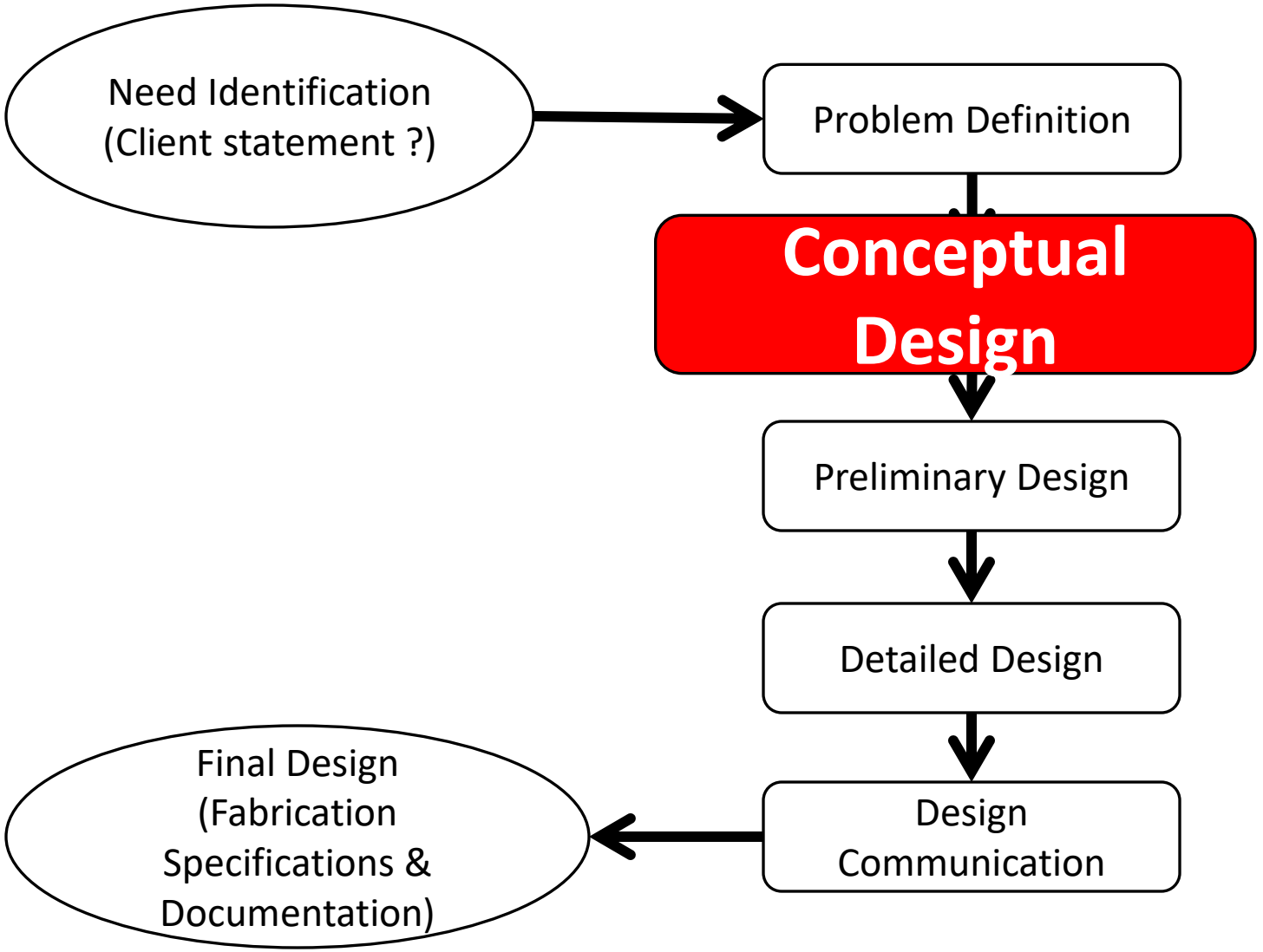
Output:
Revised problem state
Refined objectives
Constraints
User requirements
Functions

Information:
Literature on the state-of-the art
Experts
Standards and codes

Methods:
Objectives tree
Function-means tree
Requirements matrix

Means:
Literature review
Brainstorming
User surveys and questionnaries
Interviews





Engineering Design Process: Main Phases

Conceptual Design

Input:

Revised problem statement
Refined objectives
Constraints
User requirements
Functions

Tasks:

Establish design specifications (5)
Generate design alternatives (6)

Output:

Conceptual design(s)
Design specifications

Sources of Information:

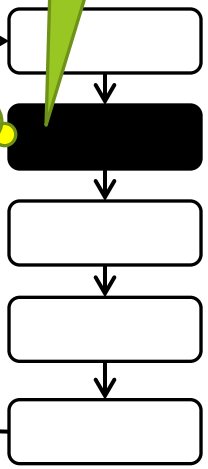
Competitive products

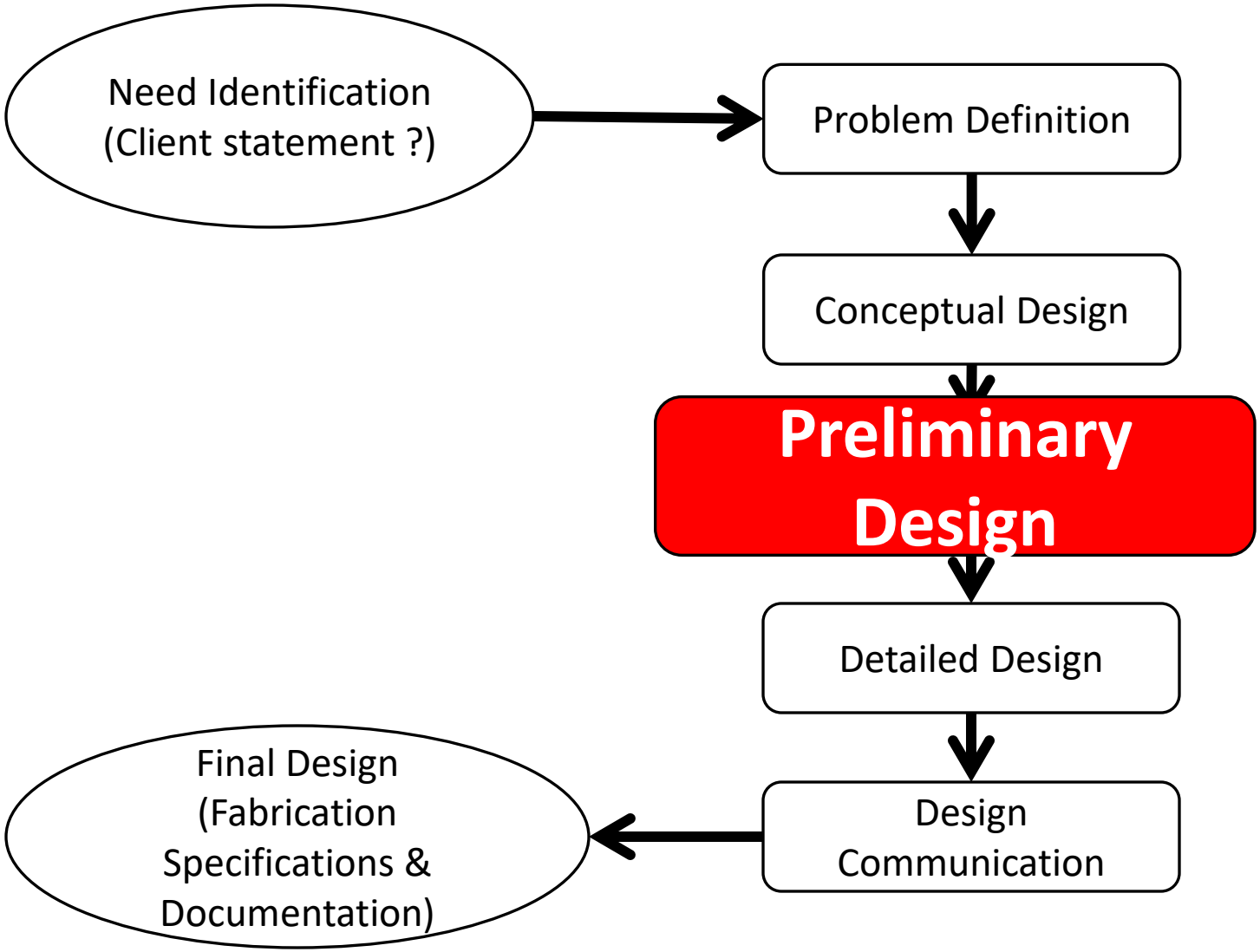
Methods:

Quality function deployment (QFD)
Morphological chart

Means:

Brainstorming, synectics and analogies, benchmarking and reverse engineering





Engineering Design Process: Main Phases

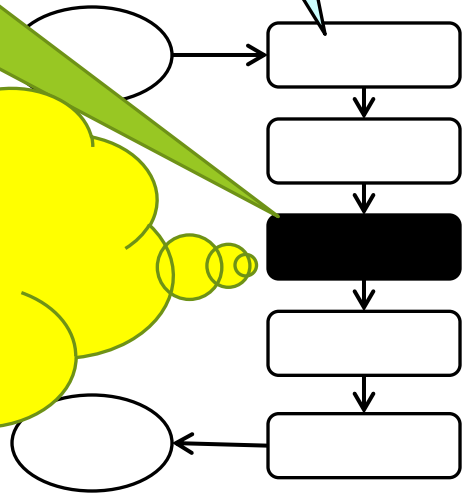
Preliminary Design

Means:
Laboratory experiments, prototype development, simulation and computer analysis

Input:
Conceptual design(s)
Design specifications

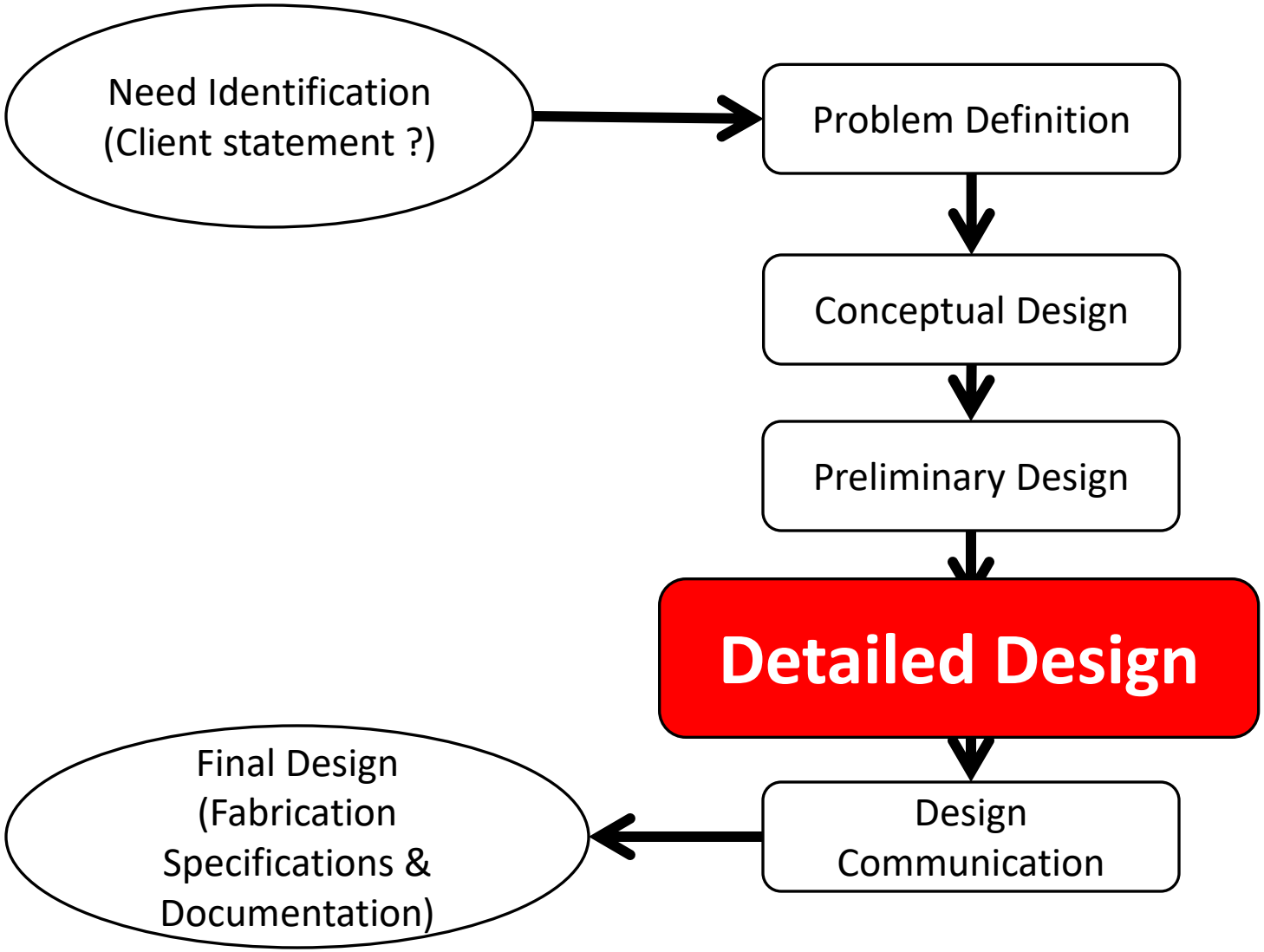
Sources of Information:
Rules of thumb
Simple models
Known physical relationships

Tasks:
Model and analyze conceptual design (7)
Test and evaluate conceptual design (8)



Methods:
Refined objectives tree
Comparison charts

Output:
A selected design
Test and evaluation results



Engineering Design Process: Main Phases

Detailed Design

Input:
A selected design
Test and evaluation results

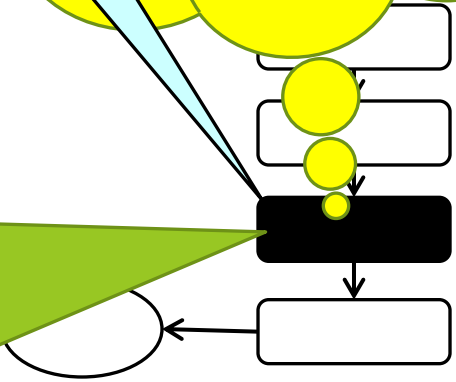
Means:
Formal review
Public hearing

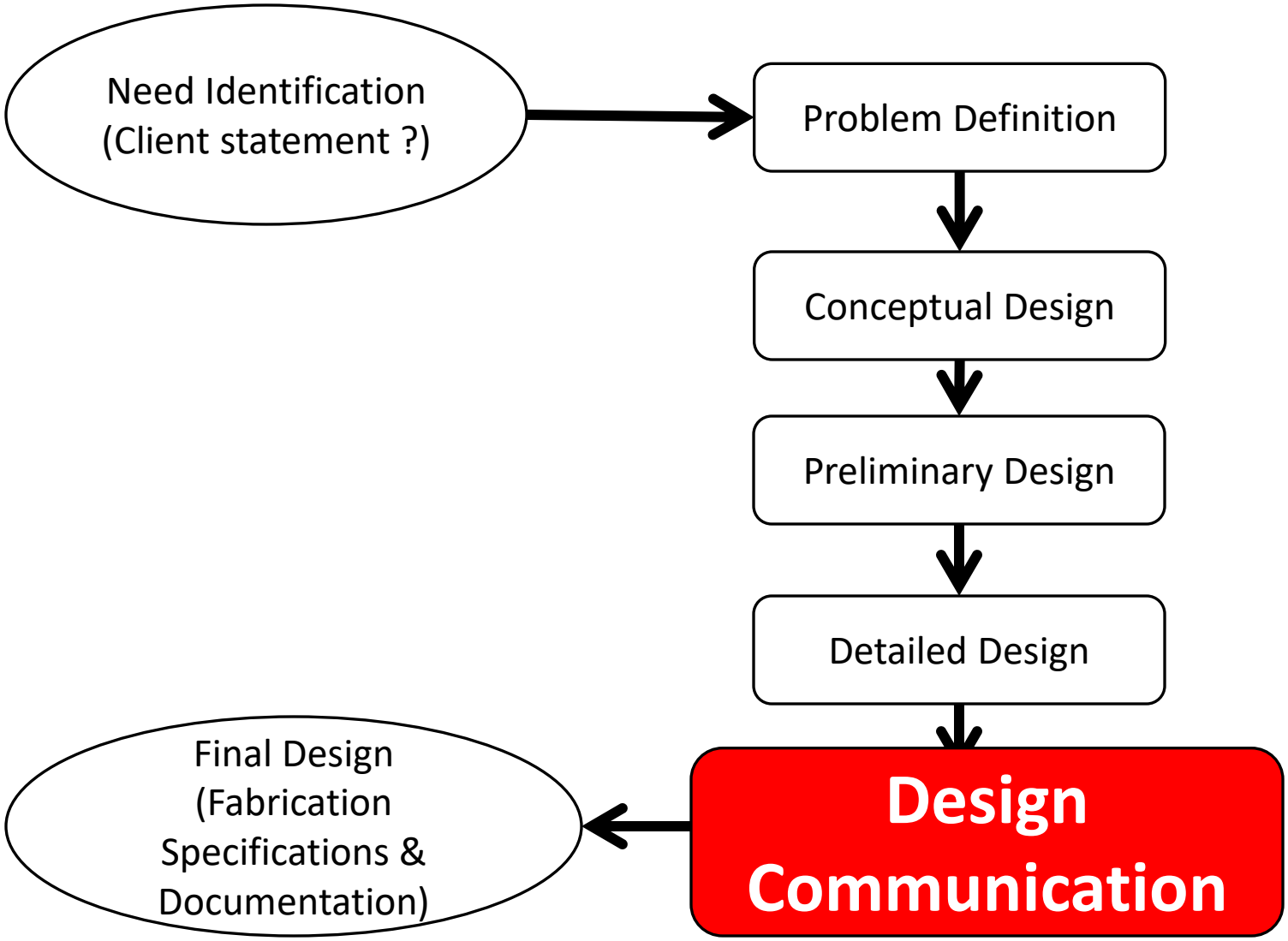
Tasks:
Refine and optimize the chosen design (9)

Methods:
CADD-Computer Aided Design and Drafting

Output:
Proposed manufacturing specifications
Final design review for client

Sources of Information:
Design codes
Handbooks
Local laws and regulations
Suppliers' component specifications





Engineering Design Process: Main Phases

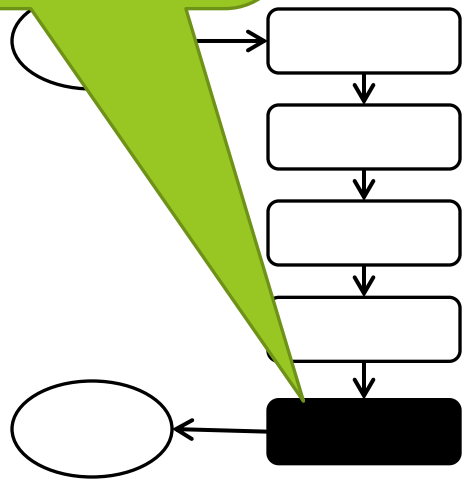
Design Communication

Input:
Manufacturing specifications

Tasks:
Document the completed design (10)

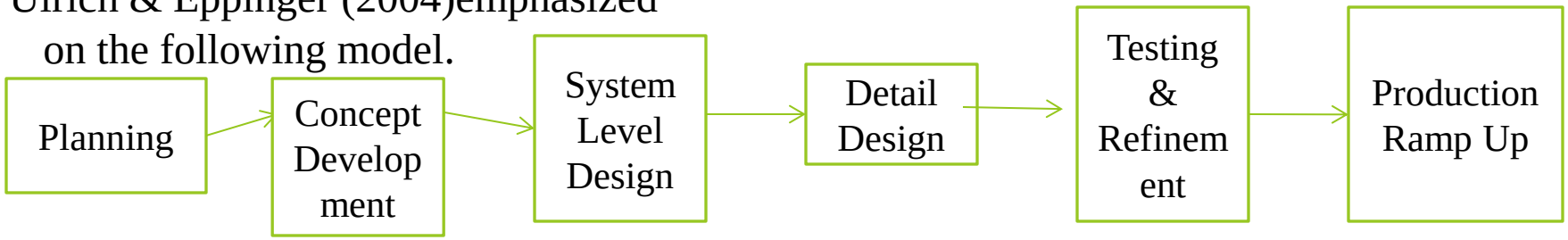
Output:
Final report to client containing manufacturing specifications

Sources of Information:
Feedback from clients and users



Generic Product Development Model

Ulrich & Eppinger (2004)emphasized on the following model.



Authors	Process Flow (->)							
Sun & Wing (2005)	Idea Generation & conceptual design		Design & Specification		Prototype & Development		Commercialization	
Urban & Hausser (1993)	Opportunity Identification		Design		Test		Introduction	Life Cycle Management
Crawford & Di Benedetto (2003)	Opportunity Identification & Selection		Concept Generation		Concept/Project Evaluation		Development	Launch
Bruce & Biemans (1995)	Idea Generation	Screening	Concept Development	Marketing Strategy	Business Analysis	Product Development	Market Testing	Commercialization
Osteras et al. (2007)	Front End		Conceptual Design		Detail Design		Component Development	Prototype Development	Production
Cooper (1983)	Idea		Preliminary Assessment		Concept		Development	Testing	Trial	Launch
Kowang (2013)	Opportunity Identification		Concept Development		Design & Development		Product Testing		Product Commercialization