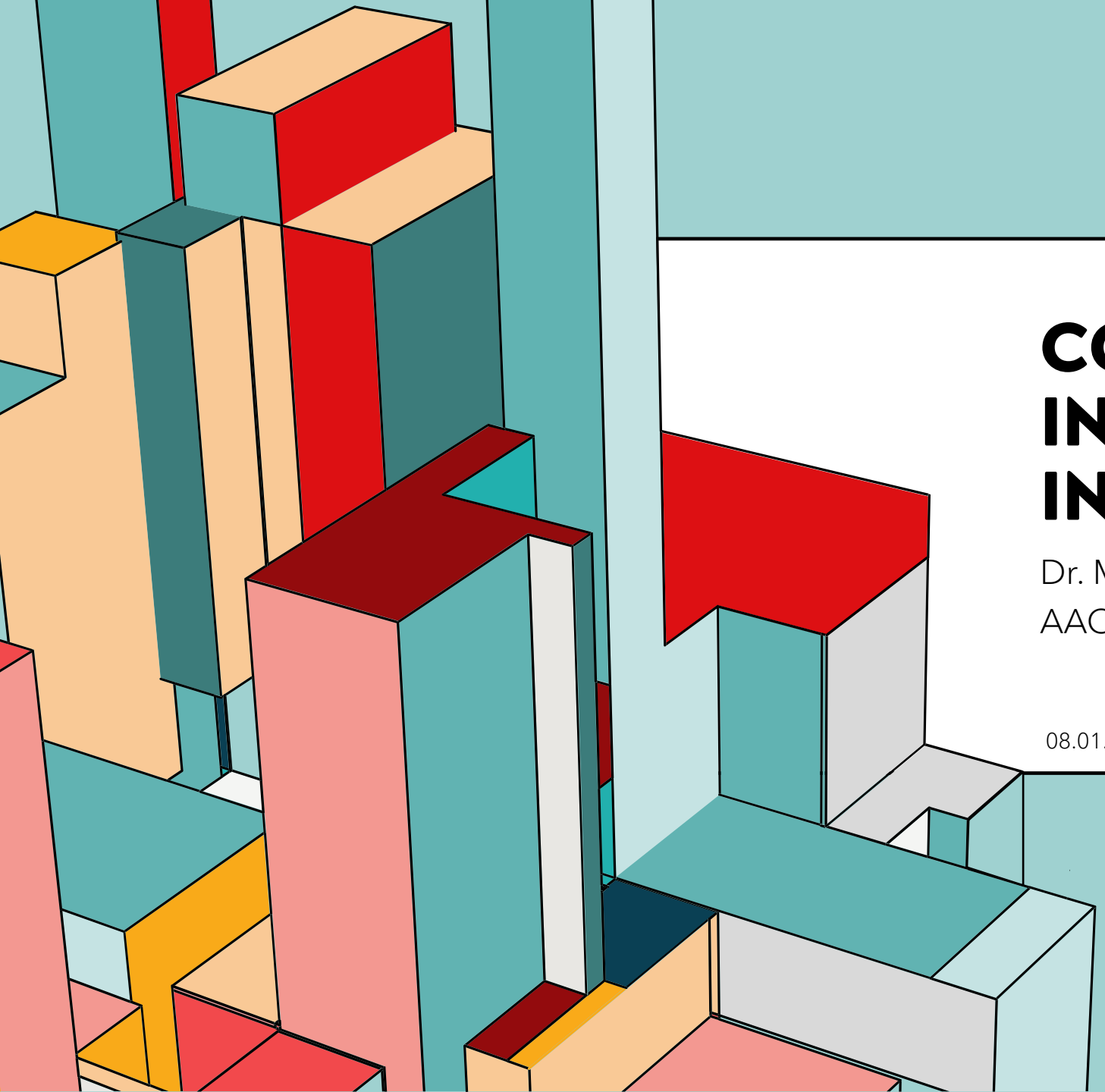


COST ESTIMATION IN THE PROCESS INDUSTRIES

Dr. Mirela Tsagkari, CEP
AACE DACH Section Chairwoman

08.01.2025

Dr. Mirela Tsagkari, CEP

Cost Estimation & Benchmarking Specialist

E: mirela.tsagkari@gmail.com

Work Experience

- Cost Estimation & Benchmarking Specialist (Boehringer Ingelheim, Germany)
- Head of Cost Estimation (ERAS EQUANS, France)
- Cost Estimation Manager (ERAS EQUANS, France)
- Cost Estimator (Technip Energies, France)
- Process Engineer (Technip Energies, France)
- Process Systems Engineering & Cost Estimation Researcher (Arkema, France)
- R&D Engineer (Imerys, Greece)

Projects

· Pharmaceuticals · Biorefineries · Specialty Chemicals · Bulk Chemicals · Giga Factories

Education

- PhD in Process Systems Engineering & Cost Estimation of Biorefineries

National Technical University of Athens

- Diploma in Chemical Engineering

National Technical University of Athens

Certifications

- AACE Certified Estimating professional

Volunteering

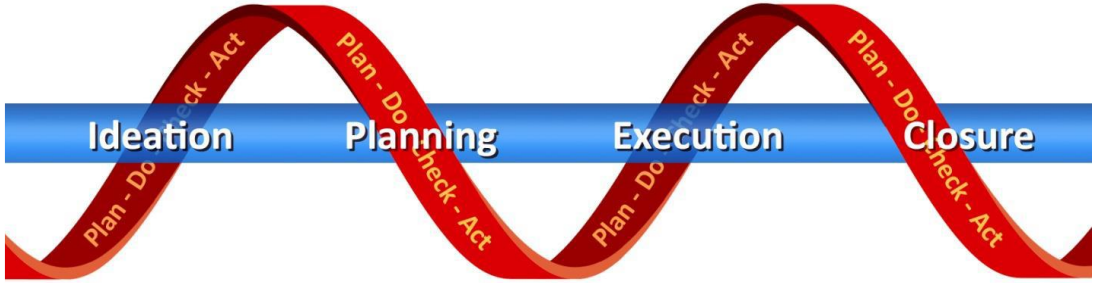
- AACE DACH Section Chairwoman,2023-
- AACE Women in Project Controls Chair for Europe & Africa,2024-

Languages

• Greek • **English** • **French** • **German**

Contents

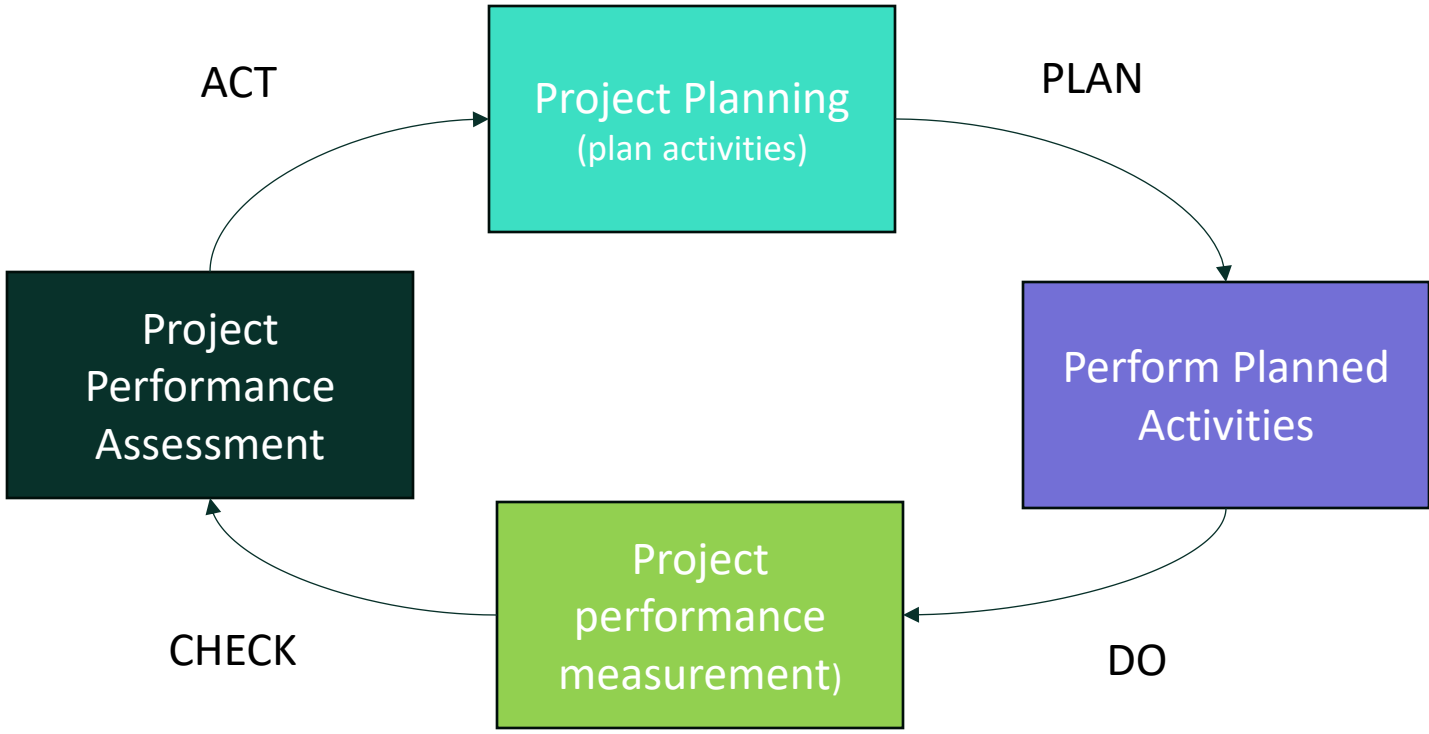
The Total Cost Management Model: Plan, Do, Check, Act



The PDCA is applied throughout the Project Life Cycle for Continuous Improvement throughout the project lifecycle.

Project control is a process for controlling the investment of resources in an asset.

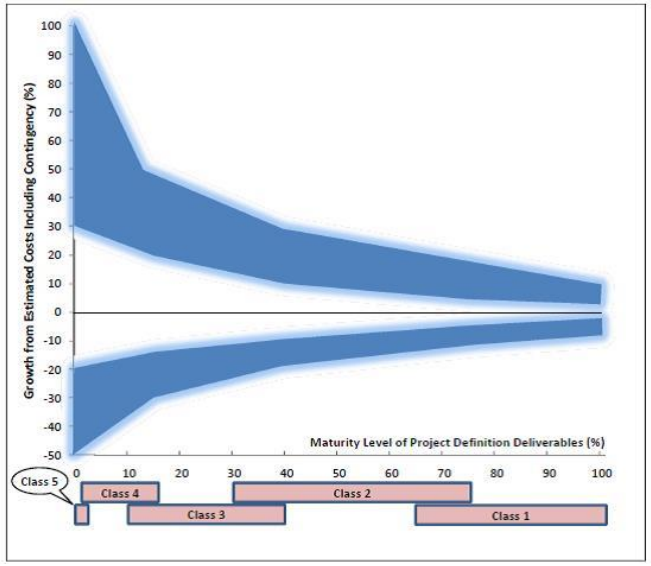
- Scope definition & execution strategy
- **Cost Estimating & Budgeting**
- Schedule Planning & Development
- Resource Planning
- Risk Management
- Forecasting
- Progress & Performance Measurement
- Procurement Planning
- Change Management



Total Cost Management Framework, AACE Int, 2nd Edition

Cost Estimation & Budgeting

- Cost estimating is the process used to quantify, cost and price the resources required by the project scope.
- Budgeting is the allocation of estimated costs into cost accounts against which cost performance will be measured.
- Estimating is applied at the end of each planning/design phase to estimate the project scope as it is defined and quantified at a certain deadline (the “cut-off date”).
- As the level of project maturity increases, the estimating methods become more detailed, and the accuracy ranges become narrower.



Total Cost Management Framework, AACE Int, 2nd Edition

Total Plant Costs (I)= (a) + (b) +(c)+(d)
Direct Costs (Material & Labour) (a)
Purchased Equipment
Equipment Setting
General Earthwork/ Foundations/Buildings
Steel structure & piperack
Piping/ Valves
Electricity / Instrumentation / Controls
Fire Protection
HVAC
Miscellaneous (painting, …)
Spare parts
Indirect Costs (b)
Pre-FEED/FEED/EPCm/Home office/Overhead
Indirect Field Costs
Indirect Field Labour
General Facilities
Escalation (c)
Risk Contingency (d)

Total Capital Requirements (II) = (I) + (e) + (f) + (g) + (h) + (i)
Start-up Costs (e)
Initial Catalysts & Chemicals (f)
Land purchase (g)
Financing, legal fees, custom duties, exchange rate (h)
Royalties (i)

*Indication of Capital Requirements. Variations apply within organisations.

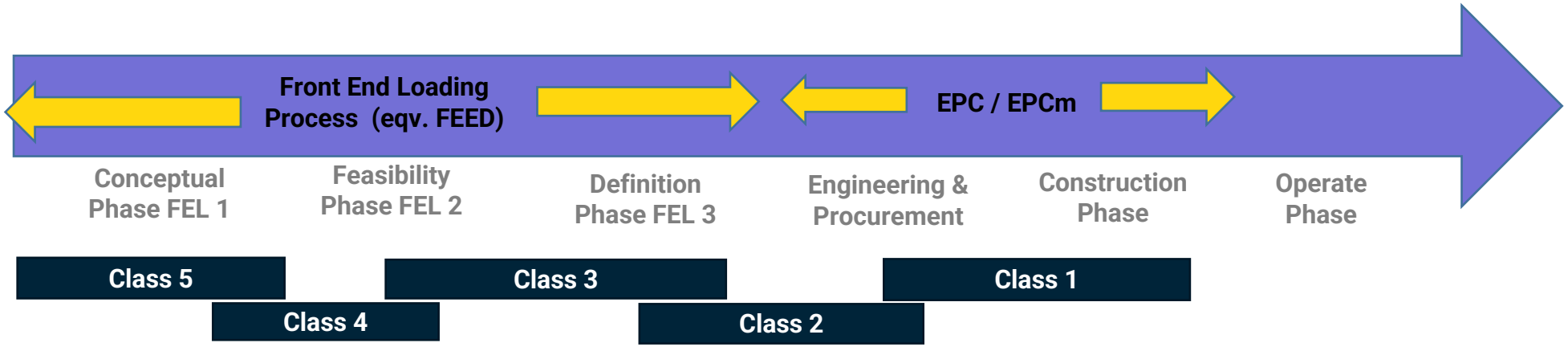
Total Operating Costs
Raw Materials
Utilities & Chemicals
Direct Operating Labour
Maintenance, Supervision, Overhead

Technical & Economic Evaluation

AACE Int RP (16R-90)

Mirela Tsagkari

Cost Estimate Classification



Estimate Class	Phase	End Usage	Level of project definition	Key Delivereble	Estimating Methodology
Class 5	Order-of-Magnitude	Concept screening	0% to 2%	Block Flow Diagram	Cost/ Capacity curves, factors & parametric models
Class 4	Study or Feasibility Estimate	Techno-economic feasibility	1% to 15%	Process Flow Diagram	Factored Estimating methods, ex. equipment factors
Class 3	Budget estimate	Project funding request	10% to 40%	Piping & Instrumentation Diagrams	Unit cost line items at assembly level & factoring methods
Class 2	Control Estimate	Monitoring of variations actual costs & resources against detailed contractor control baseline	30% to 75%	Completed specifications & datasheets	Unit cost line items based on detailed material takeoff
Class 1	Check or Bid estimate:	Bid checking evaluation, contractor negotiations	65% to 100%	All deliverables complete	Unit cost line items based on actual design quantities

AACE Int RP (18R-97)

Cost Estimate Classification & Accuracy

Estimate Class	Maturity Level of project definition	Process Industries RP 18R-97	Pharmaceutical Industries RP 102R-19	Building & General Construction RP 56R-08
		Expected Accuracy Range: Typical variation in low and high ranges at an 80% confidence interval		
Class 5	0% to 2%	L: -20% to -50% H: +30% to +100%	L: -25% to -50% H: +40% to +150%	L: -20% to -30% H: +30% to +50%
Class 4	1% to 15%	L: -15% to -30% H: +20% to +50%	L: -20% to -40% H: +30% to +75%	L: -10% to -20% H: +20% to +30%
Class 3	10% to 40%	L: -10% to -20% H: +10% to +30%	L: -10% to -25% H: +20% to +50%	L: -5% to -15% H: +10% to +20%
Class 2	30% to 75%	L: -5% to -15% H: +5% to +20%	L: -5% to -15% H: +10% to +30%	L: -5% to -10% H: +5% to +15%
Class 1	65% to 100%	L: -3% to -10% H: +3% to +15%	L: -3% to -15% H: +5% to +20%	L: -3% to -5% H: +3% to +10%

- Estimate Classes are related to Maturity Level
- Estimate Classes are **NOT** related to Estimate Accuracy
- There is no pre-determined standard accuracy range for any Estimate Class
- Estimate Accuracy tends to improve as project definition improves

Other AACE Recommended practices:
47R-11 Mining & Mineral Processing Industries
69R-12 Hydropower industries
87R-14 Petroleum Exploration & Production
96R-18 Power Transmission Line Infrastructure
97R-18 Pipeline Transportation Infrastructure

Risk Contingency

The base estimate is not adequate from a funding or budgeting standpoint
It has a small probability of underrun

→ Low probability : Capital Cost <= Base Estimate

Contingency: Financing for systemic & project specific risks mitigation considered in Project Budget.

Contingency covers:

- Inadequacies in complete project scope definition
- Inadequacies in Estimating methods
- Inadequacies in data for costs and schedule
- Project risk exposure, ex. Degree of innovation, technology complexities

Contingency does not cover:

- Scope changes not included in project scope
- Force majeure events, such a tsunami, a pandemic and a prolonged labour strike

Expected Cost Estimate Accuracy

Estimate Accuracy: The degree of variation of the Cost Estimate from the final actual cost of the completed project.

Accuracy is based on a probabilistic assessment of uncertainties & risks that may have an impact on the Base Estimate.

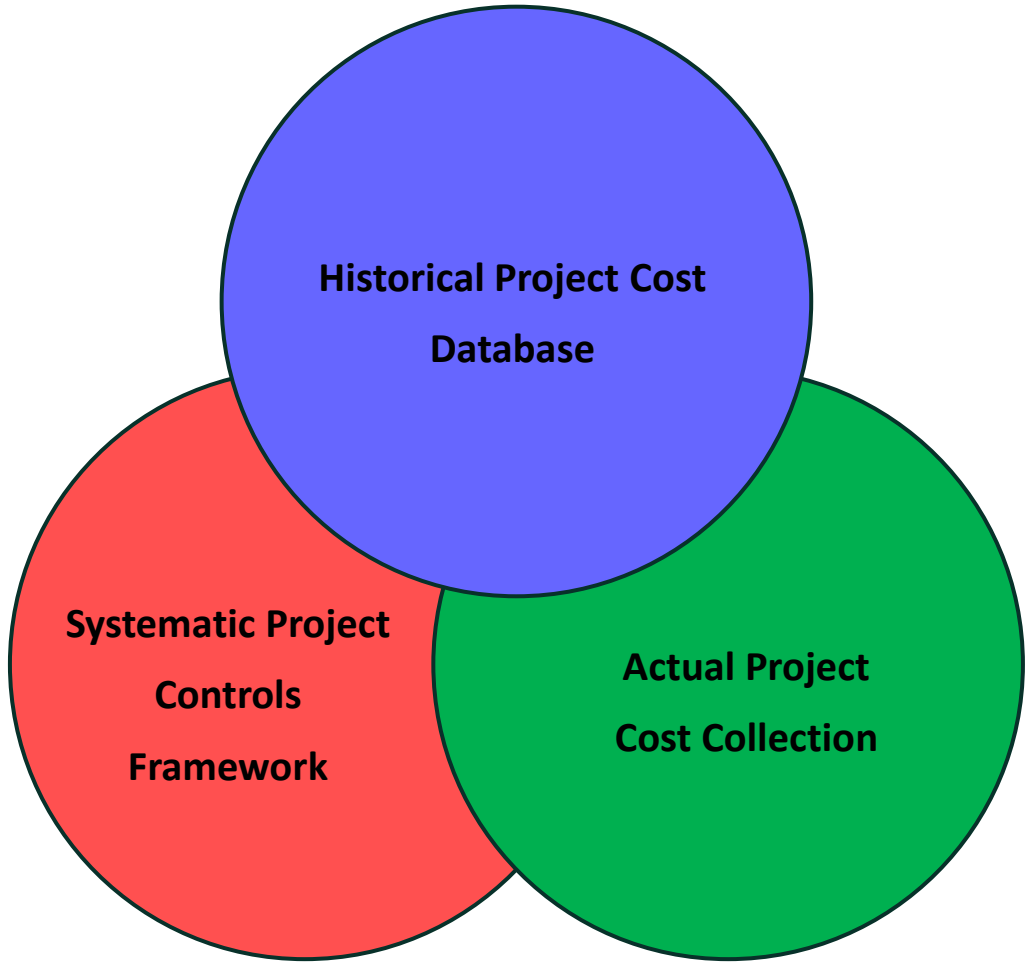
Estimate Accuracy is independent of Contingency

Accuracy is estimated via a quantitative risk analysis study that results in a probability distribution.

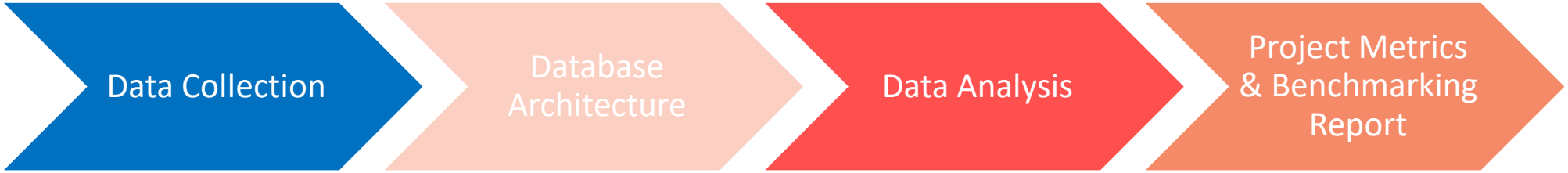
Benchmarking

Benchmarking: a measurement & analysis process that compares project measures to a selected basis of comparison (ie. Historical projects) with the goal to improve performance. Ex. Estimated vs actuals costs, schedule durations, quantities

- Benchmarking is requested & developed more & more within Owner organisations.
- The purpose is to take data-driven investment decisions, accelerate project execution & save capital.
- Robust Benchmarking Frameworks rely on Integrated Historical Cost Data Management & Digital Solutions.
- Benchmarking metrics can be used for Estimate Review & Validation but should not be used for Estimating.



Benchmarking & Historical Project Database



Planning methods and tools

- Scope Development
- Cost Estimating & Budgeting
- Schedule Planning
- Resource Planning
- Procurement planning
- Risk Management

- Project System Learnings
- Estimating, Scheduling & Resource References
- Benchmark & Validation metrics

Historical Project Database

Control Baseline

Actual Project Data

Cost Accounting & Tracking

Physical Progress & Performance measurement

Performance assessment

Forecasting & change management

Total Cost Management Framework, AACE Int, 2nd Edition

Roles & Responsibilities of a Cost Estimator

Owner Estimator	Engineering Estimator	Construction Estimator
Economic Evaluation of project	Estimation of Contractor‘s scope on behalf of Owner	Construction activity estimate
Baseline Estimate & Budgeting	Pricing the Cost Estimate (Turnkey)	Review & Compiling of sub-contractors bids
Review & Validation of Contractor‘s Estimate	Tender pricing	Estimate databases
Owner‘s items estimate	Conceptual, budget & definitive Estimates	Tender pricing
Conceptual Estimating	Estimate databases	
Risk Management	Value Engineering	
Benchmarking & Historical project databases	Estimate Reconciliation	
Value Engineering		
Estimate Reconciliation		

Estimating Skills & Knowledge	Other Skills & Knowledge	Analytical Skills
Engineering (chemical, civil, mechanical…)	Bidding & Budgeting	Statistics & Probabilities
Cost Estimating Terminology & Classification	Cash Flow & Forecasting	Economic & Financial Analysis
Code of accounts	Project Control Process	
Planning the Estimate	Resource Management	**Soft skills**
Estimate Methodologies	Value Analysis & Engineering	Communication
Quantification	Contracts & Claims	Presentation
Costing & Pricing		Quick decision making
Risk Evaluation & Contingency Determination		Empathy
Estimate Review & Validation		
Estimate Reporting		
Historical Project Database Management		

AACE Int RP (46R-11)

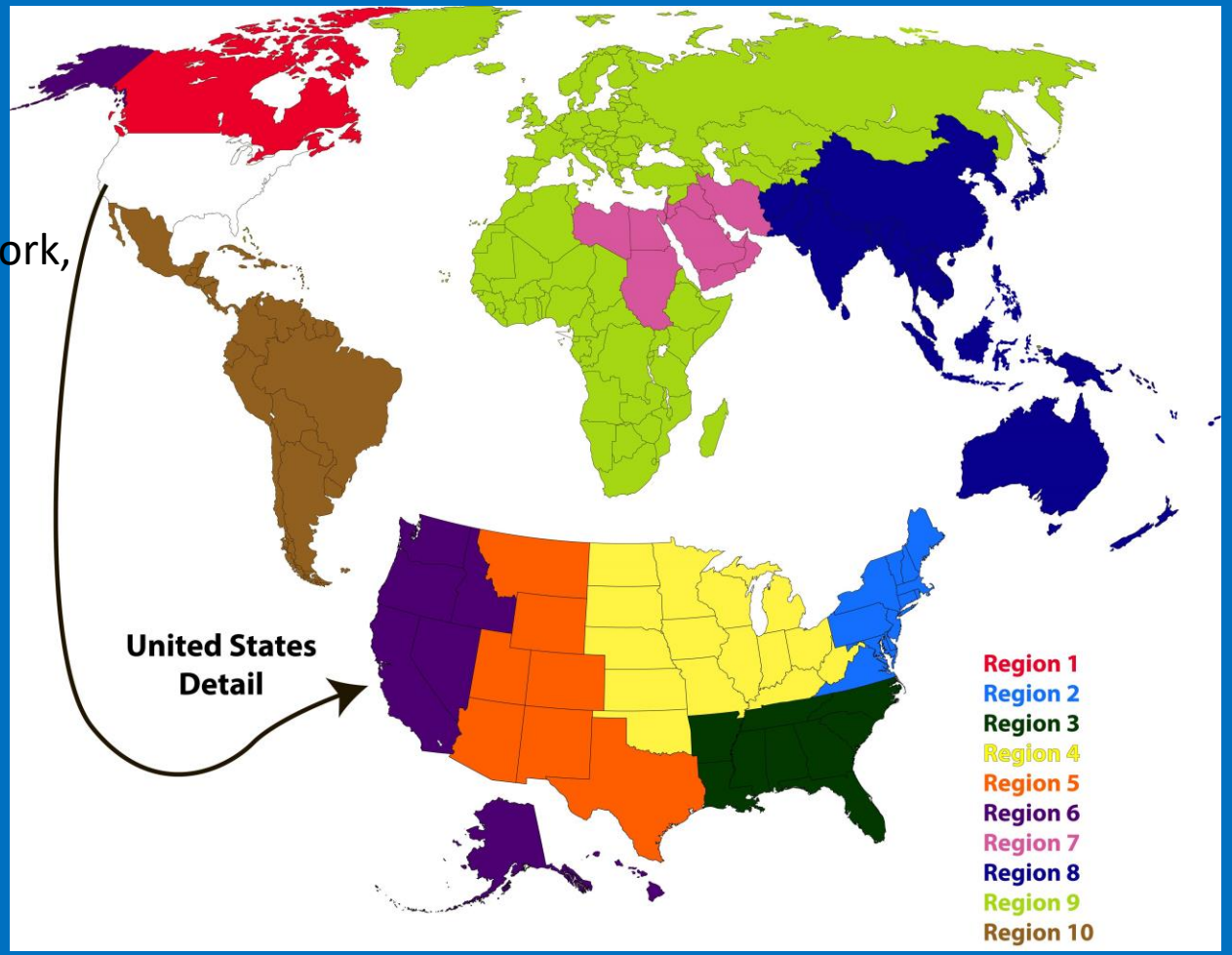
AACE International

- AACE International (the Association for the Advancement of Cost Engineering) is the authority for total cost management.
- With a network of more than 9,500 members in 100 countries, AACE is the largest global organization serving the total cost management community.
- We are committed to the exchange of ideas between members, development of technical guidance and quality education, and the recognition of subject matter experts through our various accredited certification programs.

AACE International

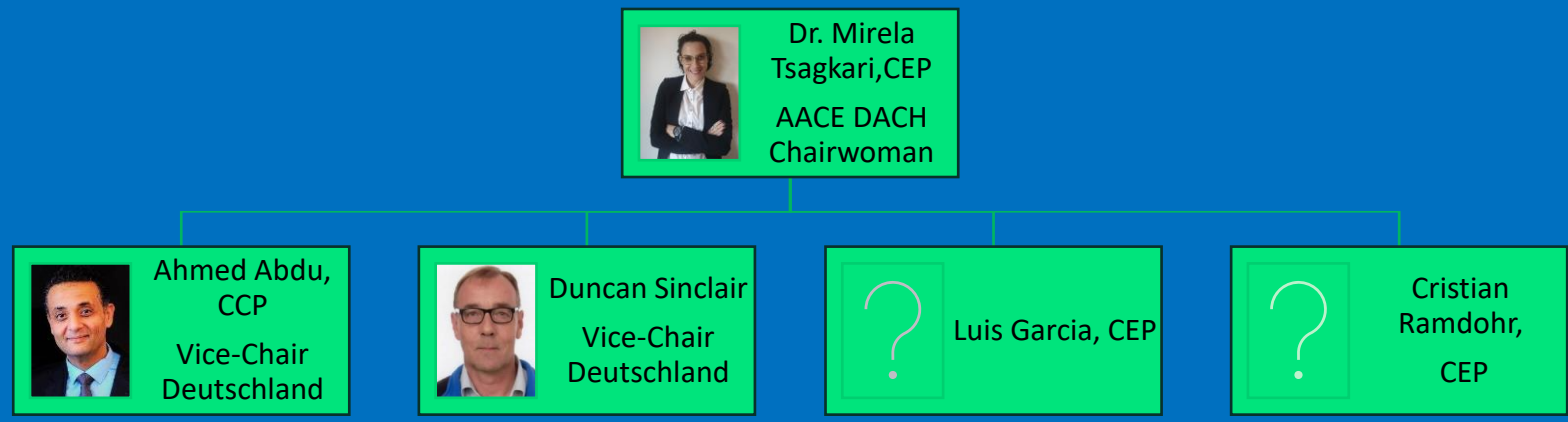
- **Why join AACE International?**
  - Information : 24-7 access to AACE technical papers, Recommended practices, Total Cost Management Framework, Professional Guidance Documents
  - Education : professional development
  - Networking : get to know industry peers
  - Credibility : AACE Certification programs (CEP,CCP,EVP,PSP,PRMP,CFCC,DRMP)

- **Memberships**
  - Individual Membership
  - Organizational Membership
  - Public Membership



AACE DACH: Deutschland, Austria & Switzerland

- Established in October 2023
- Members: 70
- Contact : dach@aacei.org
- Linkedin : AACE DACH Section: Overview | LinkedIn
- Communities : Home - AACE DACH Section (aacei.org)



AACE DACH: Mission & activities

Webinars

Networking events

Joint Webinars & Seminars

Development of training/certification centres

Women in Project Controls

Academic Outreach

Thank you

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