
EFFORT ESTIMATION AND RISK MANAGEMENT USING THE COBRA[®] APPROACH

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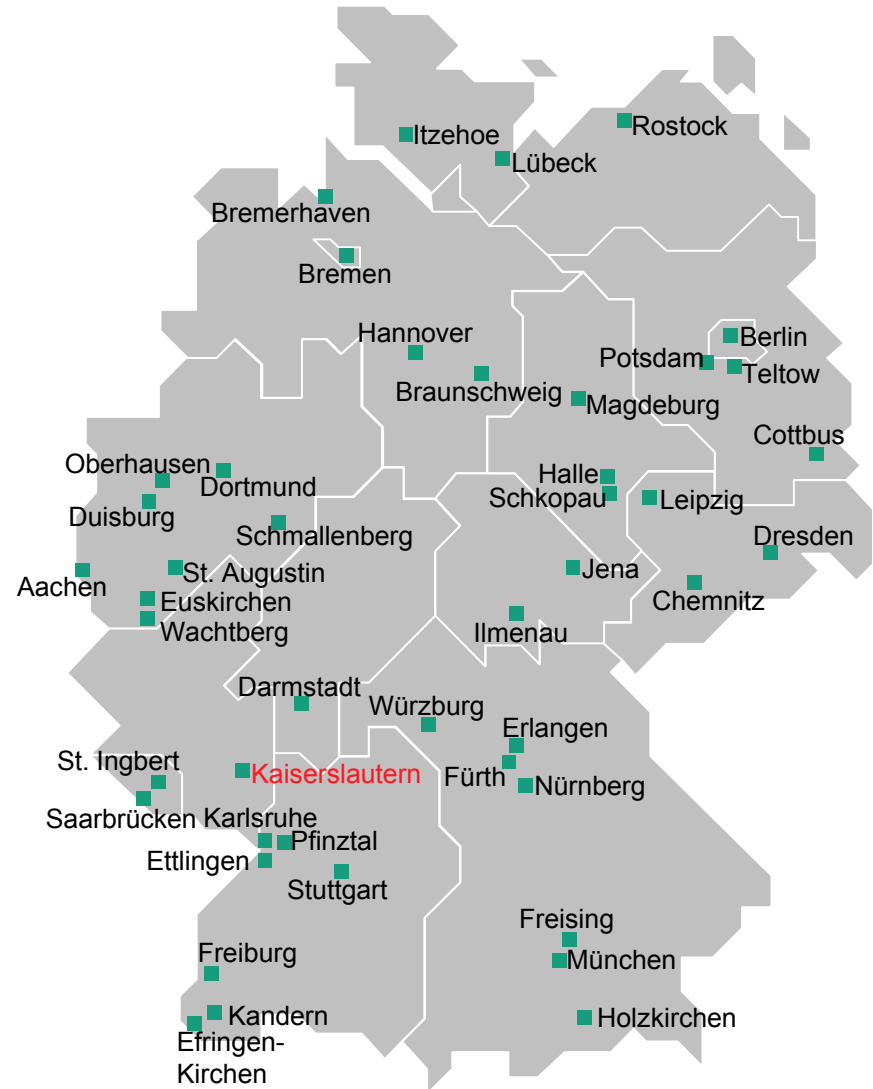
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About the Fraunhofer Gesellschaft

- Named after **Joseph von Fraunhofer** (1787-1826), a researcher and inventor and entrepreneur
- Germany's leading organization for **applied research and technology transfer**
- 60 institutes
- 18000 employees

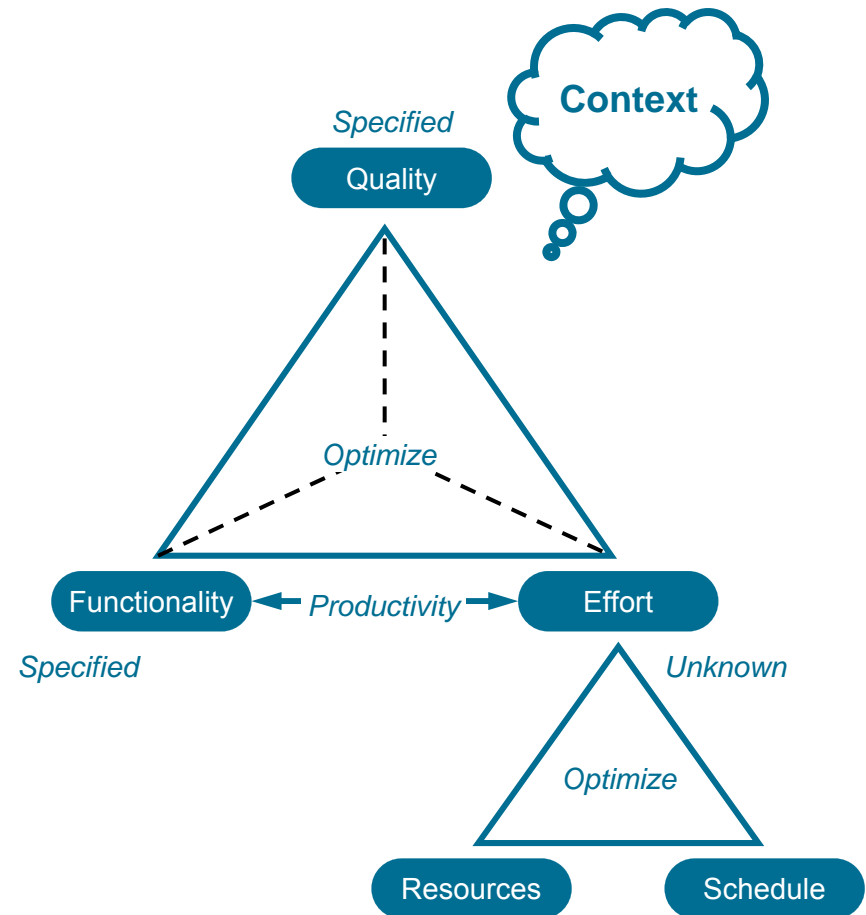


**Fraunhofer Institute for
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(IESE)**
Kaiserslautern, Germany



Software Cost and Effort Estimation - Common Mistakes and Challenges

- Estimating before knowing basic requirements
- Creating estimates solely as a rule of thumb
- Not considering basic risks
- Brooks's Law: "adding manpower to a late software project makes it later" (fixing wrong estimates in runtime is difficult)
- Using „Off the shelf“ estimation models work without calibration



Existing Cost Estimation Methods

Expert-based

- Rule-of-thumb
- Wide-band Delphi
- Planning Game (XP)
- ...

Hybrid

- CoBRA®
- BBN-based
- ...

Data-driven

- SEER
- COCOMO
- CART-based
- ...



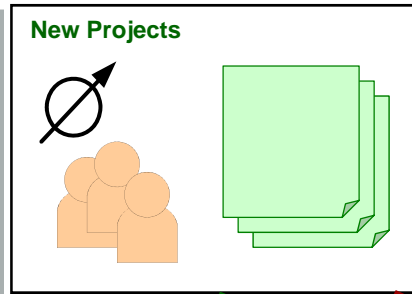
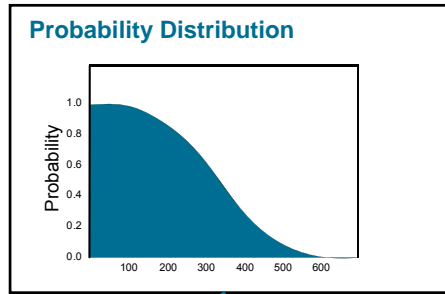
The CoBRA[®] Method:

Cost Estimation, Benchmarking, and Risk Assessment

- Creates a **custom-tailored estimation model**
 - Company-specific size measure
 - Company-specific influencing factors
- Follows a **hybrid approach**
 - Makes use of historical data (at least 10 projects)
 - Captures expert knowledge about effort drivers
- More characteristics
 - **Accurate:** Estimation error about 9%-14% (MMRE)
 - **Reusable:** Documents company experiences (white box models)
 - **Customizable:** Estimation model can be adapted to company needs

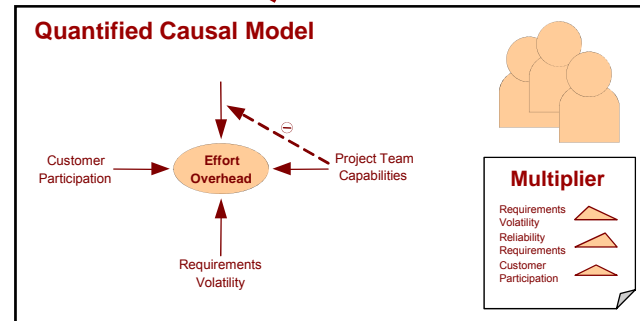
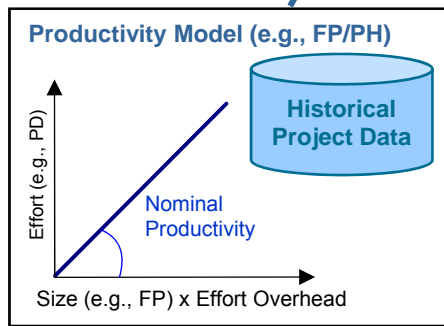


Basics: Cost/Effort Estimation Equation



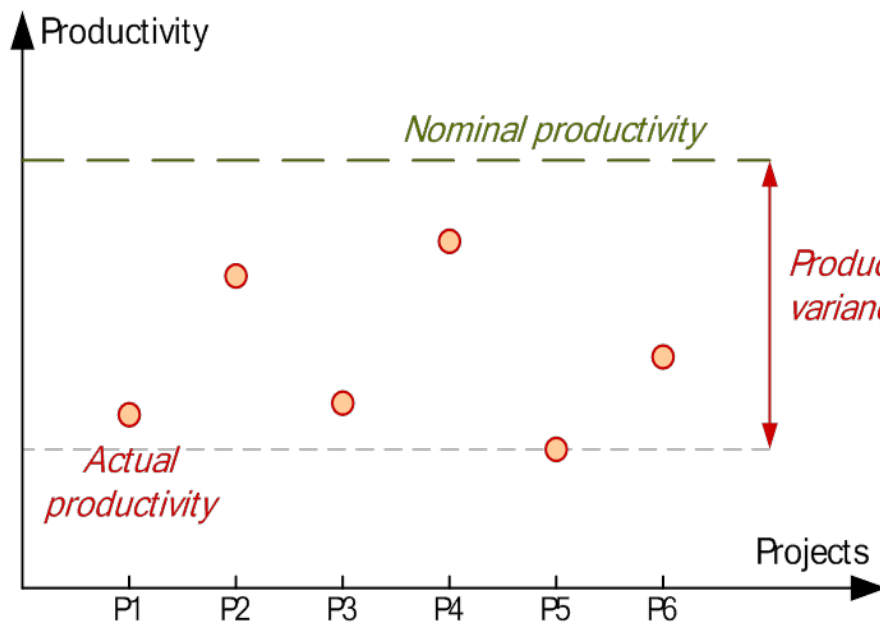
Characterization of the new projects regarding size and effort drivers

$$\text{Effort} = 1 / P_N \times \text{Size} \times (1 + \text{Effort Overhead})$$

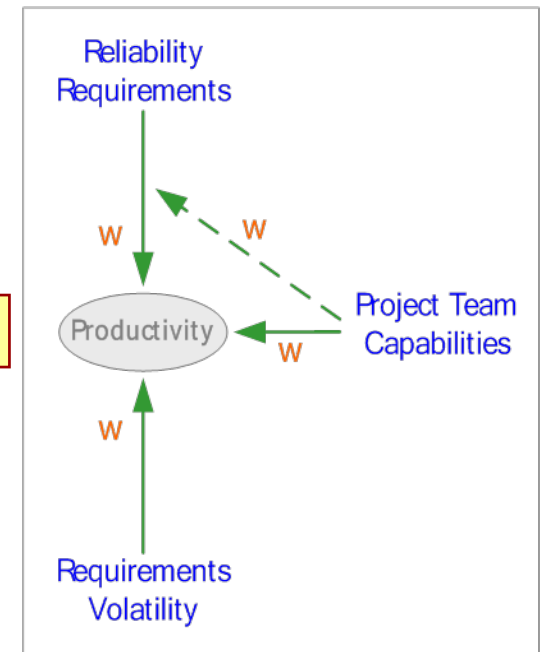


Basics: Underlying Idea of the CoBRA Approach

- Build causal effort model that allows explaining the variance of productivity over projects in a certain context

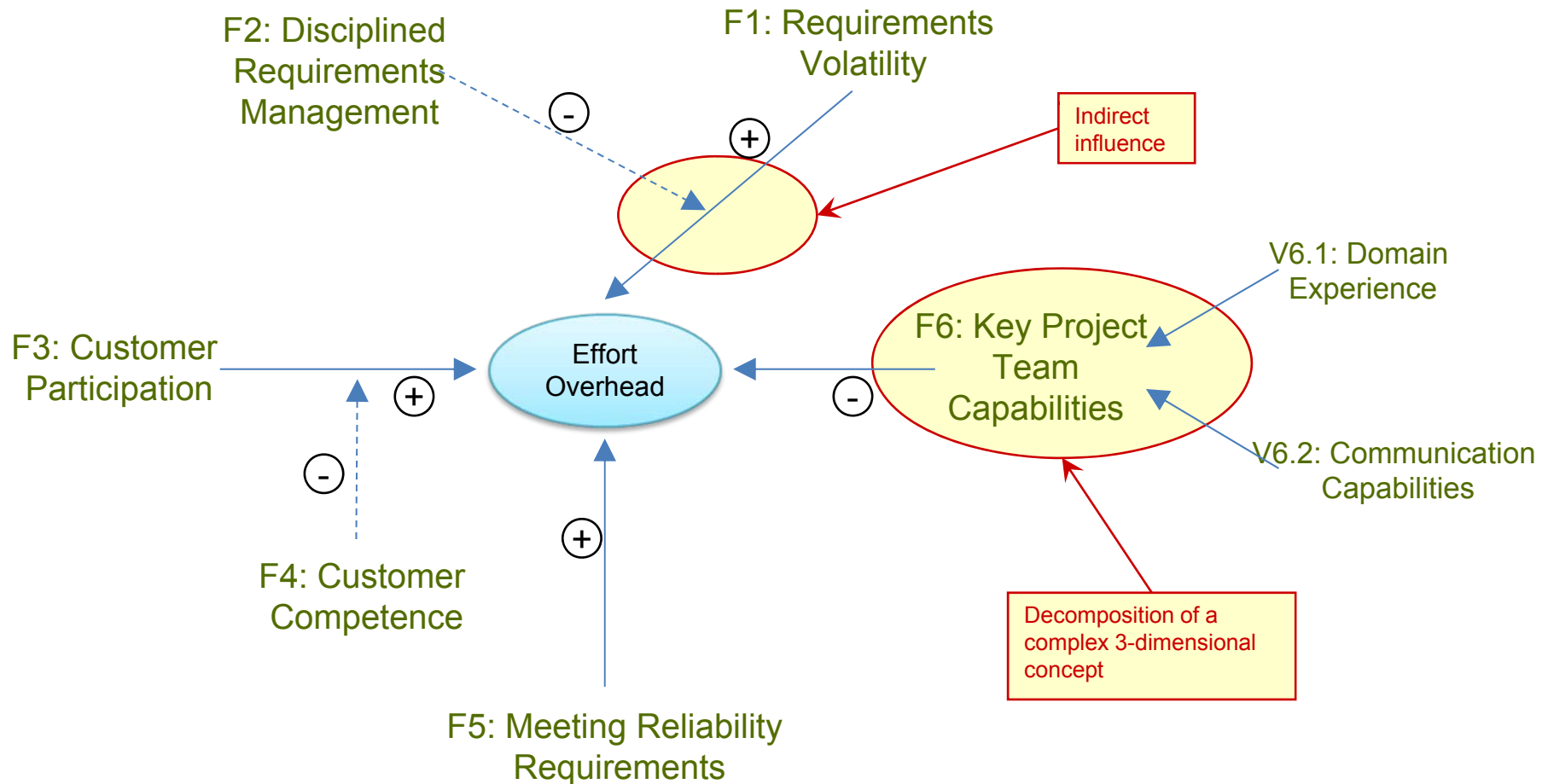


Distribution of actual productivity

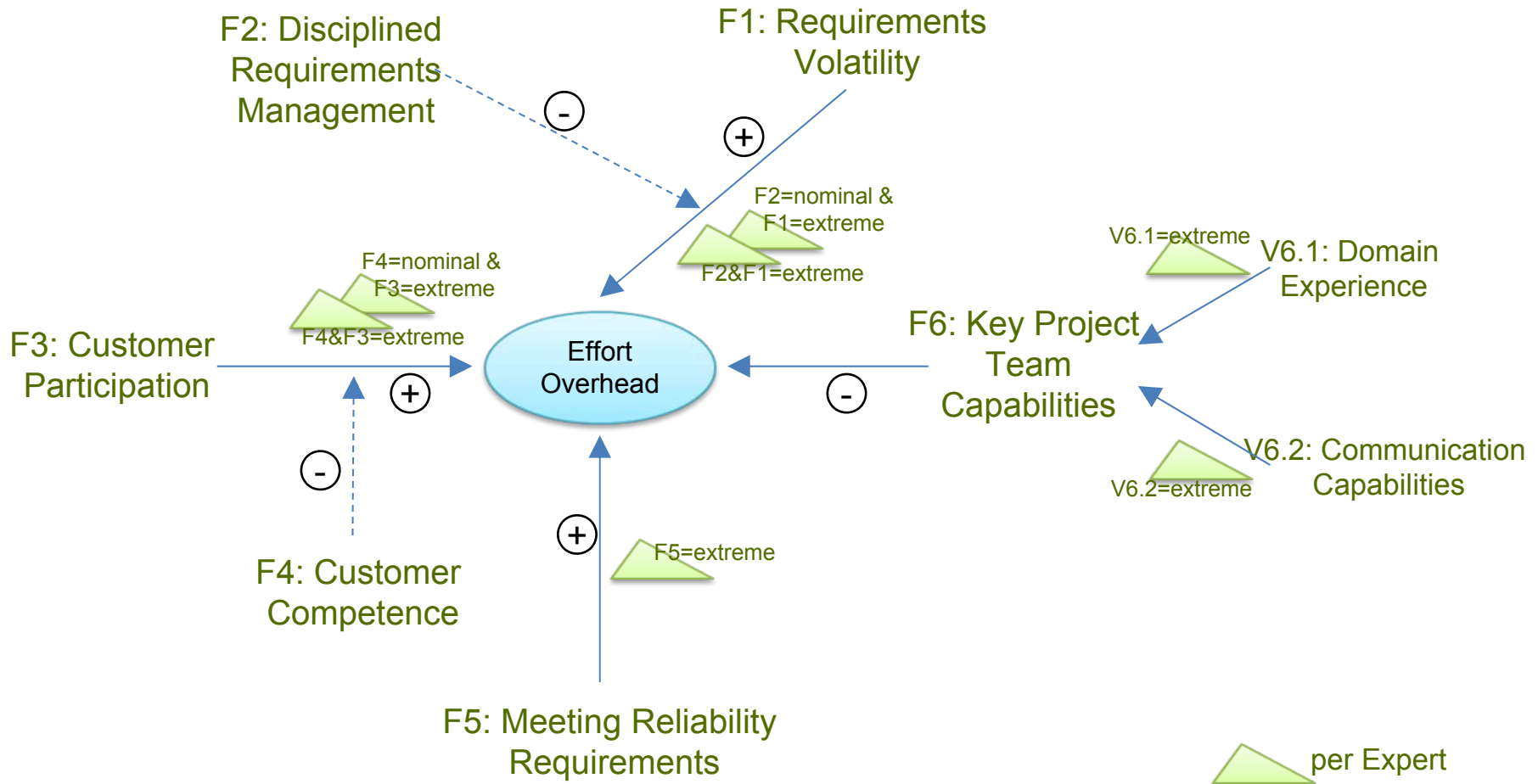


Causal effort model

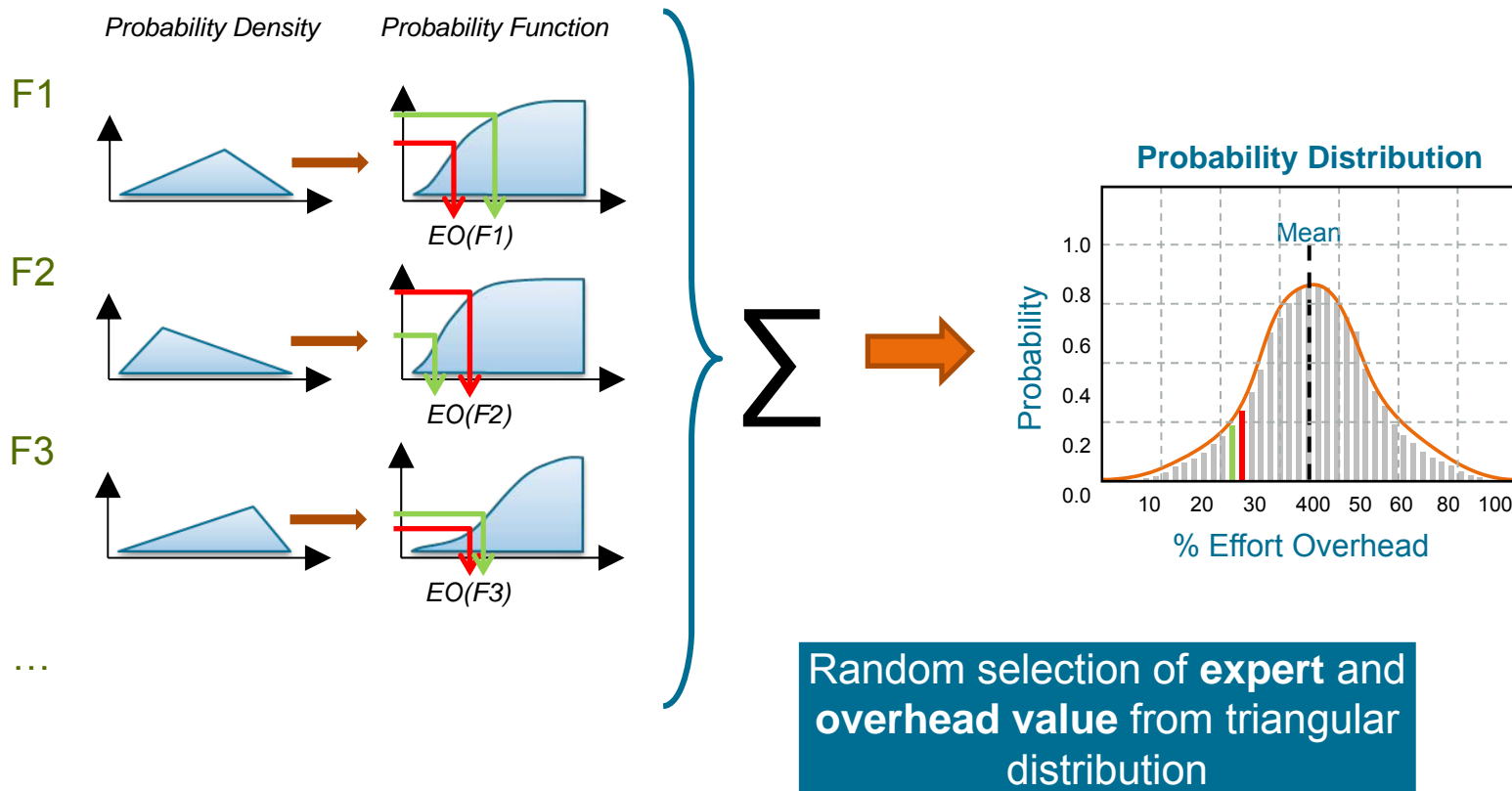
Basics: Causal Model and Cost Drivers Interaction



Basics: Causal Model and Cost Drivers Interaction (with Generic Triangular Distributions)

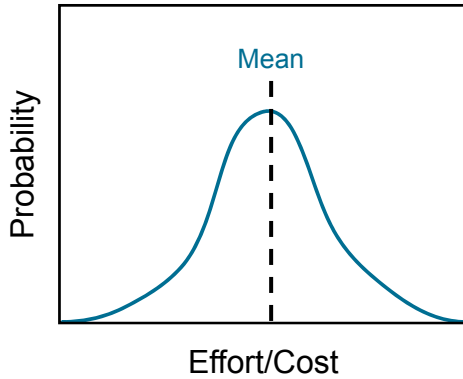


Basics: Example Simulation Runs using Random Sampling (Monte Carlo Simulation)

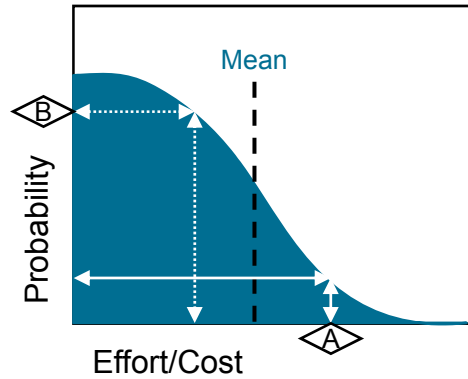


Basics: Cost Estimation, Benchmarking & Risk Assessment

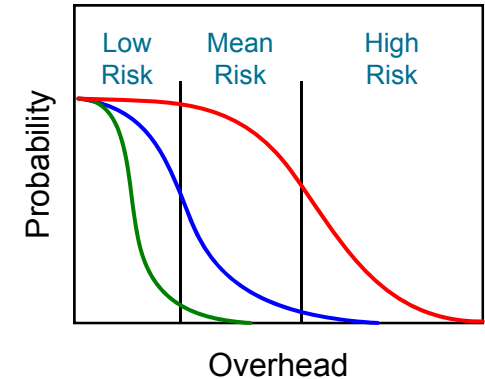
Estimation



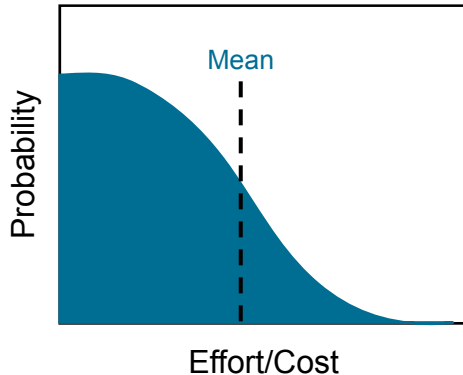
Risk Assessment



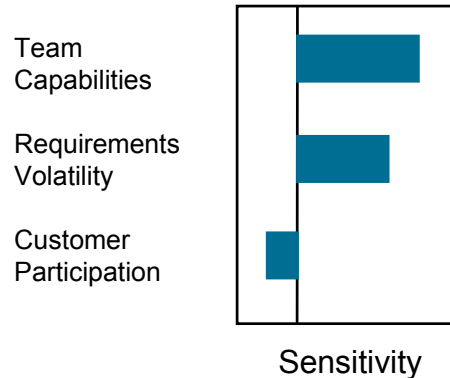
Benchmarking Projects



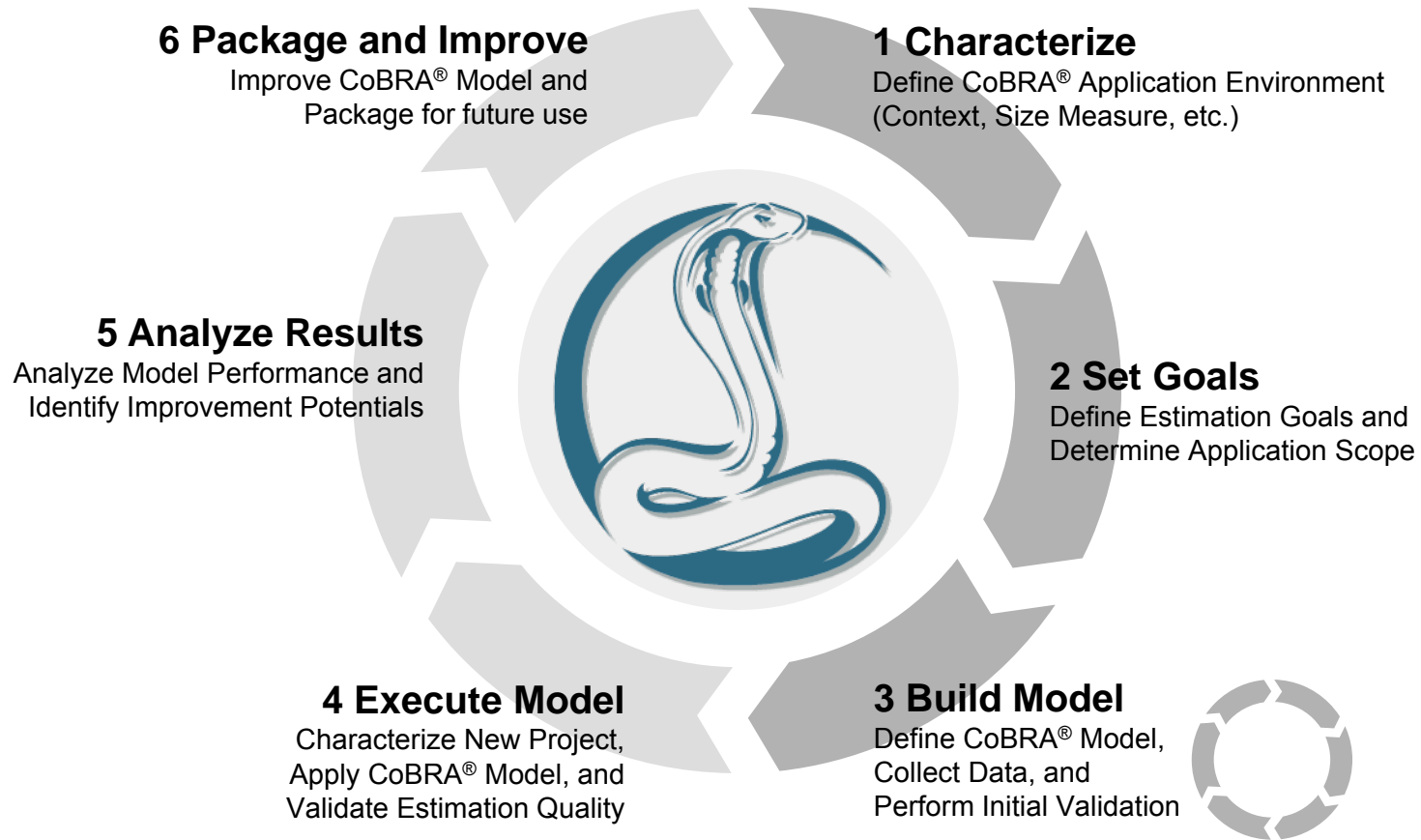
Estimation (Cumulative)



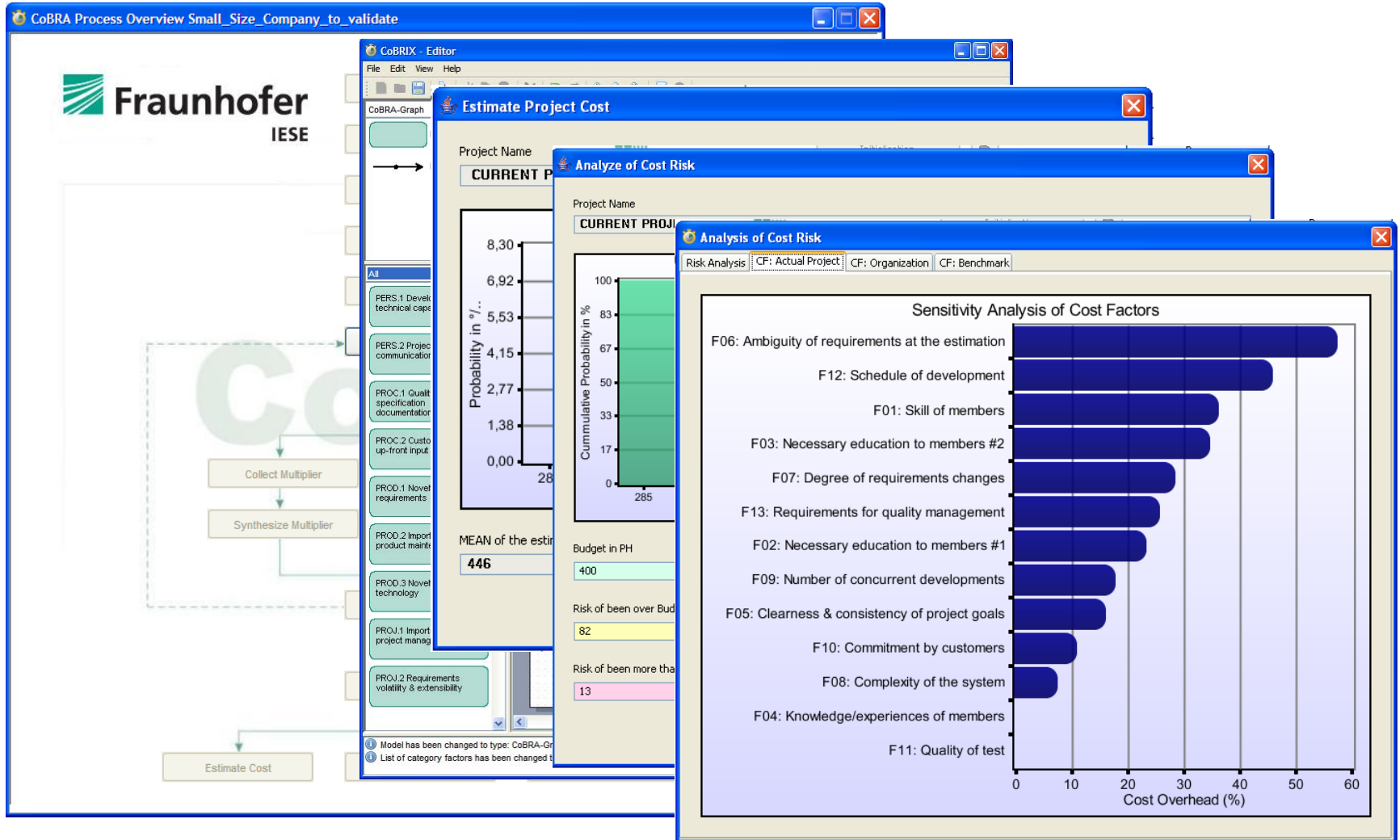
Risk Minimization



Basics: CoBRA[®] Life Cycle



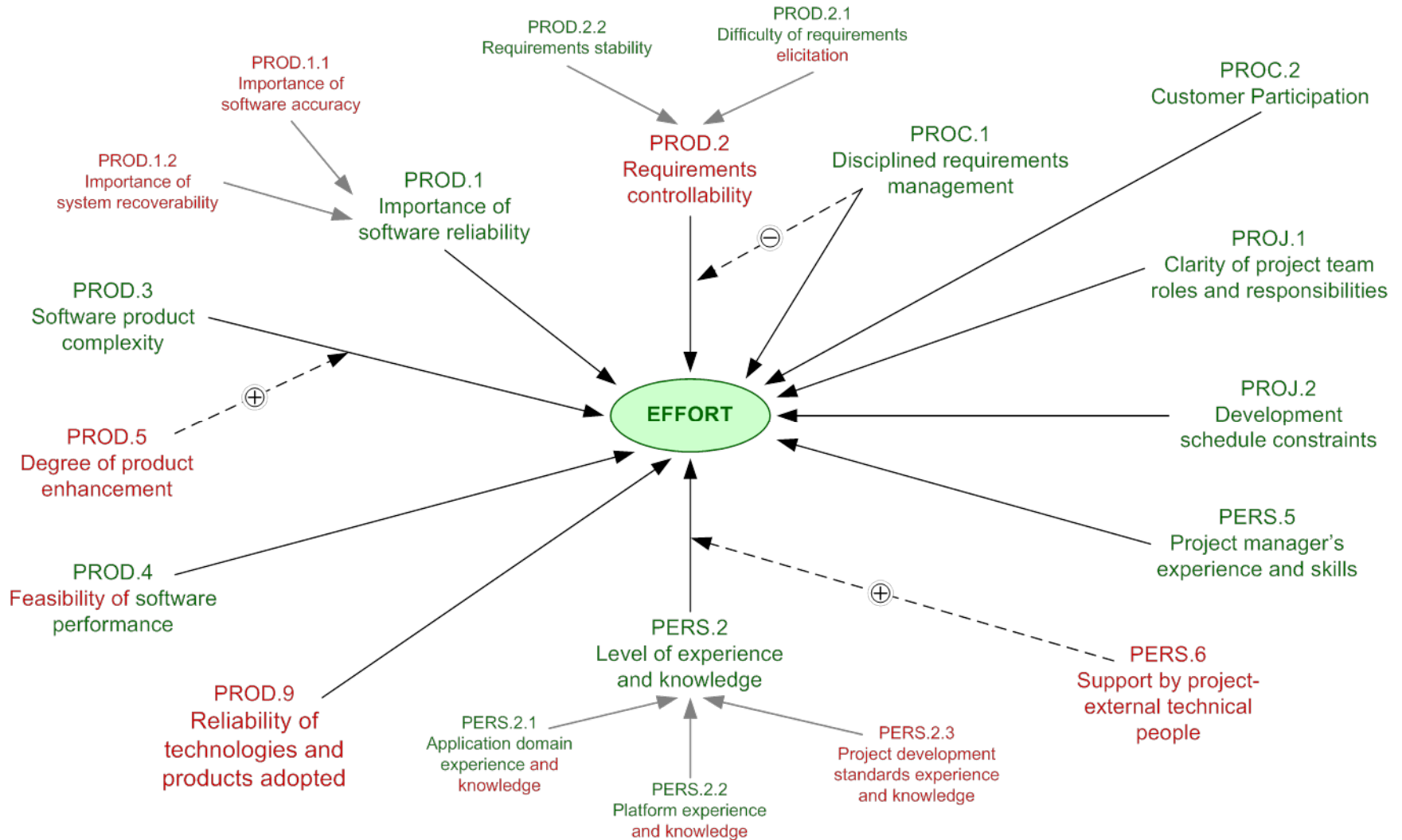
Basics: Tool Support via CoBRIX



Case 1: Oki Electric Ltd., Japan based on collaboration with Japanese Information-technology Promotion Agency (IPA) / SEC

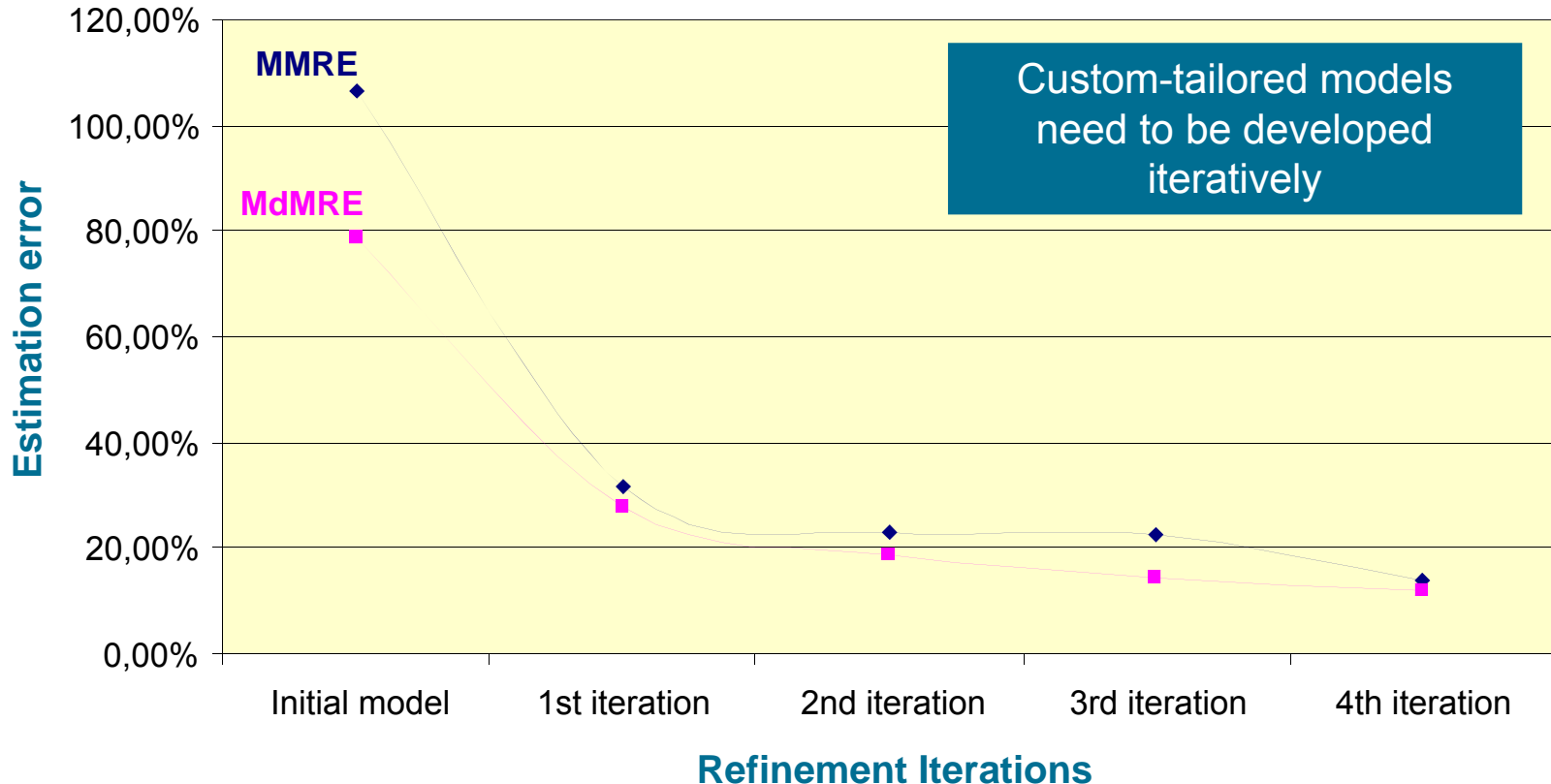
- **Goal:** Improve estimation accuracy and effectiveness as well as understanding of basic cost/effort drivers
- **Context**
 - 16 historical projects from business applications domain
 - 12 experienced project and quality manager
- **Approach:** Iterative application of the CoBRA[®] approach
- **Results**
 - Significant improvement of estimation accuracy (MMRE: 14%)
 - Better understanding of individual cost/effort drivers
 - Improvement of data collection processes
 - High acceptance of the model users

Case 1: Final Causal Model for Oki Electric Ltd.



Case 1: Iterative Improvement of the Model

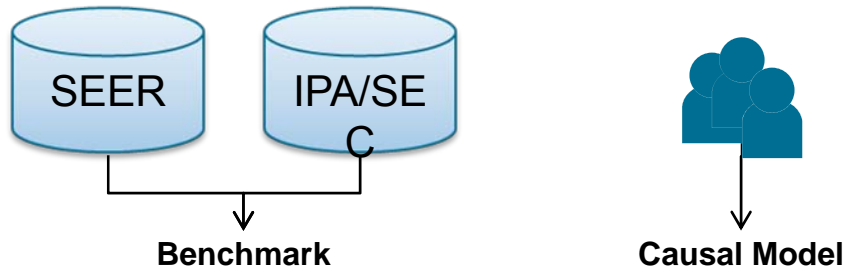
Estimation Error of CoBRA Model



Case 2: Mitsubishi Research Institute (MRI), Japan

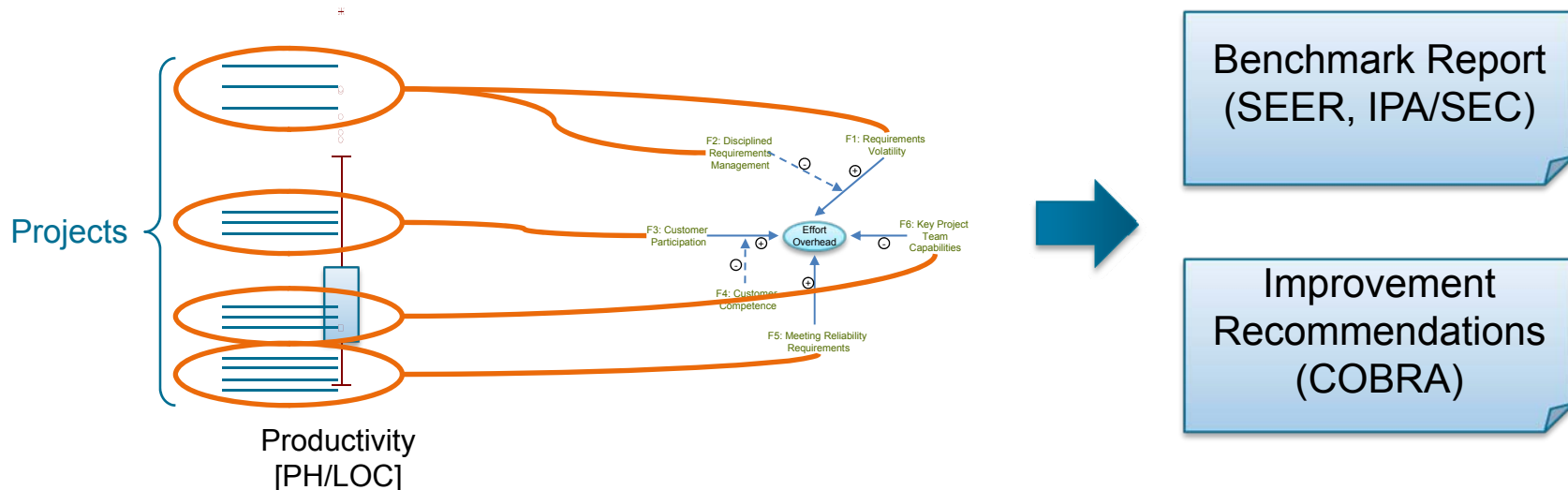
- **Goal:** Benchmarking productivity of projects of Japanese industries and recommend improvement actions
- **Context**
 - 30 historical projects of a Japanese company
- **Approach**
 - Use SEER-SEM and the IPA/SEC data white book for benchmarking projects
 - Develop CoBRA causal model with experts for identifying individual improvement potential
- **Results**
 - Industry-proven ranking of projects
 - International (SEER)
 - Japanese (IPA/SEC data white book)
 - Better understanding of individual cost/effort drivers (CoBRA)

Case 2: Combining Data-Driven and Hybrid Approaches



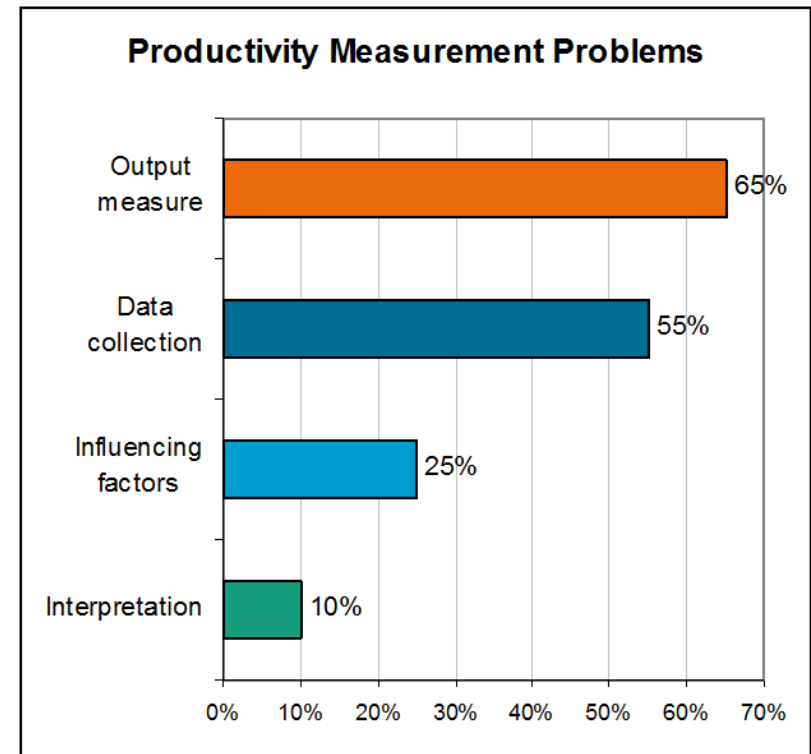
Combining the “best” of both worlds:

SEER for benchmarking and
CoBRA for individual improvement models



Conclusion: Common Challenges in Practice

- **Output measure** (sizing)
 - Candidates limited by context
 - LOC depends on the PL and may be hard to estimate early
 - Functional sizing may be too costly
- **Data collection**
 - Data completeness/reliability
 - High measurement effort
- **Influencing factors**
 - Hard to identify and quantify
 - Factor dependencies makes analysis extremely difficult
- **Interpretation** may be misleading



Around 60% of organizations do not measure and consider influencing factors explicitly

Conclusion: Lessons Learned

- Effective effort estimation is **key for successful project management**
- There is no ultimate „best“ method that works everywhere
 - **Success depends on many factors**
 - The „right“ method may create many synergies
 - **Combining existing methods may maximize your benefits**
- An estimation method is **no oracle**
 - Results need to be checked and interpreted
- A good estimation approach is...
 - **integrated** into organizational processes
 - **adapted** to the specific needs
 - continually **improved**

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