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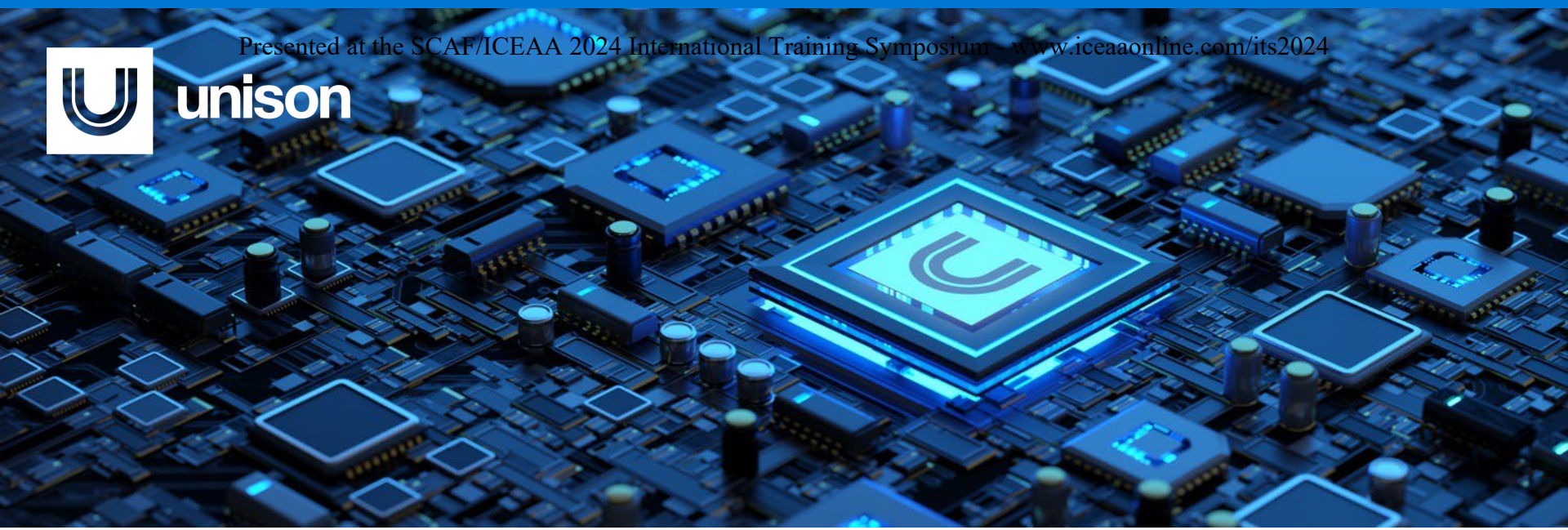

# Biases in Project Estimating and Mitigation Strategies to Overcome Them

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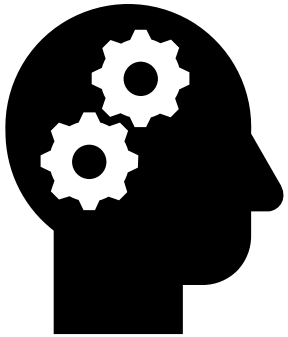
# Introduction

- Project estimating is a critical process in project management,
  - Involves the prediction of time, resources, and costs required to complete a project.
- Various cognitive biases and logical fallacies can significantly influence estimates, leading to inaccuracies.
- This presentation (and associated paper) explores:
  - Common types of biases and fallacies in project estimating
  - Their impacts
  - Strategies to mitigate them
  - Real-world examples—particularly from the aerospace and defense industries—where such biases have had profound negative impacts.

# Bias versus Cognitive Bias

## Bias

- Bias is typically a conscious and intentional inclination in favor of or against an idea, thing, person, or group, usually in a way that is inaccurate, closed-minded, prejudicial, or unfair.



## Cognitive Bias (Kahneman D. &., 1972)

- A cognitive bias is an unconscious and automatic inclination resulting from past experiences, preexisting beliefs, mental shortcuts, and other contributors.
- These mental shortcuts (called heuristics) influence our thinking and decision-making, leading us to process information in a selective and subjective manner, often resulting in inaccurate or irrational judgments.
- In project estimation, these biases often affect our ability to make rational decisions and may have a negative impact on project estimates, thereby leading to negative project outcomes.

# COMMON BIASES IN PROJECT ESTIMATING

| Cognitive Bias | Definition | Impact | Mitigation |
|---|---|---|---|
| **Optimism Bias** (Weinstein, 1980) (Lovallo D. &., 2003) | Tendency to underestimate time, costs, and risks while overestimating benefits. | Overly optimistic (inaccurate) forecasts lead to project cost and schedule overruns. | • Use reference class forecasting: Base estimates on actual performance from a reference class of comparable projects.<br>• Be transparent and realistic in scheduling and cost estimation. |
| **Anchoring Bias** (Tversky, 1974) | Relying too heavily on initial information (the "anchor") when making estimates. | Initial estimates become fixed points, affecting subsequent adjustments even when new information or data suggests otherwise. | • Use reference class forecasting to avoid over-reliance on initial estimates.<br>• Consider a range of possible outcomes. |
| **Confirmation Bias** (Nicherson, 1998) | Searching for, interpreting, and remembering information that confirms preexisting beliefs or expectations. | Can lead to ignoring evidence that contradicts initial estimates. | • Encourage a diverse team to challenge assumptions.<br>• Seek out disconfirming evidence.<br>• Use reference class forecasting including a full range of relevant historical data. |

# COMMON BIASES IN PROJECT ESTIMATING

| Cognitive Bias | Definition | Impact | Mitigation |
|---|---|---|---|
| **Availability Bias** (Tversky, 1973) | Tendency to prioritize information or events that come to mind easily. | Can skew estimates based on recent experiences by overestimating the likelihood of events or the importance of information. | • Use historical data and reference class forecasting.<br>• Avoid relying solely on personal anecdotes. |
| **Hindsight Bias** | Seeing events as having been predictable after they have occurred. | Leads to overconfidence in future estimates based on past successes. | • Document assumptions and reasoning during estimation.<br>• Reflect on lessons learned from previous projects. |
| **Expert Bias** | Over-reliance on the judgment of experts (who themselves may have bias). | • Experts consciously or subconsciously include bias leading to optimistic or pessimistic estimates.<br>• Can also affect risk assessment which is often calculated based on expert opinion.<br>• May cause one to disregard data or input from less experienced team members. | • Experts should be trained to recognize and mitigate bias.<br>• Perform external review for reasonableness.<br>• Use of parametric models which are objective and repeatable, being aware that bias in parameter inputs may lead to misestimation. |

# COMMON BIASES IN PROJECT ESTIMATING

| Cognitive Bias | Definition | Impact | Mitigation |
|---|---|---|---|
| **Groupthink** | Desire for harmony or conformity in a group, leading to irrational decision-making. | Discourages creativity and individual responsibility. Can also suppress dissenting opinions and innovative ideas. | • Have a diverse composition of participants offering different perspectives.<br>• Promote open discussion allowing all team members to voice their opinions and ideas.<br>• Welcome skepticism and challenges to status quo to foster critical and independent thinking. |
| **Survivorship Bias** | Concentrating on successful projects while ignoring failures. | Creates a skewed view of success and failure leading to unrealistic expectations by not considering the full range of factors that contribute to outcomes. | • Actively seek out and consider data from both successful and unsuccessful projects.<br>• Ensure all data sources are considered to include the full distribution of outcomes. |

# COMMON BIASES IN PROJECT ESTIMATING

| Cognitive Bias | Definition | Impact | Mitigation |
|---|---|---|---|
| **Commitment Bias** | When we persist in following through with an unsuccessful idea or action, rather than admitting that it was a mistake. This is especially true when we have made public commitments. | • Hinders objective decision-making by focusing on past commitments, leading one to make decisions that are not in their best interest.<br>• Causes people to persist in failing endeavors.<br>• Refusing to accept that the resources already invested cannot be recovered and instead, insist on more spending to justify the initial investment. | • Regularly assess progress against baseline estimate using objective measures and make necessary adjustments.<br>• Limit personal attachment to reduce emotional investment. Make data-driven decisions based upon observed progress (or lack thereof). |
| **Framing Effect** | The way information is presented affects decisions and judgments. It is a cognitive bias where people decide on options based on whether the options are presented with positive or negative connotations. | Leads to biased decision making that can result in overly optimistic or pessimistic project estimates. | • Take an "outside view" and try to reframe the problem to examine different outcomes.<br>• Have a standardized process for project estimation. |

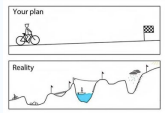
# Logical Fallacies

- Fallacies, like biases, contribute to flawed thinking that leads to negative impacts on project estimating.
  - Biases and fallacies seem similar but are not the same.
- A fallacy is a pattern of reasoning that contains a flaw, either in its logical structure or in its premises whereas cognitive biases are systematic errors in thinking that affect the decisions and judgments that people make.
- Both cognitive biases and logical fallacies can lead to significant errors in project estimation.

# LOGICAL FALLACIES

| Fallacy | Definition | Impact | Mitigation |
|---|---|---|---|
| **Fallacy of Silent Evidence** (Taleb, 2007) | Focusing only on visible successes while ignoring failures. It refers to the overlooked bulk of information that often remains unconsidered in decision-making processes. | Leads to overly optimistic estimates. | Analyze a comprehensive dataset including failures and conduct failure reviews. |
| **Error of Causal Analysis** | Incorrectly inferring causation from correlation. | Leads to flawed estimates and strategies. | Distinguish between correlation and causation, use experimental methods, and consult experts. |
| **Texas Sharpshooter Fallacy** (Taleb, 2007)  | • Cherry-picking data clusters to suit an argument.<br>• Occurs when differences in data are ignored, but similarities are overemphasized, leading to false conclusions. | Leads to misleading conclusions and inaccurate estimates. | Use all available data and apply rigorous statistical methods. |

# LOGICAL FALLACIES

| Fallacy | Definition | Impact | Mitigation |
|---|---|---|---|
| **Narrative Fallacy**<br>(Taleb, 2007)<br>  | Creating coherent and plausible stories out of random or incomplete data, leading to oversimplified explanations and overlooked complexities. | Leads to oversimplified explanations, unrealistic projections, and overlooked complexities. | • Data-Driven Analysis: Rely upon data analysis rather than anecdotal evidence or compelling stories. Use statistical methods to identify trends and correlations.<br>• Develop best-case, worst-case, and most likely outcomes and prepare for uncertainties.<br>• Involve diverse stakeholders to challenge the narrative and provide alternative viewpoints. |
| **Planning Fallacy**<br>(Kahneman & Tversky, 1979)<br>  | • Occurs when predictions about task completion time display an optimism bias.<br>• People underestimate how long a future task will take, even if they know similar tasks have taken longer in the past. | Leads to overly optimistic estimates. | • Use reference class forecasting.<br>• Before estimating project completion time, compare it to similar past projects, grounding predictions in historical data. |

# A Behavioral Bias Worth Mentioning

- **Strategic Misrepresentation**
  - **Definition:**
    - Deliberate underestimation of costs and overestimation of benefits to get a project approved.
    - Differs from Optimism Bias due to the deliberative nature, often to further one's own interests.
  - **Impact:**
    - Leads to cost overruns, a shortfall of benefit realization and often inefficient resource allocation.
  - **Mitigation:**
    - Use reference class forecasting
    - Foster a culture where honesty and transparency are valued and rewarded. (As project estimators, we need to be recognized as the "truth tellers.")

# Real-World Example - F-35 Joint Strike Fighter Program (United States Government Accountability Office (GAO), 2021)

- Biases Involved:
  - Optimism Bias, Planning Fallacy, Groupthink
- Impact:
  - Initial cost estimates were about $233 billion, but the total cost is now expected to exceed $1.7 trillion due to significant cost overruns and delays.
- Lessons:
  - Overly optimistic projections and underestimation of technical challenges led to issues.
  - Better planning, conservative risk assessments, and diversified stakeholder input could have helped.

# REAL-WORLD EXAMPLES

| Program | Biases Involved | Impact | Lessons |
|---|---|---|---|
| **Comanche Helicopter Program**  | Optimism Bias, Strategic Misrepresentation | The program was cancelled after spending nearly $7 billion, as it became clear that the initial estimates were vastly underestimated. | • Over-optimistic projections and strategic misrepresentation to secure funding led to wasted resources.<br>• More realistic estimates and assessments along with transparent reporting could have resulted in a better outcome. |
| **F-22 Raptor**  | Optimism Bias, Commitment Bias | The project faced cost overruns and delays, with total program costs exceeding $66 billion for 195 aircraft (8 test and 187 production aircraft). The USAF originally envisioned ordering 750 aircraft at a total program cost of $44.3 billion. | • Overestimation of capabilities and continued investment despite issues (escalation of commitment) led to problems.<br>• Periodic reevaluation (estimations) and willingness to adjust plans could have helped. |

# REAL-WORLD EXAMPLES

| Program | Fallacy Involved | Narrative | Impact | Lessons |
|---|---|---|---|---|
| **Concorde Supersonic Airliner**  | Narrative Fallacy | The developers believed that technological superiority and national pride would guarantee commercial success. | • Despite technical success, the project was economically unfeasible due to high operational costs and limited market demand.<br>• The coherent narrative of technological triumph overshadowed the economic realities. | Comprehensive market analysis and lifecycle estimates with realistic economic assessments over compelling narratives could have prevented this failure. |
| **Airbus A380**  | Narrative Fallacy | The narrative of unprecedented passenger capacity and luxury led to high expectations for market domination. | Despite initial excitement, production delays, cost overruns, and shifting market preferences toward smaller, more efficient aircraft reduced the program's viability. | Producing credible estimates, factoring in industry trends, and potential shifts in market preferences could have provided a more accurate project outlook than an appealing narrative. |

# MITIGATION STRATEGIES

| Mitigation Strategy | Definition | Application | Benefits |
|---|---|---|---|
| **Reference Class Forecasting** (Kahneman & Tversky, 1979) (Flyvbjerg B. , 2006) | Using statistical data from similar projects to predict the outcomes of the current project. | Identify a reference class of similar past projects, gather data on actual performance, use this data to create a baseline estimate, and adjust for differences. | Reduces optimism and anchoring biases by relying on empirical data. It allows us to learn from the past and make better predictions. (See Note 1) |
| **Using Historical Data** | Leveraging data from previous projects to inform current estimates. | Maintain a repository of past project data, analyze trends, use statistical analysis to uncover patterns, and apply these insights to inform estimates. (See Note 2) | Provides a reality check and helps calibrate expectations. |

Note 1
- In the absence of collected/available data, commercial parametric models are based in part on a reference class of past projects.
- The use of commercial parametric models can enhance the process of reference class forecasting by providing a structured, comprehensive, and systematic approach to analyzing historical data and predicting future outcomes.
- These models can help in identifying relevant reference classes and in developing credible and reliable estimates.
- These models also guide an estimator to the questions they should be asking/answering by eliciting inputs to the appropriate cost driving parameters.

Note 2
- Again, if a proper or sufficient data collection has not been performed, consider using commercial parametric models that have done data collection and normalization, and/or databases such as ISBSG for software projects.

# MITIGATION STRATEGIES

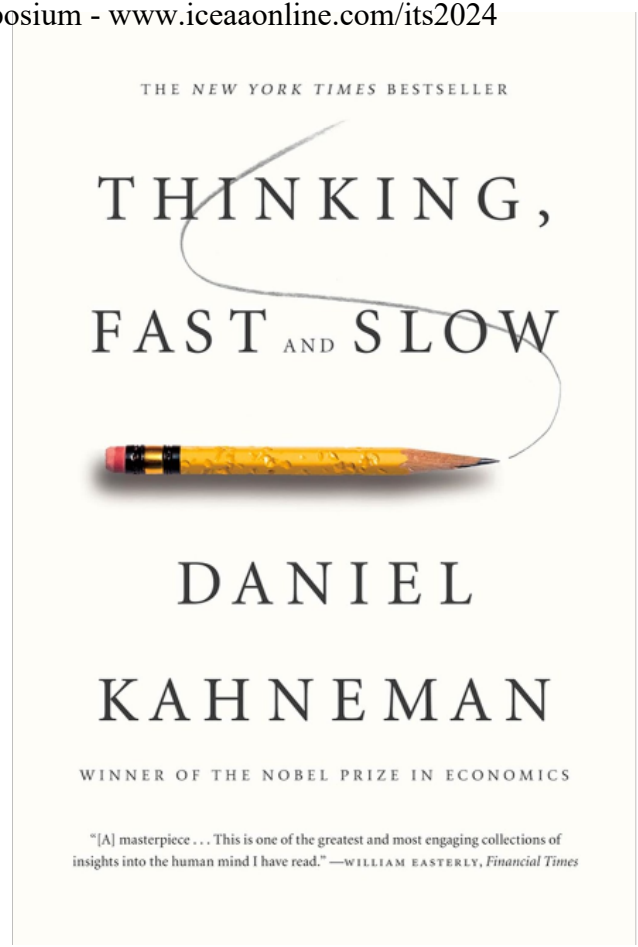
| Mitigation Strategy | Definition | Application | Benefits |
|---|---|---|---|
| **Involving Diverse Perspectives** | Including input from a wide range of stakeholders and team members. | Organize cross-functional workshops, encourage open discussion, use techniques like the Delphi method, and ensure representation from both experienced and less experienced team members. | Reduces groupthink and confirmation bias, leveraging collective wisdom. |
| **Applying Structured Decision-Making Processes** | Implementing formal methodologies and frameworks to guide the estimation process. | Use Uncertainty Analysis or Monte Carlo simulation to account for uncertainty and variability in estimates. Use decision trees, standardized templates, and checklists to evaluate different scenarios and their probabilities. | Provides a systematic approach to estimation, reduces reliance on intuition, and enhances transparency. |
| **Data-Driven Analysis** | Relying on comprehensive data analysis rather than anecdotal evidence or compelling stories. | Use statistical methods to identify trends and correlations. | Mitigates narrative fallacy by grounding decisions in data. |
| **Scenario Planning** | Developing multiple scenarios, including best-case, worst-case, and most likely outcomes. | Understand the full range of possibilities and prepare for uncertainties.. | Reduces the impact of narrative fallacy by considering diverse outcomes. |

# MITIGATION STRATEGIES

| Mitigation Strategy | Definition | Application | Benefits |
|---|---|---|---|
| **Critical Review** | Encouraging critical review and skepticism. | Involve diverse stakeholders to challenge the narrative and provide alternative viewpoints. | Reduces groupthink and confirmation bias. |
| **Incremental Validation** | Validating assumptions and projections incrementally through pilot projects or phased implementations. | Allow for course corrections based on real-world feedback. | Identifies and addresses issues early, mitigating the impact of planning fallacy. |
| **Value and Demand Analysis** | Hypernomics finds that all markets work with four or more opposing mathematical (as opposed to physical) dimensions as it reveals the ways markets form. | For early identification of market thresholds, limits, and responses to product features offered to the buyers that make up the given market. Also to identify open spaces in existing markets where optimizing new product features provides the market with what it wants, doesn't have, and can afford. | • Identifies market positions to determine product viability and the extent that buyers will support it.<br>• Helps balance Cost, Value, and Demand before significant investments and resources are expended.<br>• This would have certainly been beneficial for the Concorde Supersonic Airliner, A380, Comanche, and perhaps others mentioned previously. |

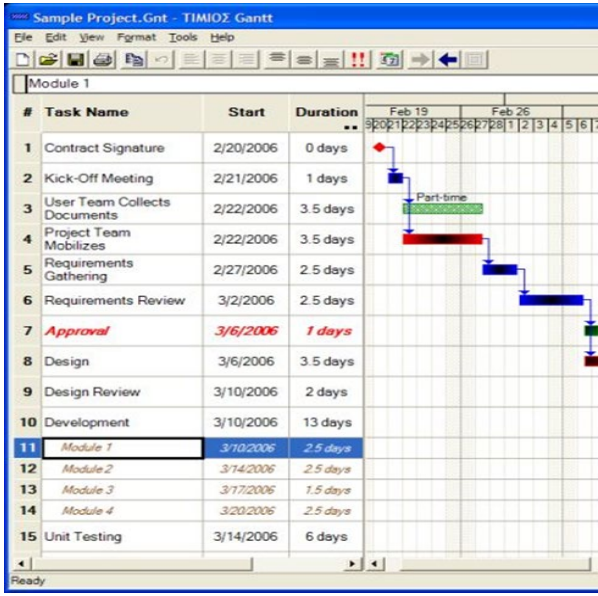
# Lessons from Daniel Kahneman

- "Thinking, Fast and Slow" explores how our minds operate through two distinct systems:
  - System 1: This automatic, intuitive system operates quickly and effortlessly. It is responsible for snap judgments, instincts, and impulsive reactions. Think of it as the brain's autopilot.
  - System 2: This deliberate, analytical system requires effort and conscious thought. It is engaged when you perform calculations, solve complex problems, or focus on details to make informed decisions.
  - Kahneman explains how these systems shape our judgments, decisions, and actions, leading to both errors and insights.
  - Kahneman goes on to describe what he calls taking the "inside view" versus taking an "outside view."



# Lessons from Daniel Kahneman – The Inside View

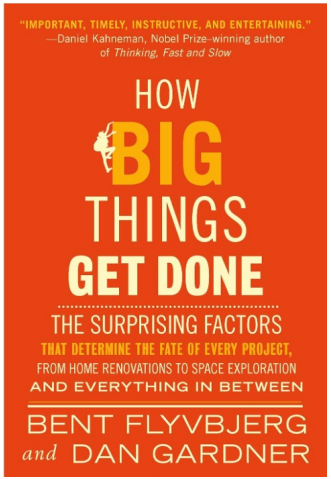
- Beware the "inside view."
  - The insider view is not a simple cognitive bias. It's a superbias—a combination of a lot of powerful biases that sway us from making intelligent decisions.
  - When it comes to plans and predictions, people can know the past well and yet be doomed to repeat it.
  - Events usually don't unfold exactly as people imagine.
  - Even thoughtful people are likely to encounter unexpected obstacles, delays, and interruptions.
  - Using incumbents to support a proposal is helpful but they are strongly influenced by their inside view.
  - "Delusions of Success: How Optimism Undermines Executives' Decisions," Dan Lovallo and Daniel Kahneman explores how executives often fall prey to the planning fallacy.



# Lessons from Daniel Kahneman – The Outside View

- Kahneman and Tversky coined the term planning fallacy to describe plans that are unrealistically close to best-case scenarios.
  - Remember the Planning Fallacy is an optimistic prediction bias in which people underestimate the time it will take them to complete a task, ***despite knowing that similar tasks have typically taken them much longer in the past.***
- Take the "outside view"
  - The outside view, Kahneman and Tversky found, is the cure to the planning fallacy. It is now called reference class forecasting—using information and statistics of similar cases to help predict cost, schedule, and effort.
  - Using distributional information from previous cases (reference class) like the one being forecast is taking an "outside view" since it does not rely on specific estimates of a project manager (inside view); rather it compares the project to a statistical distribution of similar historical projects, resulting in more credible estimates.
  - Taking an outside view may involve getting input from independent sources that do not have a vested interest in the project's success.
    - Alternatively, invite your "inner outsider" to the table. In other words, imagine that a friend has asked for help in preparing for the same estimate. What advice would you give them? The answer is your outside perspective.

# Lessons from Bent Flyvbjerg




- INDEPENDENT REVIEWS
  - Use independent reviewers to assess project estimates and identify potential biases or misrepresentations.
- TRANSPARENCY AND ACCOUNTABILITY
  - Ensure transparency in the estimation process and hold stakeholders accountable for their estimates while also ensuring that they are based on data and evidence.
- MODULAR APROACH
  - Break large projects into smaller, more manageable modules that can be independently estimated and monitored.
- PHASED IMPLEMENTATION
  - Implement projects in phases, using feedback from earlier phases to inform estimates and plans for subsequent phases.
- CONTINGENCY PLANNING
  - Include contingency plans and buffers to account for unforeseen issues and risks.
- MONITORING AND REPORTING
  - Establish robust monitoring and reporting mechanisms to track project progress and identify deviations from plans.
- RISK MANAGEMENT
  - Develop comprehensive risk management strategies that include regular risk assessments and mitigation plans.

# Summary

- Project estimating is susceptible to various cognitive biases and logical fallacies
- These biases and fallacies often lead to significant inaccuracies resulting in cost overruns, delays, and project failures.
- By understanding these biases and applying mitigation strategies such as reference class forecasting, using historical data, involving diverse perspectives, and implementing structured decision-making processes, project managers can improve the accuracy and reliability of their estimates.

# In Conclusion

- Underpinning many of the mitigation strategies is the use of data, which leads me to two quotes from Dr. W. Edwards Deming:

"In God we trust.
All others must bring data."

"Without data
you're just another person
with an opinion."

Dr. W. Edwards Deming