Biases in Project Estimating and Mitigation Strategies to Overcome Them

Brian Glauser

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.	• Temper optimism with realism. • Use reference class forecasting: Base estimates on actual performance from a reference class of comparable projects.
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. • 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. • Seek out disconfirming evidence. • Use reference class forecasting including a 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. • 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. • Reflect on lessons learned from previous projects.
Expert Bias (Halo effect)	Over-reliance on the judgment of experts (who themselves may have bias).	• Experts consciously or subconsciously include bias leading to optimistic or pessimistic estimates. • Can also affect risk assessment which is often calculated based on expert opinion. • May cause one to disregard data or input from less experienced team members.	• Experts should be trained to recognize and mitigate bias. • Perform external review for reasonableness. • 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. • Promote open discussion allowing all team members to voice their opinions and ideas. • 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. • 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. • Causes people to persist in failing endeavors. • 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. • 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. • Have a standardized process for project estimation.

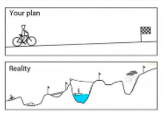
Logical Fallacies

- 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. • Occurs when differences in data are ignored, but similarities are overemphasized.	Leads to misleading conclusions and inaccurate estimates.	Use all available data and apply rigorous statistical methods.

Logical Fallacies

Fallacy	Definition	Impact	Mitigation
Narrative Fallacy (Taleb, 2007) 	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.	• Rely upon data analysis rather than anecdotal evidence or compelling stories. Use statistical methods to identify trends and correlations. • Develop best-case, worst-case, and most likely outcomes and prepare for uncertainties. • Involve diverse stakeholders to challenge the narrative and provide alternative viewpoints.
Planning Fallacy (Kahneman & Tversky, 1979) 	• When predictions about task completion time display an optimism bias. • 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. • 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. • 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. • Periodic reevaluation (estimations) and willingness to adjust plans could have helped.

Real World Examples

Program	Biases Involved	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. • The coherent narrative of technological triumph overshadowed the economic realities.
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.

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)
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.

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.

Mitigation Strategies

Mitigation Strategy	Definition	Application	Benefits
Bias Audits and Checklists		• Implement routine audits of estimation processes to identify recurring biases. • Utilize structured checklists during estimation phases to prompt teams to consider biases explicitly.	

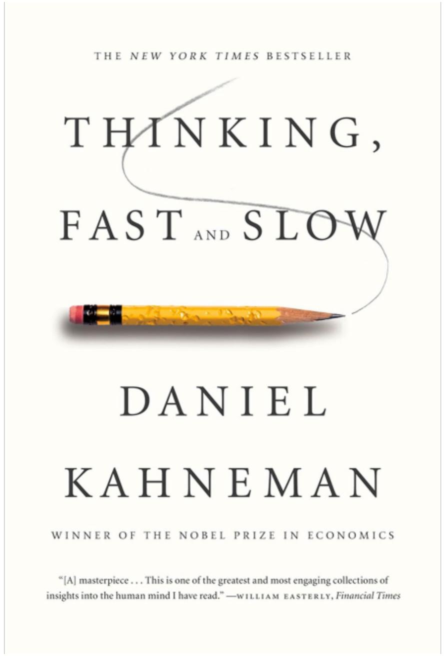
Lessons from Daniel Kahneman

- "Thinking, Fast and Slow" explains how we think using two systems:
  - System 1 is fast, intuitive, emotional, and automatic—our brain's autopilot for snap judgments and instincts.
  - System 2 is slow, analytical, and effortful—used for calculations, problem-solving, and deliberate decisions.

  These systems shape how we judge, decide, and act—often leading to both insights and errors.

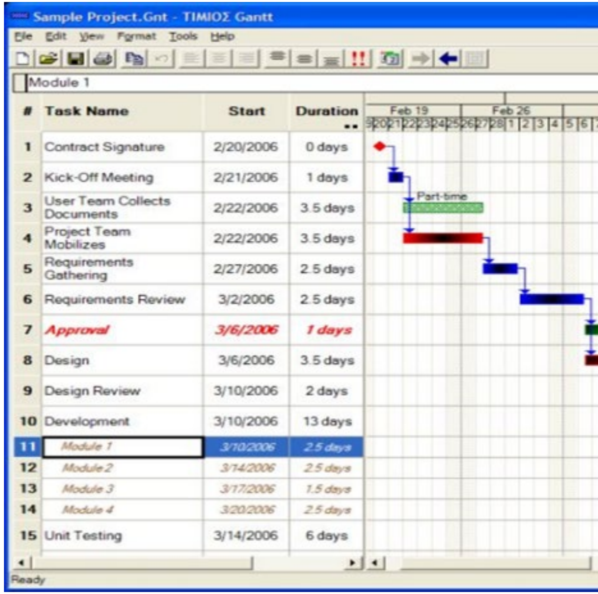
  - System 1 can lead to biased, quick estimates (e.g., overconfidence, anchoring).
  - System 2 supports more accurate, informed forecasting with data and analysis.

  Kahneman also contrasts the "inside view" (focused on specifics) with the "outside view" (informed by past data).



Lessons from Daniel Kahneman – The Inside View

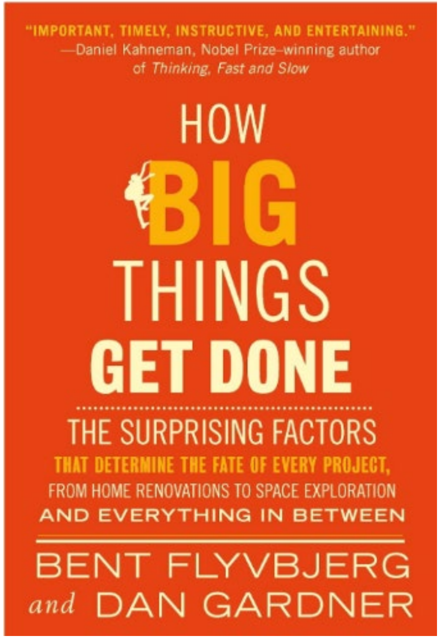
- Beware the "inside view."
  - A "superbias"—a blend of overconfidence, optimism, and flawed assumptions
  - Leads to plans based on best-case scenarios, not real-world outcomes
  - Even experienced teams underestimate risk, delays, and complexity
  - Incumbent input is useful—but often clouded by internal perspectives
  - As Lovallo & Kahneman note:
    "Executives often fall prey to the planning fallacy—despite knowing better."
    - The Planning Fallacy leads us to underestimate time, cost, and risk—despite knowing better from past experience.



Lessons from Daniel Kahneman – The Outside View

- The Outside View combats the Planning Fallacy by using data from similar past projects (reference class forecasting).
- It focuses on what usually happens, not what we hope will happen.
- Involve independent perspectives or ask yourself: *“What advice would I give a colleague facing this same estimate?”*

Lessons from Bent Flyvbjerg

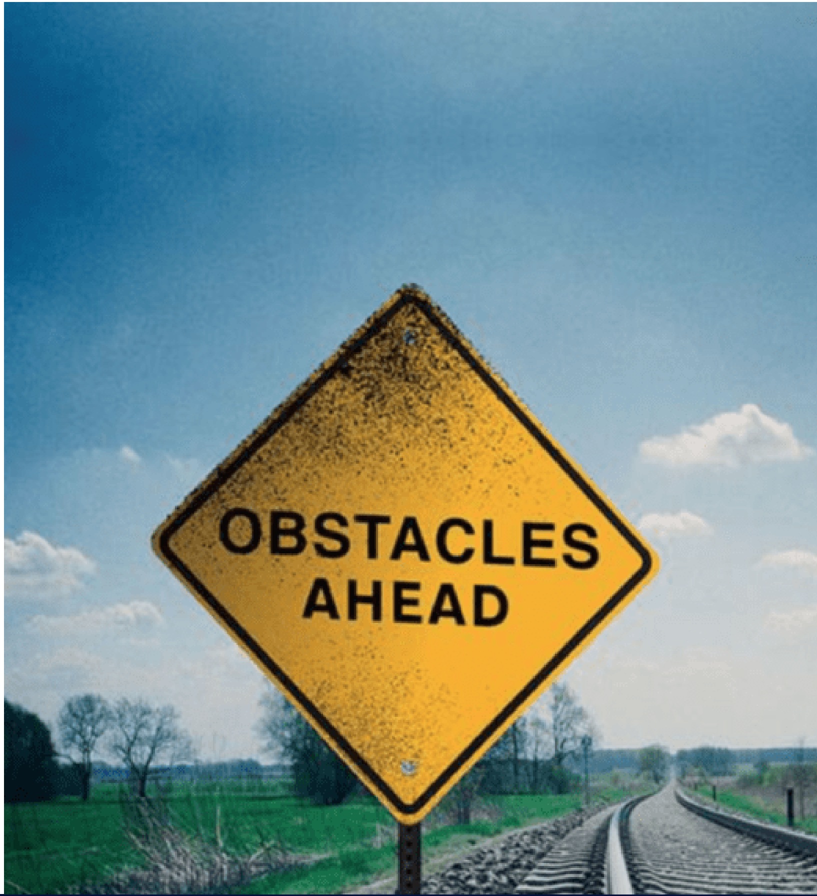


unison

- 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.

Obstacles to Mitigation

- Lack of Historical Data or Poor Data Quality
  - Without access to solid reference class data, teams rely on anecdotal or recent experience
  - **Risk:** Biases like availability heuristic and optimism bias take over.
- Overreliance on Experience or Expertise
  - Experts may default to intuition (System 1), believing their experience alone ensures accuracy.
  - **Risk:** Reinforces biases instead of challenging them with data.
- Organizational Pressure and Political Influence
  - Teams feel pressure to align estimates with desired outcomes (e.g., lower costs to win a bid).
  - **Risk:** Leads to manipulated or optimistic estimates rather than realistic ones.
- Time Constraints and Schedule Pressure
  - Estimators often work under tight deadlines.
  - **Risk:** Encourages cutting corners and skipping rigorous analysis (System 2 thinking).
- Lack of Dedicated Resources, Tools, and Processes
  - Estimating is done using ad-hoc methods or spreadsheets
  - **Risk:** Makes it harder to structure the estimating process and mitigate bias consistently.
- Resistance to Change
  - "This is how we've always done it"
  - **Risk:** Undermines efforts to implement structured or model-based approaches.



unison

Emerging Technologies

- AI and Machine Learning
- Digital Engineering and Model-Based Systems Engineering (MBSE)
- Multi-disciplinary Design Optimization (MDO); Multidisciplinary System Design Optimization (MSDO); Multidisciplinary Design Analysis and Optimization (MDAO)
- Advances in Parametric Models
- Natural Language Processing (NLP) for Document Mining
- Agile Estimating Frameworks - Estimating methodologies aligned with agile program delivery (e.g., incremental capability builds).

Summary

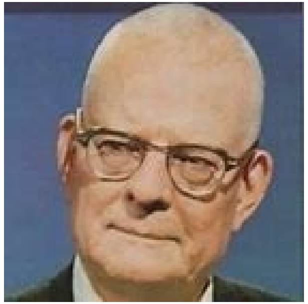
- Project estimating is susceptible and vulnerable to various cognitive biases and logical fallacies
- These biases and fallacies often lead to significant inaccuracies resulting in cost overruns, delays, and project failures.
- Awareness and understanding of biases leads to better estimating discipline.
- Structured, data-driven approaches help mitigate risk (System 2 thinking).

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

Questions?

Brian.Glauser@unisonglobal.com

Questions

- Which biases have you observed on your teams?
- What obstacles have you encountered to removing estimating bias?
- How do you currently mitigate estimation risk?
- Where could structured models or historical data help?