Reference Class Forecasting
CCS 010– Certified Case Study

February 2016

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Agenda

Section	Component	Description
1	**Overview**	• Reference Class Forecasting - What is it?
2	**Context**	• Problems with current forecasting methods • Typical Forecasting biases
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Reference Class Forecasting (RCF): What is it?

WHAT IS REFERENCE CLASS FORECASTING

- RCF is a forecasting technique that can be used in conjunction with, or as a substitution to other traditional forecasting techniques such as regression analysis
- Instead of making predictions about the case at hand, RCF builds classes of similar cases about which we already know the outcomes, RCF then uses those classes to make more accurate predictions of performance, including costs and benefits forecasts as well as completion times

KEY ISSUES WITH COMMON APPROACHES

- Predictors adopt an inside-view, which tries to extrapolate future performance based on current trends
- Predictions results being overly optimistic, over estimating benefits, underestimating costs and underestimating completion times

RCF BENEFITS

- Introduces an unbiased, outside view, ignoring the details of the case at hand
- Reduces human error and judgement
- Provides a prediction of success or failure based on similar real-world cases

WHO USES RCF

- RCF has been developed from the work of Amos Tversky and Nobel Prize Daniel Kahneman in 1979
- Endorsed by the American Planning Association
- Used by U.K., Hong Kong and Australian governments for large infrastructure projects
- Used by investment banks as well consulting firms in making predictions in large infrastructure projects, IT Projects, M&As and market entry decisions

Source: ICG analysis

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Inaccurate forecasts come from the use of the ”Inside View”

THE INSIDE VIEW

- When making prediction about a case at hand, e.g. estimating costs, revenues and completion time, we tend to **focus only on the case at hand**, disregarding information about past projects for which the outcomes is known
- We focus on the resources needed to bring the project alive as well as obstacle to its completion
- The inside view is the natural approach in making forecast
- Leads to a series of **cognitive biases**

COGNITIVE BIASES ASSOCIATED WITH THE INSIDE VIEW

- **Cognitive biases** are systematic errors in the process of thinking

- Some of the cognitive biases related to the inside view are
  1. **Planning fallacy**: the tendency to underestimate the duration and cost of an endeavour
  2. **Optimism bias**: the tendency to be overly optimistic when making predictions
  3. **Over confidence**: the tendency of decision makers to overestimate their abilities
  4. **Anchoring bias**: the tendency to rely heavily on the first prediction or even random numbers in subsequent predictions

Source: Thinking Fast and Slow, by Daniel Kahneman, Farrar, Straus and Giroux, 2011

Inaccuracy in Forecasting is Widespread

GLOBAL STUDY ON LARGE INFRASTRUCTURES

- Market entry decisions, in particular for products that use new, unproven technologies
- M&As
- Large infrastructure projects, including electricity infrastructure projects, water projects, dams, and offshore wind power
- A **global study** was conducted on the cost of **large transportation projects**
  - 9 out of 10 projects found to have a cost overrun
  - Overrun found in 20 nations and 5 continents included in the study
  - Overrun appears consistently for a 70-year period of study, showing no improvement of cost estimation over time

Type of Case	Number of cases	Avg. cost overrun	Standard deviation
Rail	58	44.7%	38.4
Bridges and Tunnels	33	33.8%	62.4
Roads	167	20.4%	29.9

COST OVERRUNS IN IT PROJECTS

%, projects >$15 million, in 2010 dollars

Project type	Average cost overrun	Average schedule overrun	Average benefits shortfall
Software	66	33	17
Nonsoftware	43	3.6	133
Total	45	7	56

Source: Megaprojects and Risk, Flyvbjerg et al; Policy and Planning for Large Infrastructure Projects: Problems, Causes, Cures, Bent Flyvbjerg, World Bank Policy Research Working Paper 3781, December 2005 ; Delivering large-scale IT projects on time, on budget, and on value, by M. Bloch, S. Blumberg and J. Laartz, The McKinsey Quarterly, no. 27 2012

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Reference Class Forecasting overcomes the drawbacks of the Inside View by adopting the so-called ”Outside View”

THE OUTSIDE VIEW

- The Outside View provides solutions to the problems of the Inside View
- Ignores the specific knowledge that you have to the inner workings of your case and looks at the case from an unbiased perspective

HOW THE OUTSIDE VIEW WORKS

- Ignores the details of the case at hand and makes no attempt to forecast the outcome of the case
- Focuses on the statistics of a class of cases chosen to be similar in relevant respects to the case at hand
- Requires deliberate intentions to compare the case at hand to outcomes of previous cases
- Minimizes the adverse impact of cognitive biases

Source: Thinking Fast and Slow, by Daniel Kahneman, Farrar, Straus and Giroux, 2011

Reference Class Forecasting follows a three step process

Create a reference class

- Can be built with limited data and cases from other industries
- Should include both successful and unsuccessful cases across various industries
- Reference class should share key characteristics to the case at hand
- These key characteristics should be driven by theoretical and empirical studies on what is likely to work in that type of projects (e.g. M&As are likely to succeed when they are merges of equal, when the companies are culturally similar, etc)

Identify the best approach to use to build the predictions

- This step can use various approaches, with different level of complexity, including
    1. Identify the values of the parameter that is forecasted
    2. Build **a probability distribution** for the parameter that is forecasted
    3. Build **similarity weights** that will assess to what extent the cases in the reference class are similar to the case at hand
- Estimations should be performed by unbiased experts and not the analysts who build the reference class

Construct predictions

- Depending on the approached used in the previous step:
    1. Use the average of the parameter to make predictions about the case at hand
    2. Olaces the project at hand in a statistical distribution of outcomes from the class of reference projecs
    3. If you have built similarity weights, apply weights to reference cases based on similarity to the current case
- Compare the predictions from RCF to the predictions of the inside view

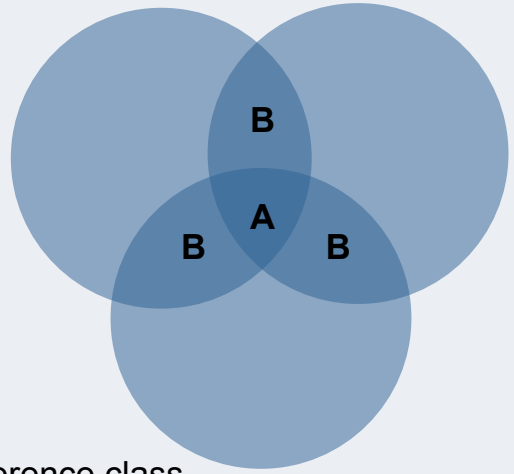
Source: ICG analysis. See also Delusion and Deception in Large Infrastructure Projects: Two Models for Explaining and Preventing Executive Disaster, by Flyvbjerg, Bent, Garbuio, Massimo and Dan Lovallo, California Management Review, 2009

As a result of the Reference Class Forecasting process, we identify Ideal and Secondary Reference Classes

TYPES OF REFERENCE CLASSES

- Cases chosen for building a reference class are not necessarily from the same industry or the same type of project of the case at hand. However, they have in common specific characteristics
- Often, case choice is driven by theory, that is success factors that have been identified in past studies
- An **ideal reference class** is a group of cases that are very similar to the case at hand
- A **secondary reference class** consists of cases with some common aspects, but missing a few key elements
- When building forecasts for the case at hand, more **weight** is given to cases in the ideal reference class than in the secondary reference class

ONE REPRESENTATION OF REFERENCE CLASSES



A Ideal reference class

B Second-best reference class

Source: Beating the Odds of Market Entry, John, Horn, Dan Lovallo and Patrick Viguerie, McKinsey Quarter, 2005, No. 4

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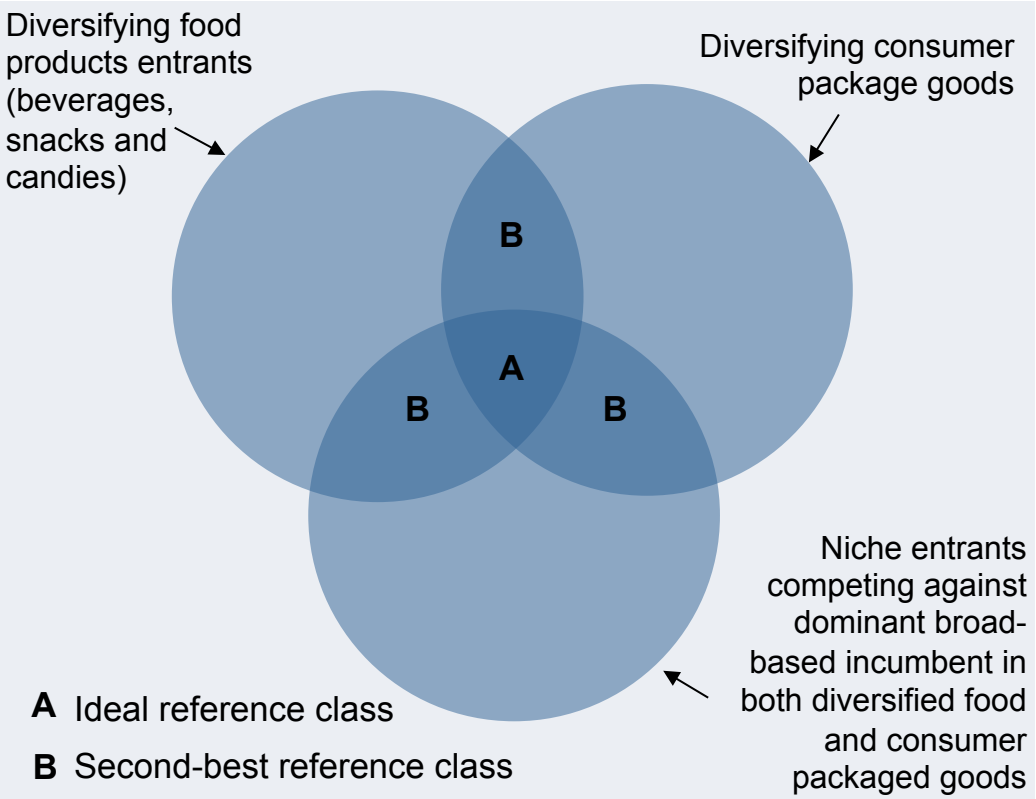
Should have Anheuser-Busch (Eagle Snacks) entered the supermarket business?

REFERENCE CLASS FOR ANHEUSER-BUSCH



THE PROBLEM

- Anheuser-Busch found success producing snack foods for airlines and taverns
- Should Anheuser-Busch expand into the decided to expand into supermarkets business?

A REFERENCE CLASS FOR A NEW ENTRY

- To decide whether to enter or not the supermarket business, Anheuser-Busch could have developed a RC based on:
  1. Diversifying food product entrants
  2. Diversifying consumer packaged-goods entrants
  3. Niche entrants

WHAT HAPPENED

- Frito-Lay decides to compete against the new entrant by cutting prices to drive Anheuser-Busch out of supermarket business
- Anheuser-Busch forced to sell snack brand
- Had Anheuser-Busch used RCF, they could have seen the failure faced by members of the same reference class and chosen not to expand as they did

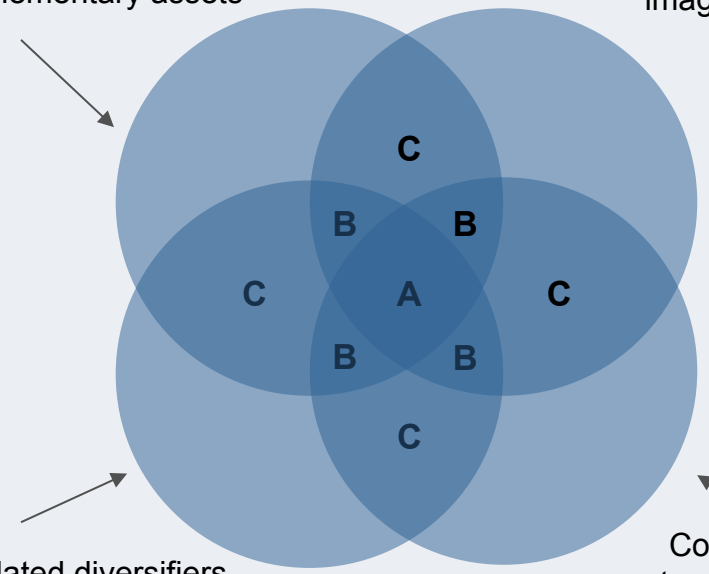
Source: Beating the Odds of Market Entry, John, Horn, Dan Lovallo and Patrick Viguerie, McKinsey Quarter, 2005, No. 4

EMI's forecast of CAT scanners success could have used four types of businesses

REFERENCE CLASS FOR SEGWAY

Technological leaders w/ few complementary assets vs. related diversifiers w/ complementary assets

Medical diagnostic-imaging companies



Unrelated diversifiers

Companies in early stage of business life cycle

A Ideal reference class

B Second-best reference class

C Third-best reference class

THE PROBLEM

- EMI, had a successful business making music production equipment
- A researcher in the company labs developed an innovation for CAT scanners
- Should EMI enter the medical equipment market?

A REFERENCE CLASS FOR A NEW ENTRY

- To decide whether to enter or not the medical equipment business, EMI could have developed a RC based on:
  1. Unrelated diversifiers
  2. Medical diagnostic-imaging companies
  3. Companies in early stage of business life cycle
  4. Technological leaders with few complementary assets competing against related diversifiers with complementary assets

WHAT HAPPENED

- EMI decided to build its own capabilities in the manufacturing and distribution of medical equipment
- It took five years for EMI to bring a product to market
- GE and Siemens entered the market soon after with experience in the field of medical equipment, outperforming EMI
- Had EMI used RCF, they could have seen the failures other companies in their RC faced with diversifying independently and partnered with another company

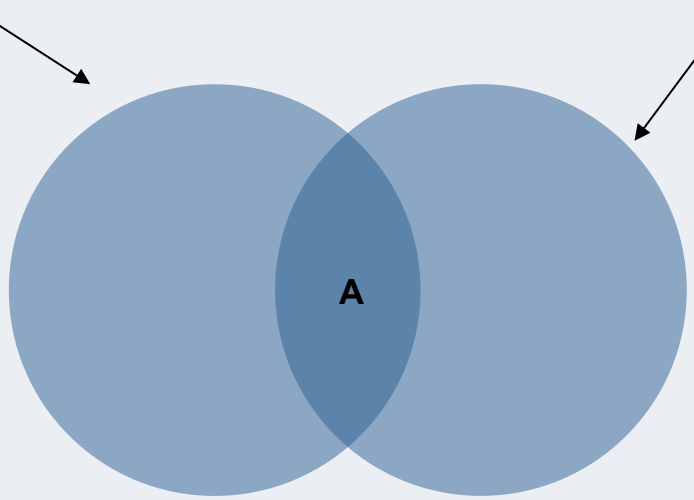
Source: Beating the Odds of Market Entry, John, Horn, Dan Lovallo and Patrick Viguerie, McKinsey Quarter, 2005, No. 4

Segway could have predicted the size of the market by using reference classed from other industries

REFERENCE CLASS FOR SEGWAY

Early transportation manufacturers (automobiles (early 1900s), fuel cell cars, private airplanes, bicycles, scooters, and motorcycles)

Other entrants requiring unique infrastructure (electric power, telephones, and high-definition television)



A Ideal reference class

THE PROBLEM

- Segway introduced a new type of two-wheeled vehicle
- An estimation of sales of Segways was needed

MARKET SIZE PREDICTIONS

- To determine the size of the market for Segways they could have used a RC consisting of:
  1. Early transportation manufacturers
  2. Other entrants requiring unique infrastructure

WHAT HAPPENED

- Many cities refused to allow the use of Segways on sidewalks
- Segways greatly undersold compared to their sales prediction
- Had Segway used RCF they would have seen the importance of securing the rights to ride Segways in cities

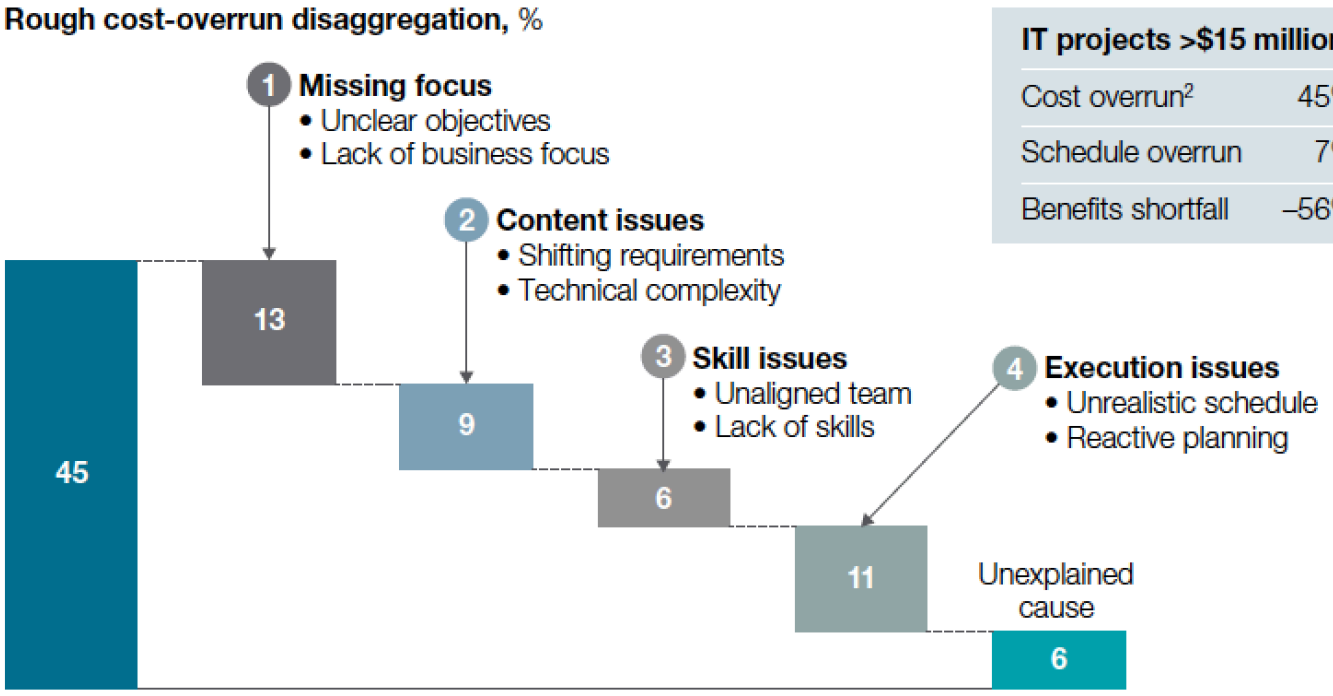
Source: Beating the Odds of Market Entry, John, Horn, Dan Lovallo and Patrick Viguerie, McKinsey Quarter, 2005, No. 4

RCF studies have identified the four threat factors of large-scale IT projects

KEY POINTS

- Study of more than 5,400 large-scale (>$15 mil) IT projects conducted by McKinsey and the Centre for Major Programme Management at the University of Oxford
- On average, projects:
  - overspend 45% of the starting budget
  - delivered 7% overtime
  - deliver 56% less value
- Four groups of issues can guide executives in building a reference class forecast for the project at hand

IT EXECUTIVES IDENTIFIED 4 GROUPS OF ISSUES THAT CAUSE PROJECT FAILURE



[1]With cost overrun, in 2010 dollars.
[2]Cost increase over regular cost.

Source: Delivering large-scale IT projects on time, on budget, and on value, by M. Bloch, S. Blumberg and J. Laartz, The McKinsey Quarterly, no. 27 2012

Other applications of RCF span across the globe and type of projects

American Planning Association	• Officially endorsed reference class forecasting and encourages planners to use it in addition to traditional techniques in order to increase accuracy • Beneficial for one-off projects, such as museums, civic centers, stadiums and arenas
UK Department of Transportation	• Recommends using reference class forecasting since August 2004 • Standard cost uplifts applied to cost estimates based on reference class estimates • Based on the Treasury Department decision that future allocations for large public works needed to have estimates of costs, benefits and duration adjusted for optimism
Forecasting movie revenues	• Has been used by major movie production companies to predict movie success • Predictions using RCF shown to be more accurate than predictions using the standard method of forecasting • Based on a data-base of over 1,700 movies
Infrastructure Risk Group (UK)	• The Infrastructure Risk Group (IRG) has conducted a study of long-term infrastructure projects in the UK (2013) • IRG made a clear recommendation towards using Reference Class Forecasting rather than alternative methods in early-stage risk analysis of infrastructure projects

Sources: From Nobel Prize to Project Management: Getting Risks Right, Bent Flyvbjerg, Project Management Journal, 2006, no. 3; Robust Analogizing and the Outside View: Two Empirical Tests of Case-Based Decision Making Dan Lovallo, Carmina Clarke, and Colin Camerer, Strategic Management Journal, 2012, No.33; Managing Cost Risk and Uncertainty in Infrastructure Projects, Infrastructure Risk Group, 2013

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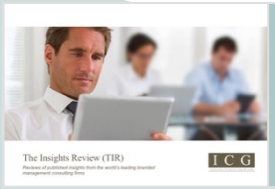

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