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DOING THE MATH

How to Estimate and Manage Results

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Presentation Outline

- The limits of planning
- Identification of key initiatives
  - Analysis of a process
  - Selection of an Improvement Initiative
- Inch Wide, Mile Deep: Minimizing Technical & Organizational Complexity
  - Predictive Metrics
- Estimation and management for change initiatives
  - Field analysis of improvement programs
  - Creation of the "Half Life" Concept
  - Example for an MRD (Marketing Requirements Document Initiative)
- Case Study: Tracking Progress over Time
- Bonus: Estimation based on no information
  - Copernican Principle

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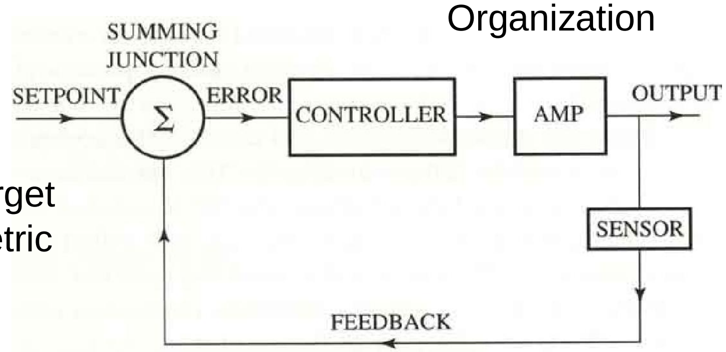
The Limits of Planning

- Even the slightest change in one attribute can cause uncertainly large changes in any other attribute
- You get more control over estimation by learning from evolutionary early and frequent result deliveries, than you will if you try to estimate in advance for a whole large project
- Any method which gives you early feedback and correction of reality is more likely to give you control over the final result than big bang methods
- Data from past projects might be useful, but it can never be as useful to you as current data from your present project

Organization

Target Metric



Actual Performance

Estimation methods alone will not change a result which is off the track. Active correction must be a part of your methodology

Reference: "Principles of Software Engineering Management", Tom Gilb, Addison Wesley

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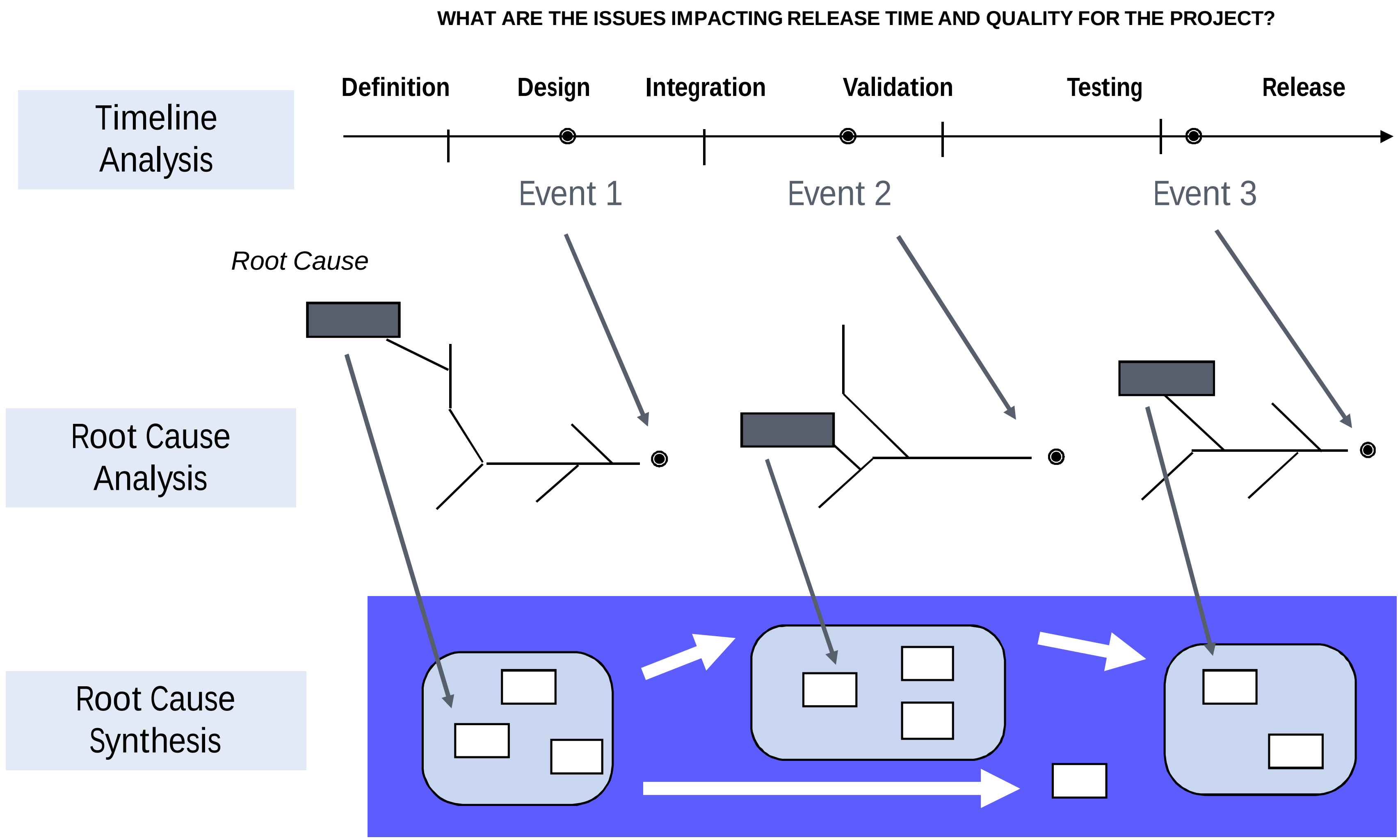
Overview: How to Determine Root Causes



Identify root causes with short half life and high impact to avoid boiling ocean

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Example Project History Synthesis

WHAT ARE THE ISSUES IMPACTING RELEASE TIME AND QUALITY FOR THE PROJECT?

A PROJECT WITHOUT A ROAD MAP AND A DESTINATION GETS YOU TO AN UNKNOWN PLACE AT AN UNKNOWN TIME.

PRODUCT REQUIREMENTS WERE NOT CLEARLY DEFINED

- PRODUCT REQUIREMENTS WERE NEVER FROZEN. (NOT EVEN FROZEN, THAWED, FROZEN,...)
- **THERE WAS NO DEFINITION OF CUSTOMER OR PRODUCT REQUIREMENTS**
  - 50% OF THE CUSTOMER REQUIREMENTS WERE NOT KNOWN BY THE DESIGN TEAM DURING IMPLEMENTATION
  - THERE WAS NO PRODUCT DEFINITION
  - THERE WAS NO PRODUCT OR CUSTOMER ACCEPTANCE CRITERIA DOCUMENTED FOR THE ENGINEERING TEAM

MRD

THERE IS NO COMMITMENT TO FOLLOW A PRODUCT DEVELOPMENT PROCESS

NO COMMON SOFTWARE DEVELOPMENT PROCESS WAS USED

- NO COMMON DESIGN METHODOLOGY WAS USED ON THIS PROJECT
- **NO FORMAL TESTING PROCESS WAS ALLOWED**
  - FORMAL TESTING WAS NOT DONE AS COMPONENTS BECAME AVAILABLE
- **NO DEFECT DETECTION WAS DONE ON THE SOFTWARE DESIGN**
  - THE APPLICATION INTERFACE WAS NOT FORMALLY REVIEWED PRIOR TO IMPLEMENTATION
  - THERE WAS NO SOFTWARE DESIGN REVIEW FOR THE VENUS 2 MODULE

THERE WAS A LACK OF COMMITMENT TO TESTING

- CUSTOMER ACCEPTANCE TESTING WAS NOT SCHEDULED
- **WE DID NOT TEST THE SYSTEM PRIOR TO SHIPMENT**
  - 1 HOUR OF TESTING WAS DONE WHEN 2 WEEKS WERE REQUIRED
  - ADDITION OF CUSTOMER DEMO TO COMPRESSED SCHEDULE DIRECTLY REDUCED TESTING TIME
- **THERE WAS INSUFFICIENT H/W AVAILABLE TO S/W**
  - DURING INTEGRATION WE HAD ONE TEST SETUP IN LIEU OF THREE NEEDED
  - SHARING RESOURCES WITH HARDWARE ENGINEERS LIMITED SOFTWARE ENGINEER'S TEST TIME BY 20% OF WHAT WAS NEEDED
  - THE DELIVERY DATE FOR HARDWARE LEFT ONLY 1.5 MONTHS FOR H/W - S/W INTEGRATION AND TESTING

- **THIS WAS A CUSTOMER DRIVEN GENERIC PRODUCT**
  - ONLY 1 CUSTOMER WAS USED TO GATHER REQUIREMENTS FOR THE PRODUCT
  - MARKETING WAS NOT INVOLVED DURING THIS PROJECT

- MAN-HOUR ESTIMATE WAS NOT CHANGED AFTER CUSTOMER REQUIREMENTS CHANGED

THERE IS NO METHOD FOR COMMUNICATING PRODUCT KNOWLEDGE

- NO TIME WAS SCHEDULED TO PROVIDE DOCUMENTATION TO APPLICATION WRITERS
- **WE DID NOT PROVIDE TEAM MEMBERS WITH BASELINE PRODUCTS S/W KNOWLEDGE**
  - AS NEW PEOPLE WERE ADDED TO THE TEAM, PROJECT LEADERSHIP DID NOT PASS ON DESIGN OR FUNCTIONAL METHODS FORMALLY
  - THE VENUS 2 SOFTWARE ARCHITECTURE IS NOT DOCUMENTED OUTSIDE OF THE CODE

Legend:
- = Top Vote Getter
- = Second Vote Getter
- = Third Vote Getter

What are “Predictive Metrics”?

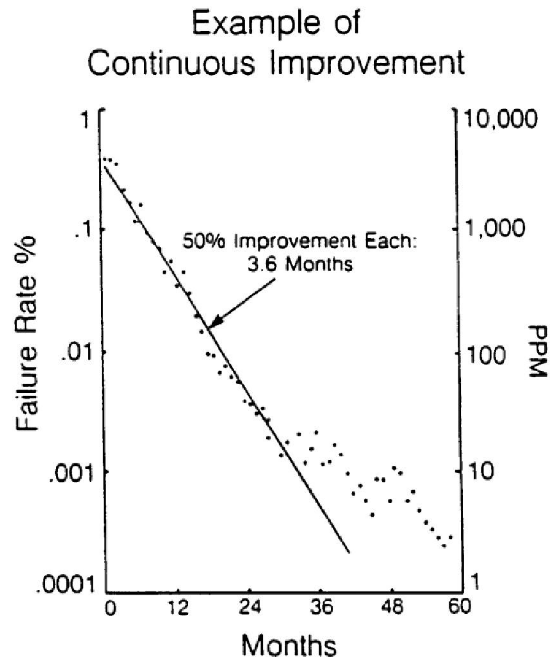
Definition: The measurement of a key driver or initiative, which if executed correctly, will lead to the achievement of overall goals

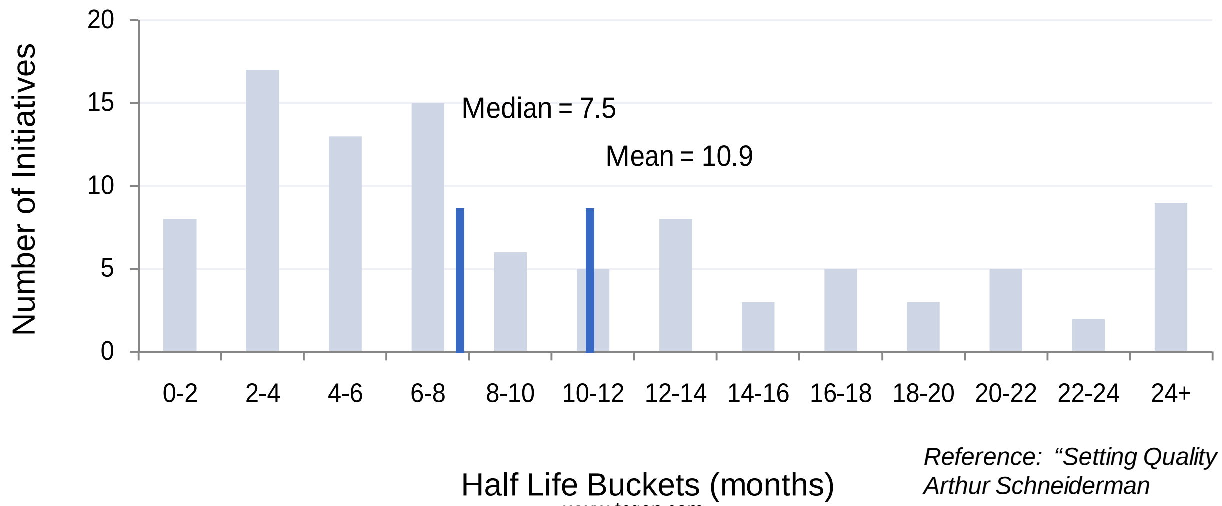
- Track Progress to plan
- Key Drivers and Milestones – Not just $
- Indicators of the outcome
- Simple, lightweight and easy to deploy

- Benefits are…
  - **Prevents** bad outcomes
  - **Focuses management** on key drivers
  - **Saves time** in preparation for project reviews
  - **Higher quality meetings** as a result of capturing history

Half Life Principles

- How fast does one expect to change?
- It depends on many factors including urgency, simplicity, number of dependencies (people, process, or technology) and the organizational scope
- Art Schneiderman, VP of Quality at Analog Devices performed a survey of nearly 100 improvement initiatives



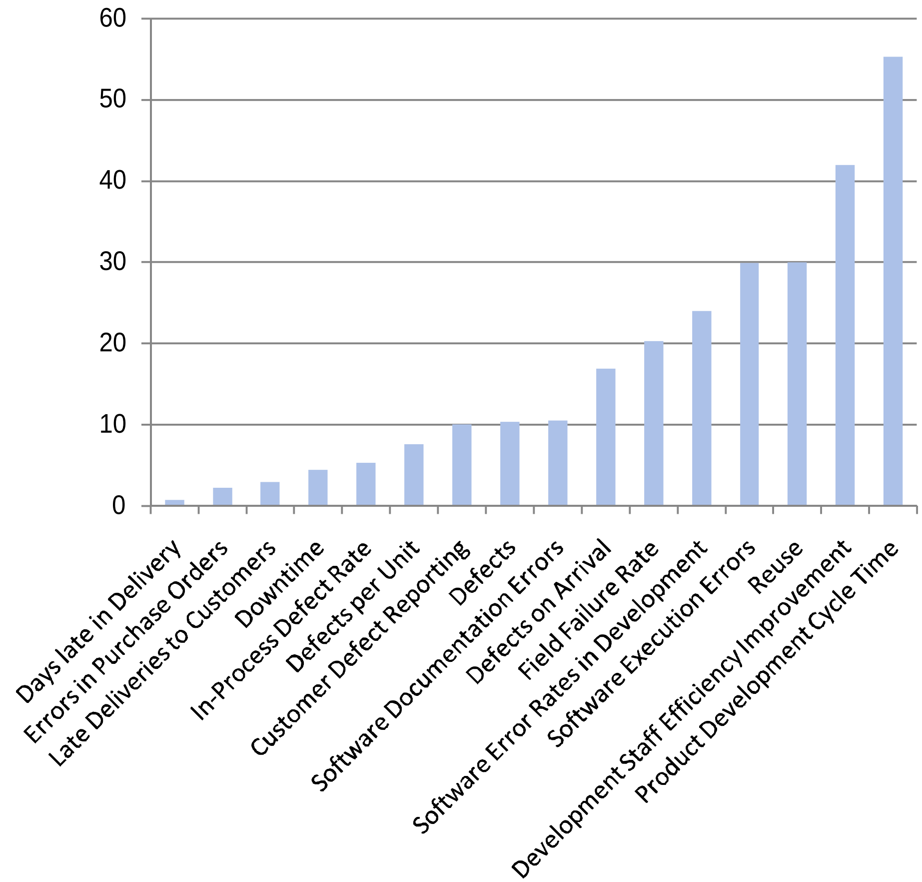


Reference: "Setting Quality Goals" Quality Progress, Arthur Schneiderman

Example Workflow Improvement Initiative Half Lives

Area	Half Life	Cycles
Days late in Delivery	0.8	7.6
Errors in Purchase Orders	2.3	1.5
Late Deliveries to Customers	3	2.7
Downtime	4.5	1.3
In-Process Defect Rate	5.3	1.1
Defects per Unit	7.6	4.6
Customer Defect Reporting	10.1	7.1
Defects	10.4	5.2
Software Documentation Errors	10.5	1.2
Defects on Arrival	16.9	2
Field Failure Rate	20.3	1.3
Software Error Rates in Development	24	2
Software Execution Errors	29.9	0.4
Reuse	30	1.6
Development Staff Efficiency Improvement	42	1.1
Product Development Cycle Time	55.3	1.1
Average	17.1	2.6

Reference: Analog Devices: The Half Life System, HBS Case 9-190-061



- Half Life is shown in months, and these examples are from reports from industry and from Analog Devices study (subset from prior chart)
- Chart is a graphical representation from table

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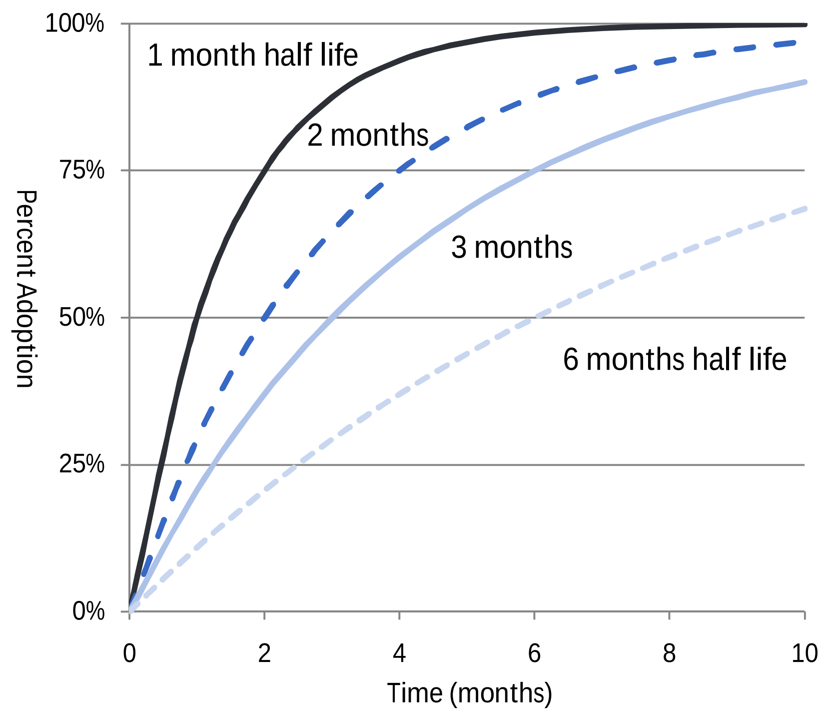
Rule Of Thumb For Improvement Goals

- Use the chart below to estimate how many months it will take to increase the frequency of use by a factor of two from the current level – this is "half life"
- Use guidelines when no other means exists to determine rate of improvement

Project Type	Examples	Typical Half Life	Minimum Half Life	Maximum Half Life
Uni-Functional	Marketing Requirements Document	3	0-1	6
Cross-Functional	New Product Cycle Time	9	6-18	12-48
Multi-Entity	Vendor Quality	18	12-18	24-48

Examples of Predictive Metrics	Half Life Estimate
Phase Review Nomenclature	1
MRD	2
Programs with Program Plans	2
Teams with Charters	2

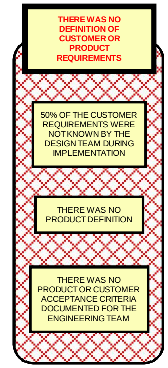
Examples of Predictive Metrics	Half Life Estimate
Software Adoption	3
Unit Testing Adoption	3
Formal Inspections	6
Process rollout to divisions	6



$$y = 1 - e^{-\ln(2)t/T}$$

Half-life Plot For Marketing Requirement Documents (MRDs)

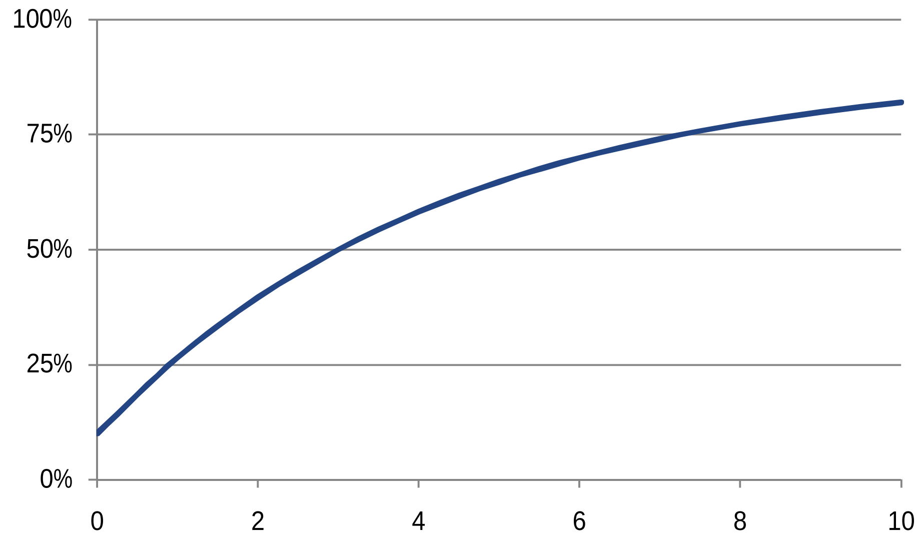
- Precise Definition
  - Out of the total projects listed as being in investigation phase in the weekly/monthly updates, how many (%) have an MRD. A project is considered to have an MRD if the team identifies a specific document as fulfilling that function, regardless of its title.
- Sample Baseline
  - Unmeasured, and difficult to measure without identifying project phases. Based on the sampling from "slotting exercises," roughly 10% of the projects are likely to have MRDs at the start. The goal is 90%



- Half life
  - 3 months (Example: Time to go from initial value of 10% to 1/2 the gap of 90% that value, or 50%)
- Baseline value
  - 10% of projects have MRDs currently

$$y = 1 - \left((y_o - y_{min}) e^{-\frac{\ln(2)t}{T_{\frac{1}{2}}}} + y_{min} \right)$$

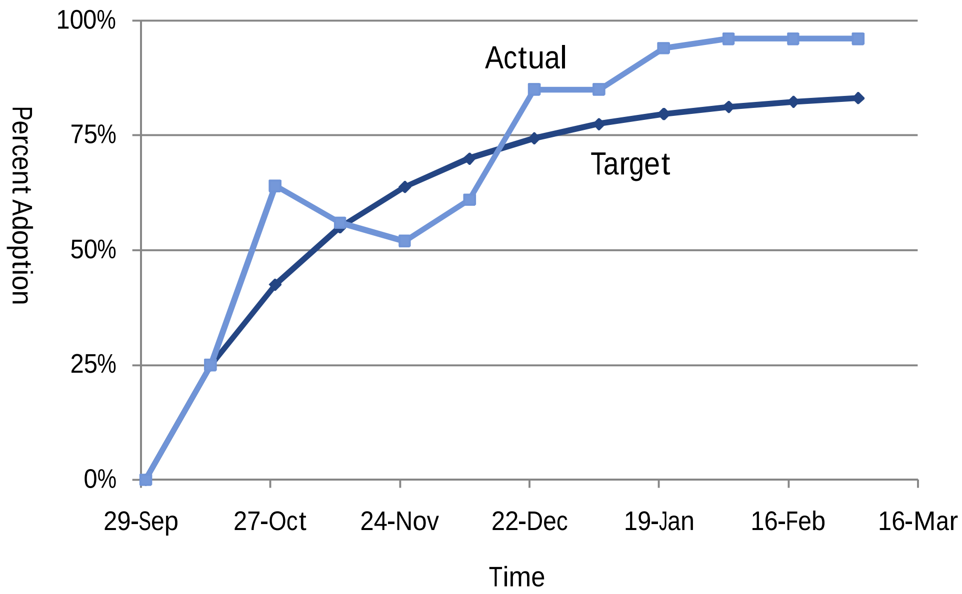
$$y_o = .9, \qquad y_{min} = .1$$



=1-((Yo-Ymin)*EXP(-1*a*E37/T2)+Ymin) [From Excel where a=ln(2) and E37 is a cell reference for time]

Use of Phase Review Nomenclature - Implementation Over Time

Graph and Table of Percent Adoption – which is easier to read and understand trends?



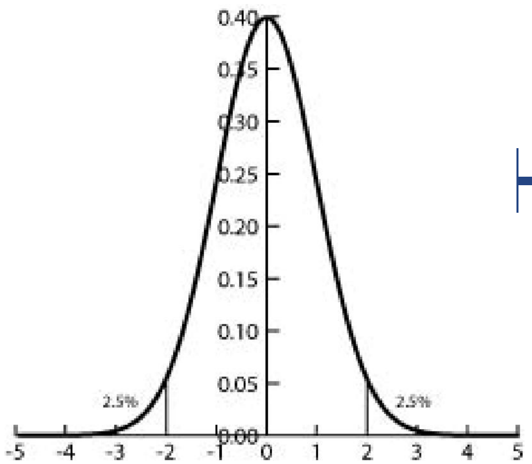
Date	Target	Actual
30-Sep	0%	0%
14-Oct	25%	25%
28-Oct	43%	64%
11-Nov	55%	56%
25-Nov	64%	52%
9-Dec	70%	61%
23-Dec	74%	85%
6-Jan	77%	85%
20-Jan	80%	94%
3-Feb	81%	96%
17-Feb	82%	96%
3-Mar	83%	96%

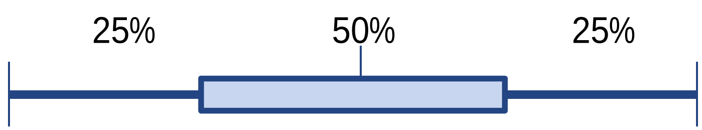
Any method which gives you early feedback and correction of reality is more likely to give you control over the final result than big bang methods

For Background see: "New Product Development: PM Network*, March 1994*

Estimation based on little (or no) information

- In Cosmology the Copernican Principle, named after Nicolas Copernicus, states the Earth is not located at the center of the universe
- The time analog to the center of the solar system, is we are not observing a phenomenon at a special time
- There is a 50% chance you are observing sometime during the middle two quarters of its existence
- There is a 95% chance you are not making your observation during the short end (2.5%) or the long end (2.5%)
- To get the 95% confidence range of existence, divide and multiply current life by 39





Where 'point estimates' have been useful

- Lifetime of partner relationship
- Lifetime of a startup
- Lifetime of a vendor
- Lifetime of a business

For Background see: "A Survival Imperative for Space Colonization" John Tierney, NYT July 17, 2007