

# The Proof is in the Project – Combining Personal and Team Process with CMMI Level 5

Steve Brady & Sherri Turner  
Northrop Grumman IT  
March 9, 2004

# IT



# Agenda

- **Introduction**
- **Challenges**
- **Project Comparisons**
- **Performance Summaries**
  - Personal Software Process (PSP)
  - Software Engineering Institute (SEI) Capability Maturity Model Integrated (CMMI) Levels 4/5
- **Positive Effects**
- **Summary**
- **Discussion**

- **Answering basic questions:**
  - How big is it?
  - How long will it take?
  - When is testing complete?
- **Inaccurate answers led to the following outcomes:**
  - Schedule slips / missed milestones
  - Cost overruns
  - Team frustration
    - Extended team dissatisfaction
    - Industry standard turnover rates (20%)
  - Increased Risk
    - Dependence on individuals
    - Insignificant end user involvement

- **We will call them Projects “A”, “B”, and “C”**
  - Project A began June 1997
  - Project B began January 1998
  - Project C began October 2000

} **Same Customer**
- **Projects Similarities**
  - All Same Contract Type
    - Firm Fixed Price (FFP)
  - Same Organization within the Company performing the work
  - Similar Level of Team Expertise and Training
  - Similar Development Environment
    - All PowerBuilder and Oracle
  - Estimated to be similar in size

## Key Process Differences

- **Project A**

- Management decided that the project was “too far along” to benefit from Process Insertion.

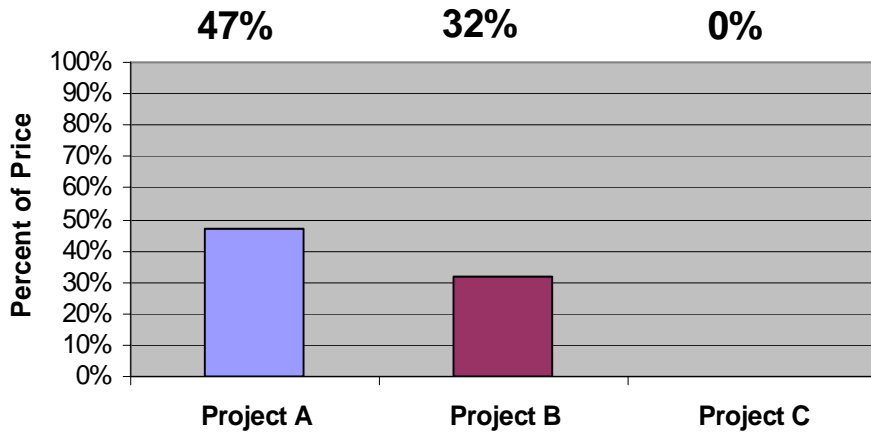
- **Project B**

- Disciplined team process used to create detailed developer design packages.
- PSP used consistently by developers during code construction.
- Peer Reviews (PR) conducted on the most critical 20% of the software.

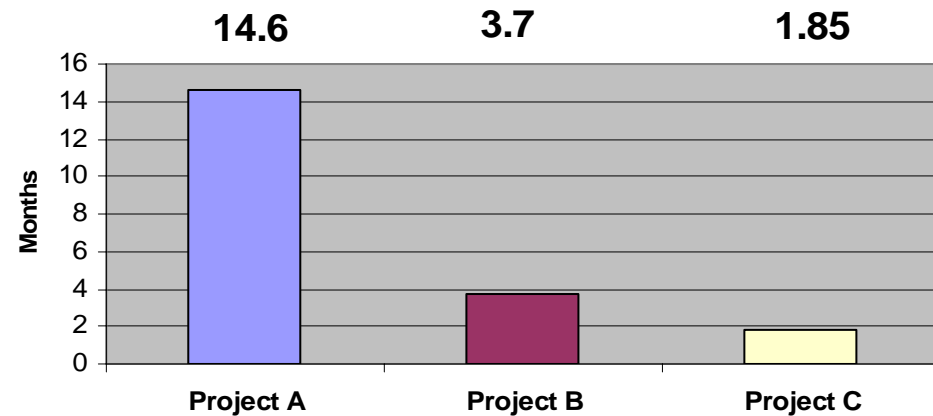
- **Project C**

- Historical data used to estimate/propose work.
- PSP Implemented from Contract Initiation (actually during the proposal).
- Peer Reviews conducted on 100% of the all work products.
- Implemented Software Engineering Institute's (SEI) Capability Maturity Model Integrated (CMMI) Level 4/5 Processes

## Cost Overrun



## Time to Accept



## Quality



- **Cost to Project B**
  - PSP cost ~ \$33,600
    - Project team must be predominately PSP trained (“seeding” does not work)
  - 20% of most critical code objects were Peer Reviewed at a cost of \$70,000
  - **Total PSP & Insertion Cost = \$103,600**

- **Returns of Project B**

- **Cost of Integration / Acceptance Test**

- Project B completed test at 25% of the cost that Project A completed.

- **Schedule**

- Project B was accepted 7 months before Project A.

- Schedule Performance Index mean (SPI<sub>m</sub>) improved from .746 before PSP and Peer Reviews to 2.657 after! More than 300% improvement of task completion.

- Assuming the team had completed in the same manner as Project A (20 month overrun), PSP saved the project 12 months potential project overrun.

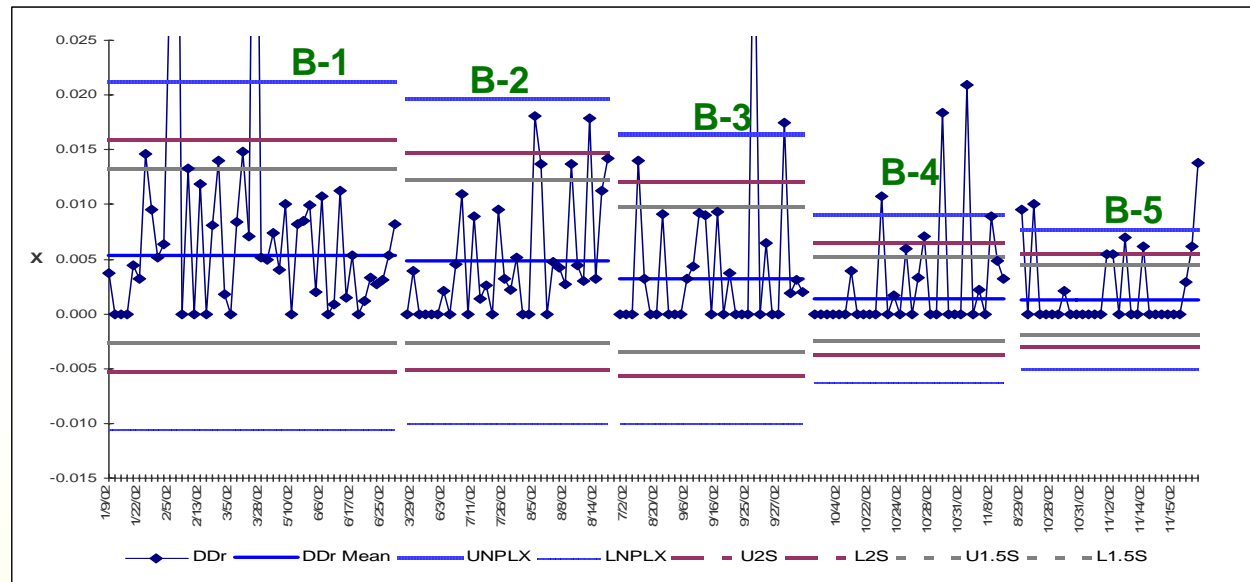
- **Quality**

- Project B Delivered 3.72 defects/KLOC (thousand lines of code) LESS than Project A



- **Project C took the risk to implement CMMI L4/5**
- **Construction Phase – Quantitative Mgt and Causal Analysis & Resolution**
  - Code was separated into 5 Builds
  - Performed 100% Peer Reviews on Code
  - Detailed Software Test Cases that were 100% Peer Reviewed
  - Performed Statistical Process Control (SPC) on Defect Densities in Review (DDr)
  - Performed Defect Prevention (DP) Cycles between Builds
  - Performed analysis on 100% of Special Causes of Variation and performed mini DP Cycles

# CMMI L 4/5 Improvements

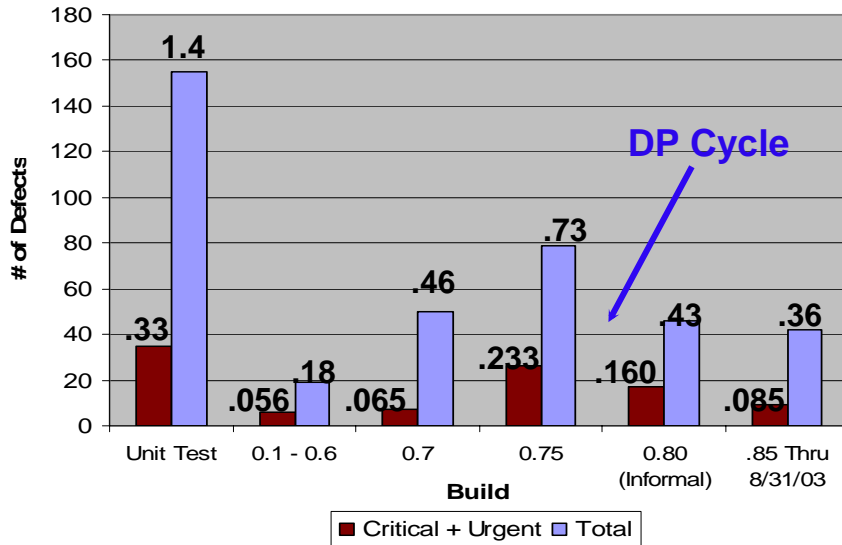


- **Construction Phase DP Cycles:**
  - Prevented ~110 Critical & Urgent code defects
  - Solidified connection between Team and Personal Processes
  - Enhanced Team Template Artifacts that are reused
  - Provided a better understanding of Team Data
  - Improved cost & schedule performance
- **DP Cycle Return on Investment:**
  - Cost: \$11,160
  - Savings - Hours: **1330%** - Dollars: **\$148,500**

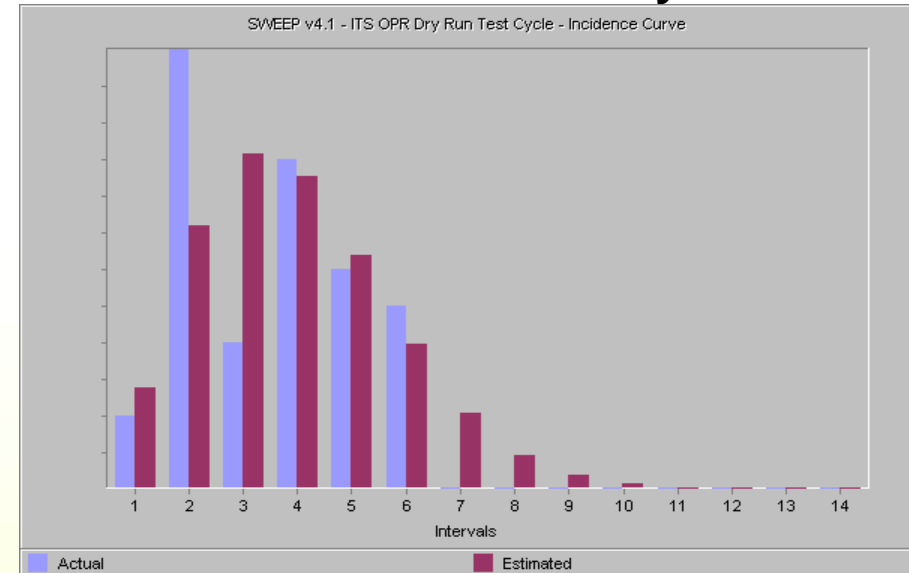
- **Test Phase**

- Detailed Tracking of Internal Integration Test Defects
- Performed DP Cycles
- Defect Discovery (DDs) - Use of statistics to plan test effort and predict remaining defects in software at each phase, test cycle, and customer release

## Project C Test Defects By Test Cycle Defect Density by KLOC



## Defect Discovery (Rayleigh) for 1<sup>st</sup> Customer Test Cycle

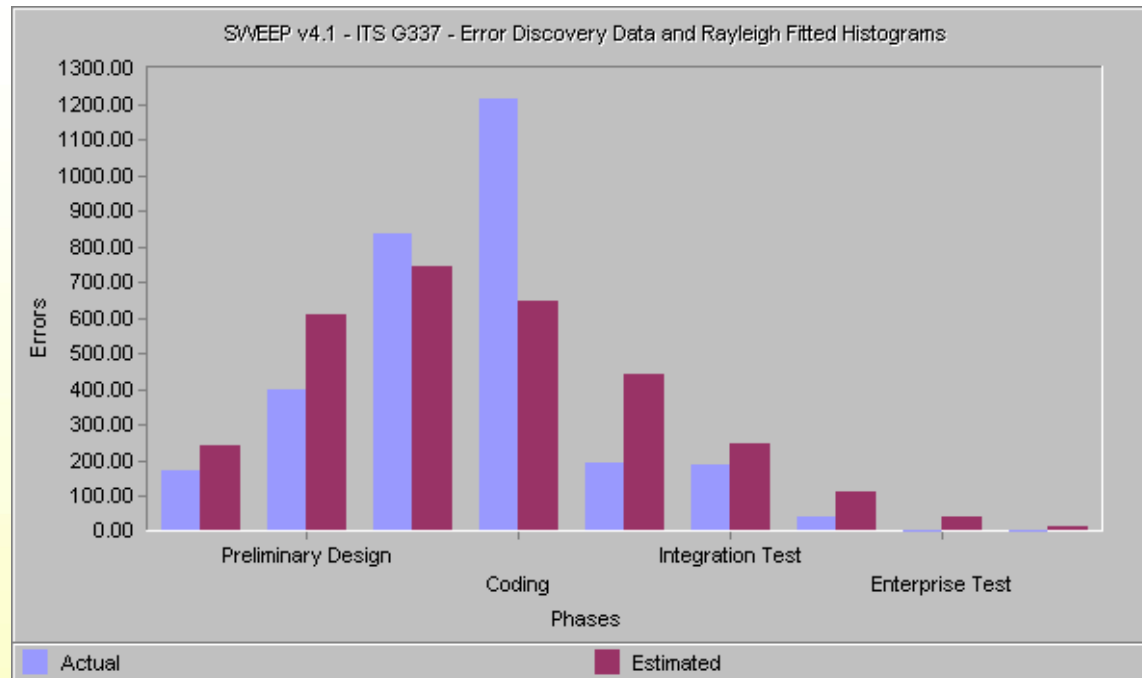


- 1<sup>st</sup> Customer Test Cycle Management Goals have been exceeded!
- 4 people executed 700+ Test Cases in 6 days!
- .36 defects / KLOC

- Predicted 41 defects, Discovered 38 “total” defects
- Take 5.75 days to eliminate 2.51 more defects.
- STOP testing

- **Defect Discovery in the Future**

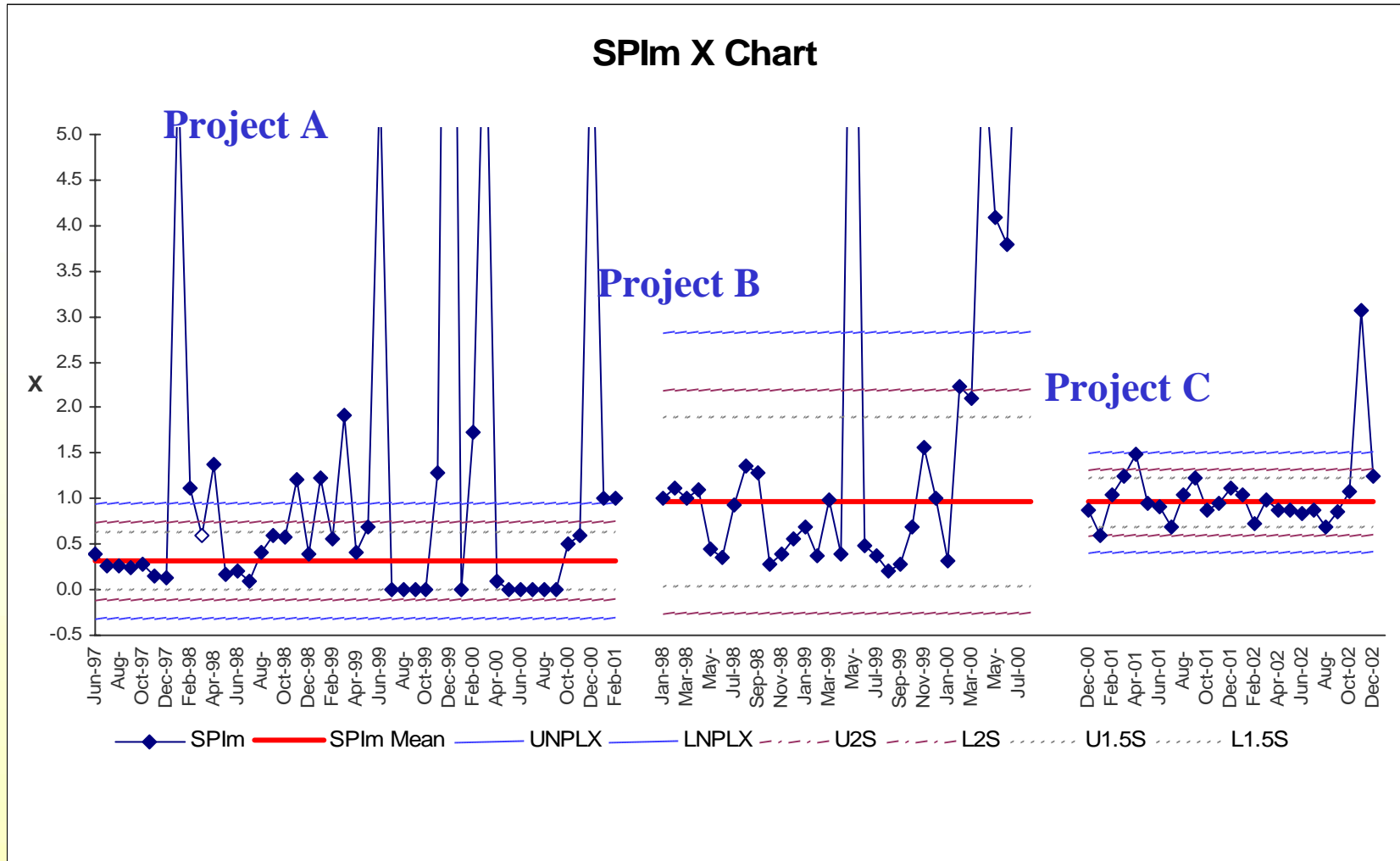
- Dry Run Test Latent = 0.044/KLOC (very close to the 41 predicted for the Test cycle alone)
- Discovery Predictions next cycle = 0.405/KLOC
- Discovery Predictions next cycle = 0.132/KLOC



Error Discovery Efficiency	Next Cycle Estimates
99.85%	43, 14

# Positive Effect of Process

Early detection of a variance with insight for corrective action



- **Stakeholder Satisfaction - Customer**
  - Past Performance Questionnaire rated Project C as **“Exceptional”** in all areas.
  - “The contractor has not missed any scheduled delivery dates.”
  - “The contractor has always provided products and services with less defects than industry standards. Most have been provided with no defects.”
  - “Their proactive approach has saved the gov’t both cost and schedule difficulties by identifying potential problems well in advance of the date needed to take action. Along with the potential problem a suggested solution or the willingness to work through the problem as a team with the gov’t has always provided.”

- **Stakeholder Satisfaction – Team**
  - We’ve lost two developers out of 23 graduates, over the course of 3+ years = 3% annualized attrition (versus 20% average).
    - Project C - No turnover of personnel for both key and non-key positions.
  - Significantly reduced “rework” – the most boring and frustrating part of development
  - Developers are not asked to be heroes.
- **Stakeholder Satisfaction – Corporate Management**
  - Return on Investment is Outstanding



- **Employing PSP**
    - Saved 15% Cost overrun
    - Saved 60% Schedule overrun
    - Improved Quality by 70%
    - Historical data is available to estimate future projects
  - **Employing PSP & CMMI L4/5**
    - Exceeded Profit Targets
    - 100% on-time completion of deliverable milestones
    - Saved at least \$150,000 by preventing defects in construction.
    - Improved Quality to date – additional 76%
    - Ability to plan test durations and predict level of quality - estimated 92% at customer acceptance.
- **Bottom line we can't afford to manage projects without process – Achieves Predictable Cost, Schedule, and Quality**

- **Northrop Grumman Information Technology**  
<http://www.it.northropgrumman.com/index.asp>
- **Software Engineering Institute**  
<http://www.sei.cmu.edu/>
- **Software Productivity Consortium**  
<http://www.software.org/>

Mr. Steve Brady  
2555 University Blvd  
Fairborn, Ohio 45324  
937-431-6043  
[steve.brady@ngc.com](mailto:steve.brady@ngc.com)

Ms. Sherri Turner  
2555 University Blvd  
Fairborn, Ohio 45324  
937-431-5858  
[sherrise.turner@ngc.com](mailto:sherrise.turner@ngc.com)