

# *Reducing Estimating Errors with the CMM®*

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# Estimates vs Actuals - Definitions

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- **ESTIMATE** - ENGINEER'S BEST GUESS (Technical Activity)
  - Size/Performance
  - Cost/ Schedule
- **BID** – RISK BASED MANAGERS GUESS (Risk Activity)
  - Win the contract
  - Make a profit
- **ACTUALS** - WHAT MANAGERS ACHIEVE (Performance Activity)
  - Size/Performance
  - Cost/ Schedule

*What happens when they don't match?*



# What Happens?

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- Low Estimate + High Actual = Overrun?
- Low Estimate + Same Actual = Miracle?
- Low Estimate + Lower Actual = Impossible?
  
- High Estimate + High Actual = Overcharge?
- High Estimate + Same Actual = Good?
- High Estimate + Lower Actual = Good for Now

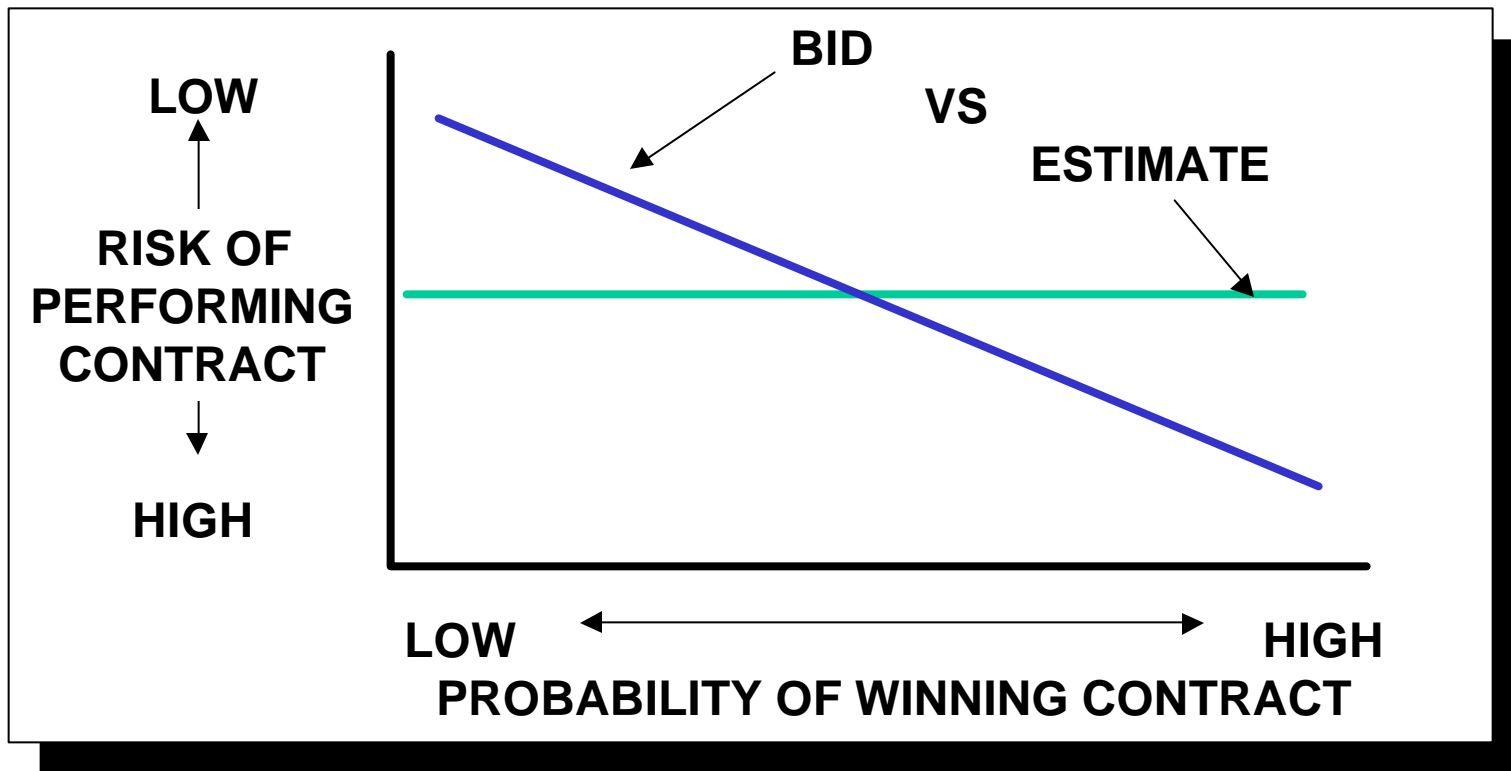
# It's Better If They Match

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- Good management can't "save" a bad estimate
  - Overwork the troops
  - Skimp on Quality
  - Destroy team morale
- Continuous mismatch destroys credibility
  - Customer
  - Team
  - Top Management

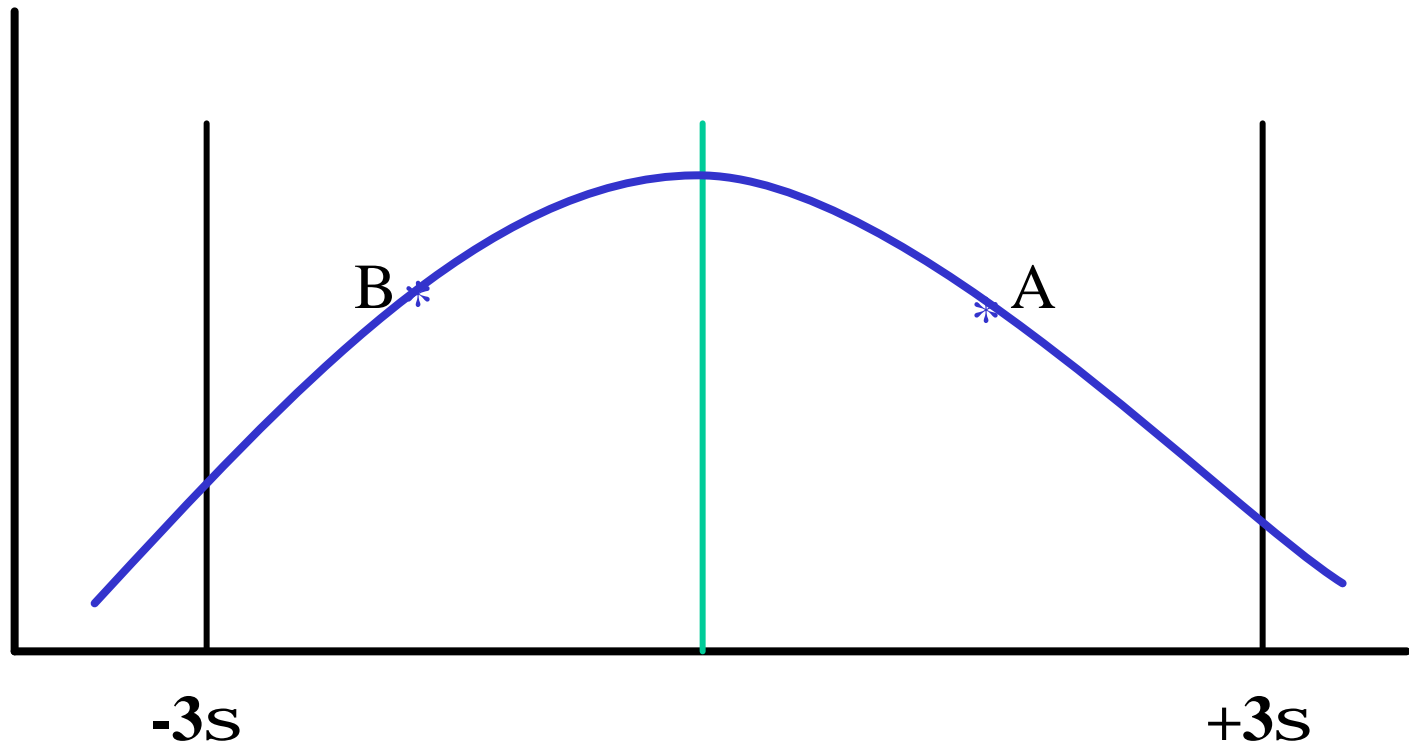


# Estimates vs Bids - Relationship



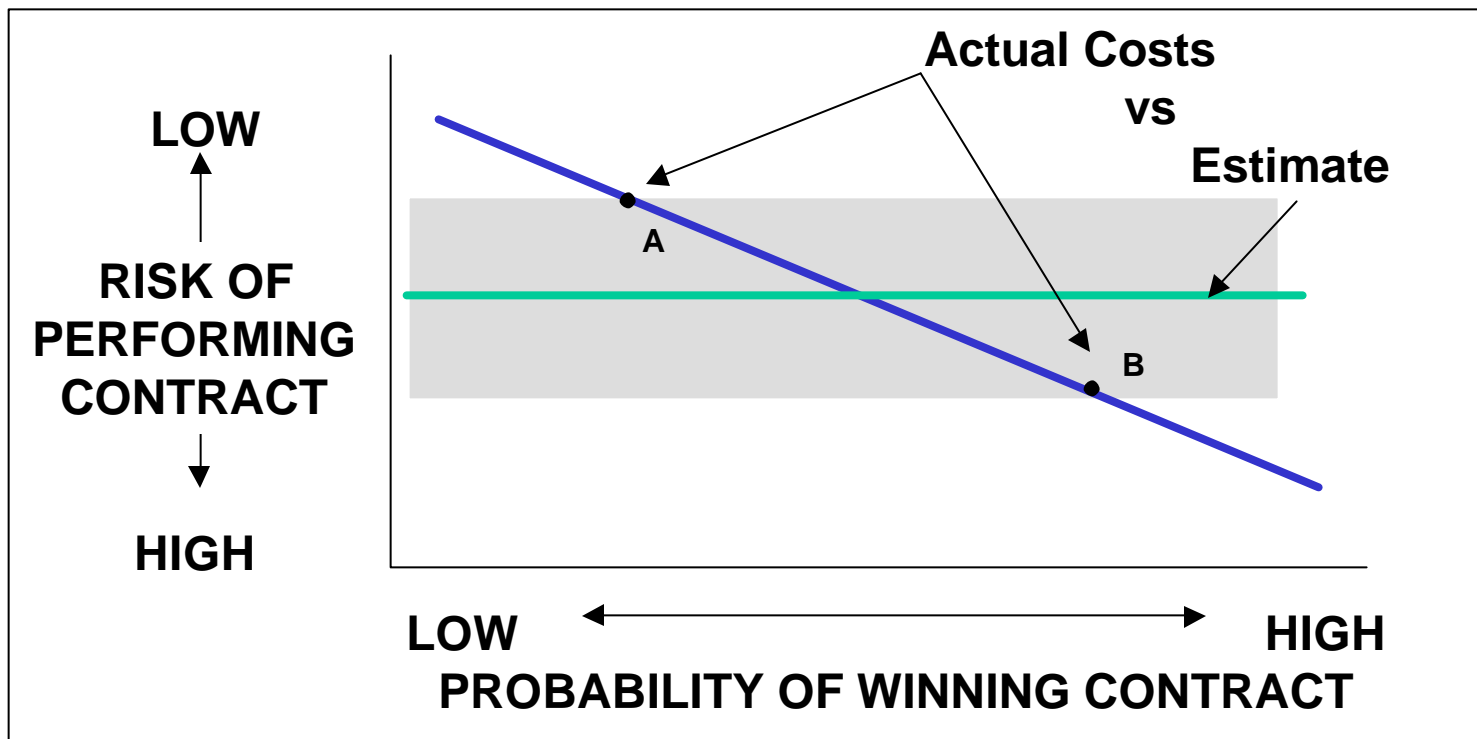
WHAT IF WE KNEW THE ESTIMATE WITH 100% CONFIDENCE?

# Estimating Reality

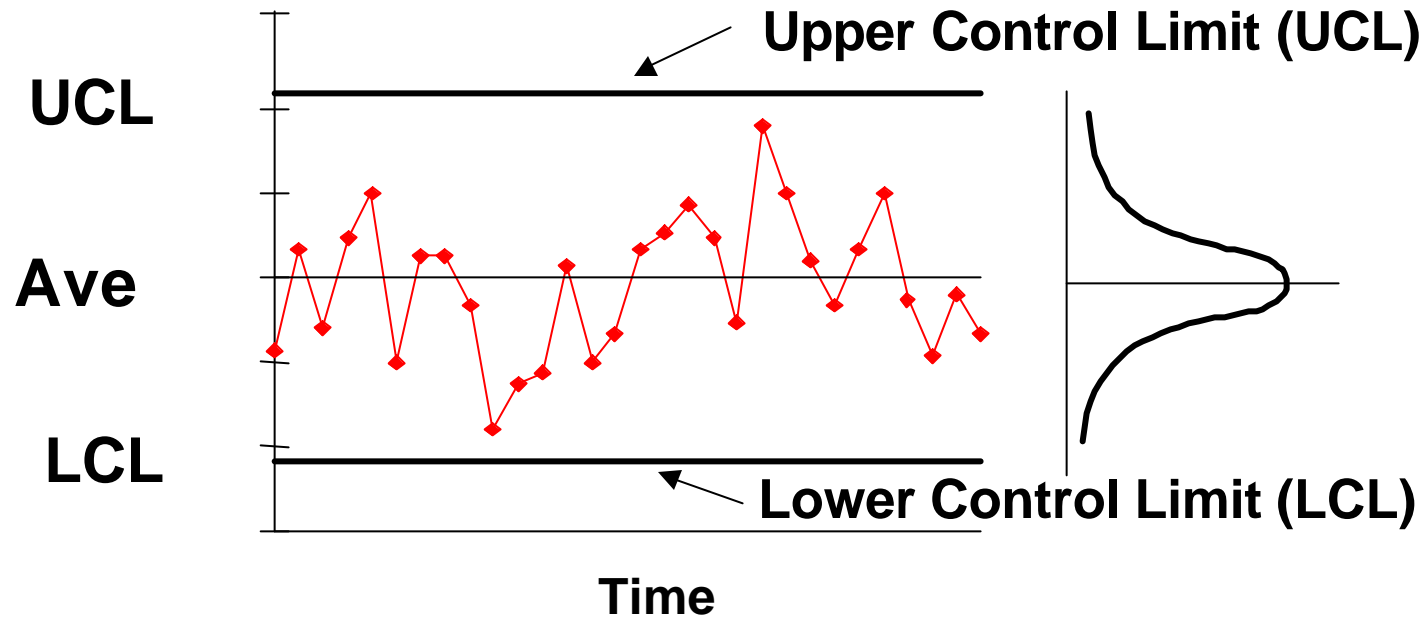


**A Perfectly Calibrated Model**

# Estimates vs Bids – The Results



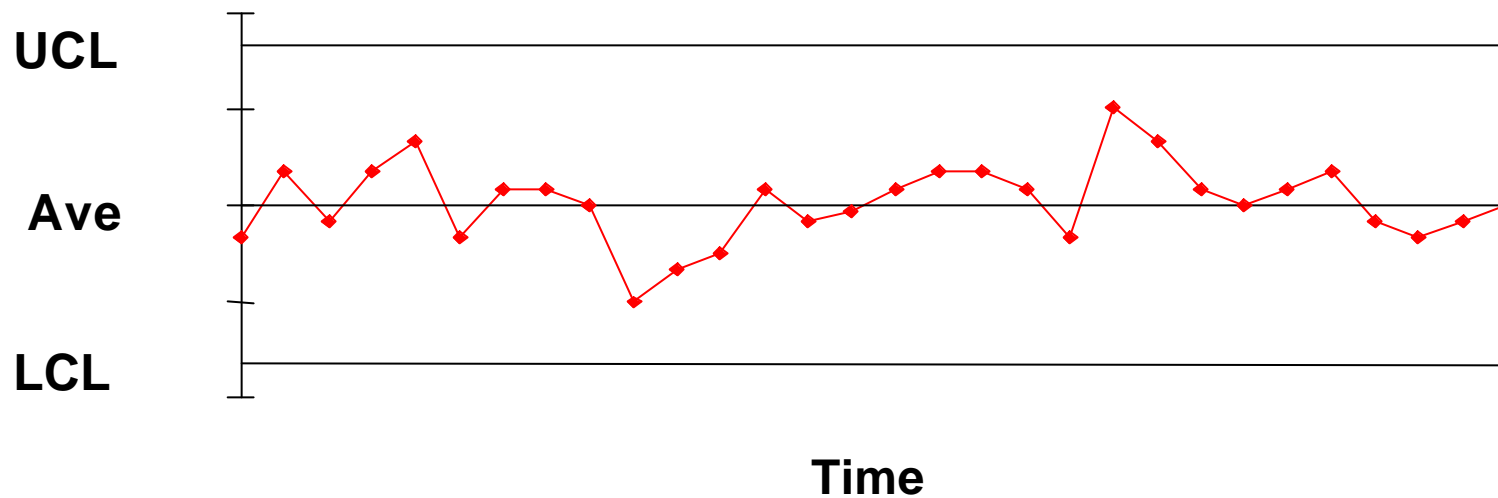
# Understanding Variation



**A normal distribution is due to variation in the data**

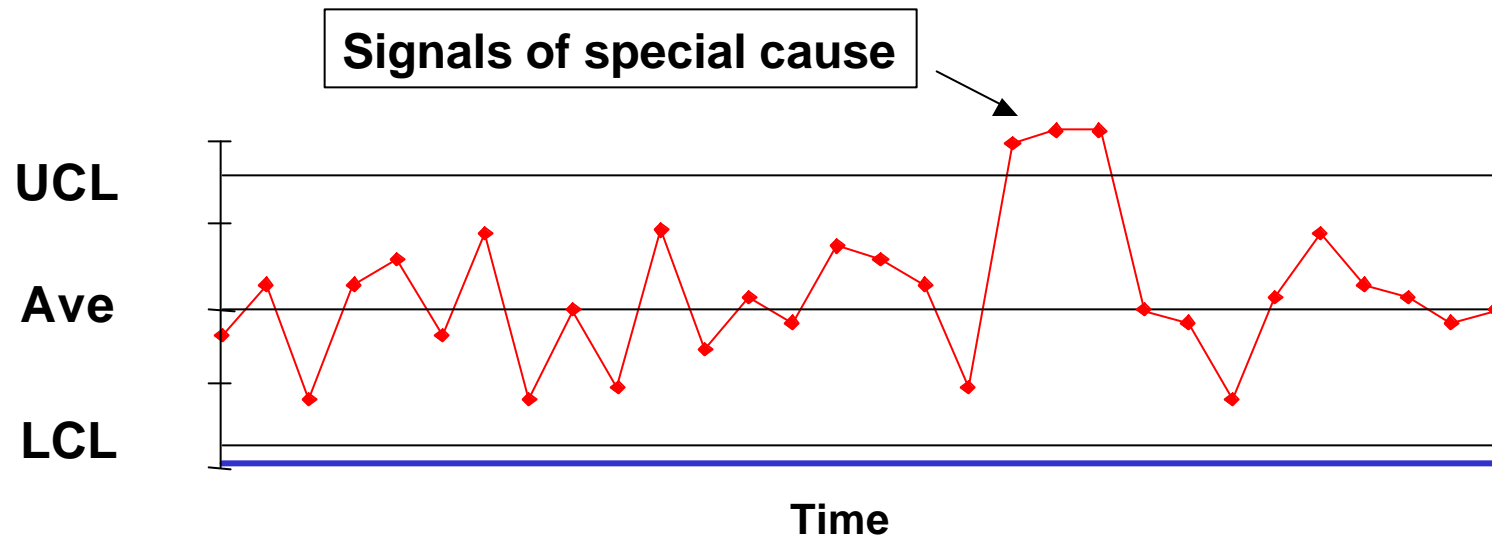
# Common Cause Variation

Variation that is inherent in the process or system and affects all outcomes of the process

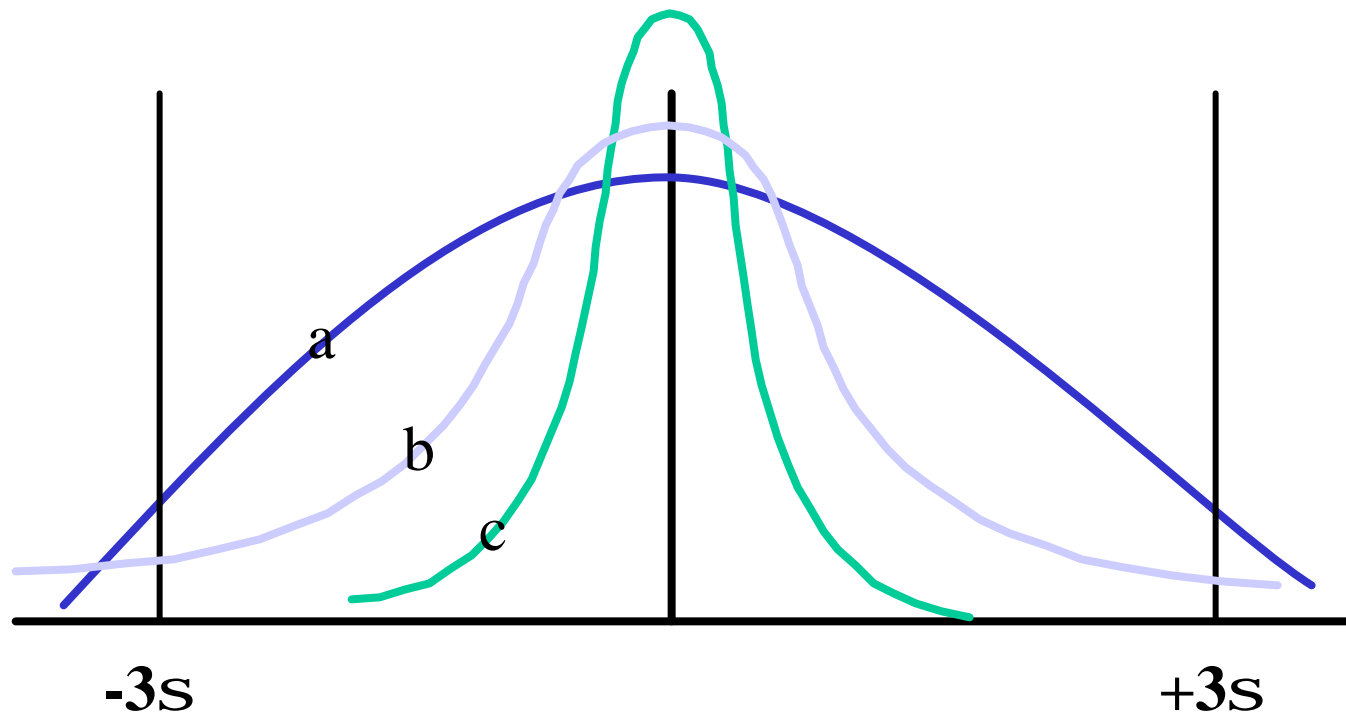


# Special Cause Variation

Causes that are not inherent in the process, but arise due to special circumstances



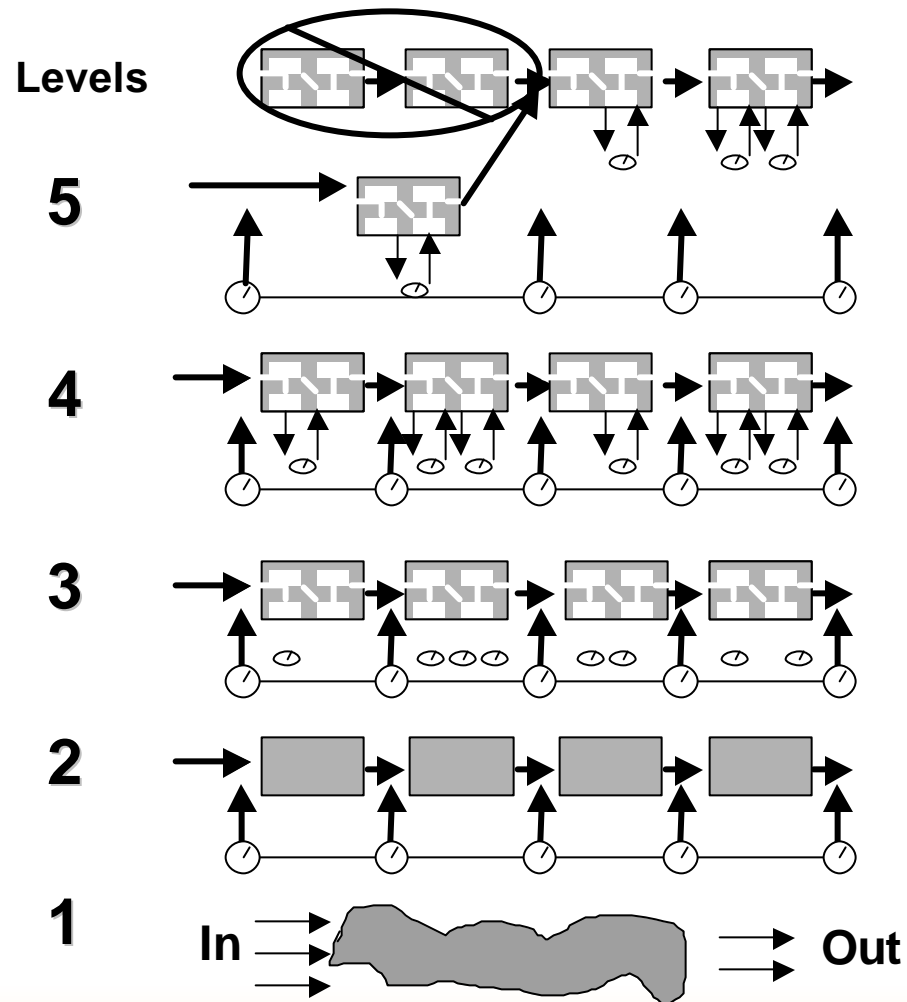
# Making Estimates equal Actuals



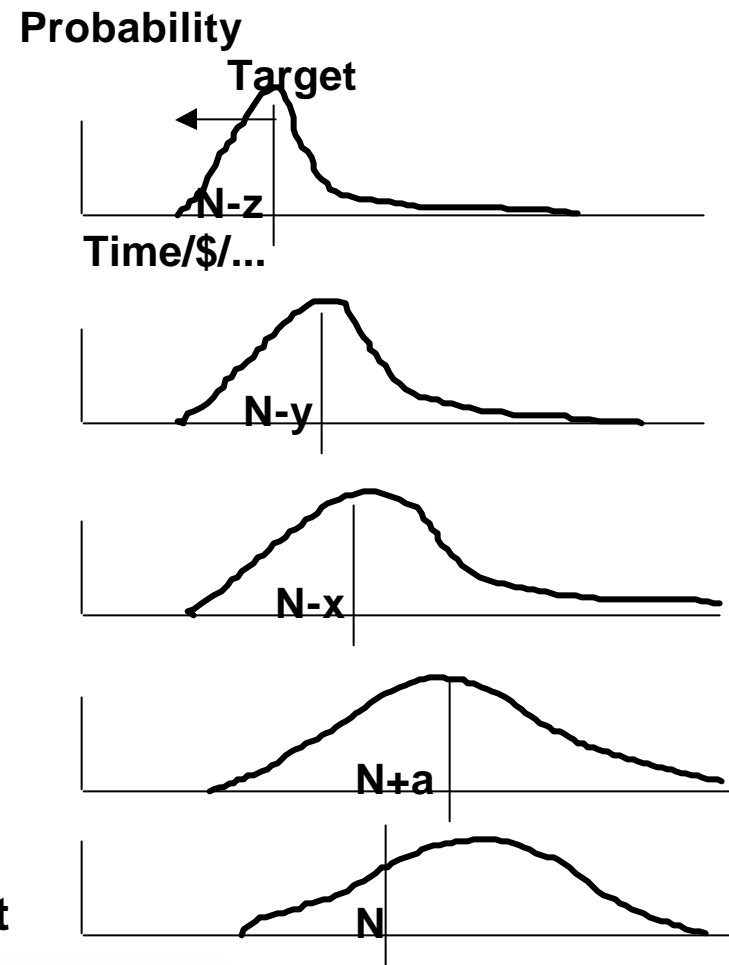
**Our goal is to reduce the Common Cause Variations and eliminate the Special Cause Variations**

# The CMM<sup>®</sup> Promise

## Management Visibility



## Process Capability



# Achieving Capability Maturity

- **Operating at CMM<sup>®</sup> level 2 -5 requires**
  - **Documenting your processes**
  - **Using your processes to plan your projects**
  - **Following your processes in daily activities**
  - **Making some measurements of the processes**



# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
<b>5 Optimizing</b>	<b>Continuous Process Improvement</b>	<b>Defect prevention Technology innovation Process change management</b>	
<b>4 Managed</b>	<b>Product and Process Quality</b>	<b>Quantitative Process Mgmt. Software Quality Management</b>	
<b>3 Defined</b>	<b>Engineering Process</b>	<b>Organization process focus Organization process definition Peer reviews Training program Inter-group coordination Software product engineering Integrated software mgmt.</b>	
<b>2 Repeatable</b>	<b>Project Management</b>	<b>Requirements management Software project planning Software project tracking Software subcontract mgmt. Software quality assurance Software configuration mgmt.</b>	
<b>1 Initial</b>	<b>Heroes</b>		

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed			
3 Defined			
2 Repeatable	Project Management	Software project planning Software project tracking Software subcontract mgmt. Software quality assurance Software configuration mgmt.	
1 Initial	Heroes		Risk

**Requirements Management – A Level 2 KPA**

- **Purpose:**
  - to establish a common understanding between the customer and the software project of the customer's requirements that will be addressed by the software project
- **Involves:**
  - establishing and maintaining an agreement with the customer on the requirements for the software project

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<b>Software Project Planning – A Level 2 KPA</b> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to establish reasonable plans for performing the software engineering and for managing the software project</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– developing estimates for the work to be performed, establishing the necessary commitments, and defining the plan to perform the work</li> </ul> </li> </ul>		Risk
3 Defined			
2 Repeatable			
1 Initial	Heroes		

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<b>Software Project Tracking and Oversight – A Level 2 KPA</b> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to provide adequate visibility into actual progress so that management can take effective actions when the software project's performance deviates significantly from the software plans</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– tracking and reviewing the software accomplishments and results against documented estimates, commitments, and plans, and adjusting these plans based on the actual accomplishments and results</li> </ul> </li> </ul>		Risk
3 Defined			
2 Repeatable			
1 Initial			
	Heroes	Software configuration mgmt.	

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<b>Software Subcontract Management – A Level 2 KPA</b> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to select qualified software subcontractors and manage them effectively</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– selecting a software subcontractor, establishing commitments with the subcontractor, and tracking and reviewing the subcontractor's performance and results</li> </ul> </li> </ul>		Risk
3 Defined			
2 Repeatable			
1 Initial	Heroes		

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<b>Software Configuration Management – A Level 2 KPA</b> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– To establish and maintain the integrity of the products of the software project throughout the project's software life cycle</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– Identifying the configuration of the software (i.e., selected software work products and their descriptions) at given points in time, systematically controlling changes to the configuration, and maintaining the integrity and traceability of the configuration throughout the software life cycle</li> </ul> </li> </ul>		Risk
3 Defined			
2 Repeatable			
1 Initial			
		Software quality assurance Software configuration mgmt.	

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result	
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality	
4 Managed	<p><b>Software Quality Assurance – A Level 2 KPA</b></p> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to provide management with appropriate visibility into the process being used by the software project and of the products being built</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– reviewing and auditing the software products and activities to verify that they comply with the applicable procedures and standards and providing the software project and other appropriate managers with the results of these reviews and audits</li> </ul> </li> </ul>		Risk	
3 Defined				
2 Repeatable				Software quality assurance Software configuration mgmt.
1 Initial				Heroes

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<b>Organization Process Focus – a Level 3 KPA</b> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to establish the organizational responsibility for software process activities that improve the organization's overall software process capability</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– developing and maintaining an understanding of the organization's and projects' software processes and coordinating the activities to assess, develop, maintain, and improve these processes</li> </ul> </li> </ul>		Risk
3 Defined			
2 Repeatable			
1 Initial	Heroes	Software subcontract mgmt. Software quality assurance Software configuration mgmt.	

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<b>Organization Process Definition – a Level 3 KPA</b> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to develop and maintain a usable set of software process assets that improve process performance across the projects and provide a basis for cumulative, long-term benefits to the organization</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– developing and maintaining the organization's standard software process, along with related process assets, such as descriptions of software life cycles, process tailoring guidelines and criteria, the organization's software process database, and a library of software process-related documentation</li> </ul> </li> </ul>		
3 Defined			
2 Repeatable			
1 Initial	Heroes		Risk

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<b>Software Product Engineering – a Level 3 KPA</b> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to consistently perform a well-defined engineering process that integrates all the software engineering activities to produce correct, consistent software products effectively and efficiently</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– performing the engineering tasks to build and maintain the software using the project's defined software process (which is described in the Integrated Software Management key process area) and appropriate methods and tools</li> </ul> </li> </ul>		Risk
3 Defined			
2 Repeatable			
1 Initial	Heroes	Software configuration mgmt.	

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<p><b>Integrated Software Management – a Level 3 KPA</b></p> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to integrate the software engineering and management activities into a coherent, defined software process that is tailored from the organization's standard software process and related process assets, which are described in Organization Process Definition</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– developing the project's defined software process and managing the software project using this defined software process. The project's defined software process is tailored from the organization's standard software process to address the specific characteristics of the project.</li> </ul> </li> </ul>		Risk
3 Defined			
2 Repeatable			
1 Initial			

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<p><b>Intergroup Coordination – a Level 3 KPA</b></p> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to establish a means for the software engineering group to participate actively with the other engineering groups so the project is better able to satisfy the customer's needs effectively and efficiently</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– the software engineering group's participation with other project engineering groups to address system-level requirements, objectives, and issues. Representatives of the project's engineering groups participate in establishing the system-level requirements, objectives, and plans by working with the customer and end users, as appropriate. These requirements, objectives, and plans become the basis for all engineering activities</li> </ul> </li> </ul>		
3 Defined			
2 Repeatable			
1 Initial			

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<p><b>Peer Reviews – a Level 3 KPA</b></p> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to remove defects from the software work products early and efficiently</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– a methodical examination of software work products by the producers' peers to identify defects and areas where changes are needed. The specific products that will undergo a peer review are identified in the project's defined software process and scheduled as part of the software project planning activities, as described in Integrated Software</li> </ul> </li> </ul>		
3 Defined			
2 Repeatable			
1 Initial	Management Heroes		Risk

# Structure of the CMM<sup>®</sup>

Level	Focus	Key Process Areas	Result
5 Optimizing	Continuous Process	Defect prevention Technology innovation	Productivity & Quality
4 Managed	<b>Training Program – a Level 3 KPA</b> <ul style="list-style-type: none"> <li>▪ <b>Purpose:</b> <ul style="list-style-type: none"> <li>– to develop the skills and knowledge of individuals so they can perform their roles effectively and efficiently</li> </ul> </li> <li>▪ <b>Involves:</b> <ul style="list-style-type: none"> <li>– first identifying the training needed by the organization, projects, and individuals, then developing or procuring training to address the identified needs</li> </ul> </li> </ul>		Risk
3 Defined			
2 Repeatable			
1 Initial	Heroes		

# Summary

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- Differences between estimates and actuals are driven by variations in the performance of project teams
- Applying the CMM® Level 2 KPA disciplines to our processes will reduce the common cause variations
  - Documenting a standard way of doing business
  - Following the standard on projects
- Applying the CMM® Level 3 KPA disciplines can help reduce special cause variations
  - Organizational standards
  - Organizational training
  - Continuous process focus

