Achieving Quality QPPO via Effective Usage of PPBs and PPMs

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Outline

- PPBs and PPMs’ usage in quality goal setting
- PPMs and PPBs’ usage in quality goal management
- Controllable factors

  Improvement Observed
- Some lessons learnt

The Context of the Case Studies

- Org is serving one customer
- High quality is the most Important Product Requirement
- Business goals are set up by the client

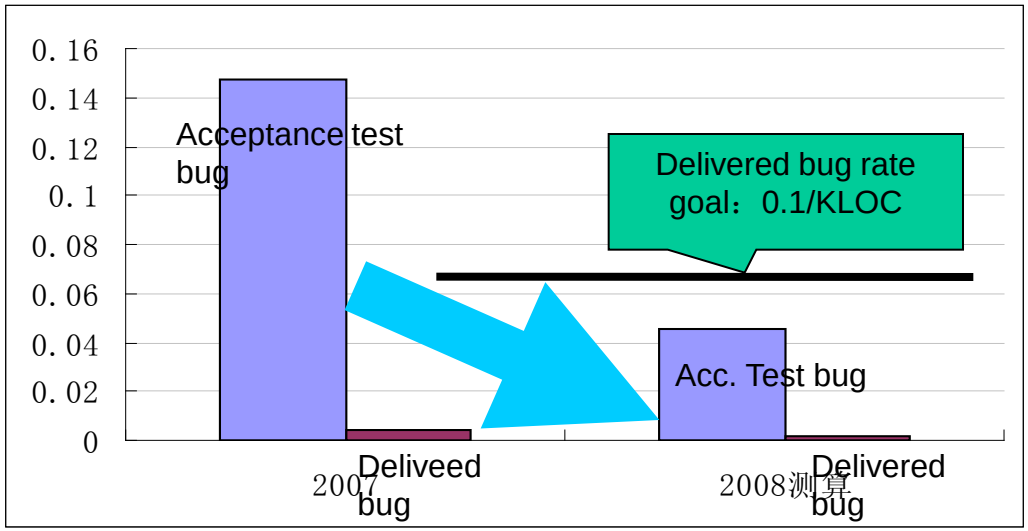
Customer’s Product Quality Requirement

- **4 Nines - 99.99%:**

  Escaped defects < 0.1 per KLOC

Org's Quality Objective

- **Defects density identified in acceptance test is less than 0.11/KLOC which is based on the AT performance baseline.**



- Historical data shows that the lower bug rate identified by acceptance test，the lower of delivered bug rate. With 95% confidence, it has been show that **if the acceptance test bug rate lower than 0.11个/KLOC， delivered bug rate will be lower than 0.1个/KLOC.**

The Rationale for Choosing the Quality Objective

- It meets clients' quality requirement.
- Org's baseline supports it.
- The org's metrics support it.
- It can be easily used by project team.

Setting up the Interim Quality Objectives

- **The following quality control activities are conducted before the acceptance test is performed by the independent Testing Center:**

  - Requirement Peer Review

  - System Design Peer Review

  -Detailed Design Peer Review

  - Code Inspection + Unit Test

  - System Test

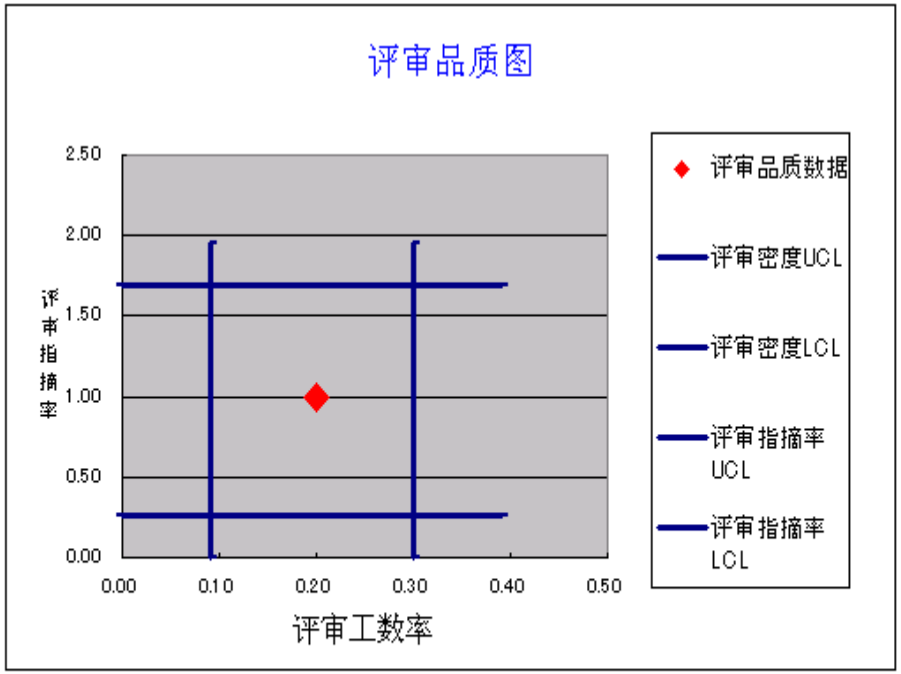
  The related interim goals need to be developed to ensure achieving the Quality Objective, thus the goal becomes a manageable one.

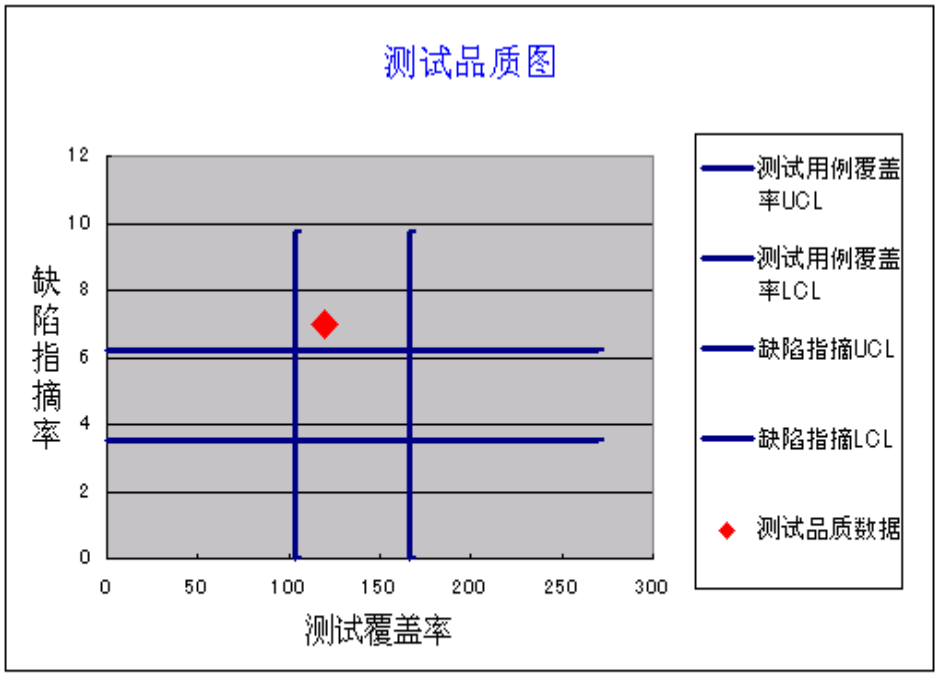
PPBs Needed to Support the Interim Goals

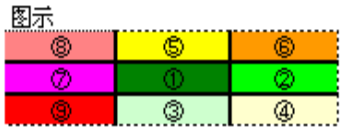
- **Defect injection distribution**
- **Defect removal rate in requirement/design/code review + UT and system test**
- **Efforts devoted to these quality control activities**

Abnormal Analysis

Effort baselines is needed to support this analysis







Quality Related Baselines – Measured by defect removal rate

组织级缺陷清除密度基线							
序号	Q C 活动		中值	下限	平均值	上限	标准差
B115	验收测试缺陷密度－工程升级	（单位：个/百功能点）	8.11	3.82	8.09	12.35	2.13
B116	验收测试缺陷密度－工程新开发		11.13	8.47	10.73	12.98	1.13
B117	验收测试缺陷密度－研发升级		5.14	2.11	4.76	7.42	1.33
B118	验收测试缺陷密度－研发新开发		4.47	0.45	5.49	10.53	2.52
B119	需求评审效率	（单位：个/人时）	1.44	0.76	1.39	2.03	0.316
B120	设计评审效率		1.25	0.62	1.28	1.93	0.327
B121	走查效率		9.86	6.24	8.74	11.23	1.248
B122	系统测试效率		0.50	0.22	0.52	0.81	0.148
B123	系统测试用例密度_工程升	（单位：用例个数/百功能点）	168.32	93.41	159.31	225.21	32.95
B124	系统测试用例密度_工程新		182.95	150.20	181.55	212.90	10.45
B125	系统测试用例密度_研发升		131.30	87.06	142.60	198.14	27.77
B126	系统测试用例密度_研发新		174.40	119.90	171.50	223.10	25.80
B127	需求评审_清除率	（%）	63.60%	36.34%	61.50%	99.24%	0.252
B128	设计评审_清除率	（%）	55.62%	23.23%	50.72%	91.96%	0.275
B129	代码走查_工程清除率	（%）	19.04%	12.91%	18.27%	34.35%	0.054
B130	代码走查_研发清除率	（%）	25.64%	13.93%	27.61%	68.65%	0.137
B131	系统测试清除率	（%）	86.10%	81.98%	86.30%	94.94%	0.043
B132	需求阶段植入率	（%）	11.58%	6.38%	11.56%	16.74%	0.026
B133	设计阶段植入率	（%）	8.98%	3.58%	9.81%	16.05%	0.031
B134	代码阶段植入率	（%）	78.49%	69.66%	78.33%	87.01%	0.043

Quality Related QPPOs

Acceptance test bug rate lower than 0.11 defects/KLOC:

①Requirement review identifies at least 0.09* total number of estimated defects；

②System design review identifies at least 0.1* total number of estimated defects；

③Detail design review identifies at least 0.02* total number of estimated defects；

④Code Review and UT identifies at least 0.36* total number of estimated defects；

⑤System test identifies at least 0.41* total number of estimated defects.

Another Example

- Requirement Peer Review should at least identify 80% of defects introduced so far
- Design Peer Review should at least identify 70% of remaining defects introduced so far
- Code Inspection should at least identified 40% of remaining defects introduced so far
- System Testing should at least identify 90% remaining defects introduced so far

Interim Goals and Overall Quality Objective

- **Statistical studies show that if the Interim Goals are achieved, the overall goal will be achieved too.**
- **QPM is all about managing the goal achievement.**

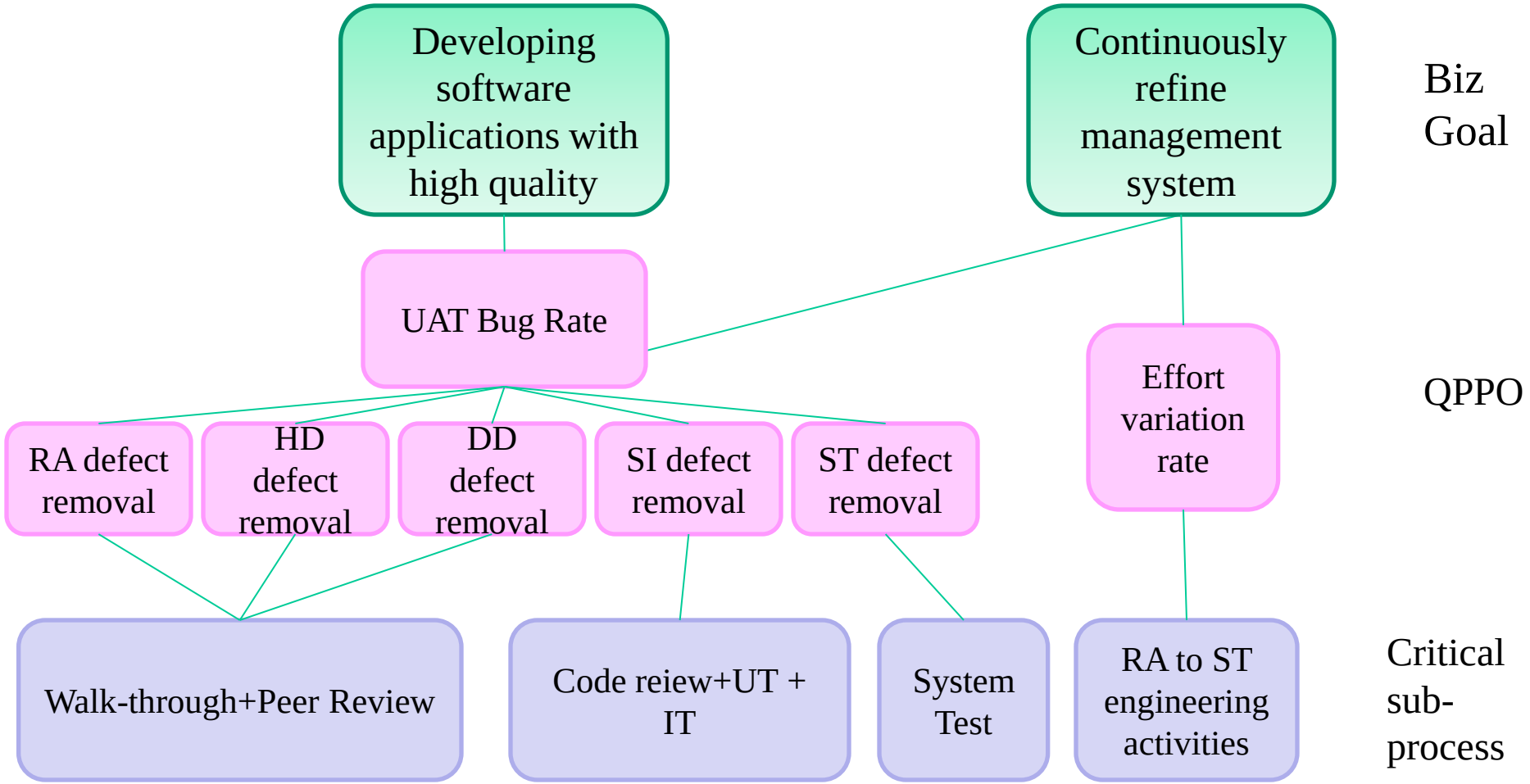
Prediction models needed for quality goal management

- Number of defects introduced in Requirement Phase
- Number of defects introduced in Design Phase
- Number of defects introduced in Coding Phase
- Number of defects removed by Requirement Peer Review
- Number of defects removed by Design Peer Review
- Number of defects removed by Code Review for Java and .Net
- Number of defects removed by Code Review for C and C++
- Number of defects removed by System Test
- Gompertz Model – a Reliability Growth Model

Risk Management

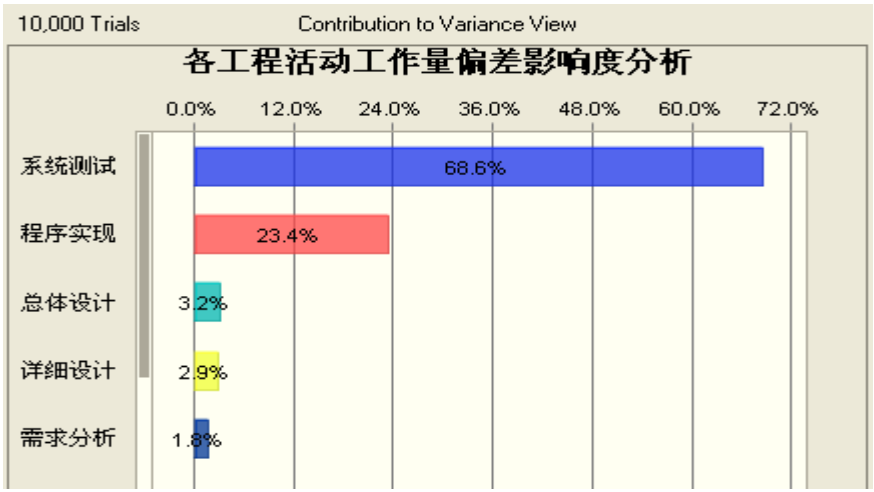
Monte Carlo is used for managing risks in obtaining Quality Goals during the planning phase and throughout the LC.

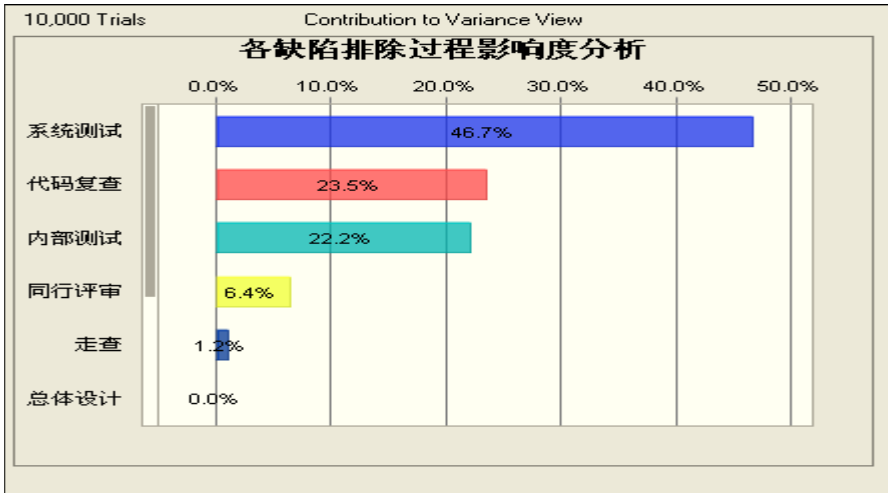
Relationship between Goals and Key Subprocesses



Critical Key Sub-process Selection Criteria

- Customer’s concerns
- The Impact to the QPPOs
- Statistical impact analysis





Largest impact occurs in system test 70.3%

The impact of system test and code review are 47.3%、22.7%。

The Goal-Model-Baseline Matrix

质量和过程性能目标		关键子过程	度量指标	基本测量	统计方法	相关模型	相关基线
1、项目验收测试 bug 率不高于 0.11 个/KLOC，且截止系统测试阶段结束，项目[illegible]不低于项目[illegible]		所有工程活动	验收测试 bug 率	验收测试发现的缺陷数 代码行	XMR、	[illegible]项目缺陷发现分布及预测模型 [illegible]发现数估算模型	（1）验收测试 bug 率 （2）各阶段缺陷发现占比
（1）	需[illegible]	走查+同行评审	每规模问题数	评审发现问题数↓ [illegible]审文档规模		[illegible]项目缺陷数估[illegible]	（1）各阶段缺陷发现占比（%）-需求分析 [illegible]评审每规模问题数（个/页）
（2）	总体设计阶段缺陷排除	[illegible]	[illegible]	[illegible]	XMR	项目缺陷数估算模型	[illegible]缺陷发现占比（%）-总[illegible]设计 （2）技术评审每规模问题数（个/页）-总体设计
（3）	详细设计阶段缺陷排除	走查+同行评审	每规模问题数			[illegible]算模型	各阶段缺陷发现占比（%）-详细设计
（4）	程序实现阶段缺陷排除	代码复查 单元测试+组装测试	代码复查缺陷发现率	代码复查发现的缺陷数↓ 代码行数 [illegible]测试	XMR U 图 假设检验	（1）项目[illegible] （2）代码复查[illegible]	[illegible]陷发现占比（%）-程[illegible] [illegible]陷发现占比（%）-代[illegible]查 （3）代码复查缺陷发现率（个/KLOC）
（5）	系统测试阶段缺陷排除	系统测试	[illegible]陷率	[illegible]发现的缺陷数	Gompertz	（1）项目缺陷数估算模型 （2）系统测试缺陷预测模型	各阶段缺陷发现占比（%）-系统测试
2、项目工作量偏差率不高于 21.14%		需求分析至系统测试工程活	工作量偏差率	实际工作量 预算工作量	Monte Carlo 仿真方法、	（1）工作量偏差预测模型 （2）系统测试工作量偏差估算模型	（1）工作量偏差率（%） (2)各工程活动工作量偏差率（%）（需求分析—系统测试）

PPOs

Statistical Method used

PPMs

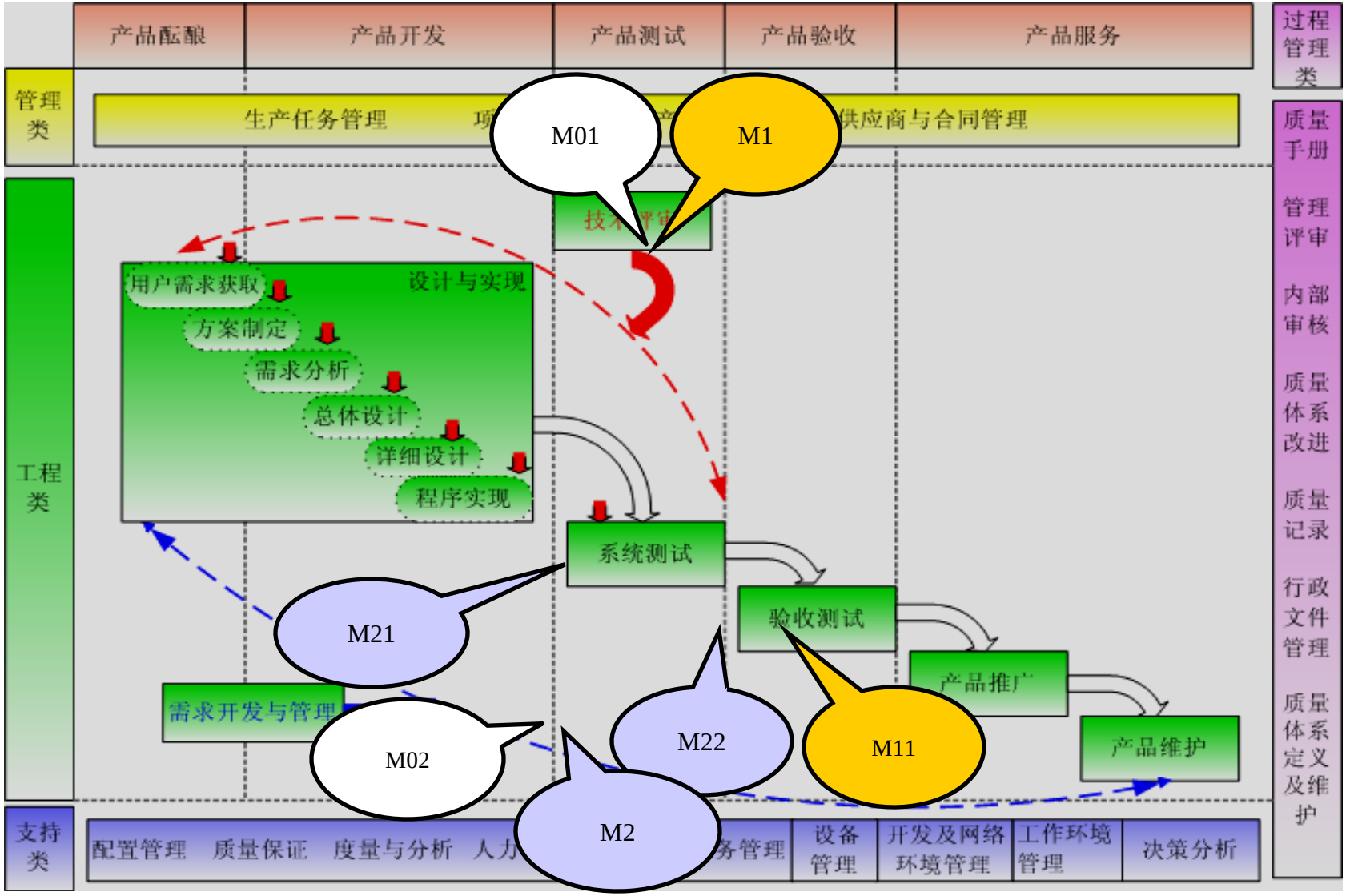
Critical Processes

Measures

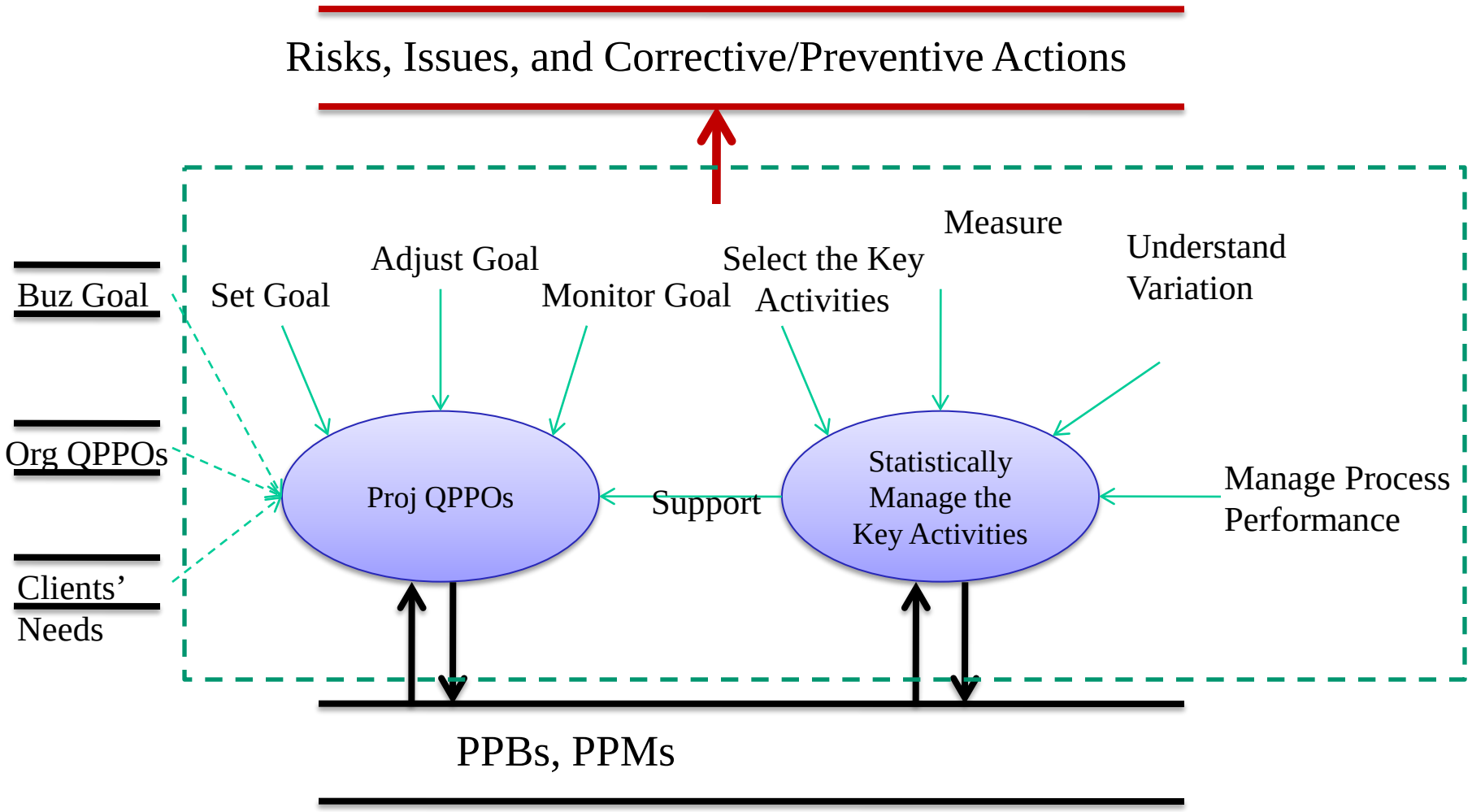
PPBs

Indicators

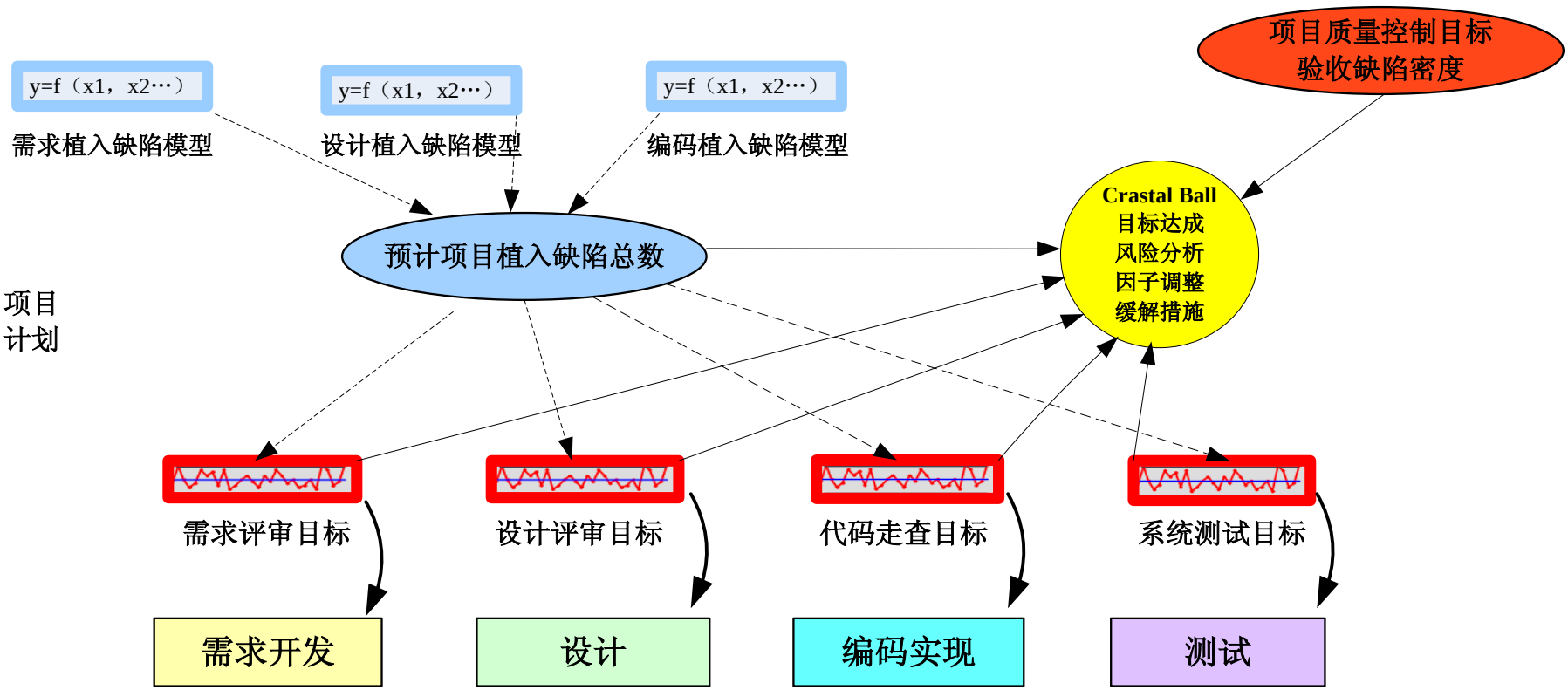
How Models fit in the Quality Goal Mgt



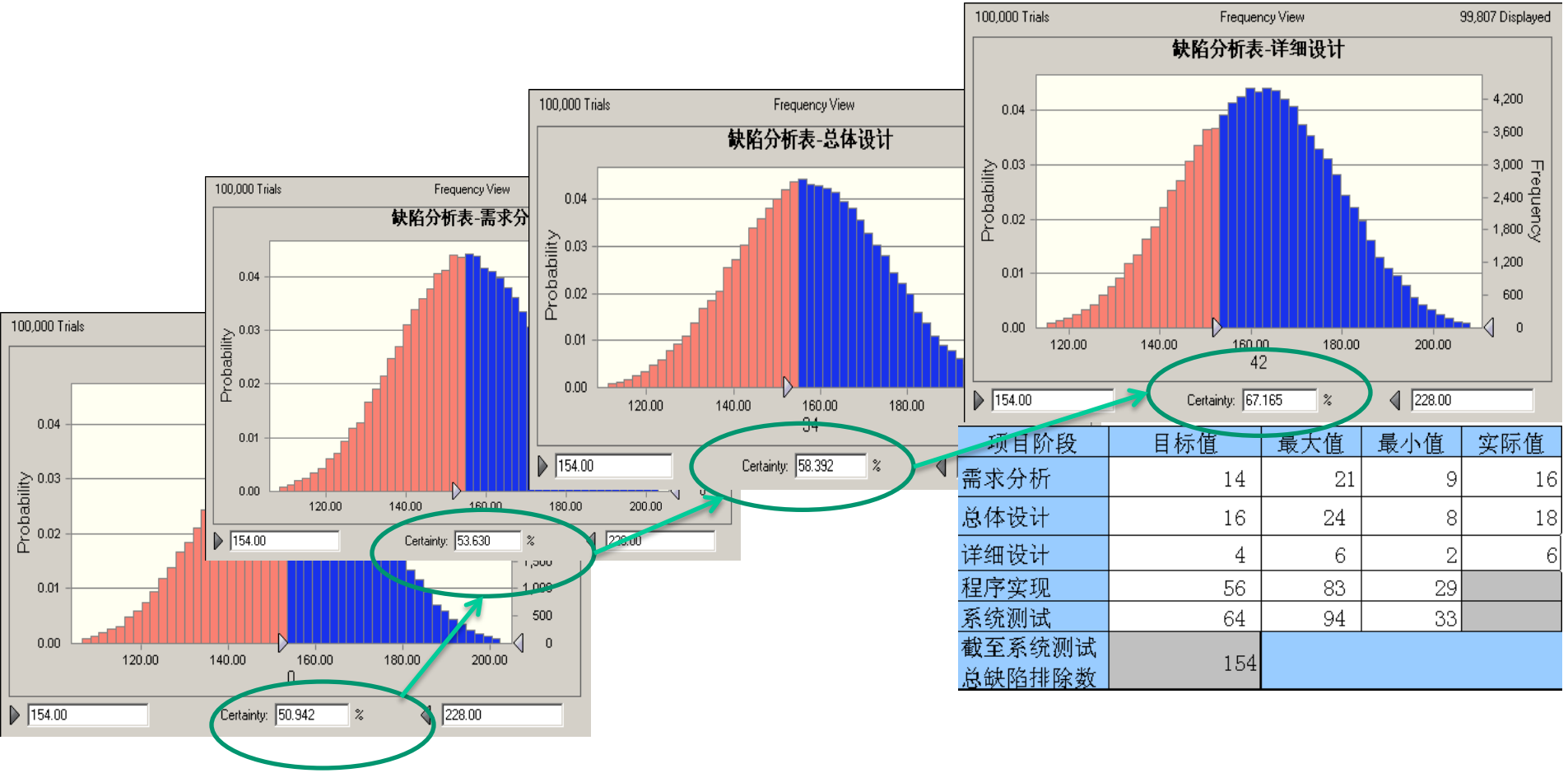
It is all about achieve the goals!



Overview on How PPBs and PPMs are Used



Monte Carlo Simulation on Goal Achievement



项目阶段	目标值	最大值	最小值	实际值
需求分析	14	21	9	16
总体设计	16	24	8	18
详细设计	4	6	2	6
程序实现	56	83	29	
系统测试	64	94	33	
截至系统测试总缺陷排除数	154			

Controllable Factors

- **Sources of variation**

- HM means you truly understand your critical processes.

- **Where you might make adjustments**
- **Key areas to improve your process**

Which model allows you to adjust?

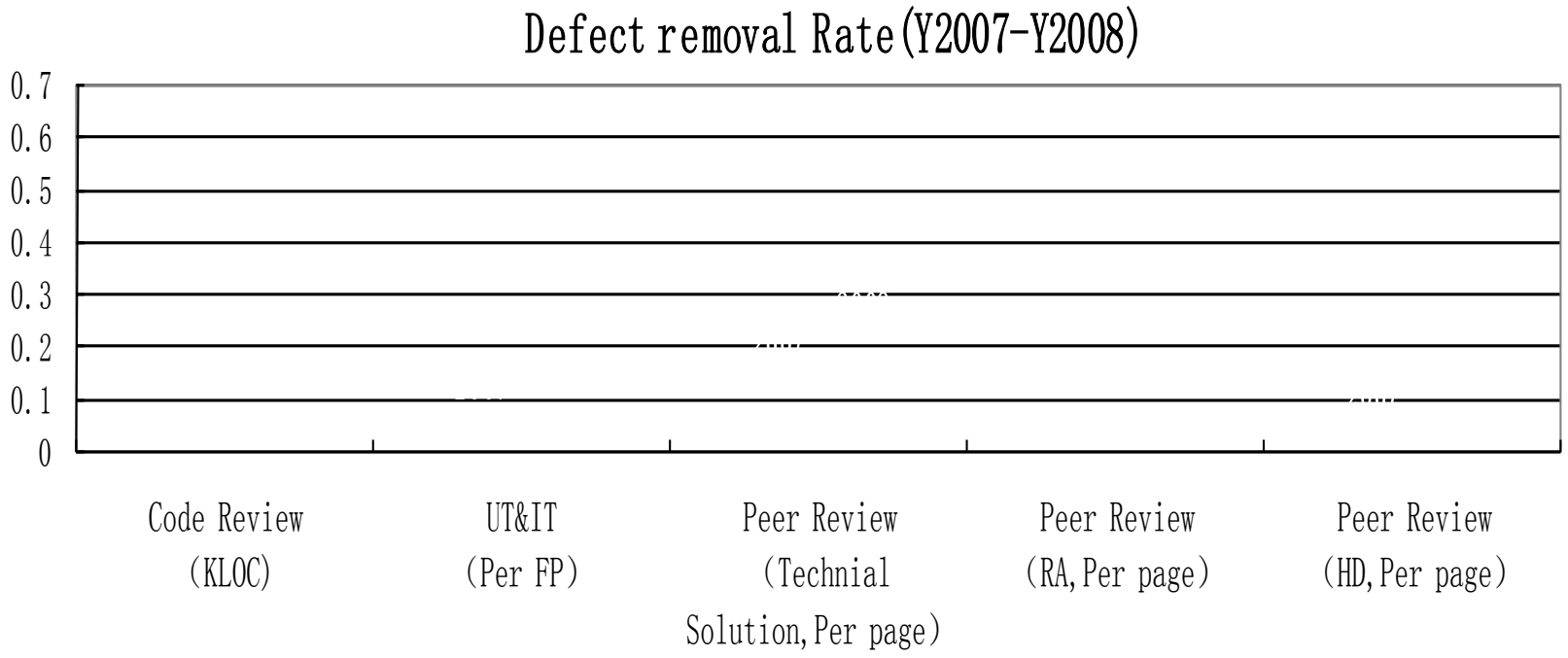
- **Defect Removal Predictive Model for Requirement Peer Review:**

f (Size, Type, Complexity)

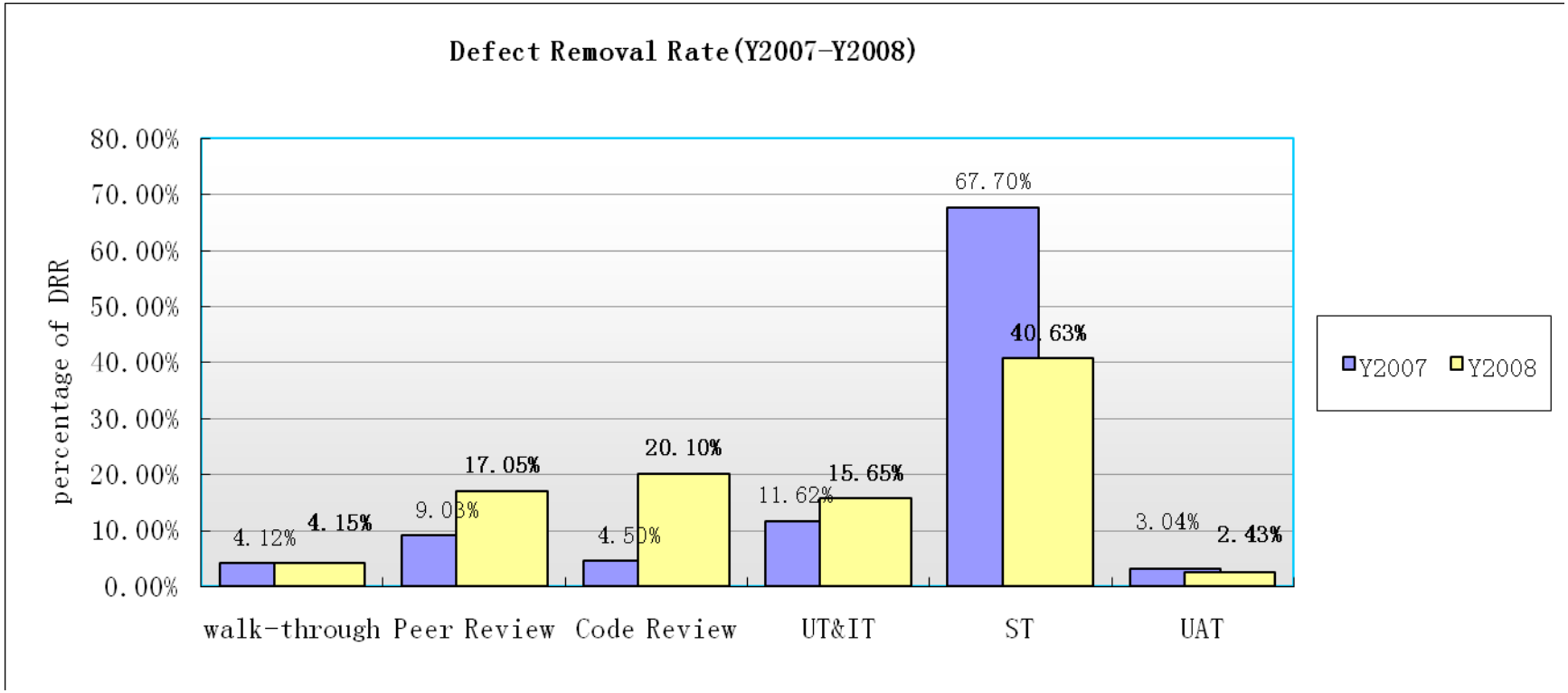
f(Size, Review Effort, Review Team Ability Index, Type)

Improvements Observed

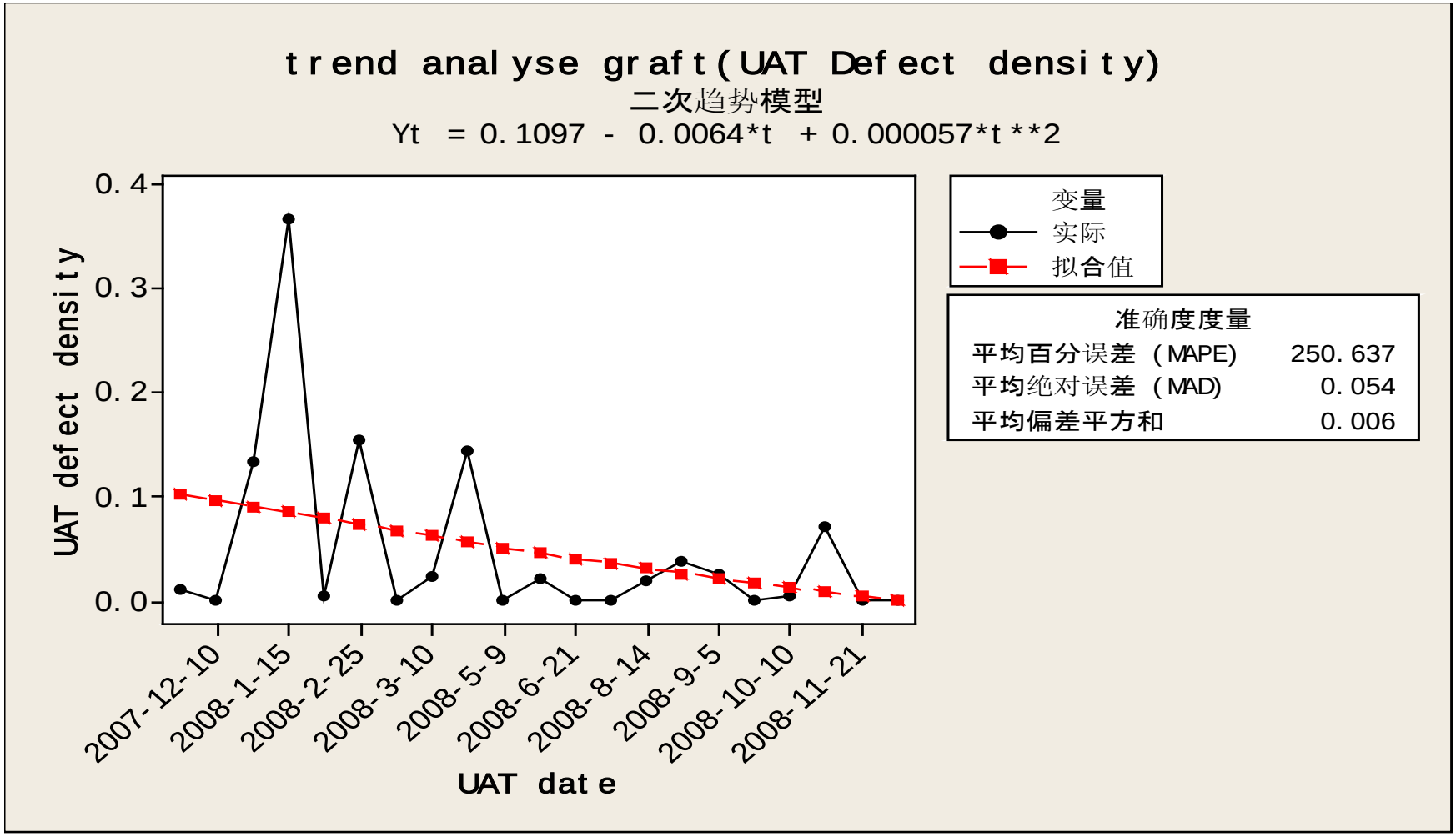
Defect removal rate improved in code review and UT&IT.



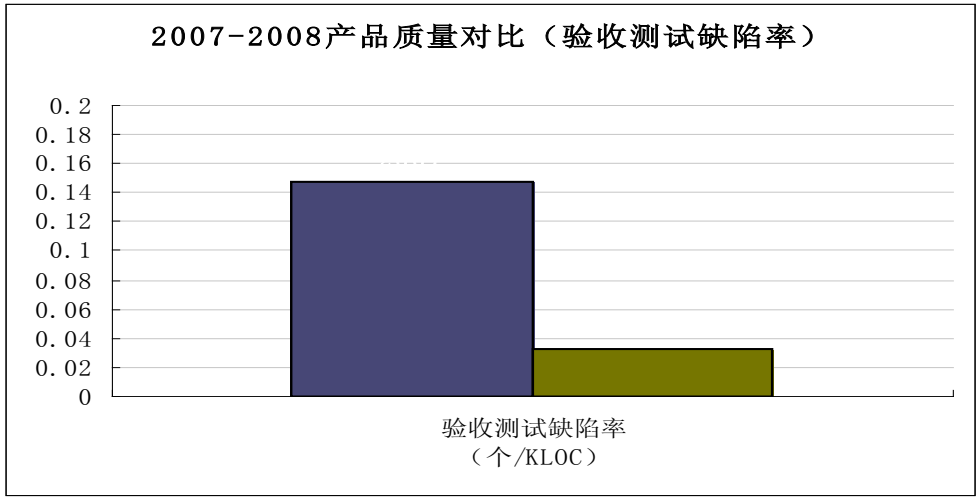
Defect Removal Pattern Moves to Front



Less Number of Defects Fund at UAT



Quality is Improved



Mote-Carlo模拟　　代码行数：　100000

	可能值	最大值	最小值
需求分析评审	22	38	7
总体设计评审	23	39	6
代码复查	50	97	4
内部测试	54	94	15
系统测试	107	181	33

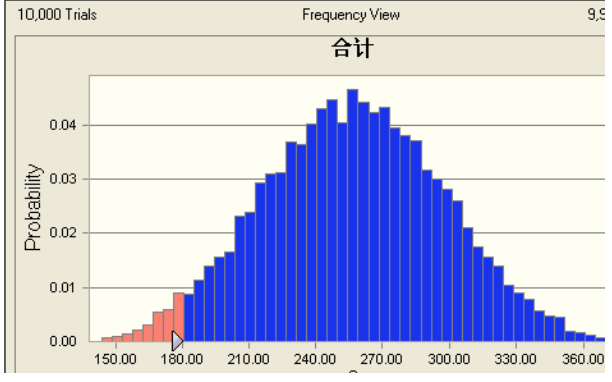
	均值	标准差
模拟结果	257.33	40.32

	均值	上限	下限
预测的验收测试缺陷率	0.064	0.094	0.034

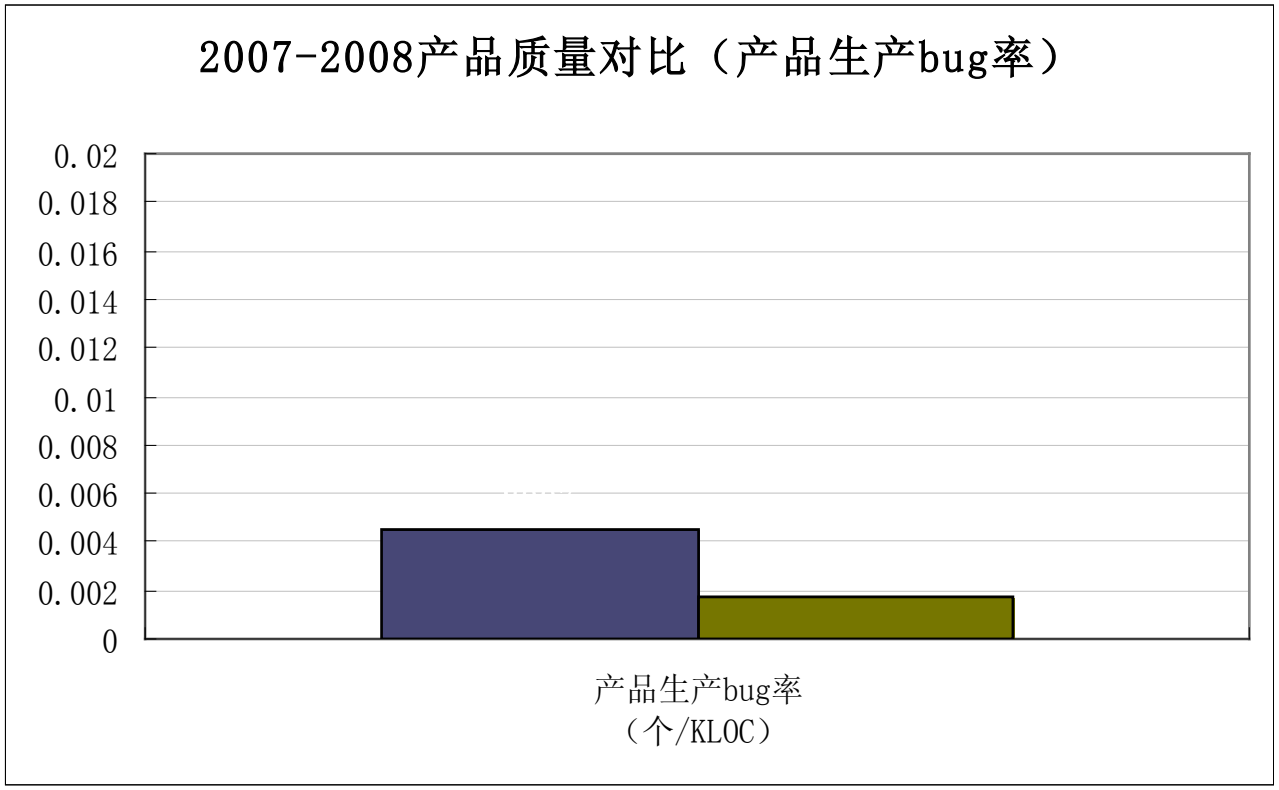
2007年验收测试缺陷率基线均值：0.147个/KLOC

根据目前各缺陷排除活动基线水平进行仿真模拟，模拟的验收测试缺陷率结果低于2007年水平。

	模拟值
需求分析评审	0
总体设计评审	0
代码复查	0
内部测试	0
系统测试	0
合计	0



Clients' Quality Goal is Met



Some Lessons Learnt - I

- **Set up the big picture first with clearly defined overall goals and interim goals.**
- **Clearly think through how the PPBs and PPMs will be used. You may want to write the PPBs and PPMs' User Guidelines before actually developing them. The PPBs and PPMs will be refined from time to time but how they are used will change much less frequently.**
- **Model development process is to really get to know your process: factors in the model – sources of variations. It is not enough if you only master the statistical techniques and know how to use Minitab.**
- **Model development process can also help you to identify areas to improve.**

Some Lessons Learnt - II

- When conducting regression analysis, do not just look at R square but also think “will the model allow you do What-If analysis?”
- Benchmarking a process does not make it a key process. A key process should also be the focus of your improvement. The factors in a good process performance model are the candidate areas to improve.
- PPBs can support the use of Monte Carlo simulation.
- Spec limits and control limits can get people confused.
- QPPOs and Controllable Factors!!!

Thank you !