# Maximize Software Development ROI With Quality Assurance

Showing the value of the Quality Process

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## Agenda

**Software Quality Assurance ROI**

- Quantifying the Cost of Quality
- Justifying a Software QA/QC Budget

**Software Quality Principles for Managers 101**

- Quality Assurance vs. Quality Control
- Quality Methodologies

Part 1
Measuring
Quality Assurance
Return on Investment (ROI)

## Quality Definition

**PMBOK ®**

The degree to which a set of inherent characteristics [consistently] fulfills requirements

## What is QUALITY worth to you?

- How does one quantify quality?
- How does one justify a QA/QC Staff?

## Measuring the Cost of Quality

- **Price Of Compliance (POC)**
  - Cost of Prevention, QA/QC
- **Price of Non-Compliance (PONC)**
  - Cost of Internal Failures
  - Cost of External Failures

Price of Quality
= POC + PONC

## Price of Compliance - **POC** (1 of 2)
## Development Activities

- Staff training
- Requirements analysis
- Early prototyping
- Fault-tolerant design
- Defensive programming
- Accurate internal documentation
- Proper Requirements
- Detailed Design Documents

## Price of Compliance **(POC)** (2 of 2)
## QA/QC Activities

- Design review
- Code inspection
- Unit testing
- End-to-End testing
- Regression Testing
- Beta testing
- Test automation
- Pre-release testing by staff

## Price of Non-Compliance **(PONC)**
## Internal **High Visibility** Costs

- Bug fixes
- Wasted in-house user time
- Developer fixing time
- Tester re-testing time
- Cost of late software product shipment
- Receivables potentially affected

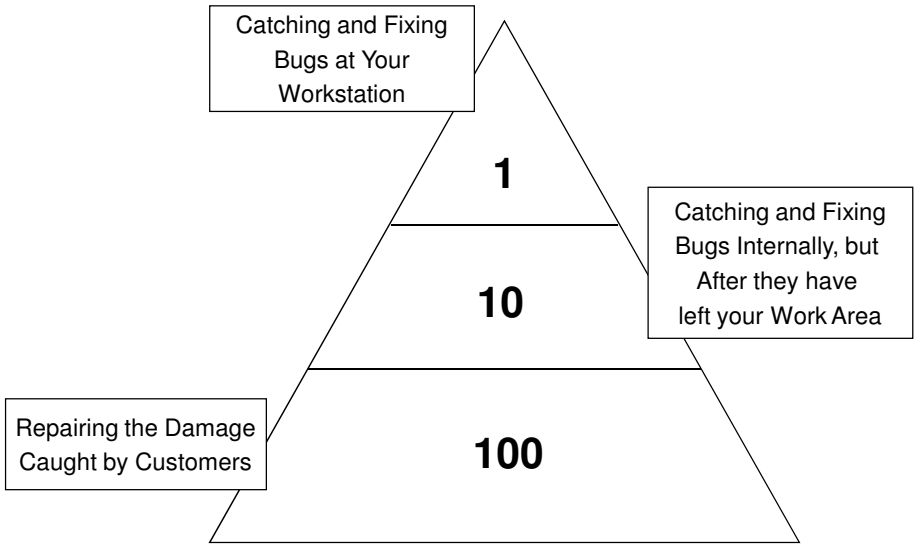
## Price of Non-Compliance (PONC)
## External **Low Visibility** Costs

- Cost of decisions made based on bad data
- Lost Market Share
- Technical support calls
- Investigation of customer complaints
- Refunds and recalls
- Coding / testing of interim bug fix releases
- Shipping of updated product
- Added expense of supporting multiple versions of the product in the field
- PR work to soften drafts of harsh reviews
- Lost sales
- Lost customer goodwill – Reputation for producing buggy software
- Discounts to resellers to encourage them to keep selling the product
- Warranty costs
- Liability costs
- Government investigations – if company subject to regulatory rules
- Penalties
- All other costs imposed by law

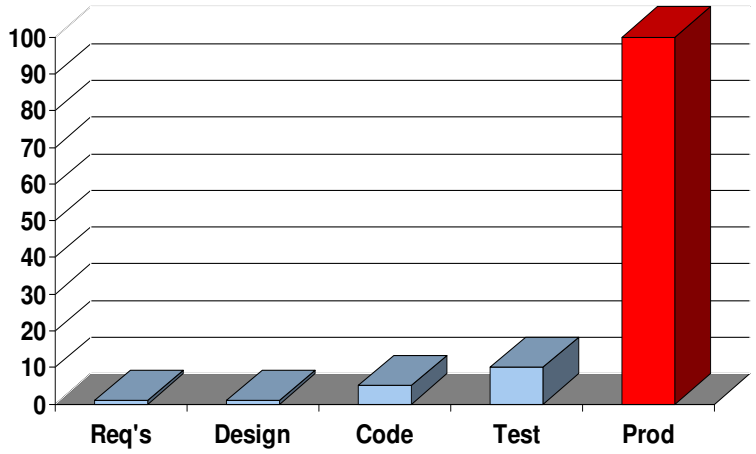
# #1 Cost of Quality Evaluation Pitfall: **External or Low Visibility Costs**

- Typically easy to overlook or minimize because hard to quantify
- Internal Costs often the only visible part of the PONC analysis - "iceberg effect"
- Also referred to as "**SOFT COSTS**" because hard to quantify

# The 1-10-100 Quality Cost Rule



# The Relative Cost of Fixing Bugs




Source: Quality Assurance Institute

# The 1-10-100 Rule
# Cost of Quality WITHOUT QA/QC

- 125 Bugs / Year, **80% caught by developers**
- $100.00 to fix a bug at developer level
- **NO QA/QC COST**

| Cost of resolving bug | Cost of Resolving a Bug Immediately | Cost of Resolving a Bug at QC | Cost of resolving a Bug once it reached the users | Total Cost of Bug Fixes |
|---|---|---|---|---|
| 1-10-100 Rule | 1 | 10 | 100 | |
| Distribution of 125 Bugs | 100 x $100 x 1 | 0 x $100 x 10 | 25 x $100 x 100 | |
| Distribution of Costs @ $100/bug | (100x$100 x 1) $10,000 | (0x $100 x 10) $0 | (25 x $100 x 100) $250,000 | $260,000 |
| NO QA/QC TEAM COSTS | | | | $0 |
| Total Cost | | | | $260,000 |

# The 1-10-100 Rule
# Cost of Quality WITH QA/QC

- 125 Bugs / Year, **80% caught by developers**
- $100.00 to fix a bug at developer level
- **$75,000 QA/QC Costs/Year, 80% QC Catch**

| Cost of resolving bug | Cost of Resolving a Bug Immediately | Cost of Resolving a Bug at QC | Cost of resolving a Bug once it reached the users | Total Cost of Bug Fixes |
|---|---|---|---|---|
| 1-10-100 Rule | 1 | 10 | 100 | |
| Distribution of 100 Bugs | 100 x $100 x 1 | 20 x $100 x 10 | 5 x $100 x 100 | |
| Distribution of Costs @ $100/bug | (100x$100 x 1) $10,000 | (20x $100 x 10) $20,000 | (5 x $100 x 100) $50,000 | $80,000 |
| + Cost of QA/QC Team | | | | $75,000 |
| Total Cost | | | | $155,000 |

# Quality Assurance
# Return On Investment (ROI)
# Internal View

- **Cost of quality without QA team: $260,000**
- **Cost of quality with QA team: $155,000**

**========**

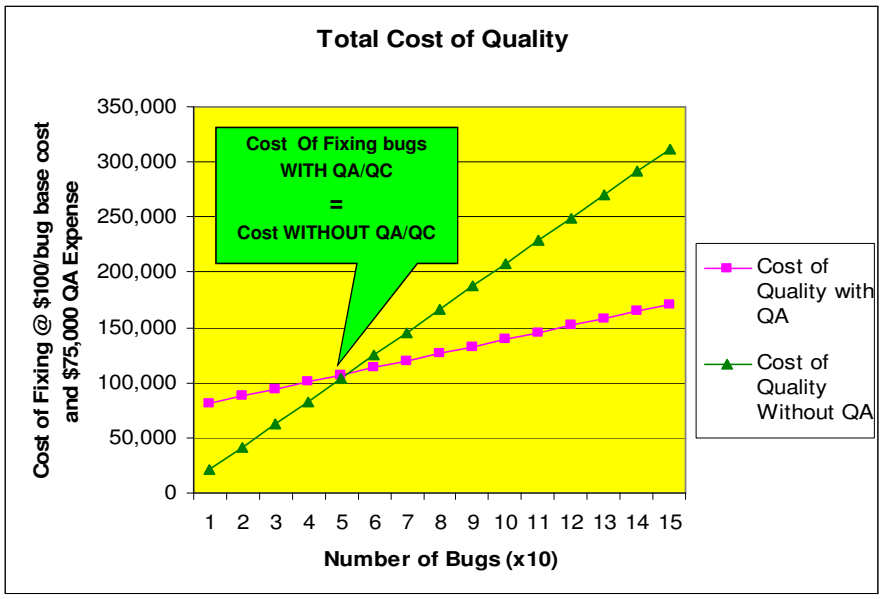
- **Difference: $105,000**

**Money Spent on QA/QC for one year: $75,000**
**Money Saved with QA/QC for one year: $105,000**

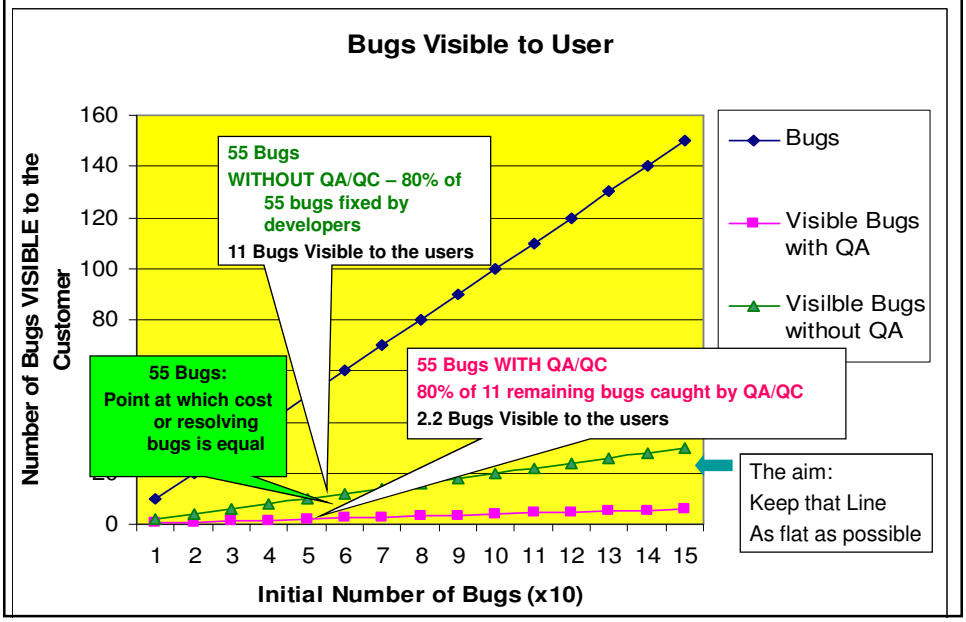
**==========**

**ROI using the 1-10-100 Rule for 1 year: 140%**

# The Quality Cost Curve




# The Visibility Curve



## The Ford Pinto Case – Part 1

"The Pinto was not to weigh an ounce over 2,000 pounds and not cost a cent over $2,000."

## The Ford Pinto Crash Data

Rear end Crash > 25 MPH:
Gas Tank Fire

Rear end Crash > 40 MPH:
Gas Tank Fire
**+ DOORS JAMMED SHUT!**

# The Ford Pinto Case Part 3

compress.mov

http://www.youtube.com/watch?v=rcNeorjXMrE

# The Danger of QA Cost Analysis: The Ford Pinto Case Part 2

| Ford's Cost/Benefit Analysis Relating to Pinto Model Rear-End Crash | |
|---|---|
| **The "BENEFIT"**<br><br>**(INTERNAL Cost Of Non-Compliance)** | Gas tank related accidents- 180 burn deaths, 180 serious burn injuries, 2100 burned vehicles<br>Unit Cost -- $200,000 per death, $67,000 per injury, $700 per vehicle<br>Total Cost: - 180 x ($200,000) + 180 x ($67,000) + 2100 x ($700)<br>**Total: $49.5 million** |
| **The "COST"**<br><br>**(Cost Of Compliance)** | Recalling 11 million cars, 1.5 million light trucks to fix vehicles with this model of gasoline tank:<br>Unit Cost -- $11 per car, $11 per truck<br>Total Cost : (11,000,000 + 1,500,000) x $11 =<br>**Total: $137 million** |

## QA Cost Analysis: What did Ford Miss?

| | |
|---|---|
| **The "BENEFIT"**<br><br>**INTERNAL or VISIBLE Cost of Non-Compliance** | Gas tank related accidents- 180 burn deaths, 180 serious burn injuries, 2100 burned vehicles<br>Unit Cost -- $200,000 per death, $67,000 per injury, $700 per vehicle<br>Total Cost: - 180 x ($200,000) + 180 x ($67,000) + 2100 x ($700)<br>Total: $49.5 million |
| **The "INVISIBLE" or EXTERNAL Cost Of Non-Compliance** | - *State of Indiana v. Ford Motor Co: Ford First American corporation ever indicted or prosecuted on criminal homicide charges*<br>- Lawsuits + Court Costs<br>- Production stopped 5 months after trial<br>- Lost Reputation<br>- Small car market share lost<br>**Total: $ BILLIONS, not millions!** |

## The Danger of QA Cost Analysis: Missing the EXTERNAL COSTS!

| | |
|---|---|
| **The VISIBLE or "INTERNAL" Cost Of Non-Compliance Recognized by Ford and labled as "BENEFIT" [of not doing anything]** | **Total: $49.5 million** |
| **The INVISIBLE or "EXTERNAL" Cost of Non-Compliance NOT RECOGNIZED BY FORD [of not doing anything]** | **Total: $BILLIONS** |
| **VS.** | |
| **The "COST" (Cost Of Compliance – doing the $11 repair)** | **Total: $137 million** |

Part 2
Software Quality Principles
for Managers 101

## Software Quality

Quality Control / Quality Assurance

Pareto Rule

Quality Model Considerations

## Quality Control / Quality Assurance

## ISO Definition:

| Quality Control: | Quality Assurance: |
| --- | --- |
| The operational techniques and activities that are used to fulfill requirements for quality | All those planned and systematic activities implemented to provide adequate confidence that an entity will fulfill requirements for quality |

## Quality Control

Characterized by:

- Tactical in nature
- Technical skills
- Attention to detail
- Front-line Quality Checking Activity

## Quality Control Outputs

- Crossed-off Checklist - Pass/Fail

If Fail:

- Recommend Corrective Actions if needed
- Document Defects in Bug Track

## Quality Assurance

**Characterized by:**

- Strategic: important or essential in relation to a plan of action
- Quality Planning
- Consistency of measurements
- What can be improved in the future?

## "Bug Track" Considerations

- Document bugs properly – data, circumstances, screens prints, library lists, sequence of events etc.
- Categorize the bugs reported
  - What type of bug (data? Formula? Screen Flow?)
  - From what module?
  - Using what programming language?
  - Batch or Interactive Processing?
  - How much time has been spent on QC?
  - Was this a Design bug?
  - How much time has been spent on the Fix (if applicable)

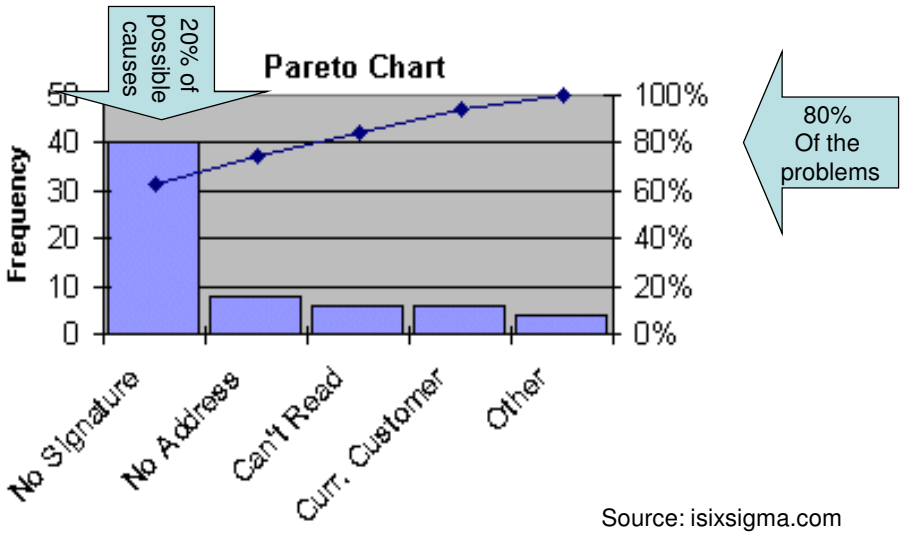
## QA Bang-for-the-Buck
## The Pareto Rule (80/20) Rule

- Vilfredo Pareto (1848 – 1923) : "80% of the land in Italy Is owned by 20% of the population"

**QA Application of the 80/20 rule**

- 80% of customer complaints arise from 20% of your products or services.

# Pareto Chart Example: Credit Application Rejection Reasons

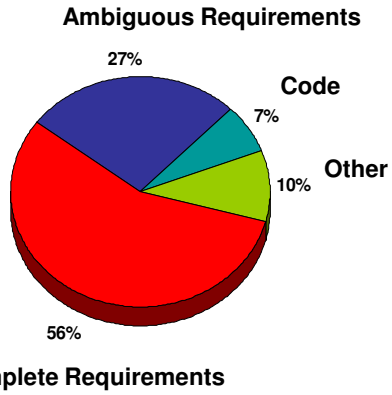



Source: isixsigma.com

# Where do Defects Originate?

**Ranking:**

1. **Incomplete Requirements**
2. **Ambiguous Requirements**
3. **Code Logic Defects**
4. **Defect Handling**
5. **Wrong Requirements**




**Source: Quality Assurance Institute**

# QA Bang-for-the-Buck
# Discovering your own 80/20 Rules

- Ensure you know your bug track database
- Categorize problems in a meaningful way
  - By type of problem
  - By module
  - By time spent repairing
- Use your bug track database to find the 80/20's
  - SQL
  - Microsoft XL
- **Find <u>where improving quality immediately</u> will deliver best return for the QA investment**

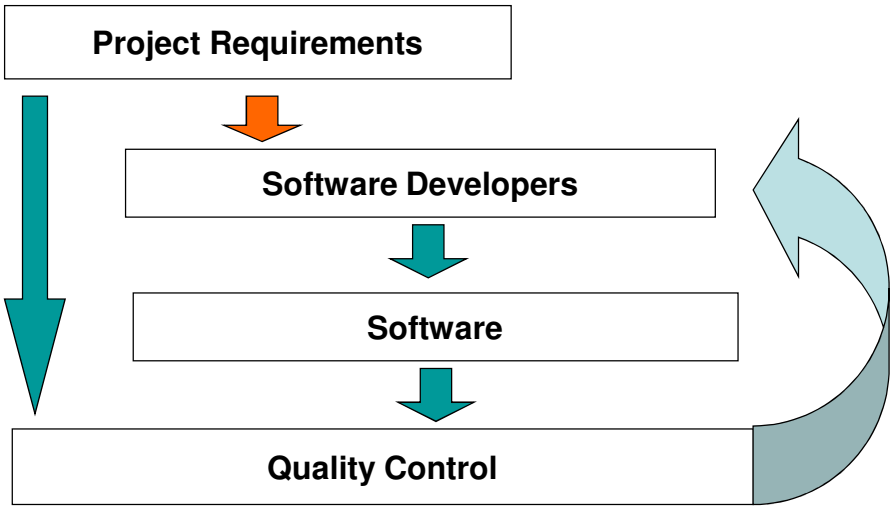
# Find your Worst Offenders
# SQL Example

```
SELECT  MODULE,
        COUNT(*) MODULE_COUNT
FROM BUGTRACK_DB
   GROUP BY MODULE
```

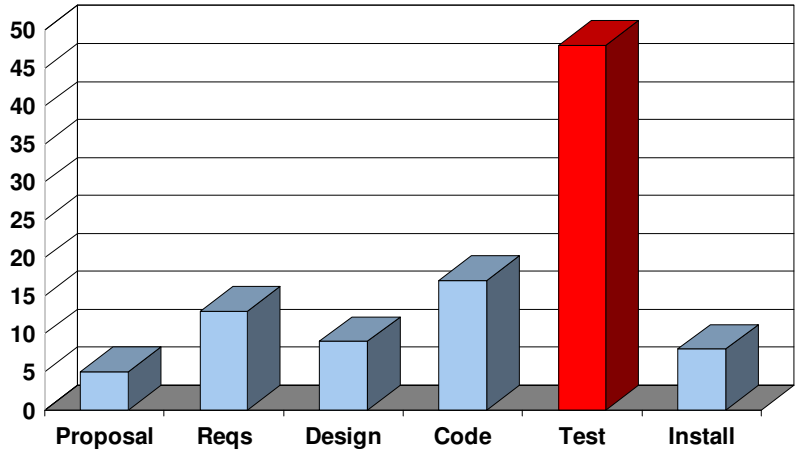
| MODULE | MODULE_COUNT |
|---|---|
| GL | 25 |
| SHOP_FLOOR | 7 |
| SALES_REPORTING | 3 |

Quality Management Systems,
Methodologies
Worthwhile Reading

## Quality Control Flow
## Traditional Model: "The Waterfall"



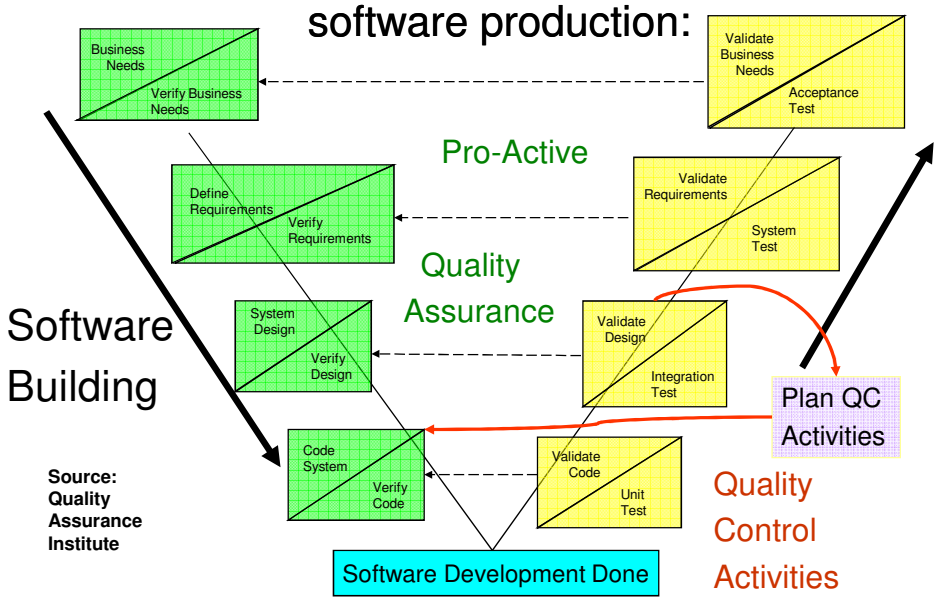
# Waterfall Quality Cost Concentration




Source: Quality Assurance Institute

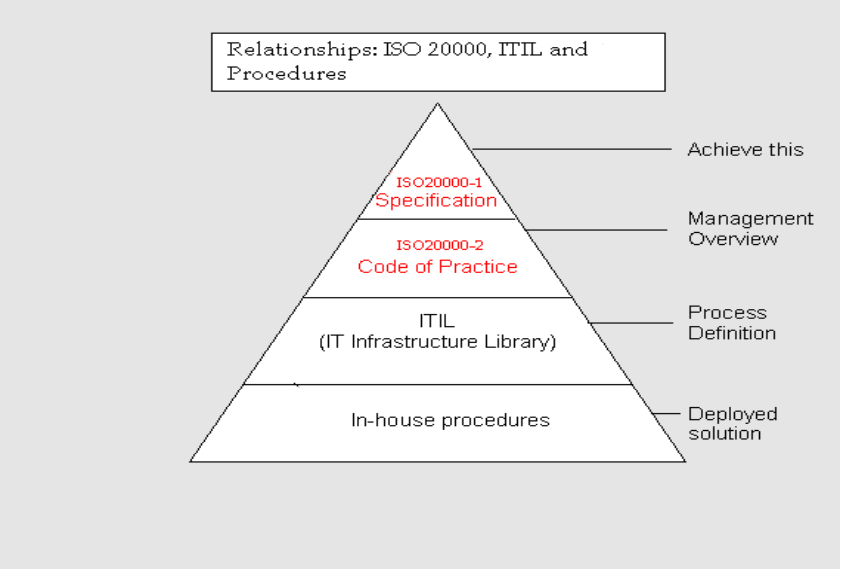
# The "V" Diagram New Flow

QA/QC is applicable at ALL stages of software production:




Source: Quality Assurance Institute

# ISO 20,000 Quality Standard and ITIL




# Capability Maturity Model (CMM)

- **Developed to describe the capability of software contractors to provide software on time, within budget, and to acceptable standards**
- **Often used by Government or large companies**

**Method for Evaluating the Maturity of an Organization – 5 Levels**

1. **Initial** – **Follows little or no rules**
2. **Repeatable** – **Disciplined Process**
3. **Defined** – **Standardized Disciplined Process**
4. **Managed** – **Using precise measurements**
5. **Optimizing** – **Quantitative feedback, continuous improvement**

# Quality Planning Resources: Six Sigma

- Origin of Six Sigma

  + or – 6 Standard deviations (sigma) from the mean

  **6 Sigma: 3.4 defect/million**
  By contrast:
  **3 Sigma: 2,700 defects/million**

  More on Six Sigma at
  http://www.isixsigma.com/
  http://www.ge.com/sixsigma/

# QC/QA Web Resources

http://satc.gsfc.nasa.gov/assure/agbsec3.txt
http://home.att.net/~iso9k1/tqm/tqm.html
http://www.isixsigma.com/
http://www.ge.com/sixsigma/
http://www.badsoftware.com/qualcost.htm
http://www.kaner.com/qualcost.htm
http://www.extremeprogramming.org/map/code.html

## Quick Bugtrack Starter: BUGZILLA

- Bugzilla (bugtrack) http://www.bugzilla.org/
- Used by
  - AMD
  - McGraw Hill Higher Education
  - Motorola
  - France Telecom
  - University of Minnesota
  - Indian Institute of Astrophysics

## Points to Remember

- Sell the QA/QC VALUE PROPOSITION :
- Explain the Value Proposition
  - 1-10-100 Rule
- Explain the Quality Process
  - Why Requirements are critical
  - QA vs QC
  - Quantified knowledge can lead to improvement

Questions