"The Ten Most Powerful Principles for Quality in [Software and] Software Organizations"

The Second World Congress for Software Quality (2WCSQ)

Pacifico Yokohama Conference Center(Tokyo Bay Area)
September 25th(Mon.) - 29th(Fri.), 2000

ABSTRACT:
Software knows it has a problem. Solutions abound. But which solutions work? What are the most fundamental underlying principles we can observe behind those successful solutions? Can these principles guide us to select successful solutions and avoid time wasters? One hint: in Observing successful software organizations in the US, the dominant principle seems to be feedback and control.

By Tom Gilb, Result Planning Limited

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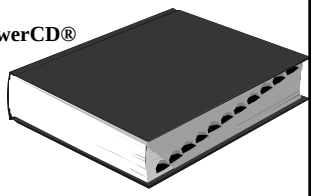
Version 1.01 : 25 March 2000

Principle



Webster's New World™ College Dictionary (Third Edition) on PowerCD®

prin•ci•ple (prinse pel)

n.

1 the ultimate source, origin, or cause of something

2 a natural or original tendency, faculty, or endowment

3 a fundamental truth, law, doctrine, or motivating force, upon which others are based [moral principles]

4 a) a rule of conduct, esp. of right conduct b) such rules collectively c) adherence to them; integrity; uprightness [a man of principle]

5 an essential element, constituent, or quality, esp. one that produces a specific effect [the active principle of a medicine]

6 a) the scientific law that explains a natural action [the principle of cell division] b) the method of a thing's operation [the principle of a gasoline engine is internal combustion]

in principle

theoretically or in essence

on principle

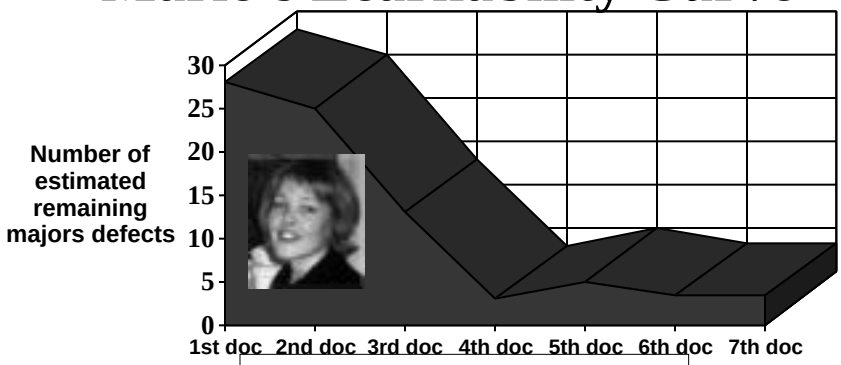
because of or according to a principle

1. Feedback

- Rapid feedback allows rapid correction.
  - Methods using rapid feedback succeed, those without seem to fail.
    - Methods:
      - Defect Prevention Process (CMM 5, Mays, IBM 1985)
      - Inspection (Fagan, IBM 1975) *
      - Evolutionary Project Management (Mills, IBM, Cleanroom, 1970) *
      - Statistical Process Control (SPC): Shewhart, Deming, Juran (1920's)

* reprints IBM Systems Journal, 2&3 1999

Marie's Learnability Curve



Number of Document Inspections where she got useful feedback about quality and rules.

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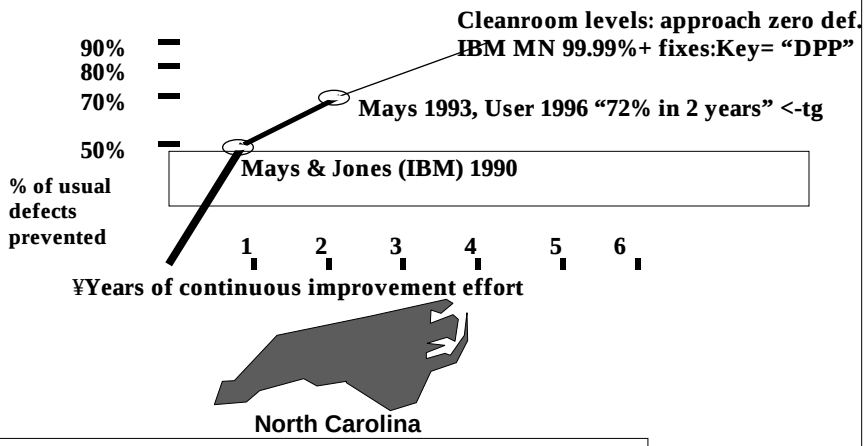
Defect Prevention Experiences: Most defects can be prevented from getting in there *at all*



IBM Research Triangle Park Networking Laboratory

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Gilb@acm.org, 2000

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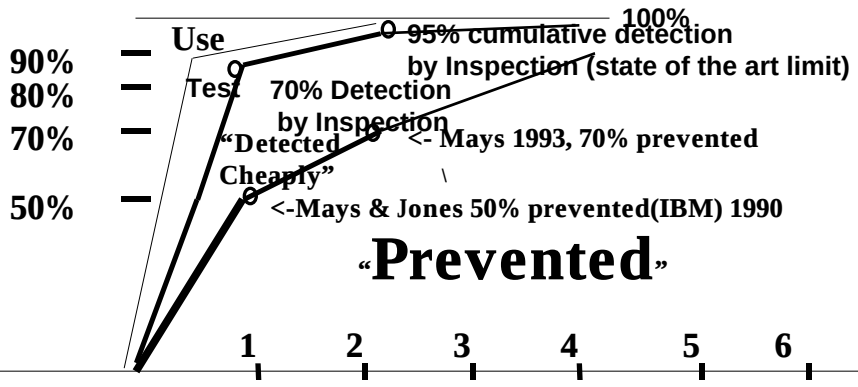
Prevention + Pre-test Detection is the most effective and efficient



- Prevention data based on state of the art prevention experiences (IBM RTP), Others (Space Shuttle IBM SJ 1-95) 95%+ (99.99% in Fixes)
- Cumulative Inspection detection data based on state of the art Inspection (in an environment where prevention is also being used, IBM MN, Sema UK, IBM UK)

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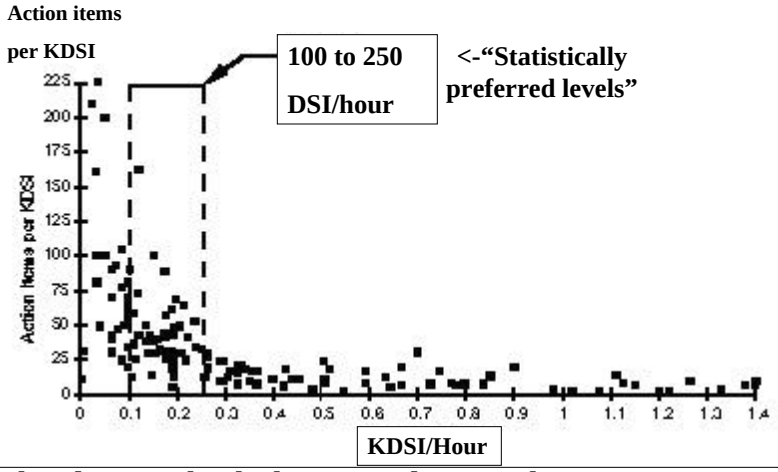
IBM MN & NC DPP Experience.
High <u>quantity</u> feedback leads to real change.

- 2162 DPP Actions implemented
  - between Dec. 91 and May 1993 (30 months) <-Steve Kan
- RTP about 182 per year for 200 people. <-Robert Mays 1995
  - 1822 suggested ten years (85-94)
  - 175 test related
- RTP 227 person org <- Mays slides
  - 130 actions (@ 0.5 work years
  - 34 causal analysis meetings @ 0.2 work years
  - 19 action team meetings @ 0.1work years
  - Kickoff meeting @ 0.1 work years
  - TOTAL costs 1% of org. resources
- total ROI (Return On Investment) DPP **10:1 to 13:1,**
- internal ROI 2:1 to 3:1
- Defect Rates at all stages **50% lower** with DPP

Fault Density versus Checking Rate: Raytheon 95
Slide **8**

Feedback on optimum rates leads to orders of magnitude better performance



Why do you think they avoid using the optimum rate?

Hint: "Our process mandates 100% inspection coverage"

Effectiveness a function of checking rate (Buck)
Feedback on optimum rates permits more effective performance

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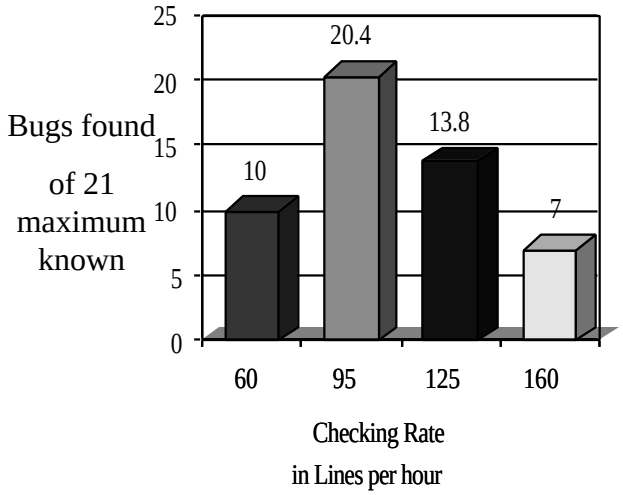

From Frank Buck IBM 1980

Evo 'Learning' model

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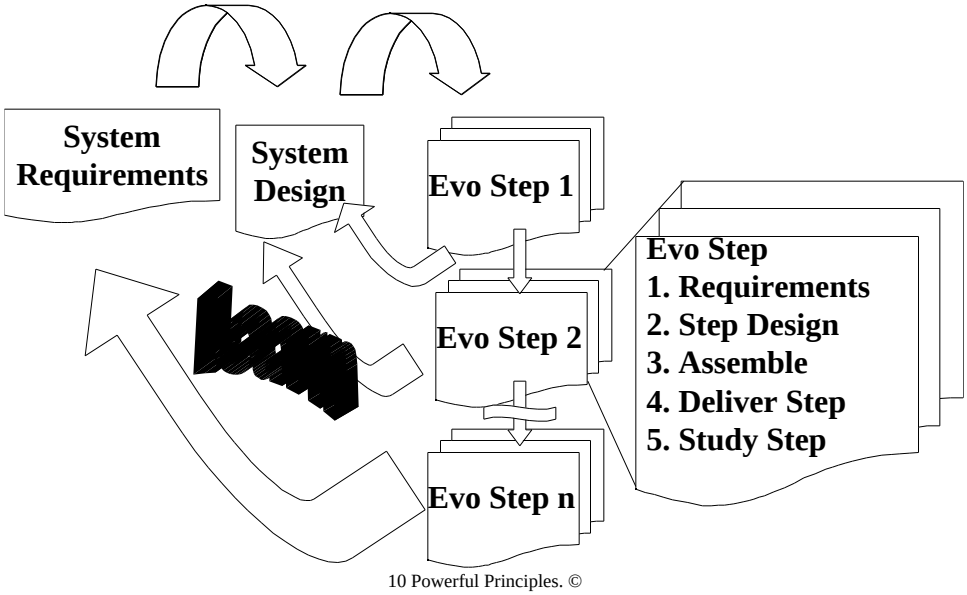
Project feedback improves requirements and design and process!



Evo shortens project by feedback (MS)

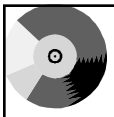
- "It appears that this incremental approach takes longer, but it almost never does, because it keeps you in close touch with where things really are"
- Brad Silverberg, Sr. VP for Personal Systems Microsoft in CUSUMANO95 , page 202

Customer feedback weekly!

An example of a typical one-week Evo cycle at the HP Manufacturing Test Division during a project. [MAY96, HP* Journal Aug 96]

	Development Team	**Users**
Monday	✓ System Test and Release Version N ✓ Decide What to Do for Version N+1 ✓ Design Version N+1	
Tuesday	✓ Develop Code	✓ Use Version N and Give Feedback
Wednesday	✓ Develop Code ✓ Meet with users to Discuss Action Taken Regarding Feedback From Version N-1	✓ Meet with developers to Discuss Action Taken Regarding Feedback From Version N–1
Thursday	✓ Complete Code	
Friday	✓ Test and Build Version N+1 ✓ Analyze Feedback From Version N and Decide What to Do Next	

* one of my direct customers, TG

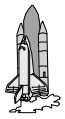


Direct Customer Input (MS)

- "Microsoft's general philosophy has been to ….. focus on evolving features and whole products incrementally, with *direct input from customers during* the development process."
  CUSUMANO95 , 13, Microsoft Secrets

Harlan Mills on Project Control:
2% deliveries feedback gives full project control!

- **"Software Engineering began to emerge in FSD" (IBM Federal Systems Division, from 1996 a part of Lockheed Martin Marietta) "some ten years ago [about 1970] in a continuing evolution that is still underway.**
  - **Ten years ago general management expected the worst from software projects – cost overruns, late deliveries, unreliable and incomplete software.**
  - **Today [1980] , management has learned to expect on-time, within budget, deliveries of high-quality software.**
- **A Navy helicopter ship system, called LAMPS, provides a recent example.**
  - **LAMPS software was a four-year project of over 200 person-years of effort,**
  - **developing over three million, and integrating over seven million words of program and data for eight different processors distributed between a helicopter and a ship,**
  - **in 45 incremental deliveries.**
  - **Every one of those deliveries was on time and under budget.**
- **A more extended example can be found in the NASA space program,**
  - **where in the past ten years, FSD has managed some 7,000 person-years of software development, developing and integrating over a hundred million bytes of program and data for ground and space processors in over a dozen projects.**
  - **"There were few late or overrun deliveries in that decade, and none at all in the past four years." Harlan Mills [IBM Systems Journal No. 4, 1980, p. 415], Reprinted IBM SJ Vol. 38 1999, 289-295**



User Feedback (JPL)

- Evo “expects active feedback from the experience gained from one incremental delivery to the requirements from the next.
- As Evo periodically delivers to the users an increment of capability, the users are able to provide understanding of how effectively that delivery is meeting their needs.
- As the users assess the impact of a delivery on their operations, the system developer is able to work with them to adjust the system requirements to better satisfy their operational needs.
- Evo lets that adjusted set of requirements be the basis for all subsequent incremental deliveries.
- This feedback process is formal and proactive. It is a key element in making Evo effective from a user’s perspective.”
- [SPUCK93] Jet Propulsion Labs

2. Critical Measurement

- If you do not focus on the few measures critical to your system, then it will fail.

- *This principle is supported by the slide detail for several other principles here, so I will not comment in more detail just here. TG*

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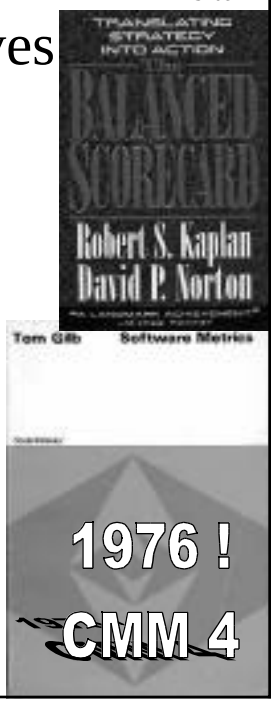
3. Multiple Objectives

- If you cannot control multiple measures of quality and cost simultaneously, then your system will fail due to the ones you did not control.



10 Powerful Principles. © Gilb@acm.org, 2000

Impact Table for Step Management: how to directly control many cost and quality objectives in small evolutionary project steps simultaneously **18**

	Step #1 Plan A: {Design-X, Function-Y}	**Step #1 Actual**	**Difference. - is bad + is good**	**Total Step 1**	**Step #2 Plan B: {Design Z, Design F}**	**Step #2 Actual**	**Step #2 Difference**	**Total Step 1+2**	**Step #3 Next step plan**
Reliability 99%-99.9%	**50% ±50%**	**40%**	**-10%**	**40%**	**30% ±20%**	**20%**	**-10%**	**60%**	**0%**
Performance 11sec.-1 sec.	**80% ±40%**	**40%**	**-40**	**40**	**30% ±50%**	**30%**	**0**	**70%**	**30%**
Usability 30 min. -30 sec.	**10% ±20%**	**12%**	**+2%**	**12%**	**20% ±15%**	**5%**	**-15%**	**17%**	**83%**
Capital Cost 1 mill.	**20% ±1%**	**10%**	**+10%**	**10%**	**5% ±2%**	**10%**	**-5%**	**20%**	**5%**
Engineering Hours 10,000	**2% ±1%**	**4%**	**-2%**	**4%**	**10% ±2.5%**	**3%**	**+7%**	**7%**	**5%**
Calendar Time	**1 week**	**2 weeks**	**-1week**	**2 weeks**	**1 week**	**0.5 weeks**	**+0.5 wk**	**2.5 weeks**	**1 week**

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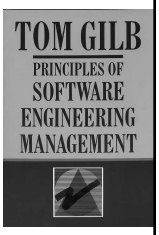
4. Evolution

- You must evolve in small steps towards your goals; large step failure kills the entire effort.
  - And early frequent result delivery is politically and economically wise.
  - 2% of total is a small step, you can afford to fail on



Ericsson case in Japan

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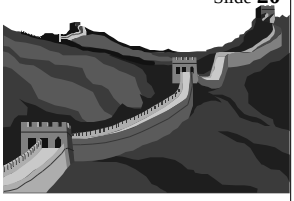
Tao Te Ching (500BC)



- That which remains quiet, is easy to handle.
- That which is not yet developed is easy to manage.
- That which is weak is easy to control.
- That which is still small is easy to direct.
- Deal with little troubles before they become big.
- Attend to little problems before they get out of hand.
- For the largest tree was once a sprout,
- the tallest tower started with the first brick,
- and the longest journey started with the first step.
  - From Lao Tzu in Bahn, 1980 Penguin book

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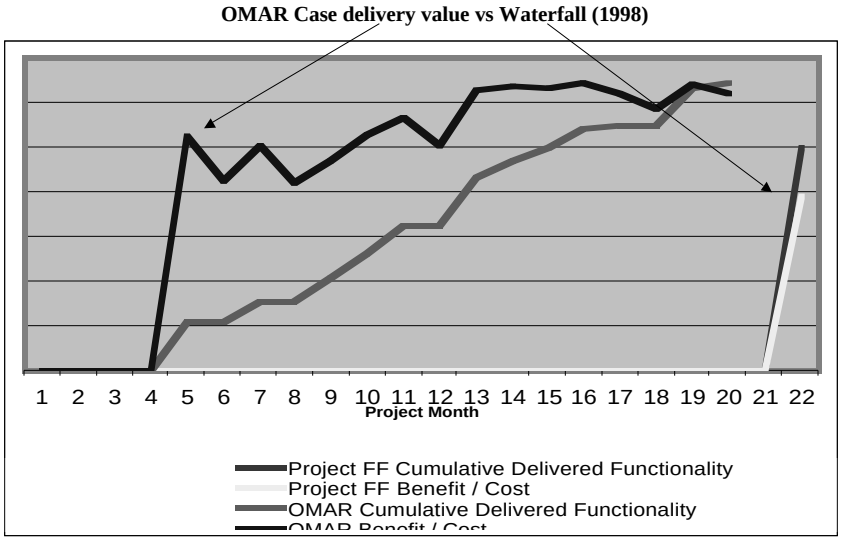
Value delivery early



Using Evolutionary Project Management, To Get More Quality, From Fewer Resources, In Less Time; By Stuart Woodward, DoubleHelix Software & Services Ltd.

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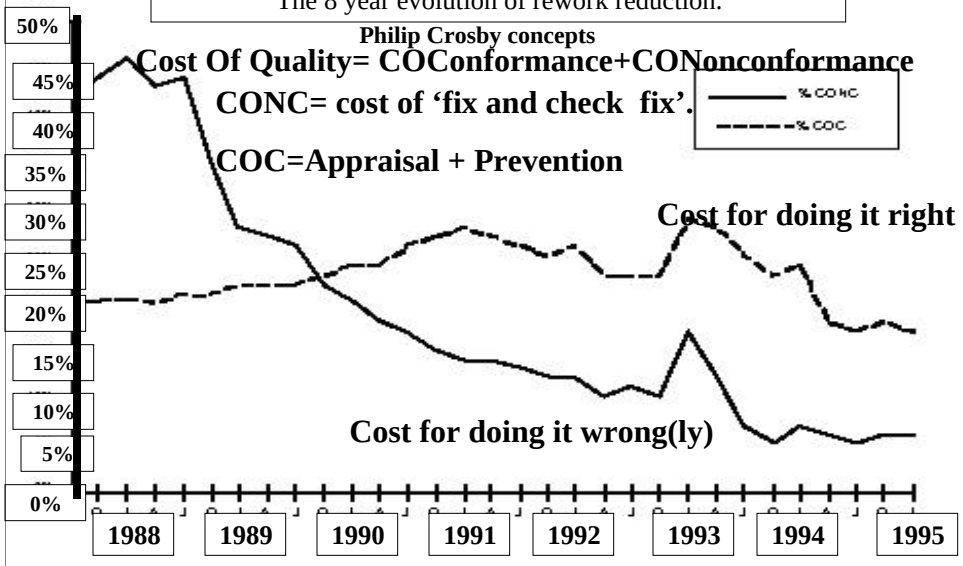
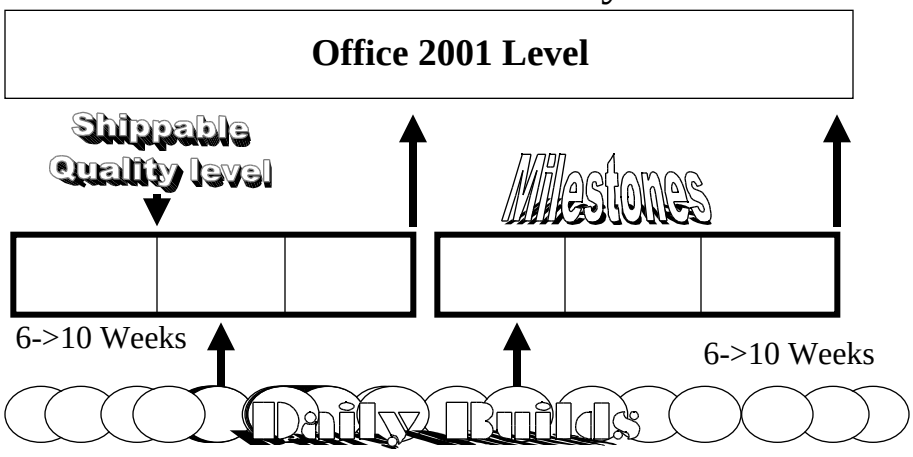
Cost of Quality versus Time: Raytheon 95
The 8 year evolution of rework reduction.



Project Cost = {Cost of Quality + Cost of Performance}.
Cost of Performance={Planning, Documentation, Specification}.

Multiple Levels of Microsoft Evo: Ms does Evo daily!



Go to next Graphic

Early simple proof of concept (Ericsson):

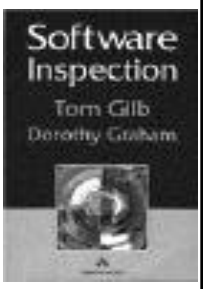
Ericsson used Evo to deliver a 15 month project in 9 months to Japan

ERICSSON

- **"Organic integration [Evo] is a way of getting rid of the myth [that problems don't exist] very early on.**
- **You could say that organic integration demands of an organization that it do the specifications, the system, the design and the verification for *one first very small task* very quickly.**
- **It also demands of the organization that it *do this right* in terms of delivering products correctly.**
- **If the organization cannot even manage its first simple task in the time agreed, it certainly should *question the ability* to manage more difficult tasks.**
- **This *process of questioning* is very healthy. It may for example prevent the *delusions of grandeur* so common in nearly all organizations".**
- **[Ericsson94], page 26, Jack Järkvik, in the context of building mobile telephone base stations**

Ericsson case in Japan

5. Quality Control



- Quality Control must be done as early as possible, in planning, to reduce the delays from late defect finding.
  - Use numeric Exit from development process
    - Like “Maximum 0.2 Majors/Page”
  - Use Inspection sampling to keep costs down, and to permit early, before completion, action and learning.

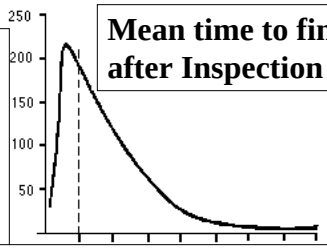
August 1999

10 Top Advanced Inspection Principles

- Pr1. *Prevention* is more effective than Cure
- Pr2. *Avoidance* is more efficient than removal
- Pr3. *Feedback* teaches effectively
- Pr4. *Measurement* gives facts to control the process
- Pr5. Priority to the *Profitable*
- Pr6. *Forget perfection*, you can’t afford it!
- Pr7. Teach *fishing*, rather than ‘give fish’
- Pr8. *Framework for Freedom* beats bureaucracy
- Pr9. *Reality* rules
- Pr10. *Facts* beat intuition

The downstream alternative cost of quality
at a Defence Electronics Factory
(all types of documents).

Number of defects of the 1,000 sampled Majors



Mean time to find and correct a Major after Inspection was 9.3 Hours.

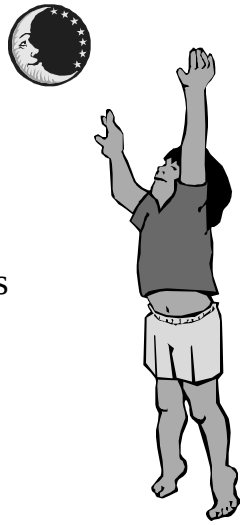
It cost about 1 hour to find and fix a Major using Inspection

Estimated hours to find and correct in test or in field.
Range 1 to 80 hours

Source: Trevor Reeve, Case Study Chapter in "Software Inspection"
Philips MEL became "Thorn EMI", then Racal, now Raytheon. Crawley UK.

Advanced Inspection Objectives

- Central Objectives
  - 1. Engineering Process Control
  - 2. *Measuring* Document Quality
  - 3. Reduce Project Time & Cost
- Secondary Objectives
  - 4. Identify and Remove Major Defects
  - 5. Reduce Service/Maintenance Costs
- *NOT* Objectives
  - Approve document '*content*'
  - Remove *minor* defects
  - '*Improve*' Quality



Larger set of Inspection Objectives

1. Time-to-Delivery
2. Measurement
   - •document quality
   - •doc. process quality
   - •inspection value/cost
3. Release "downstream"
4. Identify defects
5. Fix defects
   avoid new defect injection
6. Improve process
   product producers
   inspection itself
7. On-the-job training

8. Motivation
9. Help Author
10. Effectiveness (Quality)
11. Efficiency (Productivity)
12. Train Inspection team leader
13. Certify the leader
14. Motivate Managers
15. Reduce Maintenance Costs
16. Relieve Project Leader.
17.many others

6. Motivation

- The 'best methods' work only when people are motivated
  - 'Drive out fear' (Deming)

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Motivation ‘is Everything!’

- **People are ‘sensitive’**
- **Avoid all ‘threats’**
- **Give ‘positive’ motivators**
- **Very many ‘details’ support this attitude**
- **You will respect this, or fail!**
- **Do unto others, as you would have them do with *your* work!**

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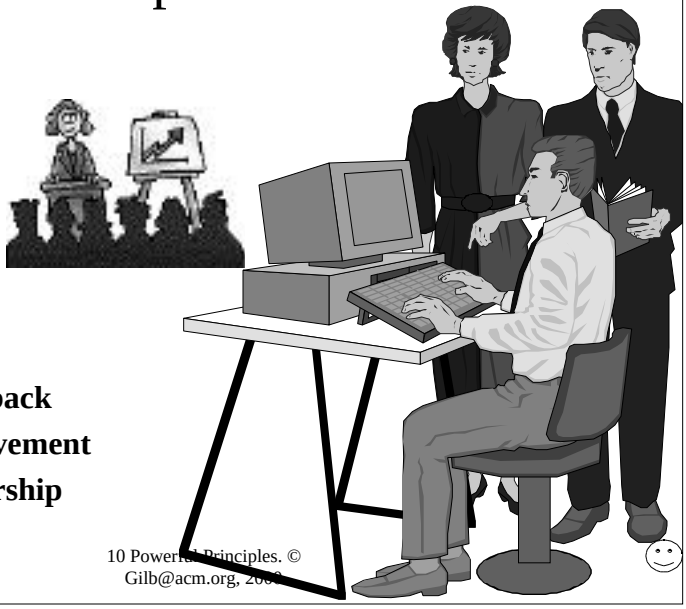
Positive Motivators in our Inspection version

- **Group-work**
- **Team**
- **Freedom**
- **Learning**
- **Game**
- **Experiments**
- **Challenge**
- **Numeric Feedback**
- **Process Improvement**
- **Positive Leadership**
- **Sampling**



Slide **33**

Potentially Negative Motivators in bad Inspection practice

- Time Pressure
- Result Pressure
- Personal Attacks
- Bureaucracy
- Small-minded Leader
- Personal-fault blaming
- Process corruption
- High volume/cleanup

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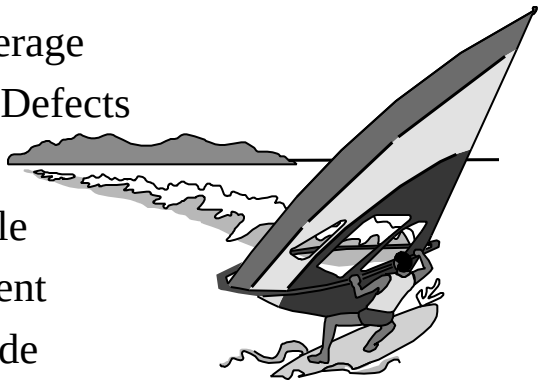
Motivational Philosophy

- Intelligent Inspection
- Maximum Leverage
- Process causes Defects
- Trust people
- Empower people
- Allow experiment
- Let results decide
- Continuously improve



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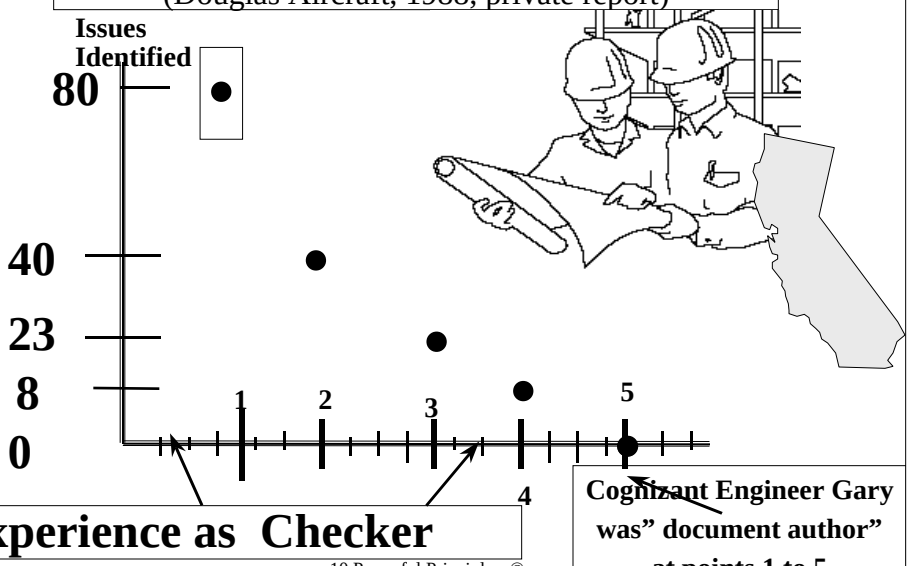
Gary's Personal Learning
(to follow process) Curve
(Douglas Aircraft, 1988, private report)



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MOTOROLA
Motorola India Electronics Ltd.

THE BUSINESS IMPACT OF REACHING CMU/SEI LEVEL 5

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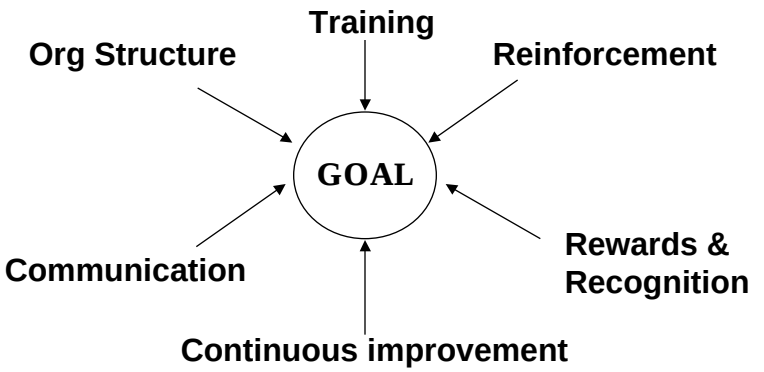
Slides July 1996 Given Gilb by Fordham 1999

MIEL ~ THE EXPERIMENT



ORGANIZATIONAL VALUE SYSTEM & MANAGEMENT COMMITMENT

CONCLUSION

- ***Benefits of a well-controlled process in terms of quality, productivity and cycle time are very apparent.***
- ***Developing software across an ocean can be done in no other better way.***
- ***Process maturity provides a sense of self-esteem for individuals.***
- ***Process ownership has to lie with the decision makers.***
- ***Complete commitment, cooperation & participation from all levels of management required.***

CONCLUSION(2)

- ***Process maturity requires an open & mature culture.***
- ***Fear of making / admitting failures should not exist, however all failures should provide lessons learnt & same mistakes should not be repeated.***
- ***Involvement wears out resistance.***
- ***Empowerment is key to process maturity. It must be tempered with explicit bounds on what employees can & cannot address.***
- ***Long term cost benefit orientation will help in directing organizational change.***

RESULTS (1 of 2)

- LINES OF CODE RELEASED IN 1995
  - OVER 3 MILLION
- PRODUCTIVITY
  - 2 TIMES THE INDUSTRY AVERAGE
- POST-RELEASE QUALITY
  - **190 TIMES** INDUSTRY AVERAGE*
    - (they had 2 bugs in 800,000 LOC!, TG)
- 85% OF PROJECTS ARE DELIVERED ON SCHEDULE
- CUSTOMER SATISFACTION HAS BEEN CONSISTENTLY BETWEEN GOOD & EXCELLENT.

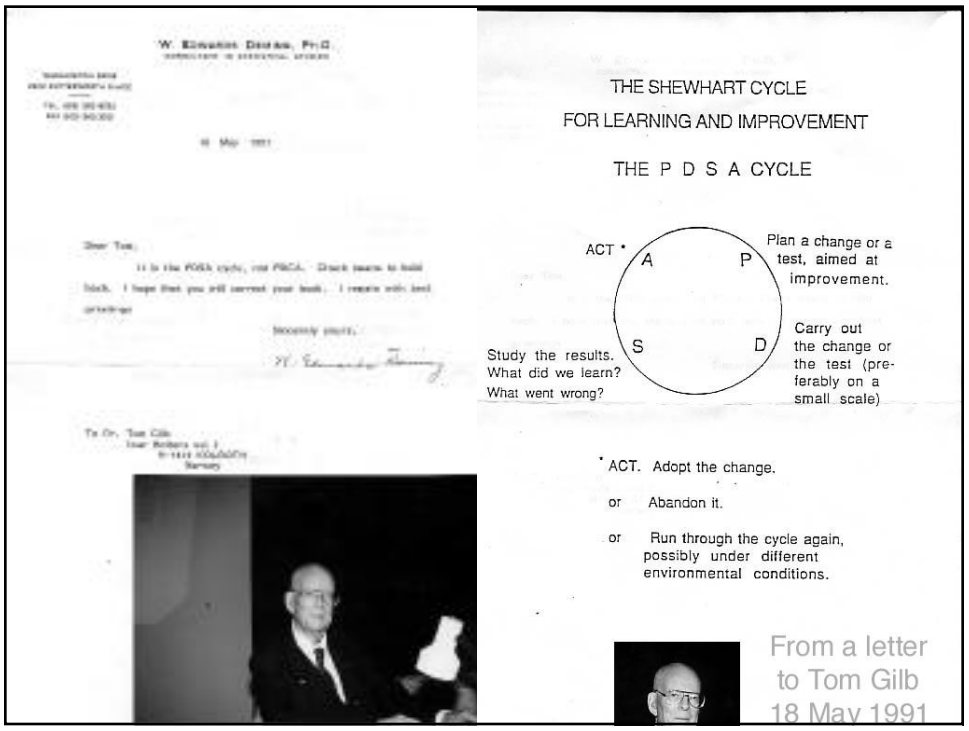
* US AVERAGE POST RELEASE DEFECTS OF 0.75 DEFECTS/FUNCTION POINT
(6 DEFECTS/1024LOC) *Industry average*
SOURCE: CAPERS JONES

RESULTS (2)

- BUILT BASELINES OF PRODUCTIVITY & DEFECT DENSITY FOR ELEVEN CATEGORIES OF PROJECTS.
- HAVE ACHIEVED BETTER THAN 20% ACCURACY FOR DEFECT PROJECTIONS 50% OF THE TIME
- BUILT SUFFICIENT HISTORICAL DATA FOR A BETTER REFINEMENT OF THE REGRESSION MODEL.
- BUSINESS HAS GROWN 300% IN THE LAST 5 YEARS.

7. Process Improvement

- Eternal Process improvement is necessary as long as you are in competition
  - Paraphrasing Deming about PDSA cycle end.



The Road To Wisdom : Piet Hein

"The road to wisdom

is plain and simple to express,

to err, and err, and err again,

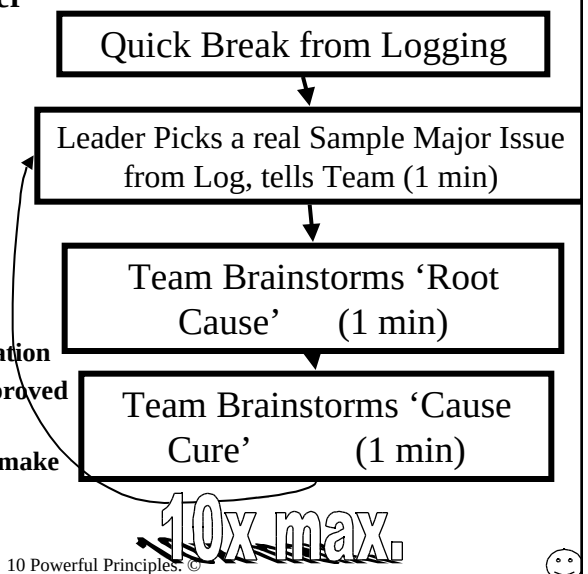
but,

less, and less, and less."

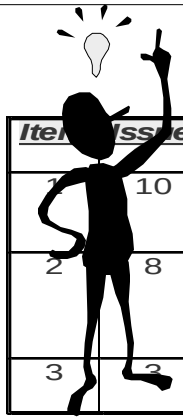
Piet Hein,
(Danish Philosopher

The PB Process

- **Team Stays together after 'Logging'**
  - **Same room**
  - **Same people**
  - **Maybe a break first**
  - **Same documents**
  - **Up to half an hour**
- **Shift mentality!**
  - **Not the project**
  - **The process, our organization**
  - **How we feel it can be improved for us**
  - **So we are not 'forced' to make mistakes**



The P.B. Log



Item	Issue	Classify	Root Causes	Improvement Suggestions
1	10	Oversight	• Time pressure • no tools • no info	• optimum time • build tool • give info on PC
2	8	Education	• trainees don't know • manual not updated	• special meeting for trainees • manual on Web
3	3	Commun-ication	• authors are unknown	• publish their email on doc. head

- Brainstorming Rules: no criticism, flow ideas in
- Getting 'Grass Roots' opinions, investigation later

Defect Prevention Process within 'Inspection'

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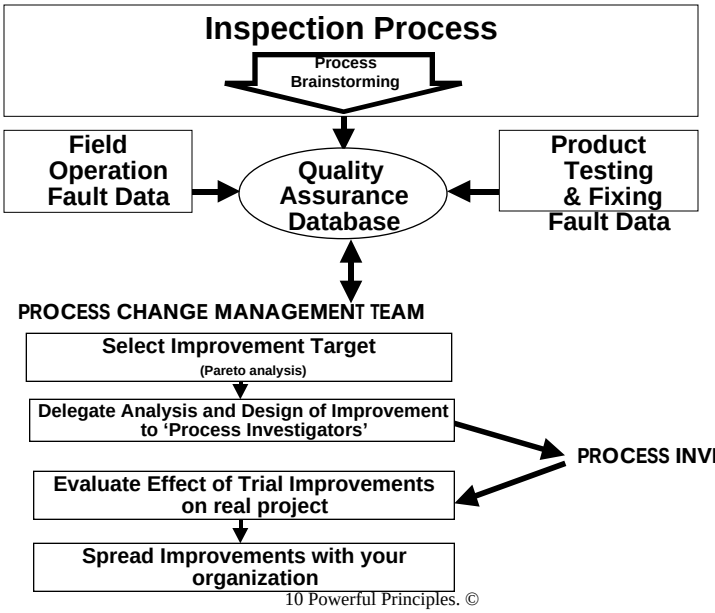

10 Powerful Principles. © Gilb@acm.org, 2000

See 'Software Inspection' Chapters 7 and 17 for detail.

The Process Brainstorming Aftermath

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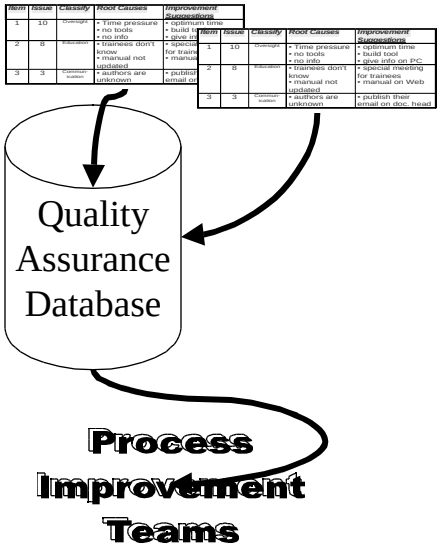
Process Brainstorming

- **Brainstormed suggestions**
  - **Are input to Process Improvement Teams.**
  - **Are part of the inputs**
    - **& cost of defect data**
    - **& frequency of defect.**
  - **PB Insights are**
    - **Accurate**
    - **Decentralized**
    - **Real time**
    - **Socially acceptable**
    - **Proven (Mays) to work better than centralized efforts (Fagan's Method 1973)**



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8. Persistence

- Years of persistence are necessary to change a culture.
- W. Edwards Deming
  - It takes 2-3 years to change a project, and a generation to change a culture
- Piet Hein (Denmark)
  - Things Take Time (TTT)

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1 $ $ $

IBM®

Secrets of Software Quality

Software Quality Week

Craig Kaplan, Ph.D.

ckaplan@iqco.com

I.Q. Company

http:\\www.iqco.com

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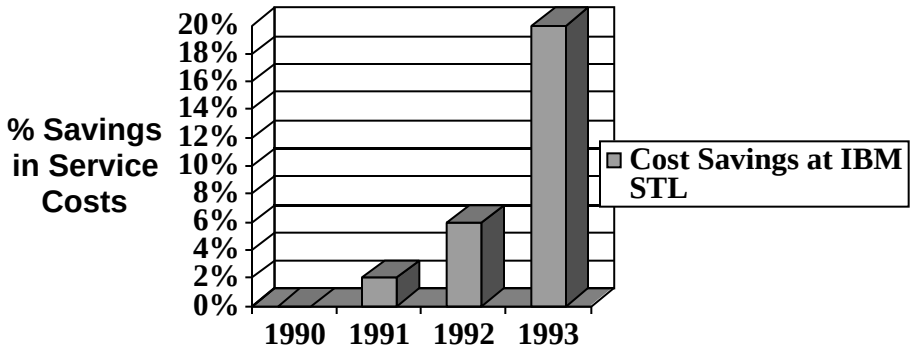
20% Savings on Service Costs
Note the 4 year time perspective.



10 Powerful Principles. ©
Source: Secrets of Software Quality by Kaplan, Clark, & Tang (McGraw-Hill 1995)

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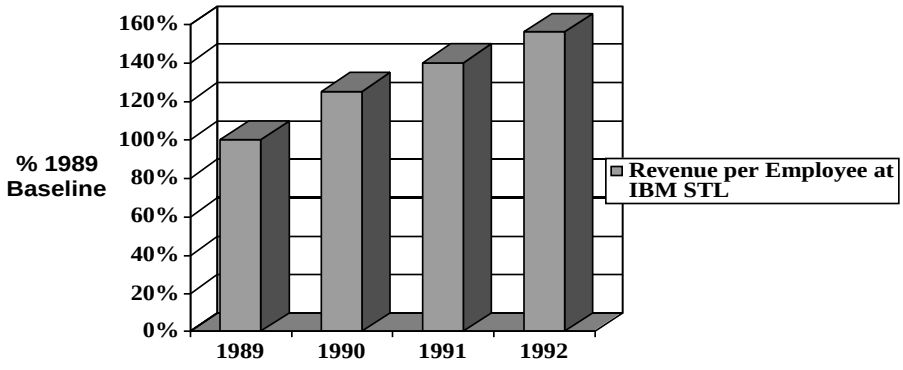
56% Increase in
Revenue per Employee



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Source: Secrets of Software Quality by Kaplan, Clark, & Tang (McGraw-Hill 1995)

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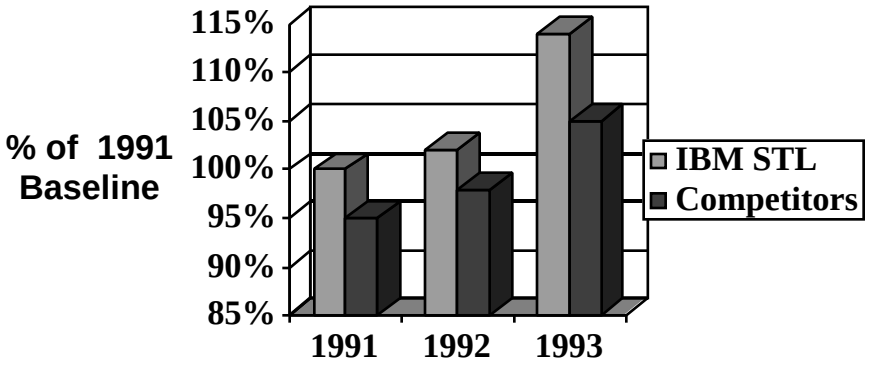
14% Improvement in Customer Satisfaction



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Source: Secrets of Software Quality by Kaplan, Clark, & Tang (McGraw-Hill 1995)

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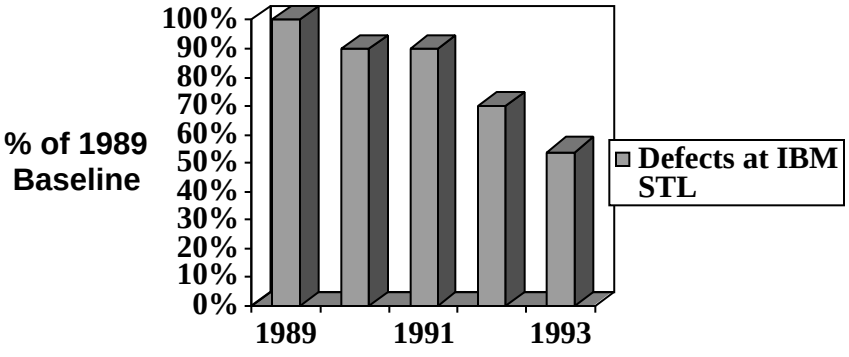
46% Reduction in Field Defects



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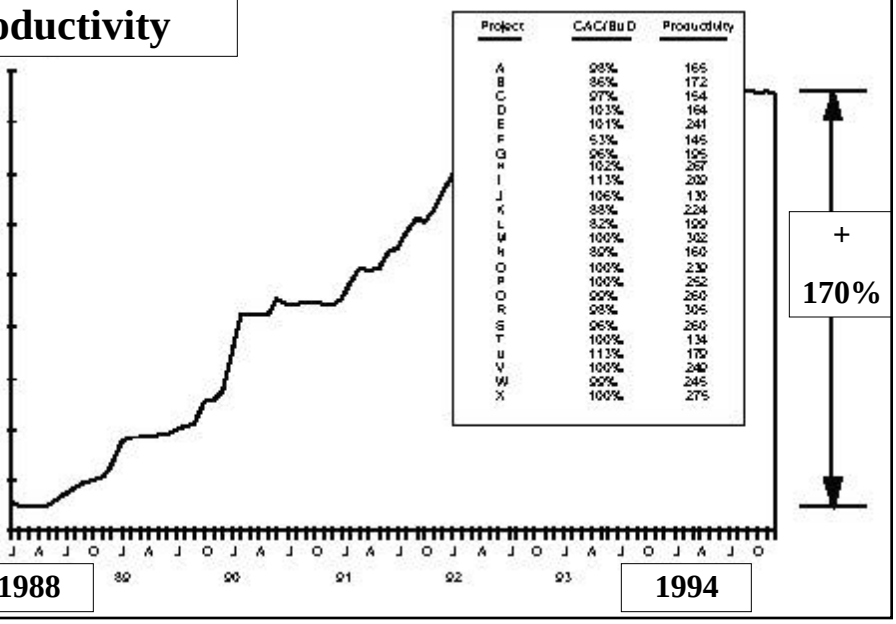
Source: Secrets of Software Quality by Kaplan, Clark, & Tang (McGraw-Hill 1995)

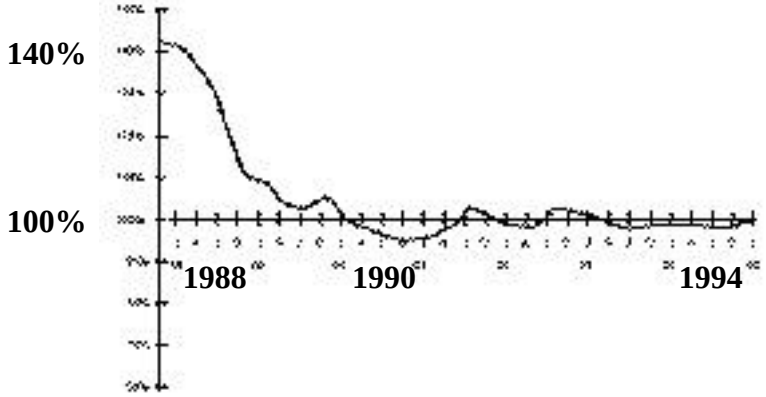
Raytheon 95 Software Productivity 2.7X better.
Note the 5 years to peak time perspective.

Productivity

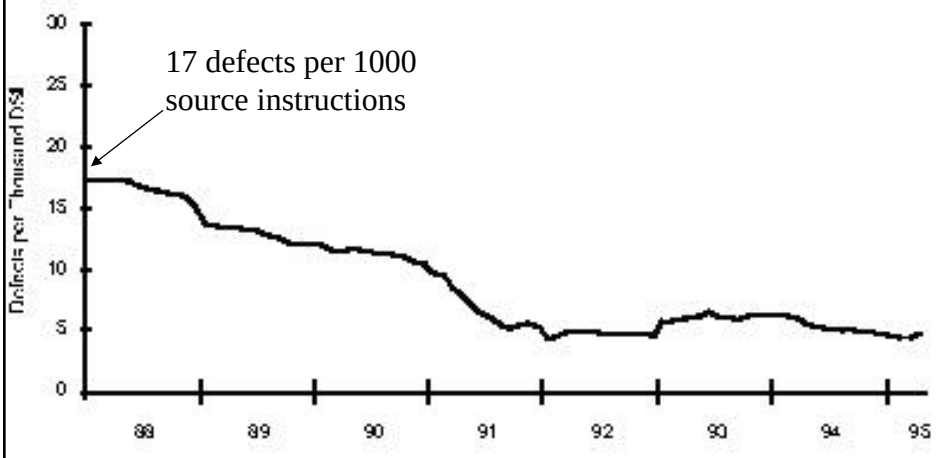


Achieving Project Predictability: Raytheon 95:
This miracle took almost 2 years

Cost At Completion / Budget %



Overall Product Quality: Raytheon 95
Defect Density Versus Time: 3 times better.
This took about 4 years.



Source:http://www.sei.cmu.edu/products/publications/95.reports/95.tr.017.html

9. Multiple Impacts

- Any method you choose will have multiple quality and cost impacts, whether you like them or not!
  - We need to estimate all impacts on our objectives
  - We need to reduce or accept negative impacts
  - We must avoid simplistic one-dimensional arguments

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Single next Step Comparison Table
Evaluating multiple impact to decide which step to deliver first.

	Next-Step Candidate **A**: {Design-X, Function-Y}	Next-Step Candidate **B:** {Design Z, Design F}
Reliability 99%-99.9%	**50%**	100%
Performance 11sec.-1 sec.	**80%**	30%
Usability 30 min.-30 sec.	**-10%**	20%
Capital Cost 1 mill.	**20%**	5%
Engineering Hours 10,000	**2%**	10%
Performance/Capital Cost Ratio	80/20= *4.0*	30/5= *6.0*
Quality/Cost Ratio	**120/22=5.46**	150/15=**10.00**

For written details of Impact Estimation method: see Competitive Engineering, free at www.result-planning.org and available from Addison Wesley

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Risk Analysis for each Step
Which is 'best' when risk is considered, on multiple qualities and costs?

	Step Candidate A: {Design-X, Function-Y}	**Step Candidate B: {Design Z, Design F}**
Reliability 99%-99.9%	**50% ±50%**	**100% ±20%**
Performance 11sec.-1 sec.	**80% ±40%**	**30% ±50%**
Usability 30 min.-30 sec.	**-10% ±20%**	**20% ±15%**
Capital Cost 1 mill.	**20% ±1%**	**5% ±2%**
Engineering Hours 10,000	**2% ±1%**	**10% ±2.5%**
Worst Case B/C ratio (1 to 3)	**(0+40-30)/(21+3) =*0.42***	**(80-20+5)/(7+12.5) =*3.33***
Best Case B/C ratio	**(100+120+10)/(19+1) = 11.5**	**(120+80+35)/(3+7.5)= 22.38**

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Step Choice with 'Credibility'

Evaluating multiple impacts with respect to experience spread and evidence credibility.

	Step Candidate **A**: {Design-X, Function-Y}	Step Candidate **B:** {Design Z, Design F}
Reliability 99%-99.9%	50% ±50%	100% ±20%
Performance 11sec.-1 sec.	80% ±40%	30% ±50%
Usability 30 min.-30 sec.	-10% ±20%	20% ±15%
Capital Cost 1 mill.	20% ±1%	5% ±2%
Engineering Hours 10,000	2% ±1%	10% ±2.5%
Worst Case B/C ratio	(0+40-30)/(21+3) =**0.42**	(80-20+5)/(7+12.5) = **3.33**
"Worst Worst" case considering estimate credibility factor	0.8 x 0.42= **0.33**	0.2 x 3.33= **0.67**

A's Credibility=0.8 (High)

B's Credibility=0.2 (Low)

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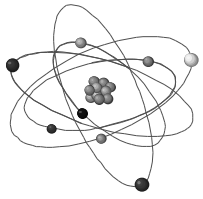
10. Results Orientation

- You must keep your focus on the essential results, and never fall victim to the means.
- *"Perfection of means and confusion of ends seem to characterize our age"*
  – *Albert Einstein.*



Software Engineering Productivity Study

- An example of setting objectives for process improvement
- For 1997 Multinational Electronics Company with 70% software labor development content in products
  -

Levels of objectives.

- **1. Fundamental Objectives (above us)**
- **2. Generic Constraints (our given framework)**
  - Political Practical
  - Design Strategy Formulation Constraints
  - Quality of Organization Constraints
  - Cost/Time/Resource Constraints
- **3. Strategic Objectives (objectives at our level)**
- **4. Means Objectives:** (*supporting* our objectives)

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Strategic Objectives

- Support the Fundamental Objectives (Profit, survival)
  - Software Productivity: Lines of Code Generation Ability
  - Lead-Time:
  - Predictability.
  - TTMP: Predictability of Time To Market:
  - Product Attributes:
  - Customer Satisfaction:
  - Profitability:

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Predictability of Time To Market: A sample strategic objective

- **TTMP: Predictability of Time To Market:**
  - » *Gist: From Ideas created to customers can use it. Our ability to meet agreed specified customer and self-determined targets.*
- **Scale: % overrun of actual Project Time compared to planned Project Time**
  - **Project Time: Defined:** time from the date of Toll-Gate 0 passed, or other Defined Start Event, to, the Planned- or Actually- delivered Date of All [Specified Requirements], and any set of agreed requirements.
  - **Specified Requirements: Defined:** written approved Quality requirements for products with respect to Planned levels and qualifiers [when, where, conditions].
    And, other requirements such as function, constraints and costs.
- **Meter: Productivity Project or Process Owner will collect data from all projects, or make estimates and put them in the Productivity Database for reporting this number.**
- **Past [1994, A-package] < 50% to 100%> <- Palli K. guess.**
  [1994, B-package] 80% ?? <- Urban Fagerstedt and Palli K. guess
- **Record [IBM Federal Systems Division, 1976-80] 0%**
  <- RDM 9.0 quoting Harlan Mills in IBM SJ 4-80
- ***"all projects on time and under budget"***
- **[Raytheon Defense Electronics, 1992-5] 0% <- RDE SEI Report 1995 Predictability.**
- **Must [All future projects, from 1999] 5% or less <- discussion level TG**
- **Plan [All future projects, from 1999] 0% or less <- discussion level TG**

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Means Objectives:

- **Support the Strategic Objectives**
  - **Complaints:**
  - **Feature Production:**
  - **Rework Costs:**
  - **Installation Ability:**
  - **Service Costs:**
  - **Training Costs:**
  - **Specification Defectiveness:**
  - **Specification Quality:**
  - **Improvement ROI:**

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Complaints:
a sample 'means' objective

- **Complaints:**
  - *"Customer complaint rate to us"*
- *Gist:*
  - Means Goal: for Customer Satisfaction (Strategic).
- Scale: number of complaints per customer in [defined time into <operation>]
- Past [Syracuse Project , 1997] ?? <bad> <- ML
- Plan [Long term, software component, in first 6 months in Operation] zero complaints <- R PROJECT 96 1.1 b
- "zero complaints on software features"

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Strategies
Intended to impact strategic objectives

- **(means to achieve objectives)**
- **Evo [Product development]:(serious)**
- **DPP [Product Development Process]: Defect Prevention Process.**
- **Inspection?**
- **Motivation.Stress-Management-AOL**
- **Motivation.Carrot**
- **DBS**
- **Automated Code Generation**
- **Requirement -Tracability**
- **Competence Management**
- **Delete-Unnecessary -Documents**
- **Manager Reward:?**
- **Team Ownership:?**
- **Manager Ownership:?**

- **Training:?**
- **Clear Common Objectives:**
- **Application Engineering area:**
- **Brainstormed List (not evaluated or prioritized yet)?**
- **Requirements Engineering:**
- **Brainstormed Suggestions?**
- **Engineering Planning:**
- **Process Best Practices: (silly)**
- **Brainstormed Suggestions?**
- **Push Button Deployment:**
- **Architecture Best Practices:**
- **Stabilization:**
- **World-wide Co-operation?**

A mixture of silly and serious strategies! 2 examples given.

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US Army Example: PERSINSCOM

STRATEGIES ➔ OBJECTIVES	Technology Investment	Business Practices	People	Empow-erment	Principles of IMA Management	Business Process Re-engineering	SUM
Customer Service ?➔0 Violation of agreement	50%	10%	5%	5%	5%	60%	185%
Availability 90% ➔ 99.5% Up time	50%	5%	5-10%	0	0	200%	265%
Usability 200 ➔ 60 Requests by Users	50%	5-10%	5-10%	50%	0	10%	130%
Responsiveness 70% ➔ ECP's on time	50%	10%	90%	25%	5%	50%	180%
Productivity 3:1 Return on Investment	45%	60%	10%	35%	100%	53%	303%
Morale 72 ➔ 60 per mo. Sick Leave	50%	5%	75%	45%	15%	61%	251%
Data Integrity 88% ➔ 97% Data Error %	42%	10%	25%	5%	70%	25%	177%
Technology Adaptability 75% Adapt Technology	5%	30%	5%	60%	0	60%	160%
Requirement Adaptability ? ➔ 2.6% Adapt to Change	80%	20%	60%	75%	20%	5%	260%
Resource Adaptability 2.1M ➔ ? Resource Change	10%	80%	5%	50%	50%	75%	270%
Cost Reduction FADS ➔ 30% Total Funding	50%	40%	10%	40%	50%	50%	240%
SUM IMPACT FOR EACH SOLUTION	***482%***	***280%***	***305%***	***390%***	***315%***	***649%***	
Money % of total budget	15%	4%	3%	4%	6%	4%	
Time % total work months/year	15%	15%	20%	10%	20%	18%	
SUM RESOURCES **BENEFIT/RESOURCES RATIO**	***30*** **16:1**	***19*** **14:7**	***23*** **13:3**	***14*** **27:9**	***26*** **12:1**	***22*** **29:5**	

Sample of Objectives/Strategy definitions

- *Example of one of the Objectives:*

Customer Service:

Gist: Improve customer perception of quality of service provided.

Scale: Violations of Customer Agreement per Month.

Meter: Log of Violations.

Past [1991] Unknown Number ←State of PERSCOM Management Review

Record [NARDAC] 0 ? ← NARDAC Reports 1991

Must : <better than Past, Unknown number> ←CG

Plan [1991, PERSINCOM] 0 "Go for the Record" ← Group SWAG

Technology Investment:

Exploit investment in high return technology.

Impacts: productivity, customer service and conserves resources.

- *An example of one of the strategies defined.*

The summary principle

Motivate people

towards real results

by giving them numeric feedback frequently

and the ability to change anything for success.

Arigato

- Sayonara
- Tom San