Watts Humphrey

A tribute to the Father of Software Quality

SQGNE
Software Quality Group of New England

1927-2010

Slide 1

Biography

- **Born with dyslexia and failed first grade. Eventually graduated as Valedictorian HS Class**
- **1953 – came to Boston work for Sylvania designing circuits**
- **1959 – joined IBM initially as a HW architect. Eventually became VP Technical Development where he oversaw 4,000 engineers in 15 development labs over 7 countries**
- **Many people influenced his thinking during this time…**
  - **Fred Brooks** (Mythical Man-Month)
  - **Barry Boehm** (Economics of Software, Spiral Model)
  - **Michael Fagan** (Formal Inspection process)
  - **Harlan Mills** (Chief Programmer Teams and Cleanroom)
  - **Gerry Weinberg** (Psychology of Computer Programming)

Slide 2

Biography

- **1986 – after retiring from IBM, joins the newly formed Software Engineering Institute at Carnegie Mellon where he makes "outrageous commitment" to change world of software development by developing sound management principles.**
- **SEI had a DOD contract to "Provide guidance to the military services in selecting capable software contractors" (1)**
- **This work evolved to the Capability Maturity Model (CMM) for software and now to the CMM Integrated (CMMI)**

Software Engineering Institute | Carnegie Mellon

(1) "A method for assessing the software engineering capability of contractors," SEI Technical Report SEI-87-TR-23, September 1987

Slide 3

Awards and Honors

- **2003 – National Medal of Technology**
  - For his contributions to the field of software engineering

- **1995 - Named as first SEI Fellow**

Software Engineering Institute | Carnegie Mellon

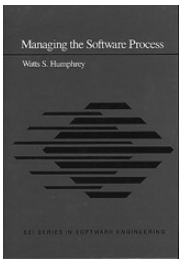
- **2009 – Named an ACM Fellow**
  - For his outstanding accomplishments in computing and information technology

- **Honorary doctorate of software engineering from Embry Riddle Aeronautical University**

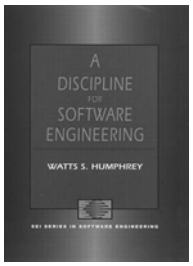
EMBRY-RIDDLE Aeronautical University

Slide 4

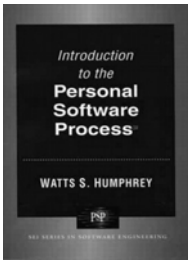
Books



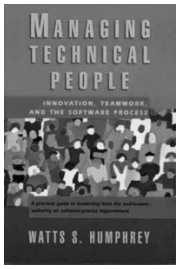
1989 - Managing the Software Process



1995 - A Discipline for Software Engineering



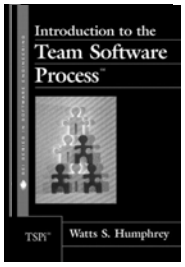
1996 - Introduction to the Personal Software Process



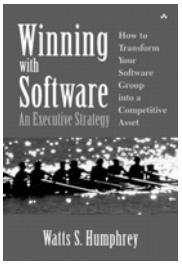
1997 - Managing Technical People - Innovation, Teamwork and Software Process

Slide 5

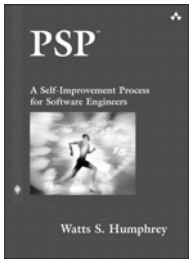
Books



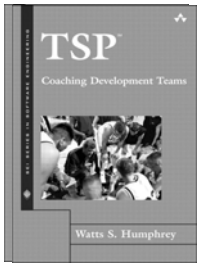
1999 -Introduction to the Team Software Process



2001 - Winning with Software: An Executive Strategy



2005 –PSP - A Self-Improvement Process for Software Engineers

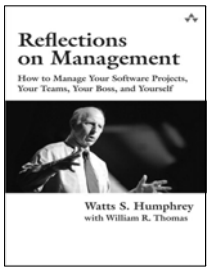


2006 – TSP Coaching Development Teams

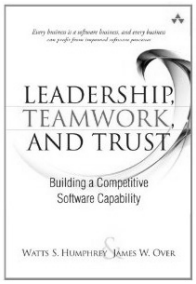
Slide 6

Books

2006 -TSP Leading a Development Team



2010 - Reflections on Management: How to Manage Your Software Projects, Your Teams, Your Boss, and Yourself

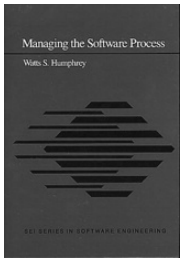


2011 - Leadership, Teamwork, and Trust: Building a Competitive Software Capability

Slide 7

Managing the Software Process

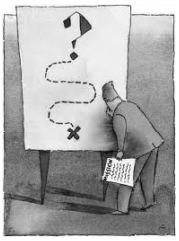
- **Evolved from project to "Provide guidance to military services in selecting capable software contractors"**
- **Describes "technical and managerial topics assessments found most critical for improvement."**
- **Roots in work of Demming and Juran**
  - **Statistical process control**
- **Foundation for CMM**



(1) "A method for assessing the software engineering capability of contractors," SEI Technical Report SEI-87-TR-23, September 1987

Slide 8

Managing the Software Process



- **Asks three questions:**
  - **How good is my current software process?**
  - **What must I do to improve it?**
  - **Where do I start?**
  - **"If you don't know where you are a map won't help."**
- **Basic Principles of Software Process Change**
  - **Major changes to software process must start at the top**
  - **Ultimately, everyone must be involved**
  - **Effective change requires a goal and knowledge of current process**
  - **Change is continuous**
  - **Software process changes will not be retained without conscious effort and periodic reinforcement**
  - **Software process improvement requires investment**

Slide 9

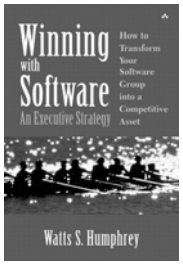
Managing the Software Process

- **Goals of Software Quality Assurance:**
  - **To improve software quality by appropriately monitoring both the software and the development process that produced it**
  - **To ensure full compliance with the established standards and procedures for the software and the software process**
  - **To ensure that inadequacies in product, process, or standards are brought to management's attention so they can be fixed**

Slide 10

Winning With Software

- **Why Executives should insist that software quality be measured and managed:**
  - **Poor quality software can cause major property damage and even kill people**
  - **Quality work saves time and money**
  - **If you don't manage software quality, nobody else will**
- **Identified most common causes of project failure**
  - **Unrealistic schedules**
  - **Inappropriate staffing**
  - **Changing requirements**
  - **Poor quality work**
  - **Believing in magic**



Slide 11

The Quality Attitude

- **Even though current industrial-quality software has many defects, quality has not been an important customer concern.**
- **This is because even software with many defects works.**
- **Having right attitude can make an enormous difference.**

Humphrey, W., "The Quality Attitude", news@sei, Number 3, 2004

Slide 12

The Quality Attitude

- **We must change the way we think about quality.**
- **Every developer must view quality as a personal responsibility and strive to make every product element defect free.**
- **There is growing evidence that defect free software is possible.**

Humphrey, W., "The Quality Attitude", news@sei, Number 3, 2004

Slide 13

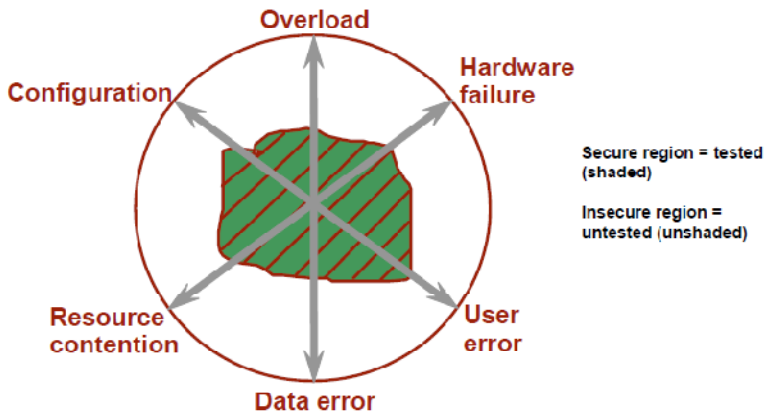
The Quality Attitude

- **Some development groups are now producing reasonably large-scale software products that have had no defects found by users.**
- **While these products may actually have latent defects, for all practical purposes, they are defect free.**
- **Today, a few development teams can consistently produce such software.**

Humphrey, W., "The Quality Attitude", news@sei, Number 3, 2004

Slide 14

The Quality Attitude



Testing Footprint

Humphrey, W., "The Quality Attitude", news@sei, Number 3, 2004

Slide 15

Defect Injection Rate Study

- **An analysis of data from over 8,000 programs written by 810 experienced software engineers found that:**

Group	Avg. no. defects injected per (KLOC)
All	120.8 (~ 1 defect per 8 LOC)
Upper Quartile	61.9
Upper 10%	28.9
Upper 1%	11.2

- **Usually about 95% of these defects are found prior to release.**
- **Software is released with some known defects and a significant number of unknown defects.**

Humphrey, W., "The Quality Attitude", news@sei, Number 3, 2004

Slide 16

Defect Injection Rate Study

- **One million LOC = 1,000 KLOCs**
  - **Avg. defect injection rate of 120 defects/KLOC**
  - **120,000 defects injected**
  - **Assume 95% found = 114,000 defects found**

- **Unknown defects = defects injected – defects found**
  = (120,000 – 114,000)
  = 6,000

- **"So, the first required attitude change for software professionals and their managers is to accept the fact that testing alone will not produce quality software systems. Also, since defective software cannot be secure, testing alone won't produce secure systems either."**

Humphrey, W., "The Quality Attitude", news@sei, Number 3, 2004

Slide 17

CMM Defined 5 Levels

#	Level	Focus	Key process areas
5	Optimizing	Continuous process improvement	•Defect prevention •Technology change management •Process change management
4	Managed	Process and product quality	•Quantitative process management •Software quality management
3	Defined	Engineering process	•Organizational process focus •Organizational process definition •Training program •Integrated software management •Software product engineering •Intergroup coordination •Peer reviews
2	Repeatable	Project management	•Requirements management •Software project planning •Software project tracking •Subcontractor management •Software quality assurance •Software configuration management
1	Initial		

Slide 18

Key Contributions

1. **Established a repeatable and managed way of assessing (measuring) software development processes**
2. **Gave management a mechanism to identify <u>what to do</u> and <u>how to do it</u>**
3. **Guidance on where to start (KPAs)**
4. **Focus on data and how to use it**
5. **Promoted the use of PDCA / PDSA**

Slide 19

Success of CMM Opened Doors

- **Appointment as SEI Fellow**
- **Allowed him to work on anything he wanted**
- **Watts' response: "I've always believed we can provide statistical control to what the individual software engineer does."**

Software Engineering Institute | Carnegie Mellon

Slide 20

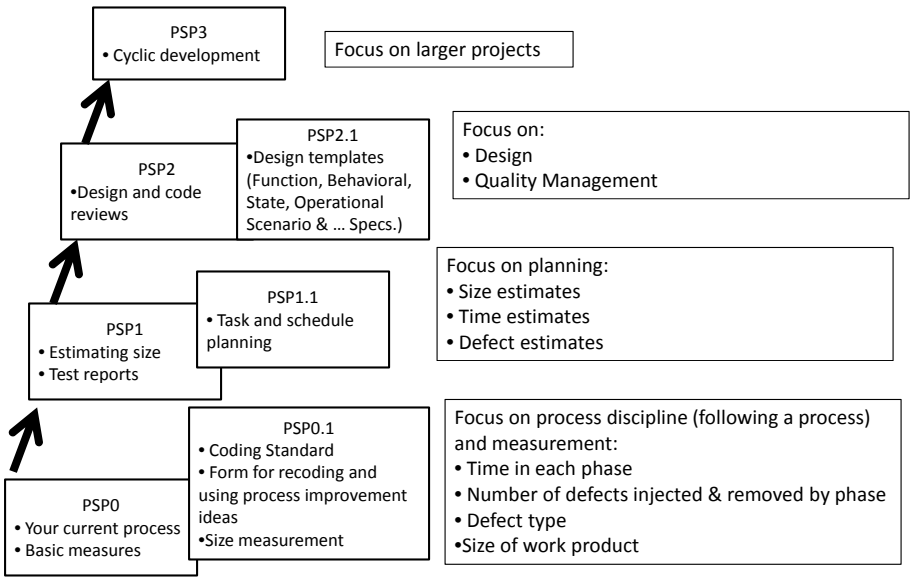
Personal Software Process (PSP)

- **Set of scripts, methods and tools, that allow the individual engineer to produce a product**
  - **On time**
  - **On budget**
  - **At a defined quality level**
- **Show the value of the scripts, methods and tools as they are being learned and applied**

Software Engineering Institute | Carnegie Mellon

Slide 21

PSP has 3 "levels" each adds a different focus



Slide 22

Scripts

- **Instructions on what to do**
  - **Inputs required**
  - **Tasks**
    - **Planning**
    - **Development**
      - Design
      - Design review
      - Code
      - Code review
      - ...
    - **Postmortem**
  - **Exit criteria**

Slide 23

Example of a Method

- **PROBE (PROxy Based Estimating) for size and resource (time) estimates**
  - **A high level (conceptual) design is made**
  - **Each design element is classified**
    - **Size: VS, S, M, L, VL**
    - **Type: Calculation, I/O, Logic, ...**
  - **For each new design element, something similar (a Proxy) is selected from your historical database**
  - **The size and time data of the Proxies are summed up to form the size and time estimates for the project**
- **Upon completion of the project**
  - **The size and type information is entered into the historical database for future use**

Slide 24

Tools

- **Written scripts**
- **Forms and spreadsheets to record data**
- **Templates to record designs**
- **Defect classification scheme based on ODC**
- **Checklists**
  - **Reviews: Design and Code**
- **Requirements for programs to calculate LOC and perform statistical analysis of the data**

Slide 25

Scaled down versions of activities used on large projects

#	Level	Focus	Key process areas
5	Optimizing	Continuous process improvement	•**Defect prevention** •**Technology change management** •**Process change management**
4	Managed	Process and product quality	•**Quantitative process management** •**Software quality management**
3	Defined	Engineering process	•**Organizational process focus** •**Organizational process definition** •Training program •**Integrated software management** •**Software product engineering** •Intergroup coordination •**Peer reviews**
2	Repeatable	Project management	•Requirements management •**Software project planning** •**Software project tracking** •Subcontractor management •Software quality assurance •Software configuration management

Slide 26

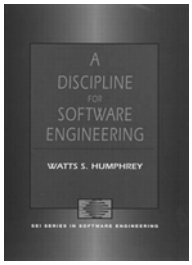
Key Contribution

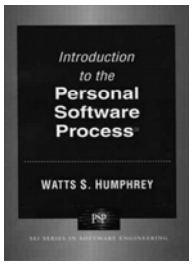
- **"In God we trust, all others bring data."**
  W. Edwards Deming
- **The PSP helps the individual engineer get the data and therefore accomplish statistical process control**
- **"I've always believed we can provide statistical control to what the individual software engineer does."**
  Watts Humphrey

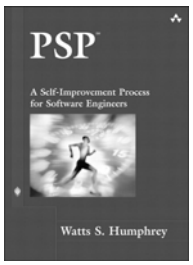
Slide 27

PSP Books

- **1995 - *A Discipline for Software Engineering***
- **1996 - *Introduction to the Personal Software Process***
- **2005 - *PSP, A Self-Improvement Process for Software Engineers***







Slide 28

Enter Team Software Process (TSP)

- Most software projects are done by teams not individuals
- TSP is a process
  - Launch through design, implementation, testing and postmortem
  - Each phase is a PDSA

- TSP elements
  - Self directed team
  - Quality focus
  - Work Management
  - Team roles
- Prerequisite to TSP are PSP trained engineers

Slide 29

TSP Elements

Self Directed Teams

- Define own work processes
- Produce own plan
- Track and report on own work
- Share team management responsibilities

Quality Focus

- Team sets own quality goals
- Builds plans to achieve those goals
- Tracks actual against goal
  - Defects found per phase
  - Inspection examination rates
  - Defect densities: Compile and test
  - Yield of each phase

Slide 30

TSP Elements

Work Management

- **Plans**
  - Guides work, short term goals, focus
- **Data**
  - Labor hours
  - Tasks completed
  - Defects found - removed
- **Earned value**
- **Team meetings**

Team Roles

- **Leader (not manager or supervisor)**
- **Managers for**
  - Design
  - Customer interface
  - Implementation
  - Planning
  - Quality
  - Test
  - …

Slide 31

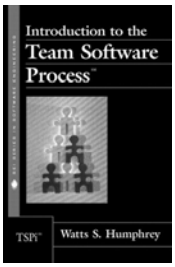
TSP Contributions

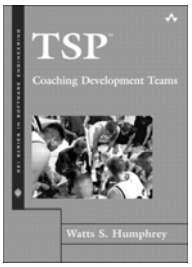
- **Integrated PSP trained engineers into teams**
- **Provided a clear framework for teams**
  - What roles are needed
  - Team responsibilities
    - Internally
    - To management
  - Process flow
  - What teams can (and should) expect from management
- **Data driven software development**
- **Defining a methodology to teach TSP**

Slide 32

TSP Books

1999 - *Introduction to the Team Software Process*
2006 - *TSP, Coaching Development Teams*
2006 - *TSP, Leading a Development Team*



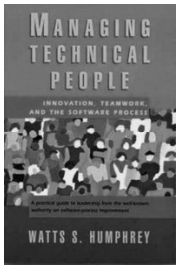


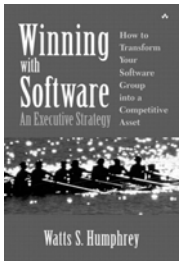
Slide 33

Key contribution: How to get management on board

1997- Managing Technical People - Innovation, Teamwork and Software Process

2001 - Winning with Software: An Executive Strategy





Slide 34

Skeptical? Some data…

Topic	Before TSP	With TSP
Deviation from schedule (average, range)	~33% -30% to + 150%	<10% -5% to + 23%
Test (system test) defect density (defects per KLOC)	1 to 8	0.1 to 1.1
SWAT and post release defect density (defects per KLOC)	0.2 to 0.9	0 to 0.35

Slide 35

Contribution Recap

- **CMM and CMMI: Management framework**
- **PSP: Individual Engineer**
- **TSP: Teams**

- **All integrated together to accomplish all the CMMI level 5 KPAs that apply to individuals and teams**

Slide 36

Thank You Watts!

1927-2010

Slide 37

SQGNE Software Quality Group of New England

SQGNE is made possible by the support of our sponsors:

ASQ Software Division

Oracle and
Sun Integrated Systems

Software Quality Consulting
consulting • training • auditing

Logo design: Sarah Cole Design

Welcome to our 17th season!

- An all-volunteer group with no membership dues!
- Supported entirely by our sponsors...
- Over 700+ members
- Monthly meetings - Sept to July on 2nd Wed of month
- E-mail list - contact John Pustaver **pustaver@ieee.org**
- **SQGNE Web site: www.sqgne.org**

Volunteers / Hosts / Mission

Officers and Volunteers

- John Pustaver – President and Founder
- Steve Rakitin – VP and Programs
- Gene Freyberger – Annual Survey
- Howie Dow – Treasurer
- Dawn Wu – Clerk and official Greeter

Our gracious Hosts:

- Paul Ratty – Board of Dir
- Tom Arakel
- Margaret Shinkle
- Jack Guilderson

Mission

- To promote use of engineering and management techniques that lead to delivery of high quality software
- To disseminate concepts and techniques related to software quality engineering and software engineering process
- To provide a forum for discussion of concepts and techniques related to software quality engineering and the software engineering process
- To provide networking opportunities for software quality professionals

ASQ Software Division

- Software Quality Live - for ASQ SW Div members...
- Software Quality Professional Journal www.asq.org/pub/sqp/
- CSQE Certification info at www.asq.org/software/getcertified
- SW Div info at www.asq.org/software

SQGNE 20010-11 Schedule

Speaker	Affiliation	Date	Topic
Steve and Howie Dow		9/8/10	Test your Testing Aptitude!
Stan Wrobel	CSC	10/13/10	CMM vs. Agile - Finding the right fit for your project
Capers Jones	SPR	11/10/10	Software Quality in 2010: A Survey of the State of the Art
Steve and Howie		12/8/10	A Tribute to Watts Humphrey – Father of SQA
Robin Goldsmith	GoPro Management	1/12/11	Add Steak to Exploratory Testing's Parlor Trick Sizzle
Rick Spiewak		2/9/11	A fundamental approach to improving software quality
Stephen P Berczuk		3/9/11	Build, SCM, and QA: Enablers for Agility
Johanna Rothman	Rothman & Assoc.	4/13/11	SQA in an agile environment
Linda McInnis		12/8/10	Career Paths for SQA Professionals
Marc Rene	MetLife Auto & Home	6/8/11	Maximizing the Value of Testing to the Business First Annual Election for SQGNE Board of Directors and At-large Members
Everyone		7/13/10	Annual Hot Topics Night...

Tonight's Speaker...

A Tribute to Watts Humphrey
The Father of Software Quality
Howie and Steve

The software engineering community has lost one of its most influential and charismatic leaders. On October 28 2010, Watts Humphrey passed away. Watts has been an inspiration to a generation of software engineers, many of whom considered Watts a mentor and a role model. He was a person with a unique gift - he was able to make software engineering understandable to managers and executives in a way that has led to significant changes in how software development is performed and how software quality is perceived.

Please join us as we pay tribute to the man the Software Engineering Institute calls the Father of Software Quality.