

# The Effectiveness Formula

A Quantitative measure of Organization Capability

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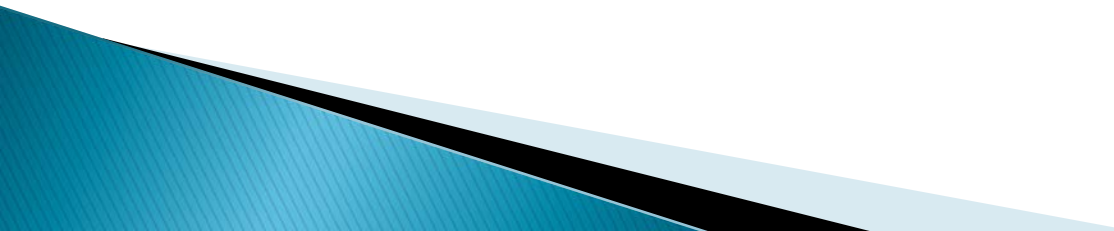
# Software Problems

- Unreliable
- Late delivery
- Modification costs prohibitive
- Impossible to maintain
- Inadequate performance
- Product exceeds budget costs

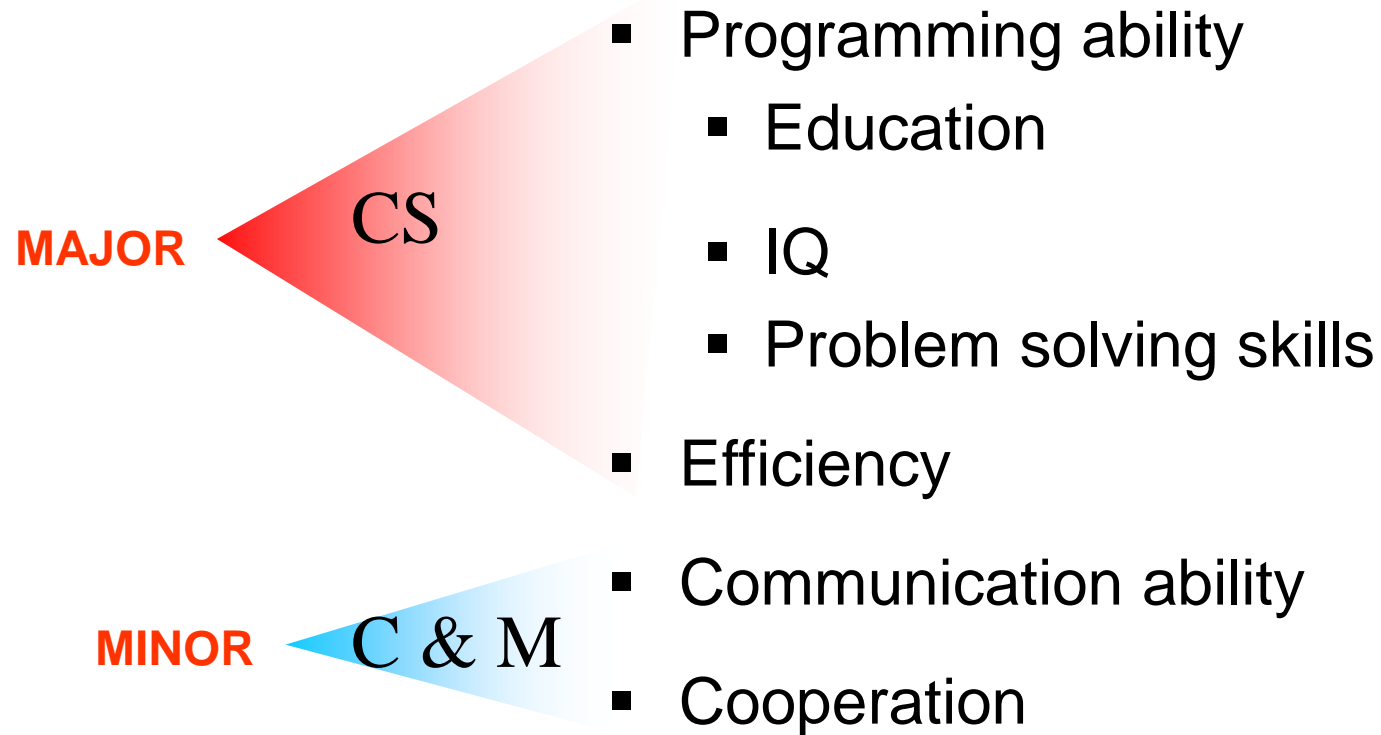


**1968** NATO CS Conference, Munich, Germany

# 1970 Development Environment

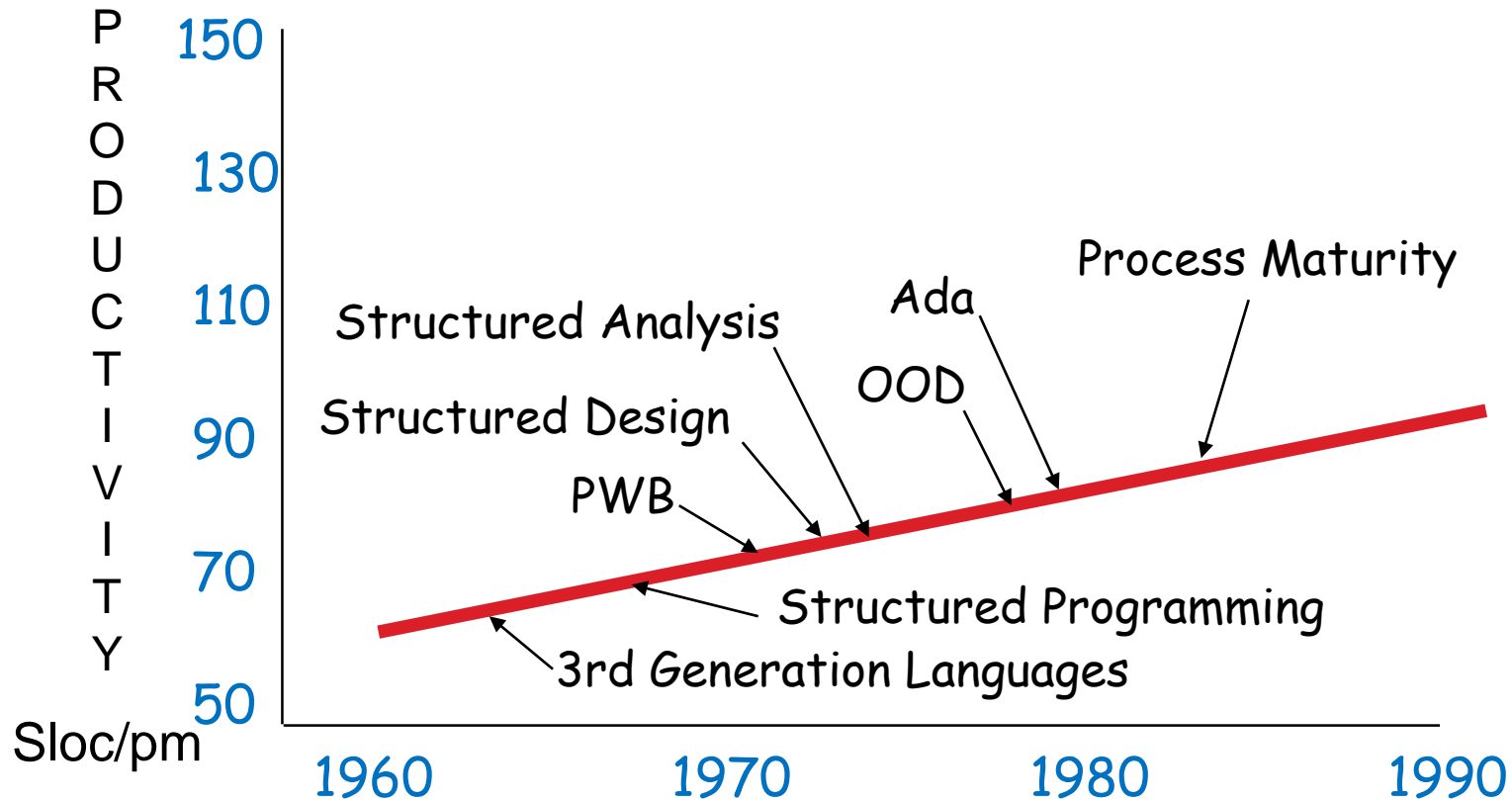
- Stable process
  - Intelligent, experienced, dedicated programmers
    - Ethic of workaholism
    - Sacrificed personal lives
    - Gulled into hopeless schedules
  - Stable environment
  - Advanced technologies
  - **2010 Environment identical except for technologies**
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# Traditional Capability Rating



Traditional data does not work for agile development environments

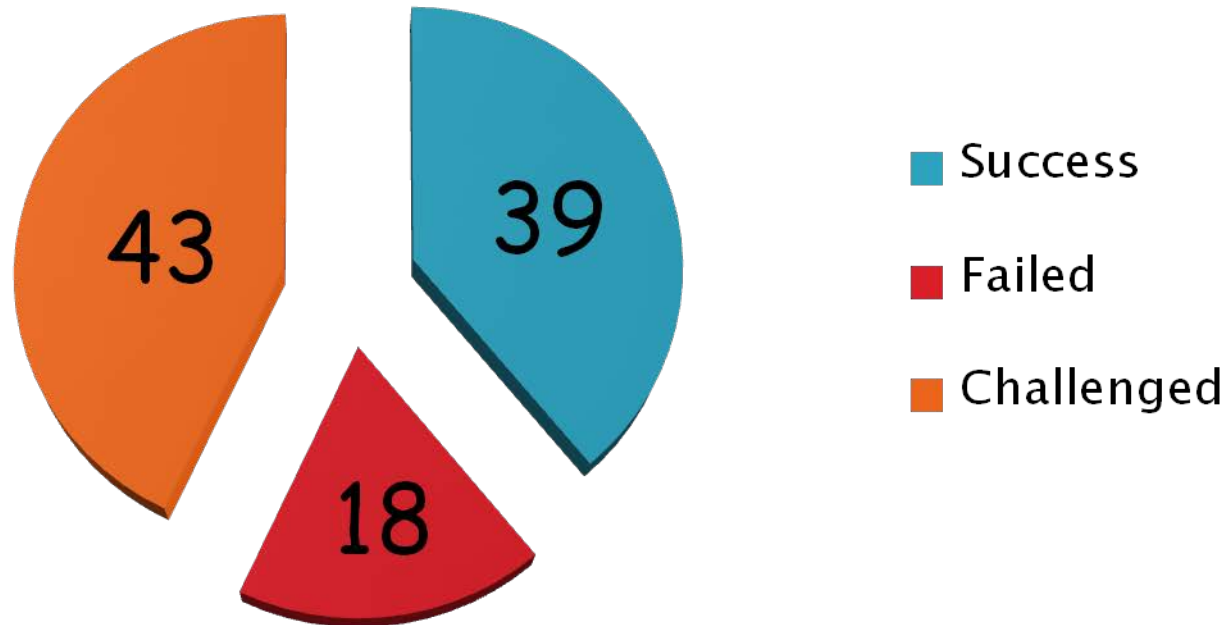
# Productivity Gains -- Technology



\* 1.5 SLOC/PM/Year productivity gain

# Chaos 2013 Software Project Survey

## Success Rate



# 1975 Pair Programming Pilot Study

- Real time system executive
- 30,000 Fortran source lines
- 6 software components
- 5 two-person teams plus manager
- Average productivity prior to study = 77 LPPM
- Pilot study productivity = **175 LPPM**
- Error rate **<0.1%** of norm

# Effective Capability Rating

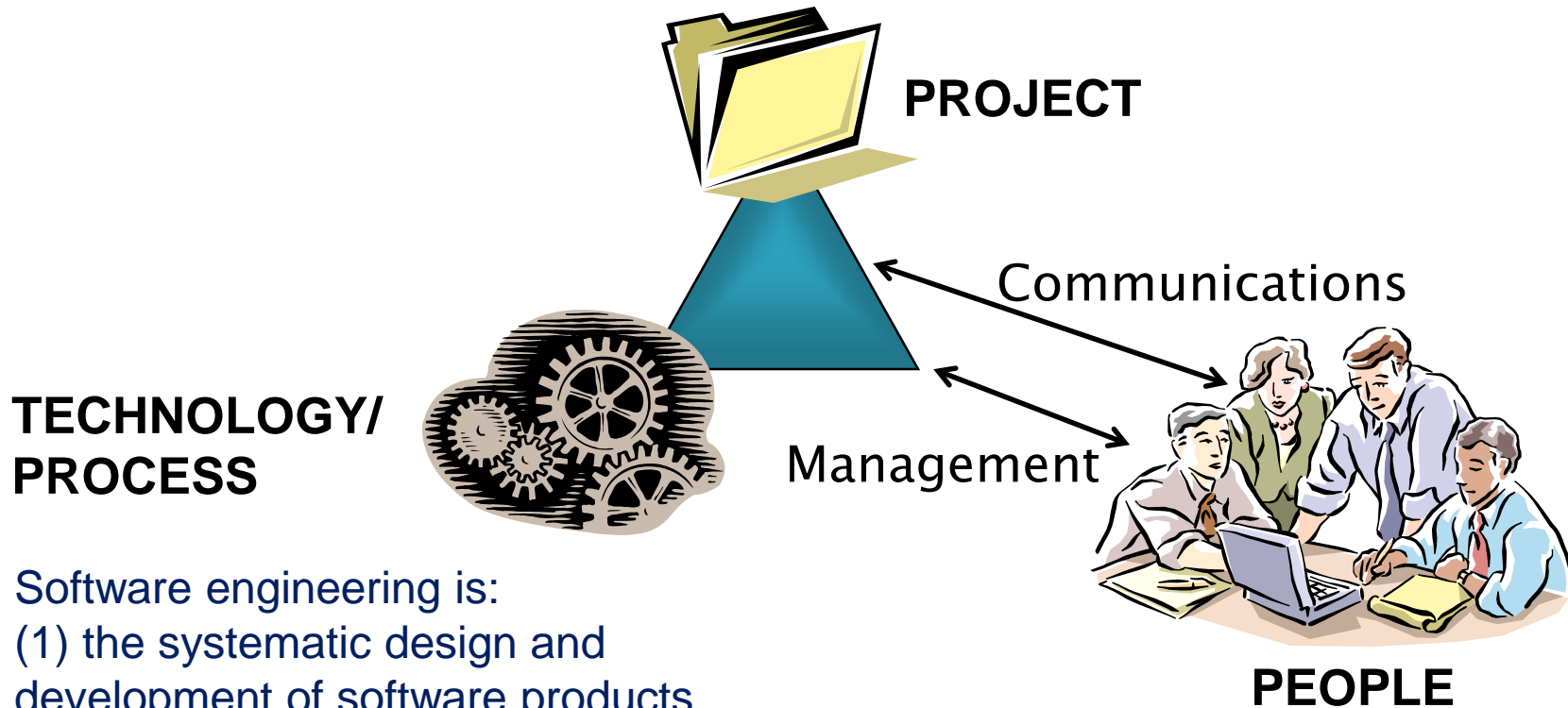
C & M

- Motivation
- Management style
- Use of team methods
  - Communication ability
  - Cooperation
- Hawthorne Effect
- Working environment
  - Noise level
  - Individual working (thinking) space
  - Proximity of team members

CS

- Problem solving skills
- Programming ability

# Three Dimensions of Management



Software engineering is:  
(1) the systematic design and development of software products  
(2) the management of the software process.

# Effectiveness Formula

$$E = C[M(CS)]$$

where

$E$  = Effectiveness

$C$  = Communication skills (0 – 1)

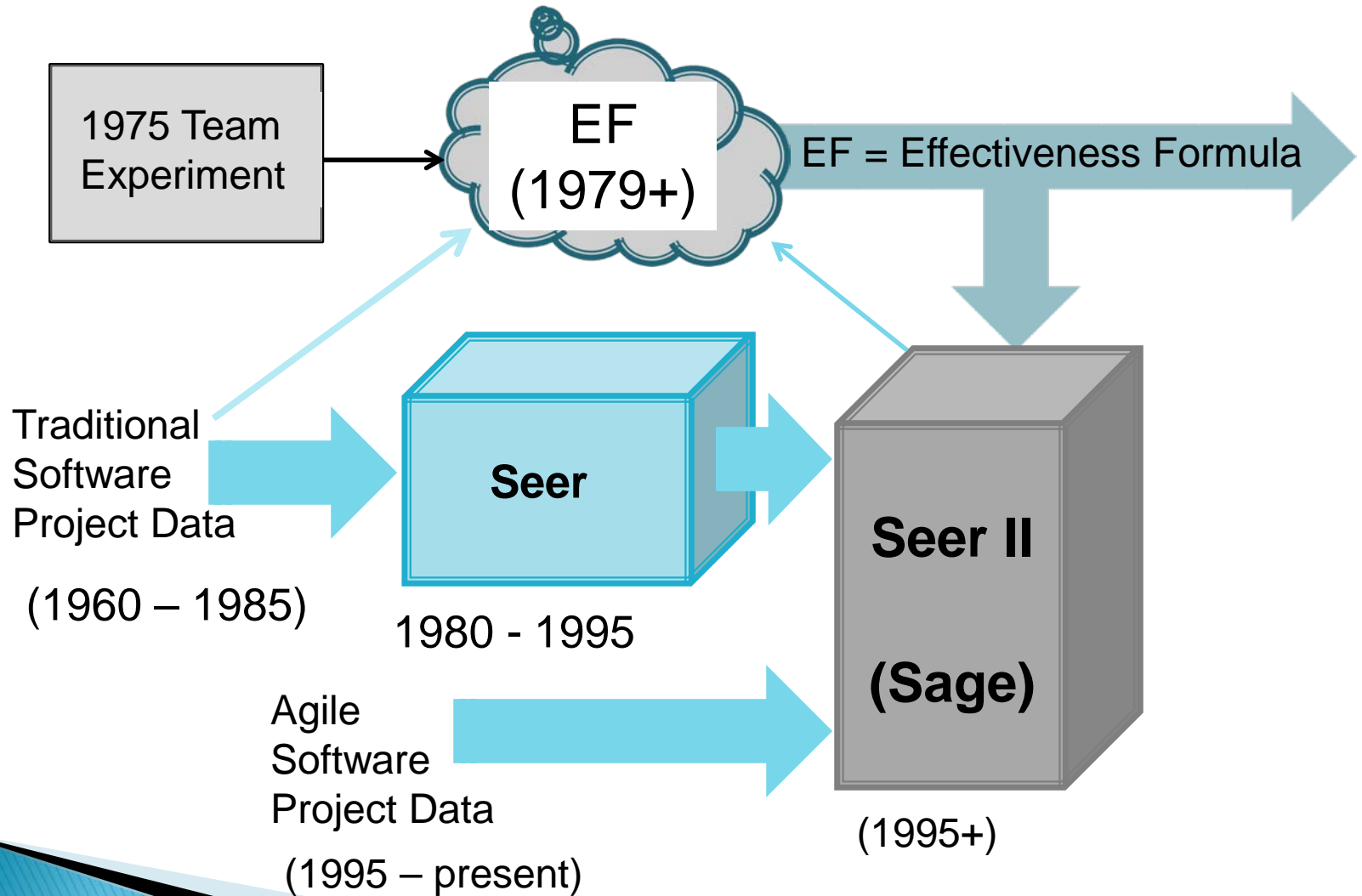
$M$  = Management concept awareness (0 – 1)

$CS$  = Computer science technical ability (0 – 1)



Jensen and Tonies, *Software Engineering*, PH, 1979

*Initial Goal: Development environment model*

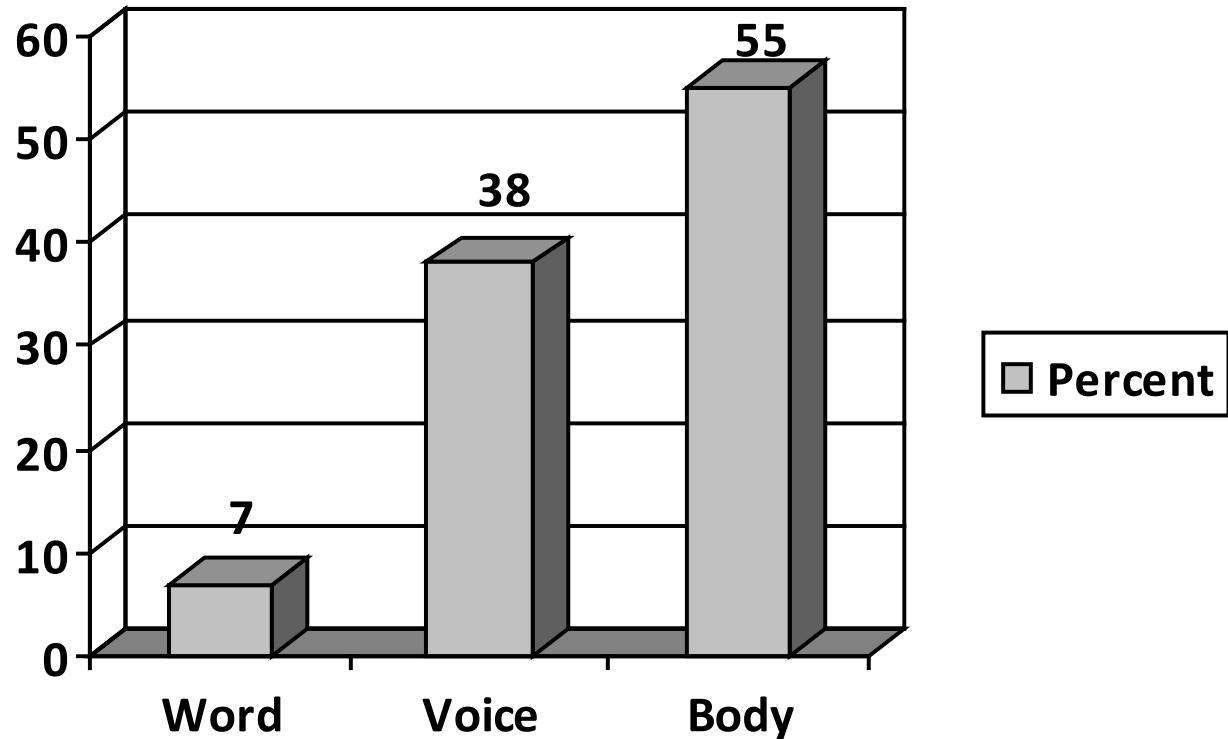
# Effectiveness Formula Evolution



# Capability Score Calculation

Ctb Calculation	
<b>ACAP</b>	1.00
AEXP	1.00
MODP	1.00
<b>PCAP</b>	1.00
RESP	1.00
TOOL	1.00
TURN	1.00
 Capability Score	0.23
 Percentile Rating	50%
Ctb	5,707

# Components of Communication



Mehrabian, A., and S.R. Ferris. "Inference of Attitudes from Nonverbal Communication in Two Channels." *Journal of Counseling Psychology*, Vol. 31, 1967.

# How Much Communication Here?



(0 – 1) scale

= 0.07!

# Does Management Matter?

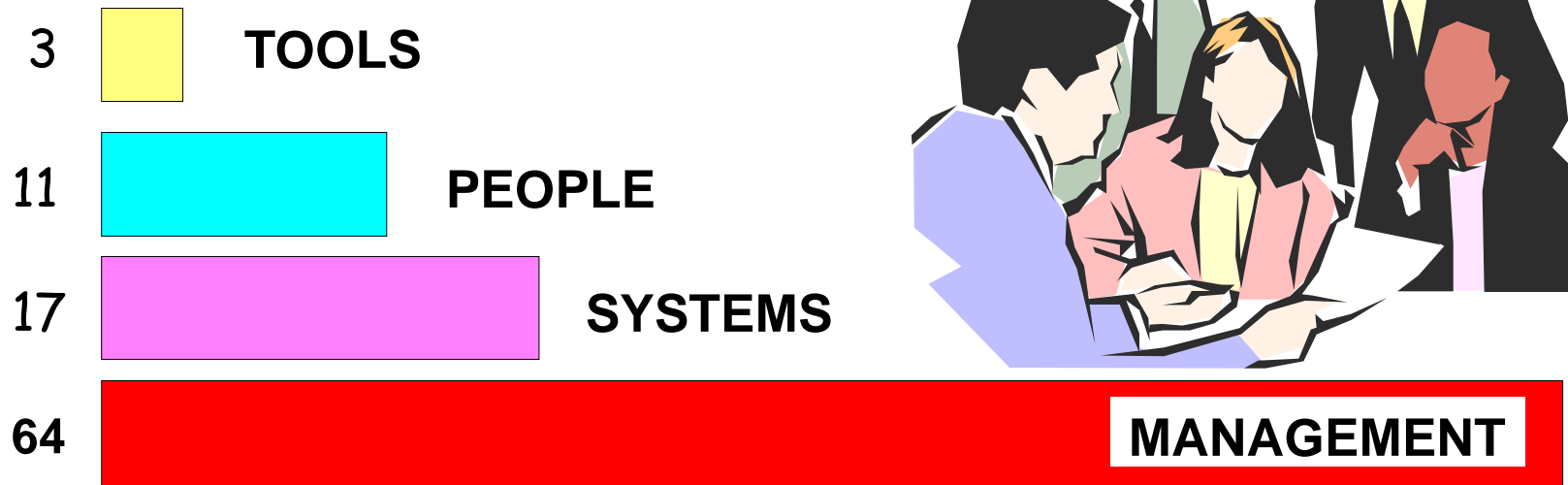
*Poor management can increase software costs more rapidly than any other factor...*

*Despite this cost variation, COCOMO does not include a factor for management quality, but instead provides estimates **which assume that the project will be well managed...***

B. Boehm, *Software Engineering Economics*, 1981, pg 486-7

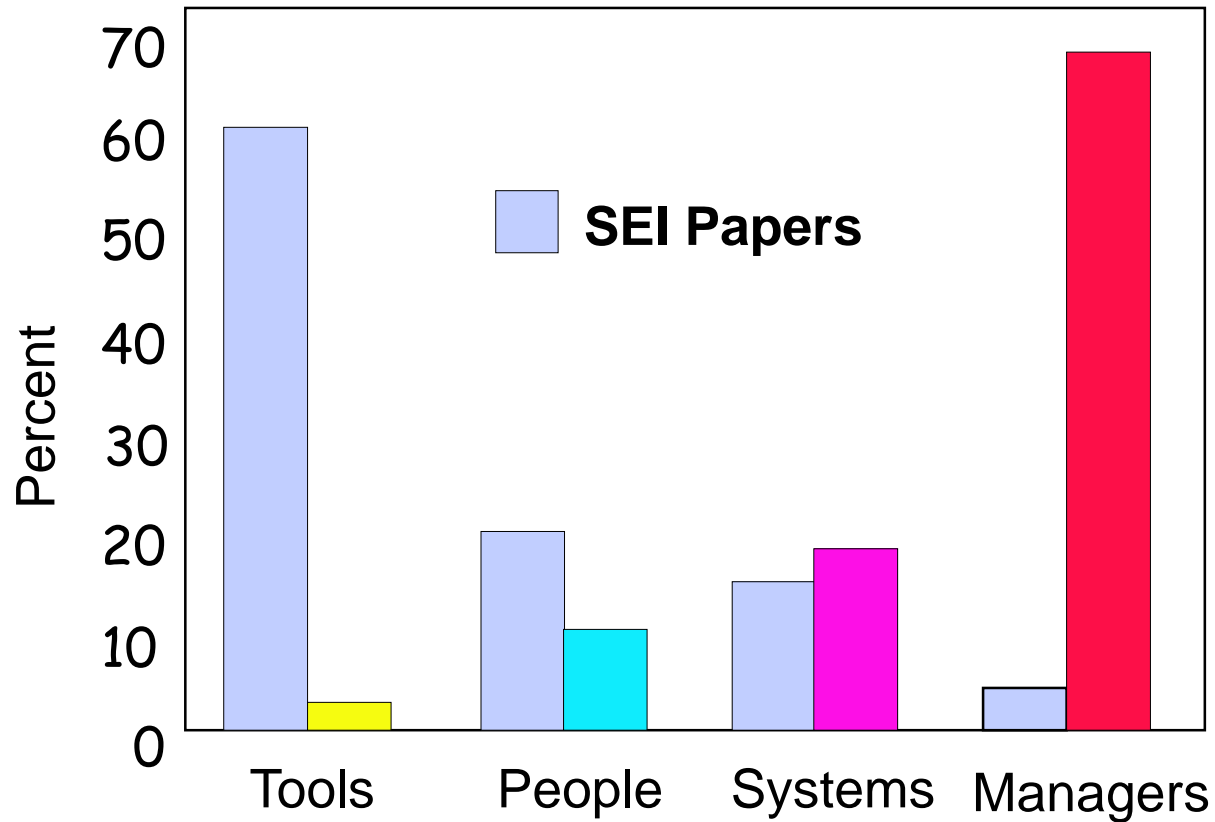


# Weinberg's Analysis of COCOMO Drivers



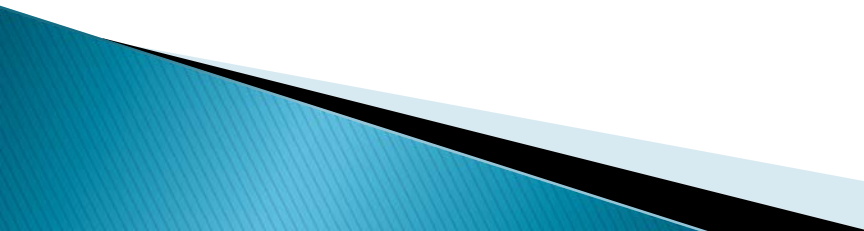
*Source: G. Weinberg, Quality Software Management, Vol. 3, 1991*

# SEI Publications



Source: G. Weinberg, *Quality Software Management*, Vol. 3, 1991

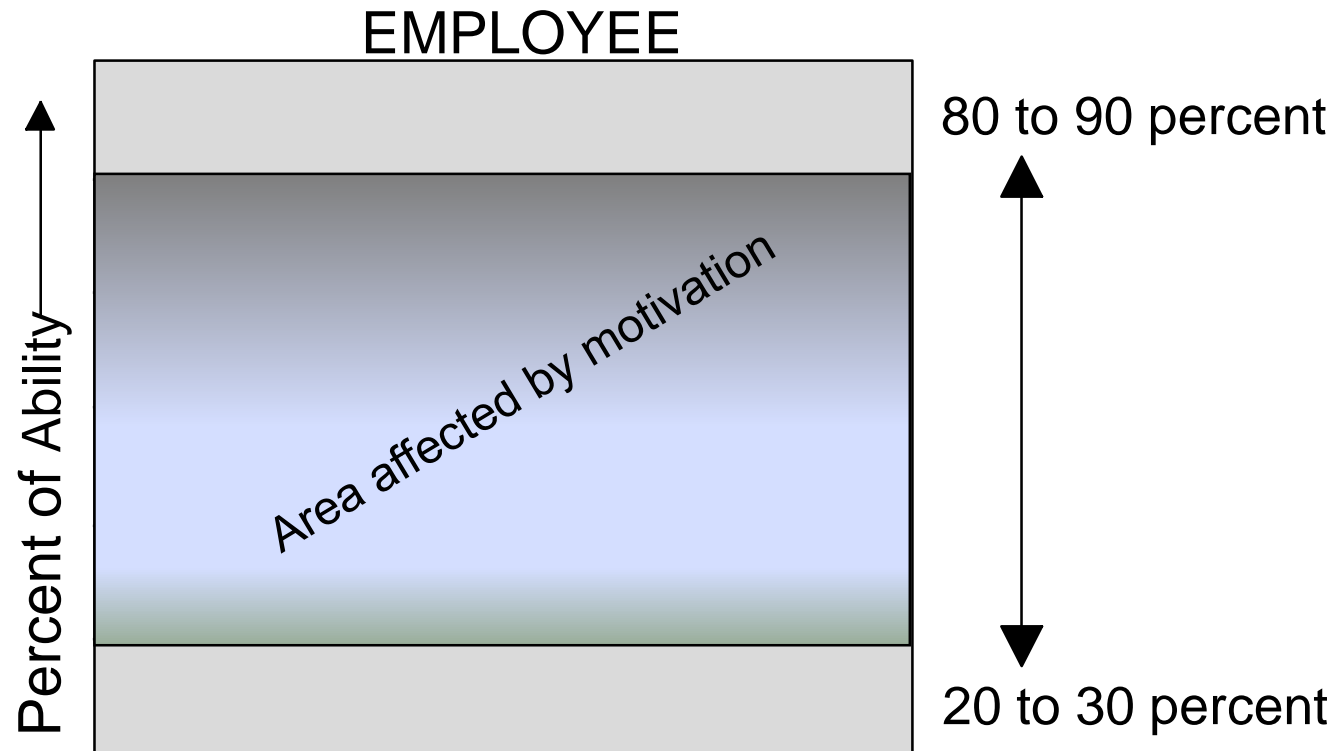
# Management Research Highlights

- General management concepts, 1911  
Management philosophy: Plan, Organize, Command, Coordinate, Control
  - Hawthorne experiment (1924-1932)
  - People impacts, Mayo, 1933
  - Lockheed Skunk Works, 1940s
  - Theory X/ Theory Y, McGregor, 1960
  - CMM, Humphrey, 1989
- 

# Theory X /Theory Y Management

Theory X	Theory Y
<ol style="list-style-type: none"><li>1. Work is inherently distasteful to most people.</li><li>2. Most people are not ambitious, have little desire for responsibility, and prefer to be directed.</li><li>3. Most people have little capacity for creativity in solving organizational problems.</li><li>4. Motivation occurs only at the physiological and safety levels.</li><li>5. Management philosophy: Plan, Organize, Command, Coordinate, Control</li></ol>	<ol style="list-style-type: none"><li>1. Work is as natural as play, if conditions are favorable.</li><li>2. Self-control is often indispensable in achieving organizational goals.</li><li>3. The capacity for creativity in solving organizational problems is widely distributed in the population.</li><li>4. Motivation occurs at the social, esteem, and self-actualization levels, as well as physiological and security levels.</li></ol>

# Motivation Impact on Productivity



# CMMI Impact

*While there are many unique characteristics to software, **they all require more management discipline, not less.** Managers should thus demand detailed plans, tracking systems, and periodic technical and management reviews. **Software management should be entirely traditional, only more so.** Unfortunately, many managers who insist on these items for hardware let their software teams get by without them.*

Watts S. Humphrey, *Managing the Software Process*, (Addison-Wesley, Boston, MA), 1989

# Effectiveness Formula Redux

$$E = CM (CS)$$

where

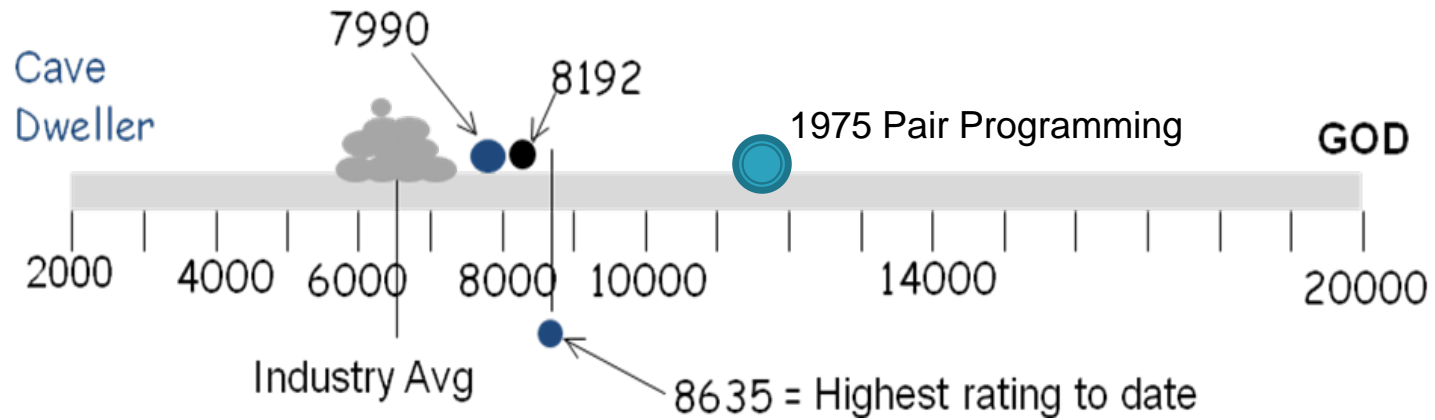
$E$  = Effectiveness

$CM$  = Communications/Management ability (0 – 1)

$CS$  = Software Engineering technical ability (0 – 1)


- Forty five years of validation data !!
- Data does not permit communication – management split

# Effective Formula Distribution



EF Value	Percent ile	Ctb
0.11	10	2000
0.25	50	6500
0.38	70	8192
0.40	78	8630
0.50	88	12,500

# Conclusions

- Low productivity improvement over the last 3 decades has been primarily driven by technology
  - Productivity/Effectiveness is a function of 3 attributes: communications, management, and technology
  - Communications and management are **KEY** productivity drivers
  - Estimates for non-classic environments must account for all 3 effectiveness attributes for application to agile development.
  - Effectiveness Formula applies to almost all development environments
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# Caverns of Socrates

*Our job is to escape the cave, look around, then come back and tell others what we have seen . . . .*  
*Of course, they won't believe us.*

Plato, *Republic* Book 7