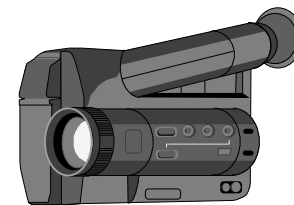
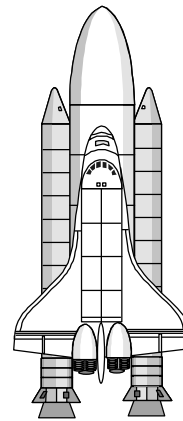
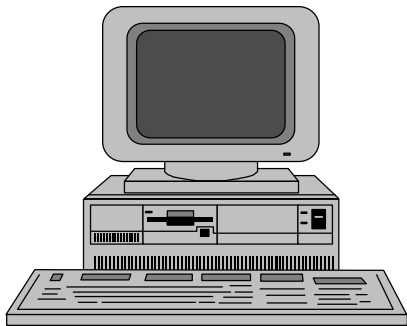
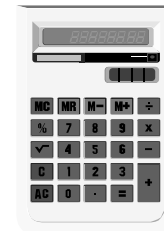
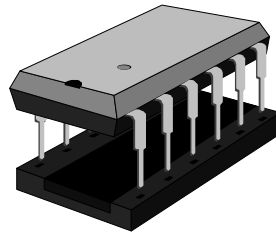
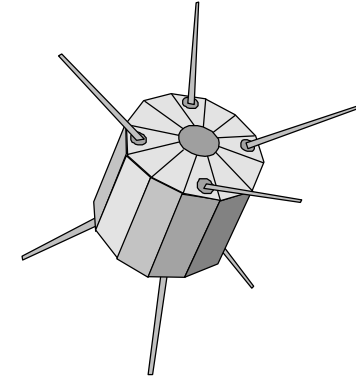
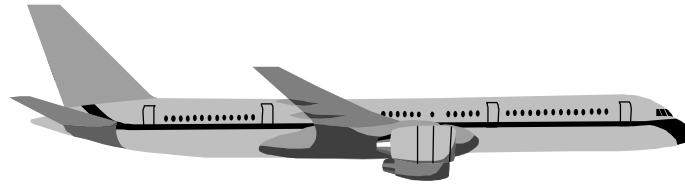
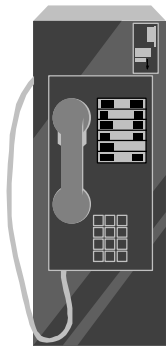


Software Process Improvement Using The Capability Maturity Model (CMM)

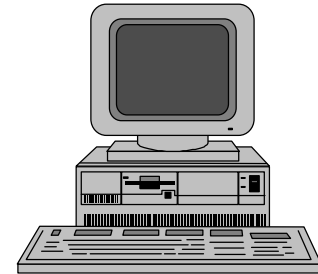
**Presenter: John D. Vu
Associate Technical Fellow
The Boeing Company**

Software Is Needed Everywhere



Software Issues

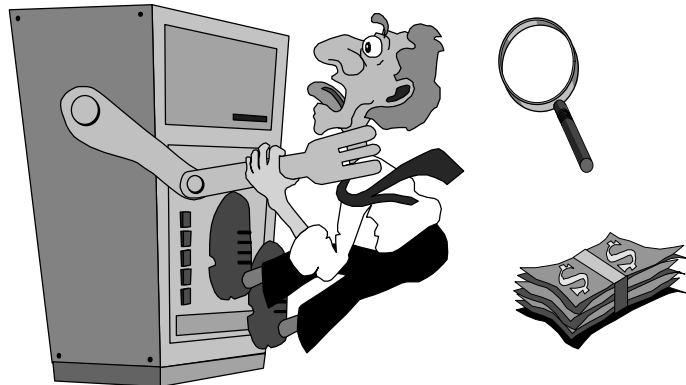
High cost, low quality: Use at your own risk



Unpredictable performance

Constant surprises

Excessive maintenance costs



Unsatisfied customers

Take too long

Cost too much

Low visibility into progress and quality

State Of Software Project in U.S

Much of the \$250 billion in annual U.S. software development spending is wasted, late, incomplete, or spent on canceled projects:

53% (\$132.5 billion) are considered over budget, delayed, and less functional than planned.

31% (\$77.5 billion) are considered impaired and must be canceled.

Only 16% (\$40 billion) of software projects are completed within budget, on time, and with all functions included.

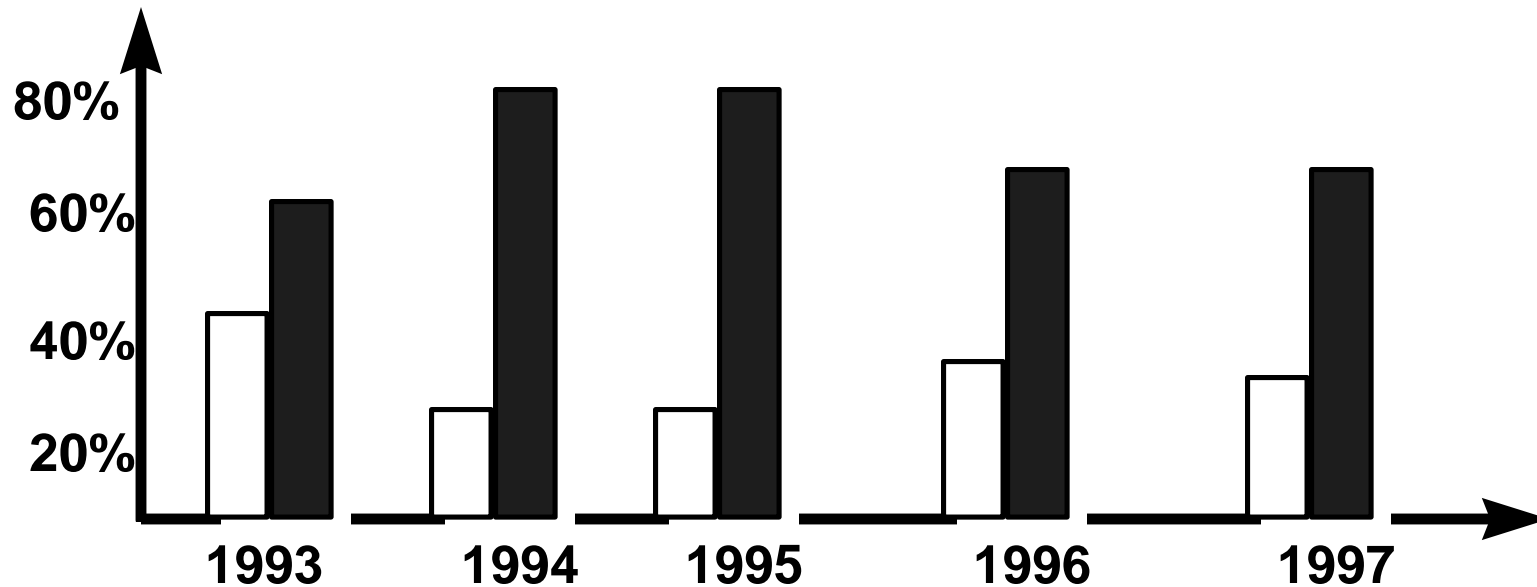
Source: Investor's Business Daily (Jan. 25, 1995)

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J. D. Vu

Missed Delivery Dates



What are the costs of missed delivery dates ?



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- Penalties
- Market share
- Lost revenue
- Overrun budgets
- Repeat customer business

 **on-time**
Missed

Major Software Issues



Rapidly changing technology

Many existing systems need upgrade, modernize

Lack of engineering disciplines

Lack of defined architecture for successful integration

Long term vs Short term planning

Product oriented management

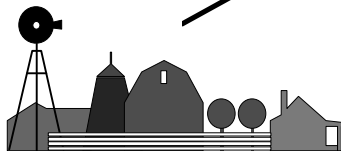
Lack of Software project management skills

Scalability Problems

Order of magnitude growth in software size - Every 5 years

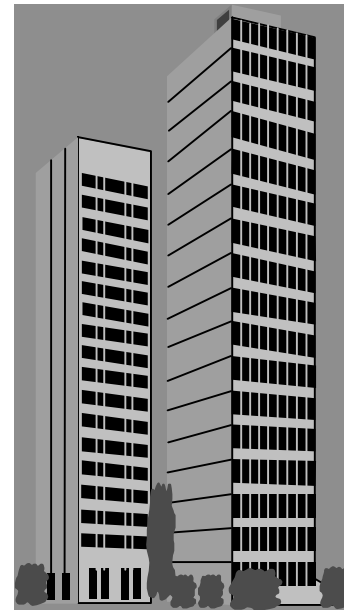
Scaling requires fundamental process changes:

- Can't go from 6 mph to 60 mph by trying harder
- Can't build skyscraper using carpenter hand tools



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J. D. Vu

The Focus On Product vs Process

Focusing on product alone misses:

- **Scalability issues**
- **Knowledge of how to do it better (CQI)**

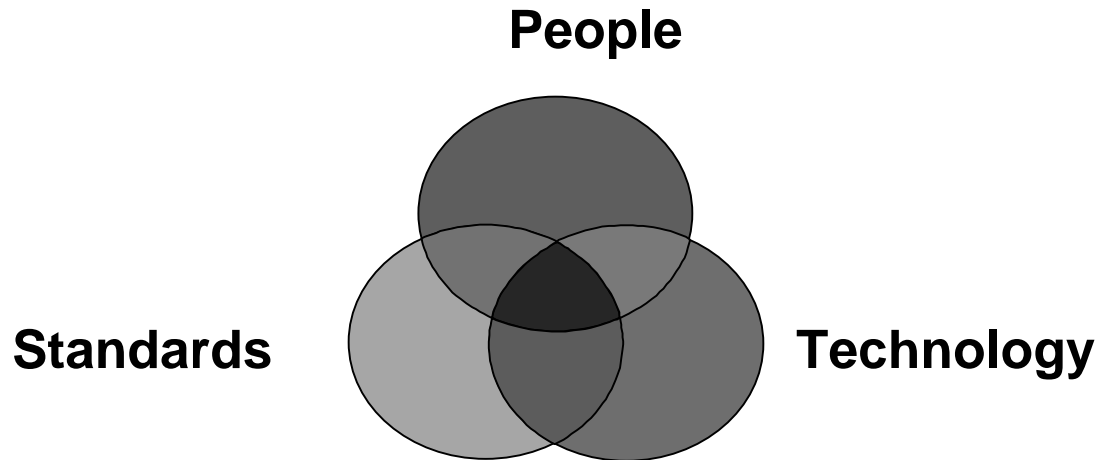


Focusing on process predicts:

- **Repeatability of outcomes**
- **Project trends**
- **Product characteristics**

The Definition Of Process

The logical organization of people, technology, standards and procedure into work activities designed to produce a specified end result



Perspectives

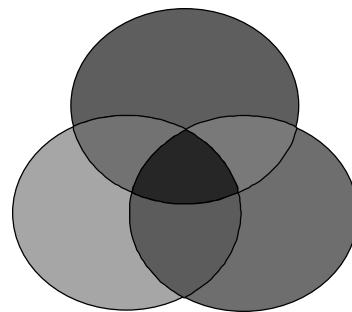
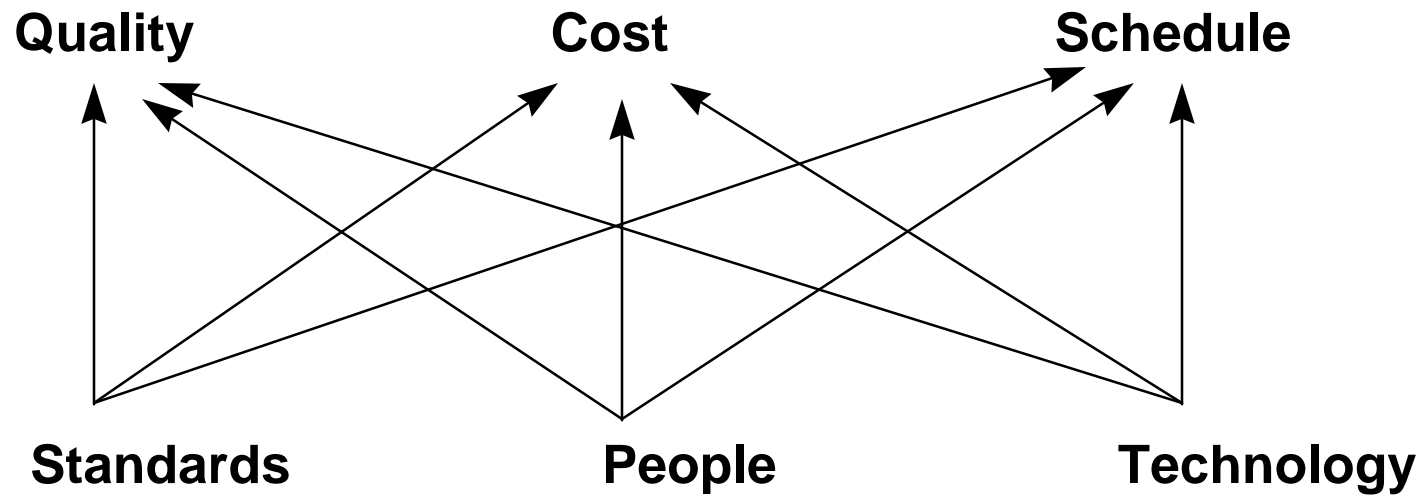
People: Must have the skills, training, and motivation necessary to do the work. They must be managed in a way that will increase their effectiveness

Standards: Must be defined to guide people and the application of technology in the business of providing products and services to the customers

Technology: Must be selected that enhance the business process and product needs.

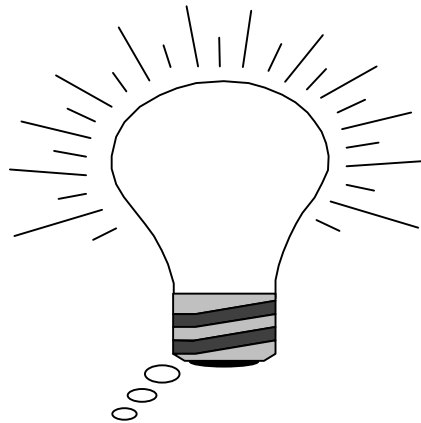
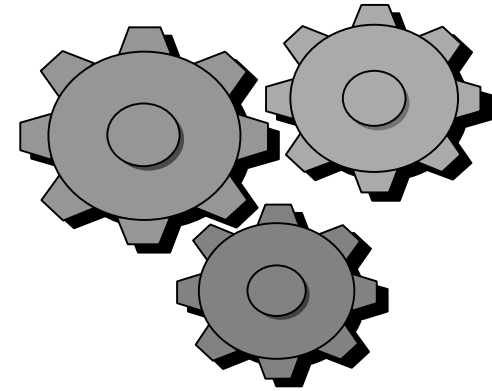
Relationships among these components must be managed in order to achieve the maximum progress. How these components play together directly affects how the work is performed.

Interrelationship



Process Management Premise

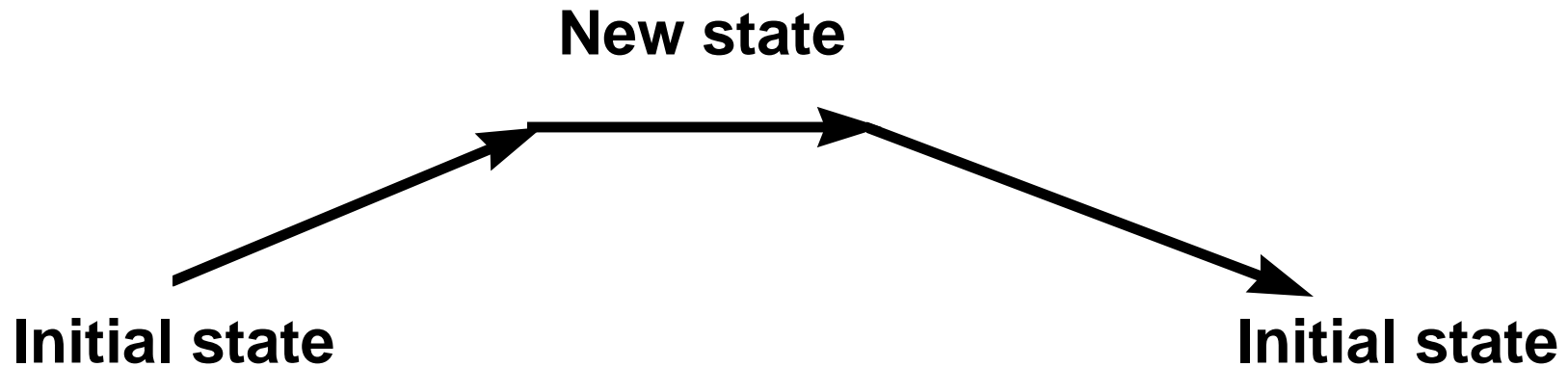
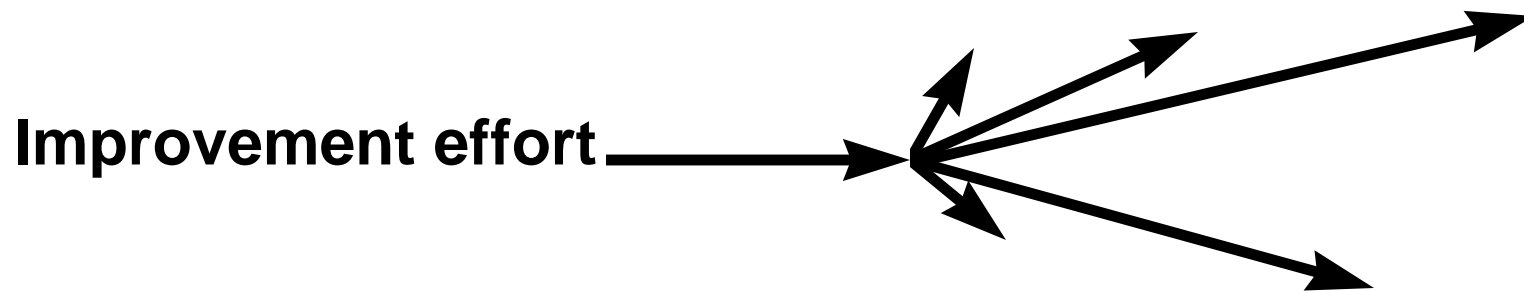
The quality of a product is governed by the quality of the process used to develop and maintain it.



To improve quality of the product, one must improve the quality of the process that creates the product.

Typical Problems of Improvement Efforts

Improvement effort becomes unfocussed and vanishes



New methods & tools are forgotten over time

Possible Causes

Misunderstanding of the problem being solved

Lack of consensus in the organization about which problem to solve first

Too many changes happening at the same time

Newly introduced solution disrupts current process

Everybody busy "Fighting Fires"

→ Lack of a framework for process improvement

Capability Maturity Model (CMM)

A conceptual framework to help organizations:

Characterize the maturity of their process (As Is)

Establish goals for process improvement (To Be)

Set priorities for immediate actions (Transition)

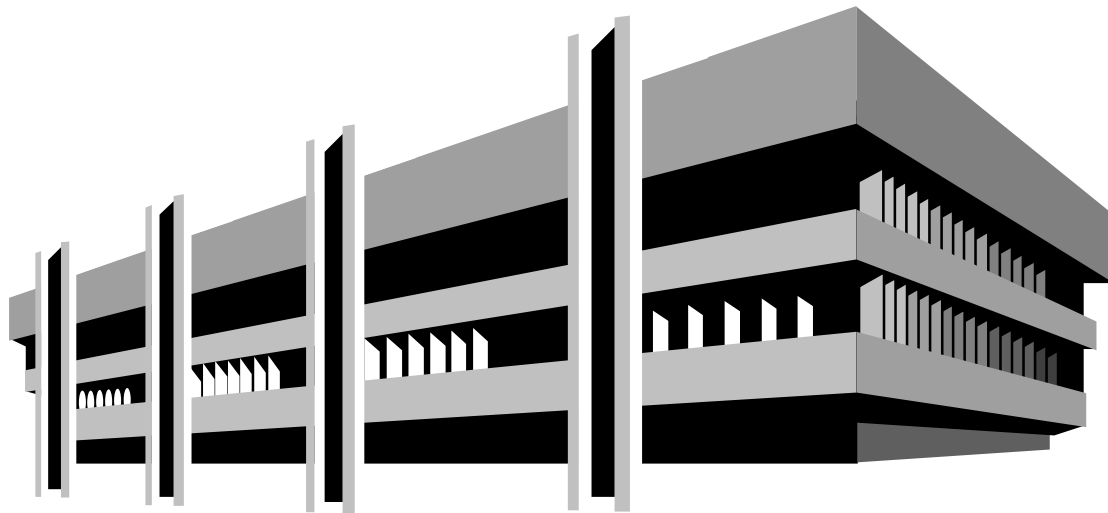
Manage and sustain change in organizations (Stabilize)

Introduce changes incrementally, to avoid disrupting current processes

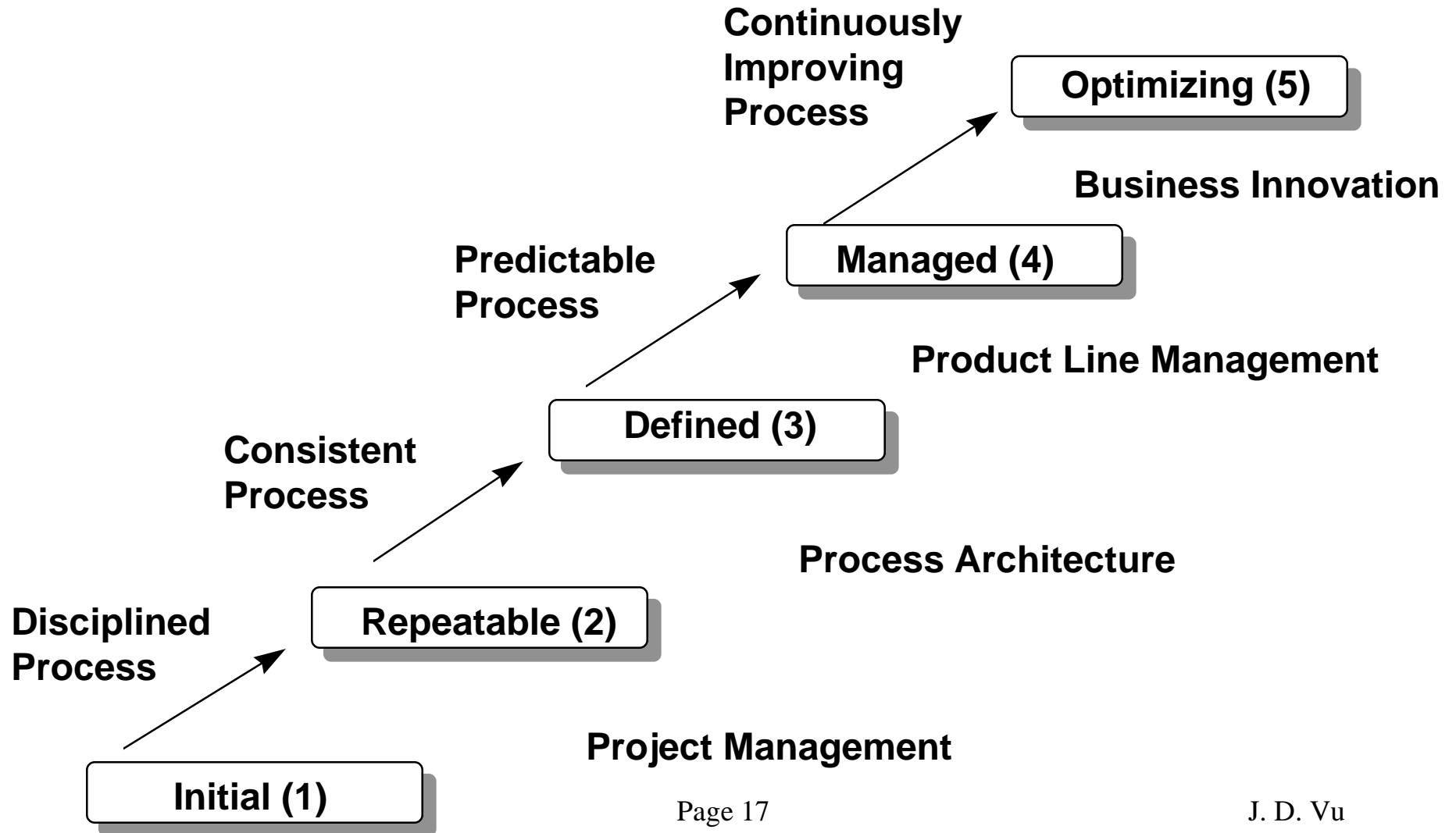
The Software Engineering Institute (SEI)

A federally funded research and development center

Affiliated with Carnegie Mellon University (CMU)



Process Maturity Levels



Maturity Level 2 (Repeatable)

**Requirements Management
Software Project Planning
Software Project Control
Software Configuration Management
Software Quality Assurance
Software Acquisition Management**

**Disciplined Process
(Project Management)**

Maturity Level 3 (Defined)

**Organization Process Focus
Organization Process Definition
Integrated Software Management
Intergroup Coordination
Software Product Engineering
Peer Reviews
Organization Training Program**

**Consistent Process
(Process Architecture)**

Maturity level 4 (Quantitatively Managed)

**Organization Asset Alignment
Organization Process Performance
Statistical Process Management**

**Predictable Process
(Product Line Management)**

Maturity Level 5 (Optimizing)

**Defect Prevention
Organization Process Innovation
Organization Improvement Deployment**

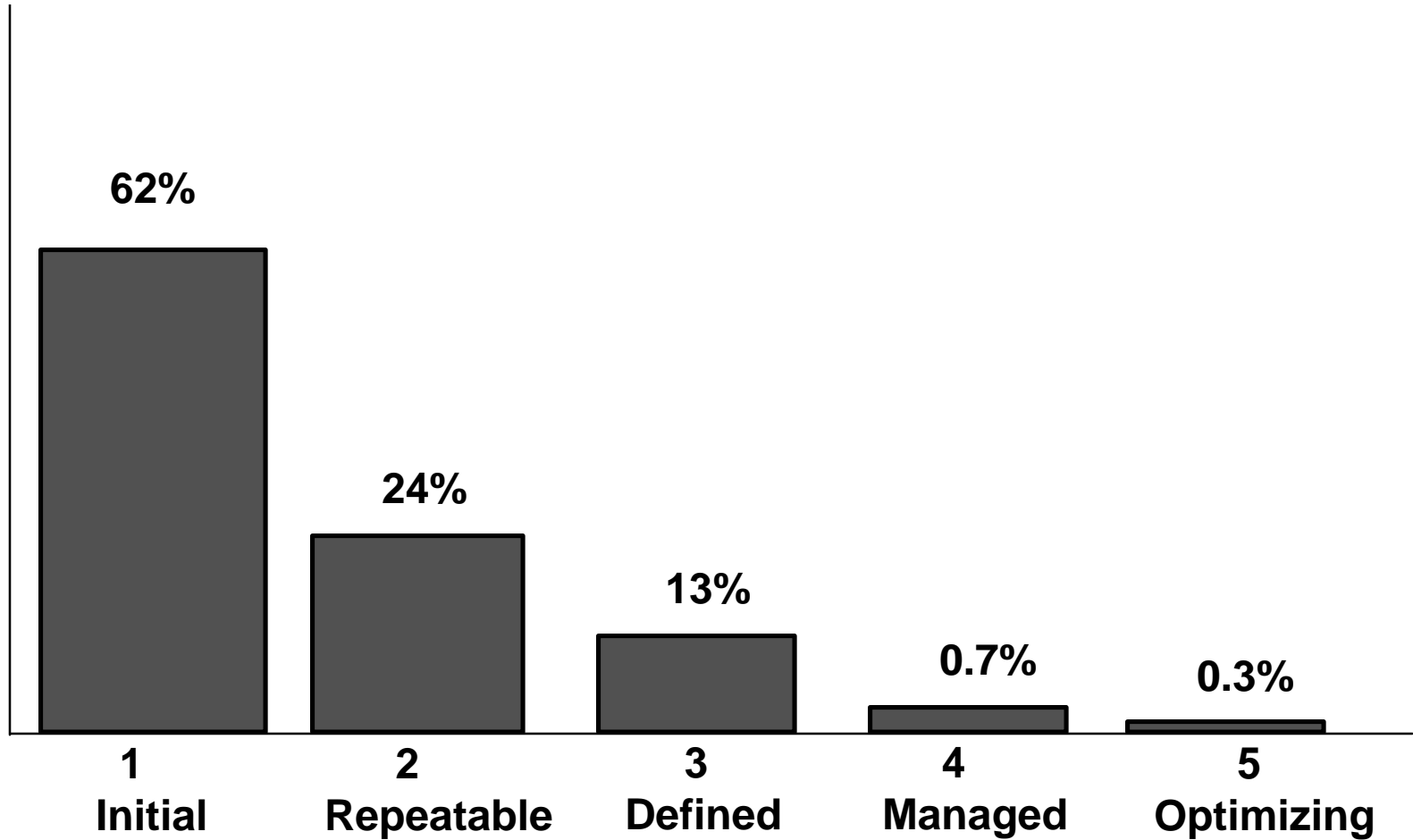
**Continuous Improving Process
(Business Innovation)**

Population

Current State Of Software Practice in U.S

100%

0%



* Source: ^{3/23/98} Carnegie Mellon University Dec 1997 Page 22

J. D. Vu

Return On Investment

Hughes Aircraft *
(Ground System Division)
Level 2 in 1987 to level 3 in 1990
Reduce cost overruns 50% for a 5X ROI



Raytheon **
(Software System Lab)
Level 1 in 1988 to level 2 in 1990
Reduce the cost of re-work by \$8.2 million
A 7.7X ROI

* IEEE Software, July 1991

** IEEE Software July 1993

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QSM Evidence *

Application area: Business and management information system.
Data based on average 100K SLOC projects

SEI Level	Effort (Person/Mos.)	Defects Discovered	Defects Remain	Average cost per Project	Number of Projects
1	243.2	771	33	\$ 2,229,000	1166
2	58.6	185	9	537,000	251
3	32.6	104	4	298,000	163
4	17.5	56	2	161,000	85
5	6.5	21	0	60,000	73

(Source: Quantitative Software Management & Stan Rifkin)

Uninflated cost per person month = \$ 10,000 Person hours per month = 173 ,
Reflect results of detailed design, code, test, integrated & Delivery only

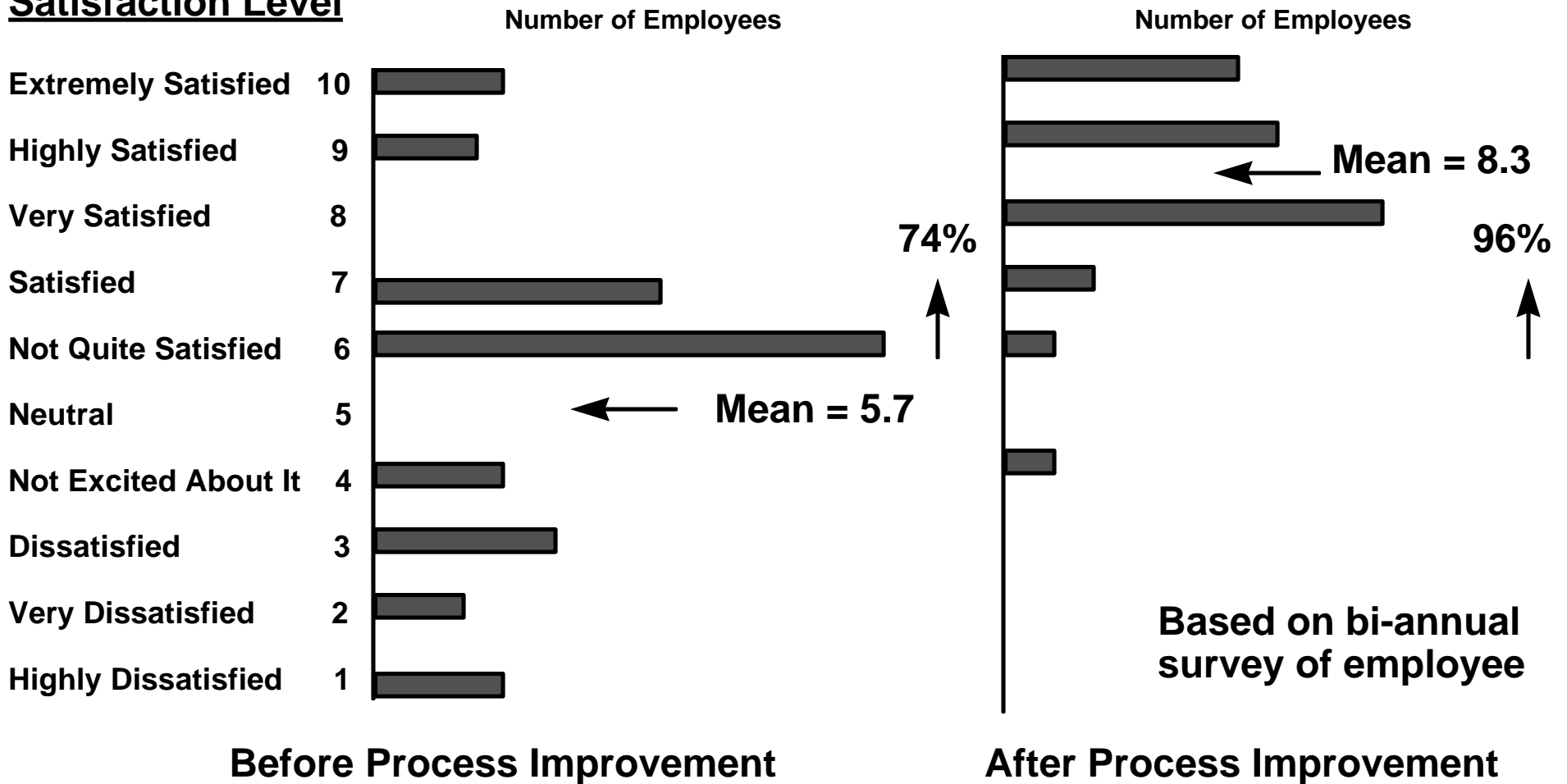
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Employee Satisfaction

Satisfaction Level



(Based on data of Boeing Space Transportation Systems)

Observations

We believe:

There is a systematic approach to improve the way software is developed and maintained.

There are stages of process maturity in which the organization will improve by following a recommended sequence to decrease risk and increase software performance.

By following an evolutionary path the organization will continuously improve their knowledge to produce better, faster, higher quality products, and achieve customer satisfaction.

Conclusion

Software Process Improvement using the Capability Maturity Model (CMM) will help an organization improve its software process to achieve its business objectives.

Software process maturity will determine which organization has the potential to deliver higher quality products at reasonable cost to the customer.

