Coaching Development Teams

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Agenda

Systems Problems

Teams – What and Why

Team Coaching

The Team Life Cycle

An Example Process – TSP

Example Coaching Results
Systems Problems

The IRS system – finally started to use in 2005
- 5 years of delays
- costs exploded to $2 B

FBI system killed
- 3 years of work
- $150 M
- 5 CIOs, 9 program managers

Britain’s child-support project
- a year late
- $844 M
- didn’t pay 50% of cases
Transportation

Automobiles
• Mercedes Benz – batteries, windows, temperature
• automatic braking systems
• Ford Explorer

Boeing 777
• Malaysian Airlines
• Singapore
This Is No Joke!

These are not new problems.
- CONFIRM system 20 years ago
- Cancelled after 3 ½ years and $125 M

How long will society tolerate such performance?

Do we want government controls?
- Methods standards and approval?
- Pre-shipment reviews?
- Legislated warranties?

We had better solve our own problems or others will solve them for us.
Geopolitical Changes

While these technological challenges are significant, recent geopolitical changes are even more important.

- fall of the Berlin Wall
- opening of Eastern Europe
- China’s transition to capitalism
- India’s embrace of international trade

These changes mean that competition in our industry is world-wide.

- Computing power is in everyone’s hands.
- The world’s information is at our fingertips.
- World-wide communication is nearly instantaneous.
Workflow Changes

The flow of work has totally changed in five years.
  • Borders have disappeared.
  • Everybody can compete with everyone else.
  • Distributed teams capitalize on world-wide talent.
  • Open source cuts the cost of entry.

Work can now be done by the smartest, lowest cost, best informed, and best managed people – wherever they are.

As Thomas Friedman says: “The world is flat.”
Challenges of the Future

Our priorities must change. Systems are now
- larger
- distributed
- integrated
- pervasive
- critical

The methods of the past are not suitable today.

In the future, they could be dangerous!
Future Opportunities

While the challenges of the future are great, so are the opportunities.

Very few organizations know how to consistently and predictably develop large-scale software-intensive systems.

The methods are known and available.

Those who take the lead in this field will be ahead for a long time.
Truly great products are built by people who understand what these products are intended to do.

Engineers must find the proper balance among conflicting pressures.
- customer needs
- technological capability
- business reality
Great software work requires working with:
- teammates
- users
- technologists
- business professionals
- managers and executives

This is not just building things; it is knowledge work.
Knowledge Work

Knowledge work involves assimilating, relating, and integrating concepts and ideas.

Knowledge work produces intangible intellectual products.

Managing knowledge work fundamentally differs from managing the development of physical devices.

Essentially all software and systems work is knowledge work.
Managing Knowledge Work

There is one key rule to managing knowledge work.

The rule: managers can’t manage knowledge workers; they must manage themselves.

The principal problem is that today few development professionals can manage themselves. They cannot
• make accurate plans
• negotiate commitments
• track their work
• consistently do what they agreed to do

This requires a new engineering paradigm.
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Teams –What and Why

A team is a group
- with two or more members
- that has a common goal
- where each member has a defined role
- in which the members cooperate to meet their goals
Team Benefits

Teams provide important benefits.
  • needed resources
  • a mix of talents and skills
  • a working structure
  • a support system
    - membership – roles
    - technical support
    - task support
    - emotional support

Teams also provide a power base for negotiating commitments.
The Engineering Problem

There is no secret to negotiating plans and meeting commitments.

The methods are known and can be taught to anyone.

Systems and software engineers today are bright people who should be consistently successful.

Yet most software-intensive projects are late, over cost, and of marginal quality.

Even routine software-intensive projects typically fail because the teams do not use proper methods.
Self-Management Skills

The ability to make accurate and detailed plans.

The self-confidence to negotiate commitments with management.

The skill to consistently meet committed schedules.

The ability to use historical data to make accurate plans.

The skill and discipline to gather the data for accurate planning.
Quality Commitment

Quality is the most fundamental single element of engineering work.

Software engineers must own the quality of the products they produce.

Engineers should learn how to produce quality work before they are even called engineers.

A personal commitment to quality should be an essential qualification for being an engineer.
Building Commitment

A personal commitment to quality must be developed.
• while growing up
• during one’s education
• from role models
• through painful experience

Lifetime commitments take experience and knowledge.

These cannot be instilled in brief industrial training classes.
Best Engineering Practices

The performance of an engineering organization is determined by the performance of its teams.

The performance of an engineering team is determined by the performance of the members.

The performance of the members is determined by their personal practices.

To perform at their best, members’ personal practices must be
• defined
• measured
• tracked
• managed
Teamworking

The principles of sound teamworking are well understood and proven.

Why aren’t these practices more generally used?
  • The developers lack skills, knowledge, and experience.
  • Management does not support teamwork.
  • No coaching support.
The Need for Coaching

Development skills and management priority are essential, but not sufficient.

Without coaching resources and skills
- it is almost impossible to get started
- the teambuilding efforts will not be sustainable
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High-performing groups typically have professional guidance and support.
  • sports teams
  • performing arts
    - conductors
    - directors

A poor coach leads to a poor team.
  • The coach forms, energizes, and motivates the team.
  • Development teams typically do not have coaches.
The Coaching Job

The team leader uses the team to develop the product.

The coach uses the project to develop the team.

The coaching job has five parts.
• building talent
• setting and maintaining standards
• building and sustaining motivation
• focusing on improvement
• celebrating and rewarding achievement
Building Talent

People have latent talents that even they do not suspect.

People often produce extra-ordinary results when they are
• motivated
• guided
• supported

An important part of the coaching job is to
• identify latent talent
• guide, motivate, and develop that talent
• sustain and enhance recognized talents
Standards

Standards define job performance.
- What is acceptable.
- What is good work.
- What is superior work.

Standards can be highly motivating when they
- are realistic
- make business sense
- are challenging
- are owned by the team and team members

The coach’s job is to help teams set and manage to challenging standards.
Motivation

The coaching focus must be on
• striving for success
• establishing personal and team bests
• future wins not past losses

If the team or team members miss some goals or standards, the coach helps them to
• learn from the experience
• be motivated to do better the next time
Improvement

Arbitrary goals are rarely motivating. They are often
• unrealistic
• unjustified
• soon forgotten

Goals to surpass personal or team bests are motivating.

The coach helps the team and team members to
• set their own improvement goals
• strive to meet these goals
• continue improving in small steps
Celebrating Success

In engineering work, success is invisible.

Management expects teams to deliver quality products on schedule.

The coach must
• identify superior work
• ensure that superior work is recognized
• ensure that superior work is rewarded
A Coaching Example

Maurice Greene and coach John Smith
- videotaped sprint
- measured each phase
- guided improvement

June 16, 1999, Greene won the Gold Medal in Athens.

He was the fastest man alive.
Coaching Responsibilities

Meet with each individual team member.
- Consider their interests and experiences.
- Recognize their strengths and weaknesses.

Help the members to improve themselves.
- Define personal processes.
- Establish measures.
- Set personal improvement goals.
- Focus on small achievable steps.
Coaching Relationships

Build and maintain personal relationships.
  • personal trust
  • helpful attitude
  • coach with data
  • private personal data

Problem team members
  • guide and support where possible
  • be realistic
  • establish management partnership
Team Responsibilities

While coaches have responsibilities, so do teams.

The key team responsibilities are to
- strive to do superior work
- follow defined and measured practices
Importance of Measures

To improve, you must know performance.

To improve in small steps, you must know performance precisely.

Without measures, there is no way to know performance precisely.

Without measures, coaching is impossible.
Development Measures

In development, the key measures are
- productivity
- predictability
- quality

The data required to calculate these derived measures are the
- size of the product produced
- time spent in each process step
- defects found in each process step
Defect Measures

Developers usually feel that
• quality is testing’s responsibility
• testing should gather the data

Quality is a key development responsibility.
• Testing can only find a fraction of the defects in a product.
• Unless a quality product is put into testing, a quality product cannot come out of testing.
Test Effectiveness

- Overload
- Hardware failure
- Configuration
- Resource contention
- Operator error
- Data error

Safe region = tested (shaded)
Unsafe region = untested (unshaded)
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Group formation has four natural phases.
- forming
- storming
- norming
- performing
Teambuilding Support

Teams will naturally progress through the four phases of group formation.

However, these steps by themselves will not necessarily produce effective teams.

To consistently build effective teams, you must follow a defined and supported teambuilding process.
Teambuilding

Successful teams need
- a compelling mission
- realistic and achievable commitments
- suitably skilled resources
- proper guidance and support

Unless these conditions are consciously established, they will not likely occur.

Producing these conditions is called teambuilding.
Teambuilding Exercises

Typical teambuilding exercises are

• off site
• not connected to the job
• done with strangers
• risky and stressful

They also typically require that all team members work cooperatively to meet their objectives.

While the results are often positive, they are generally temporary.
Teambuilding Objectives

An effective teambuilding process accomplishes three things.

• Satisfies the conditions for effective teamwork.
• Applies in the team’s working environment.
• Guides the team in using effective working styles.
Group Styles

Closed

Synchronous

Open

Random

More Directive

Less Interactive

More Interactive

Less Directive
Teambuilding Requirements

To actually improve a team’s performance, the teambuilding process must
- directly relate to the team’s work
- include all the team members
- involve the team leader
- have the support of the team’s management
- be competently coached
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An Example Process - TSP

The Software Engineering Institute (SEI) has developed the Team Software Process (TSP). The TSP objectives are to

• improve the performance of engineering teams
• guide qualified coaches through the teambuilding process
• provide the data and process structure required for effective team coaching

Team Software Process and TSP are service marks of Carnegie Mellon University.
TSP Overview

The TSP is usually used by teams of 3 to about 15 developers.

The TSP includes

- a full set of process forms, scripts, and standards
- standard team-member roles
- a structured launch and tracking process
- a team and developer support system
TSP Structure and Flow

A 4-day TSP launch kicks off each major project phase.

The team builds a common understanding of
• the process
• the work
• the plan

The members produce plans to guide their work.

Subsequent phases kick off with a TSP relaunch.
The TSP Launch Process

Day 1
1. Establish product and business goals
2. Assign roles and define team goals
3. Produce development strategy and process

Day 2
4. Build overall and near-term plans
5. Develop the quality plan
6. Build individual and consolidated plans

Day 3
7. Conduct risk assessment
8. Prepare management briefing and launch report

Day 4
9. Hold management review

Launch postmortem

A qualified TSP team coach guides the team through a defined process to develop its plan and to negotiate that plan with management.
TSP Launch Meeting 1

In launch meeting 1, management
• describes what they want done
• explains why the job is important
• answers the team member’s questions

The objectives of meeting 1 are to
• motivate the team members to do this job
• ensure that the team understands management’s criteria for success
A TSP Industrial Project

The project was to develop communications test equipment.

Management described the product they wanted.

- a new communication-line tester
- required new hardware and software
- had to be available for first customer shipment in nine months
During the TSP launch, the team members
• define a process and strategy for doing the job
• produce detailed team and personal plans
• assess the risks of their plans
• present their plans to management

Because the team and team leader have a great deal to do during the launch, they are coached through
• building the plan
• working without observers
TSP Launch Meeting 9

In launch meeting 9, the team presents its plan.
  • best plan
  • alternative plans

Management’s responsibilities in meeting 9 are to
  • probe the team’s plan
  • assess the plan’s accuracy and completeness
  • approve the plan if it is suitable
Team plans rarely meet all of management’s objectives.

When the plan does not meet their needs, managers must
• identify the most suitable alternate plan
• suggest other choices if no suitable plan is available

At the meeting’s conclusion, management
• decides how to proceed
• tells the team its decision
• explains why they made the decision
• thanks the team members for their work
A TSP Industrial Project

The project was to develop communications test equipment.

Plan

| Size - KLOC | 110 |
| Effort - hours | 16,000 |
| Schedule - weeks | 77 |
| Defects per KLOC |
| Integration and system test | 1.1 |
| Field trial | 0.0 |
| Customer use | 0.0 |
TSP Team Operation

Following the launch, the team does the job.
- follows its plans
- tracks the work
- regularly assesses project risks
- reports to management on status and progress

For longer jobs, TSP teams periodically relaunch their projects.
Managing to the Team’s Plan

These data show project status after 7 weeks.
1. The team has completed 22.3% of the job.
2. The team is spending 20.54 hours per EV point (458/22.3).
3. At this rate, there are 1596 hours to go (77.7*20.54).
4. At the rate of 126.7 hours, there are 12.6 weeks to go.
5. This is 2.6 weeks behind the 17-week plan.

<table>
<thead>
<tr>
<th>Weekly Data</th>
<th>Plan</th>
<th>Actual</th>
<th>Plan/Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule hours for this week</td>
<td>121.0</td>
<td>126.7</td>
<td>0.95</td>
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<tr>
<td>Schedule hours this cycle to date</td>
<td>467.0</td>
<td>493.4</td>
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<tr>
<td>Earned value for this week</td>
<td>7.6</td>
<td>6.4</td>
<td>1.19</td>
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<tr>
<td>Earned value this cycle to date</td>
<td>28.2</td>
<td>22.3</td>
<td>1.26</td>
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<tr>
<td>To-date hours for tasks completed</td>
<td>354.3</td>
<td>458.0</td>
<td>0.77</td>
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<tr>
<td>To-date average hours per week</td>
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<td></td>
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</tr>
</tbody>
</table>
Team Weekly Earned Value Through Week 10

- **Earned Value for Week**
  - Earned Value for Week
  - Week Number

- **Actual vs. Plan**
  - Actual
  - Plan

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Projected Week Complete Through Week 10

Week Completed

Week Number

Average
Latest
Plan
# A TSP Industrial Project

The project was to develop communications test equipment.

<table>
<thead>
<tr>
<th></th>
<th>Plan</th>
<th>Actual</th>
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</thead>
<tbody>
<tr>
<td>Size - KLOC</td>
<td>110</td>
<td>89.9</td>
</tr>
<tr>
<td>Effort - hours</td>
<td>16,000</td>
<td>14,711</td>
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<tr>
<td>Schedule - weeks</td>
<td>77</td>
<td>71</td>
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<tr>
<td>Defects per KLOC</td>
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<tr>
<td>Integration and system test</td>
<td>1.1</td>
<td>0.6</td>
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<tr>
<td>Field trial</td>
<td>0.0</td>
<td>0.02</td>
</tr>
<tr>
<td>Customer use</td>
<td>0.0</td>
<td>0.0</td>
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</tbody>
</table>
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Example Coaching Results

Many organizations have now used the TSP.

The results have been excellent.

There is no question that the TSP works.
Cost and Schedule

With timely and precise data, TSP teams can manage their schedule performance.
Cycle Time

Typical team

<table>
<thead>
<tr>
<th>Reqs</th>
<th>Design</th>
<th>Implement</th>
<th>Test</th>
</tr>
</thead>
</table>

TSP team

<table>
<thead>
<tr>
<th>Reqs</th>
<th>Design</th>
<th>Implement</th>
<th>Test</th>
</tr>
</thead>
</table>

With the TSP, teams find and fix defects early in the development process.

This sharply reduces test time.

With shorter testing, cycle time is cut.
Defect Density of Delivered Software

- CMM Level 1: 7.5
- CMM Level 2: 6.24
- CMM Level 3: 4.73
- CMM Level 4: 2.28
- CMM Level 5: 1.05
- TSP: 0.06

Ref: SEI Technical Report 2003-014
The AIS Corporation

Schedule Deviation Control Chart

% Deviation

Date of Project Start

01/88 01/89 01/90 01/91 01/92 01/93 01/94 01/95 01/96 01/97 01/98

Pre-CMM CMM TSP

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Team Development

Team performance improves with experience. In 4 releases, one team
• delivered on time
• increased productivity by 81%

<table>
<thead>
<tr>
<th>Defect Data - Five Releases of the Same Product</th>
<th>Non-TSP</th>
<th>TSP</th>
<th>TSP</th>
<th>TSP</th>
<th>TSP</th>
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<tr>
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<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<td>Defects/1000 LOC</td>
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<td></td>
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<tr>
<td>System Test</td>
<td>13.3</td>
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<td>0.8</td>
<td>1.0</td>
<td>0.1</td>
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<td>Acceptance Test</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>Customer Production</td>
<td>1.2</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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</table>
An Industrial Study

A comparison of the performance of 80 traditional development teams with 15 first-time TSP teams

<table>
<thead>
<tr>
<th></th>
<th>Non-TSP Projects</th>
<th>TSP Projects</th>
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</thead>
<tbody>
<tr>
<td>Released on Time</td>
<td>42%</td>
<td>66%</td>
</tr>
<tr>
<td>Average Days Late</td>
<td>25</td>
<td>6</td>
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<tr>
<td>Mean Schedule Error</td>
<td>10%</td>
<td>1%</td>
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<tr>
<td>Test Defects/KLOC</td>
<td>19.5</td>
<td>12.8</td>
</tr>
<tr>
<td>Production Defects/KLOC</td>
<td>1.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Sample Size</td>
<td>80</td>
<td>15</td>
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</tbody>
</table>
Messages to Remember

Modern engineering work is more challenging than ever before.

To meet the greater challenges of the future, we need high-performing engineering teams.

To capitalize on the opportunities ahead, development teams must be
  • properly trained
  • competently coached

Such teams are capable of extraordinary work.
For More Information

Visit the PSP/TSP web site
http://www.sei.cmu.edu/tsp

Contact SEI customer relations
Phone, voice mail, and on-demand FAX: 412/268-5800
E-mail: customer-relations@sei.cmu.edu

See the Watts Humphrey books
Winning with Software: an Executive Strategy, Addison-Wesley, 2002
PSP: A Self-Improvement Process for Software Engineers, Addison-Wesley, 2005
TSP: Leading a Development Team, Addison-Wesley, 2006
TSP: Coaching Development Teams, Addison-Wesley, 2006