

# Improving Introductory TSP for Creating High Performance Student Teams

Masanobu Umeda, Keiichi Katamine, Masaaki Hashimoto  
Kyushu Institute of Technology, Japan

Yoshihiro Akiyama  
Next Process Institute Inc., Japan

# Kyushu Institute of Technology (Kyutech)

Founded 1907

Established two Engineering Schools and three Graduate Schools

Major Graduate Schools related to Engineering:

- Engineering
- Computer Science and Systems Engineering
- Life Science and Systems Engineering

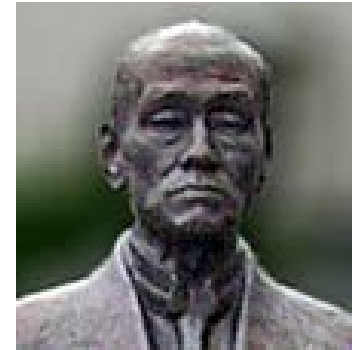
Campuses (Southern Japan):

- KitaKyushu City    *Wakamatsu Campus,*
- Tobata Campus*
- Iizuka City         *Iizuka Campus*



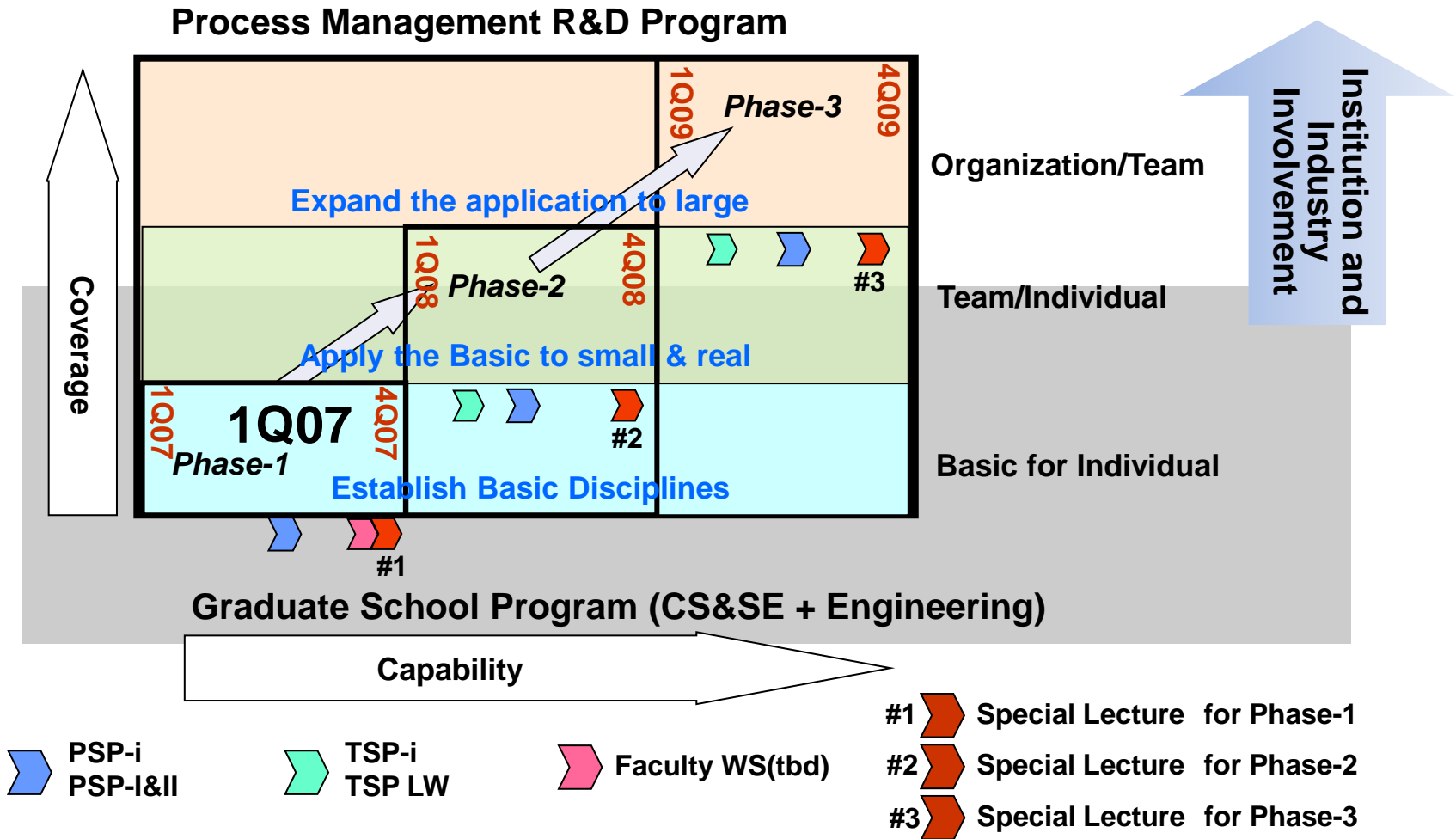
# Practical Engineering Resource Development

- Kyushu Institute of Technology
  - Founded as a private institution in **1907**
  - Develop skillful, accomplished and competent “ladies and gentlemen” with a thorough grasp of general education & technology
  - Fundamental and professional education, and character-building
- School of Computer Science and Systems Engineering
  - Established as the first national faculty focused on computer science and systems engineering in **1986**
  - Introduced new courses based on Personal Software Process (PSP) and Team Software Process (TSP) in cooperation with SEI at CMU in **2007**



**Dr. K. Yamakawa**  
**(1854 – 1931)**

# KIT Approach – three year implementation

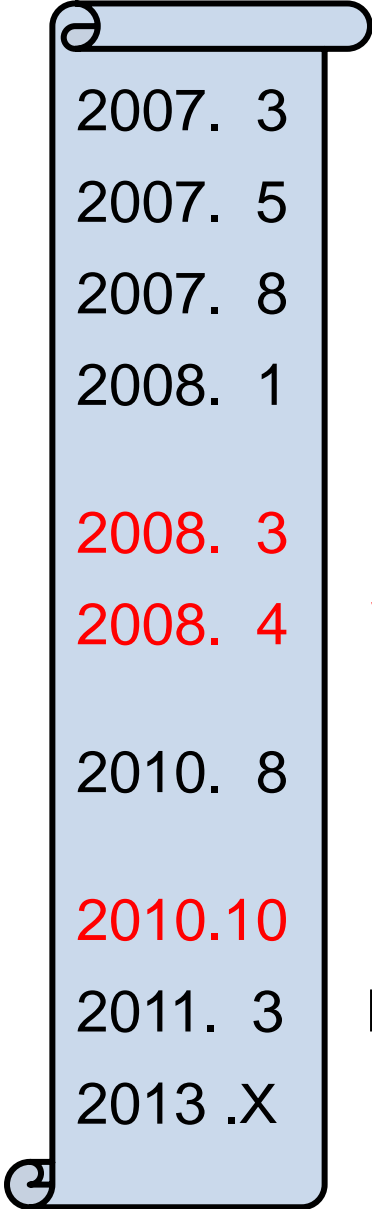


# Dr. Nielsen's Opening Talk

1. Presented to cerebrate **KIT ICT center opening**
2. **Audiences (total about 75)** – Students(25), faculty members(35), companies(15)
3. Shared that software technologies and software process are key for modern product and technology development



# History of PSP/TSP in Kyutech



2007. 3	PSP for Engineers for the staff
2007. 5	Dr. Nielsen – Key note on Software Engineering
2007. 8	PSP/TSP Faculty Workshop
2008. 1	3 faculty members completed PSP Instructor Training
2008. 3	PSP for Engineers for graduate students
2008. 4	Watts Humphrey – IEEE CS SEE&T2008, Teaching Industry-strengthened Software Engineering
2010. 8	Introduction to Personal Process for undergraduates
2010.10	TSPi for graduates students
2011. 3	Managing TSP Teams for undergraduates
2013 .X	<i>New faculty members will take PSP Instructor Training</i>

# PSP Certificate of Completion from Dr. Nielsen and Pres. Shimomura



Sep. 15, 2009



# Special Lecture

## 「View of Balancing Agility and Discipline」

Speaker: James Over

Software Engineering Institute, Carnegie Mellon University

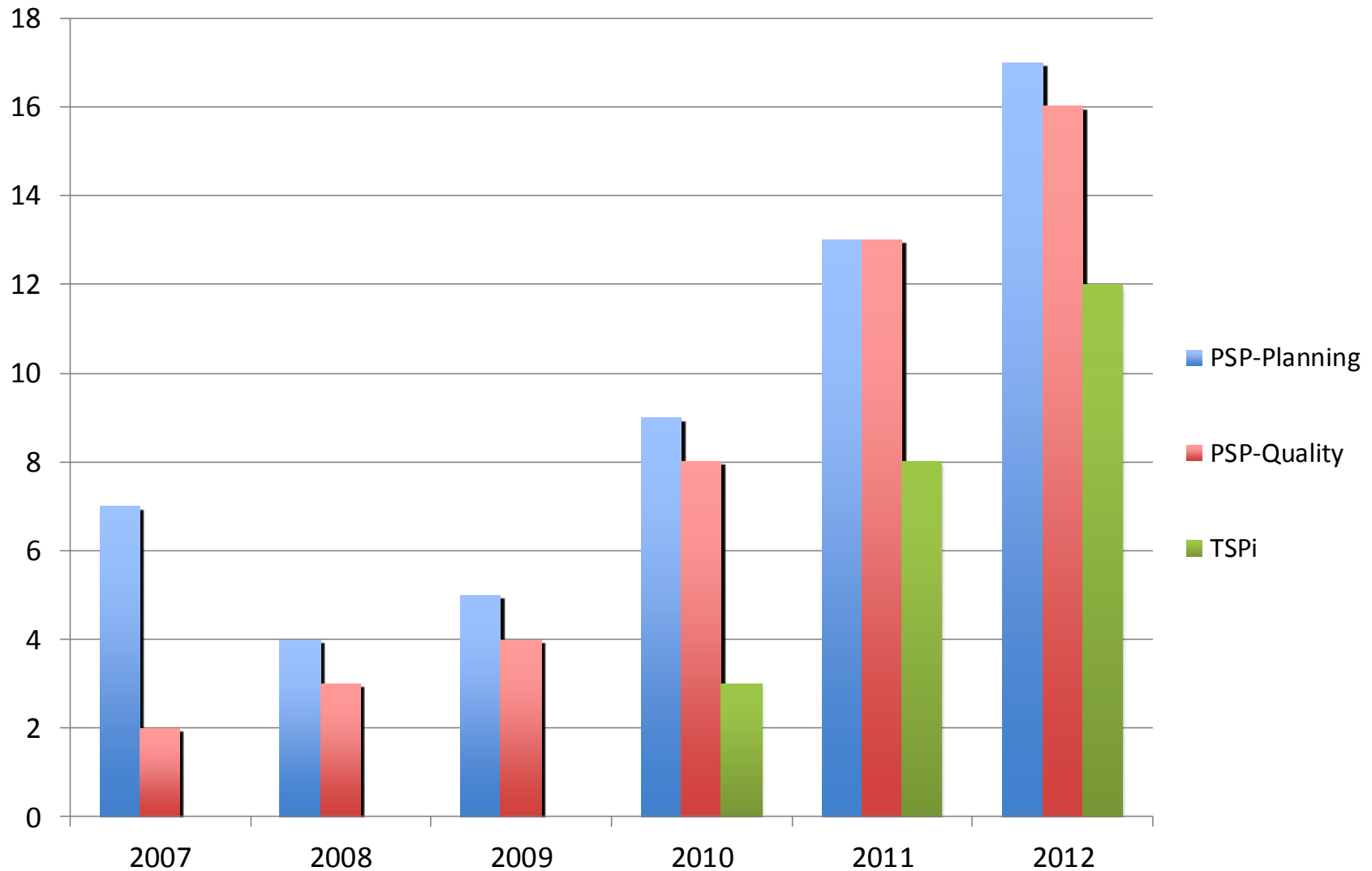
**August 31, 2012**





# Growth of PSP/TSP Courses

#Course Students



# Snapshots of PSP/TSP Classes



# Issues, Resolutions, and Outcomes of PSP Courses

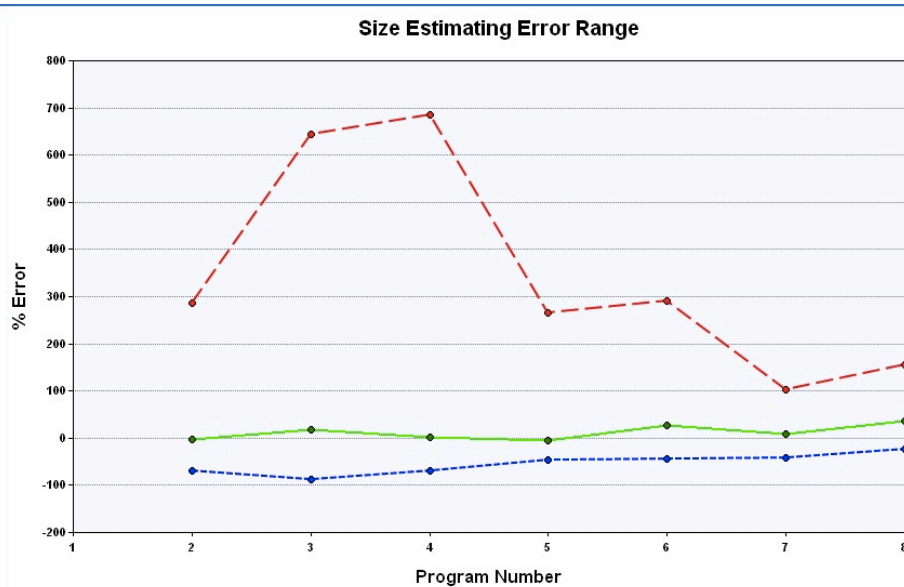
- Lessons from PSP courses before 2010
  - Quality measures indicate nearly success
  - Many students drop out
- Course process improvement
  - (STEP1) Have one day lecture in a week.

After assignment completed, move to the next when possible
  - (STEP2) Reserve lab. time after each lecture.

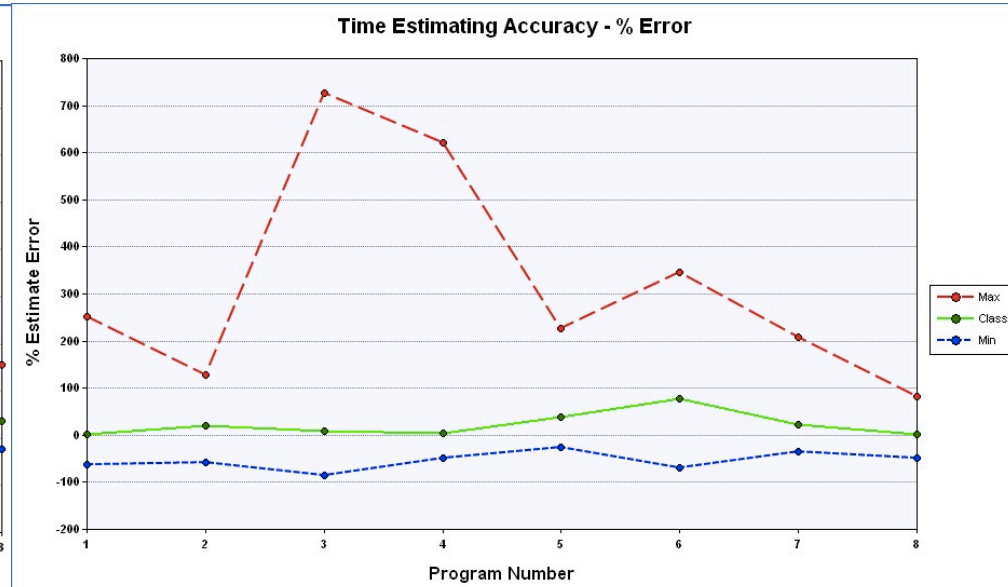
Let students finish planning phase in the lab. time
- Course outcomes
  - Estimation improvement
  - Quality improvement
  - Course completion ratio

# Size and Time Estimating Errors (2007-2012)

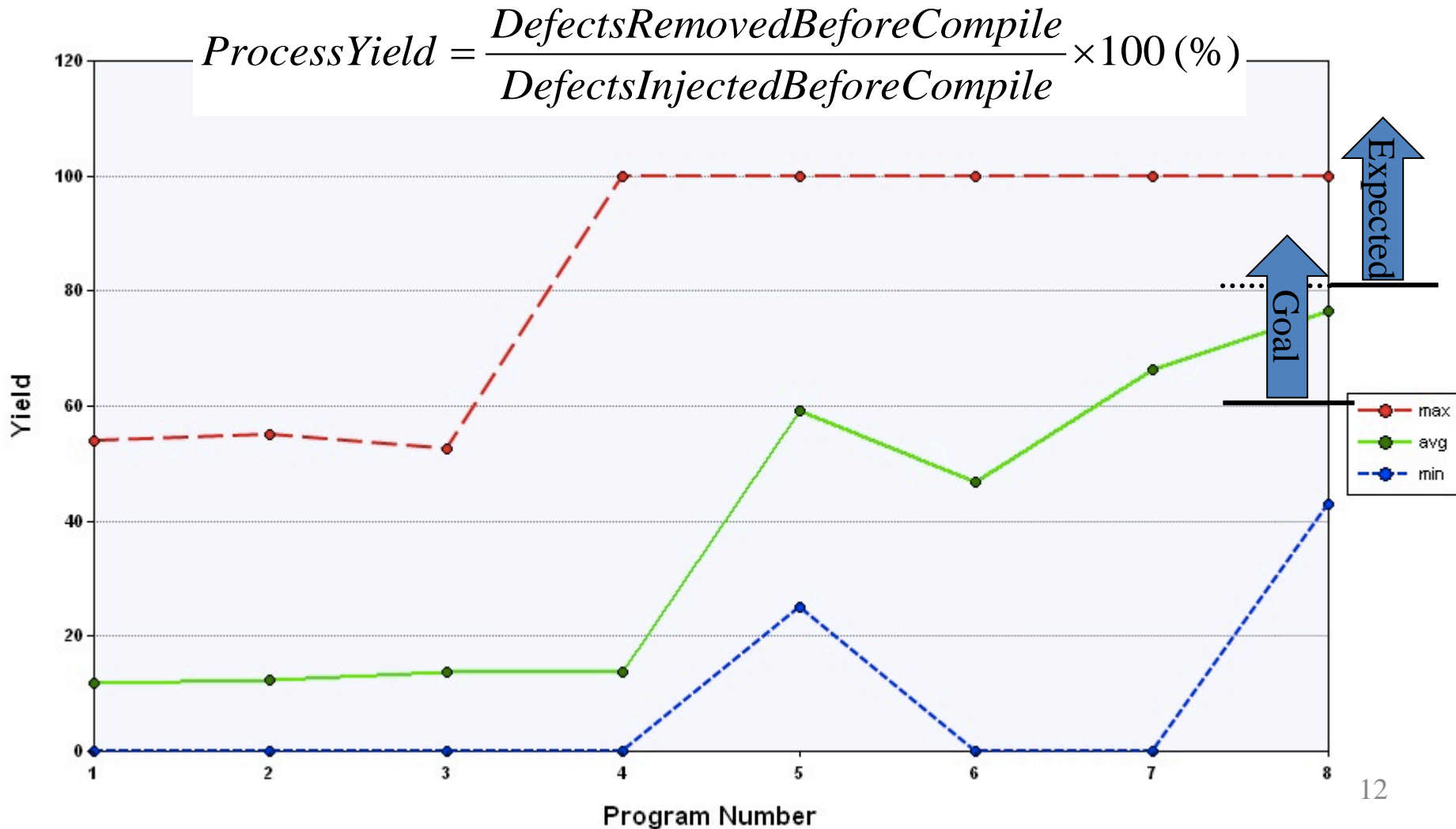
## Size estimating error



## Time estimating error

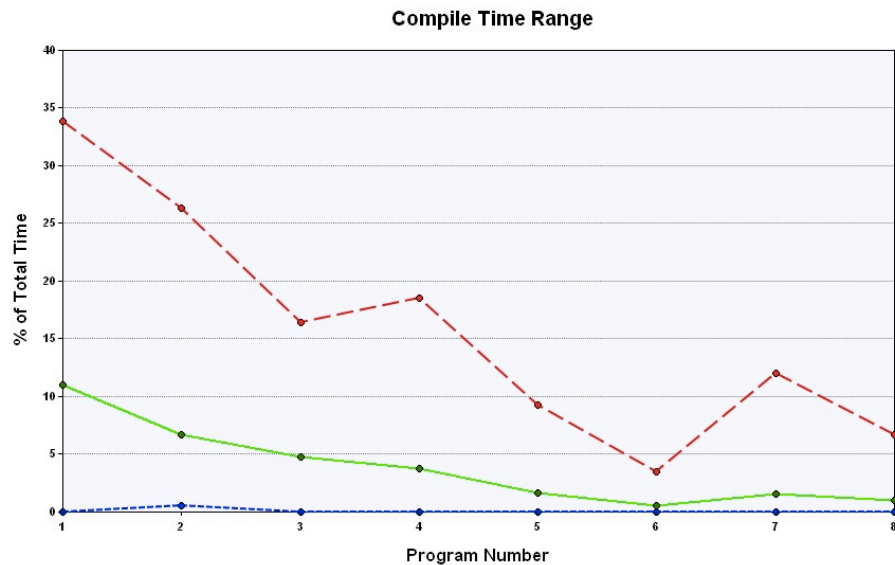


# Process Yield (2007-2012)

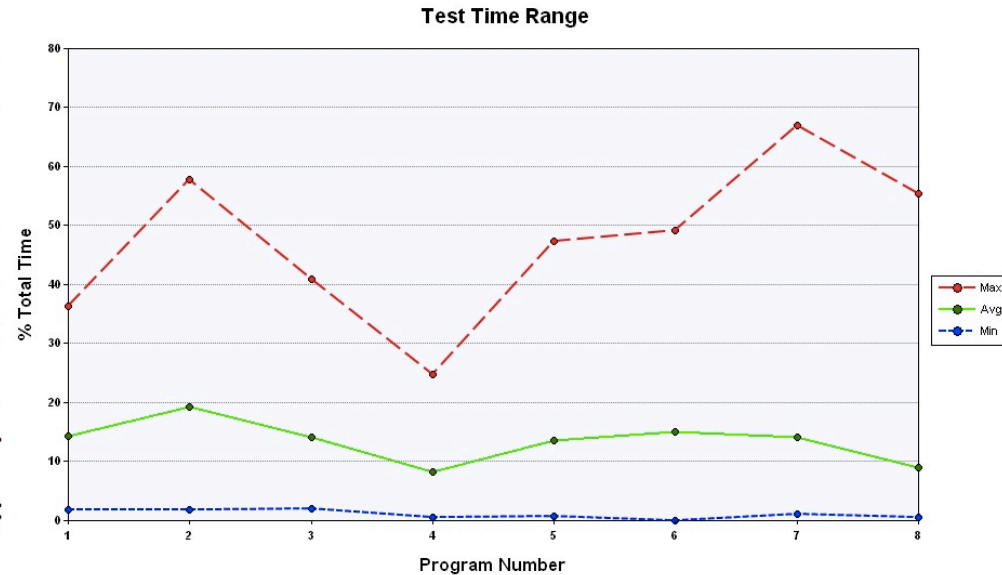


# Compile and Test Time Ranges (2007-2012)

## Compile Time Range

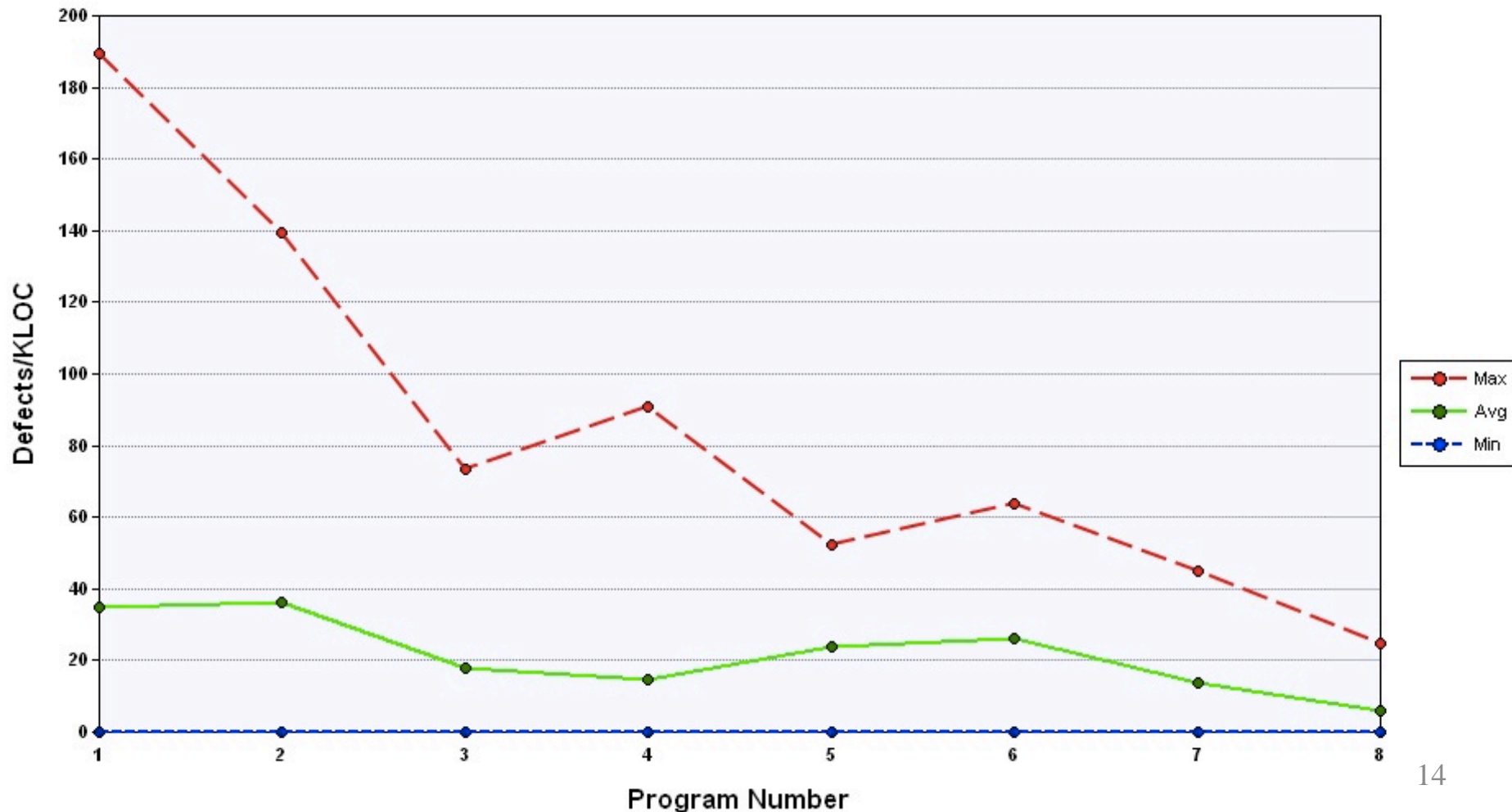


## Test Time Range



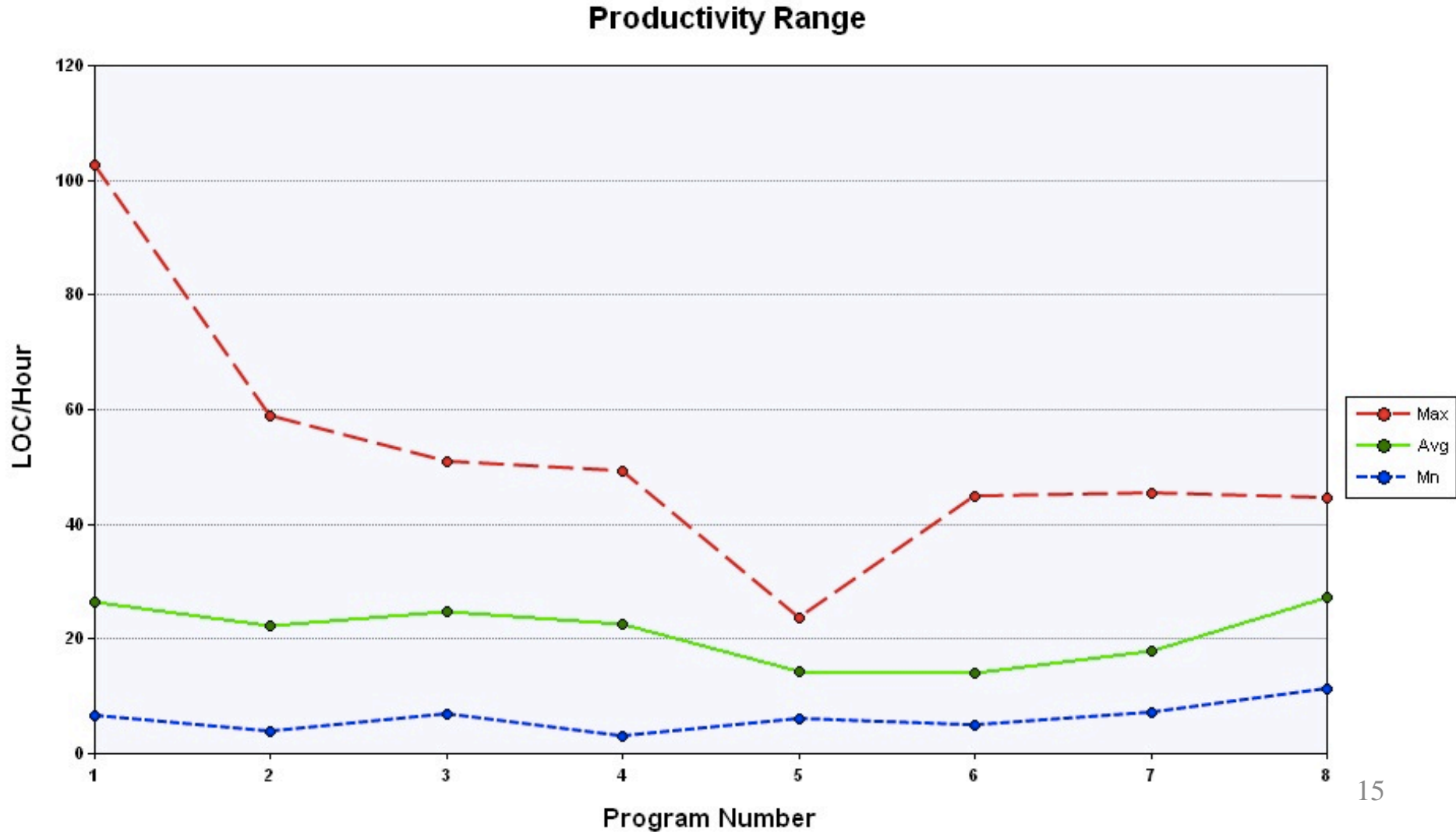
# Defect Density in UT (2007-2012)

Defects Found in Test - Range



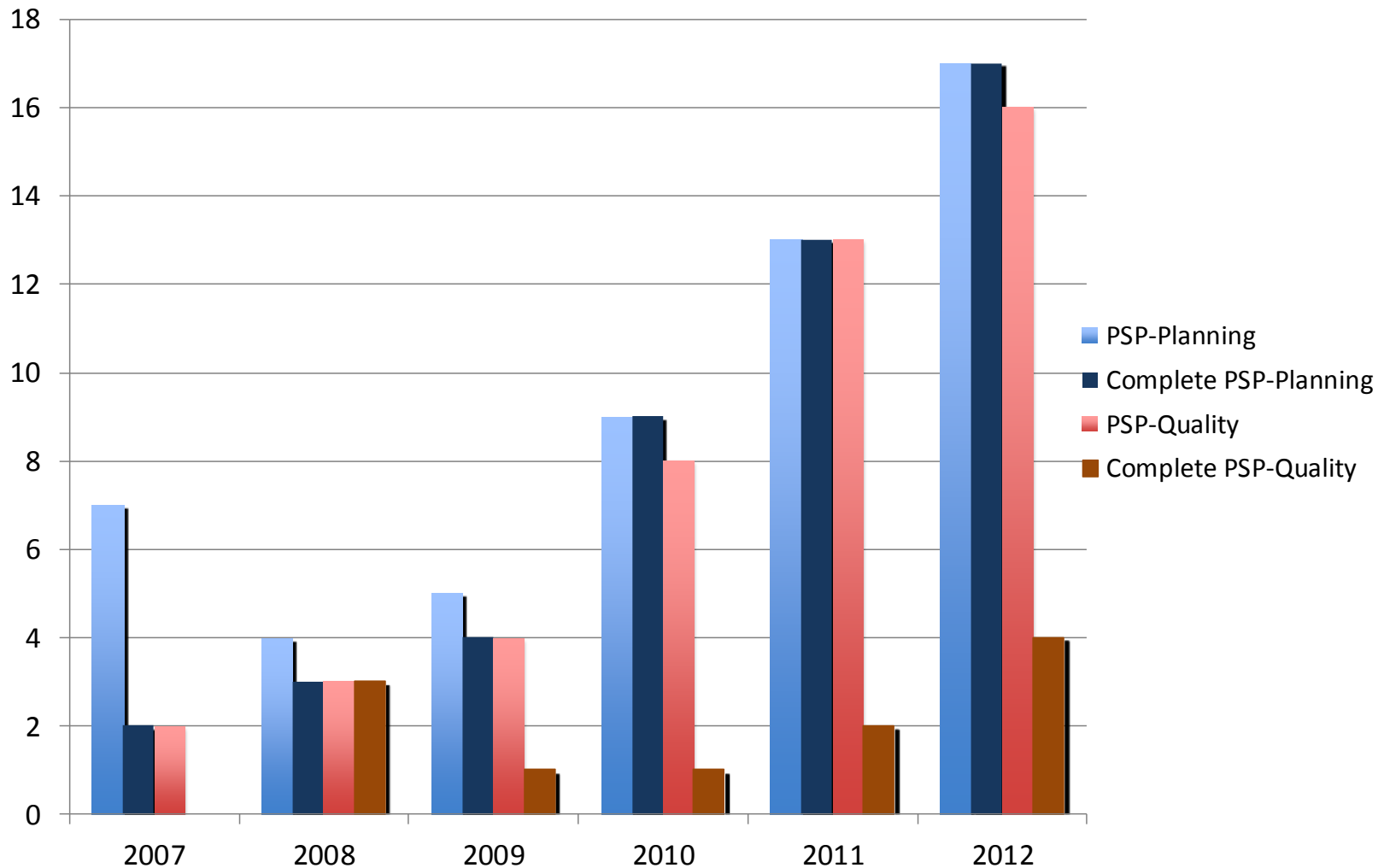


# Productivity (2007-2012)



# Completion of PSP Courses

#Course Students

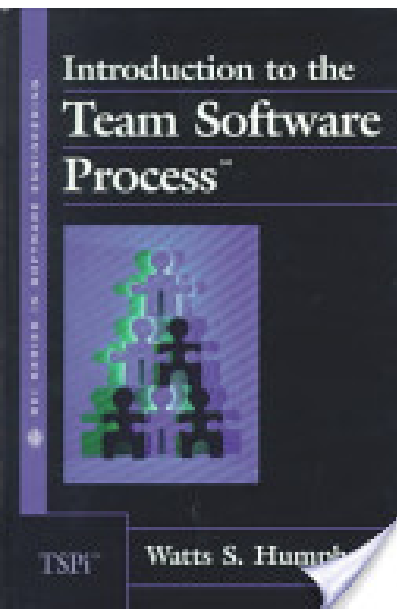
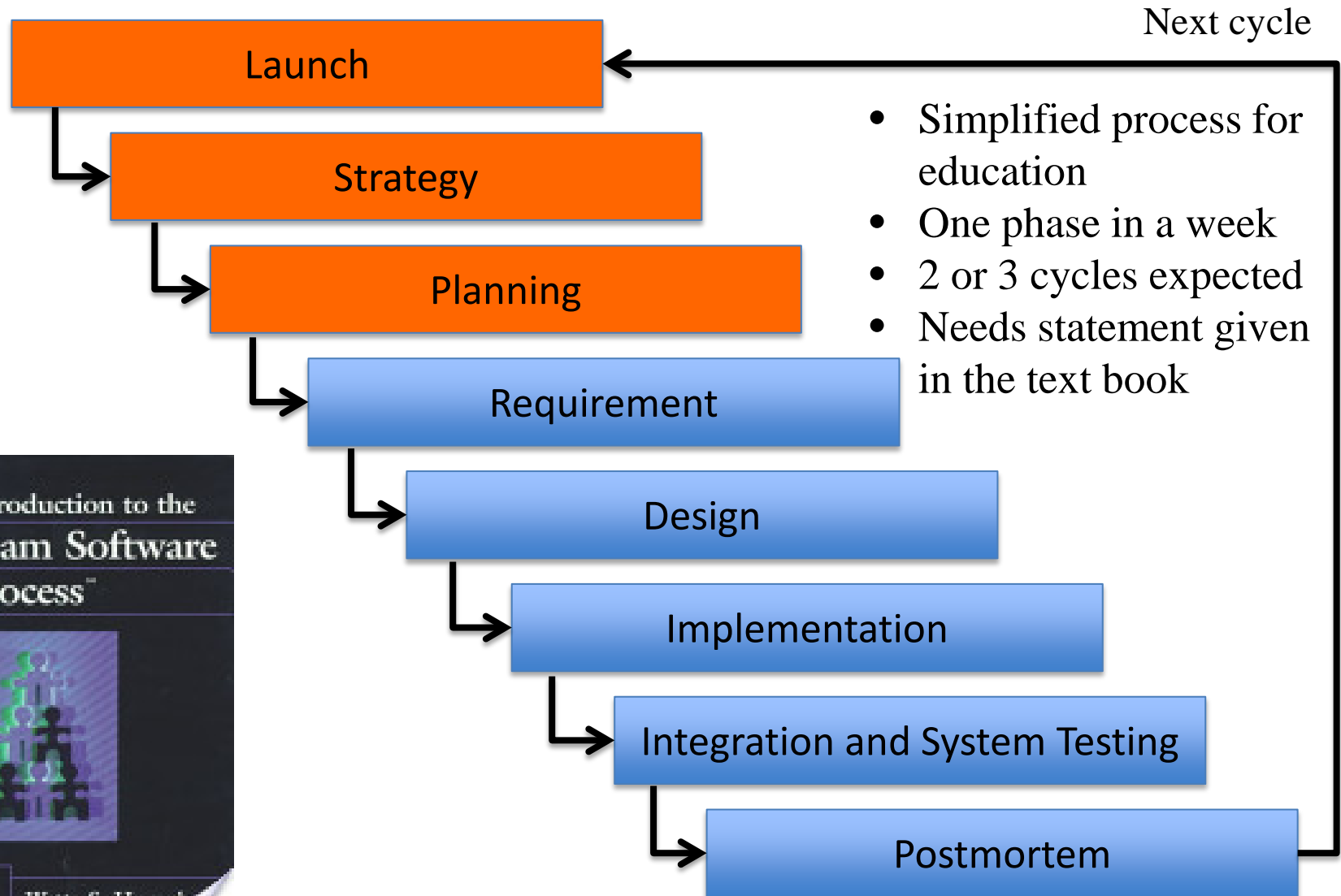


# Summary of PSP Course Results

- Size and time estimating errors
  - Estimation and trace can be done based on the process discipline
  - Errors reduced as the course progress and balanced well
- Product quality
  - Process yield  $\geq$  about 80% in average
  - 190 Defects/KLOC  $\rightarrow$  25 Defects/KLOC even in worst case
  - 35 Defects/KLOC  $\rightarrow$  under 10 Defects/KLOC in average
- Productivity
  - Nearly equal before and after the courses
  - May be improved after the courses
- Course completion ratio
  - PSP for Engineers –Planning: 100% since 2010
  - PSP for Engineers –Quality:  $\leq$  25%

# Student TSPi Teams and TSPi Course Improvement

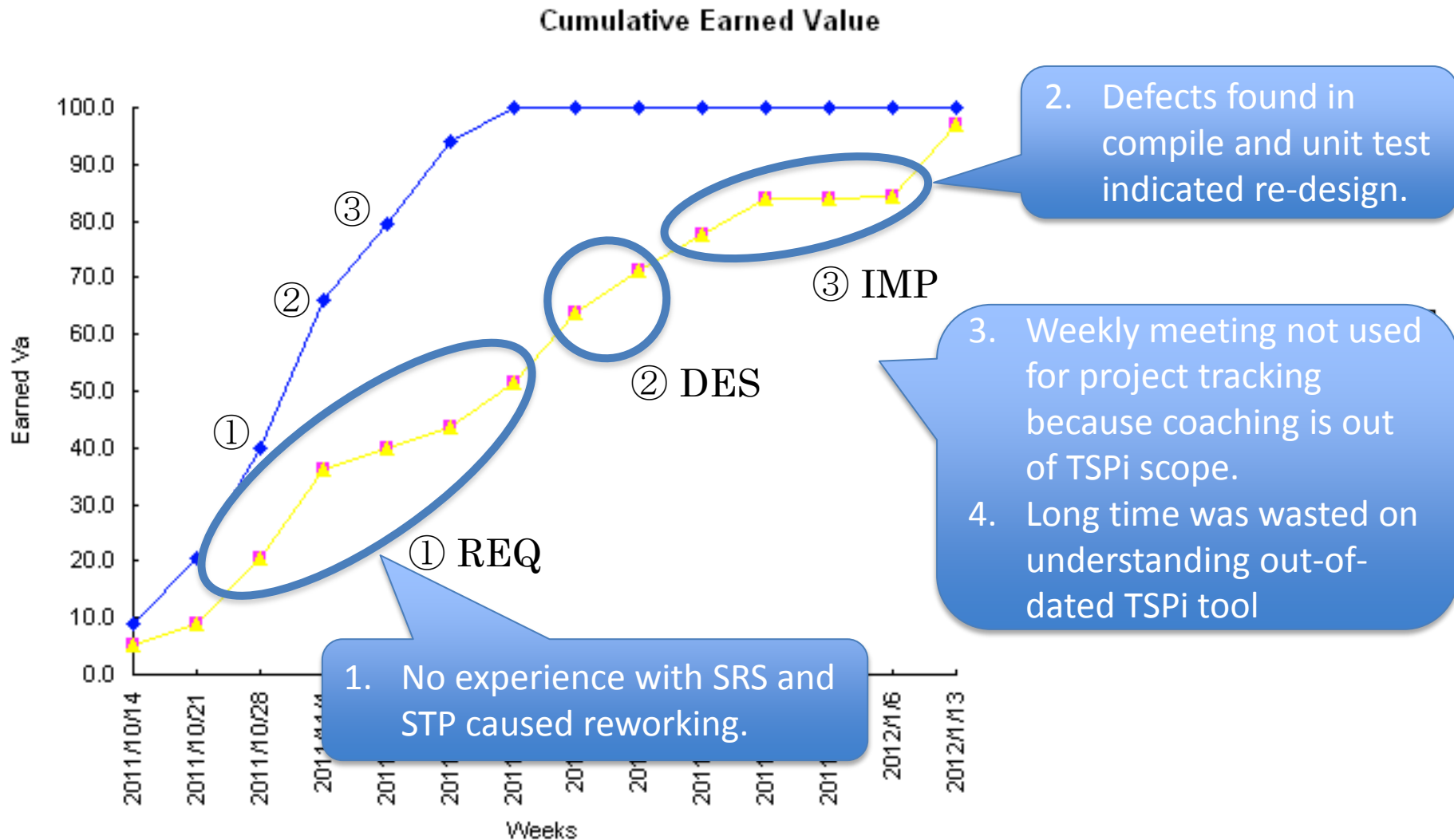
# TSPi Process Structure



# Results of Student Teams in 2011

- Project overview
  - Two teams of 4 members
  - All team members completed PSP-I at least
  - Development of “change counter” system
- Quality
  - One team has **no defects in system test**
  - But, test cases might not be enough (41.7LOC/test case)
- Schedule
  - Schedules of both teams delayed a lot
  - One team could not finish cycle 1
  - The other team completed only cycle 1 (delayed double)

# Cumulative EV of Team-J in 2011





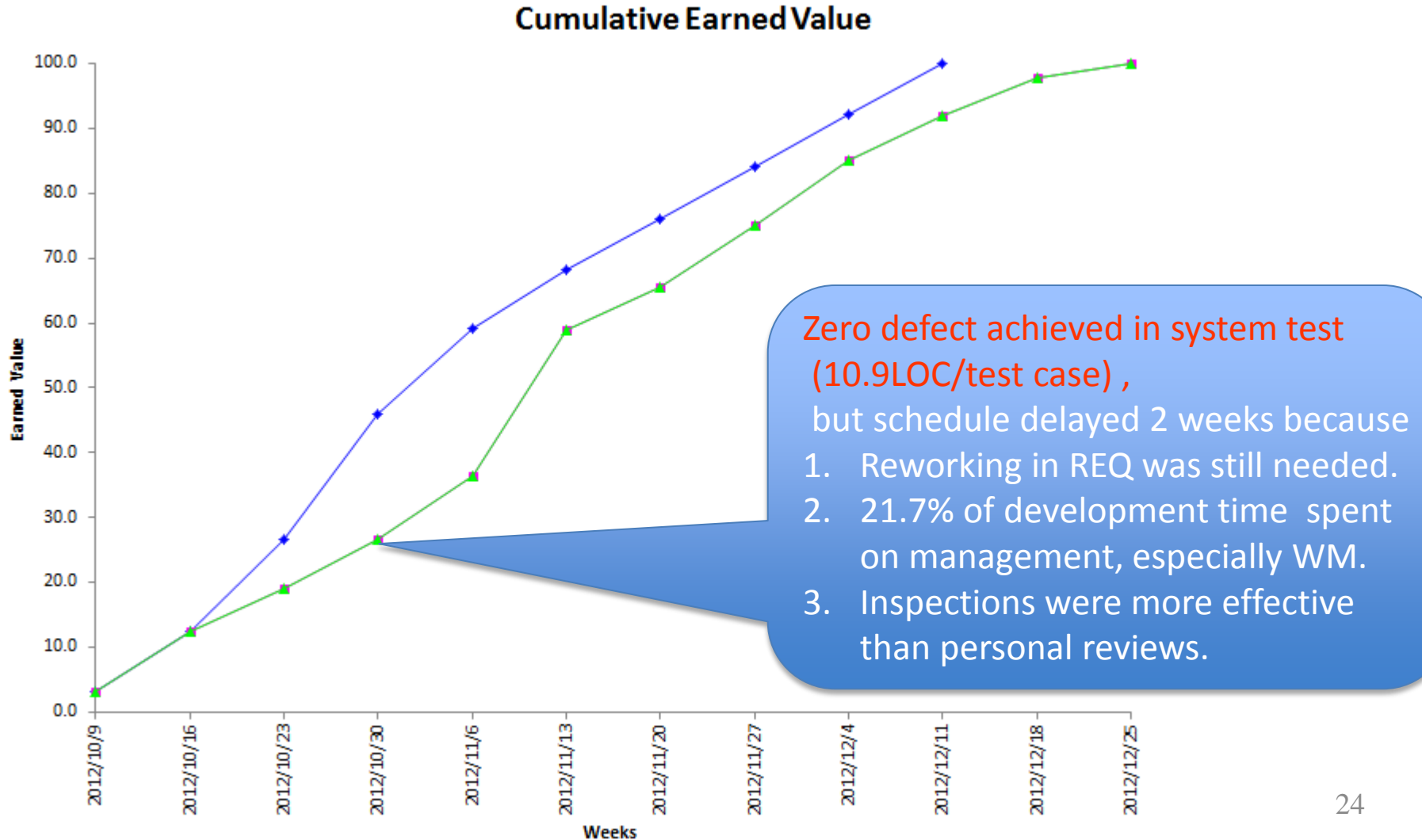
# Improvement Actions for TSPi Course in 2012

- Lack of engineering knowledge
  - Provide more detail introduction of Software Requirement Specification and System Test Plan with helps of other lectures
- Unfamiliar tasks in TSPi process
  - Take TSP Coach Training
  - Have weekly meetings at the beginning of a class
- Out-of-dated TSPi tool
  - Introduce the latest version of TSP tool with helps of SEI

# Remarkable Results of Student Teams in 2012

- Project overview
  - Two teams of 6 members
  - All team members completed PSP-I at least
  - Development of “change counter” system
- Quality
  - No defect, and 1 defect in system test in cycle 1
  - No defects in system test in cycle 2
- Schedule
  - Delayed 2 and 4 weeks in cycle 1
  - Finished on time in cycle 2

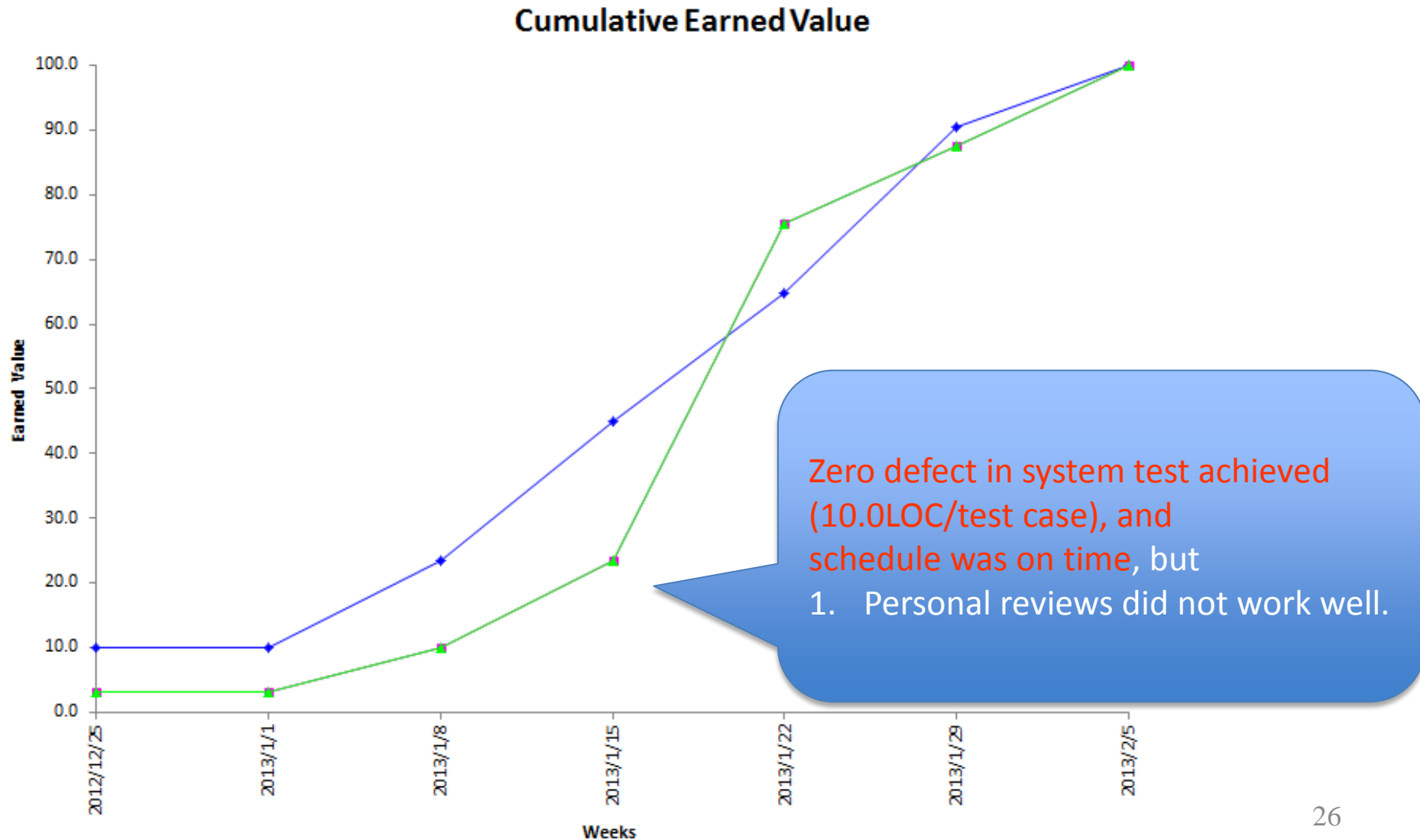
# Cumulative EV in Cycle 1 of Team-O in 2012



# Process Improvement Proposals of Team-O for Cycle 2

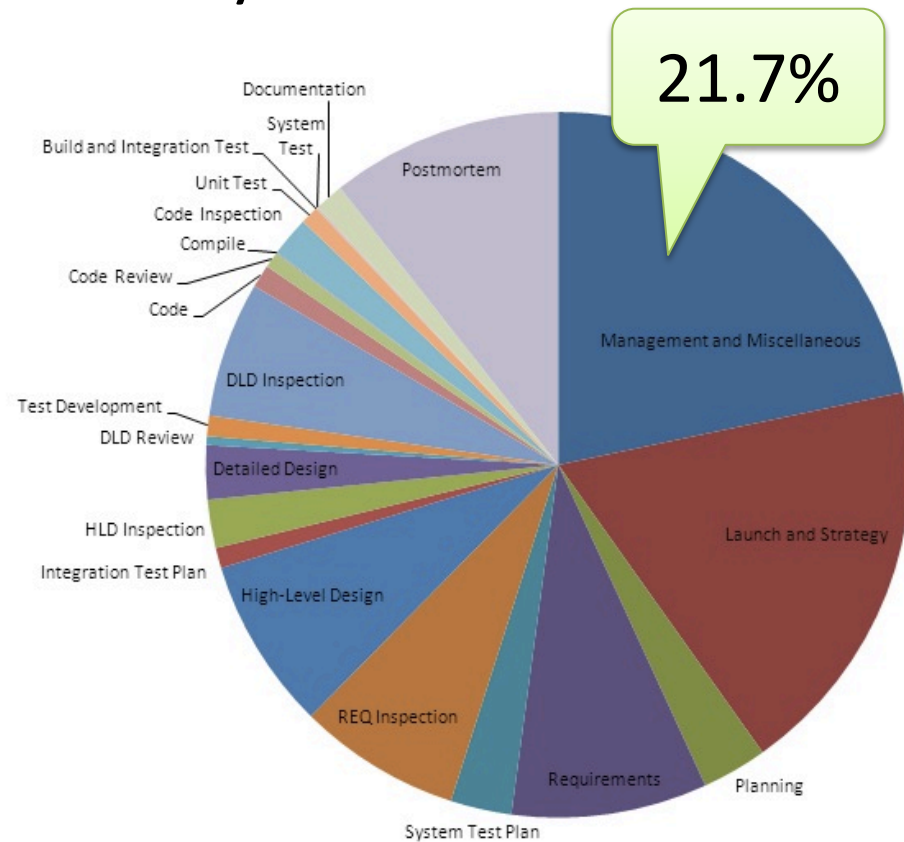
- Personal review rates
  - Agreed on reviews according to planned time
  - Update checklists based on defects in cycle 1
- Management time
  - Agree on enough preparation for weekly meetings
  - Team leader sends notification mails before WM
- Efficient communication
  - Introduce distance communication using Skype rather than team meeting

# Cumulative EV in Cycle 2 of Team-O in 2012

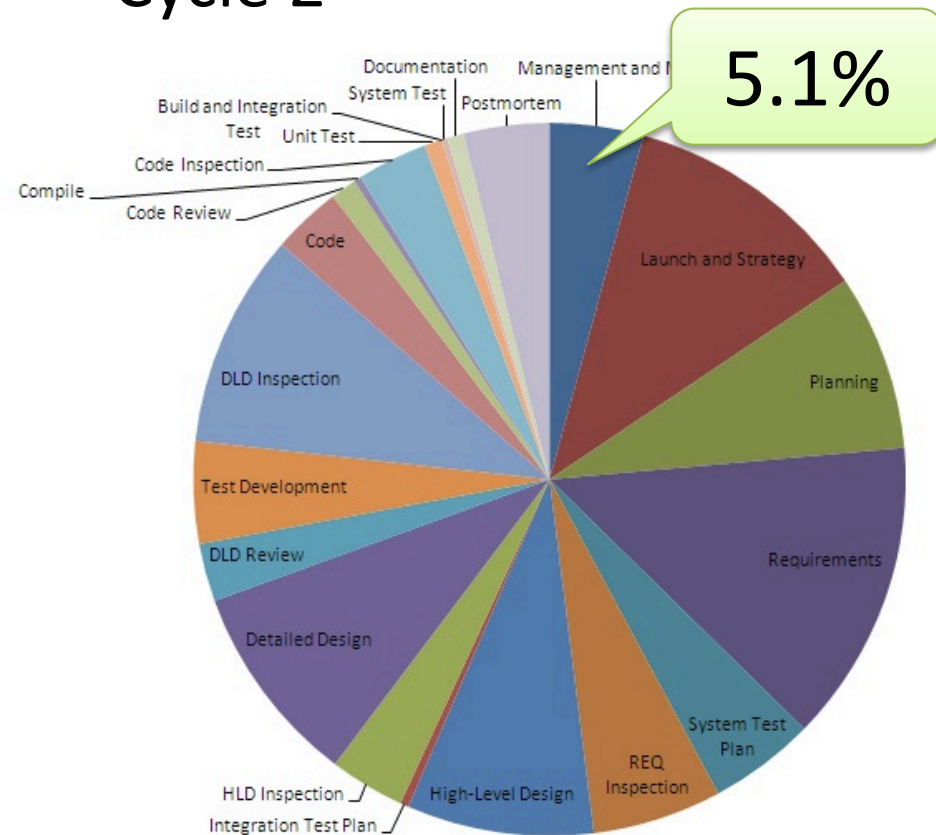


# Times in Phase Percent of Cycle 1&2

- Cycle 1



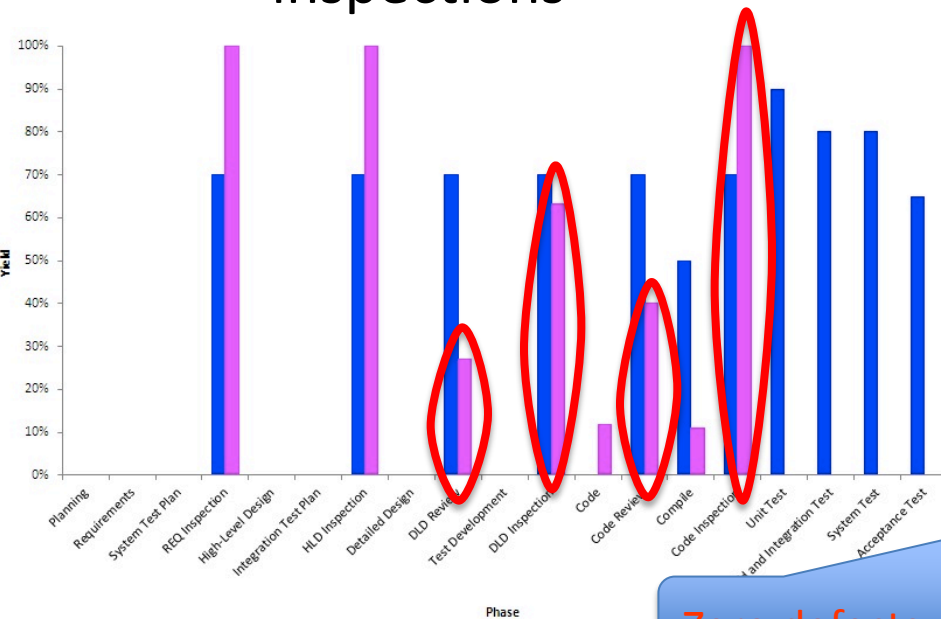
- Cycle 2



# Phase Yields of Cycle 1 & 2

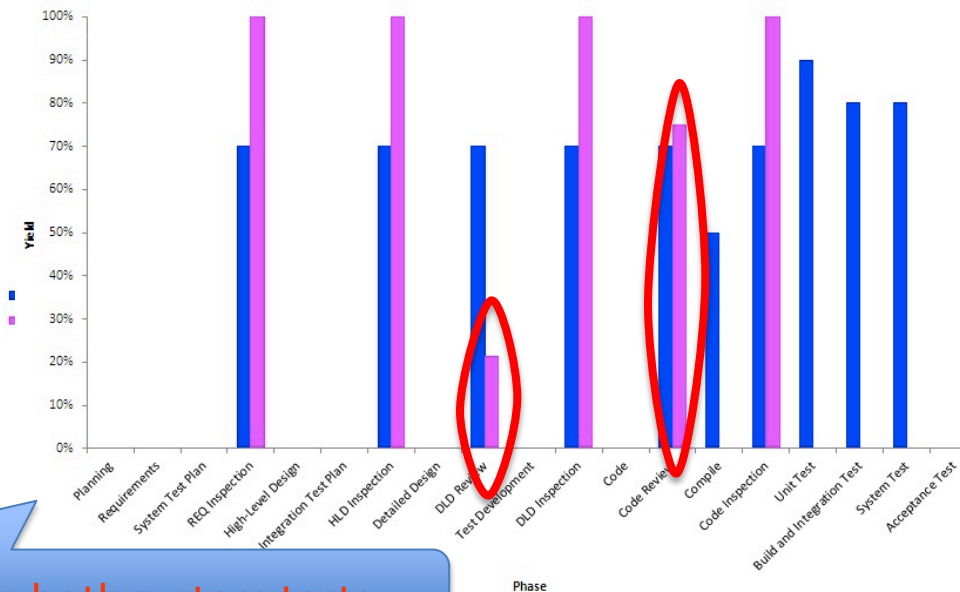
- Cycle 1

- Reviews did not work well, but instead most of defects removed by inspections



- Cycle 2

- DLD Reviews still did not work well



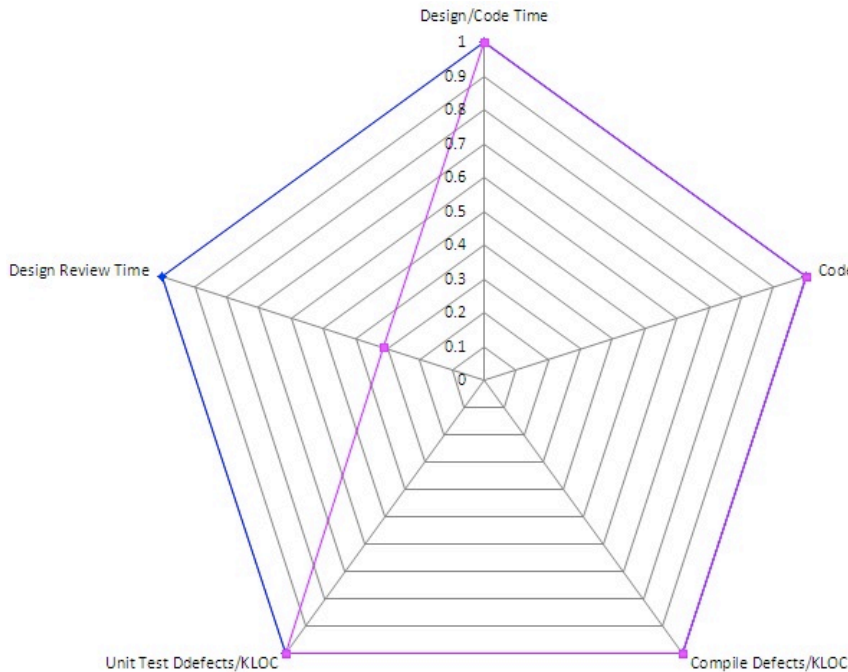
Zero defects in both system tests.



# Quality Profiles of Cycle 1 & 2

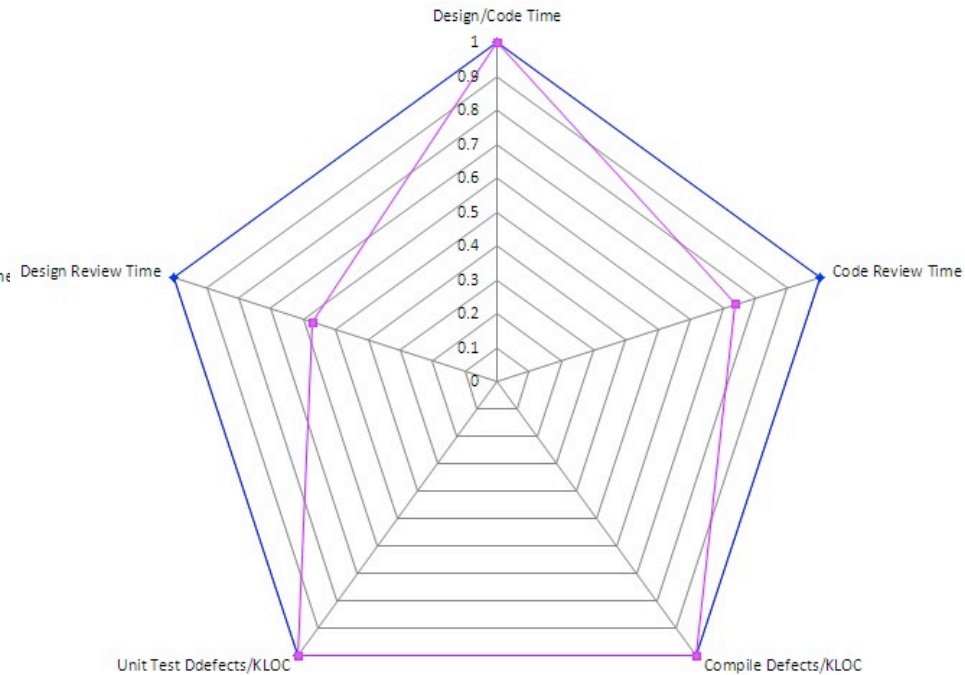
- Cycle 1

- PQI = 0.314782



- Cycle 2

- PQI = 0.422543



# Team Goals Status in Cycle 2

## 1. High quality product

- Defects removed before compile: 93.5% > 80%
- Defects removed in system test: 0 defect < 0 defect

## 2. Productive and well-managed project

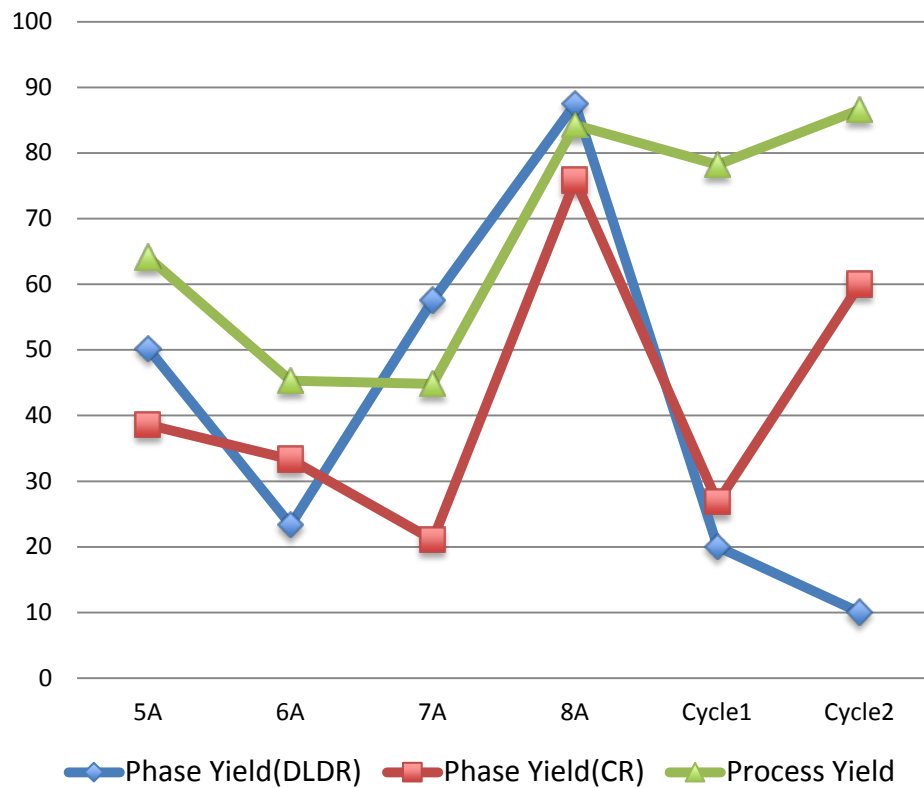
- Size estimation error: 36.7% < 20%
- Time estimation error: 17% < 20%

## 3. Finishing on time

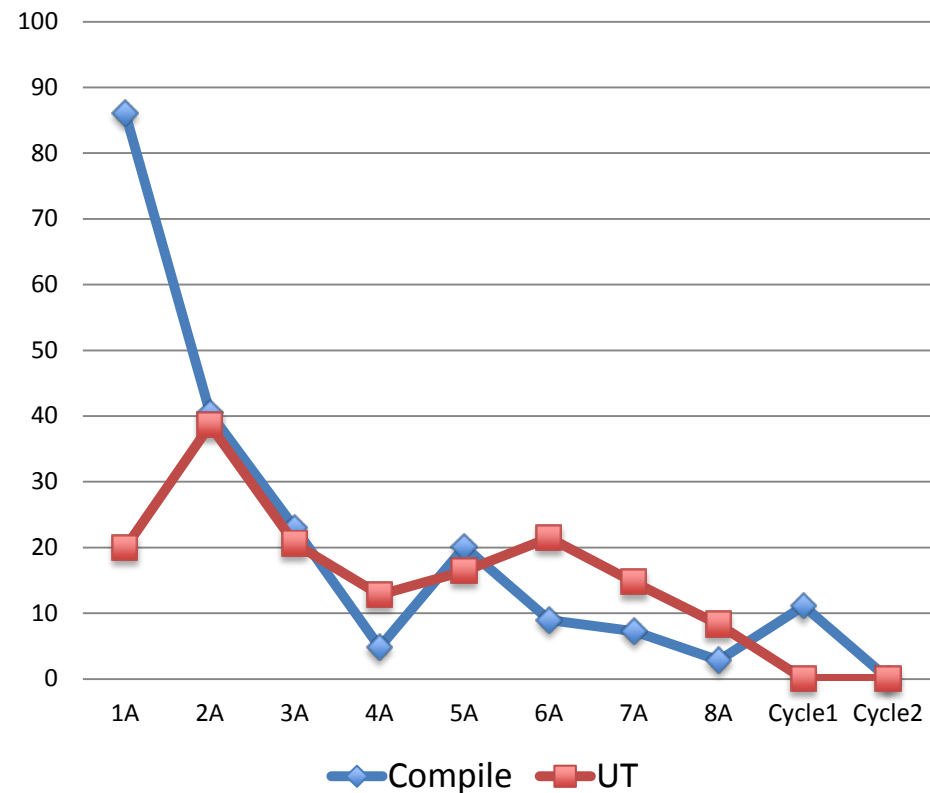
- Schedule delay: 0 week < 2weeks

# Yield and Defect Density of PSP and TSPi

## Yield



## Defect Density



# TSPi is an Effective Companion to PSP for Learning Software Process

- Effective for understanding the fundamentals of software development process in a team
  - Member roles clarify **things to do for a team**
- Experience with successful project
  - Understand **essentials to succeed** even if failed
- Opportunity of understanding why PSP is so important to learn
  - Discipline, process, planning, quality, ...
  - **Some unfinished students took PSP after TSPi again**

# Enabling TSPi to be Practical for Creating High Performance Student Teams

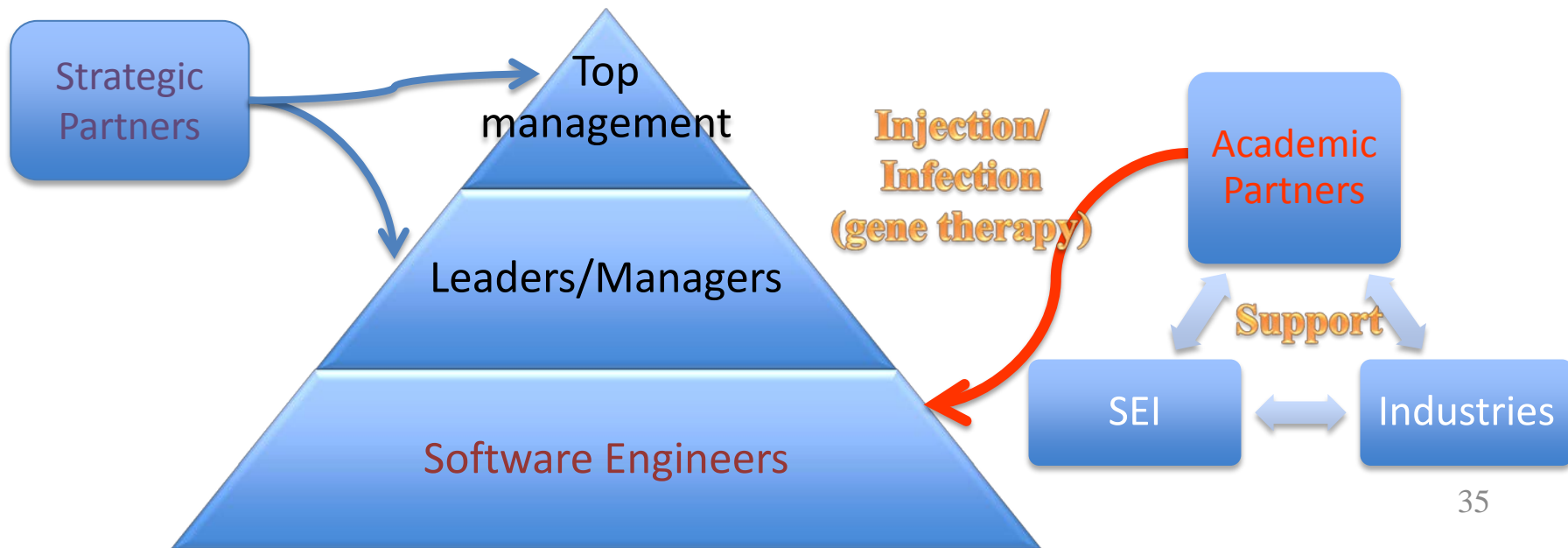
- Providing supplementary software engineering knowledge
  - Software Requirement Specification, System Test Plan
- Coaching teams in all TSPi processes
  - Preventing misunderstanding of TSPi processes
  - Resolving technical and motivational problems
- Establishment of personal reviews in PSP course
  - Completion of PSP 2.0 or later is strongly encouraged

# Conclusions

- PSP course for graduate students
  - Performance results similar to those of industry
  - Course completion ratio is still insufficient
- TSPi course for graduate students
  - Zero defect in system test is a realistic goal
  - Effective for understanding the fundamentals of software development process in a team
  - Coaching is essential for student teams
- Future research
  - Motivational process model of PSP attendees for monitoring and managing students' motivation

# Practical Strategy of TSP/PSP Deployment

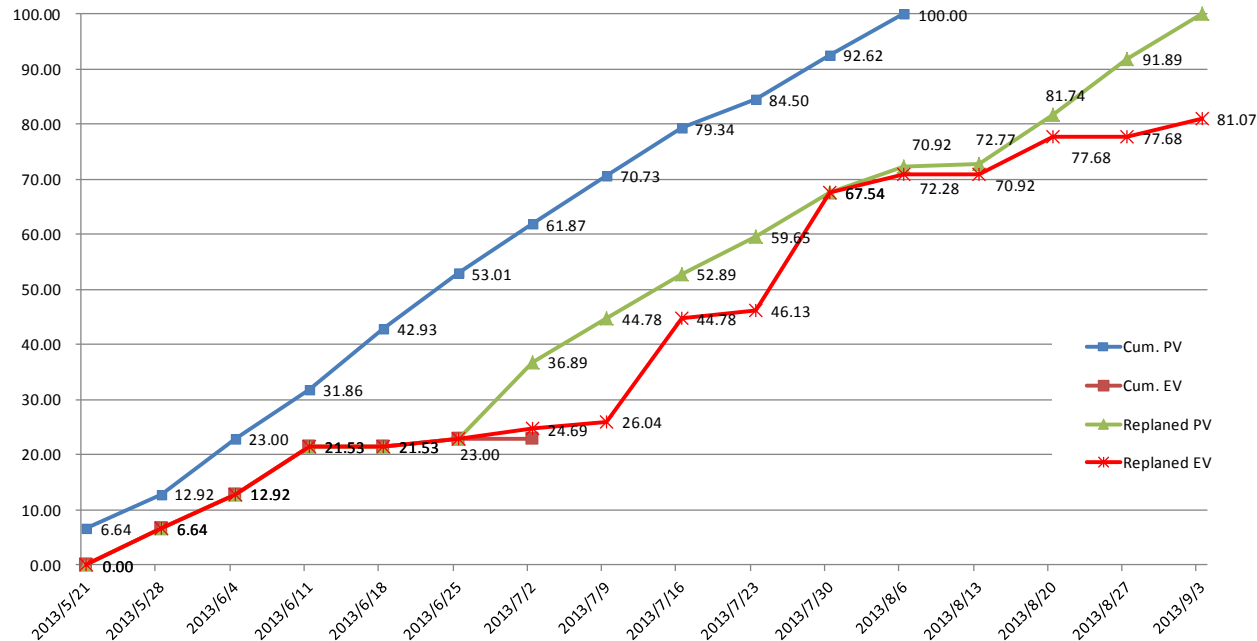
- Injection/Infection Model
  - Software management culture changed from academic education
  - Skillful, accomplished and competent students will play a key role to deploy PSP/TSP in industry





Thank you for your continuous  
strong support

# After the TSPi Course: Development of Transferred Patient Support System



- Size estimation error
  - SW Req. Spec.: -69.7[%] (Plan: 10pages、Actual: 33pages)
  - High Level Design: -26.6[%] (Plan: 22pages、Actual: 30pages)
- Time estimation error
  - In total: 29.5[%] (Plan: 151Hr、Actual: 117Hr)
- Defect density
  - SW Req. Spec.: 0.48defects/page

