Maximizing the Effectiveness and Efficiency of Software Inspections

SEPG 2005

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How many of your organizations

- **are doing inspections?**
- **are collecting data?**
- **are analyzing the data?**
- **are using the data for corrective actions and process improvement?**

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Rigorous Inspections

A review of a work product,

which passes stated entrance criteria,

led by a moderator who is not the author,

that seeks and records defects in that work product,

uses product specific checklists,

uses scenarios and/or other effective reading techniques,

initiates and monitors rework as necessary,

initiates re-inspection based on stated criteria,

passes or fails the work product based on exit criteria,

and adds to the base of historical data.

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Background

Material in this presentation resulted from work done by many different people in many different projects and organizations since 1974

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Inspection Effectiveness

- Percentage of the defects in the work product being identified
- Teams doing rigorous Inspections can typically start around 50%
- Can go as high as 90+%

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Inspection Efficiency

The business value

The hours per defect

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Why Do Rigorous Inspections?

A business decision

To remove defects at the point of lowest cost

- **Requires "cost data" for each defect removal activity**
  - **Use hours per major defect for inspections and test**
  - **If no hard data use an approximation**

    a Delphi type of data gathering

    divide total test activity effort hours by defects found

You need to make the comparison visible to support this decision

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Minimize “Bureaucracy”

When defining an inspection process

- **Keep everything as simple as possible**
- **Do not collect any data you will not use/analyze**
- **Ensure people understand how the data will be used/analyzed before collecting it**
- **Ensure that techniques critical to effective inspections are properly included (e.g., how to read, mapping to predecessor work product)**

This will ensure a reasonable degree of efficiency

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Where Should You Initially Focus?

Focus on effectiveness first

- **Why make a process which is less effective than desired more efficient?**

But where will many managers want to focus first?

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Effort To Inspect 1kloc of Code

Assume

- **Modification to existing code and uplift factor is 5**
- **Optimum rate is 100 lines of executable code per hour**

Effort required

- **1kloc + 5 kloc = 6 kloc to inspect**
- **Preparation time is 60 hours**
- **Inspection time is 60 hours**
- **Total effort required for each participant is 120 hours!**

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Key Enablers For Rigorous Inspections

Champion

- **Volunteer not a draftee!**

Metrics Policy

- **Sample at end of presentation**
- **Must have an Ombudsman**

Capacity plans

Training

Data definitions

- **Especially for loc and major defect**

Checklists

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Areas for focus

Planning and scheduling inspections

- Capacity planning and schedule refinement
- Just in Time (JIT) code inspections
- Selection criteria

Performing Inspections

- Mapping
- Reader role and use of scenarios
- Product and domain specific checklists

Data analysis and use

- Stages to go through
- Some key analysis and uses
- Some key data elements and granularity needed

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Planning and Scheduling

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Capacity planning and schedule refinement

First ensure time for activities is allocated into overall plan

- **Use data to determine amount of time to block out**
- **How much will be written?**
- **What % is the target for inspecting?**
- **If it is a modification of existing software what is the uplift factor?**
- **If you do not have optimal rate data for you project**
  - **Start with reasonable rates**

    Requirements: 3 to 12 pages per hour

    High Level design: 3 to 8 pages per hour

    Low Level Design: 100 to 200 pseudo code lines per hour

    Code: 100 to 150 lines of code per hour
- **How many attendees? Who? Allocate the time!**

As you get close to completing various pieces continuously schedule specific inspections using the selection criteria

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Inspection timing and unit test

Do you inspect before or after unit test?

There are two questions which can help the technical people decide the right answer for their product/project

- **What are the hours per defect for Inspection and unit test?**
  - **Which is cheaper?**
- **If unit test is lower what are the attributes of the defects found in Inspections and unit test?**
  - **If unit test finds code problems and Inspection finds both code and design problems which should be done first?**

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Just in Time (JIT) code inspections

- Do capacity planning
- Block out time each day for preparation and the inspection meeting
- Select code to be inspected 1-5 days prior to its being completed
- Prepare for the Inspection the afternoon it is completed
- Hold the inspection meeting the next morning
- Works best when code is being written in incremental “chunks”

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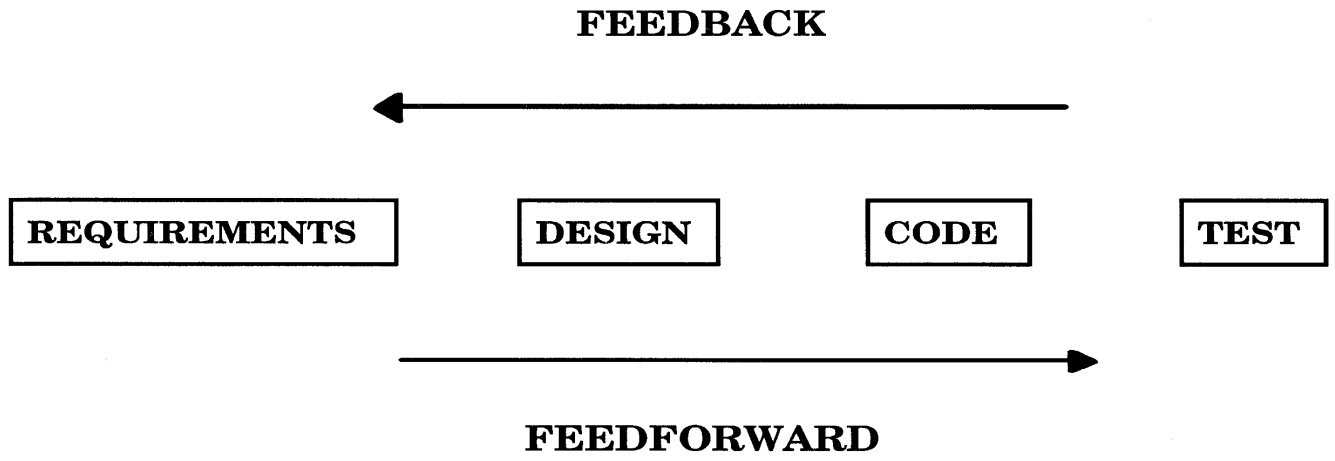
Selection criteria

If you can not inspect everything consider two separate criteria

- Critical function, especially from an end user perspective
- Defect density; go where the bugs are

Consider using the notion of “feed forward” along with historical defect density



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Performing Inspections

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Mapping

There are two types of defects

- **Something does not work**
- **Something works but is not what was intended or needed**

By using documents or other appropriate work products created earlier in the life cycle the Inspections can

- **Ensure that the refinement accurately reflects what was intended**
- **Ensure that any necessary interpretation was consistent and accurate**

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Reader role and use of scenarios

The reader would lead the team through the material during the Inspection meeting

The material can be reviewed

- **Sequentially**
- **Functionally**
- **Driven by design flows**
- **Driven by test scenarios or use cases**
- **The material can be**
  - **"Read" directly (when justified)**
  - **Paraphrased (most typical approach)**
  - **Both**

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Product and domain specific checklists

- Do all products have the same types of defects?
- Use checklists to help ensure consistency across Inspections
  - Try to limit checklists to 1 page
- List common or frequently occurring problems and ensure that they are always checked
  - Need to be specific for your products and your environment
- List any specific critical items for your project or domain for the inspectors to check for
- Direct relationship with data analysis (e.g., Pareto charts)

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Data Analysis and Use

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Stages to go through

1 of 2

Have clear definitions for key data elements

- Size, preparation time, Inspection time, Major and Minor defects, number of inspectors

Identify inconsistencies in recorded data and take corrective actions; do this as you start to collect data…do not wait!!

- Requires that you use the data you collect!

Identify the key ratios you want to use and train people on how to calculate and use them

- Amount of material per hour (e.g., loc/hour) for preparation and the Inspection meeting
- Defect density; major defects/size (e.g., defects/page)
- Hours/major defect; can be considered the "cost"
  - As long as this is less than test doing Inspections makes good business sense!

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Stages to go through

2 of 2

Analysis and use

- **Common sense!**
- **Use basic data and ratios for planning**
- **Use basic data and ratios for tracking**
  - **Compare to prior similar projects**
  - **Compare to industry data**
- **Use simple scatter charts for optimization**
- **Use Inspection data to forecast test and customer defects**
- **Put inspections (as appropriate) under SPC**

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Who does the analysis?

- The technical people must be involved
- Who else can explain what the numbers really mean?

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Inspection optimization

Consider optimizing inspections before stabilizing the process (SPC)

Start with scatter charts; if appropriate use linear regression

Ensure appropriate rationale sub grouping

Some typical scatter charts

- **LOC/hour vs. Major defects/KLOC**
- **LOC/hour vs. Hours/Major defect**
- **Segment these two charts by size**
- **Segment these two charts by number of inspectors**
- **Look for other relationships**

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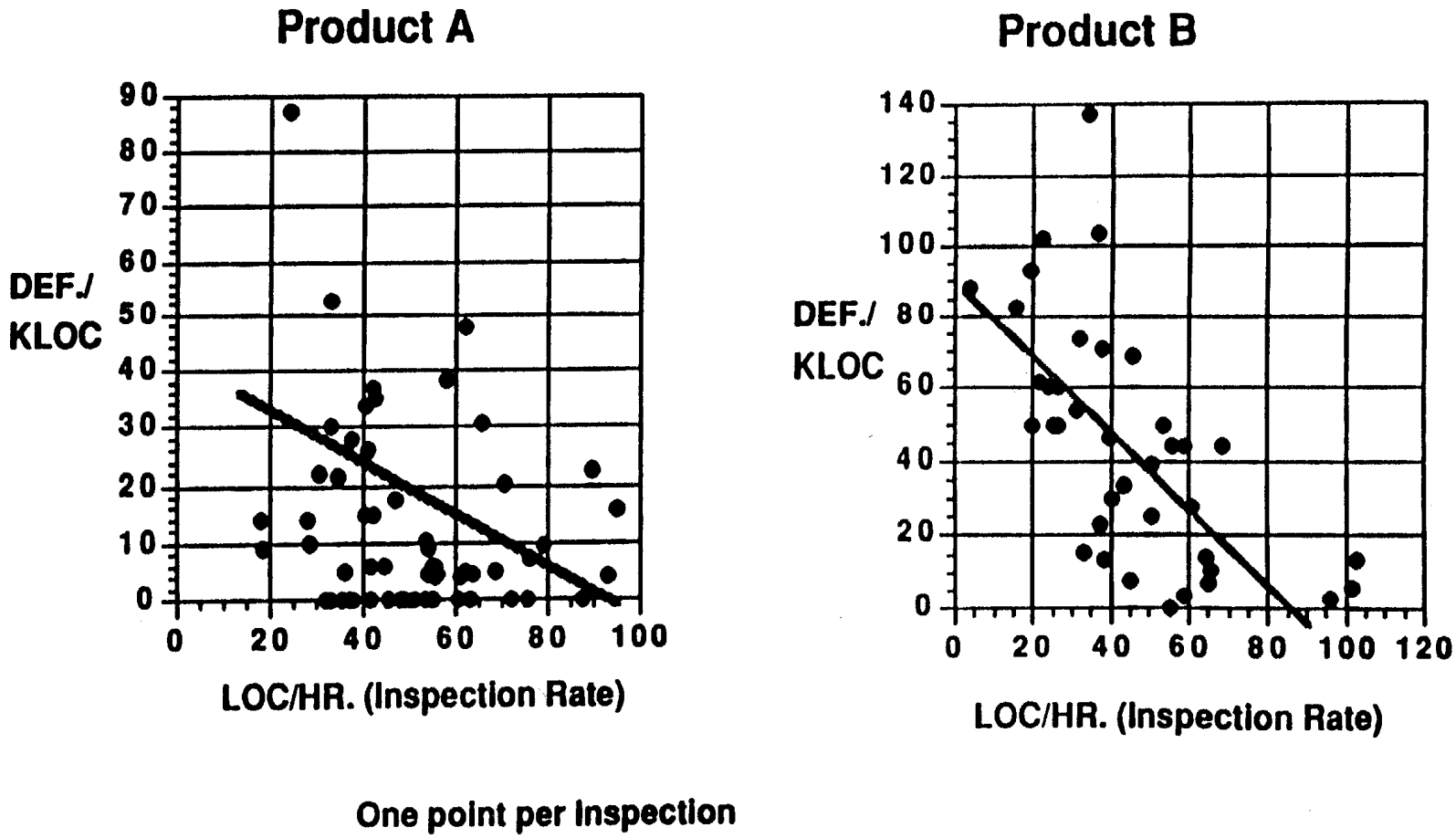
Correlation Analysis



One point per Inspection

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LET'S USE CODE INSPECTION

DATA TO HELP US UNDERSTAND

THE NUMBER OF DEFECTS

REMAINING IN THE PRODUCT

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Project Information Available

Size of product

- **10,000 lines of code**

Line of code inspected

- **2,000**

Major Defects found

- **50**

Inspection data

- **consistent and reasonable rates**

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Industry Information Available

Inspection effectiveness can go up to 90%

- **Typically requires several years of evolution**

Groups starting to do consistent inspections typically start at around 50% effectiveness

- **Rarely over 60% for groups just starting**
- **Rarely are they ever less than 40%**

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Let's Assume We Are 50%

Size of product

- 10,000 lines of code

Line of code Inspected

- 2,000

Major Defects found

- 50

Inspection defect density is

- 25 defects/kloc

Product defect density is 50 defects/kloc

- 25 x 2 because we are assuming 50% effective

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How Many Defects Remain?

Size of product

- **10,000 lines of code**

Major Defects found

- **50**

There are 450 defects remaining

- **10 kloc x 50 defects/kloc = 500 defects**
- **but we found 50 already in Inspections (for the 2,000 lines inspected)**

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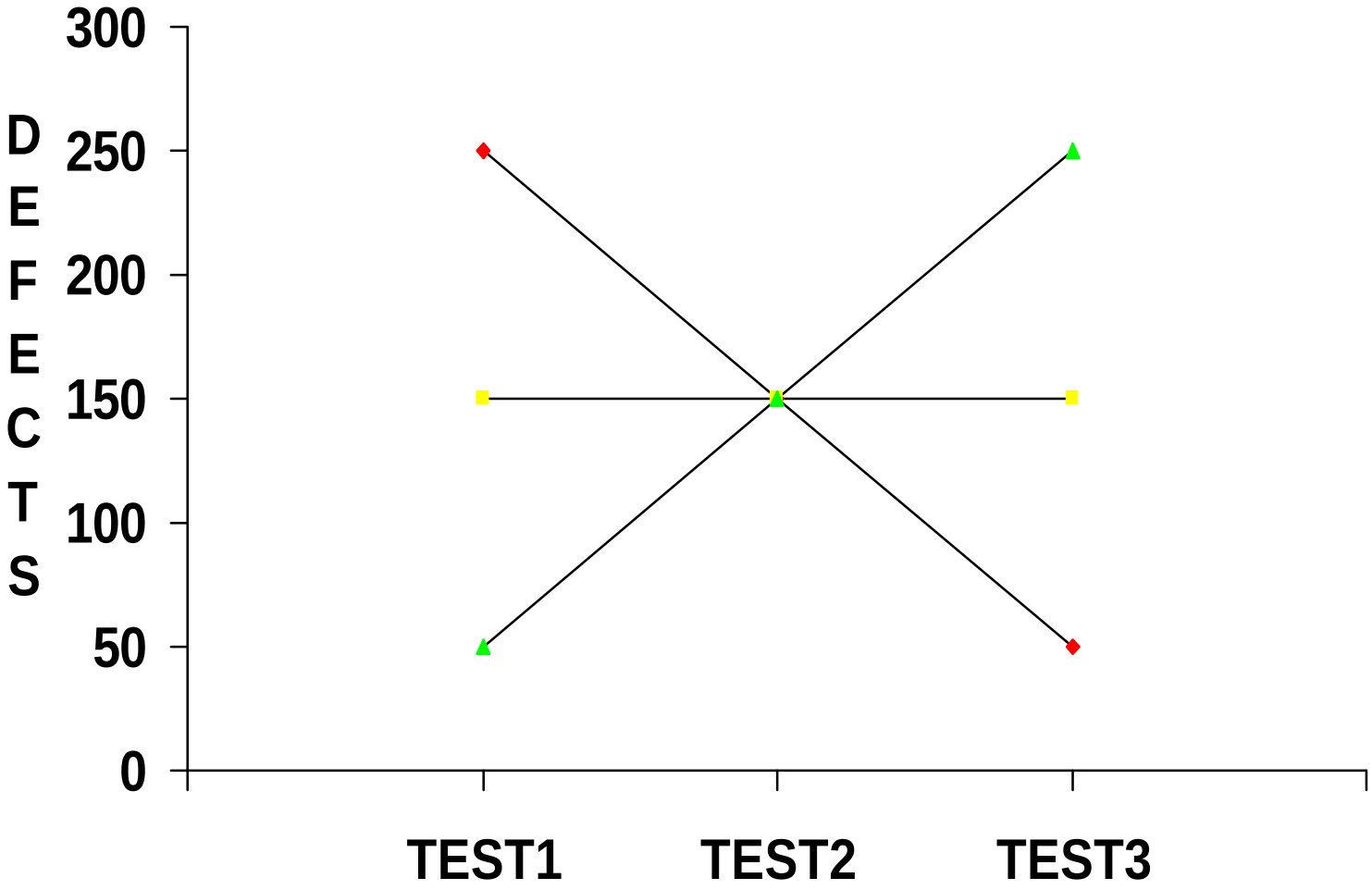
How Do You Want To Find Defects During Test?



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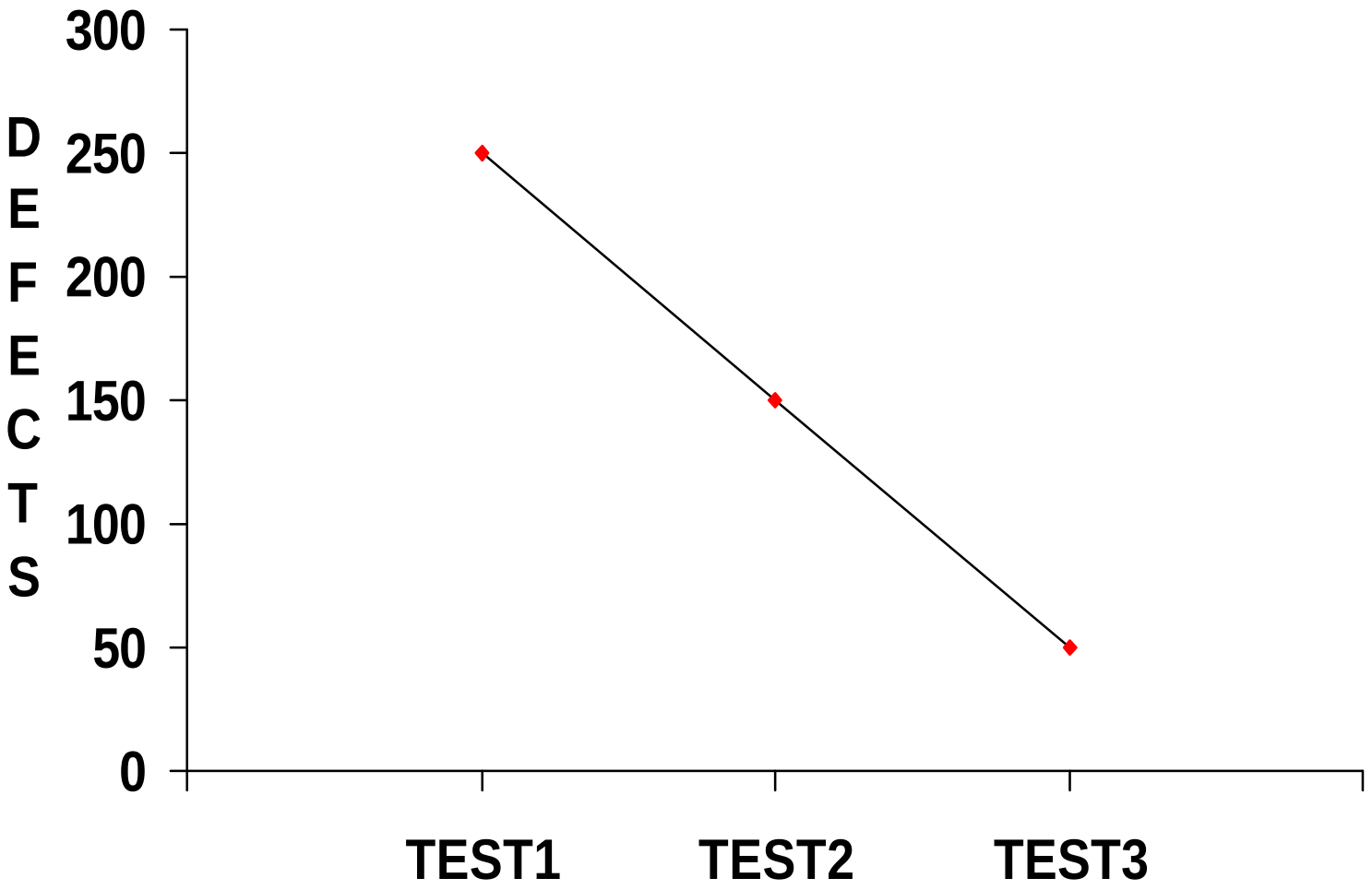
Target Defect Count By Test Activity



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Create Defect "Ranges"

What we just did was the 1st step

Go back and do this for 40% and then 60%

- **this gives you an upper and lower range**

Ask yourself if the defect density of the code which was inspected is proportional to the defect density of the product

- **if not then you need to do each calculation separately for the low density and high density parts of the product; this is explained in the paper**

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Some key data elements and granularity needed

Size

Major defects

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SIZE (e.g., Lines of Code)

Keep separate counts

- New and changed
- Existing "surround" code

Start by counting physical lines

- Include Data and Complier directives which change object code

Allows you to understand how much of the new and changed code has been inspected

The amount of "surround code" will vary

- A lot of small changes in many source modules
- One big change
- By product or environment

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Major Defects

Need to be defined so they can be compared to test and customer defects

Count major defects separately

- One count for "surround" code
- Another count for new and changed code

Allows you to:

- Understand where the errors are coming from
- Calculate defect densities for both

They may be quite different

A necessary step to enable true Defect Prevention

- Defects from earlier releases may be due to a process different from the current process!

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Defect Density for Fixes

Fixes are frequently small

- **Defect density numbers may be very large**
- **Defect density numbers may have large variability**

The real process which needs to be controlled may be the % of fixes which have an error

Consider using % fixes with an error as a measure of your fix defect density

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Sample Metrics Policy

It is the goal of XX to continuously improve in the ways we develop our products and to grow our business. In order to understand our effectiveness in meeting these goals we need to define a set of metrics that will allow us to measure the important aspects of our software development process related to quality, productivity, and costs.

While we increase our use of software metrics and data, it is important to note that:

- **Metrics and data within projects and products will be used to help define and manage to established goals and to evaluate for rates of improvement during the development process. Project and process data will be treated as an asset, as an investment for our future progress, and as a critical factor for our success.**
- **Metrics and data can be used to understand differences between projects or products, to reward what is done well, and to learn what may be required to improve our business.**
- **The collection, recording, and reporting of metrics are intended to measure and to help us improve the processes we use during the development of a product, not to evaluate the performance of individuals. All metrics will be collected and combined such that they are personally non-threatening.**

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