SOFTWARE METRICS

DEFINITIONS

- *MEASURE* - QUANTITATIVE INDICATION OF EXTENT, AMOUNT, DIMENSION, CAPACITY, OR SIZE OF SOME ATTRIBUTE OF A PRODUCT OR PROCESS.
  - E.G., NUMBER OF ERRORS
- *METRIC* - QUANTITATIVE MEASURE OF DEGREE TO WHICH A SYSTEM, COMPONENT OR PROCESS POSSESSES A GIVEN ATTRIBUTE. "A HANDLE OR GUESS ABOUT A GIVEN ATTRIBUTE."
  - E.G., NUMBER OF ERRORS FOUND PER PERSON HOURS EXPENDED

WHY MEASURE SOFTWARE?

- DETERMINE THE QUALITY OF THE CURRENT PRODUCT OR PROCESS
- PREDICT QUALITIES OF A PRODUCT/PROCESS
- IMPROVE QUALITY OF A PRODUCT/PROCESS

MOTIVATION FOR METRICS

- ESTIMATE THE COST & SCHEDULE OF FUTURE PROJECTS
- EVALUATE THE PRODUCTIVITY IMPACTS OF NEW TOOLS AND TECHNIQUES
- ESTABLISH PRODUCTIVITY TRENDS OVER TIME
- IMPROVE SOFTWARE QUALITY
- FORECAST FUTURE STAFFING NEEDS
- ANTICIPATE AND REDUCE FUTURE MAINTENANCE NEEDS

IMPORTANT TERMS

- EFFORT: ACTUAL TIME SPENT ON A PARTICULAR ACTIVITY OR A PHASE
- ELAPSED DAYS IS THE DIFFERENCE BETWEEN THE START OF AN ACTIVITY AND THE COMPLETION OF THE ACTIVITY
- DATA DRILLING: APPROACH INVOLVED IN GETTING THE GRANULAR DETAIL

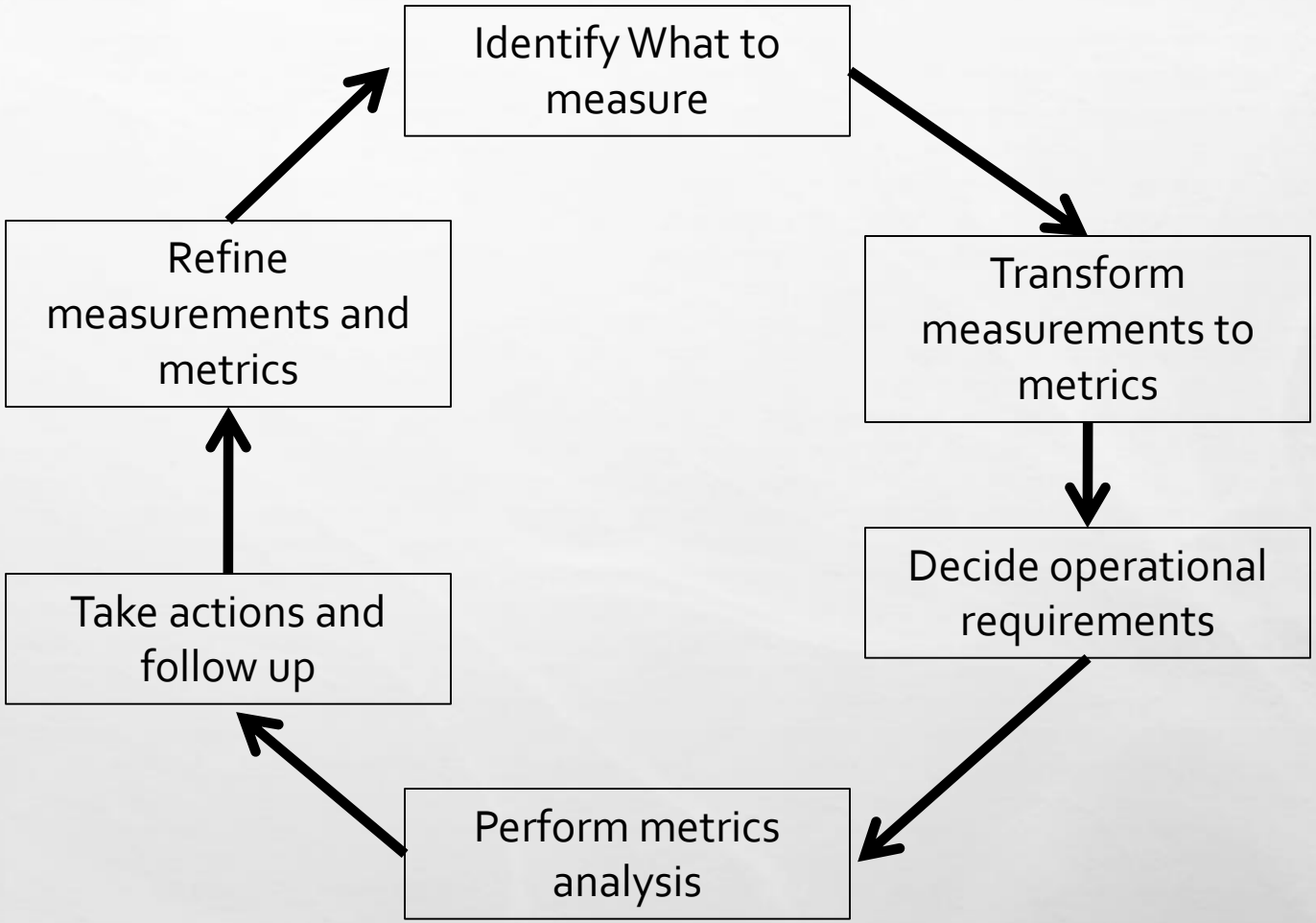
EXAMPLE METRICS

- DEFECT RATES
- ERROR RATES

- MEASURED BY:
  - INDIVIDUAL
  - MODULE
  - DURING DEVELOPMENT

- ERRORS SHOULD BE CATEGORIZED BY ORIGIN, TYPE, COST

STEPS IN METRICS PROGRAM



STEPS IN A METRICS PROGRAM

WHILE DECIDING WHAT TO MEASURE, THE FOLLOWING ASPECTS NEED TO BE KEPT IN MIND.

object to measure should be relevant to what we are trying to achieve

1. WHAT IS MEASURED SHOULD BE OF RELEVANCE TO WHAT WE ARE TRYING TO ACHIEVE. FOR TESTING FUNCTIONS, WE WOULD OBVIOUSLY BE INTERESTED IN THE EFFORT SPENT ON TESTING, NUMBER OF TEST CASES, NUMBER OF DEFECTS REPORTED FROM TEST CASES, AND SO ON.

entities should be natural, not too many overheads to measure

2. THE ENTITIES MEASURED SHOULD BE NATURAL AND SHOULD NOT INVOLVE TOO MANY OVERHEADS FOR MEASUREMENTS. IF THERE ARE TOO MANY OVERHEADS IN MAKING THE MEASUREMENTS OR IF THE MEASUREMENTS DO NOT FOLLOW NATURALLY FROM THE ACTUAL WORK BEING DONE, THEN THE PEOPLE WHO SUPPLY THE DATA MAY RESIST GIVING THE MEASUREMENT DATA

object to be measured should be at the right level of granularity

3. WHAT IS MEASURED SHOULD BE AT THE RIGHT LEVEL OF GRANULARITY TO SATISFY THE OBJECTIVE FOR WHICH THE MEASUREMENT IS BEING MADE.

STEPS IN A METRICS PROGRAM

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- THE FOURTH STEP INVOLVED IN A METRICS PROGRAM IS TO ANALYZE THE METRICS TO IDENTIFY BOTH POSITIVE AREAS AND IMPROVEMENT AREAS ON PRODUCT QUALITY.
- OFTEN, ONLY THE IMPROVEMENT ASPECTS POINTED TO BY THE METRICS ARE ANALYZED AND FOCUSED; IT IS IMPORTANT TO ALSO HIGHLIGHT AND SUSTAIN THE POSITIVE AREAS OF THE PRODUCT.
- THIS WILL ENSURE THAT THE BEST PRACTICES GET INSTITUTIONALIZED AND ALSO MOTIVATE THE TEAM BETTER.

STEPS IN A METRICS PROGRAM

- THE FINAL STEP INVOLVED IN A METRICS PLAN IS TO TAKE NECESSARY ACTION AND FOLLOW UP ON THE ACTION.
- THE PURPOSE OF A METRICS PROGRAM WILL BE DEFEATED IF THE ACTION ITEMS ARE NOT FOLLOWED THROUGH TO COMPLETION.

METRICS IN TESTING

- TRACKING TEST PROGRESS AND PRODUCT QUALITY CAN GIVE A GOOD IDEA ABOUT THE RELEASE
- TO JUDGE THE NUMBER OF DAYS NEEDED FOR TESTING, TWO DATA POINTS ARE NEEDED
  - TEST CASES TO BE EXECUTED
  - TEST CASES EXECUTED PER DAY
- TEST CASES EXECUTED PER PERSON DAY IS CALCULATED BASED ON A MEASURE CALLED *TEST CASE EXECUTION PRODUCTIVITY*

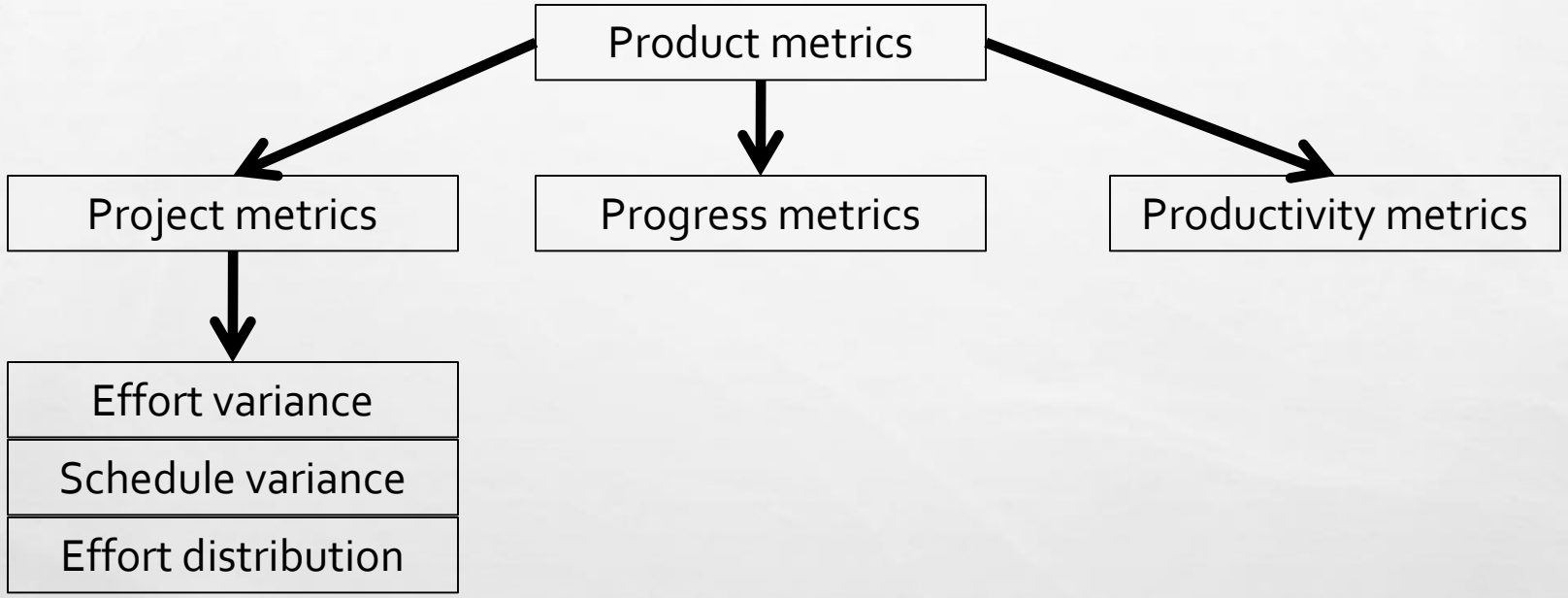
METRICS IN TESTING

- WHEN TO MAKE THE RELEASE
- WHAT TO RELEASE – BASED ON DEFECT DENSITY, THEIR IMPORTANCE TO CUSTOMERS AND IMPACT ANALYSIS
- WHETHER THE PRODUCT IS BEING RELEASED WITH KNOWN QUALITY

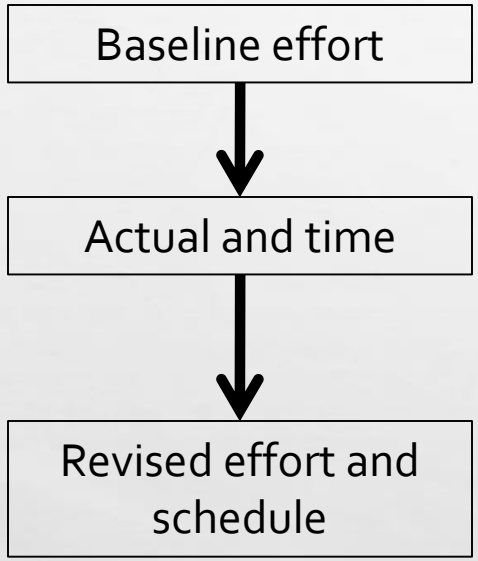
TYPES OF METRICS

- PROJECT METRICS: HOW PROJECT IS PLANNED AND EXECUTED
- PROGRESS METRICS: HOW THE DIFFERENT ACTIVITIES OF THE PROJECT ARE PROGRESSING
  - INCLUDE BOTH DEVELOPMENT AND TESTING
  - IS FURTHER CLASSIFIED INTO TEST DEFECT METRICS AND DEVELOPMENT DEFECT METRICS
- PRODUCTIVITY METRICS: PRODUCTIVITY NUMBERS THAT CAN BE COLLECTED AND USED FOR PLANNING AND TRACKING TESTING ACTIVITIES. THIS HELPS IN PLANNING AND ESTIMATING OF TESTING ACTIVITIES

TYPES OF METRICS



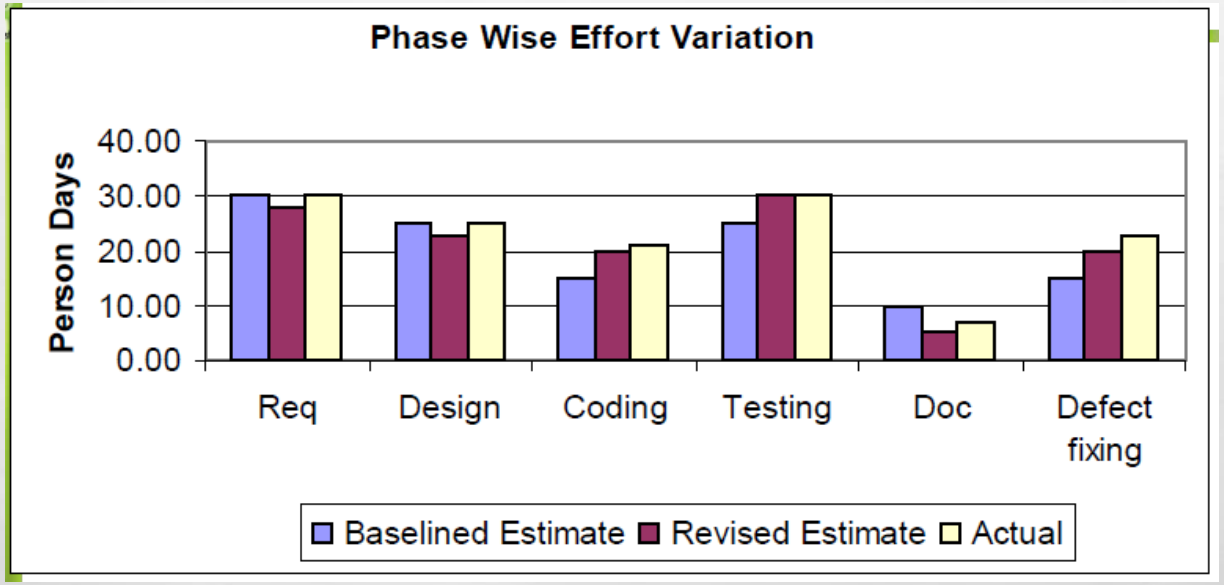
PROJECT METRICS



- BASELINED EFFORT: INITIAL EFFORT ESTIMATE FOR EACH OF THE PHASES AND ACTIVITIES BY USING THE AVAILABLE PRODUCTIVITY DATA
- REVISED EFFORT: THE EFFORT ESTIMATES ARE RE-EVALUATED

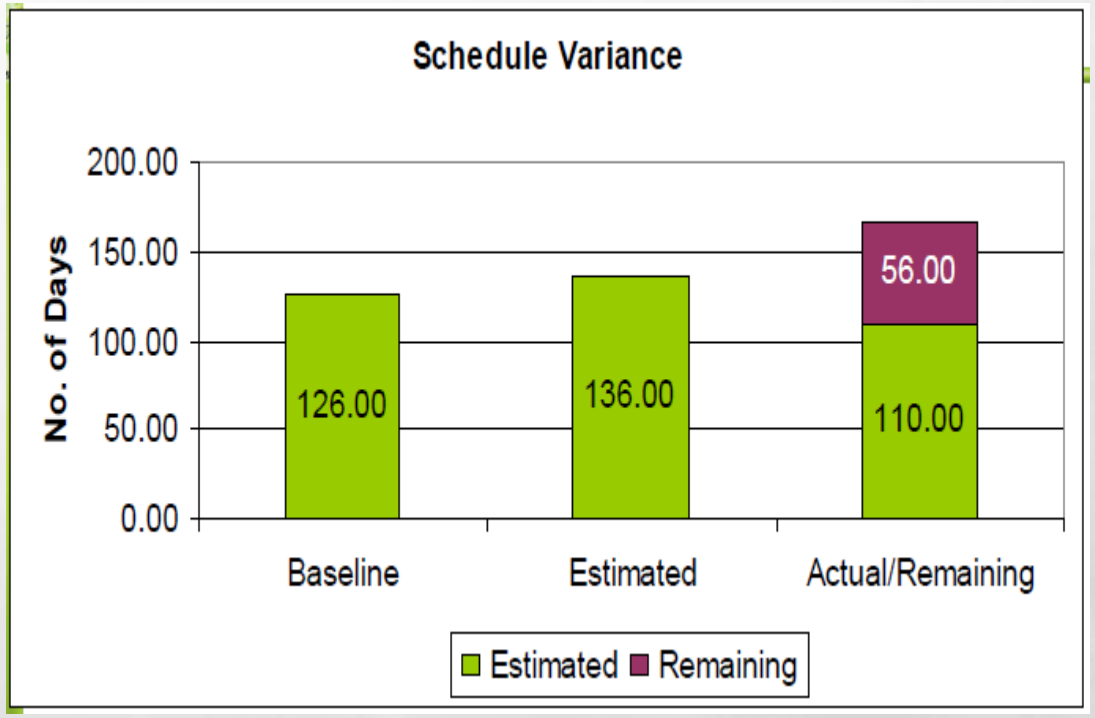
PROJECT METRICS

- EFFORT VARIANCE
  - VARIANCE % = ((ACTUAL EFFORT – REVISED ESTIMATE)/REVISED ESTIMATE) * 100



PROJECT METRICS

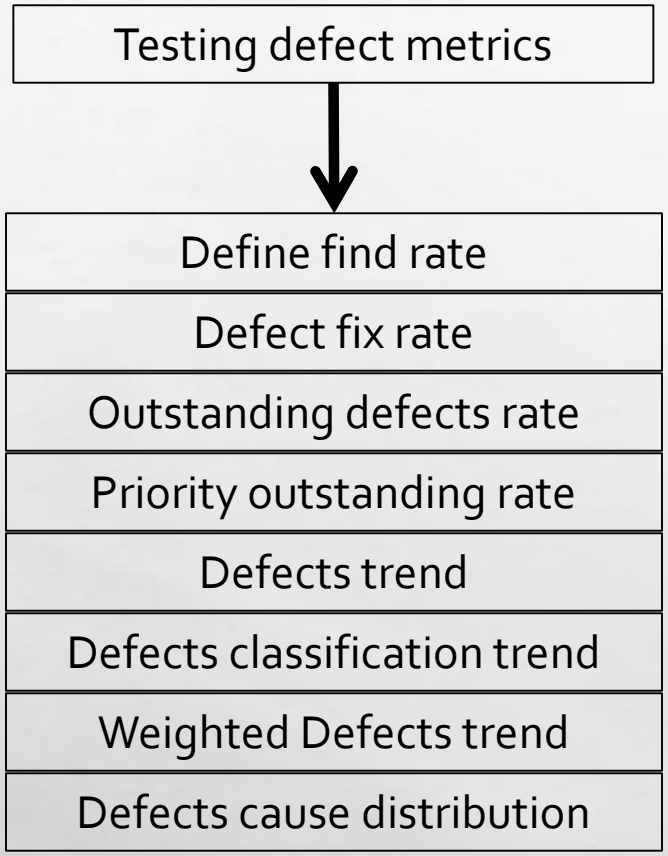
- SCHEDULE VARIANCE
  - CALCULATED AT THE OVERALL PROJECT LEVEL
  - AT SPECIFIC MILESTONES
- 0-5% IS CONSIDERED AS ACCEPTABLE VARIANCE

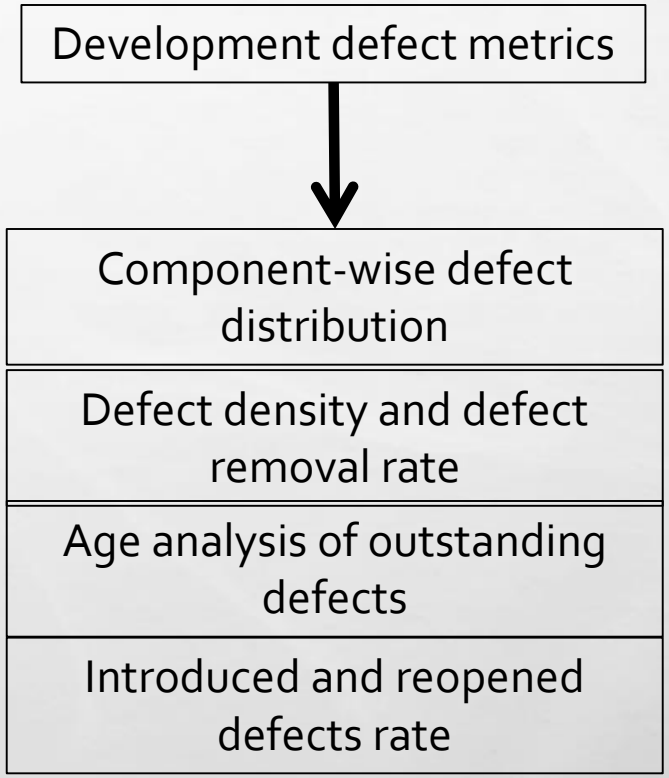


PROJECT METRICS

- EFFORT DISTRIBUTION ACROSS PHASES
  - ADEQUATE AND APPROPRIATE EFFORT NEEDS TO BE SPENT IN EACH PHASE FOR A QUALITY PRODUCT RELEASE
  - MATURE ORGANIZATIONS SPEND
    - 10-15% IN REQUIREMENT
    - 20-50% OF THEIR TOTAL EFFORT IN TESTING

PROGRESS METRICS



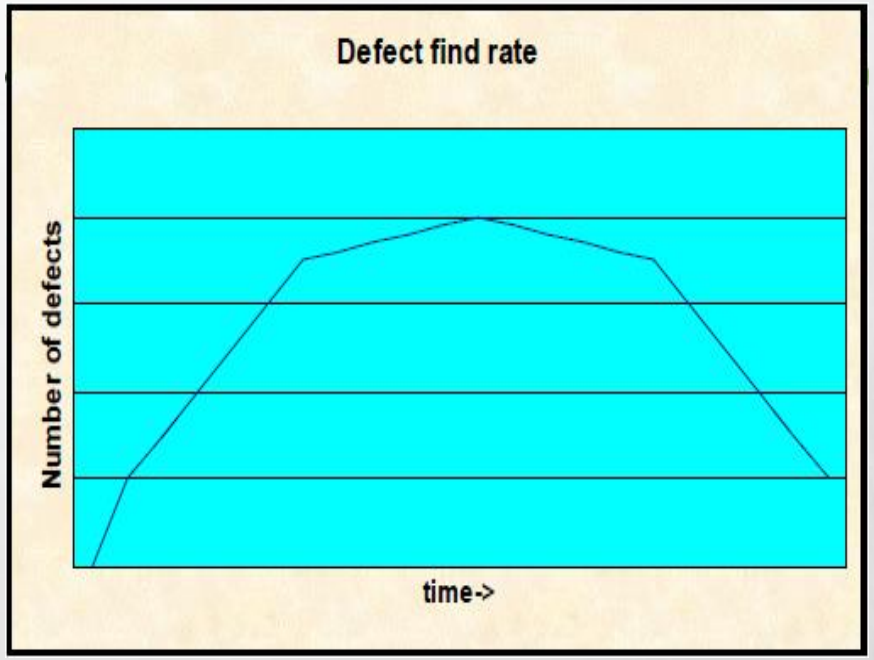


TEST DEFECT METRICS

- DEFECT PRIORITY: PROVIDES A MANAGEMENT FOR THE ORDER OF DEFECT FIXES
- DEFECT SEVERITY LEVELS PROVIDES THE IMPACT OF THE DEFECT IN PRODUCT FUNCTIONALITY
- EXAMPLE
  - PRIORITY = 1, FIX IT BEFORE THE NEXT BUILD
  - SEVERITY =1 , BASIC PRODUCT FUNCTIONALITY FAILING OR PRODUCT CRASHES

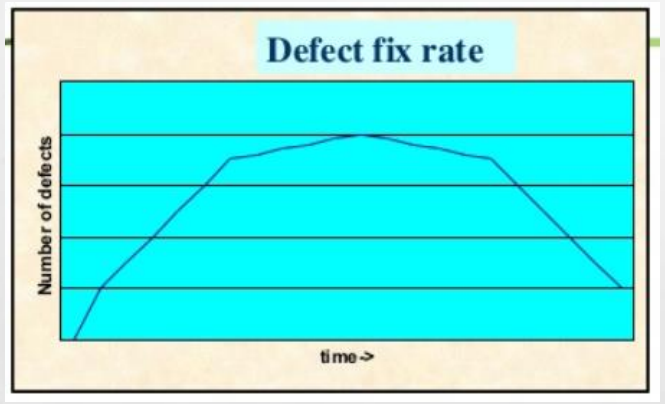
TEST DEFECT METRICS

- DEFECT FIND RATE:
  - THE PURPOSE OF TESTING IS TO FIND THE DEFECTS AT THE EARLY TEST CYCLE
  - NOT POSSIBLE BECAUSE NOT ALL THE FEATURES OF A PRODUCT BECOME AVAILABLE AND SOME TESTS CASES MAY BE BLOCKED BECAUSE OF SHOW STOPPER DEFECTS
  - A BELL CURVE ALONG WITH MINIMUM NUMBER OF DEFECTS FOUND IN THE LAST FEW DAYS INDICATE THAT THE RELEASE QUALITY OF THE PRODUCT IS LIKELY GOOD



TEST DEFECT METRICS

- DEFECT FIX RATE
  - THE PURPOSE OF THE DEVELOPMENT IS TO FIX THE DEFECTS AS SOON AS THEY ARRIVE
  - SHOULD FOLLOW THE DEFECT ARRIVAL CURVE



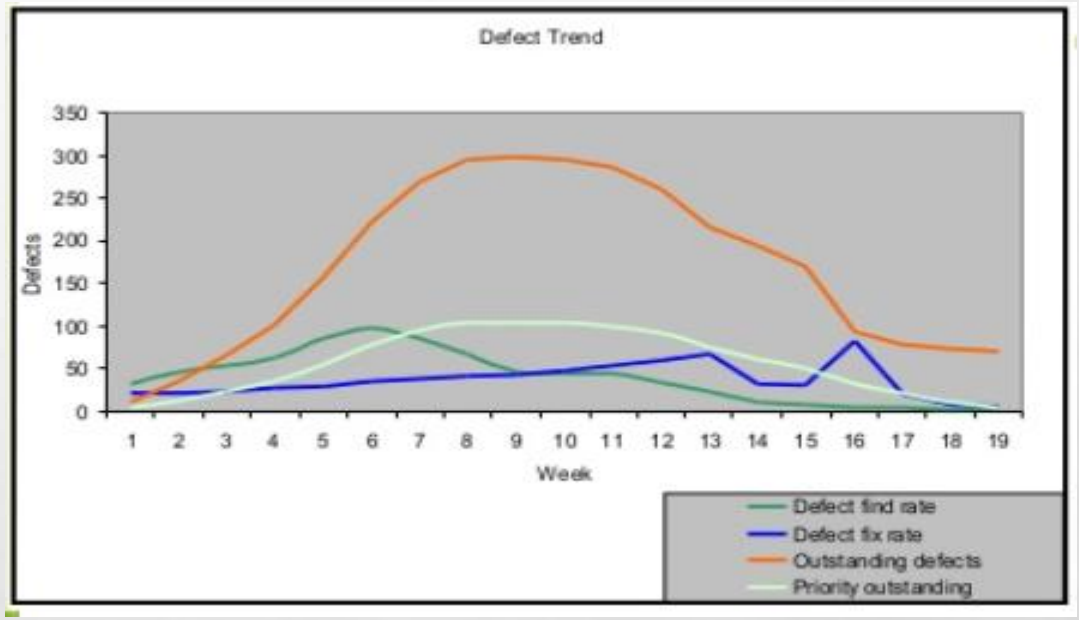
- OUTSTANDING DEFECTS RATE
  - NUMBER OF DEFECTS OUTSTANDING = TOTAL DEFECTS – TOTAL DEFECTS FIXED

TEST DEFECT METRICS

- PRIORITY OUTSTANDING RATE
  - CONSIDERING ONLY THE HIGH PRIORITY OUTSTANDING DEFECTS
  - CORRESPONDS TO EXTREME AND CRITICAL DEFECTS
  - SOME HIGH PRIORITY DEFECT MAY REQUIRE A CHANGE IN DESIGN OR ARCHITECTURE. FOUND LATER MAY DELAY THE RELEASE
  - SOME DEFECT FIXES MAY REQUIRE RELATIVELY LITTLE TIME BUT SUBSTANTIAL TESTING EFFORT
  - WHEN PRIORITY OUTSTANDING DEFECTS ARE PLOTTED, THE OBJECTIVE IS TO SEE THE CURVE GOING TOWARDS ZERO
  - MEANS PRIORITY DEFECTS NEED TO BE FIXED ALMOST IMMEDIATELY

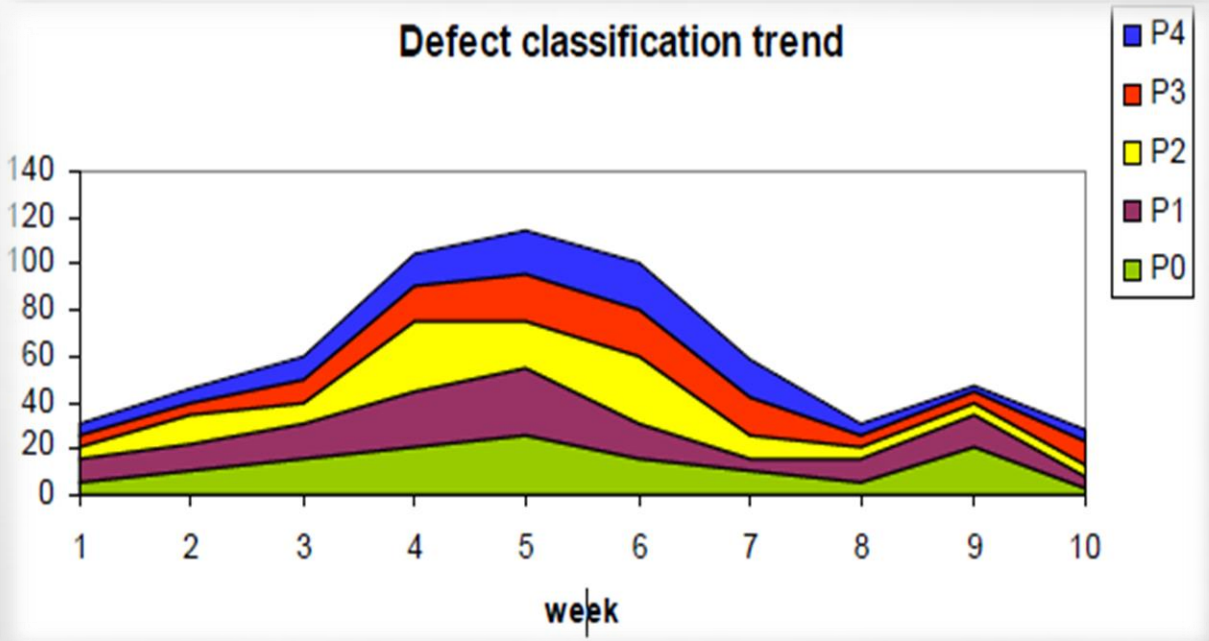
TEST DEFECT METRICS

- DEFECT TREND
  - TO CONSOLIDATE THE ABOVE SAID INTO CHART
  - THE EFFECTIVENESS OF ANALYSIS INCREASES WHEN SEVERAL PERSPECTIVES OF FIND RATE, FIX RATE, OUTSTANDING AND PRIORITY OUTSTANDING DEFECTS ARE COMBINED



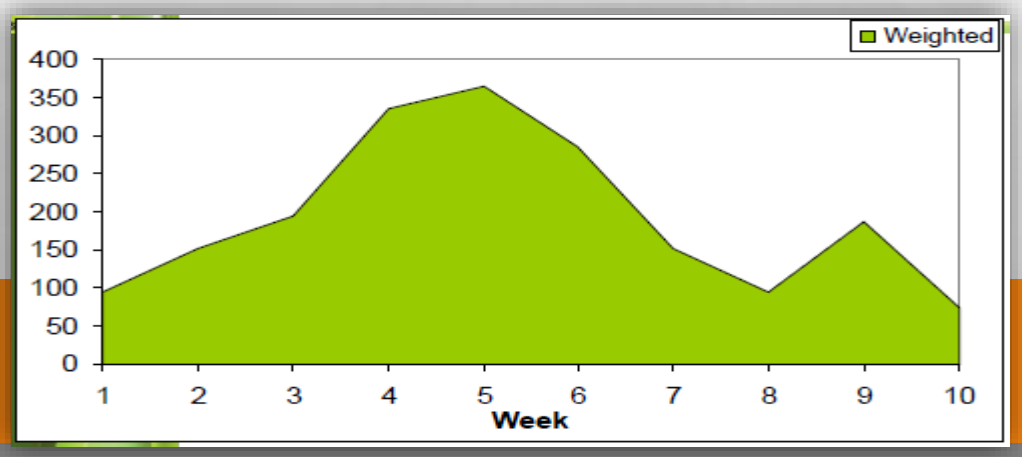
TEST DEFECT METRICS

- DEFECT CLASSIFICATION TREND
  - PROVIDING THE PERSPECTIVE OF DEFECT CLASSIFICAITON (EXTREME, CRITICAL, MINOR) IN THE CHART HELPS IN FINDING OUT RELEASE READINESS OF THE PRODUCT



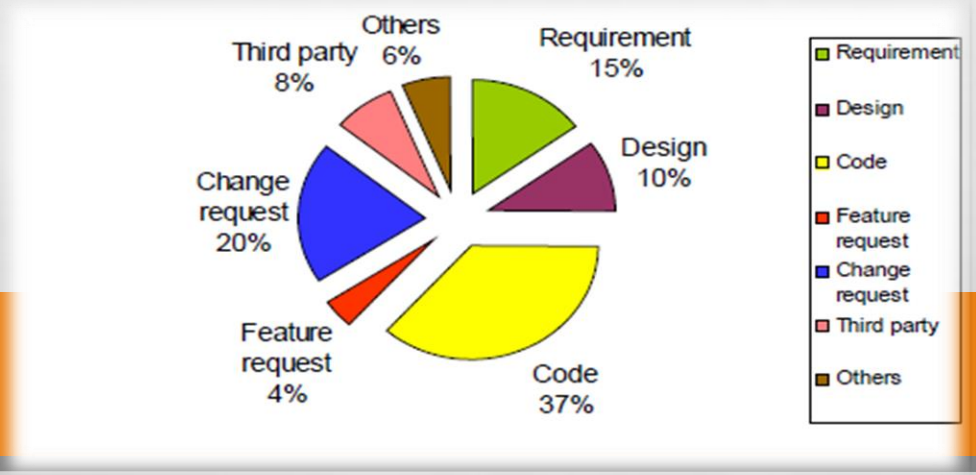
TEST DEFECT METRICS

- WEIGHTED DEFECTS TREND
  - COUNTING THE DEFECTS THE SAME WAY TAKES AWAY THE SERIOUSNESS OF EXTREME OR CRITICAL DEFECTS
  - TO SOLVE THIS A METRIC CALLED WEIGHTED DEFECTS IS INTRODUCED
  - MORE SERIOUS DEFECTS ARE GIVEN A HIGHER WEIGHTAGE THAN LESS SERIOUS ONES
  - WEIGHTED DEFECTS = (EXTREME * 5 + CRITICAL *4 + IMPORTANT * 3 + MINOR * 2+ COSMETIC)
  - BOTH LARGE DEFECTS AND LARGE NUMBER OF SMALL DEFECTS AFFECT PRODUCT RELEASE

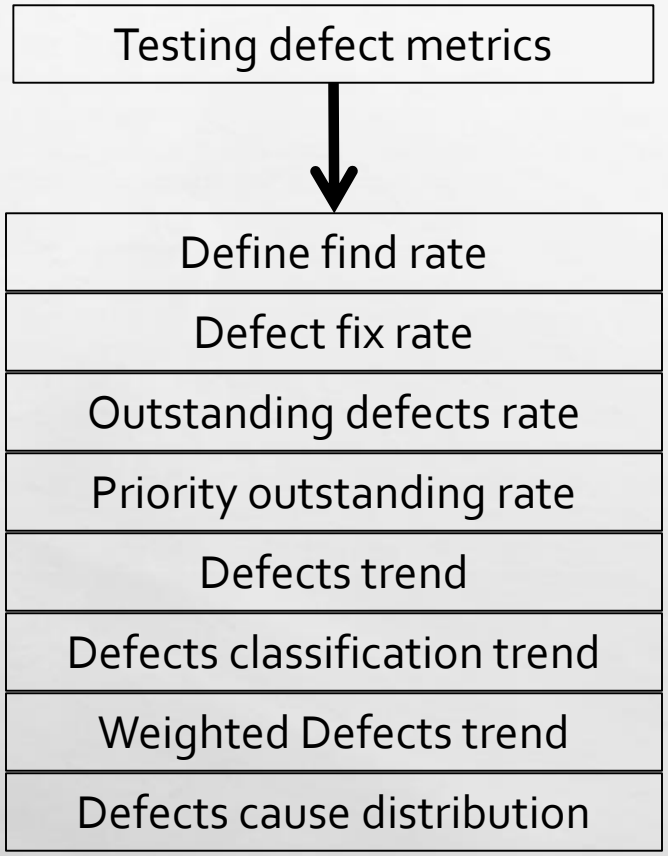


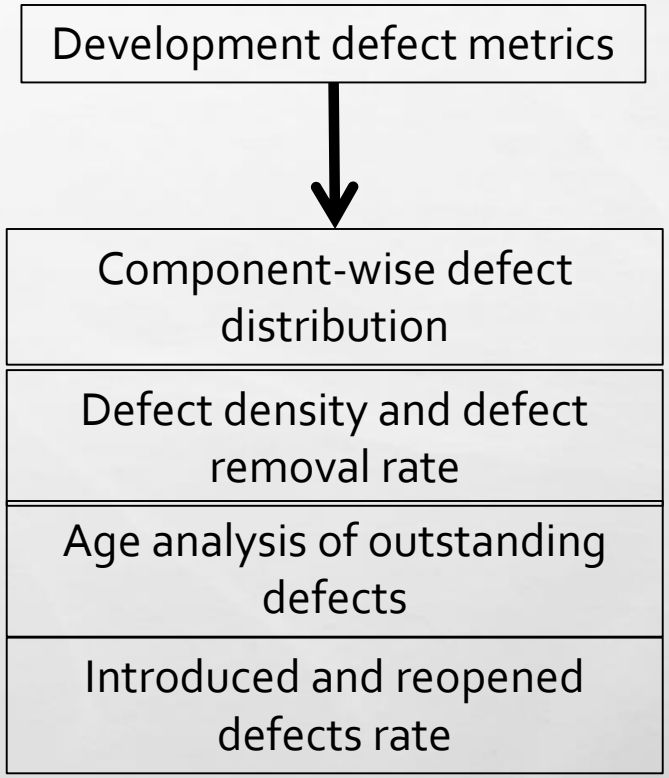
TEST DEFECT METRICS

- DEFECT CAUSE DISTRIBUTION
  - FINDING OUT THE ROOT CAUSES OF THE DEFECTS HELP IN IDENTIFYING MORE DEFECTS AND ALSO HELP IN PREVENTING THE DEFECTS
  - FOR EXAMPLE
    - 37% OF THE TOTAL DEFECTS IS DUE TO CODE, THEN MORE FOCUS IS TO BE PUT ON WHITE BOX TESTING METHODOLOGIES.
    - 20% DUE TO CHANGE REQUEST , IT MEANS REQUIREMENTS KEEP CHANGING WHILE THE PROJECT IS IN PROGRESS



PROGRESS METRICS

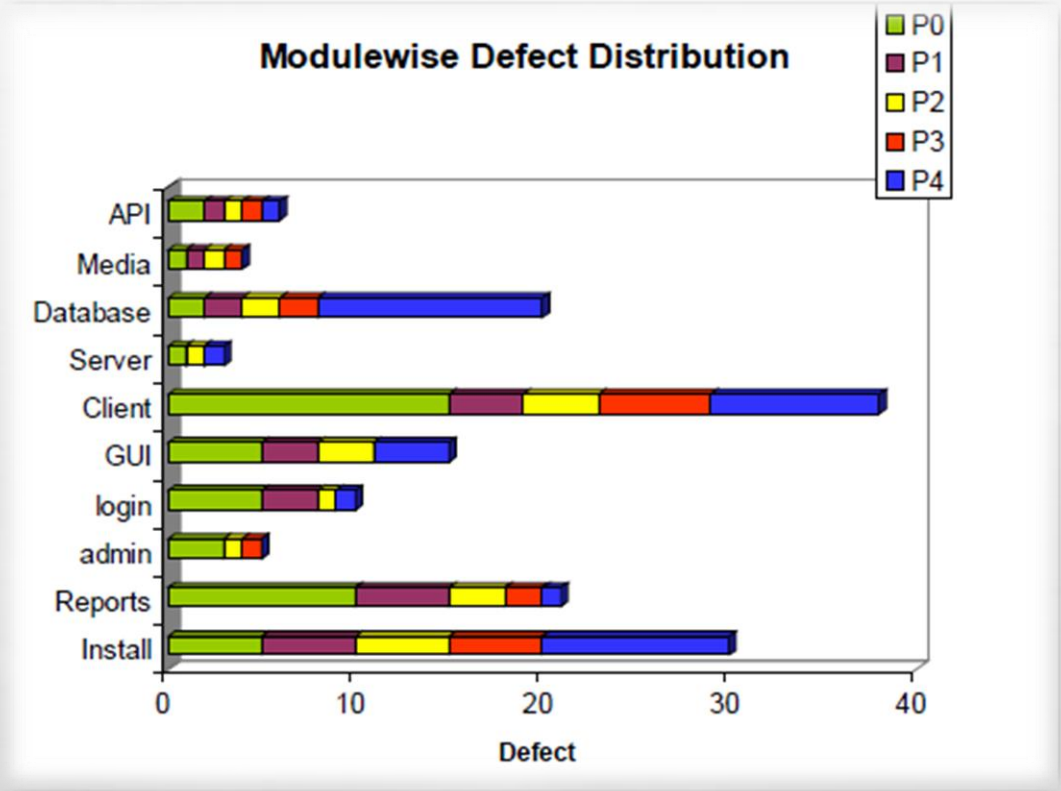




DEVELOPMENT DEFECT METRICS

- COMPONENT-WISE DEFECT DISTRIBUTION
  - THE DEFECTS TO BE MAPPED TO DIFFERENT COMPONENTS OF THE PRODUCT
  - THIS IS REQUIRED TO FIX THOSE DEFECTS TO APPROPRIATE DEVELOPERS
  - DEFECT CLASSIFICATION AND TOTAL DEFECTS CORRESPONDING TO EACH COMPONENT IN THE PRODUCT HELPS THE PROJECT MANAGER IN ASSIGNING AND RESOLVING THE DEFECTS

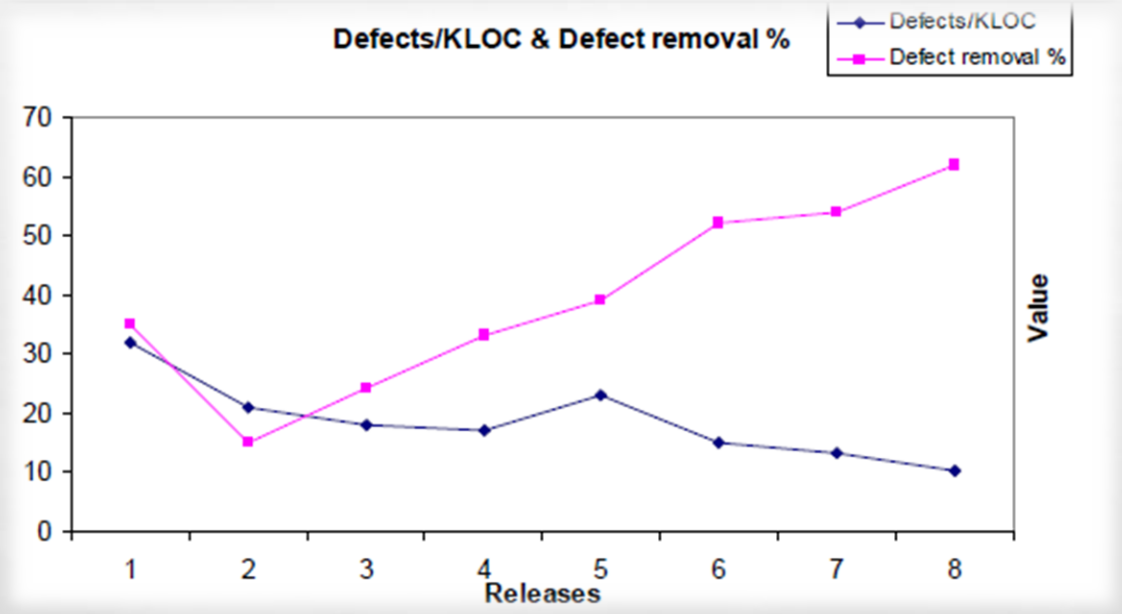
DEVELOPMENT DEFECT METRICS



DEVELOPMENT DEFECT METRICS

- DEFECT DENSITY AND DEFECT REMOVAL RATE
  - LIFE TIME OF THE PRODUCT DEPENDS ON ITS QUALITY
  - FOR A GIVEN RELEASE, REASONABLE MEASURES OF THE QUALITY OF THE PRODUCT ARE THE **NUMBER OF DEFECTS FOUND IN TESTING** AND THE **NUMBER OF DEFECTS FOUND AFTER THE PRODUCT IS RELEASED**
  - DEFECT DENSITY CORRELATES SOURCE CODE WITH THE DEFECTS
  - DEFECTS PER KLOC = (TOTAL DEFECTS FOUND IN THE PRODUCT)/(TOTAL EXECUTABLE LINES OF CODE IN KLOC)
  - DEFECT REMOVAL RATE IS USED TO ANALYZE BOTH DEVELOPMENT AND TESTING PHASES TOGETHER
  - DEFECT REMOVAL RATE = (DEFECTS FOUND BY VERIFICATION ACTIVITIES + DEFECTS FOUND IN UNIT TESTING)/(DEFECTS FOUND BY TEST TEAMS)*100

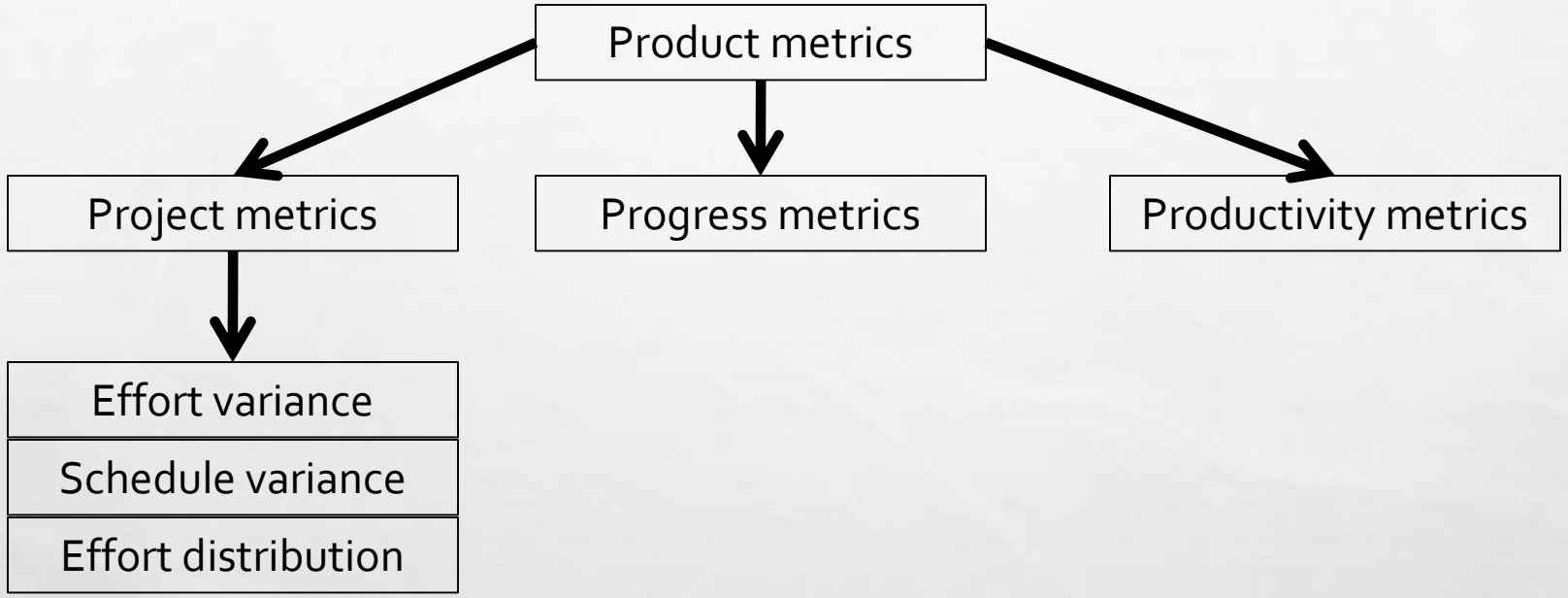
DEVELOPMENT DEFECT METRICS



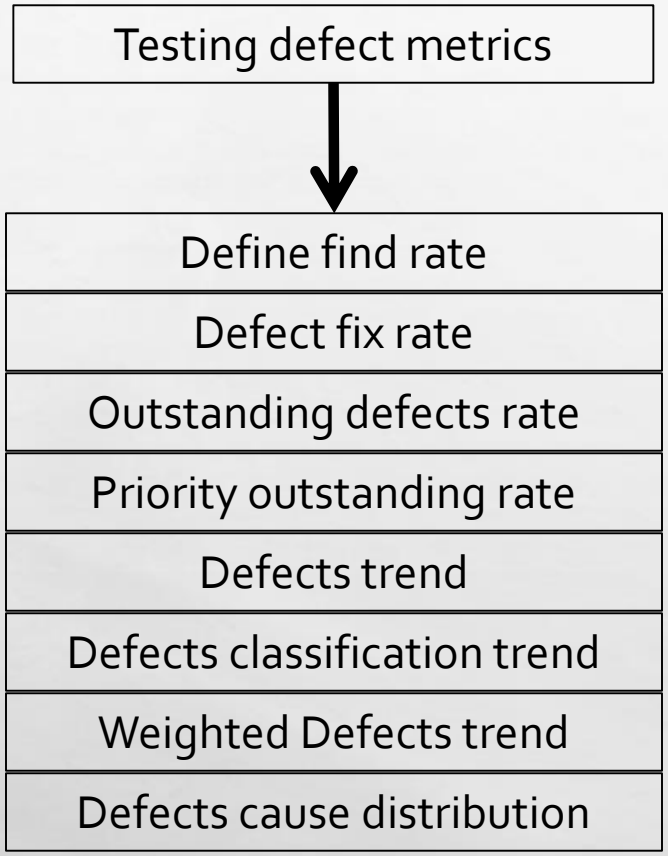
DEVELOPMENT DEFECT METRICS

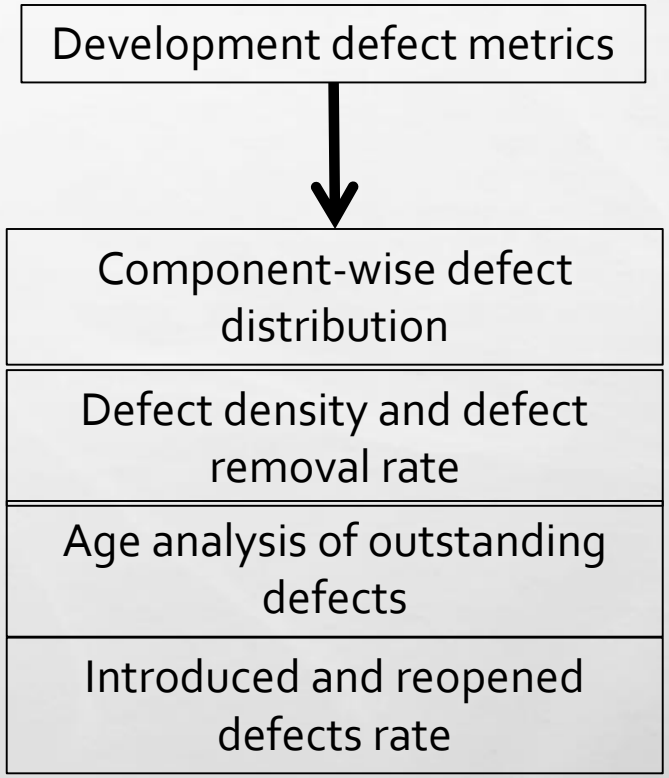
- AGE ANALYSIS OF OUTSTANDING DEFECTS
  - THE DEFECTS THAT HAVE BEEN WAITING TO BE FIXED FOR A LONG TIME
  - REPRESENTS THE COMPLEXITY OF THE DEFECT FIX
- INTRODUCED AND REOPENED DEFECTS TREND
  - WHEN ADDING OR MODIFYING THE CODE TO PROVIDE A DEFECT FIX, THINGS WORKING EARLIER MAY STOP WORKING
  - THIS IS CALLED INTRODUCED DEFECT
  - A FIX MAY REPRODUCE A DEFECT FIXED EARLIER AND IS CALLED REOPENED DEFECT
  - TOO MANY INTRODUCED AND REOPENED DEFECTS MAY MEAN ADDITIONAL DEFECT FIXING AND TESTING CYCLES

TYPES OF METRICS

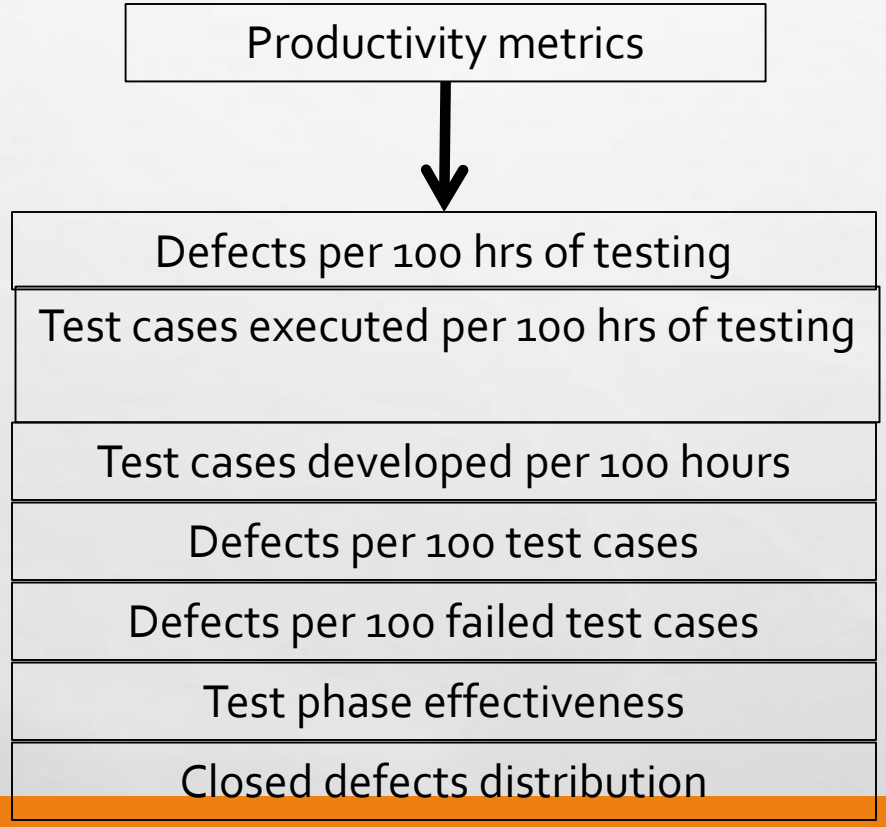


PROGRESS METRICS





PRODUCTIVITY METRICS



PRODUCTIVITY METRICS

- HELP IN FINDING OUT THE CAPABILITY OF THE TEAM AS WELL AS FOR OTHER PURPOSES SUCH AS ESTIMATING FOR NEW RELEASE, RELEASE DATE AND QUALITY
- DEFECTS PER 100 HOURS OF TESTING
  - IF THE INCOMING DEFECTS IN THE PRODUCT ARE REDUCING, IT MAY MEAN
    - TESTING IS NOT EFFECTIVE
    - THE QUALITY OF THE PRODUCT IS IMPROVING
    - EFFORT SPENT IN TESTING IS FALLING

PRODUCTIVITY METRICS

- **DEFECTS PER 100 HOURS OF TESTING = (TOTAL DEFECTS FOUND IN THE PRODUCT FOR A PERIOD/TOTAL HOURS SPENT TO GET THOSE DEFECTS) * 100**
- NORMALIZING THE DEFECTS WITH EFFORT SPENT INDICATES ANOTHER PERSPECTIVE FOR RELEASE QUALITY

PRODUCTIVITY METRICS

- TEST CASES EXECUTED PER 100 HOURS OF TESTING
  - DEPENDS ON TEAM PRODUCTIVITY AND QUALITY OF THE PRODUCT
  - IF THE QUALITY OF THE PRODUCT IS GOOD, MORE TEST CASES ARE EXECUTED
  - THIS METRIC HELPS IN TRACKING PRODUCTIVITY AND ALSO IN JUDGING PRODUCT QUALITY
  - **TEST CASES EXECUTED PER 100 HOURS OF TESTING = (TOTAL TEST CASES EXECUTED FOR A PERIOD/TOTAL HOURS SPENT IN TEST EXECUTION)*100**

PRODUCTIVITY METRICS

- TEST CASES DEVELOPED PER 100 HOURS OF TESTING
  - **(TOTAL TEST CASES DEVELOPED FOR A PERIOD/TOTAL HOURS SPENT IN TEST CASE DEVELOPMENT)* 100**
- DEFECTS PER 100 TEST CASES
  - THE EFFECTIVENESS OF THE TESTS IN UNCOVERING DEFECTS
  - EFFECTIVENESS OF CHOOSING TESTS THAT ARE CAPABLE OF UNCOVERING DEFECTS
  - **DEFECTS PER 100 TEST CASES = (TOTAL DEFECTS FOUND FOR A PERIOD/TOTAL TEST CASES EXECUTED FOR THE SAME PERIOD)*100**

PRODUCTIVITY METRICS

- DEFECTS PER 100 FAILED TEST CASES
  - IS MEASURE TO FIND OUT HOW GRANULAR THE TEST CASES ARE
  - **(TOTAL DEFECTS FOUND FOR A PERIOD/TOTAL TEST CASES FAILED DUE TO THOSE DEFECTS)*100**
- TEST PHASE EFFECTIVENESS
  - TOTAL DEFECTS FOUND BE EACH TEST PHASE
  - CAN BE USED FOR STAFFING AND PLANNING OF SUPPORT ACTIVITIES

PRODUCTIVITY METRICS

- CLOSED DEFECT DISTRIBUTION
  - TO ENSURE THAT MOST OF THE DEFECTS ARE FIXED, TESTING TEAM HAS TO TRACK THE DEFECTS AND ANALYZE HOW THEY ARE CLOSED