3. StaticTesting–80minutes

Keywords

anomaly,dynamictesting,formalreview,informalreview,inspection,review,staticanalysis,statictesting, technical review, walkthrough

LearningObjectivesforChapter 3:

3.1 StaticTestingBasics

FL-3.1.1 (K1)Recognizetypes ofproducts thatcanbeexaminedbythedifferentstatictest techniques FL-

3.1.2 (K2) Explain the value of static testing

FL-3.1.3 (K2)Compareandcontraststaticanddynamictesting

3.2 FeedbackandReview Process

FL-3.2.1 (K1)Identifythebenefitsofearlyandfrequentstakeholderfeedback FL-

3.2.2 (K2) Summarize the activities of the review process

FL-3.2.3 (K1)Recallwhich responsibilitiesareassignedtotheprincipalroleswhenperformingreviews FL-

3.2.4 (K2) Compare and contrast the different review types

FL-3.2.5 (K1)Recallthefactorsthatcontributetoasuccessfulreview

3.1. StaticTestingBasics

In contrast to dynamic testing, in static testing the software under test does not need to be executed. Code, process specification, system architecture specification or other work products are evaluated throughmanualexamination(e.g.,reviews)orwiththehelpofatool(e.g.,static analysis). Test objectives include improving quality, detecting defects and assessing characteristics like readability, completeness, correctness, testability and consistency. Static testing can be applied for both verification and validation.

Testers,businessrepresentativesanddeveloperswworktogetherduringexamplemappings,collaborative userstorywriting and backlog refinementsessionsto ensure thatuserstories and relatedwork products meetdefinedcriteria,e.g., theDefinitionofReady (seesection5.1.3).Reviewtechniques can beapplied to ensure user stories are complete and understandable and include testable acceptance criteria. By asking the right questions, testers explore, challenge and help improve the proposed user stories.

Staticanalysiscanidentifyproblemspriorto dynamictestingwhile oftenrequiring lesseffort,sincenotest cases are required, and tools (see chapter 6) are typically used. Static analysis is often incorporated into CI frameworks (see section 2.1.4). While largely used to detect specific code defects, static analysis is also used to evaluate maintainability and security. Spelling checkers and readability tools are other examples of static analysis tools.

3.1.1. WorkProductsExaminablebyStatic Testing

Almost any work product can be examined using static testing. Examples include requirement specificationdocuments,sourcecode,testplans,testcases, productbacklogitems,testcharters,project documentation, contracts and models.

Any work product that can be read and understood can be the subject of a review. However, for static analysis,work productsneedastructureagainstwhich theycanbe checked(e.g.,models,code ortext with a formal syntax).

Workproductsthatarenot appropriateforstatictestingincludethosethat are difficultto interpret by human beings andthatshouldnotbe analyzedbytools(e.g.,3rdparty executablecodeduetolegal reasons).

3.1.2. ValueofStaticTesting

Statictestingcandetectdefectsintheearliestphasesof theSDLC,fulfillingtheprinciple of earlytesting (see section 1.3). It can also identify defects which cannot be detected by dynamic testing (e.g., unreachable code, design patterns not implemented as desired, defects in non-executable work products).

Statictestingprovides theabilitytoevaluatethequalityof,andto buildconfidenceinwork products.By verifying the documented requirements, the stakeholders can also make sure that these requirements describe their actual needs. Since static testing can be performed early in the SDLC, a shared understanding can be created amongthe involved stakeholders. Communication will also beimproved between the involved stakeholders. For this reason, it is recommended to involve a wide variety of stakeholders in static testing.

Even though reviews can be costly to implement, the overall project costs are usually much lower than whenno reviewsareperformed becauselesstimeand effortneedsto bespentonfixingdefectslaterin the project.

Codedefectscan bedetected usingstaticanalysis more efficientlythanindynamictesting,usually resulting in both fewer code defects and a lower overall development effort.

3.1.3. DifferencesbetweenStaticTestingandDynamicTesting

Statictestinganddynamictestingpracticescomplementeachother.They havesimilarobjectives,such as supporting the detection of defects in work products (see section 1.1.1), but there are also some differences, such as:

- Static and dynamic testing (with analysis of failures) can both lead to the detection of defects, howevertherearesomedefect typesthatcanonlybefoundbyeitherstaticordynamictesting.
- Statictestingfindsdefectsdirectly,whiledynamictestingcausesfailuresfromwhichthe associated defects are determined through subsequent analysis
- Statictestingmaymoreeasilydetect defects thatlayon pathsthrough thecode thatarerarely executed or hard to reach using dynamic testing
- Statictestingcanbeappliedtonon-executable workproducts,whiledynamictestingcanonlybe applied to executable work products
- Statictestingcanbe usedtomeasure qualitycharacteristics thatarenot dependenton executing code(e.g., maintainability),while dynamic testingcanbe usedto measure quality characteristics that are dependent on executing code (e.g., performance efficiency)

Typicaldefectsthatareeasierand/orcheapertofindthroughstatictestinginclude:

- Defectsinrequirements(e.g.,inconsistencies,ambiguities,contradictions,omissions, inaccuracies, duplications)
- Designdefects(e.g.,inefficientdatabasestructures,poormodularization)
- Certaintypesofcodingdefects(e.g.,variableswithundefinedvalues,undeclaredvariables, unreachable or duplicated code, excessive code complexity)
- Deviationsfromstandards(e.g.,lack ofadherencetonamingconventionsincodingstandards)
- Incorrectinterfacespecifications(e.g.,mismatchednumber,typeororderofparameters)
- Specifictypesofsecurityvulnerabilities(e.g.,buffer overflows)
- Gapsorinaccuraciesintestbasiscoverage(e.g.,missing testsforanacceptancecriterion)

3.2. FeedbackandReviewProcess

3.2.1. BenefitsofEarlyandFrequent StakeholderFeedback

Early and frequent feedback allows for the early communication of potential quality problems. If there is little stakeholder involvement during the SDLC, the product being developed might not meet the stakeholder'soriginalor currentvision.Afailure todeliver whatthestakeholderwantscan resultincostly rework, missed deadlines, blame games, and might even lead to complete project failure.

FrequentstakeholderfeedbackthroughouttheSDLCcanpreventmisunderstandingsaboutrequirements and ensure that changes to requirements are understood and implemented earlier. This helps the development team to improve their understanding of what they are building. It allows them to focus on those features that deliver the most value to the stakeholders and that have the most positive impact on identified risks.

3.2.2. ReviewProcessActivities

The ISO/IEC 20246 standard defines a generic review process that provides a structured but flexible frameworkfromwhich aspecificreviewprocessmaybetailored toaparticularsituation.Iftherequired review is more formal, then more of the tasks described for the different activities will be needed.

Thesize ofmanyworkproductsmakesthemtoolarge to becoveredby asingle review. The review process may be invoked a couple of times to complete the review for the entire work product.

Theactivitiesinthereviewprocessare:

- **Planning.**Duringtheplanningphase,thescopeof thereview,whichcomprisesthepurpose, the work product to be reviewed, quality characteristics to be evaluated, areas to focus on, exit criteria, supporting information such as standards, effort and the timeframes for the review, shall be defined.
- **Review initiation.**Duringreviewinitiation,thegoalistomakesurethateveryoneandeverything involved is prepared to start the review. This includes making sure that every participant has accesstotheworkproductunderreview,understandstheirroleandresponsibilitiesandreceives everything needed to perform the review.
- **Individualreview.**Everyreviewerperformsanindividual reviewtoassessthe qualityof thework product under review, and to identify anomalies, recommendations, and questions by applying one or more review techniques (e.g., checklist-based reviewing, scenario-based reviewing). The ISO/IEC 20246 standard provides more depth on different review techniques. The reviewers log all their identified anomalies, recommendations, and questions.
- **Communication and analysis.** Since the anomalies identified during a review are not necessarilydefects,allthese anomaliesneedtobeanalyzedanddiscussed.Forevery anomaly, thedecision should be made onitsstatus,ownership and requiredactions.Thisistypicallydone in a review meeting, during which the participants also decide what the quality level of reviewed work product is and what follow-up actions are required. A follow-up review may be required to complete actions.
- **Fixing and reporting.** For every defect, a defect report should be created so that corrective actionscan befollowed-up.Once the exitcriteriaarereached,theworkproductcan beaccepted. The review results are reported.

3.2.3. RolesandResponsibilitiesinReviews

Reviewsinvolvevariousstakeholders,who maytakeonseveralroles.Theprincipalrolesandtheir responsibilities are:

- Manager– decideswhatisto bereviewedandprovides resources, suchasstaffandtimefor the review
- Author–creates andfixestheworkproductunderreview

- Moderator (also known as the facilitator) – ensures the effective running of review meetings, includingmediation,timemanagement,andasafereview environment in whicheveryonecan speak freely
- Scribe(alsoknownas recorder)–collatesanomaliesfromreviewersandrecordsreview information, such as decisions and new anomalies found during the review meeting
- Reviewer–performsreviews.Areviewermaybesomeoneworking ontheproject,asubject matter expert, or any other stakeholder
- Reviewleader –takesoverallresponsibilityforthereview suchasdecidingwhowillbeinvolved, and organizing when and where the review will take place

Other,moredetailedrolesarepossible,asdescribedintheISO/IEC20246standard.

3.2.4. ReviewTypes

There exist many review types ranging from informal reviews to formal reviews. The required level of formalitydependsonfactors suchas theSDLCbeingfollowed,thematurityofthedevelopmentprocess, the criticality and complexity of the work product being reviewed, legal or regulatory requirements, and theneedfor anaudit trail. Thesamework product can be reviewedwith different review types, e.g., first an informal one and later a more formal one.

Selectingthe right reviewtypeiskeyto achievingthe requiredreviewobjectives(seesection 3.2.5).The selection is not only based on the objectives, but also on factors such as the project needs, available resources, work product type and risks, business domain, and company culture.

Somecommonlyusedreviewtypesare:

- **Informalreview.**Informal reviewsdonotfollowadefinedprocess anddonotrequireaformal documented output. The main objective is detecting anomalies.
- **Walkthrough.** A walkthrough, which is led by the author, can serve many objectives, such as evaluating quality and building confidence in the work product, educating reviewers, gaining consensus, generating new ideas, motivating and enabling authors to improve and detecting anomalies.Reviewersmight performanindividualreviewbeforethewalkthrough,butthisisnot required.
- **Technical Review.** A technical review is performed by technically qualified reviewers and led by a moderator. The objectives of a technical review are to gain consensus and make decisions regardingatechnical problem,butalsotodetectanomalies,evaluatequalityandbuildconfidence in the work product, generate new ideas, and to motivate and enable authors to improve.
- **Inspection.** As inspections are the most formal type of review, they follow the complete generic process (see section 3.2.2). The main objective is to find the maximum number of anomalies. Otherobjectivesareto evaluatequality,buildconfidenceintheworkproduct, andtomotivateand enable authors to improve. Metrics are collected and used to improve the SDLC, including the inspection process. In inspections, the author cannot act as the review leader or scribe.

3.2.5. SuccessFactorsforReviews

Thereareseveralfactorsthatdeterminethesuccessofreviews,whichinclude:

- Definingclearobjectivesandmeasurableexitcriteria.Evaluationofparticipantsshould neverbe an objective
- Choosingtheappropriate reviewtypetoachievethegivenobjectives, andtosuitthetype ofwork product, the review participants, the project needs and context
- Conductingreviewsonsmallchunks,sothatreviewersdonotloseconcentrationduringa n individual review and/or the review meeting (when held)
- Providingfeedbackfromreviewstostakeholders andauthorssotheycanimprovetheproduct and their activities (see section 3.2.1)
- Providingadequatetime toparticipantstoprepareforthereview
- Supportfrommanagementforthereviewprocess
- Makingreviewspartoftheorganization’sculture,topromotelearningandprocessimprovement
- Providingadequatetrainingforallparticipantssotheyknowhowtofulfiltheirrole
- Facilitatingmeetings