Software Testing

Lesson 8
Test Management – Test Planning
V1.0

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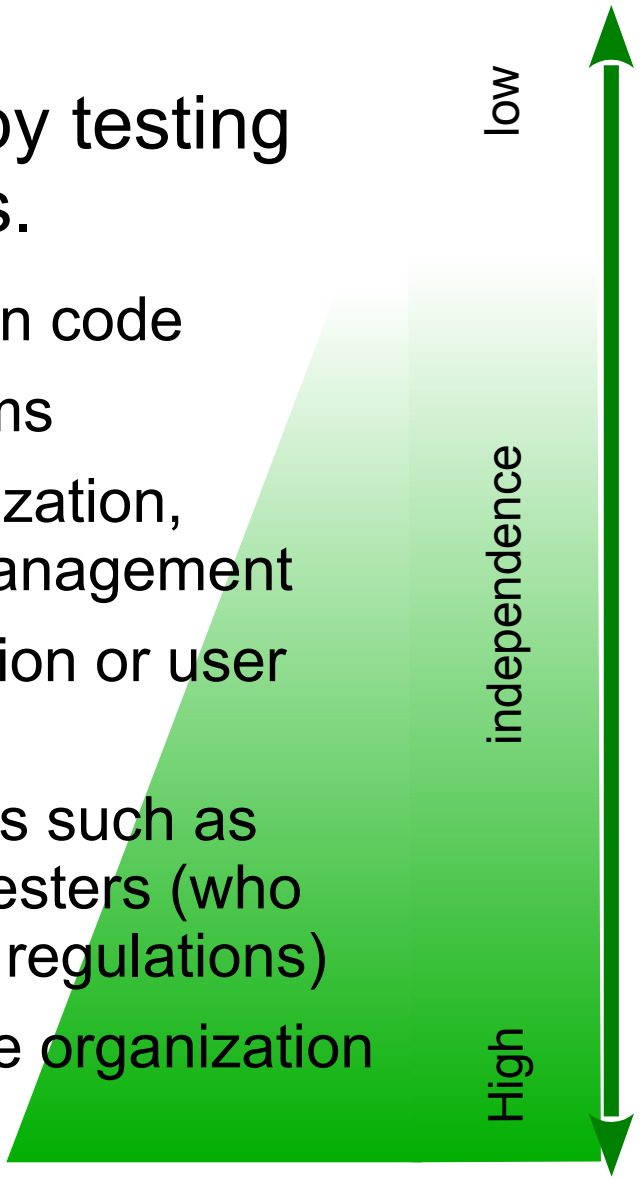
Test Organization Independence

Improve effectiveness of finding defects by testing and reviews by using independent testers.

- No independent testers; developers test their own code
- Independent testers within the development teams
- Independent test team or group within the organization, reporting to project management or executive management
- Independent testers from the business organization or user community
- Independent test specialists for specific test types such as usability testers, security testers or certification testers (who certify a software product against standards and regulations)
- Independent testers outsourced or external to the organization



Test Organization Independence

- Recommendation for large, complex or safety critical projects:
  - Multiple levels of testing
  - Independent testers for some or all of the levels
    ⇨ Development staff at lower levels
- Definition of test processes and rules
  - Good idea to be done by independent testers, but a clear management mandate required.

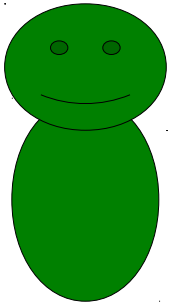
Test Organization Independence

- Benefits – Independent testers
  - see other and different defects, and are unbiased,
  - can verify assumptions people made during specification and implementation of the system.
- Drawbacks
  - Isolation from the development team (if treated as totally independent).
  - Developers may lose a sense of responsibility for quality.
  - Independent testers may be seen as a bottleneck or blamed for delays in release.

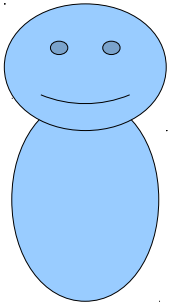
Test Organization Independence

- Who should / can do testing tasks?
  - People in a specific testing role.
  - Alternatively:
    - Project manager,
    - quality manager,
    - developer,
    - business and domain expert,
    - infrastructure or IT operations.

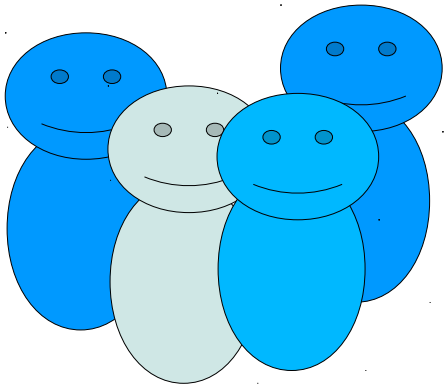
Test Organization Example



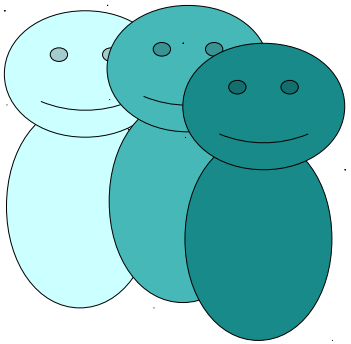
Quality manager



Test manager

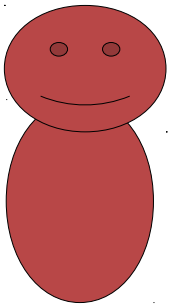


Functional tester

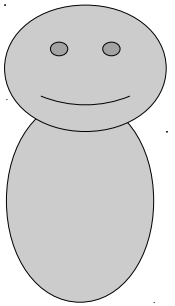


Non-functional tester

- Performance
- Security
- Operation



Defect manager



Environment manager

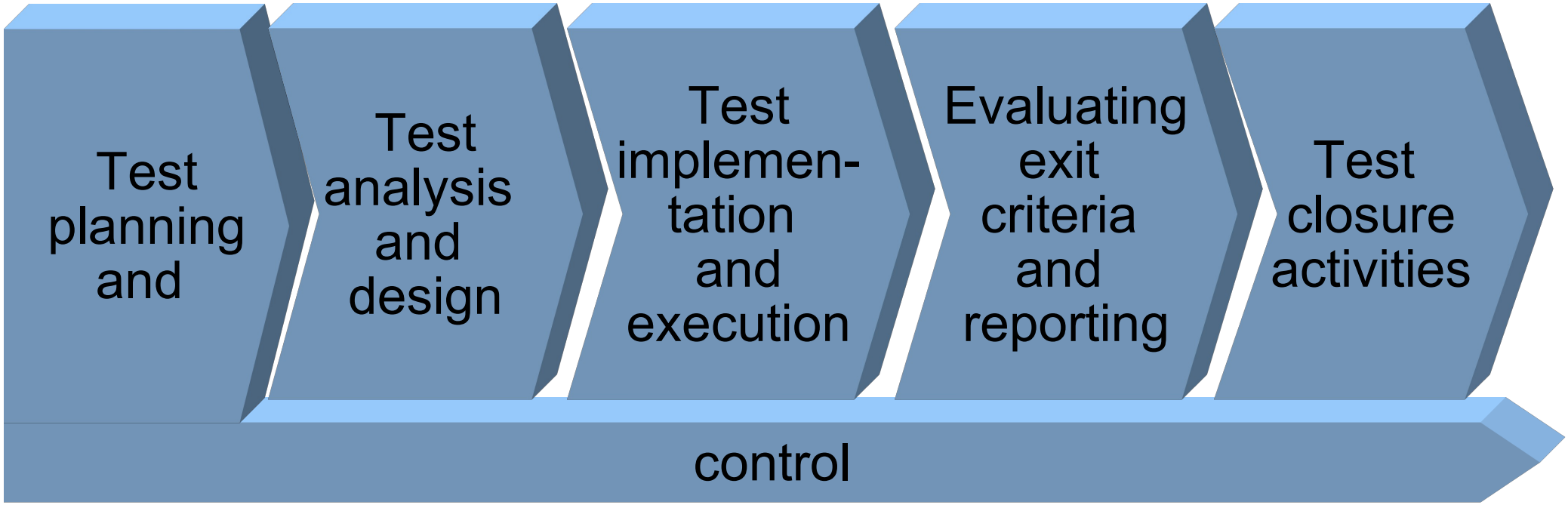
Test Organization
Test Manager

- Synonyms: Test leader, test coordinator
- Role may be performed by a
  - project manager,
  - development manager,
  - quality assurance manager or
  - manager of a test group.
- Idea: Supporting test team members, so they could do a good job.

Test Organization
Test Manager

Main tasks:

- plans, monitors and controls the testing activities and tasks, e.g. as defined in the fundamental test process

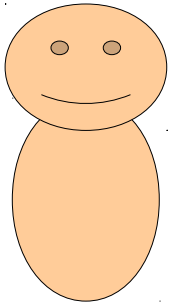


Test Organization
Test Manager

Test Manager

- coordinates the test strategy and plan with project managers and others.
- writes or reviews a test strategy for the project, and test policy for the organization.
- contributes the testing perspective to other project activities, such as integration planning.

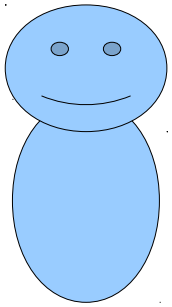
Test Organization
Test Manager



Project Manager

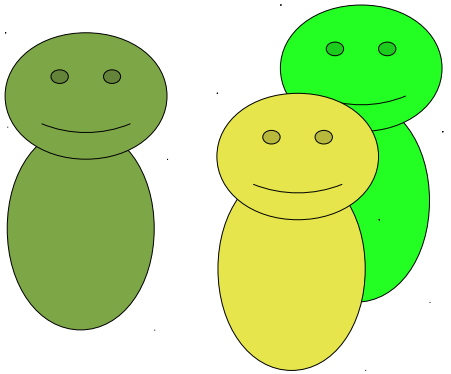
How to identify stakeholders?

reporting



Test Manager

coordinating



Stakeholders like

- customer,
- end users,
- developers,
- operation, ...

Test Organization
Test Manager

A helping tool: RACI-Matrix
(**R**esponsible, **A**ccountable, **C**onsult, **I**nform)
→ To identify and to define roles of people involved in the project (stakeholder)

[Wik14]

Responsible
Those who do the work to achieve the task

Accountable (also approver or final approving authority)
The one ultimately answerable for the correct and thorough completion of the deliverable or task, and the one who delegates the work to those responsible.

Consulted
Those whose opinions are sought, typically subject matter experts; and with whom there is two-way communication.

Informed
Those who are kept up-to-date on progress, often only on completion of the task or deliverable; and with whom there is just one-way communication.

Test Organization
Test Manager

A helping tool: RACI-Matrix
(**R**esponsible, **A**ccountable, **C**onsult, **I**nform)

Example

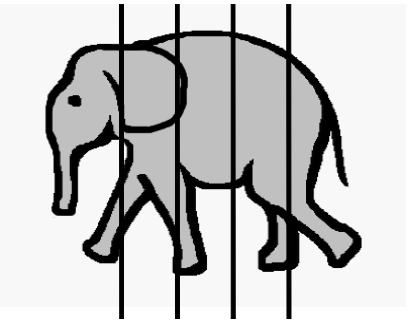
Task \ Role	Customer	Project sponsor	Project manager	Quality manager	Integration manager	Test manager
- Create project plan	C	A	R	C	C	C
- Create test plan	I	I	C	A	C	R
- Create quality plan	I	A	C	R	C	C
- Evaluate project result	R	A	C	C	C	C
- Integrate system components			A		R	C
- Write project closure report		A	R	C	C	C

Test Organization
Test Manager

Test manager

- plans the tests
  - selecting test approaches,
  - estimating the time, effort and cost of testing,
  - acquiring resources,
  - defining test levels, cycles, and
  - planning incident management.
- considers context, test objectives and risks.

Consider effort for test planning itself – depends on project (size, risk, ...)



Test Organization
Test Manager

Test manager

- initiates
  - specification of tests,
  - preparation of tests,
  - implementation of tests, and
  - execution of tests,
- monitors the test results, and
- checks the exit criteria.

Test Organization
Test Manager

Test manager

- adapts planning based on test results and progress (out of status reports)
  ==> take action to compensate problems
- sets up configuration management of testware for traceability
- introduces suitable metrics for
  - measuring test progress, and
  - evaluating the quality of the testing and the product.

Test Organization
Test Manager

Test manager

- decides concerning automation
  - what should be automated, to what degree?
  - when and how should automation been done?
- selects tools to support testing and organize any training in tool use for testers,
- decides about the implementation of the test environment(s),
- writes test summary reports based on the information gathered during testing.

Test Organization
Tester

- Synonyms: Test Engineer, Test Designer
- Best people should test!
- Software Testers are real experts after end of the tests
  - They know the software:
    Strengths and weaknesses.
  - They could support
    - as multiplier,
    - for introducing, and
    - for training.

Test Organization
Tester

- Qualification
  - Requirements Know-how
    - Modelling,
    - UML (Unified Modeling Language) concerning use cases,
    - agile methods concerning user stories.
  - IT Know-how
    Data modelling
  - Test Know-how.
  - Expertise about the subject to be tested,

Test Organization
Tester

- reviews and contributes to test plans.
- analyses, reviews and assesses
  user requirements, specifications and models
  for testability
  → Points out faults / open issues.
- Prepares and acquires test data.
- Creates test specifications
  - creates test cases,
  - creates test scenarios,
  - combines test data with test cases / test scenarios

Test Organization
Tester

- reviews tests developed by others.
- sets up and operates the test environment (often coordinated with system administration and network management).
  => Depending on effort / size of test environment this could be a special role

Test Organization
Tester

- implements tests on all test levels, executes and logs the tests, evaluates the results and documents deviations from expected results.
- opens and retests defects after fix.
- uses test administration or management tools and test monitoring tools as required.
- automates tests (may be supported by a developer or a test automation expert),
- measures performance of components and systems if applicable.

Test Organization
Tester

- Depending on the test level and the risks related to the product and the project, different people may take over the role of tester, e.g.
  - at the component and integration level:
    - Developers.
  - at the acceptance test level:
    - Business experts,
    - Users.
  - for operational acceptance testing:
    - Operators.

Test Organization
Tester

- Specialization
  People who work on test analysis, test design, specific test types or test automation may be specialists in these roles.

Test Organization
More testing roles

- Test Data Manager
  - Qualification
    - Data base expert (Data modelling know-how)
    - Test Know-how
  - Tasks
    - Test data strategy / concept
    - Test data research
    - Test data generation
    - Mapping of Test data to Test cases / Test scenarios
    - During Test execution supporting with test data

Test Organization
More testing roles

- Defect Manager
  - Tasks: Choice of tool, defect collection, defect tracking, moderation of defect meetings, control of release management.
- Environment Manager
  - Tasks: Providing Test environment – at a time for corresponding tests, accept software, installing it, running smoke test, keep the software „run capable“.

Test Organization
More testing roles

- Non functional test manager / Non functional tester
  - Tasks: Defining of a strategy, planning, organizing, execution of performance test, load tests, security tests, breakdown tests.
  - Special role “Security tester” may be required depending on project
    Task: Security test strategy, execution, consulting.
- Test automation expert
  - Tasks: Test automation strategy, choice of tool, preparation and execution (scripting, delivering reports).

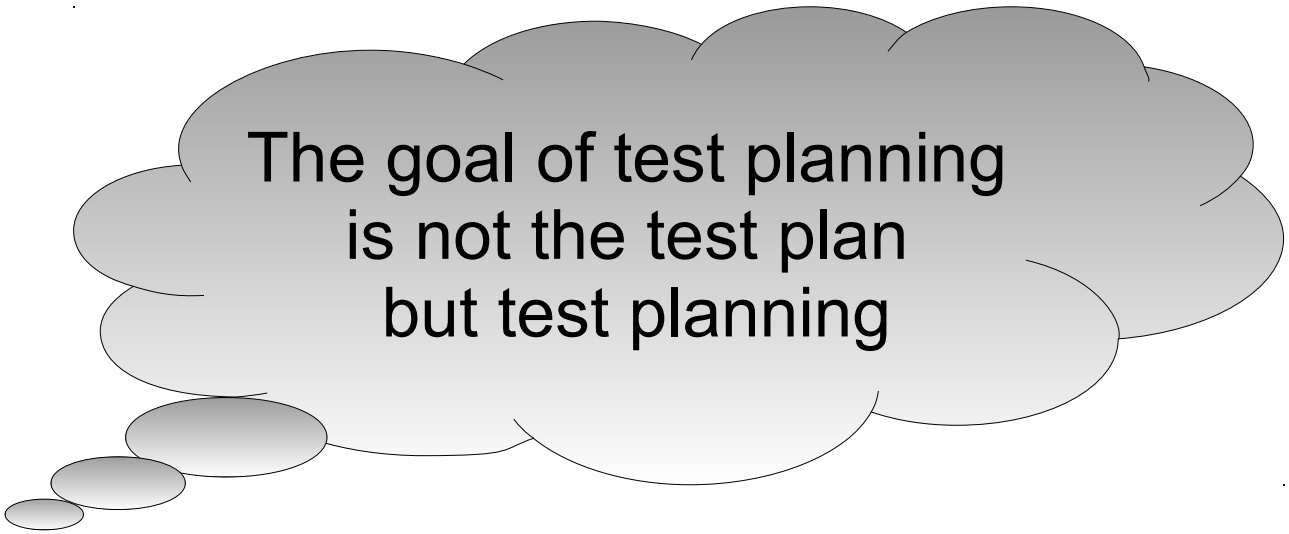
Test Organization
More testing roles

- More people could support in testing, especially stakeholder:
  - Customer,
  - Requirements Engineers (know specifications best),
  - Users („old stager“ are very valuable! Processes),
  - Operation (Architectural requirements),
  - Software developer.

Test Planning and Estimation
Test Planning

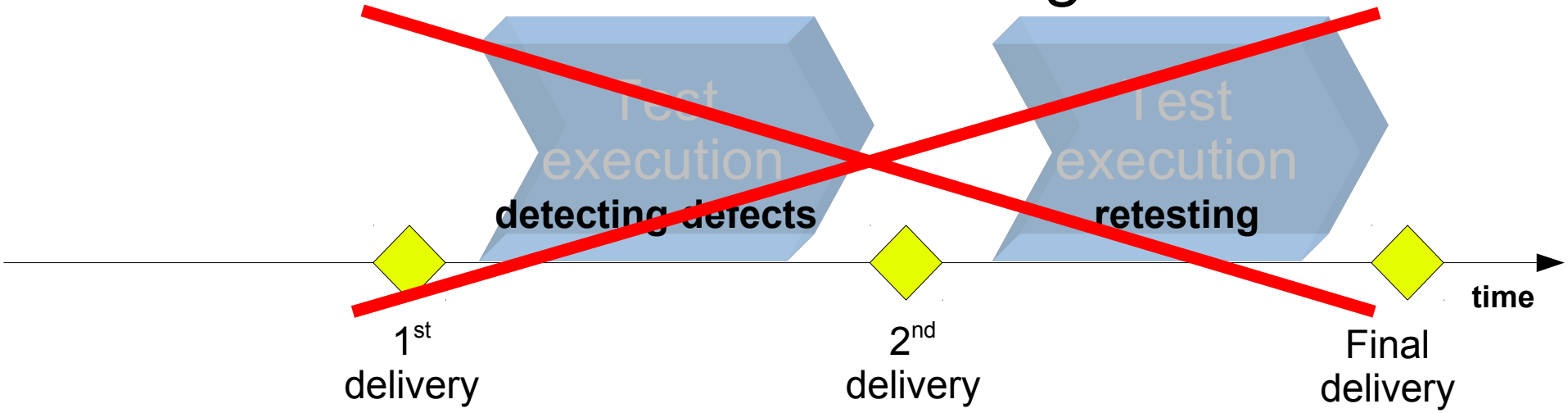
- Important: Testing is not independent – coordination with main project required.

- Testing activities have to be integrated into the software life cycle activities
  - acquisition,
  - supply,
  - development,
  - operation, and
  - maintenance.



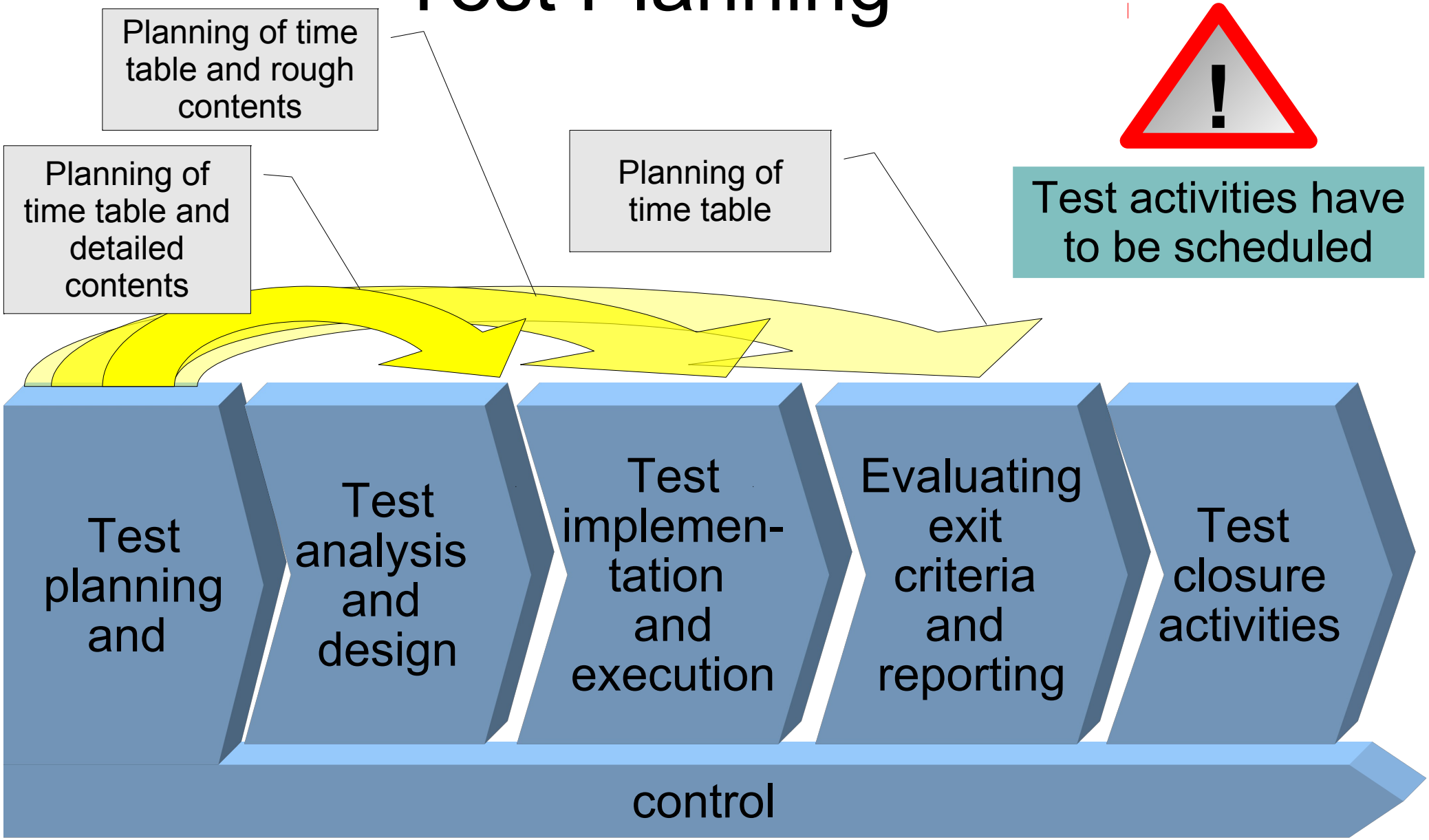
Test Planning and Estimation
Test Planning

- What to consider for Test Planning?



  - **Doesn't work! 2 test cycles not enough – why?**
    - You test better, when you learn about the product.
    - Not all bugs found in the first cycle will be fixed after the first cycle.
    - Not all bugs will be found in the first cycle.
    - Side effects not considered.

Test Planning and Estimation
Test Planning



Test Planning and Estimation
Test Planning

- Planning may be documented in
  - master test plan,
  - separate test plans for test levels such as
    - system testing,
    - acceptance testing.
- The outline of a testplanning document is covered by the ‘Standard for Software Test Documentation’ [IEEE Std 829-1998].
- Expected content:
  Time Schedule and Resource Plan.

Test Planning and Estimation
Test Planning

- Planning is influenced by
  - the test policy of the organization,
  - the scope of testing,
  - objectives,
  - risks,
  - constraints,
  - criticality,
  - testability and
  - the availability and Know-how of resources.

Consider training / training on the job for
- business related Know-how
- test tools

Test Planning and Estimation
Test Planning

- Test planning activities to be done for an entire system or part of a system.
- Test planning is a continuous activity.
- Regular update of test plan required:
  As the project and test planning progress,
  - more information becomes available,
  - more detail can be included in the plan.
  - feedback from test activities could be used
  - risks are changing

Test Planning and Estimation
Test Planning

Prioritization ... is the basic of testing!

- Why?
  - Time problems
  - Focusing on critical areas
- Which criteria are important for prioritization?
  - Complexity
  - Importance
  - Specification coverage
- How prioritization should be done?
  - Identify most important business processes
  - Identify most important use cases

Test Planning and Estimation
Test Planning

Prioritization ... is the basic of testing!

Prioritize tests
so that,
whenever you stop testing,
you have done the best testing
in the time available.

Test Planning and Estimation
Test Planning

Prioritization ... is the basic of testing!

- Test the important scope first
- Achieve as early as possible a high test coverage
- Detect critical defects as soon as possible in testing critical business processes first
- Minimize the risk of not detected critical defects at the end of testing
- Support the defect fixing in the best way

Test Planning and Estimation
Test Planning Activities

- Determining the scope and risks and identifying the objectives of testing
- Defining the overall testing approach including
  - definition of test levels
  - definition of entry and exit criteria

Test Planning and Estimation
Test Planning Activities

- Making decisions about
  - what to test,
  - what roles will perform the test activities,
  - how the test activities should be done, and
  - how the test results will be evaluated.
- Assigning resources for the defined activities.

Test Planning and Estimation
Test Planning Activities

- Test documentation
  Defining the amount, level of detail, structure and templates
- Selecting metrics for monitoring and controlling
  - test preparation
  - test execution,
  - defect resolution and
  - risk issues.
- Setting the level of detail for test procedures in order to provide enough information to support reproducible test preparation and execution

Test Planning and Estimation
Entry Criteria

- Entry criteria define when to **start** testing like
  - at the beginning of a test level or
  - when a set of tests is ready for execution.
- Typically entry criteria:
  - test environment availability and readiness,
  - test tool readiness in the test environment,
  - testable code availability,
  - test data availability.

Test Planning and Estimation
Exit Criteria

- Exit criteria define when to **stop** testing such as
  - at the end of a test level or
  - when a set of tests has achieved specific goal.
- Typically exit criteria:
  - Thoroughness measures, such as coverage of code, functionality or risk,
  - estimates of defect density or reliability measures,
  - cost,
  - residual risks, such as defects not fixed or lack of test coverage in certain areas,
  - schedules such as those based on time to market.

Test Planning and Estimation
Test Estimation

Goal: Identifying resources, draw up of a schedule

Approaches for the estimation of test effort:

- Metrics-based approach
- Expert-based approach

Test Planning and Estimation Metrics-based approach (1/4)

- Estimating the testing effort based on
  - metrics of former or similar projects or previous cycles
  - typical values / constraints
    - Number of man days available for testing
    - Number of test cases to be executed
    - Complexity of test cases

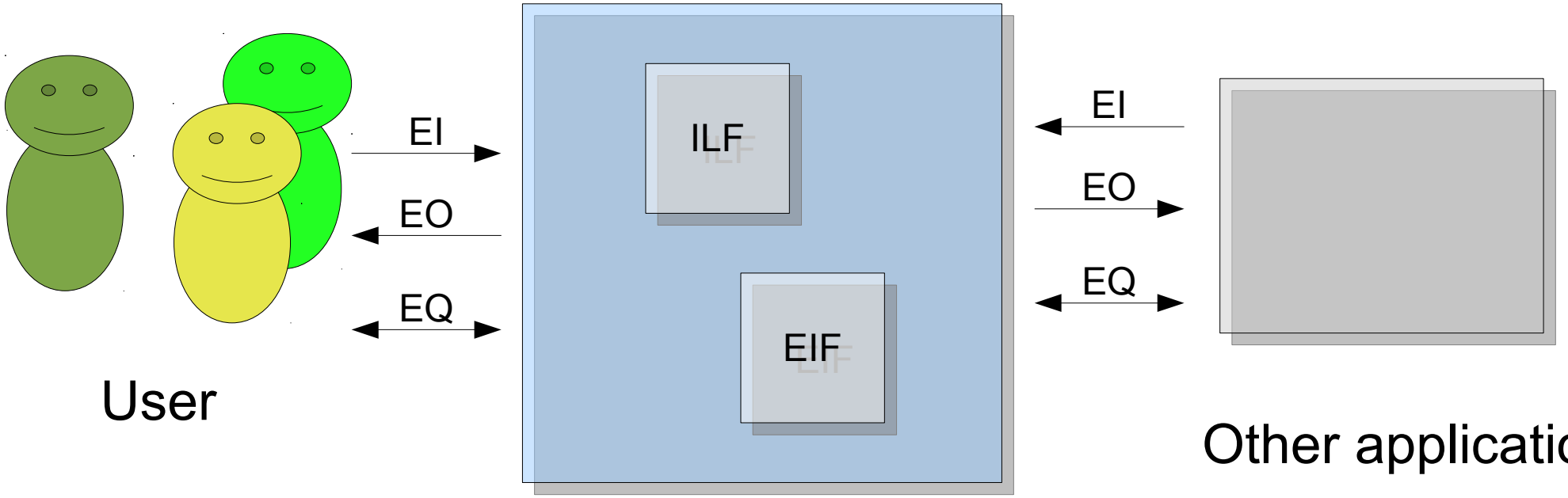
Test Planning and Estimation Metrics-based approach (2/4)

- Functional Point Analysis [Alb79]
  - Measure of the amount of business functionality. The higher the number of function points, the more functionality.
  - Function points based on functional user requirements of the software, categorized into types: outputs, inquiries, inputs, internal files, and external interfaces.
  - After a function is identified and categorized into a type, it is then assessed for complexity and assigned a number of function points.

Test Planning and Estimation Metrics-based approach (3/4)

- Functional Point Analysis
  Function Point Model [Kus07]

EI = External Inputs
EO = External Outputs
EQ = External Inquiries
ILF = Internal Logical Files
EIF = External Interface Files



Test Planning and Estimation Metrics-based approach (4/4)

- Functional Point Analysis
  Matrix to calculate Unadjusted Function Points

	Complexity weight	Low			Average			High			Total
			x			x			x		
EI =	External Inputs		3	0		4	0		6	0	0
EO =	External Outputs		4	0		5	0		7	0	0
EQ =	External Inquiries		3	0		4	0		6	0	0
ILF =	Internal Logical Files		7	0		10	0		15	0	0
EIF =	External Interface Files		5	0		7	0		10	0	0
		Total Unadjusted Function Points									0

Test Planning and Estimation
Expert-based approach

- Estimating the tasks based on estimates made
  - by owner of the tasks or
  - by experts.

- Compare:
  Planning poker
  in Scrum
  [Wik14]

Image source: http://en.wikipedia.org/wiki/File:CrispPlanningPokerDeck.jpg

Test Planning and Estimation
Test Estimation

- The testing effort may depend on
  - Characteristics of the product:
    - Quality of the specification and other information used for test models (i.e., the test basis),
    - Size of the product,
    - Complexity of the problem domain,
    - Requirements for reliability and security, and
    - Requirements for documentation.

Test Planning and Estimation
Test Estimation

- The testing effort may depend on (cont'd):
  - Characteristics of the development process:
    - Stability of the organization,
    - tools used,
    - test process,
    - skills of the people involved, and
    - time pressure
  - Outcome of testing:
    - Number of defects and
    - amount of rework required.

Test Planning and Estimation
Test Estimation

- Estimation based on fundamental test process:
  - Personal costs based on main tasks and deliverables during
    1. Test planning and control
    2. Test analysis and design
    3. Test implementation and execution
    4. Evaluating exit criteria and reporting
    5. Test closure activities
  - Material costs
  - Risk load

Test Planning and Estimation
Test Estimation

- Example:

Test effort estimation project "KU Test Project"

Test project over 8 weeks. 6 iterations planned with weekly deployments on Mondays from 3rd week on
Basic are requirements: User manual of old version, requirements specification, system architecture scetches

	Personal costs	Details				Planning values			Real values		
Id	Task	Number	hours per item	intermediate hours	Comment	Cost / hour	hours	Costs	Cost / hour	hours	Costs
1	Test planning and control			200		฿ 200	200	฿ 40.000			
2	Test analysis and design			440		฿ 150	440	฿ 66.000			
3	Test implementation and execution			224		฿ 150	224	฿ 33.600			
4	Evaluating exit criteria and reporting	6	8	48	*8 hours / week*	฿ 200	48	฿ 9.600			
5	Test closure activities			20	*workshop / documentation*	฿ 200	20	฿ 4.000			
	Sum						932	฿ 153.200		0	0

	Material costs	Planning values			Real values		
Id	Item	Price	Quantity	Costs	Price	Quantity	Costs
M1	Test Mgmt Tool incl. 5 licenses			฿ 20.000			
M2	3 test laptops	฿ 25.000	3	฿ 75.000			
M3	Load test tool, leasing for 4 weeks	฿ 1.000	4	฿ 4.000			
	Sum			฿ 99.000			0

Overview	Planning values		Real values
Personal costs		฿ 153.200	0
Material costs		฿ 99.000	0
Intermediate result		฿ 252.200	
Risk load	20%	฿ 50.440	
Overall result		฿ 302.640	0

Test Planning and Estimation
Test Strategy, Test Approach

- The test approach
  - is the implementation of the test strategy for a specific project.
  - is defined and refined in the test plans and test designs.
  - typically includes the decisions made based on the (test) project's goal and risk assessment.
  - is the starting point for
    - planning the test process,
    - selecting the test design techniques and test types to be applied, and
    - defining the entry and exit criteria.

Test Planning and Estimation
Test Strategy, Test Approach

- The selected approach depends on the context and may consider
  - risks, hazards and safety,
  - available resources and skills,
  - the technology,
  - the nature of the system (custom built or COTS),
  - test objectives, and
  - regulations.
- Different approaches may be combined, for example, a risk-based dynamic approach.

Test Planning and Estimation
Test Strategy, Test Approach

- Typical approaches include:
  - Analytical approaches
    - Risk-based testing
      where testing is directed to areas of greatest risk
  - Model-based approaches,
    - Stochastic testing
      using statistical information about failure rates (such as reliability growth models) or usage (such as operational profiles)

Test Planning and Estimation
Test Strategy, Test Approach

- Typical approaches include (cont'd):
  - Methodical approaches
    - Failure-based (including error guessing and fault attacks),
    - Experience-based,
    - Checklist-based, and
    - Quality characteristic-based

Test Planning and Estimation
Test Strategy, Test Approach

- Typical approaches include (cont'd):
  - Process- or standard-compliant approaches
    - Industry-specific standards
    - agile methodologies
  - Dynamic and heuristic approaches
    - For example:
      Exploratory testing where testing is more reactive to events than pre-planned, and where execution and evaluation are concurrent tasks

Test Planning and Estimation
Test Strategy, Test Approach

- Typical approaches include (cont'd):
  - Consultative approaches, such as those in which test coverage is driven primarily by the advice and guidance of technology and/or business domain experts outside the test team.
  - Regression-averse approaches, such as those that include reuse of existing test material, extensive automation of functional regression tests, and standard test suites.

Sources

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