SOFTWARE TESTING AS A SERVICE (STAAS)

author: Leo van der Aalst
based on the original publication in: PNSQC proceedings

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1 INTRODUCTION

The importance of IT testing is growing. Some important drivers for this are:

- Higher business demands and expectations on 'first time right' software launches.
- Legislation and regulations (e.g. SOX, SAS70, Basel II act and Clinger Cohen act) put stronger demands on quality assurance and test processes.
- Mergers, chain integrations, globalization and technological developments lead to more complex IT chains.
- Business demands swift, high quality and cost effective IT services that contribute to business processes.

IT becomes a utility. The business departments' demand guarantees from IT services that IT implementations will not threaten business continuity. The business department demands a test process which clearly demonstrates that requirements have been sufficiently met, and that risks for deployment are acceptable. Testing will become a utility also.

Test service providers who can offer the test process as demanded by the business departments will be very successful, especially if these providers always: make the client's objectives highest priority and commit to focusing primarily on the success of the client's business. A robust and successful collaboration with the customer is founded on the skills of the providers' test professionals, highly industrialized test processes, open communication and full transparency regarding objectives, measurable results, responsibility, operation procedures and costs. The model to support this all is called: *Software Testing as a Service*.

2 STAAS DEFINITION

Software Testing as a Service (STaaS) is a model of software testing used to test an application as a service provided to customers across the Internet. By eliminating the need to test the application on the customer's own computer with testers on site, STaaS alleviates the customer's burden of installing and maintaining test environments, sourcing and (test) support. Using STaaS can also reduce the costs of testing, through less costly, on-demand pricing.

From the STaaS provider's standpoint, STaaS has the attraction of providing stronger protection of its test approach and establishing an ongoing revenue stream. The STaaS provider may test the application on its own server or even use a third-party application service provider. This way, the customer may reduce their investment on server hardware too.

[1] Mike Roe, Brian Hansen, Rob Kuijt and Dirkjan Kaper; thank you for your input. You were a great help!

3 DRIVERS FOR STAAS ADOPTION

The traditional rationale for test outsourcing is that by applying economies of scale to the testing of applications, a test service provider can test better, cheaper and faster than companies can themselves. STaaS could be the next step in test outsourcing. Several important changes made to the way we work could make a rapid acceptance of STaaS possible:

Everyone has a computer: Most testers have access to a computer and are familiar with conventions from mouse usage to web interfaces. Therefore, the learning curve for new applications is lower, requiring less handholding by the customer.

The testing industry has matured into a standard practice: In the past, executives viewed corporate test centers as strategic investments. Today, people consider testing to be a cost center and, as such, it is suitable for cost reduction and outsourcing. IT is commodity → testing is a commodity!

Testing by companies themselves is expensive: In-source testing activities require expensive overhead including salaries, health care, liability and physical building space.

Standard test approaches are available: With some exceptions, testers can use a standard test approach to test any application. Refer to TMap Next [Aalst, 2006].

A specialized testing provider can target global markets: A testing provider specialized in testing widespread applications (packages) can more easily reach the entire user base.

Security is sufficiently well trusted and transparent: With the broad adoption of SSL, VPN and Citrix, testing providers have a secure way of reaching the applications under test. This still allows the environments to remain isolated from each other.

Wide Area Network's bandwidth has grown drastically: Added to network quality of service improvement, this makes it possible for testing providers to trustfully access remote locations and applications with low latencies and acceptable speeds.

IT as a utility ensures the customer that test environments are no longer scarce and mysterious environments that must be carefully managed. Therefore, test environment capacity can be quickly increased and decreased without upfront investments.

4 STaaS PROCESS

As said: Software Testing as a Service (STaaS) is a model of software testing where an application is tested as a service provided to customers across the Internet.

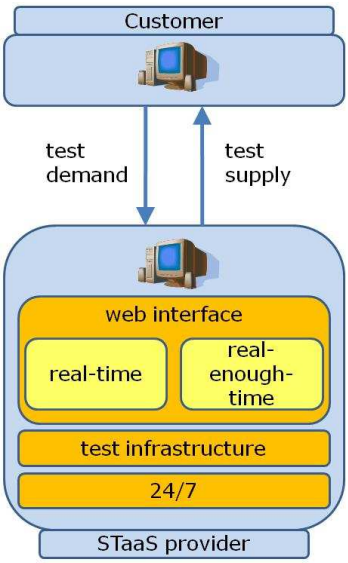

Figure 1: STaaS process.

The customer has a test demand. The demand is sent through the internet to a STaaS provider. After a certain time the STaaS provider sends the customer a test report (figure 1).

What happened in between? How did the provider deal with the test demand? For instance did the provider use a '*real-time STaaS'* or a '*real-enough-time STaaS*'? In addition, how did the provider deal with other challenges like test infrastructure, 24/7 availability and the communication between customer and himself?

Web interface

In a *real-time STaaS* (figure 2) the test demand is implemented without human intervention by the provider. In the ultimate form of the real-time STaaS a test object (e.g. application software), including test bases (e.g. requirements, use cases, set of heuristics), design and architecture model, is offered to the STaaS provider. Without human intervention this is implemented in a test environment. The entire amount of testing is performed by human simulators against the model and a neural network forecasting. A test report is sent to the customer. Is the above-described real-time STaaS science fiction? Yes, for this moment anyway. Perhaps in the future?

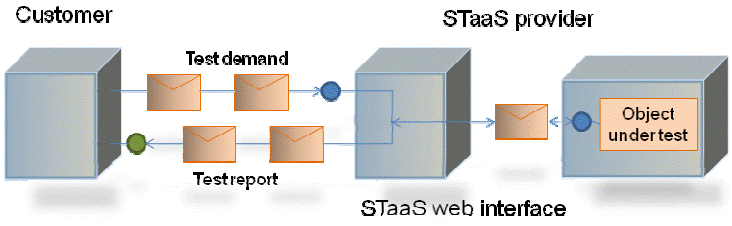

Figure 2: Real-time STaaS.

Examples of today's existing real-time STaaS are:

- Regression subscription to periodically checking the external and internal links on a web site. Are the links for instance still working correctly and not broken?
- Regression subscription for application interfaces in a suite of applications. Monitoring the health and functionality of the application landscape.
- Periodically, from various locations (worldwide), execution of performance measurements of a web site.
- Testing of SaaS applications through STaaS (e.g. web services collecting interest percentages or license plate data).

In a *real-enough-time STaaS* (figure 3) the test demand often requires human intervention in the workflow. The demand is carried out, behind the 'scenes', by many humans, through which it appears as if the test demand is carried out by computers. By its very nature, this introduces a latency and unpredictability to the STaaS process.

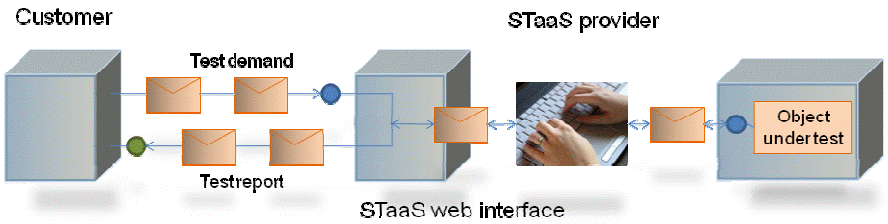

Figure 3: Real-enough-time STaaS.

Examples of existing real-enough-time STaaS:

- Work Package (WoPa) broker. Through a formal test demand mechanism everything about the assignment is specified in a WoPa. This includes items such as; what should be tested, how and when, what criteria should be used, and what knowledge is necessary. The WoPa's are stored in a kind of virtual (digital) cupboard. The WoPa can be pushed by the WoPa broker to, or pulled by, a tester or WoPa team that possesses the sufficient means to carry out the WoPa. The WoPa serves as the contract between customer and provider.
- Managed Testing Services (MTS) is the structured form of a WoPa broker who is specialized in a particular client or application. Through MTS the provider takes full responsibility for test assignments, with clear commitments expressed in KPI's on quality, cost level and time to market. MTS is organized in so-called test lines. A test line is the operational organization to provide test services to one or more customers. A test line has a fixed team of testers, infrastructure, test tools and standardized work procedures. Every test line has a permanent key team of testers that ensure continuity and knowledge retention. There is also a flex team. When the work available in their test line is insufficient, the flex team is assigned to other test lines (temporarily). It is a flexible pool of testers deployed to test lines with the most work pressure.

Test infrastructure

With STaaS it should be possible to test an application from all over the world, regardless of the location of the tester and the customer. This requires special attention to the test infrastructure. Figure 4 "Test infrastructure" below contains an existing and operational infrastructure used by a provider.

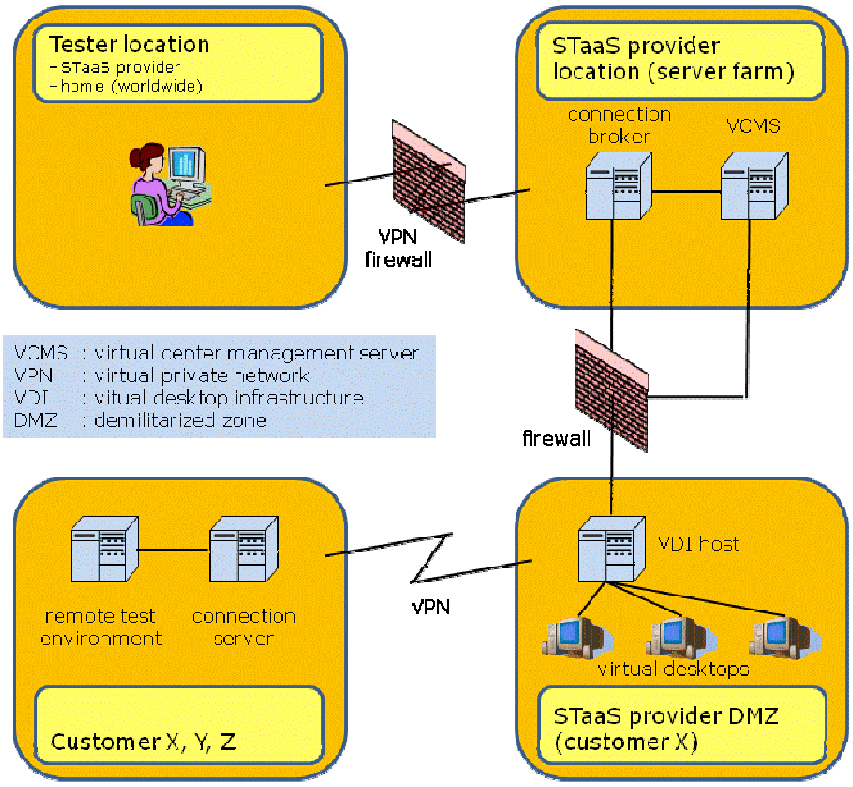

Figure 4: Test infrastructure.

The tester (either from home or provider office) has a remote connection tool on his computer with which he or she can establish a VPN connection to the connection broker of the provider.
Based on a certain classification, the tester is assigned a desktop and the VCMS prepares this desktop ready for use (e.g. VMWare Test lab manager). These virtual workstations are hosted on a server farm at the providers' location.
In case a connection with the customer is needed, a secure tunnel is set up. E.g. virtual workstations are placed in a DMZ and from the virtual workstation a second VPN connection is established to the customer.
In this way multiple customers can be connected, each with its own virtual desktops. Security is guaranteed in this way.

Other possibilities are:

- hosting of the test infrastructure by the STaaS provider
- outsourcing of the test infrastructure to a third party hosting provider.

24/7

When it is possible to test an application all over the world through the internet, the provider and his testers should be available 24/7. In this situation a test demand is not rejected just because it is night at the location where the provider is situated. The provider needs a broad network of testers spread all over the different time zones or needs testers available 24/7 in a specific time zone. Because the demand for testing services will fluctuate, it is recommended that the provider have a fixed pool of testers and a pool of flex testers (figure 5). In practice students have proven to be very suitable as flex testers; they like to work in virtual environments, are time-independent and location-independent and can be paid per assignment.

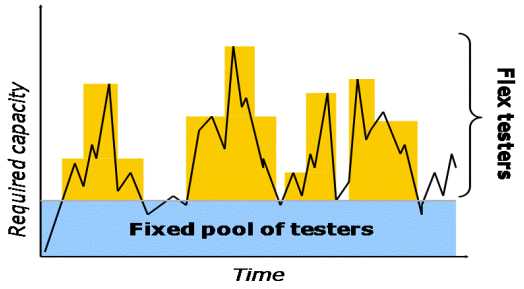

Figure 5: Fixed pool and flex testers.

In addition to the fixed pool the flex testers cover the required flexibility to cope with peaks and variation of required workload. Assignment of the flex testers is based on the planned test capacity demand and agreed reaction times. Learning time of flex testers is relatively short due to the provider's standard working practices. In principle the flex testers leave the fixed pool at the end of the peak.

Of course, using test tools and test automation could also support the STaaS providers' 24/7 availability.

Governance model (test demand ⟷ test supply)

The STaaS provider has to distinguish various interaction points where the customer and provider interact and communicate. Figure 6 "Governance of a test line" gives an overview of the generic governance model used by a STaaS provider.

- Customer contract manager ⟷ Provider delivery manager.
  Agreement on a strategic level regarding contracts and SLA. At this level there is a responsibility for setting up the contracts and SLA.
- Customer manager test services ⟷ Provider test line manager.
  Set up and maintain the standard procedures and KPI's. Initiate and start work packages.
- Customer project manage ⟷ Provider test manager.
  Planning and monitoring progress of test activities. Progress reporting, defect reporting and management. Delivering the conclusive test report after finishing the test.
- Customer development teams ⟷ Provider test coordinator.
  Findings after the testability review are reported. If required testers and designers meet in a session to clarify the findings. The result is a clear unambiguous test basis.
- Customer development teams ⟷ Provider test coordinator.
  Intake of delivered software. The initial test is performed on the basis of agreed entry criteria. Issues regarding the initial test are reported to project management and

development. If required a meeting is set up to clarify issues. The result is a system with sufficient quality to start test execution.

- Customer development teams ⟷ Provider test coordinator / test engineer. Retest of resolved defects. Through a delivery document the developer lists which defects are resolved in the new build. This document is the basis of the re-tests.

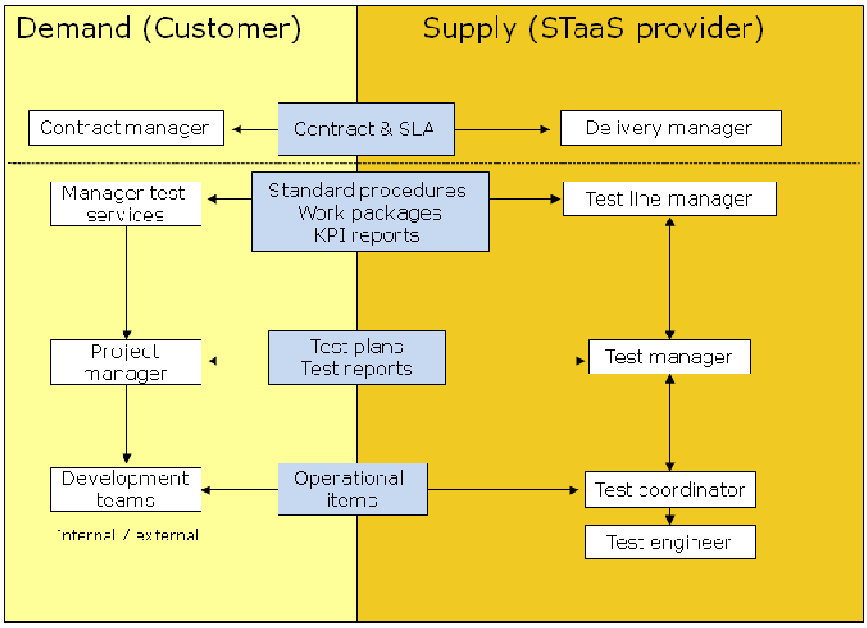

Figure 6: Governance of a test line.

5 STaaS PROVIDER SERVICES

A service item is a certain element of the test process offered to the customer for which the STaaS provider is responsible. These service items can be highly varied. Moreover, the established service offering can be modified when new services are proposed or existing ones are eliminated. The STaaS provider must deliver a result based on the demand. The delivery must occur within the pre-defined timeframe, at pre-defined costs, and at a pre-defined quality level. The provider is responsible for guaranteeing continuity in delivering the result.

Some typical service items are (in alphabetical order):

- 'chain integration' testing
- creating test scripts
- evaluating test basis
- executing tests
- infrastructure testing
- Installation testing
- localization testing
- management of defects
- performance testing
- reporting
- security testing
- setting up and maintaining test data
- setting up, maintaining and hosting test environments
- test automation
- testability review
- testing of standard packages
- testing of web applications.

6 STaaS PROVIDER PROCESS MODEL

A number of processes have to be set up by the STaaS provider to offer the services. The STaaS provider process model (figure 7) consists of two parallel primary processes:

- The process for the actual execution of the service in an assignment.
- The process that supports and monitors the execution.

The processes serve to support the assigned employees' collaboration needed to accomplish the contracted services. The processes are described in detail below.

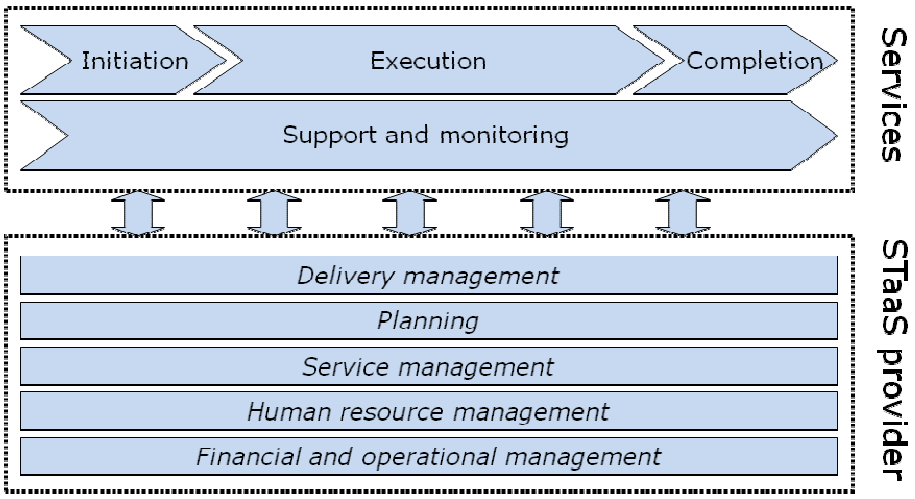

Figure 7: STaaS provider process model.

Initiation

This is the first phase for execution of the assignment. The assignment always comprises one or more services tailored to the customer's specific demand. The initiation phase serves to describe the scope of the assignment accurately. This can be done by creating a so-called *assignment description* and optionally asking the customer to approve it. An assignment description concretely describes:

- the STaaS service asked for, including preconditions and basic assumptions
- clear commitments expressed in KPI's on quality, cost level and time to market
- the agreements on monitoring by the STaaS provider in relation to communication lines, progress reporting and consultation
- the deliverables.

Furthermore, the initiation phase is used to identify what is available in the provider's organization for (re)use on behalf of the assignment. This may include templates, standards, existing test scripts or test design patterns from previous assignments, test environments and tools.

In more detail: Test design pattern

A test design pattern is a generic set up test structure and/or test strategy, which solves a specific common type of test design problem. Test design patterns are generically described, offering the advantage of a recognizable solution pattern, regardless of the implementation details. Using test design patterns accelerates the

communication of a test assignment because the solution of a common test design problem has, in fact, been given a "name".

Execution

In this phase, the assignment is executed in conformance with the agreements with the customer as described in the assignment description. Furthermore, the parties communicate via the agreed communication lines on the results, progress, risks and bottlenecks in the execution of the assignment.

Completion

Reuse of resources is one of the success factors of the provider. In this phase, the assignment is assessed and a satisfaction measurement made with the customer. The lessons learned from the assessment are fed back into the provider's organization and incorporated into the (new version of the) service. This results in formal process improvement embedded into the processes of the provider's organization.

Support and monitoring

The provider continuously supports and monitors the assignment process as described above. The progress, risks and bottlenecks involved in the execution of the assignment are monitored. Where and when necessary, the involved parties reach new agreements on the assignment.

Delivery management

This process covers activities that aim to acquire assignments for the provider and manage (long-term) relationships. Examples are maintaining the test environment, repeated testing of releases, and live monitoring of applications.
A contract is created to govern how both parties will handle the assignment. It specifies agreements on the service level provided by the provider.

Planning

The planning process ensures that the right tester is deployed to each assignment. 'Right' in this context means that the knowledge and competencies of the tester match the knowledge and competencies required for the assignment. Other planning aspects are:

- required availability of the tester (during working hours, weekends, 24/7)
- required or available location (office, home, off-shore, near-shore, on-shore)
- technology (bandwidth and processing power availability).

Service management

The range of services provided by the STaaS provider is not set in stone – it may grow or recede. To this end, it must be determined periodically whether the current service offering is in line with the requested services. In addition services must be known (to the customer, assignment management and tester) and the products for the services must be up-to-date and in line with the latest developments.

Human resource management

The process of human resource management aims, among other things, to continuously develop the skills and career of the provider's testers. This requires matters like defined job positions with associated competency, continued training and remuneration levels.

Financial and operational management

Financial management is a continuous process based on budgeting (what are the expected costs and benefits) and monitoring (what are the actual costs and benefits). Operational management can be executed based on many factors. Examples of these factors are:

- the percentage of assignments completed within the agreed key performance indicators (KPI's) on quality, cost level and time to market
- the percentage of test services acquired as compared to test services acquired by competitors.

7 ACHIEVED RESULTS BY A STAAS(-LIKE) PROVIDER

A STaaS managed test services provider with 300 testers, 20 clients and 18 test lines achieved the following results in the first year of its existence:

- proven test cost reduction
- demonstrable improvement of quality of testing, test process, test deliverables, test results and flexibility of test operations.

Optimization of costs was expressed in measurable improvements of test costs, measured in agreed units. Units could be test costs per function point, per requirement or could be expressed as a proportion of test costs versus total project costs. After agreeing on the measurement unit the STaaS provider performed a zero-measurement to establish the starting situation.

In the experience of a particular provider, managed testing services have been yielding the following results:
- 10% reduction of test costs per test unit within 6 months
- 15% reduction of test costs per test unit within 12 months
- 25% reduction of test costs per test unit within 24 months (forecast).

The provider committed itself to key performance indicators that were directly related to customers' business objectives.

Figure 8 "STaaS MTS results" shows the business objectives related to agreed ("Target") and achieved ("Score") KPI's.

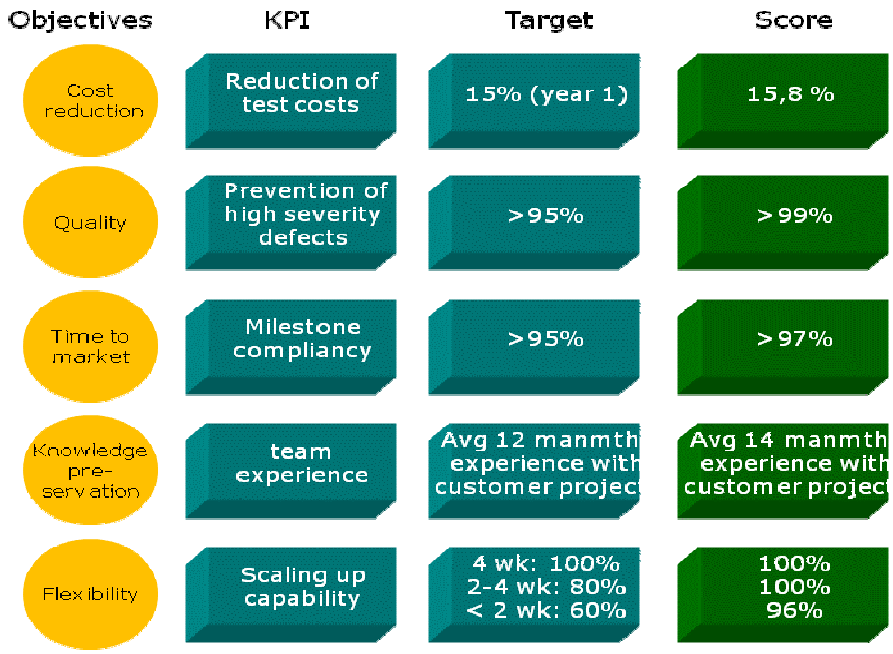

Figure 8: STaaS MTS results.

The test cost reduction was achieved through the following measures:

Measure	Short explanation	Level of cost reduction
Resource rationalisation	Assign tasks to employees with matching seniority level. Focus on healthy ratio for test management vs. test coordination vs. senior test engineers vs. junior test engineers.	Combined these three measures have led in practice to cost reductions of **5-15%.**
Sufficiently lean core team	The size of the key team is adjusted to the highs and lows of the mid term forecast in such a way that the average level of occupation for the key team is > 95%.	
Alternatives for idle time	Within testing dealing with idle time is a common phenomenon. Idle time for a test team can rise to 20% of the test effort. By using the economies of scale of the test line a very flexible process is set up that allows prompt re-assignment of testers to other projects in the case of idle time. In practice the test line has proven to reduce idle time to a level below 5%.	
Uniform process	Install a uniform test process, with standardized test products and procedures. Maintain a key team to use and re-use the process and test deliverables in multiple projects	By installing a uniform test process team cost reductions up to **5%** of original test costs have been achieved.
Test automation	Proper use of test automating contributes to test cost reduction.	Test automation has resulted in cost reductions up to **5%** of original test costs.
Near shoring and off shoring	Through off shoring and near shoring testing activities are transferred to regions with lower cost rates. In practice the amount of off/near shoring depends on certain conditions and varies from 0% to 70% of all testing activities.	Taking into account the investment cost (translations, remote connections, extra QA and communication effort) test off shoring has resulted in cost reductions varying from **10% to 30%.**

8 CONCLUSION

Benefits of STaaS

Thanks to survival of the fittest, STaaS is forced to provide its customers the best full test service solution because STaaS providers have to compete with other STaaS providers. Therefore, these providers have to make sure they:

- use the scarce expertise on structured testing, infrastructure and tools optimally
- improve the test processes continuously
- have international professional test capacity available
- industrialize the test services ('test factory')
- produce reliable test product quality
- give advance insight into costs and running time.

The STaaS provider takes full responsibility for test assignments, with clear commitments expressed in KPI's on quality, cost level and time to market. A solution should be available for single applications, full projects, and portfolios.

STaaS leads to cost optimization as well as demonstrable improvement in quality of testing, test process, test deliverables, test results and flexibility of test operations.

Challenges of STaaS

A STaaS provider must devote continuous attention to a number of challenges. Managing these challenges is critical for the provider's long-term success:

The provider must determine on a continuous basis whether the services offered still match the customer's demand. The customer, not the provider, determines the required quality level.

The professionalism of the provider is based on the knowledge and competency of the testers on the one hand, and the stability of the tester population on the other. If there is a continuous inflow and outflow of people in the 'pool of testers', there is no stability and no solid basis for knowledge building.

Often, an important objective defined for the provider is cost savings. One way to achieve this is by archiving test ware, test data, and test infrastructure for reuse. Continuous attention to optimizing, organizing, and refining test objects as intellectual property is critical.

As a provider, it is important to render an objective assessment of the delivered software or hardware, independently of the customer. On the other hand, the customer may have other interests (less costs, short time-to-market). This is an important challenge that may pose contradictions.

The test basis (e.g. requirements, use cases, design specifications, heuristics) should be available in English or translatable into a language which is understood by the testers. Preferably in a clear and simple form using tools such as QualityCenter Requirements or Rational Requisite Pro.

If the quality of the test basis is inadequate, an alternative way to gain domain knowledge is needed.

And last but not least, test environments should be accessible from various locations.

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