The Evolution of Testing Maturity

From Defect Discovery to Test Transformation

Summary

Much of our business and personal lives have become almost totally dependent on the interconnectedness of IT systems and devices. In turn, these ubiquitous and increasingly complex systems have become more and more dependent on effective testing to ensure that they are robust and risk-free – to the extent of which time and money allow.

It might appear that Testing and Quality Assurance (QA) has remained fairly constant in its structure and outputs over time, but in fact, beneath the surface, it has been quietly advancing and slowly but clearly repositioning itself to add greater value, relevance and assurance to the business.

We have observed the ability of Testing to adapt to the changing demands of the business, with an evolution over a number of quite distinct stages of maturity, which we can summarize as follows:

- In-house Testing – Teams of generalist testers and developers
- In-house Testing – Centers of Excellence
- Leveraged Testing – Managed Service Centers
- Testing Transformation – Test Optimization and Shift Left.

For many of us, our business and personal lives have become almost totally dependent on the interconnectedness of IT systems and devices. In turn, these ubiquitous and increasingly complex systems have become more and more dependent on effective testing to ensure that they are robust and risk-free – at least as much as the constraints of time and money allow.

So it might appear from the outside that Testing and Quality Assurance (QA) has remained fairly constant in its structure and outputs over time. But in fact, beneath the surface, it has been quietly evolving and is slowly but clearly repositioning itself to add greater value, relevance and assurance to the business.

Capgemini and Sogeti's insight into the business need for testing indicates that the two primary market drivers shaping the delivery of IT systems remain relatively consistent: corporate cost reduction or margin improvement, particularly at a time when revenues are flat; and faster time-to-market, reflecting the shorter lifecycles of both products and services, usually designed to maintain or improve customer satisfaction, and satisfy the appetite of end-users for new services.

Moreover, in recent years, the enterprise IT market has shifted from being supply-side producer-led (often heavily influenced by IT vendors), to being consumer demand-driven.

In order to meet these drivers, IT services are now increasingly consumed via an ever-growing range of mobile devices and platforms. The need for corporate IT systems to interface with new channels through these devices is therefore putting further pressure on CIOs. This proliferation of channels also brings with it a clear challenge; consumers and end-users, whether business or social, have developed a reduced tolerance of poor performance, functionality or user experience.

The Capgemini/Sogeti model of the Evolution of Testing

With over 25 years of developing and delivering professional testing services for clients across the world, Capgemini and Sogeti have observed this changing nature of customer needs and delivery models. This first-hand insight is further supported by the findings of our own annual *World Quality Report*, an annual in-depth global study examining the state of application quality and testing practices across industries and geographies.

This report has provided us with the largest field research-based assessment of what enterprise IT customers are thinking, planning and doing to reduce business risk by employing Testing and Quality Assurance (QA) practices.

From practical experience and data gathered, we have observed Testing's ability to adapt to the changing demands of the business by evolving over a number of quite distinctive stages of maturity, which we can summarize as follows:

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Figure 1: The Evolution of the Testing discipline, in terms of maturity and return on investment

TESTING TRANSFORMATION - 4 STEP APPROACH
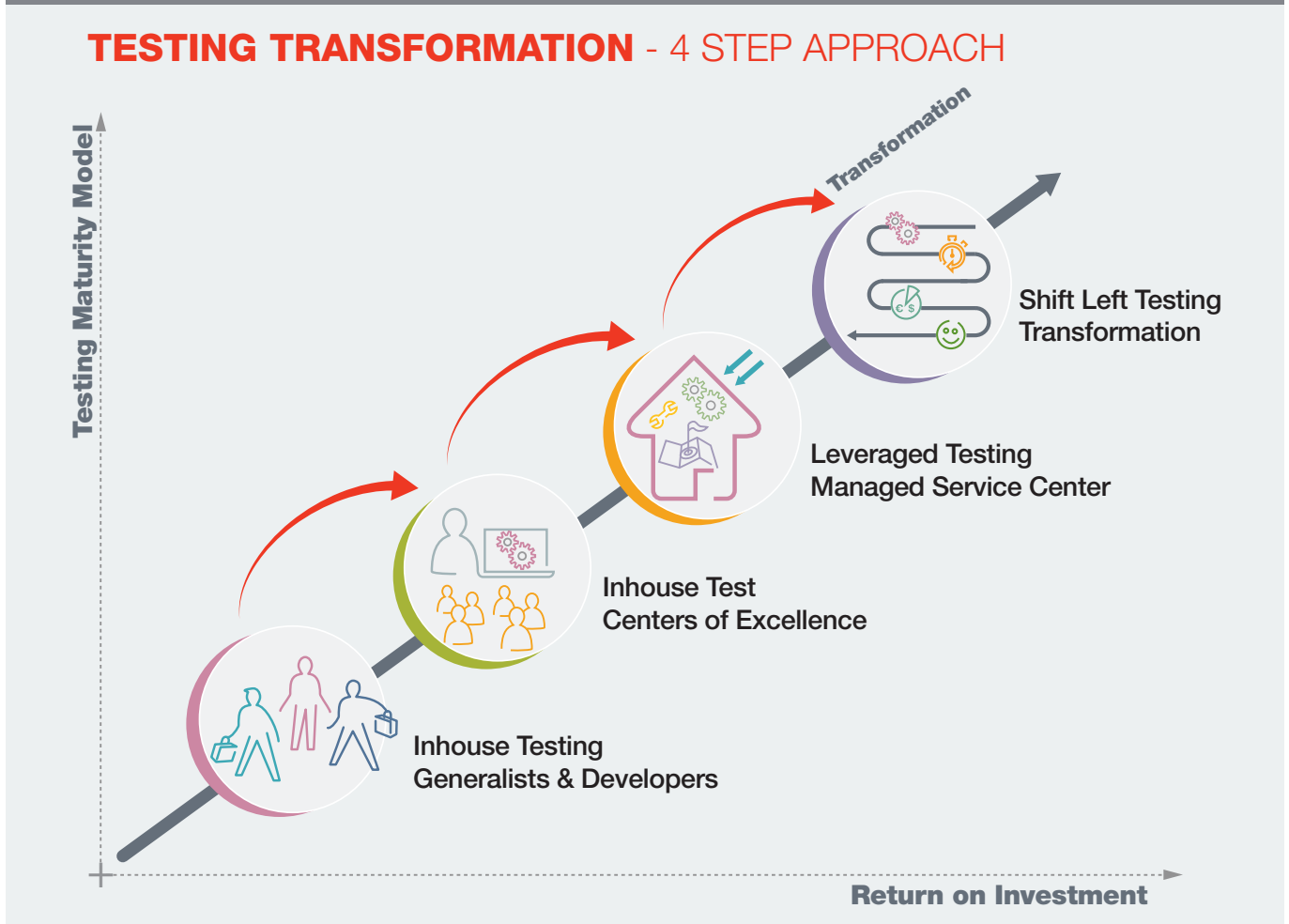
Each of these levels delivers a different level of return on investment, and is supported by different testing organizational structures, delivery models, processes and planning. Each stage may or may not be supported by an external test specialist provider, and where it does, the commercial model agreed with the organization changes according to the appropriate stage in the testing transformation journey, see Figure 1.

What remains common across all these models, which have evolved mainly over the last 15 years, is that each is designed to take the enterprise a further step along a journey to achieving more cost-efficient and performance-driven testing. The benefit of this improvement has been to help lower overall project delivery costs, reduce time-to-market for new projects and upgrades, maintain or improve the quality of software in production, and minimize operational and reputational risk for the organization at large. So this is both the evolution of the market and of an individual enterprise's journey.

However this evolution is more than the quest for continual efficiencies and improvement. Testing and QA services are also making a demonstrable contribution to the broader strategic objectives of the enterprise's senior executive. In doing so, Testing and QA is evolving into a discipline that has the structures and focus not only to transform itself, but also to have a significant impact beyond its own 'boundaries' to the whole solution development lifecycle – what we refer to as 'Beyond Testing'. In this way, Testing is becoming more about business assurance, i.e. checking that everything is working correctly together, and much less about 'bug hunting' or finding and replacing defects.

We will now look at each of these models in turn to examine their evolution and structure and in particular point to the synergistic role of test process improvement in accelerating this Evolution of Testing Transformation.

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In-house Testing – Teams of Testing Generalists and Developers

This organizational structure is probably most familiar to those with any experience of testing – either someone who commissions testing services or a testing practitioner. It is often characterized by a number of small, separate groups of in-house staff, generalist testers or contract equivalent, where testing may or may not be their full-time role and some, or perhaps all, of the testing may be delivered by developers. Aligned to a particular organizational entity, country or business system, these teams have evolved as requirements have demanded it, with a variety of bespoke testing processes and standards from group to group, and a fragmented and inconsistent use of testing tools and techniques across the different groups.

Where external support is provided, it is typically focused on staff augmentation, based on time and material pricing, on a project or weekly basis. Testing performance is largely measured by using technical criteria and certain project milestones and deliverables.

Where a provider is involved, engagement is with technical managers (test manager and team leaders), because external testing services are provided in response to a specific and usually immediate need, rather than being solution-led and part of a broader managed service. Examples include providing temporary additional headcount for specific test operations, like Oracle and SAP, or specialist technical testing

capability around (functional) automation and performance testing. Work is carried out on-site, by local onshore supplementary teams.

Clearly this model works for small-scale defined requirements, but as organizations grow, especially non-organically, and product launches proliferate, this structure coupled with low testing maturity can start to fracture under pressure, leading to cost, quality and productivity issues. Key to taking the next steps to optimizing the test function is establishing a baseline view of the organization's testing maturity, on which to build in future operational efficiencies and a plan to progress to a more 'developed' function.

In-house Testing – Centers of Excellence

The second stage of the development journey sees the loosely aligned team(s) of testers and developers becoming increasingly professionalized and specialist. Execution is now being carried out by not only the existing in-house team, but additional dedicated testers. In larger testing organizations, we often see new distributed Centers of Excellence or specialist teams that can be co-located or geographically dispersed.

These teams are usually dedicated to a particular area of testing such as performance testing or functional test automation, or to a specific architecture or technical domain. This marks the start of the development of professional test experts, with clear career paths for testers within the company, which in turn contributes to a more stable and productive test team.

Essential is the implementation of standardized testing processes that provide the benefits of consistency and greater efficiency, resulting in lower costs and/or better coverage. It also has the additional benefit of introducing a degree of mobility in the testing team, because the move to industrialized processes allows team members to move more easily between teams and helps reduce reliance on key individual experts.

Measuring progress against an improvement plan also becomes more standardized, using techniques such as GQM (Goal – Question – Metric)[1] to ensure the measurement of the business-specific 'right things' and confirm the positive impact any process changes have made.

1 The Goal Question Metric (GQM) approach is based upon the assumption that for an organization to measure in a purposeful way, it must first specify the goals for itself and its projects, then it must trace those goals to the data intended to define those goals operationally, and finally provide a framework for interpreting the data with respect to the stated goals. Authors: Victor R. Basili, Gianluigi Caldiera and H. Dieter Rombach.

Other changes made include extending test automation beyond just regression testing[2] and using proprietary testing tools from key tool vendors or Open Source solutions. Risk-Based Testing (RBT) is a term that is used frequently when referring to the activities of a testing function. It is only when Centers of Excellence are up and running that RBT really starts to make an impact. For the first time, the shift is away from ensuring that 'the solution works' and is relatively 'bug' free, towards giving serious consideration to why there is a need for testing in the first place, does it meet the business requirements or is it fit for purpose?

Other techniques also start being considered. Non-functional testing extends beyond performance testing (if it isn't already part of the testing repertoire) to include usability testing for example and more recently, accessibility testing. External and, in particular, offshore capability is assessed for its ability to reduce costs, maximize on multiple time-zone advantages, and speed up time to market. Where there is a strong business case and cultural fit, local in-house staff are supported by nearshore and offshore Centers of Excellence. All this is possible with standardized approaches, ensuring consistent quality across entities and geographies.

Ultimately, this industrialisation model aims to provide a more clearly-defined and structured function that is more cost- and time-efficient, and capable of responding more effectively to the business' demands. This degree of improvement may be enough for many organizations, but others continue to seek out further efficiencies and cost reductions by adopting a more heavily outsourced approach.

Leveraged Testing – Managed Service Centres

Testing was one of the last IT disciplines to be considered suitable for outsourcing[3], but this is now a fairly standard approach in many large organizations that have moved away from the traditional 'staff augmentation' Time and Material-type model to outsource some or all of their testing requirements to a third-party, governed by a multi-year managed services contract that offers cost and quality improvements.

For many, a Managed Testing Service (MTS), using Test Centers of Excellence and a Test Factory[4] model, is the most appropriate solution for major test challenges such as overstretched dedicated testing resources, increased demand for 'right first time' software launches, and of course reducing costs. MTS delivery with its focus on cost optimization, now represents at least 40% of testing spend according to NelsonHall[5]. An MTS is managed by one or more third-party providers that takes full or partial responsibility for a full range of test activities, at either enterprise or program level.

An important aspect of this stage is a flexible scalable resource pool that can be located onshore, nearshore or offshore, built around the concepts of standardization and automation. These are teams of testing professionals, organized in dedicated client test lines[6], which can be scaled up or down according to demand, and that work alongside in-house teams.

An advantage of MTS is that it provides a solid platform for instigating further quality improvement. This can achieved while still protecting the quality of delivery, but without impacting the day-to-day responsibilities, incurring the expense of large overheads, or losing overall control.

Most MTS agreements are in effect effort-based pricing models; multi-year contracts, built around business rather than technical requirements , where objectives are measured by organizational-specific Service Level Agreements, with performance incentives. Detailed operational and financial KPIs are closely monitored, such as: cost reduction; test quality; flexibility; time-to-market and reliability of service delivery; and innovation. The engagement level of the provider reflects this greater business focus, moving to senior IT management, namely CTOs and IT Directors.

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2 Regression testing aims to verify that all the unchanged parts of a system still function correctly after the implementation of a change.

3 Capgemini/Sogeti White Paper: *The Last Outsourcing Frontier: Software Testing?*

4 Test Factory Model: managed testing production environment, executed using factory-type delivery structures, processes and metrics for the execution of high volume testing, using shared or defined resource pool.

5 NelsonHall Report: *Software Testing Assessment and Forecast*, January 2012

6 Test Line: An operational organisation to provide test services to one of more clients, with fixed team of testers, infrastructure, test tools and standardised work procedures.

From a process perspective, this model targets waste and inefficiencies in processes, coupled with continuous improvement using models such as TPI® for example, and extending automation beyond regression testing. The focus also moves from defect detection – the default mode of the traditional professional tester – to defect prevention. This looks for opportunities to influence the upstream processes through collaborative working with other teams in the application lifecycle, paying closer attention to requirements specifications, and advanced analytical techniques such as root cause analysis and common cause failure analysis.

Typically, an MTS structure can result in cost savings of at least 25% in year one, reduce overall test effort by up to 30%, deliver detection rates of 97% or higher for high-severity defects, and improve time-to-market by 15% or more.

Test Optimization and implementing Shift Left

At this point, it could be argued that costs have been stripped back as far as possible and the test organization, processes, and environments have been optimized sufficiently to achieve optimum results and dependable software. However, we argue that there is a further level of evolution for the function, which moves it more firmly into business assurance and away from 'find and repair'.

The fourth point on the Evolution continuum is what we call Test Transformation - a combination of a focused approach to streamlining cost and productivity within the testing function, together with implementing an integrated Shift Left[7] approach– the benefits of which are so often talked about but rarely achieved- with impacts beyond the testing function.

The focus is on improving still further the effectiveness and performance of the testing function itself, by determinedly focusing on process industrialization, efficiencies and offshoring, leading to better value for money. This may not seem particularly innovative, but a key difference is the move to output-based estimation and business-outcome-based pricing, based on Test Case Points. This means that the organization pays a fixed price for a fixed scope of delivery and the associated test outputs.

This type of commercial model requires a more collaborative, approach to the usual supplier/provider engagement, as it is based on a shared risk-reward mechanism. Some upfront investment and scenario modeling is often required to

establish a baseline for a TCP approach, but in so doing, the rewards are significant. In this way, the value of testing now starts to move onto the CFO's radar and even that of individual P&L business owners.

Other mechanisms for more functional efficiencies include a clear decision to offshore a greater proportion of test tasks, even those traditionally considered to be too complex or risky, and the use of new technologies as they emerge – such as Cloud. Testing-as-a-Service, used on a turnkey, pay-per-use basis from private and secure public clouds, is increasingly providing flexibility and speed, without an organization being locked-into expensive new capital assets.

Taken together, these changes can further drive down costs by approximately 30-35%, over the life of the service, depending on functional maturity of the organization. However there are more changes to be made, and these impact beyond the testing function itself. This part of the Transformation phase leverages a number of QA and consultancy techniques to effect a broader impact within the organization and change perceptions of testing and quality.

A key component of transformation is leveraging the concept of Shift Left, aiming to drive defect detection to the beginning of the delivery process, an approach that Capgemini and Sogeti call PointZERO®. This means the results of testing execution are used to influence upstream activities and processes that are performed and delivered by other parts of the delivery organization – typically developers and business analysts. PointZERO® uses a co-ordinated combination of techniques such as model-driven testing and root cause analysis – all of which are fully utilized – as well as increased use of accelerators and accelerated automation.

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7 Shift Left: the mechanisms used to drive defect discovery as far upstream as possible to reduce costs and time to market

Much has been said of the theoretical benefits of Shift Left, but less so of the practical gains. We have found with current MTS clients that the key to achieving a measurable difference is to implement these techniques methodically and in a structured, disciplined and programmatic approach. In this way, a transformation program can be more realistically viewed as fundamentally delivering a *change* program within the project delivery function, with ramifications beyond the confines of the Testing function.

Taken together, these initiatives help to build-in quality earlier in the application development process, and take industrialization and utility usage to another level. What this also provides is an example for the wider IT function of how best practice and innovative approaches can deliver real results, and how a Quality function can delivers what the business actually needs.

The future challenges facing Testing

Despite these advances, visible high profile hardware and software failures, such as ticketing for big events and ATM malfunctions, continue to appear in media headlines indicating that Testing will need to continually evolve to manage and address these on-going challenges.

Looking ahead, we expect traditional waterfall testing[8] to shift left and become a more integrated part of the overall application lifecycle, rather than a separate activity . This will mean functional, and much of non-functional testing, like security and performance that traditionally occurs at the end of the software development, will be reassessed and integrated earlier in the software development lifecycle.

Furthermore, as software development continues to move towards any one of the multitude of agile development models, testers and testing will no longer be the quality gate-keepers and arbiters of whether tests pass or fail. Instead they will be part of a team that shares the Quality responsibility and specifies, develops and tests the solution synergistically – providing insight and guidance to developer and design colleagues to jointly achieve the acceptance criteria. All this, however, needs to be achieved without losing the hard-won gains of Shift Left and other initiatives.

Testing could also 'shift back' into a more technical and engineering discipline (certainly a way that testers could 'hold their own' in pure agile teams). For many years, Business and Test Analysts have had access to complex business modeling solutions that allow real-time simulations of their designs early on to identify bottlenecks in processes. Regrettably these are rarely used in anger in the business workplace.

In future, these tools and their outputs should be used to prove solutions at every stage, providing real business assurance throughout the lifecycle, rather than achieving late confirmation through test execution as is the norm today, thereby keeping Testing in the Boardroom and not just as an IT 'nice to have'.

Conclusion

Much of testing and test process improvement today is greeted with a "why wouldn't we" comment particularly around implementing good process upstream, and in the next five to ten years we hope to see this changing into a "we already do this" response. But this will need to be supported by the implementation of smarter and innovative approaches to test delivery and process improvement, in order to support the continuing drive for better-faster-cheaper in a diverse pool of development approaches.

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8 Waterfall testing: Part of a sequential design process in which progress is seen as flowing steadily downwards like a waterfall.

About Capgemini and Sogeti

With more than 125,000 people in 44 countries, Capgemini is one of the world's foremost providers of consulting, technology and outsourcing services. The Group reported 2012 global revenues of EUR 10.3 billion. Together with its clients, Capgemini creates and delivers business and technology solutions that fit needs and drive the results they want. A deeply multicultural organization, Capgemini has developed its own way of working, the Collaborative Business Experience™, and draws on Rightshore®, its worldwide delivery model.

Sogeti is a wholly-owned subsidiary of Cap Gemini S.A., providing local professional services, specializing in Application Management, Infrastructure Management and High-Tech Engineering. Sogeti offers cutting-edge solutions around Testing, Business Intelligence, Mobility, Cloud and Security. Sogeti brings together more than 20,000 professionals in 15 countries and is present in over 100 locations.

The Capgemini Group has created one of the largest dedicated testing practices in the world, with over 11,000 test professionals and a further 14,500 application specialists, notably through a common center of excellence with testing specialists developed in India.

Together Capgemini and Sogeti have developed innovative, business-driven quality assurance (QA) and Testing services, combining best-in-breed testing methodologies (TMap® and TPI®) to help organizations achieve their testing and QA goals.

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