NEAT EVALUATION FOR INFOSYS:

Next-Generation Software Testing

Market Segments: Overall, Mobile Testing,
AI-Based Automation Capability

Introduction

This is a custom report for Infosys presenting the findings of the NelsonHall NEAT vendor evaluation for *Next-Generation Software Testing Services* in the *Overall, Mobile Testing,* and *AI-Based Automation Capability* market segments. It contains the NEAT graphs of vendor performance, a summary vendor analysis of Infosys for software testing services, and the latest market analysis summary for software testing services.

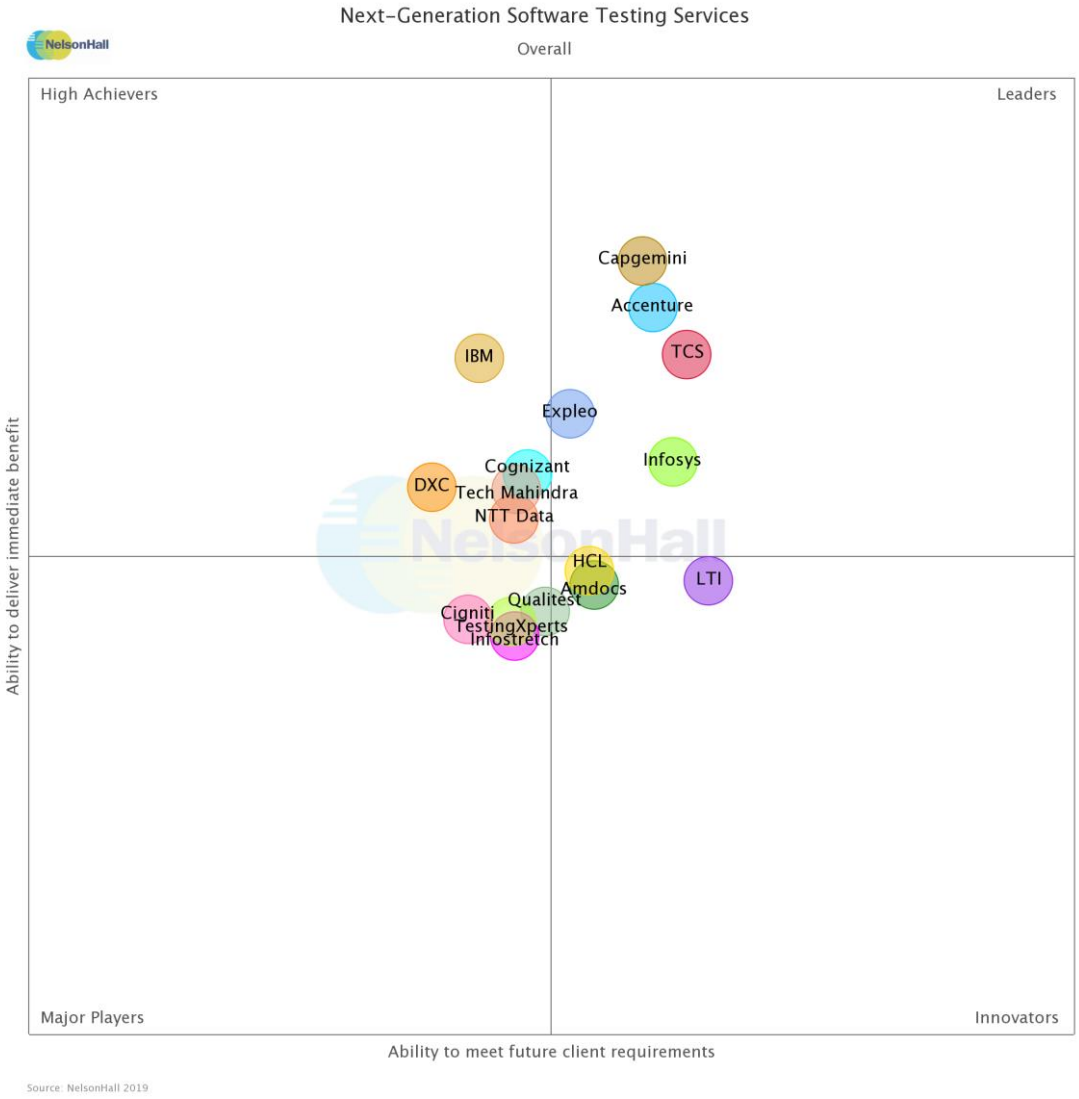
This NelsonHall Vendor Evaluation & Assessment Tool (NEAT) analyzes the performance of vendors offering next-generation software testing services. The NEAT tool allows strategic sourcing managers to assess the capability of vendors across a range of criteria and business situations and identify the best performing vendors overall, and with a specific focus on mobile testing, AI-based automation, UX testing, and other cognitive and testing capability.

Evaluating vendors on both their 'ability to deliver immediate benefit' and their 'ability to meet client future requirements', vendors are identified in one of four categories: Leaders, High Achievers, Innovators, and Major Players.

Vendors evaluated for this NEAT are: Accenture, Amdocs, Capgemini, Cigniti, Cognizant, DXC Technology, HCL Technologies, IBM, Infostretch, Infosys, LTI, NTT Data, Qualitest, SQS, TCS, Tech Mahindra, and TestingXperts.

Further explanation of the NEAT methodology is included at the end of the report.

NEAT Evaluation: Next-Generation Software Testing Services (Overall)

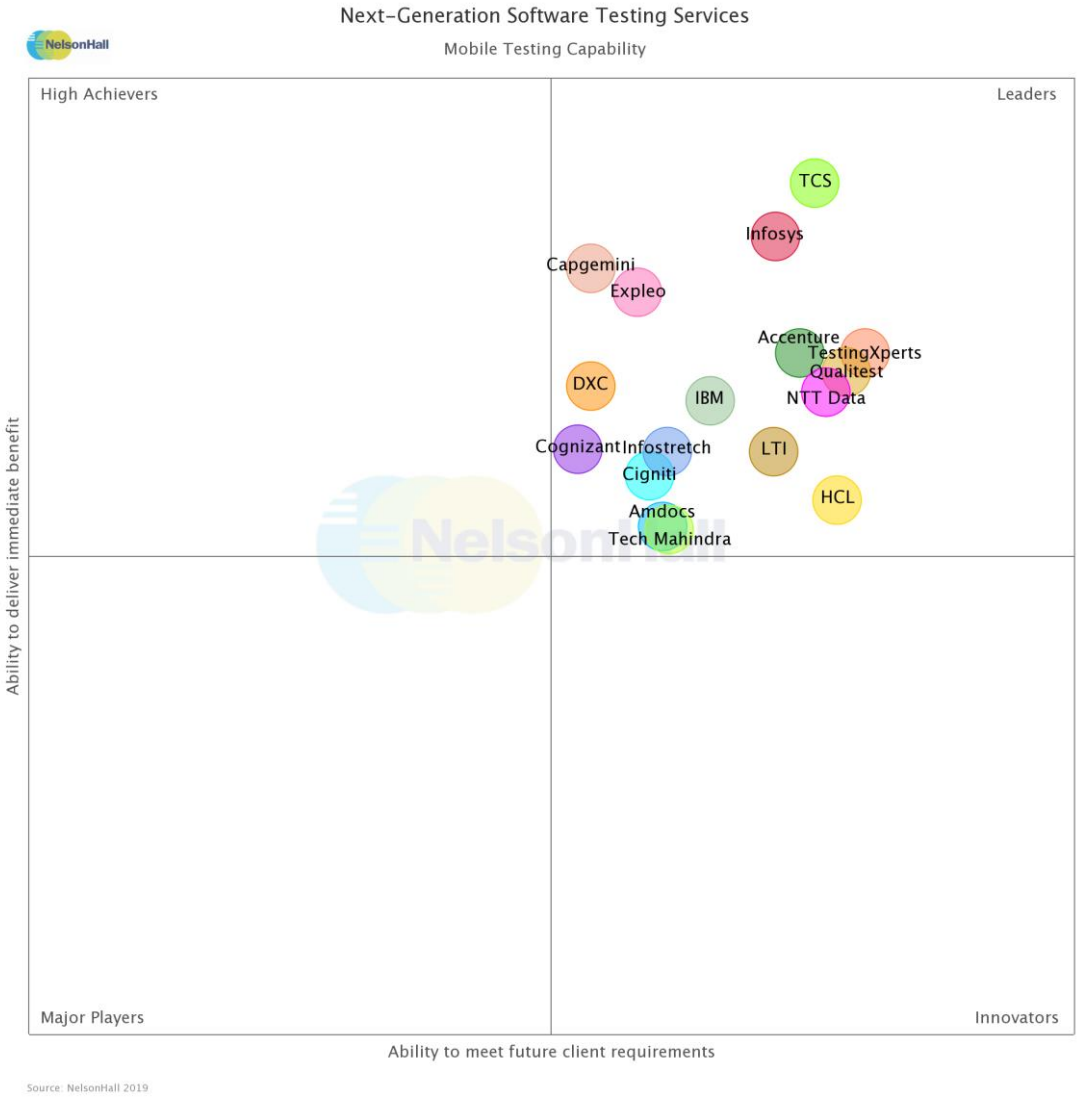


NelsonHall has identified Infosys as a Leader in the *Overall* market segment, as shown in the NEAT graph. This market segment reflects Infosys' overall ability to meet future client requirements as well as delivering immediate benefits to software testing services clients.

Leaders are vendors that exhibit both a high ability relative to their peers to deliver immediate benefit and a high capability relative to their peers to meet client future requirements.

Buy-side organizations can access the Next-Generation Software Testing Services NEAT tool (Overall) here.

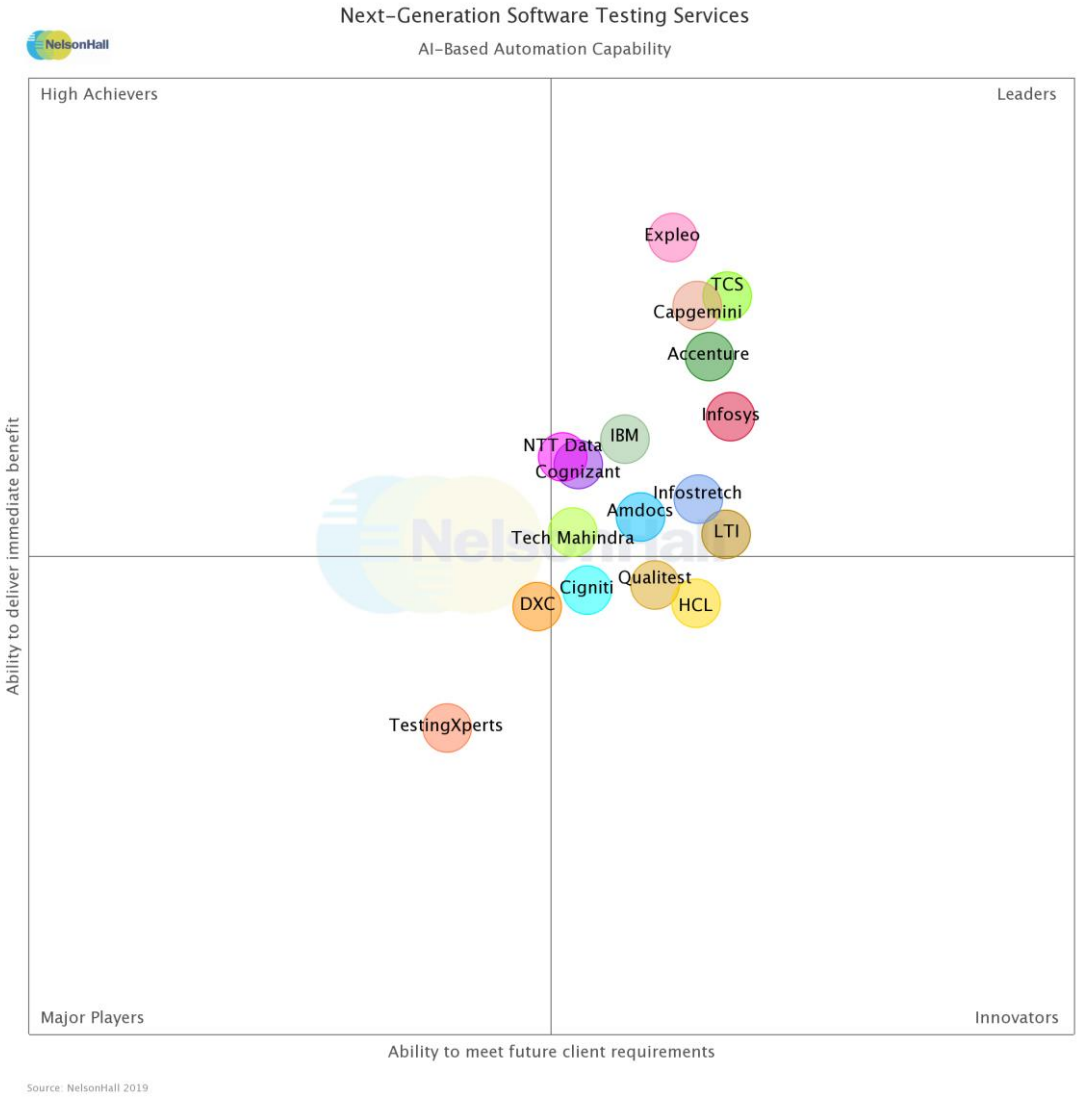
NEAT Evaluation: Next-Generation Software Testing Services (Mobile Testing Capability)



NelsonHall has identified Infosys as a Leader in the *Mobile Testing Capability* market segment, as shown in the NEAT graph. This market segment reflects Infosys' ability to meet future client requirements as well as delivering immediate benefits to software testing clients with a specific focus on mobile testing.

Buy-side organizations can access the Next-Generation Software Testing Services NEAT tool (Mobile Testing Capability) here.

NEAT Evaluation: Next-Generation Software Testing Services (AI-Based Automation Capability)



NelsonHall has identified Infosys as a Leader in the *AI-Based Automation Capability* market segment, as shown in the NEAT graph. This market segment reflects Infosys' ability to meet future client requirements as well as delivering immediate benefits to software testing clients with a specific focus on AI-based automation.

Buy-side organizations can access the Next-Generation Software Testing Services NEAT tool (AI-Based Automation Capability) here.

Vendor Analysis Summary for Infosys

Overview

Infosys primarily provides software testing services through its Infosys Validation Solutions (IVS) unit, which was founded in 2001. It initially serviced websites and e-commerce applications as an independent service (from ADM activities), focusing on TCoEs. IVS is a horizontal service line with ownership of P&L and delivery, as well as on pre-sales, centers of expertise, and portfolio management.

IVS is a large practice within Infosys and has 24.5k career testers (at the end of FY18). This headcount does not include an additional 2k career testers working in other Infosys units. IVS, therefore, represents ~11% of Infosys' total headcount.

IVS has ~435 clients. Major IVS clients include tier one organizations: Kraft Heinz, Honda, Prime Therapeutics, and Arizona Public Service. IVS has a track record in gaining very large standalone testing contracts, with TCVs of up to ~$100m and a regular flow of contracts in the $10m-$50m range.

In the past two years, IVS has shifted its focus towards testing in the context of digital, and technical services, as well as around AI.

In parallel, IVS has shifted its approach to helping clients move from a TCoE model to a more decentralized delivery structure, more aligned with development teams. IVS is also helping clients to fine-tune their agile organization structure and maintain their cost centricity while increasing go-to-market.

Another key priority for IVS is to help organizations industrialize their delivery; it continues to create testing services offerings that are backed up by an accelerator or a platform, relying on testing software standardization.

Mobile testing

IVS highlights the benefits of accessing its own devices under a shared service approach or setting up client-dedicated mobile labs. The company believes the benefits are:

- User management
- Device management and configuration management
- Software license management including distribution of apps on the devices

IVS has developed several IPs for its mobility testing offering, the most widely used of which is Infosys Network Impact Testing Suite, a network variability testing tool. Other tools include:

- Infosys Mobile automation framework
- Infosys Web Automation Framework for omnichannel testing
- Infosys App Certification: a tool which validates that an app follows Google Play's guidelines.

Also, IVS uses its Omni-Channel Experience tool for conducting business process testing.

The purpose of Omni-Channel Experience is to test business processes involving several customer touch points (e.g. mobile, browser, branches, customer services, devices, and ATMs), while conducting back-end systems (ERP and CRM) testing and banking-specific

systems/external services (e.g. online and mobile payment, stock markets, insurance, and international transfers).

Omni-Channel Experience includes a reference architecture and several services/accelerators including:

- Mobile testing with access to the device labs of Perfecto Mobile
- Multi-channel testing
- API testing through its Infosys API testing accelerator
- Functional and non-functional, including Infosys performance testing suite
- Service virtualization
- Test scenario repositories.

UX testing

The UX testing strategy of IVS is to be able to test customer interactions and processes across all of the customer's touchpoints. Those touchpoints include mobiles, websites, and increasingly chatbots and connected devices. IVS is highlighting each customer touchpoint brings a different testing focus, e.g., for a chatbot, the testing focus is on the UX, on the quality of the response and the interaction; for a connected device, hardware features, such as device screen size will matter.

To drive automation in its UX testing portfolio, IVS created its Infosys Customer Experience Suite in 2017. Customer Experience Suite has several features:

- Accessibility testing according to several standards and guidelines, e.g., WCAG 1 and 2.0, corresponding guidelines in Australia and the U.K., and BITV in Germany. The accessibility is almost fully automated
- Web compliance check, for identifying broken links
- Visual consistency check, based on providing a URL for a reference design and doing a comparison test
- Social integration: based on a questionnaire approach, on how well connected the website is in social media, e.g., is social activity on Facebook, the number of tweets
- Omni-channel: based on a questionnaire approach
- Usability: based on a questionnaire approach across navigation, presentation
- Security: testing the encryption of data communications, blockage of malicious content, and checks for access of files saved in the app by unintended users. Infosys has its Infosys Mobile Security Platform security framework
- Performance testing; checks on server connection changes from 2G or 3G to Wi-Fi, application response time; and code optimization for CPU, battery consumption, memory leakage. Infosys relies on its Infosys Mobile Load Testing Solution to conduct its performance testing activities
- Customer Sentiment Analytics.

Alongside its UX testing offerings, IVS has two other offerings: Customer Experience Index is methodology-based consulting service; Customer Sentiment Analytics is a sentiment analysis consulting offering.

Customer Experience Index (CEI) provides metrics around six parameters (performance, omnichannel, accessibility, social engagement, usability, and omnichannel integration) through a web portal. For these parameters, CEI provides a score based on assessing attributes either automatically (e.g., number of comments, scoring for mobile apps) or through manual data input (look and feel

Customer Sentiment Analytics (CSA) tracks attributes such as analysis of app combability, functionality, sentiment, and performance across Google Play, Apple app store, and social media (Facebook and Twitter). CSA is essentially a reporting portal, tracking volumes of comments, classifying comments (functional, compatibility, security and privacy, and performance), identifying sentiment (positive vs. negative), and identifying keywords.

RPA and testing

IVS has also been active in deploying workflow RPA for automating testing. The practice has targeted specific tasks such as test data management, for one U.S. client in the banking sector.

AI and testing

A priority for IVS has been to create AI use cases for automated testing services, through its PANDIT IP.

PANDIT has several use cases:

- Test case optimization
- Test scenario mining: identifying areas of applications that are most used to help prioritize testing activities
- Traceability: linking testing requirements with their test cases to estimate test coverage
- Data analytics: identify contributors to defects
- Prediction, for prediction data in the upcoming release, and helping on taking preventive testing, and test case prioritization
- Impact analysis: find a relationship between artifacts and triage defects
- Sentiment analysis.

IVS has been involved in two further AI use case initiatives. The first is a reporting tool, with IVS developing an extension to the Chrome browser. The Chrome extension provides reporting on several items, such as:

- Test script execution
- Front-end errors
- API execution status
- Broken links
- Classes loaded.

Another initiative has been to integrate AI use cases as part of the agile process, through integration with CI tool Jenkins. Currently, the AI use cases integrated with Jenkins for scheduling purpose include test case optimization, impacted test scripts/defect prediction, test coverage, screen comparison.

Cognitive testing

Testing ML systems is also a priority for IVS. IVS is initially focusing on several use cases across deterministic MLs (i.e., that will always produce the same output) such as bots, and on non-deterministic systems (e.g., defect prediction).

IVS has been working on making sure a chatbot can provide the same response to the many different ways a question can be asked. For one client, it has created an algorithm for generating text alternatives around a question. It then validates that the chatbot's response is consistent for all question alternatives, using Selenium.

IVS is expanding its offering to continuous monitoring of chatbots, targeting real-time monitoring of the bot and creating alerts.

Examples of ML testing work include:

- Image modification and for generation of test data
- Video anomaly detection.
- Workflow testing

IVS is finding that typically business processes can go across different applications that are based on different technologies (e.g., mainframes vs. client-server vs. web applications). The challenge is however that most testing tools are technology-specific (e.g., Selenium works with only web applications). IVS is working with clients on using RPA for business process testing.

Financials

NelsonHall estimates that IVS had revenues of ~1.4bn in CY 2018.

NelsonHall estimates that IVS' next-gen testing (therefore, excluding continuous testing) revenues for CY 2018 to be ~$250m

Strengths

- Overall portfolio management. Infosys demonstrates it has the scale and the budget to invest in new offerings and new IP/accelerators
- Mobile testing: an IP-based offering that is comprehensive
- UX testing: Infosys has pockets of strengths, and with its Customer Experience Suite, it has started automation UX testing, initially mostly around accessibility testing, and content testing
- AI testing: Infosys is of the furthest advanced vendors in creating AI use case for automating testing
- AI and RPA testing: Infosys is experimenting through pilots and is involved in several different projects.

Challenges

- RPA use cases: Infosys does not differentiate in its usage of RPA testing for automating testing
- The testing delivery engine remains very offshore-centric
- UX testing: Infosys misses several offerings such as marketing campaign testing.

Strategic Direction

In the short-term, IVS wants to continue to invest in its omnichannel capabilities (to conduct testing across the variety of devices/customer touch points) and around sentiment analysis. Other priorities include:

Mid-term:

- The launch of a testing framework for bots. IVS is working on its Infosys Bot Validator that relies on coordinating different testing tools for testing a workflow/business process
- Using AI for bot testing.

Long-term:

- AR testing. In AI, IVS has been involved in three pilots: replicating AR environments in test labs, exploring how to decrease AR user fatigue, and checking image/environment consistency around different AR devices
- IoT UX testing
- Testing AI systems and chatbots in a comprehensive manner, including systems integration testing, non-functional. IVS will invest in testing algorithms (e.g., fraud management testing) and in AI training data, and AI output validation.

Ultimately, IVS wants to create autonomous and self-healing systems that will identify use cases and be self-learning. IVS has based its first autonomous testing approach on a web crawler. The web crawler has several goals. It scans each page of a website to pick up defects and failures such as 404 errors, broken links, HTML related errors. Also, the web crawler will create paths/transactions across one or several screens/web pages, and then create Selenium-based test scripts for these paths/transactions.

Outlook

NelsonHall expects Infosys to continue investing primarily in automation, with continuous testing in mind and also around AI-based testing.

NelsonHall would like Infosys to further invest in its UX testing offering, and this may come. Infosys at the corporate level made several digital agency acquisitions in the past two years. The company's testing practice is pointing at offerings synergies with the 2018 U.S. digital agency acquisition, Wongdoody, which had been working in the space of usability testing.

Next-Generation Software Testing Services Market Summary

Overview

The software testing services industry is quickly shifting its services capabilities and portfolio to the context of digital and agile/DevOps. Overall, most vendors have created their continuous testing platforms, which are enhanced reference architectures and clients are currently deploying these.

Vendors are turning massively towards AI, with the intent of using mostly NLP and ML technologies to automate testing services. The range of AI use cases is gradually expanding from analytics-based services to scriptless test automation, using web crawler technology.

Vendors have prioritized AI use cases over other offerings. UX testing has high automation potential. Other priorities will need to include testing of RPA software, of AI systems and also implement RPA to automate testing.

Buy-Side Dynamics

The three major software testing services buyer segments are:

- "Efficiency organizations": clients of managed testing services are mostly IT departments and continue to be a large testing service segment. Efficiency organizations are currently working on making their TCoEs relevant to digital. They are deploying automation through continuous testing approaches, AI and other cognitive technologies
- "Digital transformation-focused organizations" are business divisions rather than IT departments. They focus on their (mostly) external digital projects and want to ensure the success of their project rollout through testing. Their challenge is to adopt the best practices of "digital natives," e.g., frequent releases and agile development, focus on UX
- "Digital natives": are organizations whose technology is a core part of their activity (e.g., travel booking sites). They need high quality as thousands or millions of end-users use their services/products. They are continuous testing-centric.

Key selection criteria for selecting a software testing services vendor are somewhat different for each client segment:

- "Efficiency organizations" consider a large presence in India as a given and now look for:
  - Structured capabilities around DevOps to serve digital and agile projects
  - The ability to expand their automation capabilities outside of test execution to continuous testing, and experiment AI use cases
  - Along with this automation effort, clients also want help in reskilling their manual testers towards technical skills
- "Digital transformation-focused organizations" want their vendors to combine the flexibility and specialized capabilities of digital agencies while bringing their ability to bring automation, repeatability, and scale. Vendors need to demonstrate:

  - A broad and deep next-gen testing portfolio, with investment in accelerators and platforms to support the automation
  - Digital consulting capabilities combined with industry knowledge, including a focus on UX
- Finally, "digital natives" have been engaged in digital for years and need to continue to develop their digital leadership over competitors while benefiting from low-cost delivery that will help them reach profitability in the mid-term. Such clients need a partner working in the long-run, not a one-off provider.

Market Size & Growth

The software testing services market is a maturing market, expected to grow by 5.6% over the 2018-2023 period, growing from $23.0bn to $30.0bn.

STS spending growth is still solid, growing one and a half time faster than IT services. However, it had slowed down very significantly from 12% growth ten years ago. The reasons include the reduction in manual testing, the impact of economic condition deteriorations, and the decline in large managed testing services contracts.

STS spending has shifted from managed testing services to project services. Since 2015, the number of new large-scale managed testing service contracts has decreased, and related spending is decelerating. NelsonHall expects this trend to continue, with clients looking to continue to decrease the cost of their managed testing contracts and reallocating services towards project services around automation, continuous testing and reskilling of their testing workforce.

Along with shift towards project services, spending is shifting from functional testing towards specialized testing services. Clients are investing in automating their functional testing activities and moving away from manual testing. NelsonHall is, therefore, expecting functional testing to remain flat, with initial automation investment resulting in less manual activites.

Spending on specialized testing services is driven by:

- Next-gen functional spending (+13%)
- Non-functional: driven by security and user-based performance testing (+11%)
- Test support services: +8%.

Next-gen testing accounts for 24% of software testing services spending. It is the fastest-growth offering with a 12.8% CAGR for the 2018-2023. Growth is driven by mobile testing, which still accounts for ~75% of all next-gen testing spending.

Outlook

Over the next few years, the main challenges of the software testing service industry are:

- Converging mobile and UX testing offerings, and invest into IP and platform to increase the level of automation in UX testing, and expand to content testing and email campaign testing
- Continuing investing in AI use cases for further automating testing services, beyond test automation
- Including RPA in their its testing considerations for both automating testing of workflows and bots, and using RPA software for automating testing
- Reorganizing their client's TCoEs. A major issue will be reskilling of manual testers, towards becoming testing software specialists. This transition of skills will have divergent success among testing personnel. At this point, it is not clear whether testing service vendors will be able to effectively retrain manual testers or will have to turn to lay-offs
- Also, TCoEs in the long-term will need to provide an increasingly share of specialized testing services, not only around next-gen testing, but also around test support services (test environment, test data, service virtualization) and non-functional.

NEAT Methodology for Next-Generation Software Testing Services

NelsonHall's (vendor) Evaluation & Assessment Tool (NEAT) is a method by which strategic sourcing managers can evaluate outsourcing vendors and is part of NelsonHall's *Speed-to-Source* initiative. The NEAT tool sits at the front-end of the vendor screening process and consists of a two-axis model: assessing vendors against their 'ability to deliver immediate benefit' to buy-side organizations and their 'ability to meet client future requirements'. The latter axis is a pragmatic assessment of the vendor's ability to take clients on an innovation journey over the lifetime of their next contract.

The 'ability to deliver immediate benefit' assessment is based on the criteria shown in Exhibit 1, typically reflecting the current maturity of the vendor's offerings, delivery capability, benefits achievement on behalf of clients, and customer presence.

The 'ability to meet client future requirements' assessment is based on the criteria shown in Exhibit 2, and provides a measure of the extent to which the supplier is well-positioned to support the customer journey over the life of a contract. This includes criteria such as the level of partnership established with clients, the mechanisms in place to drive innovation, the level of investment in the service, and the financial stability of the vendor.

The vendors covered in NelsonHall NEAT projects are typically the leaders in their fields. However, within this context, the categorization of vendors within NelsonHall NEAT projects is as follows:

- **Leaders**: vendors that exhibit both a high ability relative to their peers to deliver immediate benefit and a high capability relative to their peers to meet client future requirements
- **High Achievers**: vendors that exhibit a high ability relative to their peers to deliver immediate benefit but have scope to enhance their ability to meet client future requirements
- **Innovators**: vendors that exhibit a high capability relative to their peers to meet client future requirements but have scope to enhance their ability to deliver immediate benefit
- **Major Players**: other significant vendors for this service type.

The scoring of the vendors is based on a combination of analyst assessment, principally around measurements of the ability to deliver immediate benefit; and feedback from interviewing of vendor clients, principally in support of measurements of levels of partnership and ability to meet future client requirements.

Exhibit 1

'Ability to deliver immediate benefit': Assessment criteria

Assessment Category	Assessment Criteria
Offerings	Mobile testing - access to labs
	Mobile testing - framework
	UX testing - accessibility
	UX testing - end-user performance testing
	UX testing - research
	UX testing- content
	AI - analytics
	AI - automation
	RPA - offering
	RPA - use cases
	Testing cognitive
Delivery	Indian delivery capability
	North America onshore capability
	U.K. onshore capability
	Continental European onshore capability
	Indian leverage
Presence	Globally
	North America
	U.K.
	Continental Europe
	RoW
Benefits Achieved	Level of cost savings achieved
	Increased application quality/reduced production downtimes
	Increased speed to market for digital initiatives
	Increased end-user/business satisfaction
	Other benefits achieved
	Pricing approach

Exhibit 2

'Ability to meet client future requirements': Assessment criteria

Assessment Category	Assessment Criteria
Investment	In mobile testing
	In usability testing
	In accessibility testing
	In end-user performance testing
	In AI use cases
	In RPA use cases
	In cognitive testing
Market Momentum	Next-gen testing market momentum
Ability to Deliver Improved Outcomes	Mechanisms in place to deliver client innovation
	Extent to which client perceives that innovation has been delivered
	Suitability of vendor to meet future needs of clients
	Perception of suitability to meet future needs around mobile testing
	Perception of suitability to meet future needs around UX testing
Financial Security	Financial rating

For more information on other NelsonHall NEAT evaluations, please contact the NelsonHall relationship manager listed below.

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Sales Enquiries

NelsonHall will be pleased to discuss how we can bring benefit to your organization. You can contact us via the following relationship manager:

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