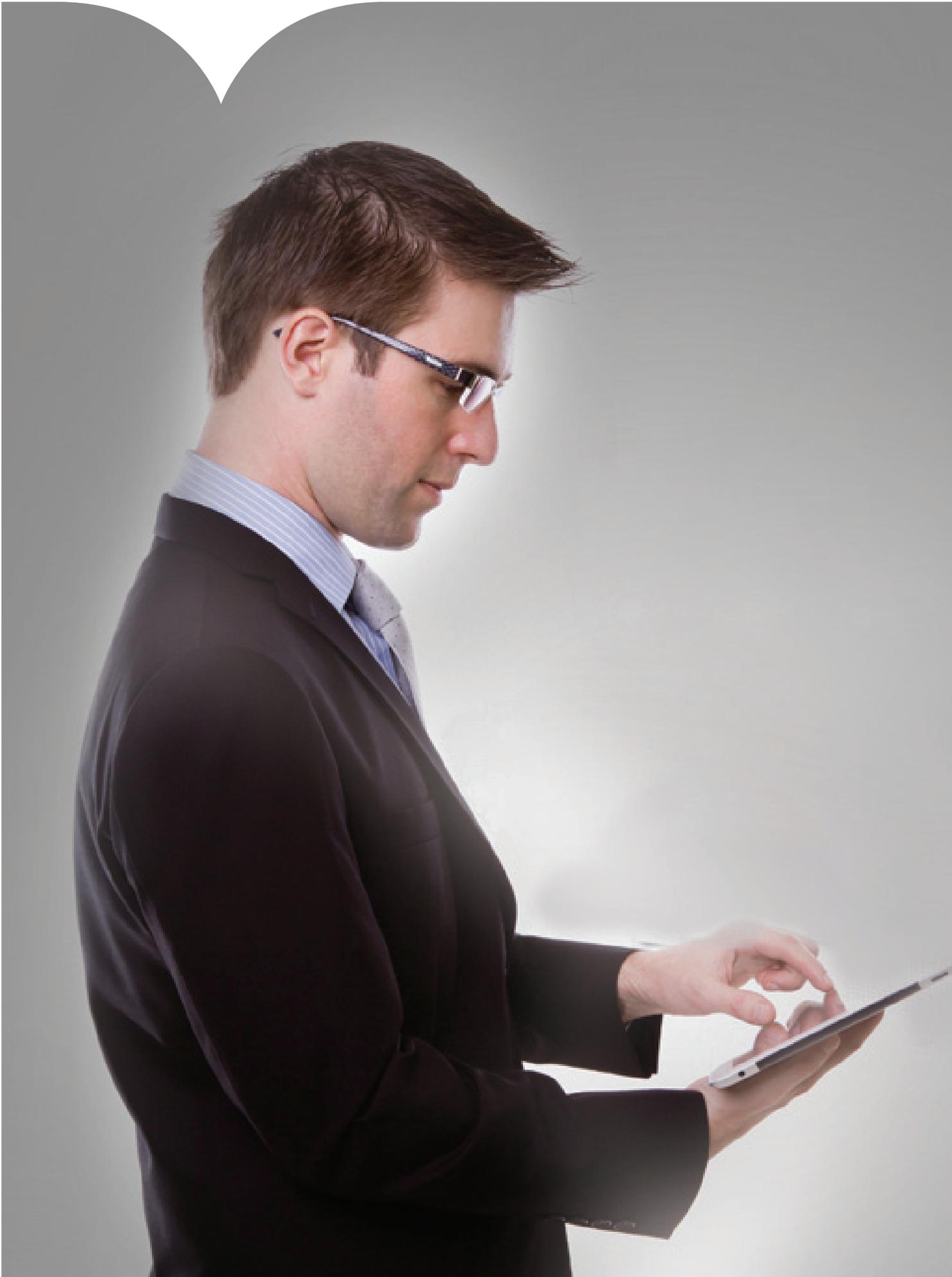


Mobile Testing: A Comprehensive Approach





In many respects, mobile testing is not all that different from other types of IT testing. From methodology all the way through to most of the actual testing tools, what quality assurance organizations and experts have learned in non-mobile testing can be applied to mobile testing.

So, where are the differences and how should you accommodate them? We have identified ten areas that are highly relevant to mobile testing and require particular attention but if they are handled correctly will mean a successful mobile testing effort:

Success Factor #1: Connectivity-related testing

Most mobile solutions depend on some kind of network connectivity. Solution design and testing are needed to address variable bandwidth, offline and flight mode scenarios, and validate user sessions moving between different network conditions. Both automated network simulations and manual testing in real network conditions are required to ensure consistent behavior.

Success Factor #2: Understanding Physical Characteristics

The physical characteristics in mobile solutions differ significantly from non-mobile solutions. Mobile testing needs to take several of these characteristics into consideration:

- Screen size
- Touch and gesture capabilities
- Orientation (vertical or horizontal) and movements in three dimensions
- Camera
- GPS

Some testing scenarios related to these physical characteristics can be automated, for example, orientation changes; but some scenarios do require manual testing, for example, synchronization of gestures and sounds.

Success Factor #3: Location Simulation

An ever increasing number of solutions utilize location data and GPS integration. In these solutions, features are designed to depend on location or distance to other locations. Successful mobile testing ensures quality across different types of GPS implementations and needs to utilize efficient location simulation.

Success Factor #4: Test Automation

The ability to automate tests using scripting or recording makes mobile testing significantly more efficient. Smart test automation utilizes parameterized scripts for both device types and user interaction, and is enabled to run on devices in-house and in the cloud. Some sophisticated user interactions involve touch, gestures, and sensors which

cannot be fully automated, and, as a result, will require manual testing.

Success Factor #5: Dealing with Fragmentation

The market fragmentation for both operating systems and device types continues to challenge solution design and testing. Most solutions, both internal and external, need to support hundreds of device types and several versions of operating systems. A relevant mobile testing tool box includes:

- Physical access to the major device type and operating systems combinations
- Ability to run manual and automated tests across both physical devices and emulators
- Access to cloud-based platforms to maximize testing a number of devices

Success Factor #6: User Experience

User experience is a main criterion for success. Testing user experience is an art that consists of both objective and subjective measurements. Key elements include:

- Adherence to platform rules and guidelines, as dictated by app store review guidelines
- User interaction – Level of intuitiveness and efficiency
- Navigation – Adherence to platform rules and guidelines
- Signup and login – Clarity and ease of use
- Layout and user interface design – Look and feel, aesthetics, and precision in layout
- Exception handling – User friendly messages and graceful exception handling

Success Factor #7: Engaging with Third Parties

Most apps are distributed through open and public app stores, each with its own set of guidelines. Apps that fail to adhere to guidelines may be rejected. And, given the third party review process, there is a bug fix latency inherent in updates. Also, when operating systems are updated, the new releases can break existing apps. This means that successful mobile testing must consider:

- Using common testing checklists based on the most recent app store rules and guidelines
- Using rapid testing cycles for updates in order to minimize impact of bug fix latencies
- Testing existing apps on beta versions of operating systems

Success Factor #8: End-to-End Integration Testing

As mobile solutions and apps become increasingly more business relevant, the scope and depth of transactional features expand and so the need for well-designed and validated system integration solutions has to be addressed as well. When specific systems are needed to remotely manage a fleet of handheld mobile devices (Mobile Device Management or MDM), the mobile solution should be

validated and tested against the main functionalities of the MDM systems:

- Device technologies supported
- Range of embedded applications supported
- IT policy control
- Device security enforcement
- Management of connected devices
- Third-party applications control

Success Factor #9: Performance

Mobile solutions can overload servers, through the rapid growth in the number of users and an increase in the average life span of transactions due to variations in bandwidth and latency. This can have a performance impact on all users. Also, there are significant performance differences across different types of devices. An app or responsive web may run well on a high-end device but may not be acceptable on a low-end device.

Successful mobile testing focuses on network capabilities, system integration and back end layers, as well as the app itself.

Success Factor #10: Security

Mobile solutions are implicit in an increasing number of scenarios where sensitive systems are accessed and private data is in transit or at rest, that is, stored in mobile devices. And given the physical nature of mobile devices, they are more easily forgotten, lost, or stolen. Mature mobile testing aims to:

- Secure confidentiality and integrity of data
- Validate whether authentication and authorizing is secure
- Verify that systems are keeping records of events (non-repudiation)

We are mobile testing experts and understand these central success factors and know how to leverage them. Our fine-tuned capabilities are summarized in this document, along with a description of our market-leading testing methodology, TMap® NEXT, which supports the complete testing process. We will explain in detail how our services can help your business achieve its mobile testing goals.

Successful mobile testing

In order to capitalize on the success factors outlined above, we offer organizations the following set of mobile testing solutions:

- Mobile Functional Testing
- Mobile Compatibility Testing
- Mobile Usability Testing
- Mobile Performance Testing
- Mobile Security Testing

Mobile Functional Testing

Mobile Functional Testing aims to validate the actual functionality of the mobile solution. The test approach is realized through a use case model in which each use case is documented, step by step, and run through to validate its actual results against the expected results. Use case-driven tests can be complemented by exploratory testing, in which the tester is given a more loosely defined set of goals to accomplish using the app.

Our experience shows that since most apps have a narrow functional scope, exploratory testing across relevant devices is an efficient method to quickly yield highly relevant test results.

We have defined a minimum set of areas to be covered during functional testing:

- Functions
 - Path testing
 - Boundary values (input)
 - Data lifecycle (using Create-Read-Update-Read-Delete-Read heuristic technique), onboard captors
- Application interoperability: verify interoperability between the most common applications embedded by the manufacturer and the most popular applications downloaded from stores:
 - Camera (movie/still) recorder, picture viewer, video player, music player, Internet browser, messaging manager, contacts manager, task manager, calendar, calculator, device setup
- Application lifecycle
 - Install by all means supported by device technology
 - Heuristic technique: Install-Use-Uninstall-Install-Use
- Network management
 - Flight mode, loss of connection, mode switching (GSM to Wi-Fi, Wi-Fi to GSM)
- Interruption management
 - Messaging, push notification, alarm, multi-display orientation, multi-tasking
- Display management
 - Multi-display orientation rendering
 - Multi-touch screen monkey test
 - Rendering and readability

Mobile Compatibility Testing

Addressing the challenge of testing hundreds of different devices is at the core of mobile testing. In our Mobile Testing Center of Excellence, we have access to hundreds of physical devices (200+) as well as licenses to use several cloud-based device testing frameworks. At the onset of a Mobile Compatibility Testing effort, the range of platforms and specific devices is clearly defined. Once the scope is set, our mobile test experts use both manual testing and highly

efficient test automation tools to validating quality across all pre-defined devices.

Mobile Compatibility Testing covers aspects of platform fragmentation, physical characteristics, and app store review guidelines.

Mobile Usability Testing

Usability is a cornerstone of all successful apps. There is a fine line between subjectivity and objectivity in any usability testing, but with experienced usability experts and mobile testers we are able to lessen the likelihood of releasing an app with a potential for poor user experience.

We recommend two levels of evaluation. During the first evaluation, we distribute the application to a sample group of users and senior mobile testers. Their feedback is organized and categorized according to a pre-defined checklist. They rate the application as they would in a store, using stars and freeform comments. The second level is to compare the user interface with applications of the same nature already on the market.

The tangible deliverables from a Mobile Usability Testing effort include specific suggestions and advice on what to improve and change to enhance the overall usability of the mobile solution.

Mobile Performance Testing

It's important to maximize end-to-end performance by working through each layer of the mobile solution's technology stack. Testing mobile solutions means measuring app performance, network availability and performance, along with system integration and back end performance.

We define a performance test strategy with you, considering each of these areas and based on the following business drivers:

- Is the back end delivering service only to mobile solutions or to both legacy and mobile solutions?
- Is the performance studied from a mobile point of view or from an end-to-end point of view?
- How many and which user stories will be used? (profiling of virtual users)
- What do you want to monitor? (our default is monitoring five critical aspects of service performances)
- What are the protocols involved?

Performance testing is not only used for validating system architecture, it is a second-to-none solution for scaling appropriate back end systems.

Mobile Performance Testing focuses exclusively on the mobile solution's performance, disregarding functional and usability aspects which are addressed in other types of testing. We execute both manual and automated testing using market-leading performance testing tools.

Mobile Security Testing

Mobile Security Testing is becoming increasingly important. Validating specified and implemented security measures often reveal critical security holes and threats. In a typical Mobile Security Testing effort we use tools to validate six common security aspects:

- **Confidentiality:** Does the app keep your private data private?

We penetrate data storage locations looking for private data or data that should have been deleted during app exit. We analyze network traffic and validate whether or not sensitive information is appropriately encrypted.

- **Integrity:** Can the data passed to and from the app be trusted and verified?

We validate the integrity of the data being passed to and from the app by monitoring network traffic and, where relevant, validate whether or not the data is appropriately encrypted.

- **Authentication:** Does the app verify the user's identity to an appropriate degree of certainty?

We test if the right level of authentication is implemented: For example, by validating the implementation of two factor authentication or by validating correct round tripping of mail-based confirmations.

- **Authorization:** Does the app properly limit user privileges?

We test whether or not server-based services are provided at the right level of privileges and only there, by trying to invoke functions or reach for data beyond the authenticated users' privileges.

- **Availability:** Can an attacker hurt the solution in any way?

We apply common attacking methods on the server-based services by first monitoring open network traffic and then trying to either get to restricted functions or data or trying to halt the entire service.

- **Non-Repudiation:** Does your app keep records of events?

Where relevant, we can validate both client and server logs to make sure that it's possible to use them to prove the user's activities through the mobile solution.

The focus here is exclusively on the mobile solution's security, disregarding functional and usability aspects which are addressed in other types of testing. We engage through both manual and automated tests using high profile and market leading security testing tools.

Test automation is a natural part of any and all testing efforts. Being able to either script or record test cases and have them run automatically is critical. It is even more so for mobility,

where the segmentation of the mobile device market means that solutions must be tested on a number of different devices. Mobile test automation creates the possibility to run the same test on different devices – saving time and effort. The additional possibility of renting devices in the cloud frees the organization from having to acquire all the devices needed for testing. However, automation is not the solution to every testing problem. Sophisticated user experience involves touch, gestures, and integration with device sensors, such as a camera, GPS, accelerometer and gyro. Interacting with these sensors cannot always be fully automated. Choosing when and how to assign manual testing is essential in planning the most efficient testing. The know-how involved in choosing what to automate and what to run manually focuses the attention on the right testing method.

The decision whether to perform these tests manually or unattended is defined within the test strategy, which is decided with the client and based on their business objectives (please see the chapter below about our TMap methodology).

We have signed partnerships with leading solution providers to support our CoE and local teams with unattended testing and to help Capgemini Group secure access to private cloud set ups.

TMap® NEXT for Mobile: A structured Mobile Testing approach

The five mobile testing services mentioned above are all supported by our industry-recognized structured testing approach, TMap® NEXT. TMap® NEXT provides a solid foundation for structured mobile testing based on four essentials:

- TMap is based on a business-driven test management (BDTM) approach
- TMap describes a structured test process and lifecycle model
- TMap contains a complete toolbox
- TMap is an adaptive test method

(We have adapted TMap® NEXT to optimally support mobile testing. We call this methodology TMap® NEXT for Mobile.)

Business-driven test management

Let's look at the first essential of TMap® NEXT for Mobile, business-driven test management. It is about the balance between risks and results on one hand and testing time and costs on the other.

Two common examples of important mobility business drivers are:

- Driving revenue and getting closer to the customer – the customer can reach your products and services from anywhere
- Cut costs, accelerate processes, and drive higher employee productivity – employees can work from anywhere

For mobile testing this means that there are a number of choices the business owner has to make in collaboration with the test manager to ensure that the business drivers are addressed, like:

- What client platforms are the most relevant in the target market?
- What are the typical network characteristics in the target market?
- How many applications are to be tested?
- What types of mobile tests need to be performed (functional, compatibility, usability, performance, security)?
- What are the specific risks the test has to prioritize?
- How much effort should be spent on usability, security and performance?
- How will you distribute your app (privately or through a public store), and how are app store review guidelines met?

Structured test process

The second pillar in TMap is the structured test process, which helps test managers structure their approach based on business risks. The most important tool for this is the TMap NEXT® lifecycle model (Figure 1).

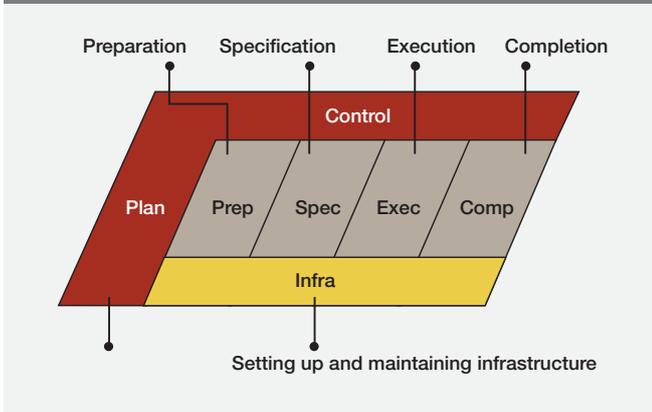
This structured test approach helps coordinate the tests so that time spent to execute test cases is as short as possible. The **Planning phase** defines the test approach and is done together with the business owners. The deliverable from this phase is typically a test plan. The required types of mobile testing are specified in the test plan.

The phases before the **Execution phase** are used to prepare for test execution so that the actual execution takes the minimum amount of time.

The **Preparation phase** is where we decide if the information about the system is detailed enough to execute the tests.

The **Specification phase** defines test cases to be executed for the manual tests, the automation testing and the unattended testing. These tests will be compiled into a test script that will be added to a scripts database, which contains script code and can be linked to test management indicators,

Figure 1: TMap Next Lifecycle Model



such as the bug detection index and the test execution key indicator - important for control of the test process.

The **Infrastructure phase** is when we set up the testing environment and tooling so that we can test effectively. Most of this is permanently set up in our mobile test centers to save clients from having to set it up themselves. Included are public device clouds and/or in-house device farms, GSM network emulation, back end, mobile, and end-to-end performance test tools. Also, there is a device database with the following characteristics:

- Key features where scripting and testing are concerned
- Undocumented features
- Scripting Index level
- Operating system variants
- Market share, distribution area

In the **Completion phase** we make sure that test results and test ware are kept and prepared for reuse in a following test project to increase efficiency of testing.

Toolbox

The toolbox required for a successful mobile testing effort needs to support client-oriented tests, end-to-end tests, performance tests, and security tests, in both manual and automated modes. Most importantly, the toolbox needs to address the core challenge, platform fragmentation.

When you work with us, we bring to you the TMap® Next for Mobile Testing toolbox, a world class toolbox with only the best practice techniques and tools. Our toolbox addresses all key mobile testing requirements and stays dynamic, adding new tools as they emerge along with best practices updates.

Our mobile testing experts have access to a wide range of testing tools and will use the tools as needed, depending on the nature and purpose of the tests.

TMap NEXT® for Mobile includes methodology, techniques, checklists (including checklists for app store guidelines), metrics, and accelerators tailored for mobile testing.

An adaptive test method

The TMap NEXT® for Mobile test method can be used in several contexts. It is adaptable to very different clients, circumstances, and development methods. This is relevant for mobile, because mobile development processes are often agile, with a short time to market. TMap NEXT® for Mobile can also be used in different settings. For example, it can be used in projects on client sites but also in our own Mobile Testing Centers of Excellence. It can be used in an agile development process as well as in waterfall projects.

The TMap® NEXT for Mobile test approach ensures the right balance between risks, results and costs. Essentially, we drive business driven mobile tests that focus on core aspects of delivering business value.

Conclusion

Capgemini and Sogeti are global leaders in testing and mobile application development. We offer mobile testing methodologies and solutions to ensure that the intended business value is delivered by the mobile solution. We offer five fine-tuned mobile testing services supported by our proven and industry recognized testing approach, TMap® NEXT, and can deliver mobile testing capabilities to your organization through our Mobile Testing Center of Excellence.

Mobile Testing is at the very heart of business-driven initiatives across companies and organizations. Make sure you are well prepared and teamed up with the strongest and most experienced team!

About Capgemini and Sogeti

With more than 120,000 people in 40 countries, Capgemini is one of the world's foremost providers of consulting, technology and outsourcing services. The Group reported 2011 global revenues of EUR 9.7 billion. Together with its clients, Capgemini creates and delivers business and technology solutions that fit their 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, its wholly-owned subsidiary, is a leading provider of local professional services, bringing together more than 20,000 professionals in 15 countries and is present in over 100 locations in Europe, the US and India.

Together, Capgemini and Sogeti have innovative, business-driven quality assurance (QA) and testing services, combining best-in-breed testing methodologies (TMap® and TPI®) and the global delivery model, Rightshore. The Capgemini Group has created one of the largest dedicated testing practices in the world, with over 9,500 test professionals and a further 14,500 application specialists.

Capgemini and Sogeti also offer end-to-end Mobile Solutions for mobile strategy and services as an Enterprise Mobility Orchestrator. Deploying a framework of harmonized methods, accelerators and industrialized services, the Enterprise Mobility Orchestrator services can help create, implement and support an organization's mobile strategy.

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**For more information,
please contact:**

Jean-Pascal Duniau
Mobile Testing Leader
jean-pascal.duniau@sogeti.com

Mark Buenen
Global Service Line Testing,
Vice President
mark.buenen@sogeti.com

Andreas Sjöström
Mobile Solutions Global Service Line
andreas.sjostrom@sogeti.com

Percy Hilloo
Associate Director,
Testing Global Service Line
and Europe RightShore Lead
percy.hilloo@capgemini.com