WHITEPAPER

RE-IMAGINE QUALITY & SPEED WITH INTELLIGENT TEST DESIGN AUTOMATION

CONFORMIQ

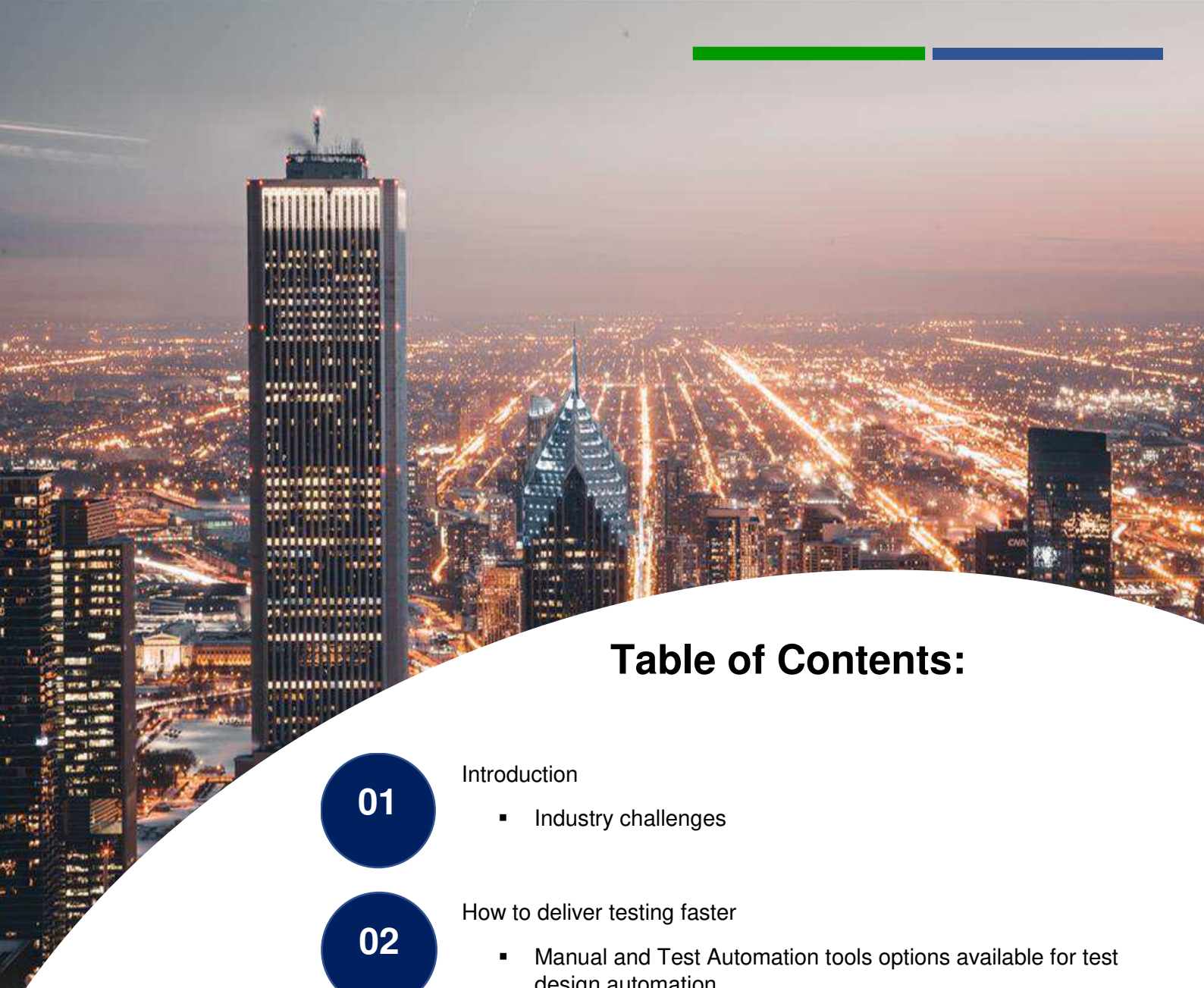**HEXAWARE**

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CONFORMIQ + **HEXAWARE**

The current trend of digitalization and automation is affecting all aspects of product design and test. It has led to the situation where software applications, customer service portals, device types, and platforms are rapidly increasing in numbers, complexity, and interoperation. As a result, testing complexity and requirements are growing exponentially while at the same time the release cycles have decreased from years to months and the risk of errors has increased along with the cost of any such errors. Delayed time to market can mean the difference between product success and failure so the stake is high. Testing these systems is often time-consuming and expensive.

Today roughly 80% of testing is carried out entirely manually. Some of the key challenges in these traditional approaches are listed below:

- Manual test design introduces significant risk, is hardly reproducible, bound to ingenuity of individual test engineer and is costly. There is a high probability of human error such as missing tests, incorrect tests, or redundant tests, not to mention that this task consumes significant portion of the overall testing effort.
- The results of manual test design are often subpar. For example, the test cases often do not often even include enough details to make them executable.
- Test coverage with respect to the requirements is not either measured at all or the coverage remains unacceptable low, often less than 70%.
- The maintenance of manually designed and written test cases is a significant undertaking which results in test cases easily being outdated.

In an attempt to remedy these issues, many organizations have realized that automation is the key in addressing these challenges.

> Test design is a separate task from test execution and is performed before executing the tests against the system. It typically concerns (1) the decisions on what to and what not to test; (2) how to stimulate the system and with what data values and (3) how the system should react and respond to the stimuli (test validations).

However, most of the focus has been on test execution automation primarily for regression testing, while still relying on manual test design. Therefore, existing test automation solutions do not guarantee systematic and repeatable coverage of the system behaviour.

This non-repeatability removes predictability – there are no assurances that you are testing what needs to be tested. With manual test design, it is difficult to assess the quality of testing efforts, which often leads companies to evaluate the quality and progress of the manual test design processes using meaningless metrics, such as the number of test cases or the hours spent on testing.

This is time-consuming and hardly reproducible, and the test coverage with respect to requirements and traceability still has to be done manually. As IT teams ride the digital wave to keep up with the pace of business, with Agile and DevOps, quality as an imperative is assuming a pivotal role in the application delivery life cycle. The customer expectation is not just quality or speed – but quality with speed! This drives leading innovators such as Hexaware to consider latest technology for more efficient approaches to testing.

HOW TO DELIVER TESTING FASTER

Manual and Test Automation tools options available for test design automation

As a leading innovator in the IT industry, Hexaware strives to continuously innovate and develop out-of-the-box solutions, which benefit their customers' business through enhanced software quality and increased efficiencies.

A good *test design* has always been a back bone for any successful testing project and therefore '**Design Right'** is the winning pitch for any *Quality with Speed* projects. Reducing manual intervention in any phase will increase the efficiency of any testing project.

When quality with speed has become more of a necessity than luxury, having to wait until test execution phase for automation is not scalable and cannot deliver quality testing fast enough for agile type projects.

In order to avoid last minute surprises on defect leakage to production, especially when last minute design changes are made, the process of test design needs to be automated as well.

The basis of "**Design Right**" is the utilization of advanced test design software that integrates and links heterogeneous testing tools into a seamless process for end to end automation. Conformiq's Creator software is at the core of this full automation This approach is very different from a majority of other test automation solutions on the market today, which mostly address the automation of test management and/or test execution. With these tools *test design* remains a manual activity.

Conformiq automates this crucial and often overlooked phase of the overall testing process. Instead of using test cases or test models, Conformiq derives tests automatically from *system models*, i.e., artefacts that represent and graphically model the desired behavior of the system or application under test.

The Conformiq Test Design engine uses semantics-driven methods[1] for automatically designing and generating test suites with data combinations used as stimuli to the application being tested with the expected response from the application.

[1] Conformiq test generation is guided by deep state space analysis of the behavior implied by the model, instead of being based on syntactic analysis or simple heuristics.

While this might seem like unnecessary technical jargon, the aim is to highlight a fundamental difference between Conformiq technology and manual approaches and even with other test automation tools available in the market.

Other model-based testing solutions that claim to automate the test design fall short with data and with full automation. While, on the surface level the tools all look more or less the same, the reality however is that without such a unique and powerful technology platform, other tools are capable of only solving the design of test flows while test data design is left out as tests are generated only for manual execution.

While on the surface level, the tools all look more or less the same, the reality however is that without such a unique and powerful technology platform, other tools are capable of only solving the design of test flows while test data design is left out as tests are generated only for manual execution. The vast majority of test design and the validations, even after deploying these other tools, still must be carried out manually.

With the "shift-left" approach in vogue, achieving quality with speed has become necessary, no longer a luxury. Automation is really the only way to succeed and in order to deliver good quality testing faster than ever before, Hexaware relies on Conformiq for its Creator test design software.

Conformiq provides an opportunity for leading service providers like Hexaware to deliver advanced customer specific automation solutions.

Once Conformiq Creator has been used to generate test cases, they can be exported for automated execution or a human readable format for manual testing. Conformiq products also automatically create test case documentation and upload it to the customer's Application Lifecycle Management (ALM) or test management system.

By leveraging state-of-the-art technology and with this one- of- a- kind go to market strategy, Hexaware's customers are benefiting by keeping their existing testing tools yet upgrading their end to end process to be fully integrated and automated, saving time, costs, and reducing defect slip through to achieve both speed with quality.

> **At the core of Conformiq's test automation is the automation of the test design process.**
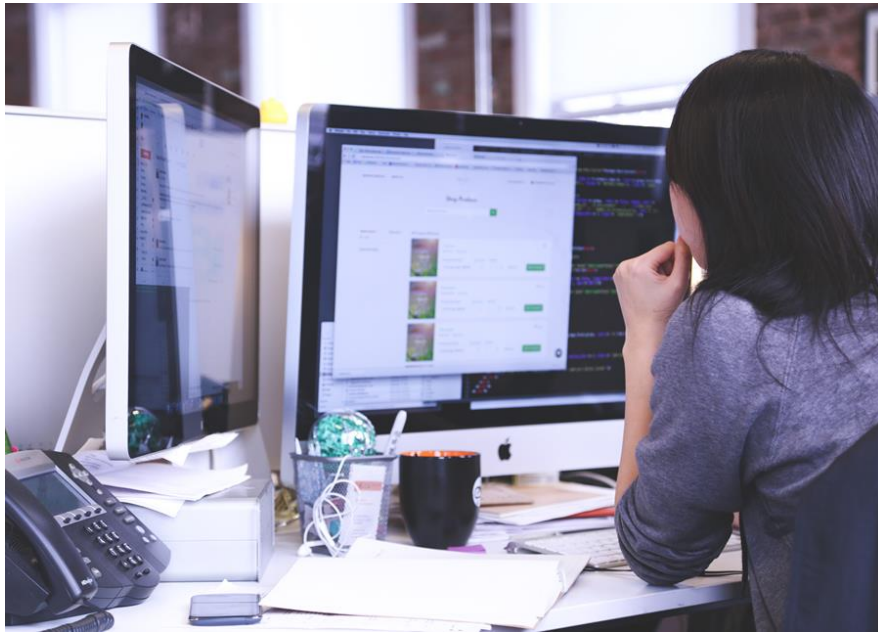
WHY AUTOMATED TEST DESIGN

A quick comparison with manual and test automation tools

Typically, when manual test design is being applied, a test designer goes through the requirements document or user stories and manually invents test cases for testing an implementation that is based on the same set of requirements. In order to do this, the test designer needs to possess expert knowledge about the application and he also needs to have test design strategy skills.

The main benefit of the manual testing approach is that it's very easy to start with and the initial cost is low. However, manual test design is an implicit, creative process that is not reproducible and bound to the ingenuity of individual engineers.

It does not guarantee a systematic and repeatable coverage of the system behaviour either, which is a huge risk already in itself.

With manual test design, it is hard to assess the quality of your testing efforts which quite often leads one to evaluate the quality and progress of the manual test design process using spurious metrics such as number of test cases or number of hours spent on doing testing.

At the same time, manual test design is also very expensive process - especially when there are changes in the requirements.

In practice, test engineers are forced to manually analyse each of the test cases individually in order to see which of them needs to be updated, which to be removed and which added in order to fill the coverage gap when there are changes in the requirements.

This eats a lot of productivity.

And did we mention that the requirement tracking is also done manually?

Due to the nature of the typical test design process, designing test cases manually for complex applications that change rapidly is simply too overwhelming a task for the human brain and in fact a computer algorithm is much better in this kind of endeavour. Therefore, it seems logical that in order to "solve" the problem of test design, the "hard work" should be actually outsourced and done by computer software based on a description of the problem and the ability to automatically generate the data needed to fully test the logic in a data-driven application[2]. This is indeed what Hexaware is doing with Conformiq. Hexaware is describing the problem instead of trying to manually solve the and using Conformiq technology to do the 'heavy weight lifting in mathematics'.

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[2] Think about Sudoku puzzle as an example. A manual approach to test design or even a tool that does not automatically generate test data would leave the task of solving the puzzle, i.e. finding correct numerical values for each empty square in the game, entirely up to the user. On the other hand, a technology capable of conducting data design as well, such as Conformiq Creator and Designer, would automatically solve the puzzle for you. It would give the correct answer thru click of a button to your Sudoku puzzle.

The description of the problem here is referred to as a "model"; the model graphically describes how the application that we are testing should work – not how it should be tested.

That is, with Conformiq, as opposed to other approaches, we focus on the behaviour of the application itself and we model, on a high level of abstraction, the behaviour of the application. And then we leave the problem of test design and optimization to the computer. The computer is then responsible for figuring out how we should stimulate the application with what data and what precise output the application should give back if it is operating correctly. We do not model the environment; the computer determines that out from the model. Therefore, with Conformiq, the *computer generates an environment that drives the real system*.

Creating such a model is more straightforward and less error-prone process than modelling the test cases themselves or modelling an environment/test/usage model. This is simply because the mental step involved in designing the testing strategies and oracles is simply omitted.

Actually, the modelling can be compared to a translation problem – the *goal is to translate the specification and / or requirement documents in to computer readable format instead of creatively designing a highly complicated behaviour for input selection and output validation* which are tasks that the human mind is not really good at doing. Due to the fact that modelling is like encoding the requirements directly into the model without having to be creative, the model is very easy to update when the requirements change. This is a huge time saver in the maintenance step and when last minute design changes are made.

The benefits algorithmic test design can be summarized as follows:

- The algorithmic approach to test design does not accidentally miss a test case that is dictated by the requirements for an error handling case, or a limit value of a data parameter, or an expiration of a rarely activated timer.
- The algorithmic approach to test design eliminates randomly incorrect tests.
- With the algorithmic approach to test design there are fewer missing tests, because the algorithm does not accidentally miss corner cases or negative paths if they are included in the model.
- With the algorithmic approach to test design there are no redundant test cases because the resulting test sets are rigorously optimized by a computer and checked for importance.
- With the algorithmic approach to test design the generated tests are always related to the requirements, so the quality of the generated test suite is always measurable.
- The whole process of algorithmic test design is systematic and repeatable.

NEED OF THE HOUR – INTEGRATED E2E APPROACH

For faster & continuous testing cycles

Hexaware's **iD2E (Integrated Design to Execution Automation)** solution is a key component of Hexaware's **AutomationFirst** architecture, which extends automation beyond regression testing by bringing in seamless automation across test design, execution and reporting.

iD2E delivers this capability using three integral solutions.

1. Automation of test design using **Conformiq Creator**
2. Generation of test scripts for immediate test execution directly from Conformiq Creator, and
3. Automation of test reports using **Hexaware's Online Test Dashboard – Insight 360**

Let's elaborate these points below:
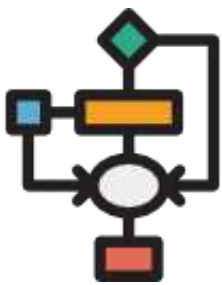
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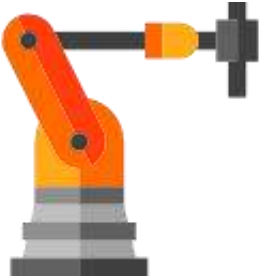
Automation of Test Design using Conformiq Creator

Hexaware's model-based testing solution is powered by Conformiq Creator. The application behavior is modelled and represented graphically. Once the models are ready, the test cases (along with auxiliary information including the requirement traceability matrix and graphical coverage of every test case path through the model) are generated literally through click of a button. The test generation process is rigorously optimized for generation of as compact a test suite as possible while covering all the control flow and data permutations, including corner and negative cases using built-in highly advanced algorithms. The generated test cases are then exported directly to various test management tools through Conformiq Creator integrations referred here as "connectors".

For any incremental changes in the functionality of the application, test engineers update the model and Conformiq Creator takes care of the "impact analysis". That is, the engineers simply reflect the changes in the requirements into the model, and then the tool analyzes the model changes and generates an updated test suite with color coding utilizing categorization such as

- new test cases needed for new functionality coverage,
- test cases that has not changed and are still valid, and finally,
- test cases that are no longer valid with respect to the updated model logic.

The actual modeling process can be further streamlined by actually creating models automatically. In the Hexaware context, this is carried out by importing the existing Business Process Model Notation files, or through the concept of reverse engineering, where existing test assets like manual test cases are used as an input for model creation through Creator's AI-based reverse engineering functionality.

It is worth pointing out that Hexaware's iD2E is not just about **enhanced coverage, 100% requirement traceability and optimal test cases**, it also **delivers 40% or better savings on test design efforts**.

02

Generation of Test Scripts for Immediate Test Execution Directly from Conformiq Creator

The second component of our iD2E solution is the "connector" between Conformiq Creator and test automation accelerators such as **Selenium Test Manager** and **UFT Accelerator**. From the model, these connectors allow generation of automation scripts, with minimal customizations, for the corresponding accelerator.

The concept of a connector can be extended to any other tool or customer specific automation framework or accelerator. Hexaware has actually built a maintenance utility that inherits the impact analysis from Conformiq Creator and helps users to identify the specific automation scripts that are impacted due to the incremental change in functionality. With this approach, teams can cut down **efforts in creation of automation scripts and maintenance by as much as 50%.**

03

Automation of Test Reports using Hexaware's Online Test Dashboard – Insight 360

The third component of Hexaware's iD2E solution is Online Dashboard – Insight 360, which fully automates the test reporting activities. Insight 360 is a tool agnostic" solution and can integrate with virtually any commercial or open source Test Management tools.

Insight 360 provides a real time view on the progress in testing with a transparent view on performance of the vendor, against the contractual SLAs or KPIs. It also eliminates the need for having commercial licenses for viewing the test results and reports, thus further saving costs.

SUMMARY

Integration of automated test design powered by Conformiq into test execution framework is one of the key differentiators to Hexaware's traditional automation technique. This exemplifies "Shrink IT spend and Grow Digital" strategies to its customers and would definitely help them to achieve speed with quality. A total implementation of iD2E can empower QA teams with 4X more productivity across test case design, execution and reporting, resulting in faster time to market and reduced cost without compromising the test quality.

An example Hexaware customer that adheres to the testing process presented in this whitepaper, is a leading insurer in life, health, property and casualty insurance, specialty insurance, worker compensation and investment management. This organization has a global presence across major continents with more than 165000 employees worldwide. This particular customer was facing a collection of business challenges and in order to remedy some of them was looking for (1) an Agile testing solution with a high percentage of automation to align with development and (2) a digitization program to replace their legacy non-life PAS platform with a COTS product. By adopting Hexaware's iD2E solution, this customer reported the following benefits

- Reduced overall testing effort by 20%

- Improved test design productivity by 40%

- Automated requirement traceability information

- 100% updated test documentation

- 30% reduction in review efforts

- Re-usability of models across multiple LOBs and country roll outs

- Enhanced known test coverage

ABOUT THE AUTHORS

Krishna Balagurunathan is a post graduate from Middlesex University, London. He has more than 12 years of experience in Program Management, Test Strategy Consulting and Quality Assurance Practices and Solutions group. He has successfully managed large testing engagements and has vast experience in Customer Management, Transition Management, Process Consulting, Solutions and overall QA delivery. Krishna currently spearheads the QA Life Cycle Automation practice focusing on building new age solutions like iD2E framework on integrated design to execution service offerings.

Kimmo Nupponen is the leader of Conformiq's R&D team and has overall responsibility for Conformiq's R&D operations. For over a decade, he has had the key role in the definition and implementation of Conformiq core technology and is product owner of various Conformiq products. Kimmo has created a distinct R&D culture that integrates technology innovation and close customer collaboration to bring new products to market. Prior to joining Conformiq, Kimmo worked for SGI and the ESRF (European Synchrotron Radiation Facility) research institute. Kimmo holds a M.Sc. Tech. degree from Helsinki University of Technology where he studied software systems and theoretical computer science. Kimmo serves on the Conformiq Board of Directors.

ABOUT CONFORMIQ:

Conformiq is a leading software technology company, focused on automating test automation, functional testing design and software quality. Conformiq's Intelligent Test Automation solutions are designed to automate the entire testing processes from design to generation to execution with minimal human intervention. Our solution adapts quickly to new product requirements, eliminating the time required for laborious test case creation, test execution & script maintenance during short sprints. Thus, enabling High Quality@Speed through a no-touch, script-free testing platform.

Conformiq's e2e automation approach applies AI to Model Based Testing technology, which enables end-to-end test automation in software development lifecycle. This full automation is at the heart of Conformiq's proposition: that you should never have to fall back on manual coding.

www.conformiq.com

ABOUT HEXAWARE:

Hexaware is a global leader and the fastest growing next-generation provider of IT, BPO and consulting services. We are a team of seasoned IT practitioners, distinguished engineers and 'Automateers'(our resources with a deep-rooted passion for automation), striving as the customer's trusted partner in managing their technical complexities and providing the best possible solutions.

We've pioneered a new supercharged growth strategy, evolved at the intersection of advanced technologies – 'Automate Everything', 'Cloudify Everything' and 'Transform Customer Experiences', that helps in fast-tracking enterprises into the digital era.

We are led by a simple guiding purpose of being the first IT services company in the world, with half of our workforce as digital.

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