

# Testing in the digital age

AI makes the difference





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**AI makes the difference**

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# Foreword

In the current digital age, the quality assurance conundrum of what to test, and how much to test is magnified multifold. The convergence of physical with the cyber has added another layer of complexity to the testing activity. Product strategy is shifting from building discrete products to building connected eco-systems. The interface with wider eco-system entities has opened opportunities as well as vulnerabilities. The book gives insight into all aspects of testing for digital solutions. It ranges from the use of artificial intelligence or machine learning in testing to cooperation between robots and humans. It also addresses the special considerations in testing 3D printed products and autonomous machines.

New age software development techniques embracing continuous delivery and integration (CD&I) can skew the focus towards “delivery” instead of the “deliverable”. The book stresses the use of feedback loop in learning from past cycles and building machine learning algorithms to manage the “what” and “how” of the testing scope. It introduces the concept of a test intensity table to determine the focus for business value and quality risk, striking a good balance between the deliverable and the delivery.

In the digital age we need to test for experience rather than functions or features. Building on this thought, the test engineer elaborates three additional quality characteristics. The characteristics intelligent behavior, morality and personality are needed in addition to the product quality characteristics already defined in well-known international standards.

As we enter the realm of early AI testing it is critical to build knowledge based on artifacts we already collect like defect log data, life cycle information, fields defects, and production events to improve effectiveness. The authors provide us with key insights on the concept of cognitive QA and how we can leverage analytics and artificial intelligence to improve decision making and the way we do testing.

The book concludes with an interesting perspective on the digital quality engineering skills that an AI quality engineer needs. This can be used as a ready reckoner when setting up cross-functional testing teams armed with the right digital test engineering skills.

As we forge ahead in deploying advanced and highly connected AI systems, this book provides practical guidelines for the corresponding testing activities. The comprehensive ideas cover all aspects that need to be considered to deliver a satisfying customer experience. In the last chapter interviews with influencers of a variety of leading companies confirm the value of the content of the book, and the vision of its authors, for testing in the digital age.

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**1**

# Introduction

## 1.1 Reading guide

You have just started reading the book *Testing in the digital age* where AI makes the difference. In five hops we explain how digital testing takes shape. The chapters in this book are grouped under these five hops. Organization maturity, personal interest or your project stage has influence on the part you want to read. The following table guides you to the right chapters (should you have no time to read it all).

Chapter Name or hop	Summary	Must-read for:
<b>1</b> Introduction	Here you read the reason this book was written. As part of the TMap suite this book describes the changes the digital age brings to the test discipline.	Everyone
<b>2</b> Background	Background information on the term digital and a first glance into how smart testing can make a difference.	Everyone
<b>3</b> Set up your digital testing roadmap	Testing in the digital age is about a new vision on test engineering, using new quality attributes that tackle intelligent machines and a roadmap split up in five hops.	Head of R&D Test engineering Project or team lead
<b>Hop 1</b> Automation and robots	Automate everything possible in order to speed up the complete product development cycle using all possible means, even a robot taking over human test activities is a possibility.	Product development Test engineering
<b>Hop 2</b> Use the data	Digital test engineering needs to cope with data for the purpose of testing and monitoring. We need to be smart about it in order to tame the data beast growing out of control.	Data analysis Test engineering
<b>Hop 3</b> Go model-based	Modelling, using models and using the digital twin are crucial to keep up with continuous testing. It helps to build confidence in products operating in the field that we think have elusive characteristics.	Scientific engineering Test engineering

Chapter Name or hop		Summary	Must-read for:
<b>Hop 4</b>	Use artificial intelligence	The goal of using artificial intelligence in testing is not to take people out of the loop. The goal is to make testing easier and faster. This hop also gives insight into how to use AI solutions.	Everyone
<b>Hop 5</b>	Test forecasting	The test forecasting hop is aimed at being ahead of the test results. To get to that situation all previous hops need to be put into place.	Head of R&D Test engineering
<b>15</b>	Interviews with leading companies on their digital vision	We have interviewed companies on their view of the digital age. The new risks and challenges, opportunities and the impact on their test activities now and in the future.	Everyone
	Glossary	Clear terminology is key when communicating. This glossary is an extensive list of terms that supports you in all your test communications	Everyone

## 1.2 TMap Suite

TMap is an established name in testing since 1995. Since its introduction the TMap method has been continuously extended and improved. This book brings testing to the digital domain. It expands the TMap test methodology to situations where a strategy for testing digital solutions is needed.

All information about TMap together forms the TMap Suite. In addition to this book you are reading, the TMap Suite consists of:

- ▶ The TMap.net website. This website contains the building blocks of TMap. Together with the building blocks in this book you can build your own testing method. On TMap.net templates and checklists are available for download.
- ▶ The book *Neil's Quest for Quality: A TMap HD Story*, describes the human driven and quality driven test approach for modern, agile organizations.
- ▶ The book *TMap NEXT* with the core test method, describes techniques and processes for testing in every part of the product development lifecycle. Its adaptiveness ensures that TMap can be applied in traditional, iterative and hybrid organizations.

- ▶ The book *IoTMap: Testing in an IoT Environment*, expands the TMap Suite to the IoT and high-tech domain. Together with the other elements from the TMap Suite a complete test strategy for your project, fitting your product development methodology can be set up.
- ▶ Several other books about testing, quality assurance and test process improvement.

## 1.3 AI makes the difference

Digital companies rise quickly in traditional analog markets. Tesla is claimed the biggest car manufacturer of the “Big 3”! Traditional (call them analog) car manufacturers have been selling cars for over a century. The digital car manufacturer only started a decade ago. The digital age is testing the limits of companies. A demand for extremely quick market response, new technology and keeping up with emerging more agile competitors, is what they face right now. Keeping up with all this, is putting you on your toes. Running an experiment in the field is nothing new. It is more and more accepted to crowd test and immediately move to large scale market solutions.

The technology is here, and it will work. Digital unlocks a new world of possibilities and there is no time to sit back, relax and watch it unfold. With digital, huge amounts of data are unlocked. Everywhere a sensor is put, data is collected, transmitted and stored. Data lakes are flowing into oceans of 1’s and 0’s.

Digital is put in front of a lot of terms. This makes existing processes, products or solutions different from how we know them. Digital twin, digital manufacturing, digital assurance, digital transformation, digital age and digital enterprise are just a few examples of digital terminology. We even have digital football players!

Digital creates an environment of like-minded products. A digital aspect of a product makes it possible to communicate with another digital product in one way or another. Integration is the keyword here. A flurry of recent acquisitions of major API management vendors shows the world that APIs are part of a bigger market called integration. API management is much more an extension of integration, because that’s where they are developing their APIs. A clear indication that IT recognizes the value of APIs for application integration. The Internet of Things (IoT) is maturing fast, making integration of “Thing” data a reality. IoT brings IT and OT together, making it the biggest integration project of this day and age. Finally, blockchain technology is contributing to all these integration initiatives. Companies ranging from Fintech to healthcare are getting in line to adopt this new way for fast and secure payments.

Integration will be the key that ties these new initiatives into your business, adding new channels for secure and fast business. IT departments need to find a new way forward to support the enterprise infrastructure and maximize the potential benefits of having improved access to this data. With the IoT, APIs, blockchain and chatbots thrown into the mix, integration is no longer the problem of your IT department, it is everyone's problem.

Digital is extending human possibilities, new ways of working, new thoughts and takes on existing products. Where new things are created, things are tried and tested. This is where **testing of digital solutions** comes into play. The common denominators with all digital terminology are:

- ▶ Speed: Extremely fast market response
- ▶ Data: Huge amounts of data are collected
- ▶ Integration: Everyone needs to integrate with everything.



**Figure 1** The digital age acts as an accelerator for all our product development activities.

Extremely high speed, huge amounts of data and an infinite amount of possibilities for integration are the elements we are facing for testing. They extend beyond our human capabilities.

One way to help us out is test automation. Test automation in the context of digital testing, is automating everything possible in order to speed up the complete product development cycle using all means possible means, even a robot taking over human test activities is a possibility. Further help can be found in combining it with another new technology not yet mentioned: artificial intelligence (AI). AI works with huge amount of data, finds smart ways through infinite possibilities and has the potential to hand us solutions quickly. Let us not forget that AI needs to be tested as well, but AI can make the difference here.

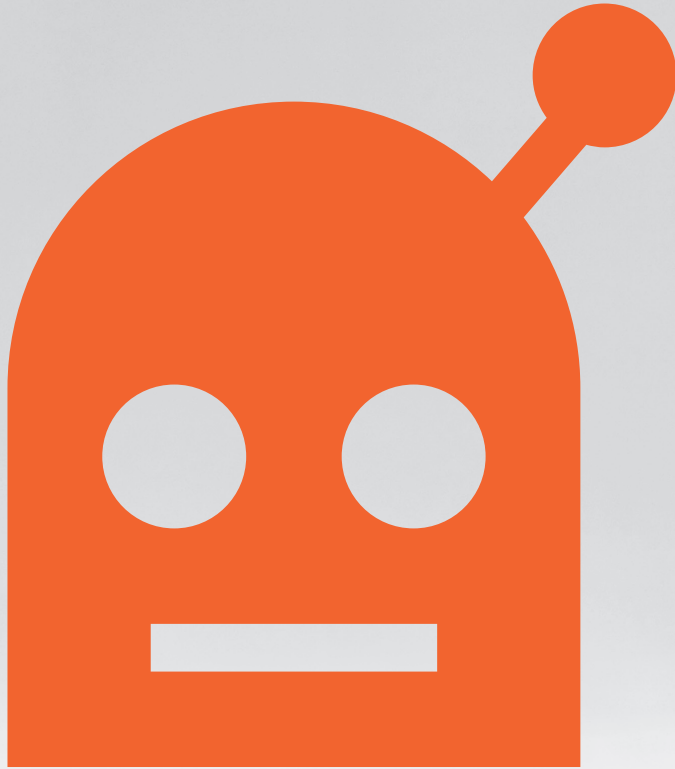
We can create robots that can do all the testing automatically and monitor data coming from the field. The robots also have to keep up with growing amounts of test cases, test data and test environments. Tests are executed on a system under test. In that sense it is a reactive (and time consuming in the release train) activity. Testing must keep up and shift from an executing activity, to a monitoring role, towards a quality-forecasting medium that is ahead of the game.



**Figure 2** Testing is moving from a reactive activity (for example test execution) towards test monitoring (for example monitoring data from operating products). Eventually testing becomes the forecasting of faults.







**Testing in the digital age** brings a new vision on test engineering, using new quality attributes that tackle intelligent machines and a roadmap split up in five hops. With everything digital there are more possibilities for test automation and piles of (test) data growing out of control. Working together with robots (cobotics), using artificial intelligence in testing and eventually predict the occurrence of defects brings your testing to the digital age. We have interviewed companies on their view of digital testing. A glossary brings an extensive list of terms that supports you in all your test communications.