The T-Shaped Tester

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Improve IT Services BV, Bonaire (CN)

EuroSTAR Huddle

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We are delighted to present this eBook written by Drs. Erik van Veenendaal, a recipient of the EuroSTAR Testing Excellence Award.

Enjoy!

The EuroSTAR Team

Drs. Erik van Veenendaal

Drs. Erik van Veenendaal, CISA (www.erikvanveenendaal.nl), is a leading international consultant and trainer, and a recognized expert in the area of software testing and requirement engineering. Erik is the (co-) author of numerous papers and a number of books on software quality and testing. He is a regular speaker at both national and international testing conferences and a leading international trainer in the field of software testing.

Since its foundation in 2002, Erik has been strongly involved in the International Software Testing Qualifications Board (ISTQB). From 2005 to 2009, he was the vice-president of the ISTQB organization; living in Bonaire, today he is the president for the Curaçao Testing Qualifications Board (CTQB).

Erik one of the core developers of the TMap test methodology and the TMMi test improvement model, and currently the CEO of the TMMi Foundation. For his major contribution to the field of testing, Erik received the European Testing Excellence Award (2007) and the ISTQB International Testing Excellence Award (2015).

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Abstract

In this Agile era the concept of being a T-shaped person is a popular one. A T-shaped person is defined as someone who capable in many things and an expert in one of them. Also testers are now expected to be T-shaped persons. Many talk about this concept, and many testers today state they are a T-shaped. But what is a T-shaped tester? What is expected from a T-shaped tester in terms of attitude, knowledge and skills?

The e-book will define the T-shaped person in detail and discuss what it means to be a T-shaped tester. The correct attitude and required knowledge and skills will be discussed and subsequently defined. The reader can use the e-book to understand what is means to be a T-shaped tester and assess oneself against the defined criteria.

T-shaped testers are needed in Agile teams; the traditional I-shaped test professional does not suffice anymore. Learn how you measure up against the T-shaped tester and make becoming a true T-shaped tester part of your career development path. Working toward the correct attitude and building a T-shaped set of knowledge and skills is one of the most valuable things a tester can do for his/her future career and personal development.

Key Takeaways

After reading this e-book the reader will:

- Understand the need for a tester to become a T-shaped tester.
- Understand the concept of a T-shaped person.
- Be able to compare the T-shaped concept to other shaped concepts.
- Understand that a T-shaped tester needs to posses both the correct attitude and required types of knowledge and skills.
- Understand the need for test specialists as an alternative to the T-shaped tester, but also their associated risks.
- Be able to explain what the correct attitude is of a T-shaped tester.
- Have an overview of the required testing knowlegde and skills for a T-shaped tester.
- Have an overview of the required IT knowlegde and skills for a T-shaped tester.
- Understand where a tester will benefit from having domain knowledge .
- Have an overview of the required soft skills for a T-shaped tester.
- Be able to perform a self-assessment for compliance with the requirements to be a true T-shaped tester.

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The T-Shaped Tester

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The e-book is partly based on earlier publications [Veenendaal,19], [Veenendaal,20] by the same author.

State of the Practice

In recent years the way software is being developed has changed dramatically. In addition to the rapid and dynamic changes currently in the software development arena, there is an increased growth in innovation and expansion of IT throughout most industries and society. There has been a large shift towards adopting an Agile and/or DevOps way of working. Agile typically provides benefits such as the ability to better manage changing priorities, improved project status visibility, higher team morale, increased team productivity and better delivery predictability (see figure 1).

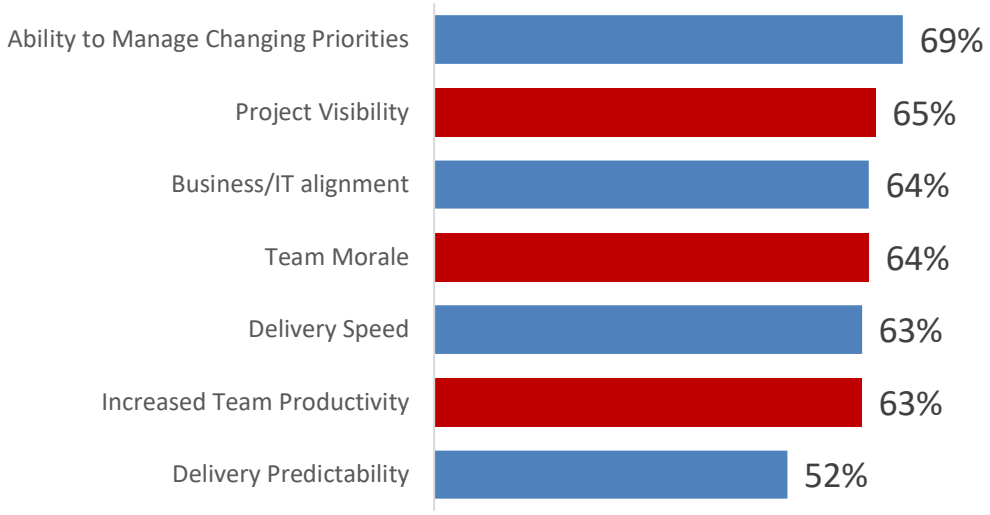


Figure 1: Benefits of Adopting Agile[1]

However, Agile is not the silver bullet. Many organization are struggling with Agile and scaling Agile, and it also has become apparent that moving towards Agile does not automatically guarantee improved software quality [Mah], [Veenendaal,14]. This is also confirmed by the 12th and 13th Annual State of Agile report that both show, whatever the reasons, that a majority of the organizations using Agile do not (yet) report benefits in terms of software quality. Testing, although in Agile organized differently than in traditional organizations, is therefore still and will remain (at least for the time to come) an important part of software development. This is not only due to the importance of software in today's society, but also due to the many (technical) challenges that IT projects are facing, e.g., increasing complexity, new technologies, systems-of-systems, variety of devices and OS's, and security vulnerabilities. Following these and other challenges and the shift towards Agile, the requirements for a professional tester have changed and increased. In this e-book, the knowledge and skill set required for a tester to add value and survive in today's rapidly changing IT world will be presented taking the concept of so-called T-shaped persons as a starting point.

1 Source: 13th Annual State of Agile Report (www.stateofagile.com)

A Broader Knowledge and Skill Set

Testers need to change their attitude and broaden their knowledge and skill set. They need to become a so-called T-shaped person **/** tester. Changing ones attitude and possessing the right knowledge and skills is a challenge for many testers. It is just not good enough anymore to understand testing and hold an ISTQB or other test certificate. In Agile context, testers will also most often no longer work in their safe independent test team environment. They will work more closely together with business representatives and developers helping each other when needed and as a team trying to build a quality product. Besides strong communication skills, it is also expected from testers to have amongst other domain knowledge, requirements engineering and scripting skills. One must become a 'tester plus'. In the area of testing, someone who can test, but also organize testing and supports others in testing. In short a tester, who can do much more than just test.

The concept of a T-shaped person is popular in the Agile world and refers to the need for cross-skilled developers, business analysists and testers in an Agile team, e.g., a Scrum team. In today's Agile world, many talk about being a T-shaped tester, but not many truly are. So, what is the correct attitude and required knowledge and skill set to be a true T-shaped tester? Before starting to answer this question, let us look more in detail on what the concept of a T-shaped person actually means and stands for.

The Concept of T-shaped

The concept of T-shaped skills, or T-shaped persons, is a metaphor originally used in job recruitment to describe the abilities of persons in the workforce. The term T-shaped is considered to have been first used by David Guest in 1991 [Guest], and was later popularized by Tim Brown, CEO of the IDEO design consultancy. Tim Brown endorsed this approach to résumé assessment as a method to build inter-disciplinary work teams for creative processes. The vertical bar on the T represents the depth of skills and expertise in a single field, whereas the horizontal bar is the ability to collaborate across disciplines with experts from other areas, and to apply knowledge in areas of expertise other than one's own (see figure 2). More in detail the horizontal stroke is composed of two things. Firstly empathy, this is important because it allows people to look at a problem from another perspective - to stand in somebody else's shoes. Interestingly, the empathy part of being a T-shaped person is often forgotten and not addressed. It is however, an essential part of being a true T-shaped person. Secondly, T-shaped persons tend to get enthusiastic about other people's disciplines to the point that they will actually start to learn and practice them. T-shaped people have both depth and breadth in their skills.

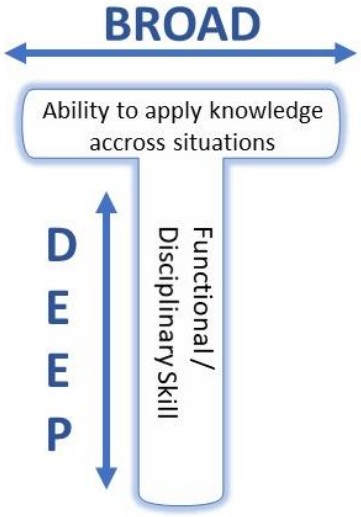


Figure 2: T-shaped person

A T-shaped person is a person that has deep knowledge and skills in one area and a broad base of general supporting knowledge and skills.

To better understand what a T-shaped person is, it is perhaps easier to first understand what the converse, a so-called I-shaped person, is. An I-shaped person (see figure 3) is one who is a functional expert - their functional expertise being represented by the vertical stroke in the letter I. There is of course in principle nothing wrong in being an I-shaped person - a functional expert. However, let's image an number of functional experts trying to work together on a new mobile app. An app developer, a SEO expert, an analytics expert, a content developer, and an art director have a kick-off meeting to decide on a strategy for the new mobile app. The SEO expert insists that build the app should be around a keyword map to make sure that the structure of the app mirrors an emphasis on keywords. The app developer insists that the mobile app should be as easy to code as possible. The analytics expert states that the new design has to be based on what the app analytics shows about usage of the current app. For the content developer it's all about developing interesting, engaging and navigable content. And finally, the art director is insisting that app composition and brand beauty is the number one objective. Which one of these I-shaped people is right? How do we manage all these different opinions and make decisions? No matter how good the I-shaped functional experts are at their individual functions, what they lack is not only an appreciation of their fellow co-workers' areas of expertise, but also the training to actually find solutions at the intersection of their respective functional areas

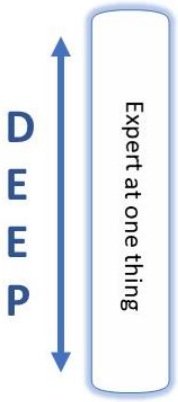


Figure 3: I-shaped person

Let's now compare the I-shaped persons to those being T-shaped. A T-shaped person is typically multi-function aware, collaborative, and seeking to learn more about how their function impacts others and the end product. T-shaped people are far more flexible and more able to easily catch on to new trends, but are of course they are not as substantial in each adjacent discipline as in their primary skill. Contrary to a I-shaped person, a T-shaped person tends to get the general picture rather than immerse themselves in details, unless it's really needed.

T-shaped people and the teams they work in can achieve results far better than teams that consist of only so-called I-shaped people. But the development of T-shaped people is a serious, long-term undertaking and most often largely underestimated. It requires people with the right attitude and self-determination to start, but thereafter it requires effort to continue to provide them with the training and resources they need, and a safe collaborative environment that allows for T-shaped person and teams to perform at their best.

Other shaped concepts

In addition to the T- and I-shaped concept, there are other descriptive variations that have emerged recently. Briefly they will be discussed and evaluated to determine whether they can be applied to testers as well. The most common variations are (see figure 4):

- π-shaped – two legs of key skills connected with a dash of general knowledge
- M-shaped – three (or more) key deep skills.

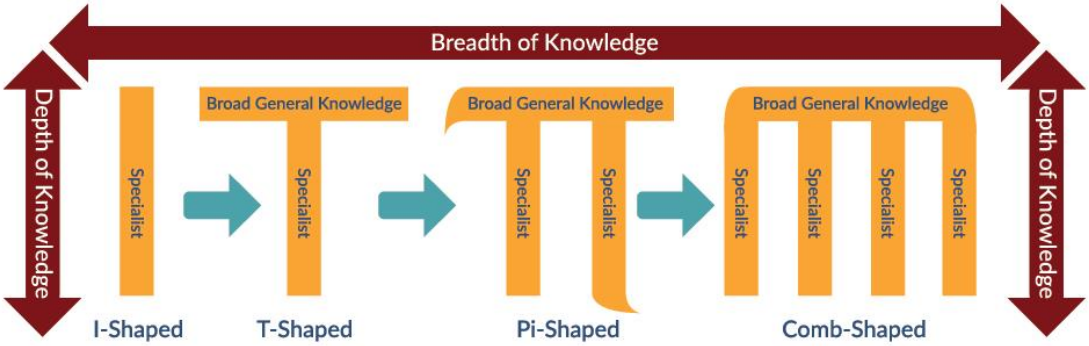


Figure 4: Variations to the T-shaped concept

π-shaped, M-shaped

Although the concept of going beyond T-shaped, such as π-shaped or even M-shaped, is certainly an interesting one for some disciplines, it probably is not the way to go for testers. As we have learned over the years a certain degree of independence makes the tester most often more effective at finding defects due to differences between the author's and the tester's cognitive biases (critical distance). Having multiple specialist areas by being a π-shaped or even M-shaped tester, would typically make it much harder to keep the independent perspective. In these cases, a tester would as an expert be involved in tasks, that he/she should also as a tester evaluate. In Agile preserving independence is already often more difficult with the tester being embedded in the Agile team. If the tester at the same time, by being a π-shaped person, performs other specialist tasks beyond testing, this would probably make the required level of independence (almost) disappear altogether.

In addition, but this is a more general comment towards the π-shaped and M-shaped concepts, one could easily argue that becoming a true expert in multiple areas is a huge challenge for most people. It may be achievable for some, but for the majority of the workforce becoming an expert in only one area is already a challenge.

Finally, two more shaped concepts that you may come across when browsing the internet for T-shaped:

- X-shaped – broad and deep expertise combined with the ability to lead
- Y-shaped – having an open eye on what the business objectives and IT trends mean for their expertise and activities.

X-shaped

An X-shaped person is defined as someone who has a deep expertise built on solid credibility and can also lead diverse teams to accomplish a goal. The X-shaped is a in essence an evolution of the T-shaped. Where T-shaped understands that collaboration is a key for growth; the X-shaped profile understands that leadership and strategic thinking are a crucial ingredient to move a small or large group toward goals that require massive action (see figure 5). Authoritativeness and leadership are added as critical skills to make the jump from T-shaped to an X-shaped profile. Thus, the X-shaped person is in addition to being T-shaped person also a recognized leader within the organization. Although an interesting concept for some T-shaped testers who want to push their career in that direction, for most testers the T-shaped concept offers enough challenges. It goes beyond the scope of this e-

book to discuss X-shaped persons in detail and what this could mean for testers pursuing a leadership career.

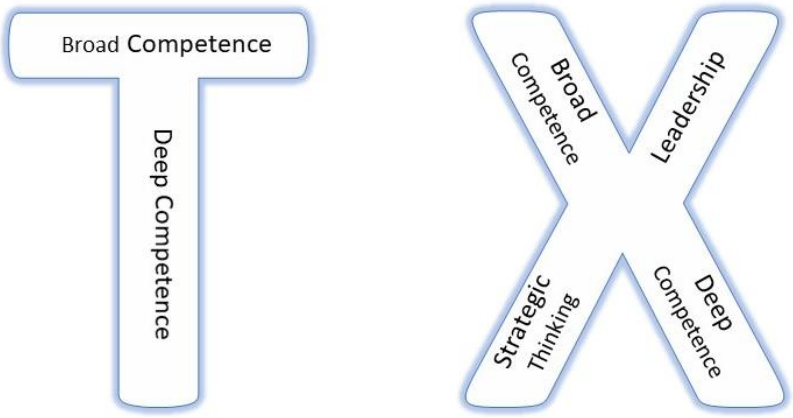


Figure 5: Comparing T-shaped to X-shaped concept

Y-shaped

Regarding the Y-shaped concept, there are different definitions and interpretations. According to some, an Y-Shaped person is one that has a 'why' or purpose running through them, and through everything they work on or take part in. An Y-shaped person struggles when they are doing things that go against their core beliefs and values; or when projects simply don't feel like they are coming from a meaningful place to begin with. Others define an Y-shaped person as someone with a broad funnel through which the person filters and transforms every piece of information and looks how this can be applied to their primary skills. The latter is basically and I-shaped person that actively follows trends and has an eye open for new developments.

Studying and combining the different definitions of Y-shaped, we can deduct that an Y-shaped person is one that is passionate about delivering business value, is result-oriented, has an open-mind and is eager-to -learn. In today's Agile world, one of the main principles is delivering and focusing on customer value. As such, it is expected that a tester does not just test and routinely apply testing practices, but rather understand what the team is trying to achieve and what has value.

Certainly the wider perspective of an Y-shaped person, taking customer value into account and having an open eye for new trends that can be applied to strengthen their primary expertise, have much added value. In the context of defining the T-shaped tester, the wider perspective of an Y-shaped person will hereafter be re-used and embedded as part of the correct attitude expected from a T-shaped tester.

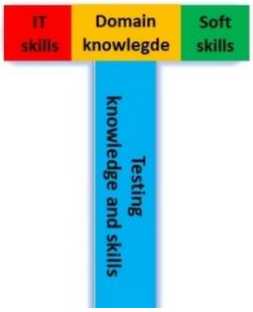
The T-Shaped Tester

To drive a career in software testing, what are the most valuable knowledge and skills to possess? In previous decades there was a demand for I-shaped testers working in an independent test department or test team. They were experts in the field of testing. With the transformation to working in Agile teams, there is now a fast growing need for T-shaped person including testers. Those who have deep knowledge and skills in one discipline and in

addition empathy, the correct attitude and general knowledge and skills across disciplines, will much easier be able to work and adapt in changing environments. In the Agile world, the T-shaped tester is a team member whose key expertise is testing, but who also appreciates the areas of expertise of the other team members and can provide support in their activities, for example, activities that lie in the fields of programming or business analysis (requirements engineering). So, in the context of becoming T-shaped, we should look for the knowledge and skills that will boost the tester's profile. However as stated before, it's not just about possessing knowledge and skills, it's also about having the correct attitude.

In order to be successful as a T-shaped Agile tester you will need a balance of the required technical skills, required soft skills and correct attitude. Good knowledge and skills options would be:

- ***Testing***: have a deep set of knowledge and skills across the testing domain
- ***Development***: business analysis, programming, technical writing, etc.
- ***Domain knowledge***: medical, insurance, banking, IoT, etc.
- ***Soft skills***: provide a positive impact on personal effectiveness and collaboration with others.



Discussing the skill set of T-shaped testers, we should also be aware of the proportions between 'horizontal' and 'vertical' aspects in the skill set. Depending on the work environment, the need in each family of skills will differ. Those who have very deep and narrow expertise in an area can become over-skilled, as employers don't tend to pay for skills they don't need. Those who have broader skills can feel the lack of expertise in their key discipline at some point and will need to catch up.

An alternative: The Test Specialist

However, there is an alternative to the career path of becoming a T-shaped tester: become a test specialist. A specialist is defined as a person who concentrates primarily on a particular subject or activity; a person that is highly skilled in a specific and restricted field. Following the concept of 'shaped' persons, a test specialist is an I-shaped person, which means that their skills are seen as being narrow but deep. A tester with a deep (vertical) expertise in one testing area and less knowledge and skills in other testing areas, let it be outside testing. Their expertise in that one testing area is much deeper than the expertise possessed by a T-shaped tester for the same testing area. However, in today's fast-pace world, this strategy has evident risks, such as if the area of specialization becomes outdates or unpopular.

As products are becoming more and more complex and integrated in an almost open environment, many so-called non-functional testing areas have become extremely challenging. These non-functional testing areas cannot just be done on the side, they require much specialized knowledge and skills, training and dedication. To some testers it may not be their piece of cake, or even too (technically) difficult to master. As a result, to still be able to test as an IT-industry non-functional characteristics, such as security, interoperability, performance and reliability, or other complex aspects, e.g., systems-of-systems, highly

specialized testers are needed. These specialists are typically full-time test professionals with in-depth knowledge and skills in one specific (non-functional) testing area only.

Also from a customer point of view that comes to us for a solution, the customer may sometimes come in the door with a problem that is to be addressed by a single specialist only. It doesn't need a team based solution. It is with these kind of problems or questions that the I-shaped specialist clearly has much added value.

So what are typical test specialists areas? The product portfolio of the International Software Testing Qualifications Board (ISTQB) identifies some testing topics that are generally considered to be areas where we would benefit from having test specialists. ISTQB clearly points us, in their specialist track, in the direction of non-functionals, e.g., security test specialist, usability test specialist and performance test specialist. These are valuable test specialists in the context as defined above. Based on its portfolio, ISTQB also considers test automation and mobile application testing to be specialist areas within testing. Interestingly today, these are almost like standard requirements for a tester. The fact that these were originally defined as specialist areas by ISTQB, perhaps shows how quickly the market changes. What is defined as a specialist area today, could well be a common requirement for knowledge and skills tomorrow. This also points out a danger for being an I-shaped test specialist. Today, there is a huge demand for security test specialists and perhaps slightly less for performance test specialists. However, this may change over time or the specialism gradually moves to become a generalized knowledge and skill area that is required for T-shaped testers. Usability testing is probably somewhere in that transition.

To summarize, test specialist are needed and have much added value. It certainly is an alternative from being a T-shaped tester. Be careful which specialism to choose and keep an eye out for what is happening in the market today and the near future. Sometimes is it possible to hop from one test specialism to a new one when the current one become obsolete. At the same time, is doesn't hurt to also have some knowledge and skills that typically belong to the T-shaped tester as a fall back scenario. The latter will also be beneficial when working less stand-alone and being part a team. It will again also help to appreciate what others are doing and assist in looking at things from a different perspective.

Correct Attitude

Moving back to the core topic of this e-book, what is the correct attitude and are the required knowledge and skills for a T-shaped tester? We will start by looking at the correct attitude and thereafter the various knowledge and skill types distinguished earlier, will be discussed.

In psychology, attitude refers to a set of emotions, beliefs, and behaviors toward a particular object, person, thing, or event. Simply speaking it is a settled way of thinking or feeling about something. Attitudes are often the result of experience or upbringing, and they can have a powerful influence over behavior. While attitudes are enduring, they can also change. However, changing an attitude is like changing the characteristics of a person. Whereas (soft) skills are trainable, changing ones attitude means changing ones behavior. This involves a long term commitment and is certainly not an easy thing to do. This is also explains the statement "Recruit for attitude, Train for excellence". It is difficult to change people's intrinsic

personalities and ways of thinking, so it is important to get the right selection of people for your organization or team. People with the correct attitude can be trained to enhance their knowledge and skills. This is typically is a much easier and a more effective activity than changing the attitude and characteristics of a person.

Testers might have special expertise and experience in testing, but a good T-shaped tester isn't afraid to jump into a design discussion with suggestions that will help testability or create a more elegant solution. Creativity, openness to ideas, willingness to take on any task or role, focus on the customer, and a constant view of the big picture are just some components of the T-shaped mindset. A T-shaped attitude is one that is results-oriented, craftsman-like, collaborative, eager to learn, and passionate about delivering business value in a timely manner. T-shaped testers are customer-focused and solve the problem till the end.

Attitude is about what drives a person, why does someone wants to become a T-shaped tester and part of an Agile team. The T-shaped tester is not only defined by what knowledge and skills are required. It's also about having an attitude being empathic to other, to actively use and apply their horizontal knowledge and skills, and not sticking to the 'safe' core vertical primary expertise. Having the correct attitude is what makes the difference.

Figure 6: Attitude elements for a T-shaped tester

The correct attitude for a T-shaped tester covers a wide and varying range of partly overlapping characteristics that also strengthen each other (see figure 6). There is no definite or complete list, other authors will use different terms or focus of different characteristics. However, reading and studying the ones below, should provide the reader with a good understanding of the attitude expected from a T-shaped tester.

- *Team player*
  Being part of an Agile team, one always need a team effort to achieve something. A T-shaped tester motivates the team towards better testing and good levels of product quality. To achieve quality software, it is important for a T-shaped tester to be a good team player. They are committed to helping the team deliver quality products. They are willing to train others in areas where they may not be confident. T-shaped persons enjoy pairing up with another team member to perform a task and are highly collaborative. They understand that it's about the success of the team, not individual success or heroic

behavior. It is more important for the team to succeed than for the individual to have completed their tasks. Being prepared to move outside of your comfort zone in order to help on a particular task for the overall good of the team is a valuable trait.

- *Knowledge sharing*
  A T-shaped tester should have an attitude of helping and coaching other Agile team members by sharing his knowledge. Not only will this avoid gaps and confusion, it allows them to assist in and do better testing themselves, but also motivates other team members to share their expertise and knowledge.

- *Positive attitude*
  There are always challenges on projects; people are human and make mistakes, and everything is not always going according the plan. What is most important is how team members deal with these situations. As issues are identified, they need to be dealt with in a timely manner with a positive attitude. Do you speak in terms of what is wrong, or in terms of how can we move forward? T-shaped persons enjoy their work and come up with suggestions for solutions.

- *Eager to learn*
  If you're eager to learn, and willing to take on any activities outside your comfort zone needed to help the team deliver a quality product, you have a bright future as a tester. This is also about being flexible and 'constantly' looking for new challenges. As a T-shaped tester one should try to learn as much as possible about the product in order to deliver a quality product - you should not make assumptions that what you are doing is best for the customer. We are often challenged to think outside the box to get tasks done within the tight timeframes of an iteration. It is crucial for the tester to be aware of the latest IT trends, tools and technologies and to keep learning. (Remember the Y-shaped wider perspective!) When you have knowledge about the latest tools and technologies, you make better decisions. Participation in meet-up groups and reading technical articles are good sources of new ideas.

  Note that eager to learn and willingness to take on activities outside ones comfort zone also implies that you are ok with failing now and then. Some people say that the best way to learn is to fail at something. You do not hide the failure and feel empowered to talk about this failure so that also others may learn from it. This in turn relates back to the characteristic of knowledge sharing.

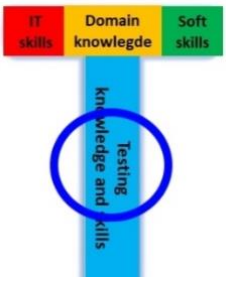
- *Craftsmanship*
  Craftsmanship is the quality that comes from creating with passion and care. It is a quality that is honed, refined, and practiced over the course of a career. It's about having focus and being passionate on delivering the best possible products. In combination with the previous characteristic, there is also mindset that includes the quest to learn and leveraging what has been learned to continuously improve and getting better in developing great products.

- *Results-oriented*
  Simply put, a results-oriented person is focused on the end-result of any task assigned, rather than the process. Being results-oriented means getting the job done. This implies

that the person understands what end-result is expected by stakeholders, as such it includes being passionate about delivering business value and customer satisfaction. (Again, remember the Y-shaped wider perspective!) The focus should be on the value to the business and customer, not on the software itself. Results-oriented people live by the Agile principles that working software is the core measure of progress and simplicity - the art of maximizing the amount of work not done - is essential.

- *Flexible*
  Flexibility is a personality trait that describes the extent to which a person can cope with changes in circumstances and think about problems and tasks in novel, creative ways. Flexibility on the job includes the willingness and ability to respond to these changing circumstances and expectations readily. Persons with an orientation towards flexibility never say, "It's not my job" or "Do I have to?" when they are asked to take on a new assignment. Flexible persons modify their approach to tasks based on the preferences of stakeholders and the unique demands of each situation. Flexible persons take on more responsibilities, do different tasks, and have more to offer than persons who can only do one or two tasks. Flexible people are willing to do whatever is necessary to get the task accomplished (i.e. they are results-oriented). Some say that being flexible also means these people are more pragmatic than others.

Deep: Testing Knowledge and Skills



Now that we have achieved a common understanding regarding the correct attitude for a T-shaped tester, we will move to discussing the required knowledge and skills. Hereafter the key four knowledge and skill areas identified earlier for the T-shaped tester are elaborated upon with examples, starting with the required testing knowledge and skills.

Today's tester needs to have acquired a full toolbox with varying testing methods and techniques that they can draw upon. Working in a team, depending on the context and charter, the most appropriate methods and techniques shall be selected from the toolbox. Trying to define the toolbox for the tester, and thus the required set of testing knowledge and skills, the ISTQB product portfolio[2] can easily be used as a reference model. Although there is much criticism on ISTQB in some testing communities, from a content point-of-view there is without doubt much interesting material available across many areas of testing documented in the various ISTQB syllabi. Contrary what some still believe, ISTQB today is much more than the basic ISTQB foundation level syllabus.

Taking the ISTQB product portfolio as a starting point, many interesting topics and syllabi are available. Trying to define the required testing knowledge and skills, it is at least strange to observe that ISTQB does not consider Agile testing to be a part of the core knowledge and skills. It is defined within the portfolio as a separate stream. Test automation and mobile application testing are by ISTQB considered to be a specialist areas within the testing domain. However today, these are almost like standard requirements for a tester. As already stated,

2 see www.istqb.org for the latest version of the portfolio

the fact that these were originally defined as specialist areas by ISTQB, probably shows how quickly the market changes.

The picture hereafter (figure 7) is by no means intended to be complete, or based on some extensive survey or study. It is intended to show on a high-level what is expected today from a professional tester in terms of testing knowledge and skills.

Having attended an ISTQB Foundations in Software Testing course (and having passed the exam) and subsequently stating you are a professional tester ready for the future, is almost like a joke. An ISTQB foundation course teaches the basics and principles of testing only, and although of importance, this doesn't get the job done. Nowadays, one at least also needs to be trained in Agile testing. However, the real meat is in attending more advanced hands-on, practical courses and workshops which focus on how to apply the testing practices in context. These advanced hands-on courses should include areas such as test automation and mobile application testing and be taught from an Agile perspective. Following the T-shaped concept, and requiring a deep knowledge in testing, testers are not expected anymore to choose between follow-up areas such as test manager, test analyst or technical test analyst. Testers are expected to cover all three areas to become a true test professionals. Most testers today are embedded in an Agile team, as such they perform typical testing tasks, but also coach and support business analysts doing functional user story based testing and developers doing automated unit testing. Being a tester in an Agile team also means you are heavily involved in tasks that were originally in the exclusive domain of the test manager, e.g., product risk sessions, estimations, retrospectives, reporting, etc.

Note there are many other means of acquiring the testing knowledge and skills, ISTQB is just one option and used here as an example only. There are often great (hands-on) tutorials at testing conferences that discuss interesting topics and areas, and of course alternatives exist to doing formal training as well, e.g., mentoring, on-the-job learning, etc. In some Agile organizations a test guild has been established. These test guilds sometimes organize a weekly stand-up for testers only, where testers from various teams share their experiences. Another good practice is a monthly knowledge sharing meeting, where a tester presents and shares practical experiences in detail on a specific topic, e.g., on product risk analyses, applying a test design technique, the application a new test tool, etc.

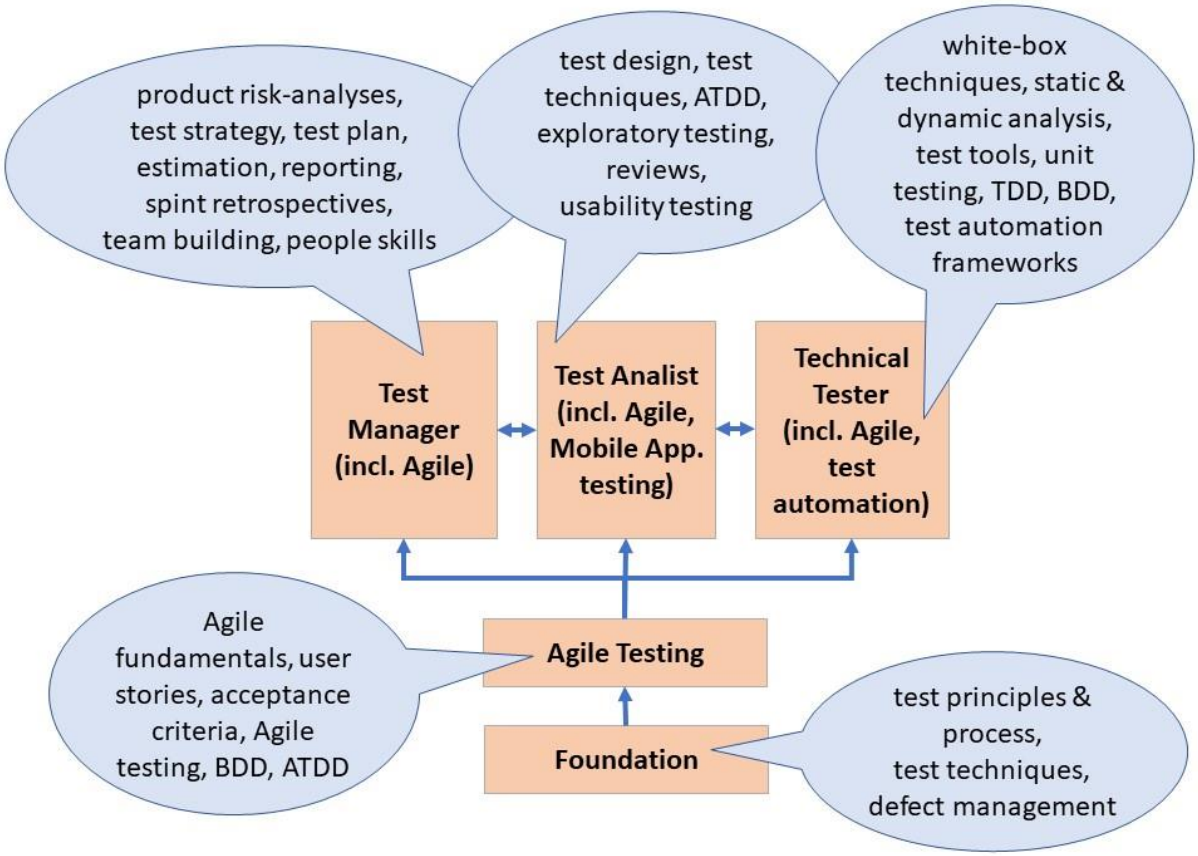


Figure 7: Tester knowledge and skills set (ISTQB based)

Context-driven Testing

Coming back to the concept of the tester's toolbox mentioned earlier, the ISTQB portfolio can be used to fill the toolbox. But following these testing processes, techniques, methods and tools without considering the context is not what should done to achieve effective and efficient testing. Testers should also have the experience, knowledge and skills to select depending on the context and charter, the most appropriate methods and techniques from the toolbox. This is an essential skill for a T-shaped tester, who is expected to coach and support the team defining the most appropriate test approach to get the job done. As such, a T-shaped tester should not only look at the ISTQB portfolio and its practices, but is expected to have a wider view.

The T-shaped should also be familiar with the approach represented by the context driven school of testing [Kaner]. Every project has different circumstances, e.g., documented vs. undocumented requirements, closely working vs. geographically distributed teams, sufficient time vs. tight deadlines, process followed (agile vs. traditional), etc. Context-driven testing is when you let these circumstances decide your test practices, techniques and sometimes even definitions rather than standard, industry-perceived 'best practices'.

Context-driven testing is developed around 7 basic principles. The two most important ones in the context of this e-book are:

- The value of any practice depends on its context.
- There are good practices in context, but there are no best practices.

The imperative factor which is the value of a particular project is highly dependent on the related context. Context driven testing means making the circumstances (not the standards) the primary inputs and influencers for your test approach and strategy. It urges the tester to look around and take 'everything' into account. Testers subsequently select their test objectives, methods, techniques, and documentation based on the particulars of the specific situation. The thing that should be kept in mind, good practices only exist in context, there are no best ones. Good context driven testing is not an easy job; it is rather a very challenging and intellectual practice. During a project, judgement and prowess are the keys and by exercising these together throughout a project, effective testing of the products can be achieved. Context-driven testing compliments ISTQB practices and vice versa. Both are part of the required testing knowledge and skill set for a T-shaped tester.

Not just the tester!

There will most likely still be professional testers in the future, but even more so testing as an activity will remain to be extremely important and challenging. Not only the tester performs testing tasks, also other team members, e.g., developers and business analysts, will perform testing tasks especially as a result of the Agile transformation. Testing is no longer just a role, but rather is has become an activity to be performed by the whole Agile team. Following the T-shaped concept, the tester is expected to have deep knowledge and skills in testing, but from other team members it is expected that they acquire testing knowledge and skills as part of their horizontal skill set bar (see figure 8). The test professional cannot just direct other people to perform testing tasks, they need to be trained and coached in testing to be able to perform these tasks. Remember what Glenford Myers already stated in his founding software testing book The Art of Software Testing: "Testing is an extremely complex and intellectually challenging task" [Myers]. Interestingly this principle is re-used by the context driven school of testing as one of their 7 basic principles re-stating "Good software testing is a challenging intellectual process" [Kaner].

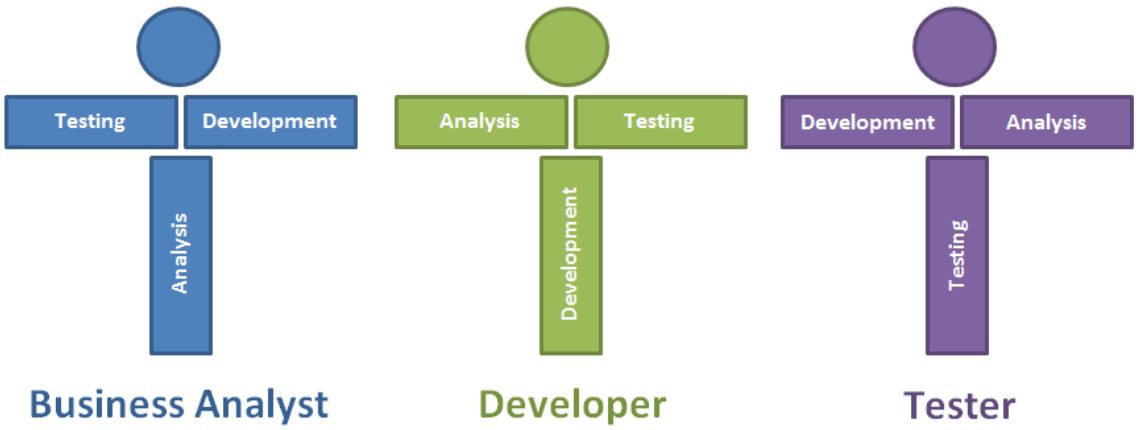
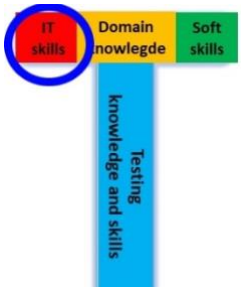


Figure 8: T-shaped Agile team

Broad: IT Knowledge and Skills



Working in a cross-functional team, closely with developers and business analysts, implies that a tester at least needs to appreciate and understand what other team members are doing and is preferably also able to support them in their tasks. It is typically expected that a T-shaped tester can support a software developer with unit testing, e.g., review unit tests, and a business analyst with requirements engineering, e.g., defining acceptance criteria for user stories. It is also expected that they thoroughly understand the life cycle model that is being used, and the technical environment in which development takes place.

IT knowledge and skills for a T-shaped tester covers a wide and varying range of which some essential examples are listed and hereafter:

- *Requirements Engineering / Business Analysis*
  Testers are of course one of the main requirements stakeholders. Test planning, product risk analysis, test cases are all based upon requirements. Tester are involved in requirements reviews, and need to understand what level of requirements quality is reasonable is ask for. Often in Agile teams, testers support the identification and specification of requirements (user stories) and their acceptance criteria.

- *Programming*
  It isn't that testers need to work like a developer, but it is important to understand the inside of the application so that it becomes easy to comprehend its functioning and risks areas, and create tests accordingly. Programming knowledge helps in identifying possible errors in the code and work closely with the developer on static analysis and unit testing possibly using Test Driven Development. It is advisable for a tester to learn at least two programming languages, e.g., Python, Java or C++. Of course having programming skills also strongly supports the ability to perform test automation tasks. With the increasing complexities and integrations in the applications, relying on manual testing alone very often doesn't get the job done (anymore).

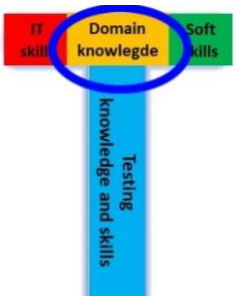
- *Web and Mobile technologies*
  Testers must also be familiar with web and mobile technologies so that they can understand the application, its built and scalability, and apply a suitable course of actions for its testing. It is highly important that testers keep an eye open on web and mobile technology advancements since it guides them in comprehending the coding architecture and technical challenges to deliver effective testing solutions.

- *Software development lifecycle*
  Testers need to learn and understand the software lifecycle as it will help them understand the development tasks and plan testing activities and cycles accordingly. Having an in-depth knowledge of the lifecycle will also help anticipate challenges in the development process which can guide in taking the right measures beforehand. With Agile and DevOPS methodologies being popular, testers need to learn and understand both of them, especially the impact this has on how testing is performed.

- *Project management*
  Learning the skills of project management will support the tester in becoming a better test manager. Project management skills also prepare testers to be accountable and answerable for their work to concerned stakeholders, and also undertake responsibility and management for specific test activities. In this way, project management skills contribute to delivering quality results, improving the entire test process. Note that within Agile teams, a tester most often performs tasks that traditionally belonged exclusively to a dedicated test manager.

- *Configuration management*
  The purpose of configuration management is to establish and maintain the integrity of the component or system, the testware, and their relationships to one another. For the tester this an important process to ensure quality and as such it is essential to have some knowledge on configuration management. In addition also testware needs to be managed via this process. All items of testware should be uniquely identified, version controlled, tracked for changes, related to each other and related to versions of the requirements and software so that traceability can be maintained.

Broad: Domain Knowledge



In this context, domain knowledge is defined as knowledge about the work and office environment in which the target system will operate. For a tester, it's important to understand the domain in order to be able to communicate with business stakeholders (product owners), but also to make the right decisions while performing testing activities. Remember, exhaustive testing isn't possible, and testers are constantly making trade-off decisions. What features are most important to test, which configurations occur most often, etc.? Hence for a tester possessing domain knowledge along with the other knowledge and skills is a big plus. In the context of being a T-shaped tester, there are also benefits outside of testing. A tester with domain knowledge can much better support a business analyst, or assist other team members by bringing the necessary domain perspective.

Domain knowledge is undoubtedly a critical success factor for testers. When testing a system, it important to be able to think from an end-user perspective since they are the ones who are going to use the product. Domain knowledge typically includes user profiles, workflows, business processes, business policies and configurations. Without going into detail on how to acquire business and domain knowledge, there is again much more than just attending a training course, also consider apprenticing, observing users/customers actually using the system, visiting on-line forums and becoming part of communities.

Some examples where a tester will benefit from having domain knowledge include:

- *Better understanding risks and writing better test cases*
  Unless you are aware of the domain, you can't identify and analyze the product risks. Likewise you can't write and execute test cases to effectively simulate the end-user. It's

not just about using domain knowledge at a particular activity, it is required throughout all testing activities.

- *Better understanding impact*
  When an issue arises, a tester understanding the purpose of the functionality of the system will much better be able to analyze the impact of the issue. For example, when a defect is found in the on-line shopping payment process, a domain-based testers will have a clear idea about the process steps impacted needed for a successful transaction. This will assist the tester in doing better confirmation and regression testing when the defect is reported as being fixed.

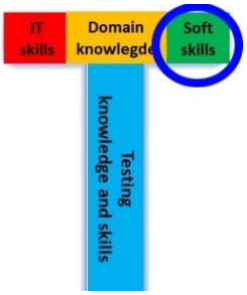
- *Finding more important defects*
  Domain knowledge testers are high in demand due to their ability to understand the system beyond just finding defects, e.g., during exploratory testing. They typically find more defects that matter.

- *Being able to prioritize defects better*
  A tester that understands the domain, will have a clear idea on how to best prioritize the outstanding set of defect fixes and confirmation tests.

- *Being able to review more effectively.*
  A tester with domain knowledge is more productive at the start of the project or iteration. Good knowledge of the functional flow of the business processes and business rules, will ensure a better understanding of the requirements and as a consequence being able to perform reviews more effectively.

Note, there seems to be a strong tendency to prefer technical testers over domain based testers in the Agile community, but as we have learned in this paragraph there is also a strong need and benefit to having testers with domain knowledge and even with domain background, e.g., end-users that pursue a career in testing. As always there is never is a right answer in these kind of situations, but it is something that needs to considered and balanced when assigning testers to a team and defining a required knowledge and skill set for the T-shaped tester.

Broad: Soft Skills



Any T-shaped tester working in an Agile team should also possess so-called good soft skills (also known as interpersonal skills or people skills). Soft skills relate to attitudes and intuitions. The difference being that where soft skills are trainable, changing an attitude is like changing the characteristics of a person.

Testers should have an instinct and understanding for where and how software might fail, and how to find defects. A tester should also have the soft skills to influence and communicate, a sometimes difficult message, in a manner that they become vital to the project. Thus for a tester, two types of soft skills can be distinguished:

- those that influence the ability to find defects, e.g., critical thinking skills

- those that influence their ability to communicate more effectively, e.g., reporting and presentation skills.

Hereafter, some of the important soft skills which testers should possess in order to excel in their field are listed:

- *Communication*
  Since a tester has to deal with so many different team members, it is very important to have a proper communication channel with them. Whether it is a defect to report, explanation or clarification of an ambiguous requirement, a tester has to communicate with respective business analysts, developers and sometimes end-users. When you have good communication skills, you eliminate ambiguity and misunderstanding while talking to the different team members. Also, most of the issues which arise due to a communication gap would be at par. For example, when you find a crucial defect, it is very important to explain it in a polite neutral way so that developer doesn't feel like you are blaming him for the root cause.

  There are four main types of communication professional testers should use on an almost daily basis: verbal, non-verbal, written and visual.

  - *Verbal communication* is the use of language to transfer information through speaking. It is the most common type of communication, often used during presentations, video conferences and phone calls, meetings and one-on-one conversations. Verbal communication is important because it is efficient. It can be helpful to support verbal communication with both non-verbal and written communication.

  - *Non-verbal communication* is the use of body language, gestures and facial expressions to convey information to others. It can be used both intentionally and unintentionally. For example, you might smile unintentionally when you hear a pleasing or enjoyable idea or piece of information. Non-verbal communication is also helpful when trying to understand others' thoughts and feelings. If a person is displaying 'closed' body language, such as crossed arms or hunched shoulders, it comes across as feeling anxious or angry. If a person is displaying 'open' body language with arms by their side or on the table, it comes across more positively and open to information.

  - *Written communication* is the act of writing, typing or printing symbols like letters and numbers to convey information. It is helpful because it provides a record of information for reference. Writing is commonly used to share information through reports, memos and more. Emails and chats are other common form of written communication in the workplace.

  - *Visual communication* is the act of using photos, sketches, charts and graphs to convey information. Visuals are often used as an aid during presentations to provide helpful context alongside written and/or verbal communication. Because people have different learning styles, visual communication might be more helpful for some to consume ideas and information.

- *Time management*
  Time management is a very important skill for a tester, also in Agile the last days on an iteration are often packed with 'stress full' last minute testing. When you know how to use your time properly and how to prioritize tasks according to the end date, you will end up meeting the end dates more easily and encounter less work pressure. Time management directly relates to being better able to perform testing tasks, and as a consequence indirectly being able to find more defects.

- *Analytical and detail oriented*
  This is one of the skills which can help a tester to find more and the most important defects. When you understand and are able to analyze requirements, not only gaps in the requirements can be found and fixed but also you get to know the whole functionality, flow, and the expected outcome of the product. Sometimes details are missed that later result in a major issue which are much more difficult to rework. To mitigate such situation it is also very important to have a good reading and analytical skills and as a result know how to focus on details. An interesting review skill for a tester is perspective based reading.

- *Critical thinking*
  Critical thinking is the kind of thinking that specifically looks for problems and mistakes. It is the ability to reason by carefully analyzing something in order to determine its validity or accuracy. Critical thinking is about being an active learner rather than a passive recipient of information. It is possibly the most important type of thinking in the context of testing. As testers, we should always question ideas and assumptions rather than accept them at face value. Critically-thinking testers save projects from dangerous assumptions and ultimately from disasters. Critical thinking is learnable and improvable soft skill one can master. Today there are many courses and conference tutorials available that focus on critical thinking skills for testers.

Conclusions

With the current state-of-the-practice of the IT industry, we are far from achieving zero defects. Software testing is and will, at least for the time to come, remain an indispensable part of software development. Throughout this e-book the correct attitude and required knowledge and skills of the test professional were presented. In detail the T-shaped tester was introduced and explained. In practice many claim to be a T-shaped tester, but I believe in reality most testers are far from being a true T-shaped tester. Testers shall acquire the correct attitude and broaden their knowledge and skills and become a true test professional (T-shaped tester), ready for the future.

As a T-shaped tester, one gets the benefits of specialization and generalization, while avoiding the pitfalls of being only a specialist or generalist. A T-shaped tester is better at collaborating with others and more attractive to employers. Working toward the correct attitude and building a T-shaped set of knowledge and skills is one of the most valuable things one can do for ones future career and personal development.

For testers driving their career, it is extremely important to define ones individual direction of growth and development. Not forgetting the T-shaped concept, base your choice on your own strengths and passions, and take into account your work environment (lifecycle, domain), trends in the industry and the current (and future) demands of the job market. In addition, review your career plan on a regular basis will help you to stay on top, and get the best value out of the work you do.

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Since its foundation in 2002, Erik has been strongly involved in the International Software Testing Qualifications Board (ISTQB). From 2005 to 2009, he was the vice-president of the ISTQB organization; living in Bonaire, today he is the president for the Curaçao Testing Qualifications Board (CTQB).

Erik one of the core developers of the TMap test methodology and the TMMi test improvement model, and currently the CEO of the TMMi Foundation. For his major contribution to the field of testing, Erik received the European Testing Excellence Award (2007) and the ISTQB International Testing Excellence Award (2015). You can follow Erik on twitter via @ErikvVeenendaal.

Figure 9: Popular books by Erik van Veenendaal

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