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## Emerging Horizons: Green IT and the Metaverse

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**The Metaverse and its place in the real world**

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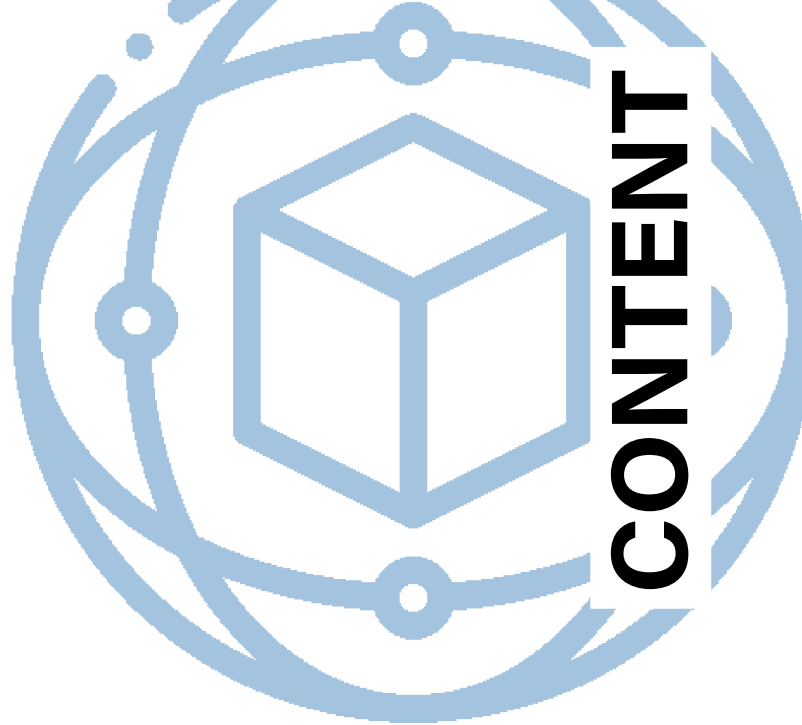
Dear reader,

New technologies have the power to disrupt industries, grow economies, and safeguard the planet. In 2023, we are highlighting two of the most captivating emerging technologies: the domain of Cleantech innovation and the intriguing subject of the Metaverse and its integration into the real world.

Our authors examine these pressing matters in depth, providing authentic insights into the key areas including generative AI and the global imperative of green technologies. These discussions emphasize that whether we are dealing with advancements in software or venturing into the metaverse, the quality of the software solutions we create remains central to how we approach these challenges.

In this edition of the SQ-mag, you will find a wealth of knowledge and ideas designed to inform and guide you in navigating these complex territories. Together, we have the opportunity to strike a balance between innovation and environmental responsibility, with technology serving as a crucial tool in our digital future.

Yours sincerely



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# ARCHITECTING A SUSTAINABLE DIGITAL FUTURE

STRIKING THE BALANCE BETWEEN INNOVATION AND ENVIRONMENTAL RESPONSIBILITY

In this increasingly digital world, software has woven itself into the very fabric of our daily existence, from the convenience of our smartphones to the smart systems managing entire cities. However, during this digital revolution, there exists an often-underestimated factor - the energy consumption of software systems. This is where the pivotal role of software architects, the visionary designers of our technological landscape, becomes abundantly clear - they are the stewards of energy efficiency and sustainability in the digital realm.

Consider this startling revelation: A complex algorithm can consume up to 200 times more energy than a simpler counterpart, all while delivering comparable results. This plain reality underscores the profound environmental implications of intricate code and calls for a concerted effort to prioritize efficiency and simplicity, echoing the wisdom of Leonardo da Vinci who famously proclaimed, "Simplicity is the ultimate sophistication."

Imagine software development as a dance, where each line of code must strike the delicate balance between functionality and efficiency. However, there's a twist in this dance - every move consumes energy. And as algorithms grow in complexity, so does their voracious appetite for energy, leaving behind a substantial carbon footprint. To address this problem, we must embrace a paradigm shift, one that places efficiency and elegance at the core of our software design philosophy.

To address these challenges and lead the way in an era of improved software energy efficiency, a range of strategies is required. As we navigate this landscape, each strategy

becomes a powerful chess move in the grand game of optimizing software architecture for both efficiency and sustainability.

We could embrace the elegance of simplicity in algorithm design, championing the notion that the most sophisticated solutions are often the simplest ones. We should optimize our code with surgical precision, surgically removing resource inefficiencies. The result? Not only energy savings but also a boost in overall performance. Let's be discerning in our choice of hardware, opting for components that align with energy-efficient practices, thereby reducing the environmental impact of our software systems.



Enter stage left, edge computing, a technological marvel that not only conserves energy but also provides real-time responses. This real-time capability is the lifeblood of applications such as self-driving cars and the Internet of Things (IoT). By relocating computation closer to data sources, edge computing curtails energy-intensive data transfers and enhances the capabilities of artificial intelligence (AI) and machine learning.

But the ripple effect of edge computing transcends individual devices. It extends to the domain of infrastructure, yielding improved grid efficiency, fewer power outages, and reduced energy bills for households. In effect, it reshapes our digital landscape into a harmonious symphony with fewer disruptions and a more sustainable future.

As the architects of this digital tapestry, we bear a profound

***"they are the stewards  
of energy efficiency  
and sustainability in the  
digital realm"***

responsibility and a unique privilege - the power to shape a sustainable future. Every algorithm we create, every line of code we inscribe onto the digital canvas, leaves an indelible mark on this symphony. By considering Cleantech principles into the fabric of our software development, we embark on a collective journey towards a future that not only respects our environment but also fosters technological excellence.

***“we bear a profound responsibility and a unique privilege - the power to shape a sustainable future”***

In summary, at the crossroads where innovation and Cleantech ideals converge, we uncover the delicate equilibrium between software complexity and energy efficiency. It's a journey defined by thoughtful innovation, where each step resonates with the essence of Cleantech - an eloquent fusion of progress and conscientious environmental stewardship.

Our role in this epic narrative? We are not passive observers but active participants. By infusing Cleantech principles into your software development practices, we become a catalyst for change, contributing to the reduction of energy consumption and the mitigation of climate change. It's not merely coding; it's coding with a purpose-driven conscience. In this digital ballet of the future, we are the choreographers, shaping each line of code with an eye towards a sustainable and innovative tomorrow.



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*Beyond his professional pursuits, Zied is fueled by a passion for continuous learning and inspiring others to invest in increasing their value. He understands that growth and development are essential to staying at the forefront of the ever-evolving software industry. With an expansive skill set and an unrelenting pursuit of excellence, Zied continually shapes the future of software architecture, leaving an indelible impact through his transformative leadership and unwavering commitment to pushing the boundaries of what is deemed possible.*



# ISTQB® AND THE NEW CERTIFIED TESTER FOUNDATION LEVEL (4.0) CERTIFICATION

The International Software Testing Qualifications Board (ISTQB®) is the leading global certification scheme in the field of software testing. As of April 2023, ISTQB® has administered over 1.2 million examinations and issued more than 845,000 certifications in over 130 countries.

The ISTQB® was founded in 2002 and operates as a non-for-profit organization. It consists of Member Boards from various countries or regions, each representing the testing community in their respective location. Working groups, composed of volunteers from different Member Boards and led by a Chair and a Vice Chair, collaborate to define and maintain the ISTQB® syllabi, examinations and other certification related activities.

The primary goal of the ISTQB® is to establish a common language and a set of best practices for software testing professionals. It offers a multi-level certification scheme that allows individuals to demonstrate their knowledge and skills in testing. The certification levels include, Foundation Level, Advanced Level, Expert Level and Specialist Level.



The ISTQB® Certified Tester Foundation Level 4.0 (CTFL 4.0) certification is the entry-level certification and demonstrates a basic understanding of software testing principles, techniques and terminology. The CTFL certification is recognized as a prerequisite to all other ISTQB® certifications where Foundation Level is required. The Advanced Level certifications delve deeper into specific areas of testing, such as Test Manager, Test Analyst and Technical Test Analyst. Expert Level certification focuses on advanced testing topics such as Assessing Test Processes and Strategic Test Management. The Specialist Level provides certification in specific types of testing and includes areas such as AI Testing, Test Automation Engineer and Performance Testing.

By obtaining ISTQB® certifications, software testing professionals can enhance their career prospects, gain industry recognition and demonstrate their expertise in all aspects of software testing. The ISTQB®'s certifications are recognised and respected in the software testing community around the world and many organization's consider them to be a valuable asset when hiring or promoting software testing professionals.

On the 9 th of May 2023, an important update to the Certified Tester Foundation

Level (CTFL 4.0), was widely publicized throughout the ISTQB® community, and it is expected to become the new global standard in the field. This will ultimately replace the previous version (CTFL 3.1) which was released in 2019, although CTFL 3.1 training and examinations will still be available until the 9 th of May 2024 (in English) and the 9 th of November 2024 (in other languages). The ISTQB®'s Vice President, Olivier Denoo, said; “The new syllabus is so much more than a simple update or a pooling of existing notions from the previous ISTQB® Foundation and Agile syllabuses, the new CTFL 4.0 syllabus is a total and deep redesign, integrating the most recent Agile concepts, together with the timeless basics from the art of software testing, but also some of the newest approaches preparing for the testing of tomorrow.”

### So, what is new in CTFL 4.0?

At the highest level, the ISTQB® Certified Tester Foundation Level Syllabus 3.1 explains the terminology and concepts used worldwide in the testing domain. It is more focused on understanding the key principles and fundamentals of software testing. It also places greater emphasis on practical applications of testing techniques. The CTFL 4.0 syllabus retains that high level knowledge but also includes significant changes from its predecessor, the CTFL 3.1, with the addition of Agile testing and a more extensive focus on risk-based testing.

Furthermore, CTFL 4.0 introduces techniques to better evaluate quality control efforts, define quality gates, and write and execute acceptance tests. Testing is no longer just a dedicated function, but a role with quality-related activities that any team member can undertake.

The addition of Agile testing is considered to be important because research has shown that 79% of all organizations are using Agile principles in their testing. The updated CTFL 4.0 syllabus highlights the importance of close collaboration with other stakeholders, introduces techniques to better estimate the effort required to control quality, and defines quality gates such as DoR, DoD, and Acceptance Criteria. The syllabus exemplifies different techniques to write and execute acceptance tests, switching testing from a dedicated function to a role with a set of quality-related activities that can be undertaken by any member of the team.

CTFL 4.0 should not be seen as a “merge” of CTFL 3.1 and the CTFL-Agile Tester certifications. It is a fully rewritten syllabus, based on certain concepts of both syllabi, but extended with new learning objectives. In detail, the ISTQB® Certified Tester Foundation Level Syllabus 4.0 is split into six chapters;



- Fundamentals of Testing
- Testing Throughout the SDLC
- Static Testing
- Test Analysis and Design
- Managing the Test Activities
- Testing Tools

Each of these chapters contains a number of topics as shown in the table below.

The table also indicates new and updated material for CTFL 4.0: Chapter Topics What is new/updated from v3.1

Chapter	Topics	What is new/updated from v3.1
<b>Fundamentals of Testing</b>	What is Testing?	Other Objectives
	Why is Testing necessary?	Testing is an activity or role
	Testing Principles	Changed Skillset
	Test Activities, Testware and Test Roles	Whole Team Approach
	Essential Skills and Good Practices in Testing	
<b>Testing Throughout the SDLC</b>	Testing in the context of an SDLC	Impact of different SDLCs
	Test Levels and Test Types	Test First Approach
	Maintenance Testing	DevOps
		Shift Left Approach
		Retrospectives
<b>Static Testing</b>	Static Testing Basics	Frequent Feedback Mechanism
	Feedback and Reviews Process	Avoid instead of detect
<b>Test Analysis and Design</b>	Test Techniques Overview	Branch Testing
	Black-box Test Techniques	Checklist-based Testing
	White-box Test Techniques	Writing User Stories
	Experience-based Techniques	Writing Acceptance Criteria
	Collaboration-based Approaches	Using ATDD
<b>Managing the Test Activities</b>	Test Planning	Release Planning
	Risk Management	Iteration Planning
	Test Monitoring, Test Control and Test Completion	Estimation Techniques
	Configuration Management	Test Pyramid
	Defect Management	Testing Quadrants
<b>Testing Tools</b>	Tool Support for Testing	DevOps Tools
	Benefits and Risks of Test Automation	Collaboration Tools

The ISTQB® Certified Tester Foundation Level Syllabus 4.0 retains its study duration of 1135 minutes (equivalent to 18 hours and 55 minutes). The examination consists of 40 questions to be completed in 60 minutes. Each question is worth 1 point, and a minimum of 26 points (65%) is required to pass and receive certification.

Successful holders of the Foundation Level certification have demonstrated that they should be able to achieve the following business outcomes (as defined in the syllabus):

- Understand what testing is and why it is beneficial
- Understand the fundamental concepts of software testing
- Identify the test approach and activities to be implemented depending on the context of testing
- Assess and improve the quality of documentation
- Increase the effectiveness and efficiency of testing
- Align the test process with the software development lifecycle
- Understand test management principles
- Write and communicate clear and understandable defect reports
- Understand the factors that influence the priorities and efforts related to testing
- Work as part of a cross-functional team
- Know risks and benefits related to test automation
- Identify essential skills required for testing
- Understand the importance of risk on testing
- Effectively report on test progress and quality

In summary, the new ISTQB® Certified Tester Foundation Level 4.0 (CTFL 4.0) certification is the cornerstone of essential testing knowledge that can be applied to real-world scenarios. The syllabus provides a comprehensive understanding of the terminology and concepts used in the testing domain worldwide, making it relevant for all software delivery approaches and practices, including Waterfall, Agile, DevOps, and Continuous Delivery.

**Simon Frankish**  
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*Simon has over 30 years' experience in the software testing industry and is currently Experimentus' Practice*

*Lead for Process Improvement. He is an experienced, accredited TMMi Lead Assessor who has worked worldwide to help organizations improve their testing processes. More recently, sustainability in software testing has become a strong interest and Simon is working to help organizations to look at process improvement through a carbon lens.*



# HOW CAN TESTERS BENEFIT FROM USING CHATGPT?

**All software, including ChatGPT, requires testing before being deployed to production.**



## What's ChatGPT and why AI technologies look threatening to engineers?

ChatGPT, an acronym for Chat Generative Pre-trained Transformer, is a chatbot developed by OpenAI. It was released in beta version to the public on November 30, 2022. At first glance, it may seem like an exceptionally intelligent automation tool capable of solving numerous problems. However, upon closer examination it may not be so. We explore the challenges and why ChatGPT is far from being a magical solution.

To begin with, various sources have highlighted limitations, and users who have experimented with different versions of ChatGPT have noticed them too.

- ChatGPT has limited knowledge of events that have taken place after September 2021 - so if you ask it to tell a story from the recent past or analyze specific events or data from this period, this may be an issue;
- ChatGPT sometimes writes plausible-sounding but incorrect or nonsensical answers - ChatGPT occasionally generates responses that sound plausible but are incorrect or nonsensical.

This behavior is common among large language models and is referred to as hallucination. Hallucination, also known as confabulation or delusion, refers to a confident response by an AI that does not appear to be justified by its training data. It means that sometimes users may receive fabricated data, but not the actual facts. There are a lot of examples, such as when ChatGPT was asked for proof that dinosaurs built a civilization, ChatGPT claimed there were fossil remains of dinosaur tools and stated, "Some species of dinosaurs even developed primitive forms of art, such as engravings on stones."

ChatGPT endeavors to decline prompts that might violate its content policy. However, presently, there remain certain vulnerabilities that users have managed to exploit, potentially leading to the generation of misleading or false information as per their intentions. This vulnerability persists, and engineers are diligently seeking the most effective solution to address this issue.

- Not all languages are supported by ChatGPT yet, the service works best with the English language for now.

However, as ChatGPT's popularity continues to soar, several successful features have been implemented to

enhance its utility:

**Basic Service:** This foundational offering allows users to engage in dialogues and receive answers to their queries. Powered by advanced machine learning algorithms, this highly capable chatbot processes immeasurable amounts of data to generate responses. It comprehends both spoken and written human language, enabling it to grasp incoming information and provide relevant responses.

**ChatGPT Plus Premium Service:** Users opting for the premium service gain access to the latest versions and updates, along with perks such as uninterrupted service during peak periods, priority access to new features, and faster response times. In July 2023, OpenAI expanded the offering by making its proprietary Code Interpreter plugin available to all ChatGPT Plus subscribers. This Interpreter offers a wide variety of functionalities, including data analysis, instant data formatting, personalized data scientist services, creative problem-solving, musical preference analysis, video editing, and seamless file upload/download with image extraction.

**Mobile App Launch:** In May 2023, OpenAI launched the ChatGPT mobile app for iOS users, extending its accessibility. An Android version of the app has been rolled out to select countries initially, with plans for further expansion in the near future.

ChatGPT can:

- Answer questions
- Solve math equations
- Translate between languages
- Debug and fix code
- Write a story/poem
- Classify things

Sounds scary from an engineering perspective, doesn't it? Let's try to understand if our fear is justified. Is it truly feasible for AI to completely replace the entire manual QA process and a significant portion of automation QA tasks?

Lately, there has been increasing chatter about ChatGPT and its potential to displace various engineering roles, particularly QA Engineers. However, it's essential to refrain from being too discouraging about AI. It appears unlikely that ChatGPT can entirely supplant all testing efforts or significantly reduce the need for manual and automation QA work. The notion that emerging technologies and a new generation of skilled workers will render current jobs obsolete is far from new. As an example, the term "Luddite" traces its origins back to a movement of 19th-century textile workers in England

who opposed textile machinery, fearing it would devalue their highly specialized craftsmanship.

In the realm of software testing, similar concerns arose over a decade ago when marketers touted test execution automation as a “silver bullet” promising improved testing efficiency. It was believed that this automation would significantly reduce testing budgets and the human effort required to accomplish project goals.

Upon analyzing the aforementioned limitations, it becomes evident that the responses generated by ChatGPT for user queries may not always be 100% efficient. Therefore, it is imperative we review the provided results, make necessary adjustments, and update queries as required.

Furthermore, it is important to acknowledge that ChatGPT may not comprehensively cover all topics and queries due to its inherent limitations. In essence, human intervention is essential to pose the right questions to ChatGPT and to review its responses. The process of proofreading demands knowledgeable individuals, and rather than replacing productivity, it serves to enhance it.

It can certainly enhance current manual procedures and assist Software Development Engineers in Test (SDETs) and Automation Quality Analysts (AQAs) in achieving more. However, it's crucial to understand that automation can never replace human involvement; it can only streamline and expedite our tasks, making them more efficient.

The positive outcome of automation is that it accelerates individual processes for Quality Assurance (QA) teams and various components of the Software Development Life Cycle (SDLC), including design and development. These individual enhancements ultimately result in swifter software delivery, allowing for changes of greater functional complexity and logical intricacy. Consequently, this leaves less time for comprehensive testing, which is where new tools could potentially play a significant role.

### **How can you effectively harness the power of ChatGPT in your testing processes?**

Both manual and automated testers stand to gain significant advantages from utilizing such robust tools, provided they are willing to invest time and effort in learning how to leverage them effectively. It is strongly recommended for test leads and test managers to allocate some time for piloting and experimenting with

ChatGPT. The benefits include process enhancement and the improved quality and efficiency of software products.

Here are some evident ways to make the most of ChatGPT for your testing needs:

**Test Documentation Generation:** ChatGPT can be employed to create initial drafts of various test-related documents, including Test Strategies, Test Policies, Test Scenarios, and more. By asking precise and targeted questions, you can obtain more meaningful answers, reducing the need for extensive post-generation revisions before finalizing your documents.

**Documentation Validation:** Testers can enlist ChatGPT's help in reviewing and enhancing provided documentation, such as user manuals, guides, and help documents. ChatGPT can assist in aligning the documentation with the software's features and functionalities, ensuring accuracy and clarity.

**Complex Scenario Simulation:** ChatGPT can be tasked with simulating intricate scenarios that might be challenging to replicate manually. These scenarios may involve conditions that are not easily triggered, and ChatGPT can provide valuable feedback based on these simulations.

**Diverse Testing Types:** ChatGPT can also be used for various testing types, including usability, load, and performance testing. By emulating desired user interactions, it can provide feedback on how the software performs under different conditions, aiding in identifying potential issues.

**Automated Scenario Generation:** Automation Quality Analysts (AQAs) can leverage ChatGPT to request the coding of specific scenarios using their preferred programming language. This automation streamlines scenario generation, improving efficiency and accuracy in testing processes.

It's essential to reiterate that ChatGPT is a valuable tool for testers across various roles. However, it's crucial to use it in conjunction with traditional testing methods and human judgment. Any content generated by AI should undergo a thorough review and refinement before being considered a final version for your future deliverables.

Furthermore, it's important to recognize that ChatGPT cannot entirely replace the necessity for specialized testing techniques and methods. This includes tasks such as creating automated testing frameworks from scratch or conducting security assessments, which require expertise and the use of highly specialized tools handled by experts in the field.

**It's important not to take the use of ChatGPT too lightly, as every tool has its limitations.**

The future across various domains appears to carry certain risks. If people aren't replaced by AI, they may heavily rely on ChatGPT's feedback, potentially leading to issues or a reliance on AI for precision, as seen in the example of a judge in Pakistan using ChatGPT to decide a legal matter concerning a 13-year-old accused. However, this doesn't necessarily apply to engineering. In engineering, we may encounter individuals who become complacent and rely solely on tools, while others may use ChatGPT to enhance their productivity and deliver their best work.

In summary, it might seem that ChatGPT could tempt engineers to take shortcuts and spend less time on their work than initially estimated. But let's pause here and consider a crucial point: any attempts at cheating or cutting corners will eventually come to light, and ChatGPT itself could play a role in that. There are already tools available to detect AI-generated text, and we can expect more in the future. Therefore, the optimal way to leverage this tool is to streamline routine and mundane tasks, creating more room for professional growth and the art of testing.



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# The Metaverse and its place in the real world

**T**echnology in all areas is constantly evolving, though very few concepts have captivated imaginations quite like the metaverse. A decade ago, the term ‘metaverse’ would have been brushed off as a fantasy, from the pages of science fiction novels or the scenes of futuristic movies. Yet, as we navigate the huge technological advances of the 21st century, this once fictional idea has begun to cement itself as a transformative element in the real-world business landscape.

The rapid development of virtual and augmented reality technologies, combined with the leaps in computing power and internet speed, have provided an ideal environment for the growth of the metaverse. Boundaries that once separated the physical from the digital are gradually becoming more permeable, giving birth to a new, interconnected universe. This digital realm, where users from across the globe can congregate, interact and transact in real-time, is offering major opportunities to those organizations who are quick to adopt these technologies.

In the subsequent sections, we’ll dig deeper into the mechanisms of the metaverse, its many uses in the professional services and retail sectors, and the undeniable significance of software testing in this

new digital frontier. As we embark on this journey, it’s essential to understand that the metaverse isn’t just a technological advancement—it’s likely to be the next digital evolution. To truly comprehend its magnitude and potential, we must first look at the technologies driving it.

At its core, the metaverse is a fusion of augmented reality (AR), virtual reality (VR), and the vast expanse of the internet. Imagine a vast digital playground where users, represented through avatars, can interact, work, learn and shop. Unlike the two-dimensional interfaces we are accustomed to—such as websites or mobile applications—the metaverse offers a three-dimensional, immersive experience that transcends physical boundaries.

## The Rise of High-Quality Hardware: Paving the Path to Immersion

An essential contributor to the metaverse’s burgeoning reality is the influx of high-quality hardware designed explicitly for VR and AR experiences. This wasn’t always the case. Initially, VR was a niche market, often plagued with issues of latency and subpar visual quality, making it more of a gimmick than a mainstream tool.

One fundamental advancement propelling the metaverse out of the shadows and into the mainstream is the increase in refresh rates, driven by the rise in computing power and the improvement in visual quality.

The once-evident lag and stutter have given way to smooth, lifelike motions, making immersion in the metaverse more comfortable and intuitive. Furthermore, as these devices become mainstream and witness a surge in adoption, their price points will continue to decrease. This process should ensure that the metaverse is not just a playground for the elite but a domain accessible to many, which is fundamental to its success.

## The Professional Services Sector

For decades, the professional services sector has thrived on real-world interactions—meetings in sleek boardrooms, one-on-one client consultations, and intense brainstorming sessions around oak tables. However, in this digital age, a seismic transformation is underway, challenging conventions and redefining service paradigms.

Leading the pack in this transformative journey are some of the biggest names in the industry. The big four global accounting/consulting firms, with their vast resources and penchant for innovation, are diving deep into the metaverse, exploring its huge potential.

But it's not just the consulting and accounting giants who are eyeing the metaverse's promise. The Magic Circle, an elite group of law firms known for their extensive global footprints and sterling reputations, are also stepping into this digital landscape. Recognizing the myriad opportunities for client servicing, internal collaboration, office layout design, visualization of data, and even legal proceedings in the metaverse, these law firms are setting benchmarks for their peers, ushering in a new era for legal services.

Imagine entering a digital representation of your firm's headquarters, interacting with colleagues from around the world in real-time, accessing virtual documents, and even hosting meetings with clients—all within the confines of the metaverse. Leveraging the metaverse's capabilities, these entities are replicating their physical offices, fostering seamless communication, collaboration, and operational efficiency in a digital setting.

(As more and more industry giants venture into the metaverse, the line between traditional and digital service delivery is set to blur, heralding a new age for the sector.)

## Virtual Stores and Real Estate

Just as in real life (IRL), there are emerging opportunities to buy land or real estate in the metaverse, especially as interest and participation in the platform are set to soar. Buying space or land is literally purchasing virtual parcels of pixels where businesses can build digital shops, offices, showrooms, and more. This virtual land, governed by blockchain technologies in many instances, becomes the property of the purchaser, allowing them to develop and leverage it as they see fit, hopefully becoming a good investment.

Within the digital landscapes available from the different platforms, we're witnessing the birth of vibrant commercial ecosystems. Unlike traditional online platforms, the metaverse offers more life-like experiences. From walking into a virtual art gallery to attending digital conferences in constructed auditoriums, businesses have the opportunity to innovate and establish their brand in unprecedented ways.

(Brands like Sotheby's and Philipp Plein are revolutionizing luxury experiences in the metaverse. They're not just selling products; they're selling a digital lifestyle. Through virtual auctions, fashion shows, and immersive brand stories, the luxury and retail sectors are staking their claim in this new frontier. Samsung is the tech leader embracing the metaverse, having established a digital store and collaboration space in Decentraland, based on their New York City store, called 837X.)

## Software Testing and the Metaverse

The metaverse, as the next frontier of digital experiences, brings to the fore both immense opportunities and intricate challenges. As users, businesses, and industries delve deeper into these virtual worlds, the reliability of these spaces becomes paramount. This reliability, in large part, is upheld by rigorous software testing.

Functional Testing is at the very heart of this digital realm. In an environment where every interaction, transaction, or engagement is virtual, every feature must perform flawlessly. Be it a simple gesture like a handshake between avatars or complex operations like virtual real estate transactions, functional tests ensure the designed features work as intended. Without such scrutiny, the metaverse could be fraught with glitches and bugs, drastically hampering user experience and putting people off.

Compatibility Testing ensures this convergence is seamless. Whether a user accesses a virtual seminar

from a high-end VR headset or a budget smartphone, their experience should be consistent and glitch-free. Testing across diverse devices and platforms ensures that software or applications within the metaverse cater to a global and varied audience.

Security Testing is vital to protect this data and remove vulnerabilities before hackers find them. By proactively identifying vulnerabilities and potential breach points, security testing ensures that user trust isn't compromised and that the metaverse remains a safe space for both business and leisure.

Lastly, imagine a concert in the metaverse, featuring a global superstar, attracting millions of fans from across the globe. Such high-profile events demand impeccable performance.

Performance Testing steps in here, gauging the metaverse's readiness for such influxes. It ensures that at peak times, be it during a major event or a large-scale virtual conference, the metaverse remains operational, free from lags or crashes. The former Director of AI at Tesla said recently, 'the hottest new programming language is English,' which illustrates the point. Test automation is becoming more accessible, allowing easier and more natural object recognition and self-healing scripts, which will be able to support the rapidly changing digital ecosystem of the metaverse and its functions for multiple test phases. These automated tests are relevant in most test phases and are vital, behind-the-scenes activities that ensure the great promise of the metaverse is fulfilled.

## **Beyond Business:**

### **The Metaverse's Societal Impact**

The metaverse's reach extends far beyond the corporate boardrooms and virtual storefronts. As its tendrils spread, society at large is on the brink of experiencing profound changes in how we communicate, learn and even perceive reality.

### **A New Dimension of Social Interaction:**

Gone are the days when social media profiles and text chats were the leading edge of digital interaction. The metaverse offers a territory where people can congregate for shared experiences, much like the physical world but without geographical constraints. Concerts, festivals, educational seminars, or simple hangouts - these virtual gatherings can mimic real-world interactions, sometimes even amplifying them with unique digital-only features.

Revolutionizing Education: Traditional brick-and-

mortar educational institutions are being complemented, and in some cases even challenged, by virtual campuses. Here, students from across the globe can learn, collaborate on projects, and immerse themselves in experiential learning scenarios, all under a virtual roof. Imagine history lessons in a reconstructed ancient Rome or physics experiments that defy real-world limitations.

## **Empathy and Global Connectedness:**

The metaverse can play a vital role in fostering global understanding. By walking a mile in another person's shoes, quite literally through avatars and controlled experiences, users can gain first-hand insights into diverse cultures, challenges, and lifestyles. Such experiences can break down barriers, dispel myths and lead to a more empathetic global society.

## **Accessibility and Inclusivity:**

One of the most profound impacts of the metaverse might be the way it can promote inclusivity of experiences. Physical disabilities, socio-economic constraints, or even geographical distances often limit real-world experiences. The metaverse, with its ability to adapt and customize, can level the playing field, ensuring everyone gets a seat at the table, regardless of real-world limitations. However, it's crucial to tread with caution. Ensuring these spaces remain safe, inclusive and free from misuse is paramount. Once again, rigorous software testing and ethical considerations will play a key role in shaping this new frontier.

## **Conclusion**

The metaverse stands at the intersection of imagination and technology, a domain poised to redefine our perceptions of reality, commerce, social interaction and more. With its roots deeply embedded in virtual and augmented reality, 3D environments and the vast expanse of the internet, the metaverse is not just a new platform but a new way of being, of communicating and of conducting business.

But like all technological marvels, the metaverse is not without its challenges. As this article has highlighted, at every stage of development and adoption of the metaverse, rigorous software testing remains paramount. Whether it's ensuring functional accuracy, compatibility across a diverse set of devices, safeguarding against security threats, or ensuring performance during high user influxes, the foundation of a reliable metaverse is continuous and comprehensive software testing. It acts as the gatekeeper, ensuring that as we plunge deeper into this virtual world, we do so with confidence and security.

## About the Author

*Jonathan Binks is the Head of Delivery for Prolifics Testing. He is passionate about software testing and the latest trends in technology, having responsibility for the UK consulting arm of Prolifics in the testing field. His career has included involvement in most testing phases at a technical and managerial level. Jonathan is also an ISTQB certified trainer for Foundation and Advanced courses, having developed and maintained these courses for almost 20 years. Prolifics Testing is a leading UK software testing services firm, a part of the Prolifics group, with offshore facilities in Hyderabad. We specialize in providing project based and full managed service delivery around test automation, performance testing, system integration, functional and security consulting. Our team of specialists use the latest tools, embrace new technologies and ensure we provide the most up to date and best technical fit solutions for our customers, who are from multiple industry verticals.*

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**Author: Jonathan Binks**  
*Head of Delivery for Prolifics Testing*

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Geoff's expertise are widely documented, he is a frequent speaker at major industry events. He is a founding member of the International Software Testing Qualifications Board (ISTQB®) and serves as Chairperson of the TMMi Foundation and the UK and Ireland Testing Board.



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Boye is a highly respected expert in the software quality industry. He has over 20 years of experience in the industry and has worked with several multinational organizations. He is the current President of the Nigerian Software Testing Qualifications Board (NGSTQB).



**Leanne Howard**

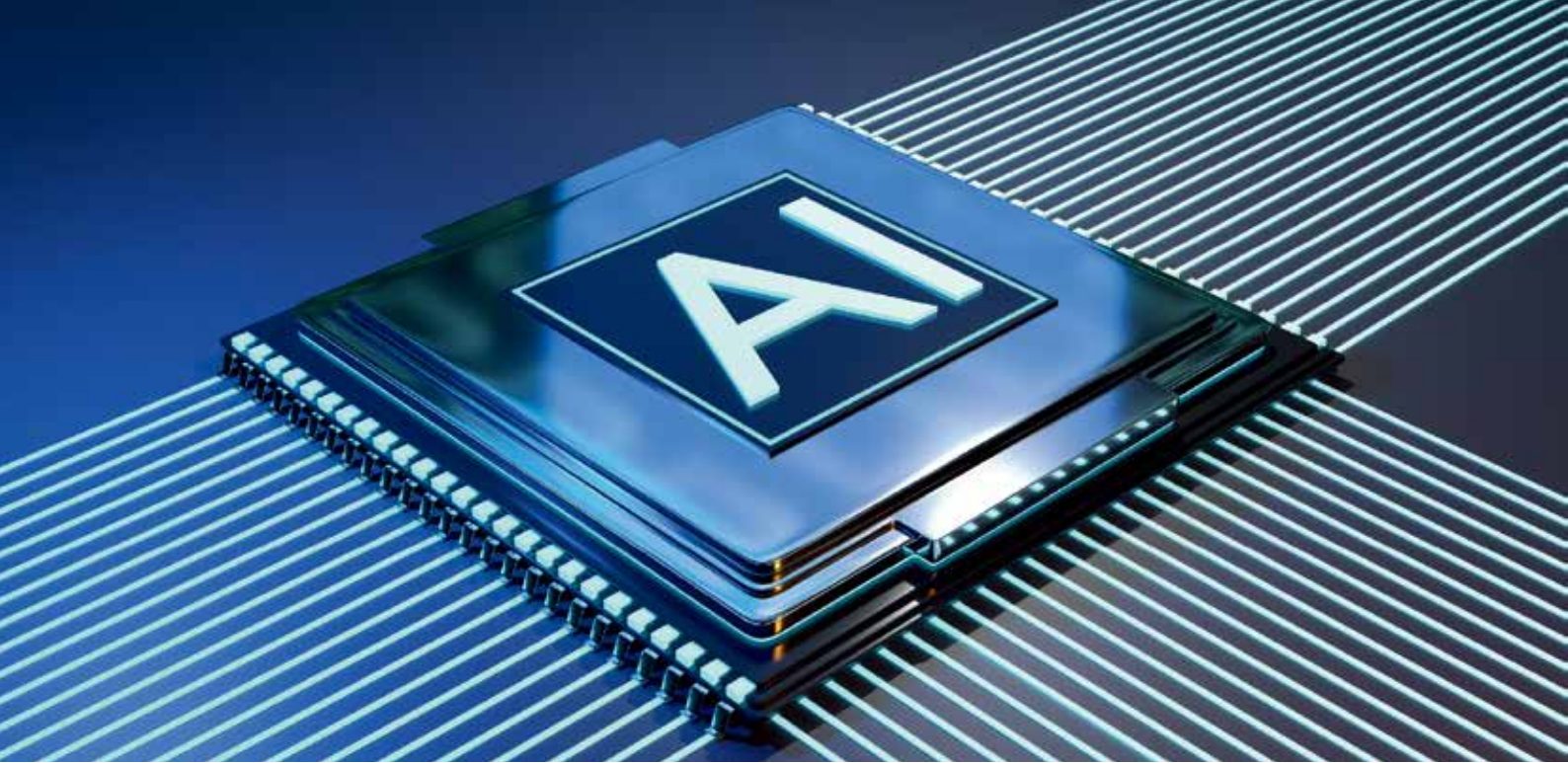
**Agile & Testing Expert | Board Member**

Leanne is an active member of both the agile and testing professions, presenting at conferences globally. She serves as a board member of ANZTB and various ISTQB Working groups. She has also been honored with the ICT Woman of the Year (NSW) award.

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# The EU Legal Framework for Artificial Intelligence: Status and Implications for Software Development

The use of Artificial Intelligence (AI) offers tremendous opportunities to improve business processes and customer experiences. In recent years, AI and Machine Learning (ML) have made significant advancements, with ChatGPT being a popular example. AI is in the spotlight, possessing the potential to bring about significant economic and societal changes across various sectors.

However, amidst this potential, critical aspects must not be overlooked. AI also poses serious risks, particularly regarding ethical, legal, and operational facets. Both executives and developers, integrating AI into products and services, need to keep specific AI risks in mind. In Europe, a pivotal law is under discussion to address this. In April 2021, the European Commission presented the first draft for an EU legal framework for AI. The draft AI Regulation aims to establish EU-wide rules for the deployment of AI systems, which will have far-reaching implications for companies and software manufacturers in Europe.

These legal requirements might complicate and increase the cost of developing and operating AI-based systems. Early understanding and compliance with legal requirements and the resulting need for action offer a valuable competitive advantage.

## SCOPE AND KEY CONTENTS

The Commission draft proposal is designed as a horizontal EU legislative instrument applicable to all AI systems introduced or used in the Union. The central term of the AI Regulation is an AI system as defined in Article 3. According to the current Council Proposal [1], an AI system is defined as “[...] a system designed to operate with elements of autonomy based on data generated by machines and/or humans, employing machine learning and/or logic- and knowledge-based approaches to achieve a set of goals, producing results like content (generative AI systems), predictions, recommendations, or decisions that influence the environment with which the AI systems interact.”

Applications falling within this definition are covered by the regulation, necessitating a risk analysis, from which legal obligations are derived. The AI Regulation specifies four risk classes: Unacceptable Risk (Article 5), High-Risk Systems (Articles 6 to 51), Low Risk (Article 52), and Minimal Risk (Article 69).

**“Unacceptable Risk”:** AI systems presenting unacceptable risks are those violating EU values by endangering health, safety, or fundamental rights. Examples include cognitive behavioral manipulation and real-time remote biometric identification systems. Applications in this risk class will be prohibited, with violations leading to fines of up to €30,000,000 or up to 6% of global annual turnover.

**“High Risk”:** High-risk AI systems can adversely affect people’s health, safety, or fundamental rights. They include safety components of products subject to EU product safety legislation and applications listed in Annex III. High-risk AI systems must meet extensive technical and organizational requirements, with providers needing to establish a quality assurance system encompassing comprehensive risk management.

**“Low Risk”:** For certain low-risk AI systems, special transparency and information obligations are relevant, including labeling requirements and instructions. Users should be informed that they are interacting with a machine.

**“No or Minimal Risk”:** Such AI systems are exempt from the scope of application, subject only to general legal provisions, especially GDPR.

## IMPLICATIONS FOR SOFTWARE DEVELOPMENT AND NEED FOR ACTION

For system providers, the new legal framework presents both challenges and opportunities. Companies must ensure their products and services comply with new requirements and adjust their development processes, as the legal requirements affect the entire AI life cycle. A robust AI governance framework is crucial, offering a structured blueprint based on proven standards and best practices. This framework supports compliance with the AI Regulation by incorporating compliance checks and governance principles into the entire AI life cycle.

## OUTLOOK

While the final text of the law is still under discussion, system providers are advised to familiarize themselves with the potential requirements. Although a multi-

year implementation period (planned between 24 and 36 months) is granted, early preparation is advisable due to the profound impacts and the importance of AI technology.

## REFERENCES

<sup>1</sup>Council Proposal: Proposal for a Regulation of the European Parliament and of the Council laying down harmonized rules on artificial intelligence (Artificial Intelligence Act) and amending certain Union legislative acts, Council of the European Union, File 2021/0106(COD), Brussels, November 2022.

1. For implementation, it is recommended to follow best practices and standards such as MLOps or, specifically for data mining, CRISP-DM, ASUM-DM, or the Halerium Methodology. Particularly for the implementation of trustworthy AI systems, the ALTAI Assessment Tool provided by the High-Level Expert Group on Artificial Intelligence (AI HLEG) or the corresponding guideline from the Fraunhofer Institute offers good support.

### About the Author Armin D. Rheinbay

*Armin D. Rheinbay is responsible for risk management at Sopra Steria Next. With around thirty years of experience in the financial industry, he has worked as a consultant, entrepreneur, and project manager for the development of risk measurement methods and the implementation of company-wide risk management systems. Armin supports his clients at Sopra Steria in effectively and cost-efficiently mastering the risks associated with digital transformation while meeting regulatory requirements. He studied Corporate Finance, Modern Capital Market Theory, and Communication Sciences at the Universities of Göttingen and Hamburg, graduating with a degree in Economics.*



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# Industry News



The A4Q Testing Summit was recently held in Switzerland. This beautiful backdrop was the perfect platform for industry experts to come together and exchange knowledge and network. Engaging presentations were broadcast live on various social media channels with interactive sessions, allowing attendees to gain valuable insights.

The A4Q Testing Summit was a resounding success and provided an unforgettable experience for all participants, whilst pursuing excellence in software testing.

We can't wait for the next Global Testing Summit!

The ISTQB® General Assembly recently met in Tokyo, Japan. This exceptional assembly of dedicated volunteers shares a common enthusiasm for testing and commits their time to bolstering the continuous evolution of the ISTQB® Certified Tester program.

A heartfelt thank you to everyone for their active involvement and unwavering support!



The prestigious ISTQB® Award celebrates those who have made exceptional contributions to software quality, through innovation, research, and promoting the software testing profession.



The ISTQB® International Software Testing Excellence Award winner for 2023 is Mark Fewster!

Mark Fewster's nomination for this award recognizes his decades-long dedication to advancing software testing. His involvement in ISTQB® committees, particularly for the Test Automation Engineer qualification, demonstrates his commitment to shaping industry standards.

Mark Fewster also created high-quality learning materials and introduced a licensing model that has enabled numerous global organizations to offer ISTQB® courses since 1999. These resources, accessible to over 40 licensees worldwide, have greatly influenced the careers and testing practices of countless software testers, solidifying Mark's status as a luminary in the field.

## The Team behind SQmag

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