

THE VOICE OF SOFTWARE QUALITY

# **ARTIFICIAL INTELLIGENCE**

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#### HOW TO TEST A SYSTEM WHEN WE DON'T KNOW THE OUTPUT WE NEED?

by Adam Leon Smith

#### MOVING TO TEST PREDICTIONS

by Tom van de Ven & Rik Marselis

#### EVERYONE HAS A PROBLEM, AND EVERYONE KNOWS THE SOLUTION - IT'S AI

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#### BETTER JOBS AND HIGHER SALARIES

Interview with Valentina Taseva

#### PERFORMANCE IN YOUR BUSINESS FOR SUCCESS

by Leandro Melendez



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isqi.org/lp/ai-software-testing-certification





Stephan Goericke CEO, International Software Quality Institute

## DIGITALIZATION IN CURRENT TIMES

COVID19 has affected the world in unimaginable ways. Leaving many people having to leave their office and start working from home. In times like this, we can observe which companies start and drive the digitalization process in order to make this possible. I am proud to say that my team is able to work remotely in a responsible and efficient manner due to our investment over the last couple of years. The workplace is changing rapidly with digitaliz ation becoming even more important in current times.

That's why iSQI has provided a solution for all of those that want to take their certification exams, while it is not possible to visit a public exam session or a test center. Our remotely proctored exam method (FLEX®) allows individuals to take their exams directly from the comfort of their own home. Some of our products have had this option available since 2013. While working together with our partners we are able to have even more certification exams via this method. We now offer the certification schemes of ISTQB, IREB, The iSAQB, and The UXQB with FLEX® too.

Enjoy the read!

Yours sincerely,

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# HOW TO TEST A SYSTEM WHEN WE DON'T KNOW THE OUTPUT WE NEED?

### **10 QUALITY PROBLEMS WHEN YOU'RE WORKING WITH AI**

Artificial Intelligence (AI) has become the new electricity or a 'must-have' for every business. The increasing uptake of AI technologies is unlocking its true potential and delivering efficiencies in many domains, not just in the cutting-edge applications we hear about in the press, but in our everyday lives, on devices in your home, on your phone, and in the workplace.

AI can be loosely defined as applying acquired knowledge to make decisions, in contrast to using explicit logic. This presents both opportunities and problems for the field of software and systems quality. AI can greatly enhance test automation, but many are grappling with challenges and managing the emerging and novel risks associated with integrating AI components. One of the most challenging aspects is the imperfection and difficulty in reproducing and explaining results.

I became interested in this topic a few years ago, as my company, Dragonfly, started building a product. We built some natural language processing and machine learning into neuro, and I started getting interested in this from a number of perspectives – how do we test AI? How do we build a trustworthy personality? People want AI systems to be trustworthy, dependable, reliable. When you get to the bottom of what trustworthy really means, it's mostly about quality.

Artificial intelligence can include symbolic rule-based expert knowledge systems and sub-symbolic machine learning systems. Machine learning is the most common AI method, and it is difficult to specify quality, and analyse how to test. It's not just QA specialists that think so either, research in Japan involving 278 machine learning engineers identified the biggest new challenges they face integrating machine learning is in decision making with customers and testing/quality assurance. Further, they identify the lack of an oracle, and imperfection as the top causes of this. <sup>1</sup>

I identified ten quality problems that QA and testing specialists need to think about when they're working with AI:

- AI, particularly machine learning, can also be defined automation with less or no specification. If there is less specification required to produce systems how will we define tests? If we aren't going to explicitly say what the software is supposed to do, how are we going to know whether it's right?
- 2. If we don't know the answer, and we are writing the program to find out the answer, how will we test it?
- 3. If this program has complex real-world sensors, how can we predict and synthesise all the ranges of inputs? How can we measure test coverage in a complex data-driven machine learning system? In many safety conscious sectors it is necessary to ensure a high level of coverage, but this isn't as easy as lines of code.

<sup>1</sup> ISHIKAWA, Fuyuki and YOSHIOKA, Nobukazu, 2019. How Do Engineers Perceive Difficulties in Engineering of Machine-Learning Systems? – Questionnaire Survey. In: 2019 IEEE/ACM Joint 7th International Workshop on Conducting Empirical Studies in Industry (CESI) and 6th International Workshop on Software Engineering Research and Industrial Practice (SER&IP) [online]. Montreal, QC, Canada: IEEE. May 2019. p. 2-9. [Accessed 1 February 2020]. ISBN 978-1-72812-264-9. Available from: https://ieeexplore.ieee.org/document/8836142/



- **4.** If a system optimises itself, how will testing it change it? Managing the interactions and data that a system has been exposed to is as important as managing your test environment, in fact it is part of your test environment.
- 5. If this system is intended to mimic human capabilities, how are those human capabilities specified? If you can't define human capabilities, and if you can't define broad concepts like human intellect, you're going to have trouble validating them.
- **6.** Any general-purpose algorithm is equivalent when it's efficiency and accuracy are assessed across all possible problems. The wider the problem space, the harder it is for contemporary, narrow-AI to perform, and the broader the test scenarios need to be.
- 7. All ML models are biased based on the data used to train them, these biases are quality issues first and foremost. AI systems usually learn from the training dataset provided by humans, and there will always be an intrinsic bias in that data (mostly because it was provided by humans...). Diversified datasets and diversity in developing and testing teams helps to reduce the selection and confirmation bias.
- 8. The correlation between inputs and outputs change over time in the real-world, some systems adjust for this and some systems don't. How can testing evaluate this through validation processes that involve real-world use? Even after you take an algorithm live, you need to constantly reevaluate it, constantly feed new observations into your test process.
- 9. Defining ethical quality requirements is incredibly hard. Especially globally. However, there are real risks especially around privacy. When you combine machine learning with personal data, there are some significant and unique risks that can manifest.
- **10.** What if AI systems are trusted too much? What if humans accept all the recommendations blindly, can this reduce the quality-in-use of the system?

Even more problems are present when you touch on areas of physical actuation in the world, and safety, such as with semi-autonomous vehicles and robots. There is significant need in industry for new guidance and best practice, ranging from how we specify acceptance criteria through to how we generate test data for machine learning. Of course, the field is still developing rapidly, so many of the answers about how to manage these issues are still evolving in parallel. DIN, the German national standards body, released a new standard for an AI Quality Meta Model in April 2019, that starts to address some of the new quality characteristics of AI systems. There's also foundation level training for testers available from A4Q and iSQI, and working groups in standardisation bodies such as ISO/IEC, working on further reports and standards in the quality and testing field in the context of AI.

This is a fascinating field to watch develop, as it is rare that an emerging technology appears set to disrupt verification and validation techniques so much.



#### Adam Leon Smith

is CTO of Dragonfly, and a quality and testing specialist. He is also Chair of the British Computer Society's Special Interest Group in Software Testing, and is leading the development of the first ISO/IEC technical report on Bias in AI systems and AI aided decision making.



# **NEWS** FROM THE NETHERLANDS

It has been a busy time for iSQI in the Benelux. A lot/A great deal is happening that we are very happy to inform you about!

- Available soon: ISTQB® Foundation in Dutch
- Public exam sessions in the North of the Netherlands
- New Amsterdam office and expanded team

More information: https://blog.isqi.org/benelux/

# WHAT'S



# THE FUTURE OF SOFTWARE QUALITY ASSURANCE

This book, published to mark the 15th anniversary of iSQI, is intended to raise the profile of software testers and their profession. It gathers contributions by respected software testing experts in order to highlight current and future challenges and trends. In addition, it covers current and emerging technologies like test automation, DevOps, and artificial intelligence methodologies used for software testing, before taking a look into the future.

More information: https://blog.isqi.org/the-future-of-software-quality-assurance/





# WHY ARE CERTIFIED TESTERS SUCCESSFUL INTERNATIONALLY?

With increasing digitalization, IT systems become more and more susceptible to errors in software. This is why software testing is a crucial part of program development. Software only becomes acceptable, if the main errors are detected and fixed in advance. Not only will the software be secure but it will be more desirable and aligned to what users want.

#### More information: https://blog.isqi.org/why-are-certified-testers-successful-internationally/

# HAPPENING

## REMOTE PROCTORED IREB EXAMS

With more people working remotely and unable to attend events, iSQI have been asked to consider how we can support people wishing to take exams.

Remote proctored exams allow individuals to take their test from their home. We are able to provide IREB exams via remote proctor for a limited period.

#### Schedule your exam:

https://isqi.org/en/ireb-requirements-engineering-foundation-level

# MOVING TO TEST PREDICTIONS

#### **Artificial Intelligence makes the difference**

The digital age is all around us. This directly influences test craftsmanship. The amount of test activities increases rapidly with the rise of digital products around us. Not only are there more products but the amount of combinations of digital products grows exponentially. A good product is more important than ever. Ten years ago, applications were mostly back office focussed. Nowadays, we see a new app or website having a direct effect on company results. For example, a new payment method for a bank needs to be tested thoroughly before introduction. With products such as medical devices (for example X-ray) or an autonomous driving car, testing can be related to a matter of life and death. In short, we want to be very sure of the quality of a product before it enters the market (now even more than before). Endless testing is not an option. It is directly related to time and money constraints. Now 30% of IT managers say that the cost for quality and testing have risen to too high levels. A change is needed. We need to add something to traditional test execution. Test monitoring and test predictions expands the test craftsmanship with new mechanisms that cope with the challenges out there.

Traditional test execution can be described as follows. A new product is designed and based on the domain knowledge of that product (for example idea descriptions, manuals, drawings, models or user wishes) test cases are designed. A test case contains at least the following elements:

- a starting condition
- steps to go through
- an expected result

Execution of this test case can only be done when the system under test is available. If you want to do a crash test with a car, you need to have the car first (or a prototype) before the test case is run. When a fault is found after executing the crash test, this is quite late in the product life cycle. Aside from a very costly prototype that has been crashed, now a new design needs to be made and the entire process to create a new prototype needs to be done. This is very time consuming. In this day and age, market introduction is crucial and extending market introduction with these types of faults is very costly. Potentially this can mean missing a whole user group and may prohibit the chances of a product line entering the market successfully (you could go as far as to say that this could mean bankruptcy for some companies).

In the digital age we collect a lot of data. Many activities are digital and data storage is relatively cheap. We can collect a significant amount of data from products that are used on a daily basis. Let's take the car as an example again. New cars are driving databases. The amount of sensors in cars potentially collect gigabytes of data on a daily basis. This data can be used to focus the test activities. We now know what to test and what not to test. This can mitigate the problem of testing every situation or scenario. Monitoring can be used to check the status of a product. An app on a mobile phone can be monitored on its usage. In this case monitoring shows the occurrence of a failure with a very specific combination of keystrokes. With test monitoring we can get closer to the end user or end user situations and we get insight into what to test and what not to test. On the other hand we still see a fault only when it occurs. Ideally you want to go to the next step: prevent the fault from occurring in the first place.

The real improvement lies in predicting quality. We can predict possible defects, risks or outright failure of a device. Before we delve deeper into the possibilities here, let us look at the definition of the word prediction. Weather predictions or football match predictions are all heavily based on historical data. The company SciSports collects huge amounts of data from games and football players. This is used to predict which team potentially wins a game and with how many goals. These predictions do not take any anomalies into account. Some freak changes in the surroundings can cause a completely different result. This is where Artificial Intelligence can make a difference. Smart algorithms can add to the historical data the changes that we may not be able to see. Historical predictions can be greatly improved in this way.

#### THE DIGITAL AGE IS ALL AROUND US. THIS DIRECTLY INFLUENCES TEST CRAFTSMANSHIP.

Adding monitoring and predictions to test execution brings testing into the digital age. It uses all the possibilities that we have at hand. More importantly, it adds these elements because we need to cope with the exponential rise of data density, infinite amounts of product combinations and environments and an ever quicker time-to-market.

#### Applying the prediction mechanism in testing

With the right data it is possible to predict the set of test cases that is needed for a new version of a product. You can also use smart algorithms to find the impact of a software change. A telecommunications company in the Netherlands is using this mechanism to determine the impact of a software change with respect to different quality attributes like safety and performance.

Quality predictions do not only give insight as to the right test approach fitting a specific scenario. Eventually you want to predict how a product will act in the crazy world out there. Predictions are no absolute guarantee. In order to build a prediction that is as accurate as possible it might help to build a 'digital twin'. Simulating a product during the many stages of the product life cycle gives insight into how a product acts in its environment. A digital twin can be a costly exercise and is not in all situations a feasible approach.

The digital twin of sensor-aided driving cars can be used to check over 10 million situations where the car has to react correctly. It is not only car manufacturers that can use this for their product development but also a country's vehicle authority. They can use this to predict autonomous driving vehicles behaving correctly after an over-the-air-update.





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#### Tom van de Ven

is a senior test consultant in digital manufacturing at Sogeti in the Netherlands. Testing in a high tech environment gives the bonus of working with physical products and not testing software only. Tom's specialties are for example Digital Twin, AI, Adding Smartness, Testing Embedded Software, Test management, Test consultant, Automotive, Quick Tech testing, and IoT.

#### **Rik Marselis**

is principal quality consultant at Sogeti in the Netherlands. He is a well-appreciated presenter, trainer, author, consultant and coach who supported many organizations, teams and people in improving their testing practice by providing useful knowledge, tools & checklists, practical support and having in-depth discussions.

Tom and Rik are authors of the book "Testing in the digital age – AI makes the difference".

### MOVING TO TEST PREDICTIONS

#### NOW, WE HAVE DATA, MODELS AND VALIDITY OF BOTH, TOGETHER WITH KNOWLEDGE ON ARTIFICIAL INTELLIGENCE ALGORITHMS.

#### Predicting quality can be done in a variety of ways:

- Analysing the impact of changes using AI tools. Based on software changes these tools give insight in the impact to quality attributes such as safety, performance and correctness. This can serve as the steering wheel for the development process and corresponding test activities, thus predicting the next steps in the test process.
- AI tools can be used to analyse product usage data. With monitoring in place a lot of data can be gathered for review. Smart algorithms can sift through the data to give insights that we would possibly have trouble finding. These are the predictions for future usage of a product and its possible response, better yet its possible error situation.
- Analyzing test data. Test activities produce a lot of test related data: test scripts, test results from all the test runs, simulation data, etc. The predictions mechanism can be used to go through all the test results and produce a smart dashboard that helps you make predictions on future defects, usage or what test scripts need to be run the next time.

#### How to learn to predict

Let us take a look at what elements we need to predict quality in the digital age. Firstly, a set of historical data will help. With a new product this is difficult, but think of the possibilities of using data from older (and similar) products or equip existing products with features that can log data so you start collecting (with Internet of Things we can unlock virtually any value in the field). Do not forget that a series of automated test runs can also provide data useful for doing predictions. Simply doing measurements (physical or digital) provides a source of data (maybe not that extensive as 1 year of logging product use but nonetheless!).

The next step is to use this data with models or to extract models from the data. A model really helps to structure data and to filter relevant data. It serves as a good check for both accuracy of the model and the validity of the data. Data not



fitting the model, or vice versa, leads to an action of finding out whether the model or data are incorrect. The final element for starting with quality predictions is the knowledge on Artificial Intelligence. A great source of learning can be online environments like Google TensorFlow. With this on-line Python environment you get hands-on examples of predictive algorithms such as linear regression algorithms. The great thing here is that without setting up complex environments a quick trial can be done and your first steps in building a neural network for recognizing cat pictures are but a day away.

Now, we have data, models and validity of both, together with knowledge on Artificial Intelligence algorithms. The ideal mix to start building your own predictive solutions in the world of testing and quality.

#### **Build your own defect predictor**

Recognizing pictures with a neural network may allow you to learn something about neural networks, but it is not yet an application in the test domain. Let us take a defect database instead of pictures as input for the neural network. The defect database contains a lot of data. For example about the severity of the error, the probability of occurrence, the description of the error and links with other findings. Here you can get a lot of information. A good first exercise to apply a neural network in a test environment is to make the defect predictor. We choose one attribute of a defect to predict: the severity of a defect. Let's keep it simple and only classify a defect as: "blocking" or "cosmetic". With a defect database as the starting point where these values are correctly entered, a neural network can learn to classify a defect. You can also test how good the defect predictor is by offering a test set of defects to the algorithm. This set contains where the classification is also known as with the learning set (these defects are specifically not used for learning, only for testing!). We therefore distinguish between the training set for the neural network and the test set. After training and testing we have our own defect predictor and we also know how good it is. And of course the predictor can get better by offering more training data.

#### THE IDEAL MIX TO START BUILDING YOUR OWN PREDICTIVE SOLUTIONS IN THE WORLD OF TESTING AND QUALITY.

The neural network can learn much more. This way, the network can learn to recognize code changes in a domain where the risk of errors is high, or learn from test cases and test data that has already been used. The neural network could also gradually learn the time at which defects occur more often or what the effect is of many complex code changes so that you can anticipate them. The defect predictor is a nice starting point to use AI in the test domain and to allow it to grow further. Always keep an eye on how well the neural network has been trained, using test data. Without understanding how well your prediction is, the prediction itself is not worth much.

Figure 1 gives the schematic overview of building, training and testing the defect predictor.



Figure 1 Schematic overview of the elements needed to build a defect predictor.

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#### Summary

The design of a neural network is an important first step towards so-called predictive quality. The first predictions will usually apply to short-term instances and providenswers to questions about what will happen within seconds or minutes. The more knowledge we build, the more often we can look further ahead. That way you can really fix mistakes before they occur at all. That will save a lot of time and money that is desperately needed to bring large quantities of digital products to the market.



# **#iSQIFORWOMEN CONTEST! iSQI NORTH AMERICA**

iSQI supports professionals at all stages of their careers with a broad range of internationally recognized certifications providing whole career path support, from Foundation to Expert level. iSQI helps professionals maximize their career goals and maintain international recognition of acquired competencies and skills! In recent years, the number of women testers has been increasing. In order to help narrow the diversity gap, we created a fun contest for all women who would like to get better opportunities!

More information: https://www.facebook.com/isqinorthamerica/ & https://www.instagram.com/isqi\_northamerica/

# HAVE YOU SEEN ...



## ANZTB AND ISQI ANNOUNCE A NEW PARTNERSHIP FOR ISTQB® EXAM DELIVERY

The Australian and New Zealand Testing Board (ANZTB) have responded to local customer demands and our predicted testing and quality trends by partnering with the International Software Quality Institute (iSQI) to deliver examination and certification for the ISTQB® Certified Tester Scheme. From 1st August 2020, iSQI will deliver an extensive portfolio of ISTQB® examinations on behalf of the Board to both training providers and individuals. Examinations will be available via paper and on-line delivery channels, including at Pearson VUE test centers and remote proctor (as approved by ISTQB®).

More information: https://blog.isqi.org/anztb-isqi-partnership-istqb/



# **ISQI MEETS RWANDA**

Stephan Goericke, CEO of iSQI met Michael Kleinbub, The GBN Coordinator, in Rwanda. The Global Business Network (GBN) Program supports the development of business and cooperation in certain countries in Africa and Asia with the aim of involving German companies in a responsible way. The program is implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Stephan and Michael discussed the economy and the future of Rwanda.

The whole interview: https://blog.isqi.org/isqi-meets-rwanda/





# A4Q ON THE ROAD TO SUCCESS!

The Alliance for Qualification® (A4Q) is celebrating its first anniversary and it is on the road to success!

Impressive figures were announced at the first shareholders' meeting. Within one year since its foundation, 111 training providers from more than 30 countries joined the alliance. Five certification bodies operating worldwide have registered almost 10,000 exams, in eight languages.

The newly introduced Selenium Tester has had outstanding recognition, with 60 training providers adding this product to their portfolio. In the first quarter of this year, the 1000th certificate for Selenium Tester was awarded.

A4Q's managing board announced new topics for 2020 which are in high demand in the training market. The Alliance reiterated its commitment to its motto for success: "Practical and high quality".

More information: https://blog.isqi.org/a4q-success/



# **EVERYONE HAS A PROBLEM, AND EVERYONE KNOWS THE SOLUTION - IT'S AI**

WITH MORE AND MORE PRODUCTS BEING DEVELOPED WITH AI CHARACTERISTICS, IT IS IMPORTANT THAT THEY ARE TESTED THOROUGHLY

In today's technology-driven world, business is disrupted by enterprises that develop innovative products. There are many drivers to this. It could be a changing technological landscape, changing business dynamics or increasing intense product competition. Especially on the technology side, the competition to work on emerging technologies is on the verge of disrupting the business models.

Looking at product transformation, usage of Artificial Intelligence-based products is fast becoming the new battleground for enterprises. Technologies such as Data Analytics, IoT and Artificial Intelligence, to name a few, are not only enhancing the product offerings of enterprises but also transforming the ways products are being developed and tested. A prominent market research organization estimates that the global AI market is expected to grow to approximately \$4 trillion by 2022<sup>1</sup>. With more and more products being developed with AI characteristics, it is important that they are tested thoroughly. Before we look deeper at the testing of AI models, let's quickly see what an AI-based system is and what makes it so challenging to test.

The traditional applications are deterministic logic-driven, which means for a determined input there is determined output and hence it is possible to predict output for a given input. The AI-based models are probabilistic logic-driven and hence there is unpredictability in the output for a given input. The output of an AI-based model depends on how the model was trained. What makes AI testing very complicated is that engineers generally know how to build/train an AI model, but don't know how it works to predict the output.

#### **Challenges of AI testing:**

- Testing of human bias of the AI model.
- Selecting the correct test data to ensure that the AI model is trained correctly. Since the AI model gets trained via multiple dynamic and static data sources, there can be several issues related to the quality of input data. The data could be incorrect, biased or incomplete in training.
- Testing that the AI model is not tricked into behaviors that affect us adversely. For example, the AI model should not reveal business sensitive information
- Many times, the training data is not enough and hence the AI model does not respond appropriately to some unique scenarios that matter, while in testing.
- Since generally engineers don't know how the AI model predicts output, it is very difficult to fix a defect in an isolated way.

While testing an AI-based model is quite challenging, it should be noted that data is the key to train and test the model. The testing must ensure that the data used to train the model is not the same as the data used to test the model. This is because the objective of training data is to make the model learn a pattern. However, the test data should have some degree of variability to ensure that the model has learned the pattern. The same sets of training and test data lead to perfect predictions in testing and hence may also lead to random predictions in production by model.

 $^1\,Gartner:\,https://www.forbes.com/sites/alexknapp/2018/04/25/gartner-estimates-ai-business-value-to-reach-nearly-4-trillion-by-2022/\#578fe68133f9$ 

#### EXAMINE THE RESULTS CAREFULLY, ESPECIALLY THE RESULTS THE MODEL IS CURRENTLY GETTING WRONG.

#### Important considerations for AI testing:

The above challenges can be overcome by careful design of a test approach, keeping the following key considerations in mind:

- Before you test, understand the core algorithm of the AI model and its basis of making a prediction. Understand the features impacting the AI model and the business rule of the same.
- Design test scenarios to remove human biases. Biases can be very harmful for the application. This is possible by selecting a separate set of test data, which was not used to train the model.
- Consider the vital test scenarios where you wouldn't want the AI to fail and construct tests for those.
- Examine the results carefully, especially the results the model is currently getting wrong. Are there any patterns or common threads in the results? These inputs will help you to further refine the test data used for testing and help detect more issues.
- Make Security Testing integral to AI model testing. Improper testing can lead to an AI model (such as chatbots) being manipulated to reveal business sensitive information.

Additionally, the test approach of AI testing must consider the following 6 testing types:

- 1. Metamorphic Testing: In metamorphic testing a relation between inputs and outputs is established which helps to validate if the output is acceptable or not. Software is checked for these relations, called metamorphic relations.
- **2. Adversarial Testing:** Adversarial scenarios cause a model to make mistakes. They can be like an optical illusion for the machines. Here a lot of adversarial examples are created to explicitly train the model not to be fooled by each of them.
- **3. Cross Validation Testing:** Cross validation testing is based on the principle that testing data set and training data set should be different.
- **4. Hypothesis Testing:** In hypothesis testing we assume as a straw man (a sham argument set up to be defeated) and run tests to try to prove it wrong.
- 5. Evolution Testing: Testing whether the model is getting evolved with time
- **6. Sensitivity Testing:** Sensitivity testing assesses how "sensitive" the model is to fluctuations in the parameters and data on which it is built.

In conclusion, to survive from disruption caused by emerging technologies, the enterprises must develop innovative and advanced ways of testing which not only test the traditional application flows but also test the intelligent algorithms driving the systems.



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Khimanand Upreti

has more than 15 years of experience in software testing and holds a university degree in Computer Science. Since 2011, Khimanand Upreti has been working for the software house Nagarro and together with his Austrian colleague Hannes Färberböck he is heading the global business unit "Accelerated Quality and Test Engineering", in short: AQT. His passion in testing is focused on new digitalization topics, such as testing of artificial intelligence or quality assurance of chatbots.



# **BETTER JOBS AND HIGHER SALARIES**

HARDWARE IS THE LARGEST SEGMENT. ICT SERVICES ARE THE SECOND LARGEST SEGMENT, FOLLOWED BY SOFTWARE.

How Semos makes young Macedonians fit for international markets

Semos Computers Education Center has been working in collaboration with the Employment Agency of the Republic of North Macedonia since 2017. Semos is an accredited training provider for the ISTQB® (International Software Testing Qualification Board) Certified Tester Scheme. During 2020, 130 participants will be trained in the foundations of software testing and agile techniques. At the end of the training, participants will need to pass an exam to gain the official ISTQB® certification. As a global provider of certifications, iSQI guarantees assessment against the robust international quality standard for certifying individuals. The SQ mag talked to Valentina Taseva, CEO at Semos, about the Information and Communications Technologies (ICT) market in North Macedonia, associated training and the software testing profession.

#### Valentina, you know the market in North Macedonia very well. The country is looking to Europe with the hope to attract investors. What are Macedonia's strengths?

With an annual growth rate between 2.5 and 8 percent over the last several years, the Information and Communication Technology (ICT) sector in North Macedonia is a promising area for foreign investors. The ICT sector in North Macedonia benefits from a skilled and cost-effective workforce with excellent English language skills, solid telecommunications infrastructure, and low corporate tax. ICT representatives expect the sector will continue to grow.

The total ICT market value in North Macedonia was an estimated USD 400 million in 2018. Hardware is the largest segment. ICT services are the second largest segment, followed by software. Many large ICT companies are present in North Macedonia via branch offices, distributors, dealers, resellers, solution providers, and business partners. THE OVERALL OBJECTIVE OF THE PROJECT WITH THE EMPLOYMENT AGENCY IS TO INTEGRATE YOUNG PEOPLE IN THE LABOR MARKET.

That sounds very compelling. It seems that there are many well educated people in the country!

Indeed! And many young ones. The recent survey from it.com.mk showed in the terms of age, 60% are between the ages of 25 to 34, while the degree of education is usually a graduate degree.

The overall objective of the project with the Employment Agency is to integrate young people in the labor market. The target group of the activities are young people up to the age of 35 registered at an Employment Agency as active job seekers. Training in advanced IT skills demanded on the labor market increased the employability of the participants and provided them opportunities to increase occupational skills and to obtain qualifications for specific jobs demanded on the labor market. That is, I think, the reason why our project is so successful.

#### Can you please explain this in more detail?

The purpose of these training sessions is to enable unemployed people to be motivated, requalified and actively involved in the job market, while at the same time mastering the IT skills and knowledge that would benefit them in their job search. The participants have prospects for a new career, better job opportunities, higher salaries and a chance to be competitive in the international market. At the same time, employers (companies and institutions) benefit from easier access to qualified, trained and certified employees. Government will benefit from a decrease in the unemployment rate.

The main benefit is the job opportunities in IT companies; with new qualifications, they 1 benefit from higher salaries.

With the integration of trained individuals into the labor market, the gap between demand and supply will be bridged and employers will have greater opportunities to employ people with the necessary IT skills. The project offers many benefits to all of the stakeholders involved.



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**Valentina Taseva** CEO & Owner of Semos Education, Macedonia

Valentina Taseva is an established entrepreneur with over 22 years of experience founding and managing IT training and certification companies in Southeast Europe. She is the CEO of Semos Education, a renowned ICT training center, and ClearView, a management training center, as well as owner of *Certiadria, a certification* center for ICT skills certifications in 12 countries regionally. She earned an MBA from Sheffield University, United Kingdom.

#### BETTER JOBS AND HIGHER SALARIES

### What role does certification with iSQI play and how do you see the future for software testers?

The demand for software testers in Macedonia in the last 2 to 3 years is high and seems to be growing. Due to the large number of foreign companies in our country that have very serious projects, testing is executed at a high level and in accordance with world standards. There is more room for software testers in our market, and lately we have noticed many programmers pursuing a career in testing. The IT sector in Macedonia are requesting iSQI certificates while recruiting their QA employees. Passing the exam and achieving certification adds value to a tester's career.

We have many success stories from trainees who have attended ISTQB® training courses, starting with manual testing and then continuing with automation testing. The many requests that we received from our clients for advanced level ISTQB training courses showed us that there is an opportunity to bring new products intoour portfolio.

### How do you see the development in the IT sector in the coming years?

The IT sector is one of the fastest growing technology markets and is set to significantly transform the way we perceive different aspects of life. In Macedonia, the IT sector is becoming one of the most innovative sectors in the country. By its very nature, tech is an innovationdriven industry, making it the ideal playground for business owners and entrepreneurs who are looking to change the world.

Thank you, Valentina.

THERE IS MORE ROOM FOR SOFTWARE TESTERS IN OUR MARKET, AND LATELY WE HAVE NOTICED MANY PROGRAMMERS PURSUING A CAREER IN TESTING.





#### **Book Presentation**

<sup>66</sup>This book, issued to mark the 15th anniversary of iSQI, is intended to make a further contribution to raising the profile of the profession of software testing. How is the profession of tester changing? What must a tester prepare for in the coming years, and what skills will the next generation of software testers need? What opportunities are available for further training today? What will testing look like in an agile world that is user-centered and fast-moving? What tasks will remain to the tester once the most important processes are performed automatically? These are questions that we will have to answer for ourselves." Stephan Goericke, CEO iSQI Group, and Editor of the book "The Future of Software Quality Assurance"

### THE FUTURE OF SOFTWARE QUALITY ASSURANCE

#### **Authors:**

Sven Amann Graham Bath Frank Faber Paul Gerrard Elmar Jürgens Tilo Linz **Rik Marselis** Mitko Mitev Alfonsina Morgavi Zornitsa Nikolova Gerard Numan Ina Schieferdecker Adam Leon Smith Andreas Spillner Mark Tannian Ignacio Trejos-Zelaya Kaspas van Dam Hans von Loenhoud Rini van Solingen Erik van Veenendahl Keith Yorkston

#### About the book:

This open access book, published to mark the 15th anniversary of the International Software Quality Institute (iSQI), is intended to raise the profile of software testers and their profession. It gathers contributions by respected software testing experts in order to highlight the state of the art as well as future challenges and trends. In addition, it covers current and emerging technologies like test automation, DevOps, and artificial intelligence methodologies used for software testing, before taking a look into the future.

iSQI has been focused on the education and certification of software testers for fifteen years now, and in the process has contributed to improving the quality of software in many areas. The papers gathered here clearly reflect the numerous ways in which software quality assurance can play a critical role in various areas. Accordingly, the book will be of interest to both: professional software testers and managers working in software testing or software quality assurance.

#### **Benefits:**

- Open Access
- Highlights the state of the art in software testing, as well as future challenges and trends
- Covers current and emerging technologies like test automation, DevOps, and artificial intelligence methodologies used for software testing
- Includes contributions by well-known software testing experts

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Enjoy the read!

# PERFORMANCE IN YOUR BUSINESS FOR SUCCESS

ASSURING EXCELLENT PERFORMANCE ON YOUR SYSTEMS CAN BE THE DIFFERENCE BETWEEN HAPPY CUSTOMERS AND CATASTROPHE.

The IT industry has come a long way since the days of dial up modems; from higher speed connections to distributed systems, there has been a rapid evolution. A guaranteed fast response is more crucial than ever to customers and users. Some guidelines recommend that the user should reach the needed content in no more than two clicks. Others indicate there should be an even quicker response in applications. In today's digital world, good performance (in multiple areas) and availability (uptime) is essential.

Due to increasing network speeds, bandwidths and hardware capabilities, it is even more important and at the same time more difficult to guarantee performance. These advances have also enabled increased complexity in online systems. Due to these speeds and the vast amount of options available, users and customers are not willing to wait for a slow response on a slow site. A customer that has had slow or bad experiences in your system may never, ever come back.

Corporate users may also react like this. On a corporate system oriented to internal users, their desire to use it, their productivity and even the ability to do their work is also impacted by its performance.

On top of that, multiple hidden costs lurk on systems with poor performance and opportunity costs are the most visible impacts. Repercussions could be lost customers, bad reputation, downtime and the inability to conduct business But with the advent of cloud computing, containers and elastic environments, bad performance can also generate considerably larger bills from your cloud providers.

Let's compare generating your own power at home under your own efforts, to being supplied by a major electricity provider. If you are responsible for your own power, then it is more likely that you will consider the power consumption of, as an example, your refrigerator and monitor its performance more closely. With an external supplier, it's tempting to take less care of individual appliance performance – until the bill arrives!

Organizations often try to assure their application's performance by just doing load tests. To trust only the measurements that load testing efforts provide, trying to know how the application is doing, is like trying to ride a motorcycle before learning to crawl, walk, run, and to ride a bicycle. Or trying to tackle all cooking practices in a kitchen with just a microwave. As well, the industry commonly confuses performance testing / assurance with load testing. So how can you ensure the performance of your application? As mentioned above, good performance is no trivial matter and there are multiple areas where an organization has to be careful to ensure the best experience for their customers and users. Here are some of the main areas together with some tips on how to assure great performance. Just remember, performance assurance is not guaranteed only through load tests.

#### IN TODAY'S DIGITAL WORLD, GOOD PERFORMANCE (IN MULTIPLE AREAS) AND AVAILABILITY (UPTIME) IS ESSENTIAL.



#### Front end / UI

Thanks to increased bandwidth, new protocol technologies, and powerful client computers, the complexity and functionalities that applications can do on the clients' end have multiplied considerably. Some of those changes range from HTML5, Javascript, HTTP2&3, front end platforms (Angular, React, Vue, etc.), high resolution/vector images, and many more. Nowadays, the amount of processes being sent to our users browsers has grown to a point where their experience can be affected by web applications' code/content being misaligned. Or just by being too heavy.

This area is commonly known as Web Performance. The hard focus the industry has had on load tests has left it unattended for some time now. Some steps one can take to ensure good Web Performance include, reviewing it through tools such as Chrome's developer tools (most browsers have an equivalent) on render time, network, memory, performance, etc. As well as reviewing Web Performance on sites dedicated to analyze and grade your application. Sites such as webpagetest.org and gtmetrix.com will provide you with insightful recommendations to provide the best possible experience on the front end side of your solution.

#### **Network / Content**

Another common source for performance blunders lies in the network layer that connects the users to the application's server. The network is a component that is often difficult to control as it resides on the hands of network providers and countries' infrastructure. Other burdens on performance in this area include: heavy content poorly managed by the application/infrastructure, and/or design flaws that might force the application to request all of the content on every interaction.

Again, browser analysis tools can help to find these types of issues. In addition, applying web caching settings to the application's elements that will not be generated on each interaction with the server can improve the efficiency. Even distributing this content can help, taking it closer to your end users by splitting your application's servers worldwide. Or also distributing the content through CDNs that will get it closer to your users and ease the bandwidth demand on your application's servers.

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Leandro Melendez is an avid performance test manager and consultant, podcast host on performance, presenter at testing conferences, and many others. Has almost 20 years of experience in the IT business ranging from Developer, DBA, Project Manager, and others.

In the last 10 years, he has been working on the QA area, specifically on the Performance and Load testing area using tools as WinRunner, LoadRunner, JMeter, HPDiagnostics, NeoLoad, AppDyn, Dynatrace, and many others. He has served multiple S&P 500 customers all over the USA, Mexico, Canada, Brazil, and Australia. He writes a performance testing blog called SeñorPerformo (www. *srperf.com*) *and cooperates* with the PerfBytes team in producing more online material for performance and agile testers. He hosts the PerfBytes podcast Spanish version.

#### PERFORMANCE IN YOUR BUSINESS FOR SUCCESS

#### BEWARE OF THE ACTIONS YOU COULD TAKE TO ENSURE THAT YOUR CUSTOMERS AND USERS HAVE AN ENJOYABLE EXPERIENCE.

#### **Backend code**

With new software development methodologies, it is easier than ever to insert more frequently a piece of code that performs poorly without noticing it. At least before it causes trouble. New underperforming pieces of code checked in can create wide impact risks for the application or even to the entire infrastructure of the organization. This situation was common in the waterfall days where issues often went undetected or unreported through all the SDLC phases. They were noticed only after UAT when the performance teams got their hands on the application. This problem worsens in the agile days that we are now living in, since new code comes in quickly without much opportunity to detect it's flaws. To make matters worse, multiple organizations do not know what the performance of the code that they have is or enhance their code/processes to detect these faulty pieces of code.

The first line of attack for this area is to know the performance of each of your pieces of code. It should be known even at the development stage and from code that is about to be released to other environments (QA, PreProd, Prod.) This can be achieved by creating integrated measurement modules in the code which enables to send and store performance metrics on platforms such as Splunk or ELK. Both will provide great visibility. Also, it is extremely recommended to add APM tools (Dynatrace, Appdyn, New Relic, etc.) to every environment. Having them eases the detection and storage of historical performance measurements of the application and even of the entire organization. Managing an application in an organization without knowing these utilization patterns and metrics would be like driving blindfolded.

#### Load / Availability

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Finally, we reach the part which everyone is most familiar with. Load testing is a very important piece of the performance assurance practice. But it is one of the last steps that should be taken as it only assures that multiple users will be able to coexist and get fast responses constantly, as well as assuring the maximum amount of uptime, even under chaotic scenarios. But beware, as mentioned earlier, load testing is not the only performance practice that should be applied to a distributed application, neither should it be the first effort. One must know the performance of each one of the pieces/ areas mentioned above. It's like knowing first all the pieces from a racing car before racing it. This is the well known practice of load testing. Using a load automation and generation tool, first, we need to identify the most frequently executed actions on our environment. Then we must create automations from steps specifically designed for load testing to trigger those actions efficiently. With those automations we can design and execute different scenarios targeted at simulating specific risk situations that need to be mitigated. Situations such as general load, spike events, long term load, expected growth, and many more. With the aid of APMs and other monitored metrics, after executing the tests one can conduct a deep analysis on the results to find out where the system has bottlenecks, failures, fatal crashes, etc. Load tests can also aid us to find out how fast can the organization bring the systems back after a fatal crash.

#### Conclusion

Application performance assurance is an underestimated practice with deep repercussions on multiple facets of our organizations, potentially including the financial impacts on the organization's balance sheet.

Beware of the actions you could take to ensure that your customers and users have an enjoyable experience. Or even better, an addictive experience such as Facebook, Netflix, or Amazon have while their users blaze through their applications.

Make sure your team is aware and applies best practices to achieve the best possible performance in your solutions. Or at least, that you have expert assistance on performance matters.



#### Any Questions?

#### **PUBLISHER**

International Software Quality Institute (iSQI) Friedrich-Engels-Str. 24 14473 Potsdam (Germany) T: +49 331 231810-18 www.isqi.org

#### EDITOR

Responsible for Editorial Content: Stephan Goericke Editorial team: Andrea Steppuhn, Alexandra Kate Spaans *contact@sq-mag.com* Friedrich-Engels-Str. 24 14473 Potsdam (Germany)

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