# Postgraduate Studies on Software Testing in Poland[1]

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**Abstract.**
Testing is a relatively new profession in common IT job market. Managers are aware that testing is a formal, systematic process based on mathematical background. Observing the job market one can find that the requirements for tester positions are different than the requirements for developers and other members of the staff.

In this paper we present those requirements based on our reseach on job advertisements. On the other side, the universities (IT departments) and technical universities in Poland (but not only) do not teach professionals in testing – typically only a few hours during studies are devoted to this subject. Postgraduate studies are the solution which is specific to Poland and rather uncommon anywhere else. We present the profile, experience and expectations of postgraduate students. Additionally the curricula of postgraduate studies at four universities and colleges located in the biggest cities of Poland are presented.
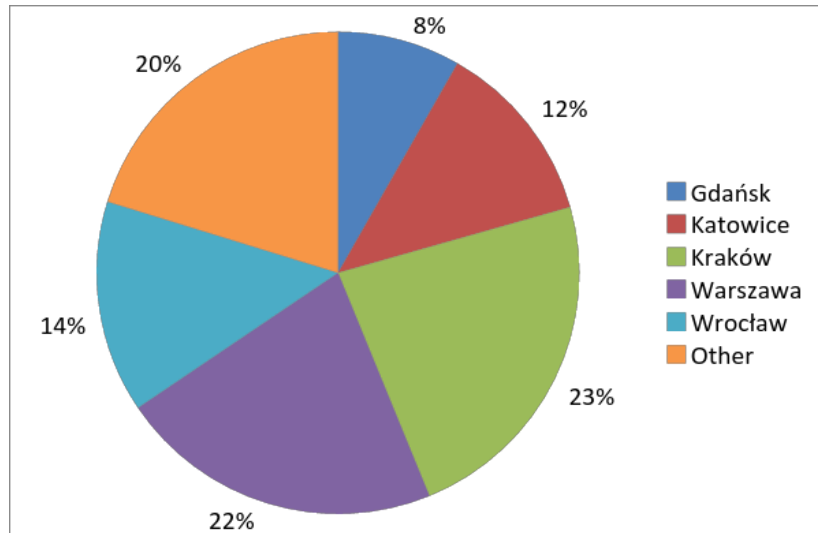
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# 1　Introduction: tester as an IT profession in Poland

IT managers constantly have a problem with testing. They do not know exactly what testing means, why it is essential in the software lifecycle and why it is worth to invest in it. Till now some IT people, when thinking about "testers", have in mind a low educated person who – by more or less randomly clicking on different fields in applications – tries to find some errors.

However, in the last few years' things become to change. More and more managers are aware that testing is not "clicking", but a formal, systematic process based on the mathematical background. They understand that testing tries to answer a very important question: what is the actual risk related to the application under test. Managers start to treat testing as a *technological investigation* which allows us to gain some information about the quality of System Under Test. *Technological* – because it heavily relies on methods such as mathematics, graph theory, logic, tools (special programs), theoretical computer science, models, measuring etc. *Investigation* – because testers do it in a formal way.
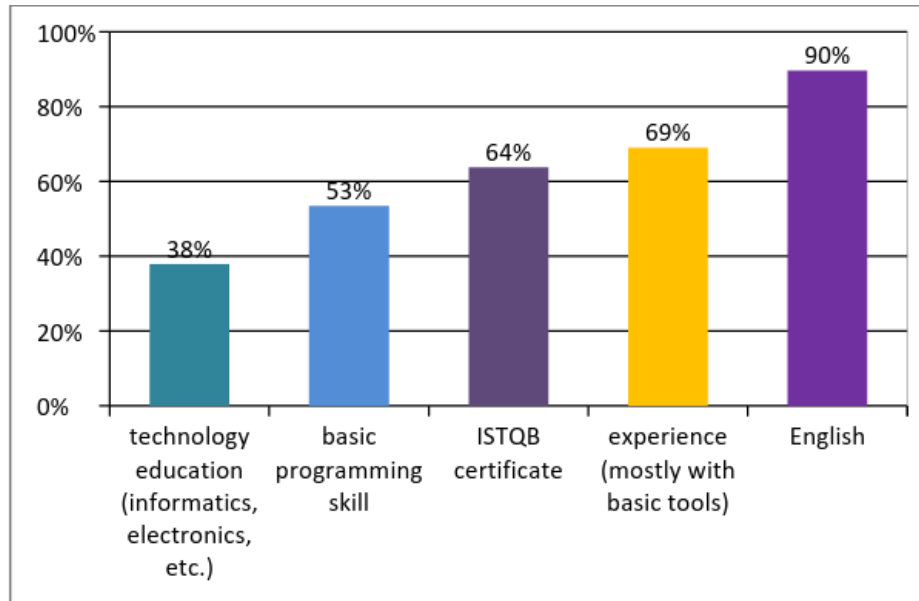
Observing the market one can find that many organizations in Poland are looking for qualified testers – mostly in big cities (see Fig. 1). It is interesting to observe the requirements for this position (see Fig. 2). It is obvious that employers are looking for persons with good English knowledge (typically on a B2 knowledge level, standard for graduates in Poland). Most of these organizations are international, most documentation is in English. Moreover, English nowadays is a *lingua franca* in the IT world. We can also understand that – especially regarding higher positions (Senior Tester, Test Manager) – employers are interested in some experience, but mostly in basic testing process, some tools like bug trackers, etc. From the data one can find that ISTQB certificate is an important basis which confirms the candidate's testing knowledge.

**Figure 1. Demand for testers in different cities in Poland – based on Pracuj.pl portal; February 2016**

It is very interesting that the minority of employers requires the education in technology (computer science, electronics) (38%). In our opinion it is because the organizations are aware of the fact that graduates with technical education prefer to work as developers, as they are usually paid much better than testers. Hence they try to omit this problem, replacing the requirement of „education" by requirement of "experience". What is also interesting, there is a small amount of requirements (a bit over 50%) for programming skills. In our opinion is comes from the fact that people with good programming skills prefer to work as developers than testers.

But computer science graduates may be reluctant in developing their careers in the quality area also for other reason. Namely, computer science curricula for undergraduate and graduate studies usually do not pay much attention to software testing or quality assurance. Much of the hours devoted to software development focus on programming (programming languages, data structures, and algorithms). Usually there is only one lecture on software engineering (typically ca. 15-30 hours) covering all SE areas (requirements, software development lifecycles, software design, architecture, UX, documentation, IT project management etc.). Therefore, there are only one or two lectures on software testing. In result the graduates have only a very limited knowledge on software quality. Their testing skills are usually related to the developers' task (frameworks for unit testing, TDD etc.).

**Figure 2. Requirements for tester positions – based on Pracuj.pl
February 2016**

Jagiellonian University in Cracow is the first Polish university that offers – constantly since 2008 – a full, 60h course on software testing for CS undergrad students (30h lectures + 30h labs). This course is obligatory for Software Engineering track and elective for other CS tracks. Every year ca. 120 3rd year students are enrolled on the course. The curriculum includes most topics covered by ISTQB Advanced Level syllabi. Moreover, several lectures are devoted to software quality assurance.

The similar course – however only as elective – is also offered to students at Warsaw University of Technology. Typically about 15 students each year are enrolled on the course.

The common lack of knowledge on software testing is noticeable when studying the contents of the job positions descriptions. Many employers do not distinguish between software quality assurance and software testing, which can be classified as a software quality control activity. Software testing is therefore a proper subset of QA, but companies looking for testers frequently call these positions like "Quality assurance engineer", "QA engineer" etc. having in mind a tester role.

But even more striking for us are the requirements for tester positions. We analyzed several job offers for tester positions published on pracuj.pl – the most popular job seeking portal in Poland. Most of the job descriptions focus on the skills

in test execution automation (that is, some knowledge on tools and programming languages) or on the knowledge of different SDLCs, Agile being the most popular. However, almost none of the job descriptions require:

- analytical skills,
- ability to read technical documents as test basis,
- good communication skills,
- inquisitiveness, exactitude, preciseness,
- knowledge on test design techniques,
- knowledge on different test approaches, like risk-based approach,
- skills on effective incident reporting.

Many companies require from the candidate the ability to manually or automatically executing test scenarios/test scripts. But even if these scripts are to be designed by the candidate herself, there is no requirement about the ability to effectively design such scripts.

We think that it is more than obvious that there is a great need to promote professional knowledge on software testing and software quality assurance. In the next sections we present the testing education in Polish universities, a general characterization of students and the analysis of curricula of several postgraduate studies in software testing.

## 2 Testing education in Polish universities

Postgraduate studies are the most specific form of the formal software testing education in Poland. This idea is specific to Poland and – according to our knowledge - rather uncommon anywhere else Curricula of regular (undergraduate and graduate) IT studies at Polish universities, technical universities and colleges typically contain a few hours devoted to software testing, usually as part of a Software Engineering course. But the postgraduate studies are becoming noticeably more and more popular. At the moment there are about 150-170 students taking such postgraduate courses at several colleges located in the biggest Polish cities (Warszawa, Gdansk, Krakow, and Wroclaw).

What is very interesting, women are the majority of the students, which is rather unexpected, because typically most of the students in technology area are men.

**Table 1.** Basic characteristics of the postgraduate studies in software testing in Poland

| University | Number of graduated/women | Number of students /woman | Year of establishing |
|---|---|---|---|

| Wroclaw, Copernicus | 91/45 | 32/25 | 2010/2011 |
|---|---|---|---|
| Gdansk, WSB | 100/56 | 62/27 | 2012/2013 |
| Vistula, Warszawa | N/A | 20 | 2015/2016 |
| UJ | N/A | 40/20 | 2015/2016 |

## 3 Students: their profile, experience and expectations

Students interested in this kind of education can be divided into two groups. The first one are people familiar with the overall high quality of the IT jobs (salaries, benefits, work environment) that we sometimes figuratively call "programmers wives". It does not necessarily mean that most of them are female, but they typically fulfill the following conditions:

- they believe that software testing is a good job with rather high salary and with relatively low technical entry level,
- among their close relatives or friends there is somebody working in the IT industry,
- they have some – typically very basic – knowledge on programming and advanced computer usage.

A good example of the student expectation is a quote from the enrollment questionnaire, being an answer to the question about the motivation to undertake such studies:

"*I want to change my job and start to make progress; my expectation is to gain knowledge that would be enough to start as Junior Quality Tester.*"

The second group consists of people who just started their careers as Junior Testers and who found out that they need some systematized knowledge. From the same questionnaire:

"*I want to learn how to effectively prepare tests, how to test software manually and with the usage of tools.*"

Students of the first edition of studies at Jagiellonian University filled out a questionnaire about their experience in software testing and IT in general. This data was used to split the students into two groups: less advanced and more advanced, but the results of this survey also shed some light on who is interested in this kind of studies and what background these people have. The results of the survey are presented in Tab. 2. The students were to perform a self-assessment in the following areas:

- knowledge on Windows systems,
- knowledge on Linux systems,
- knowledge on computer networks,
- knowledge on databases,
- knowledge on script programming,
- knowledge on C++,
- knowledge on Java,
- knowledge on C#.

Each skill was graded in the 0-5 scale, where 0 means "absolutely no knowledge" and 5 means "I have an advanced knowledge in this area". The students might also add other skills. We also asked them about their expectations related to the studies. We received 56 answers.

**Table 2**. Survey among Jagiellonian postgraduate studies candidates

| Skill | Number of responses for a given grade | | | | | | Mean |
|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | |
| Windows systems | 5 | 3 | 10 | 10 | **22** | 6 | 3,05 |
| Linux systems | **33** | 8 | 11 | 1 | 3 | 0 | 0,80 |
| Networks | 18 | **19** | 7 | 7 | 5 | 0 | 1,32 |
| Databases | **22** | 12 | 12 | 9 | 1 | 0 | 1,20 |
| Script programming | **32** | 12 | 7 | 4 | 1 | 0 | 0,75 |
| C++ | **37** | 11 | 5 | 3 | 0 | 0 | 0,54 |
| JAVA | **34** | 8 | 9 | 4 | 1 | 0 | 0,75 |
| C-sharp | **44** | 7 | 4 | 1 | 0 | 0 | 0,32 |

Students also mentioned other skills, such as: HTML/HTML5/XML/CSS (7), Python (5), Selenium (2), AutoCAD/CAD systems (2), MS Office (2), Javascript (1), php (1), Matlab (1), MathCAD (1), jQuery (1), GIT (1), Robot Framework (1), JMeter (1), JUnit (1), TestNG (1), SVN (1), DOS (1).

22 out of 56 persons indicated an IT company as their place of work. As for the expectations, two main groups are clearly visible: 24 said that they want to change their career path (so probably they have little or no initial knowledge on testing), 25 responded that they want to develop their careers in the field of software testing. 2 persons wanted to undertake the studies to prepare for the ISTQB Foundation Level exam.

23 responders indicated that during the studies they want to become familiar with

widely understood automation (test automation tools like Selenium, script languages, programming languages), 6 wanted to gain more experience in test management, 5 wanted to learn about the test design techniques.

## 4     Curricula of postgraduate studies in software testing

The curriculum of software testing studies must take into account these two groups of students and their expectations. There are some differences between locations and universities but basically the programs are more or less consistent with the ISTQB syllabi (CTFL and – partially – Agile). There are also some basic and leveling courses such as:

- programming (rather very basic), focusing mostly on writing simple scripts to solve problems automatically and on writing code for popular test automation frameworks,
- database systems, to allow for effective testing of software that uses them,
- Internet technologies that are used for websites and webservices,
- some introduction to operating systems, with special focus on Unix/Linux because they are widely used in the industry.

Curricula of Krakow, Gdansk, Warszawa and Wroclaw programs are presented in Table 3.

During the lectures related directly to software testing the main ideas from ISTQB CTFL syllabus are presented, Lecturers at postgraduate studies are mostly professionals with the IT industry experience, hence the emphasis on a practical and real-life approach; also many references to real-life projects and situations are given:

- although models are good to define, not all organizations follow them strictly,
- extensive planning is a good idea, but in many projects tester needs to manage her project with a limited plan; some hints are presented,
- because of popularity of Agile, the ideas related to the tester's role and the way of cooperation in the Agile environment are presented.

Because the test automation is on the top nowadays, much attention is put on the testing tools. As it can be observed in table 3, about 20% - 25% of the curricula is devoted to test automation. At the moment typically the following tools are discussed:

- Selenium: IDE, Webdriver and Grid,
- some tools from the xUnits family,
- JMeter as a tool for performance testing,
- SoapUI,
- Robotium as a tool for mobile testing.

Students have an opportunity to use these tools during the workshops in laboratories; they test previously prepared programs with some built-in defects.

**Table 3**. Programs of the postgraduate studies in software testing

| Subject | Number of hours | | | |
|---|---|---|---|---|
| | Jagiellonian University (Krakow) | WSB (Gdansk) | Vistula (Warsaw) | Copernicus (Wroclaw) |
| Software testing foundations, test design techniques | 40 | 26 | 40 | 35 |
| Test methodology | | | | 25 |
| Test automation | 40 | 50 | 50 | 50 |
| Test management, test documentation | 30 | | 30 | 25 |
| Networks | 20 | 82 | 20 | 55 |
| Databases | 20 | | 20 | |
| Programming | 30 | | | |
| Operating systems | 20 | | 20 | |
| Preparation to the ISTQB Foundation Level exam | | | 20 | |
| Soft skills in testing | | 14 | | 10 |
| Project seminar, additional trainings | | 28 | | |
| Total | 200 | 200 | 200 | 200 |

Stowarzyszenie Jakości Systemów Informatycznych (Society for Quality of Information Systems, SJSI) supports these studies. Most of the lecturers are the members of SJSI, they are ISTQB certified testers and they try to share their knowledge with students studying in different locations. At the moment a new ISTQB portfolio is presented to the students to explain possible paths of their careers in software testing.

Students have an opportunity to take the ISTQB CTFL exams on special prices, much less than the market prices. Authors of the best graduate projects have this

opportunity for free; they also have a possibility to present their papers on Testwarez – the biggest testing conference in Poland (about 300 participants each year) as guests of SJSI.

## 5    Conclusions

In this paper we described the present state of the software testing postgraduate studies in Poland. We analyzed the curricula and the candidates' profiles, experience and expectations. Some students attending software testing studies have an IT background, but most of them come from completely different fields. At present, salaries for software developers are usually higher than for testers or QA engineers. This is because quality assurance and quality control, in the employers view, are still underrated. However, recently this trend has started to change. We believe that in a few years quality assurance and quality control in Poland will become a mature and respected field of software development. Therefore, the salary disparity will start to vanish. As there will be a need for more experts in the field, postgraduate studies in software testing run at mathematics and computer science faculties are a big necessity. Such initiatives will have a direct influence on the quality of the software developed in Poland.