

# Management of Mobile Web Application Development with Quality Assurance

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**Abstract.** Mobile applications are becoming increasingly used because of the multitude of existing mobile devices. Mobile application development becomes more complex. For mobile devices there are native applications that run directly on the device, web applications accessed via mobile browsers and hybrid applications. Mobile Application Development in any form should be made with quality assurance since when determining the target group and the application architecture. Management of mobile application development is the result obtained and the quality of applications developed in the decisions taken. In this paper decisions made in the development of mobile web applications are presented and how this mobile web application is used by the students.

**Key-Words:** Development, Management, Mobile Web Application, Quality

## 1. Quality of mobile application

According to [1] the quality represents all characteristics and essential aspect under which one thing is distinguished from others things.

Quality is summing up of features for selected object to be used over other similar objects.

In [2], [3], [4] quality of software applications is defined as the extent to which they satisfy user requirements through technical, economic and psycho-social characteristics.

Quality software is summing up features to software chosen by users to be used against software that solves similar problems. Software applications features are its properties that users are sensitive and they attach high importance in the use. The quality characteristics are:

- **mode of interaction** represents the using of adequate controls for application such that the user will have a normal natural mode of interaction with the application;
- **commands speed** represent how quick is the application in solving the issue; the speed of commands is influenced by the data processing performed following commands; data processing solve the problem without using unnecessary variables or unnecessary actions;
- **interaction time** is a characteristic which implies the period spent to resolve a problem using that mobile application; for that data processing should be short and properly;
- **drive ability** requires the application to be as close to the user, to be easy to use and easy to handle; for that in the development

process of the application should be used controls which make a natural interface of the application;

- **volume of provided information** is characteristic by which is measured the amount of useful information is provided to the user though screen of mobile device;
- **errors management** or tolerance to errors is the degree to which the application continues to function despite invalid input without harming the user and the degree to which the system is operational in spite of hardware or software failure;
- **self-healing** determines the time required for recovery application source code attacks and damage systems;
- **integrability** is the ability to develop applications on modules which are then integrated into a comprehensive system and used by end users;
- **data security** is the ability to conserve all resources to the parameters defined by the developer and user;
- **transactions security** is the ability to manage correct all the trades on the internet or though GSM channel; the transactions should be made though trusted channels and trusted protocols.

For an application as these features must be provided even during its development.

## 2. Mobile multi-platform development

The mobile universe has been changing continuously since the first mobile device appeared and nowadays many of the limitations that once prohibited the development of rich mobile applications are gone. The flagships of the major producers have now FullHD screens, few gigabytes of RAM, lots of internal storage and quad-core CPUs of high frequency. The median screen size has grown since the touch jumped in and 5" screens are almost as common as 4, 4.3 and 4.5 inches.

The only limitations still in action are the data transfer limitations and battery autonomy. As wireless networks are available everywhere a mobile connection is not really needed for large downloads. Continuous data connections are needed only for applications that function on client-server model. Battery technology has also evolved in time, but the progress is not in line with the other hardware components. Nowadays smartphones have batteries of around 2000 mAh that, with continuous data connection can last around 8-10 hours and medium usage.

As most of the limitations of the mobile world disappeared the development must also take advantage of the new situation and create rich applications. Users are in a continuous search for new applications that bring new ways of interaction and presentation of information. Even if hardware limitations are almost gone, the screen size is still a limiting factor. The screen resolutions increased over time, but the size growth rate was much lower. The increased resolution allows developers to present much more information on the screen, but due to small physical size, the controls' size must be kept constant. This leads to the fact that the gain in resolution brings just small changes in the quantity of information that fits on the screen.

Nowadays the main players in the mobile operating systems are iOS, Android and Windows Phone. Each operating system has its advantages and disadvantages and each has development particularities.

There are frameworks that allow the development of applications for all three platforms at once. Titanium Appcelerator and PhoneGap can be used to develop applications on Windows, Linux or MacOS and export the applications for most mobile operating systems.

Due to the high fragmentation of mobile hardware, the application development must rely on relative placement and sizes of controls and high customization of data displaying controls.

As the resolution of the screen determines how much information can be distinguished on the screen the developers must test their applications on devices with different resolutions to be sure the data is readable. On low resolution screens the quantity of data that can be shown is lower than on medium resolution screens. The difference between medium and high resolutions is minimal as the information still must be kept at a certain size in order to be easily readable by users. As manufacturing technology advances, in a few years the resolution limitation will also be abolished and the developers will be free of testing their applications under different screen resolutions to see if the data fits in and is readable or addition customizations are needed. PhoneGap and Titanium Appcelerator are perfect for developing applications when there's no need to worry about low screen resolutions.

PhoneGap and Titanium Appcelerator can access most of the smartphones' sensors and input mechanisms. Table 1 shows the APIs PhoneGap has for accessing smartphone hardware on most popular mobile operating systems.

Table 1. PhoneGap access to phone's functions [5]

	iPhone 3GS and newer	Android	Blackberry OS 6.0+	Windows Phone 7+8	Symbian	Bada
Accelerometer	✓	✓	✓	✓	✓	✓
Camera	✓	✓	✓	✓	✓	✓
Compass	✓	✓	X	✓	X	✓
Contacts	✓	✓	✓	✓	✓	✓
File	✓	✓	✓	✓	X	X
Geolocation	✓	✓	✓	✓	✓	✓
Media	✓	✓	X	✓	X	X
Network	✓	✓	✓	✓	✓	✓
Notification (Alert)	✓	✓	✓	✓	✓	✓
Notification	✓	✓	✓	✓	✓	✓

(Sound)						
Notification (Vibration)	✓	✓	✓	✓	✓	✓
Storage	✓	✓	✓	✓	X	X

Titanium Appcelerator and PhoneGap support HTML5 and JavaScript for application development, but also other languages such as Python, Ruby.

Developing mobile applications in HTML5 and JavaScript is a great advantage for the developers that have lots of experience in using these technologies under the web environment. Also, the applications are written once for all platforms and deployed with minimal effort. Thus, time is saved both in the code development and testing stages and also in the deployment of the applications for the different mobile platforms. Having many experienced web developers that develop applications using HTML5 and JavaScript leads to an increase in the quality of the applications that are deployed in the application markets of iOS, Android, Windows Phone and the rest of the mobile operating systems. Nowadays the mobile operating system is not mainly defined by its functionality or ease of use, but by the application ecosystem. Users will avoid operating systems that lack applications, even if they don't really lack one they use, because they see the lack of applications as a lack of support for that operating system in the future. Also, many users just give applications a try and like to have something new every day. Taking into consideration this aspect the three mobile operating systems will probably be the only successful ones on the market for a long time. New mobile operating systems can hardly compete with them without a solid application base.

### 3. Development management of mobile applications

According to DEX [1], management is the activity and the art of lead all activities of the organization, leadership and administration of activities.

Management represents a mode of organization and administration of all activities to obtain expected results.

Quality management is way of organizing the activities for the production of high quality products.

Software quality management represents the organization and administration of software

development stages to obtain high quality applications.

Quality assurance applications aims at the whole process of software development and at every step are taken decisions aimed to ensure higher quality of the final product.

In [6] the developmental stages are presented, and besides normal stages is included emulator testing by developing applications for mobile devices:

- **establish target group** is the stage where it is assured feature generality of the application by determining the persons who will use the application to be developed;
- **defining the problem** is the stage which aims to ensure quality throughout the generality feature of the application by defining the problem to be solved according to the needs of the target group;
- **development of specifications** is the stage where software quality is ensured by tracking features:
  - errors management by ensuring operation in case of errors;
  - security by establishing specifications that respects specific security software applications;
  - integrability by setting the input and output elements according to the output and input elements of applications that wish to integrate.
- **development of solutions** is the stage where software quality assurance is done by tracking features:
  - errors management by providing optional solutions in case of errors;
  - maneuverability by providing solutions on application interface; solutions which provide an easy application usage by users;
  - self-healing by establishing implementing solutions that provide application recovery in the event of attacks or damage applications.
- **encoding** is the stage where software quality assurance is done by respecting the specifications and solutions developed in previous stages;
- **testing** is the stage where software quality assurance is done by tracking feature of accuracy, it follows that the application does

not contain errors, testing is done both in the emulator and in real environment;

- **implementation** is the stage in which application quality is assured through a good training for users on the application;
- **maintenance** is the stage where quality assurance is done by solving errors occur during the use or implementation of the application modules needed.

Therefore quality assurance is present throughout the development process.

## 4. Application for Mobile Web Learning

MLearning or Mobile E-Learning how is named in some papers allows the access of users to the information through Internet using mobile devices like phones, smartphones, PDAs, laptops, tablets[7], [8]. MLearning on the project implementation for application software quality was assured throughout the entire development process so decisions at each stage are presented in Table 2.

Table 2. Decisions taken for software quality assurance

Stage	Decision
<b>Establish target group</b>	It is chosen to develop a website to run on all platforms of mobile devices through web browser. The application is designed for: <ul style="list-style-type: none"> <li>• teachers who want to upload subjects and evaluate student performance mobile phone;</li> <li>• students who want to find grades and homework posted on the platform wherever they are via mobile phones.</li> </ul>
<b>Defining the problem</b>	Influence of mobile technologies in learning systems
<b>Development of specifications</b>	<ul style="list-style-type: none"> <li>• in case of occurrence of certain errors in the system the user is redirected to the home page;</li> <li>• logging into the system is through username and password avoiding unauthorized entry into system;</li> <li>• pages for information display are designed for mobile devices, so the number of controls within a page is reduced.</li> </ul>
<b>Development of solutions</b>	<ul style="list-style-type: none"> <li>• easy navigation between pages;</li> <li>• be possible to return to the previous page of each page;</li> <li>• application to be developed in modules for efficient self-healing and integrability of the application;</li> <li>• portability is ensured by a website that is visited through a browser; thus all mobile users will have access to the application.</li> </ul>
<b>Encoding</b>	The application is developed in PHP with MySQL database; this database system is on the server; in [9] databases for mobile devices are presented.
<b>Testing</b>	To verify the application runtime for most users it is tested through multiple mobile platforms and each platform used multiple browsers.
<b>Implementation</b>	The application is in Romanian language so that it is easier for users to understand messages transmitted in application.
<b>Maintenance</b>	When running problems occur, they are corrected for the application to run at normal parameters.

The modular structure of the developed prototype application is shown in Figure 1. This prototype application represents the result of all decisions presented in Table 2. The application

presents also the module for the site administrator. This module is not part of the topic approached in this material.

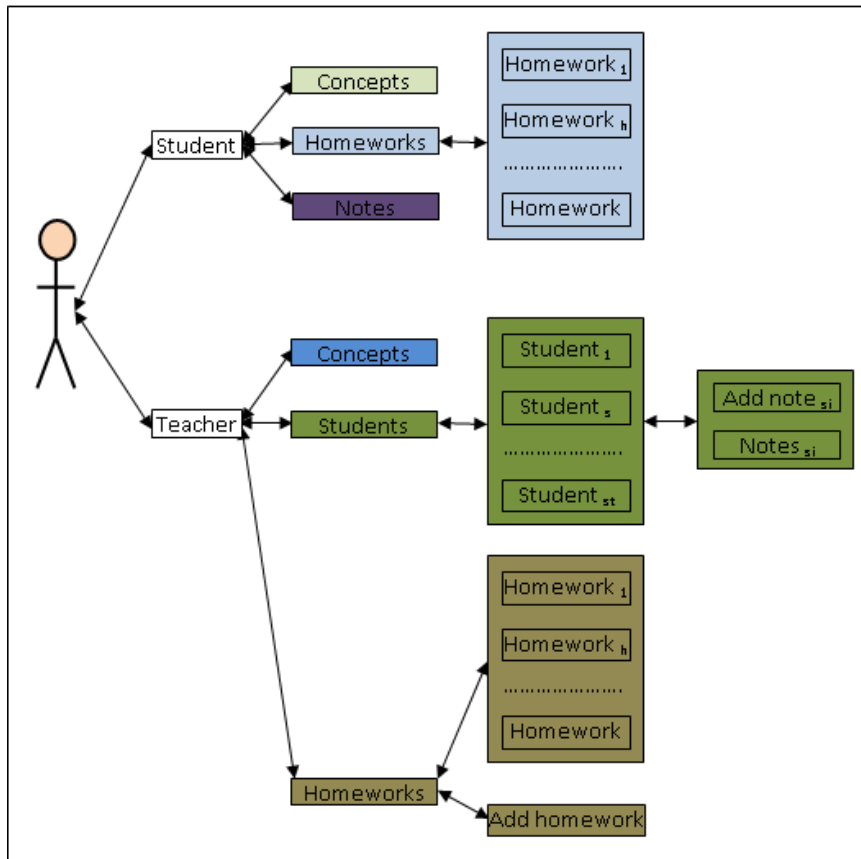


Figure 1. Modules of M-Learning application

Table 3. Operating systems accessing mobile E-Learning

Operating System	Percentages of total accesses
Android	37%
Blackberry	5%
iOS	7%
Symbian	38%
Samsung	7%
Windows phone	6%
<b>Total</b>	<b>100%</b>

When logging the user is redirected to the student or teacher page depending on the type of user logged in. From the main page the user has access to all pages and modules of the section to which the user has permission.

In Table 3 the percentages of accesses for each specific OS mobile devices are presented. Access on the platform is allowed only for mobile devices. So if the user has tried to access the platform from a normal computer, the user was redirected to a page that was notified that the platform is designed for mobile devices.

In Table 4 the browsers installed on mobile devices that accessed the platform are presented.

The platform was developed with an automated acquisition of data information about the activity of students on the site. For every action that happens on the platform is automatically saved client information about the mobile device, operating system and mobile browser in use, the time when it is performed and what operation is realized.

Table 4. Browsers accessing mobile E-Learning

Mobile Browser	Percentages of total number accesses
Android Browser	31%
Blackberry	5%
Crios	2%
Dolfin	3%
Firefox	6%
Nokia Browser	22%
Opera Mobile	24%
Safari	7%
<b>Total</b>	<b>177</b>

Besides *Nokia Browser* and *Android Browser*, browsers that are native to mobile devices, the browser *Opera Mobile* is highly used. This is a

browser developed by *Opera Software Company* for multiple platforms. Table 4 is graphically represented in Figure 2.

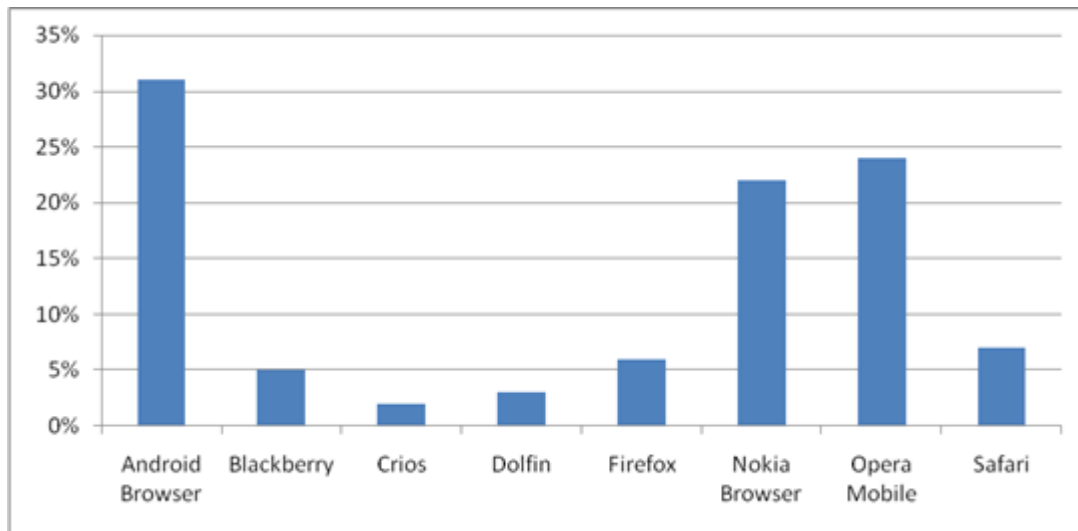


Figure 2. Browsers accessing mobile E-Learning

For usability and knowing how to organize content in a web application designed for mobile devices is very important to know the screen

resolution of mobile device. In Figure 3, screen resolutions of devices that access the platform are graphically presented.

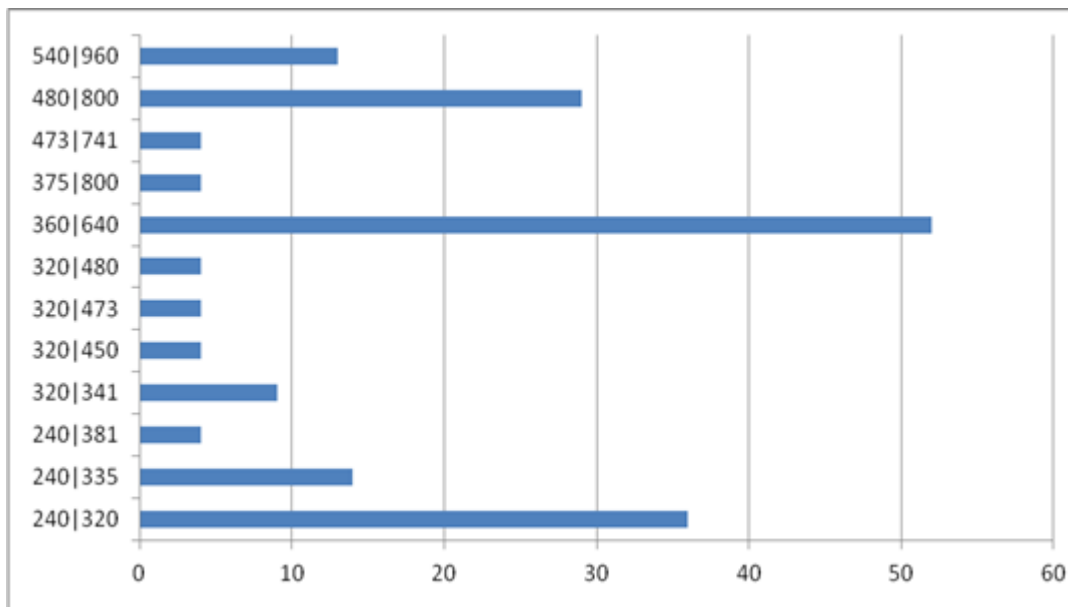


Figure 3. Screen resolution

Mobile E-Learning Platform has been viewed most often on devices with a screen resolution of 360|640.

## 5. Conclusion

During the last decade the mobile devices evolved as no other category of electronics has.

Their computing power, both in terms of processing power and available memory expanded at rates unimaginable ten years ago. The availability of mobile operating SDKs that ease the application development has led to a boom in the mobile applications development. Android, iOS and Windows Phone are the main competitors in the mobile OS sector. iOS is used by Apple and given the popularity of their devices, the application development sector



increased steadily ever since the first version. Windows Phone gives developers the opportunity to use their existing knowledge of C# and the framework. Android runs applications written in Java so the great community of Java developers just has to learn the framework in order to start developing for mobile devices.

Mobile development, though, does not imply only knowing the programming language and framework. Without permanent alignment with the quality characteristics the users price more, development is a process without aim or useful result. Taking into consideration the quality characteristics users price most in the development stages and trying hard to get them at their highest point leads to a useful product on which the user experience is top notch. The success of an application is given, ultimately, by the number of users, and in the social environment we live in today, no application lasts long unless fulfilling the users' needs. Quality is what users expect even over than functionality.

### Acknowledgement

Parts of this paper were presented by the authors at "12th International Conference on Informatics in Economy, Education, Research & Business Technologies", Bucharest, Romania, 25-28 April 2013.

### References

- [1] Dex online: [www.dexonline.ro](http://www.dexonline.ro)
- [2] Linda Northrop, *Let's Teach Architecting High Quality Software*, 19th Conference on

- Software Engineering Education & Training (CSEET'06), 2006.
- [3] Narasimhaiah Gorla and Shang-Che Lin, *Determinants Of Software Quality: A Survey Of Information Systems Project Managers*, Information and Software Technology, nr 52, pp. 602-610, 2010.
- [4] L. Cai, X. Xie and S. Huang, *Software Quality Model Development-An Introduction*, ESEP 2011: 9-10 December 2011, Singapore, pp. 8749-8758, 2011.
- [5] PhoneGap Official Website - <http://phonegap.com/about/feature/>
- [6] Ion Ivan, Catalin Boja and Alin Zamfiroiu, *Self-Healing for Mobile Applications*, Journal Of Mobile, Embedded And Distributed Systems - JMEDS, vol. 4, nr. 2, 2012, pg. 96-106
- [7] Farhan Obisat and Ezz Hattab, *A Proposed Model for Individualized Learning through Mobile Technologies*, International Journal of Communications, vol. 3, nr. 1, 2009, pp. 125-132.
- [8] Faranak Fotouhi-Ghazvini, Rae A. Earnshaw, Ali Moeini, David Robison, Peter Excell, *From E-Learning to M-Learning – The use of Mixed Reality Games as a New Educational Paradigm*, International Journal of Interactive Mobile Technologies, vol. 5, nr. 2, 2011, pp. 17-25.
- [9] Paul Pocatilu, *Building Database-Powered Mobile Applications*, Informatica Economică vol. 16, no. 1, 2012, pp. 132-142.