Portability Approaches for Business Web Applications to Mobile Devices: A Systematic Mapping

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Abstract. Applications on mobile devices have had an exponential grow; however, there are business legacies 1.0 that have not migrated or have not been adapted due to the operating or economic cost involved in the required migration. The companies are not often aware of the benefits the mobile applications have to generate new business models. This paper aims to study the different approaches used in the portability of web applications 1.0 to mobile devices in the last decade, in order to identify the edges and perspectives of the area. A systematic mapping is carried out on the main databases in the area, such as SCOPUS, IEEE, and ACM. 44 articles are selected from 824 initials and are classified with respect to the approach, the type of research and contribution. This systematic review shows that while the technical achievements on the mobile development have been outstanding, there are still many issues to be solved for migrating Web applications.

Keywords: Portability approach · Web application · Systematic mapping
Mobile devices

1 Introduction

The companies have taken advantage of a series of benefits with the new business models that arise from Web applications 2.0 [1], positioning the end user as the protagonist, and the Web 3.0 [2] providing the semantics and the cloud. Some advantages of the e-commerce are: (i) to make a client segmentation and loyalty in situ

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[3], (ii) to brand image for its positioning in the mind of consumers [4], (iii) the payment using mobile devices at a lower cost through mobile business applications functioning as extensions of an organizational core, among others. Unfortunately, there is still a system barrier and a lack of standardization [5], so the need for a new unified design with functionality, synchronization, distributed processing has to be proposed [6]. In such a way the end users will not have problems with usability and business achievement of their strategy's goals.

Similarly, there are applications that could be framed within the term Web 1.0 [7]. These applications are characterized by serving static unidirectional content, in which the business website is designed obtaining immediacy in services for customers. The reader must note that there are applications remaining as legacies that have not migrated to modern technologies. Adapting a Web application to mobile can be time-consuming and have a high cost, in accordance with the complexity of building a light mobile app from a business site, avoiding inconsistencies or conflicts with business requirements [8]. With cross-platform, the software development becomes more complicated, because Android and iOS have different SDK, programming logic, and physical devices characteristics. This scenario constrains the designs and will perhaps double the cost [9]. Since legacy Web apps are not properly rendered by mobile devices requiring scrolling and zooming for accessing data and features, this makes the user's experience unsatisfactory. The correct layout on mobile is not the only drawback to solve, mobile applications are also used in a context that involves technical and functional challenges. There are others attributes to improve in the applications like the proactivity that allows the correct recovery of information against the cuts due to the limited connectivity or the distraction of the users. Moreover, the poor usability generates a digital gap enforced by certain aspects such as demographics, economy, education, geographical location and politics [10].

Because of the latter, this topic is increasingly important and it is necessary to investigate the most optimal solutions according to the approaches that emerged through this global problem. In order to provide an overall view of current trends on techniques and approaches we conduct a systematic mapping review which aims at answering the research question (RQ): Which approaches or strategies have been applied in the portability of legacy Web applications to mobile ones? This question motivates the study of the trends in the mobile area and identifying how the problem has been addressed in researches on this subject. The outcome of this research is expected to benefit both the industry and academy with an overview of tools, techniques and approaches which allows migrating systems to mobile solutions. Because the most users today are digital natives. Internet is their main tool, and they have mobile devices: smartphones, tablets and laptops, whereby companies that are not adapted with their business models to mobile devices run the risk of failing in the medium term, these models can arise through mobile applications. At the same way, software engineers without skills to provide optimal mobile solutions will be discarded in the workplace. This article is organized as follows: the related papers are defined in Sect. 2. The review planning is explained in Sect. 3, including the protocol, the research question, the search strategy, and the selection and extraction of criteria from the articles. The synthesis of relevant studies is then presented in Sect. 4. The

discussion is presented in Sect. 5. Limitations are in Sect. 6. Finally, the conclusions and future work are contemplated in Sect. 7.

2 Related Work

By reviewing the literature, several studies were found related to the topics published which are summarized in Table 1. The findings described permit, to establish that most correspond to an informal literature, surveys or comparisons without defined research questions, without a search protocol that is evidenced or can be replicated for the extraction of information as a process of analysis of data.

Table 1. Main characteristics of related works

Author	Evaluation/Future work
Zimmerman et al. (2009)	Find the drawbacks of applications in the devices with small screens, which need to be deepened: legibility of the typography, the icons, the size, and orientation of the screen, navigation problems and audio that should be included in certain elements to increase understanding. Development a pilot project about a health application
Zhang et al. (2011)	Classify, synthesize, and compare the pros and cons of the main methods of adaptation. It raises 10 general guidelines to develop a method of adapting web pages for mobile devices
Alshahwan et al. (2011)	Experimental tests were performed between a SOAP architecture and another REST. Poses as future work, control the download process and find strategies to select an Auxiliary Mobile Host (AMH)
Deuschel et al. (2016)	Evaluate the applications covered with the main aspects of spatial perception: resizing and screen transition
Younas et al. (2016)	Survey examining the main model-based development approaches. Evaluation through phase compliance. (i) Requirements. (ii) Analysis. (iii) Design. (iv) Implementation. (v) Tests
Siebra et al. (2017)	The result of the review of 247 articles, was a classification scheme that merges the analyzed approaches. The authors conducted an experiment to assess the user experience of disabled people using the scheme

The systematic mapping presented in this document is different from previous studies because the goal is (i) to strictly compile the portability methodologies of business applications to mobile; (ii) to limit the period of time to the last 11 years (2006 period of introduction of the term Web 2.0 [7] to 2017). The procedure was carried out through a protocol performed in a systematic and rigorous manner, following the guidelines provided by Petersen [11], Kitchenham [12] and Brereton [13]. These guidelines aim to present a fair evaluation of a research subject using a reliable, rigorous and auditable methodology. The next section of this paper addresses the planning of the review, which includes the main objective, the research question, and

the search string. Also explains the digital libraries used, the search period and the preview results. Finally details the inclusion and exclusion criteria.

3 Review Planning

The main objective of this systematic mapping [11] is to obtain an overview perspective of the portability of Web applications to mobile that allows determining the state of the topic and especially to focus on the current weaknesses to determinate future researches. According to Kitchenham et al. [12], a Systematic mapping study (also referred to as a scoping study) corresponds to a broad review of primary studies in a specific topic identifying what evidence is available on the topic. Based on the RQ "Which approaches or strategies have been applied in the portability of legacy Web applications to mobile ones?" the search terms are shown in Table 2, keywords and synonyms that compose the question were built based on Brereton et al. [13] steps that use the PICO criteria.

Table 2. Search terms

PICO	Keywords	Alternative words
Population	Portability	Adaptation, modernization, migration, transformation
Intervention	Legacy Application	Web application
Comparison	Mobile	Multi devices, small screens
Outcomes	Approach	Framework

The search string is: (Portability OR Adaptation OR Modernization OR Migration OR Transformation) AND (Legacy Application OR Web Application) AND (Mobile OR Multi devices OR Small Screens) AND (Approach OR Framework).

3.1 Search Execution

The search was centered in the period 2006-2017 because in 2006 emerged the concept of Web 2.0, introduced by Tim O'Reilly, and in 2007 the first iPhone was released setting the current mobile architecture. SCOPUS, IEEE Xplore, and ACM Digital Library were used to recover investigations endorsed by Institutes or Organizations that establish standards for the development of mobile apps, are the most representative in the area. Besides SCOPUS already includes the largest publishers in the world, such as IEEE, Elsevier, Emerald, Springer, and Wiley. However, technical reports, doctoral theses or unpublished results were not considered and also the Google Scholar search engine was not used because the results include gray literature. The search resulted in 824 articles: 355 in Scopus, 169 in IEEE and 300 in ACM.

3.2 Selection of the Investigations

First, the title and summary of the resulting studies gathered from index systems were carefully reviewed, and then irrelevant documents were rejected. If the researchers did not agree, the study was included or analyzed with the help of an independent mediator. The full papers were read to get a final list of the studies reviewed with respect to the defined inclusion/exclusion criteria:

(i) Inclusion criteria: Documents that meet the search string: journals, conferences and workshops, written in English and published from January 2006 to December 2017 (inclusive).

(ii) Exclusion criteria: Papers will be excluded from the study if they are: (i) papers out of topic, documents that do not focus on portability of web applications to mobiles or that were strictly related to hardware, networks or security; (ii) papers that are available only in the form of abstracts, slides, summary of a workshop presentation or surface studies; (iii) papers duplicates (same research in different databases or improved versions); (iv) other studies that mention portability of web applications to mobiles as a general introductory term, and (v) when there is no proposal related to portability among the specifics contributions listed in Sect. 3.4 as conceptual frameworks.

3.3 Scheme for the Data Extraction

In this section, we will introduce data extracted from founded studies and their classification. Later this information will be used for generating the visual summary accordingly to the classification [11]. The data extracted from each study are:

(i) Basic metadata: title, author, and date of publication.
(ii) Type of research (based on Wieringa classification scheme [14]): opinion, personal experience, philosophical, proposal of a solution, validation of the proposal and evaluation.
(iii) Type of contribution (based on Kosar et al. [15] classification scheme [24]): process, model, prototype, tool, framework, mapping, and technique.
(iv) The scope of application: academy, industry, or mixed.

3.4 Synthesis of the Information

A quantitative synthesis method was used to present the results of this systematic mapping, and consists of counting, classifying the studies according to the dimensions and categories defined in the previous sections. The combinations of dimensions and categories are described using bubble charts and bars, statistics and frequency analyses. The next section answers the research question (RQ) evidencing the results obtained after analyzing the studies content.

4 Results

For being the study the first systematic mapping of legacies applications to mobiles corresponds to an important contribution to the subject. Table 3 presents the authors and title of the studies (all the quotes were entered and classified with the help of Mendeley [16]).

Table 3. Results of the research and filtering

No.	Author	Title
P1	Lehtonen et al.	Towards user-friendly mobile browsing [17]
P2	Di Santo et al.	Reversing GUIs to XIML descriptions for the adaptation to heterogeneous devices [18]
P3	Cheng et al.	An adaptive and unified mobile application development framework for java [19]
P4	He et al.	A flexible content adaptation system using a rule-based approach [20]
P5	Ennai et al.	MobileSOA: A Service Oriented Web 2.0 Framework for Context-Aware, Lightweight and Flexible Mobile Applications [21]
P6	Ahmadi et al.	Efficient web browsing on small screens [22]
P7	Kopf et al.	Adaptation of web pages and images for mobile applications [23]
P8	Eap et al.	Personalised mobile learning content delivery: a learner centric approach [24]
P9	Iñesta et al.	Framework and authoring tool for an extension of the UIML language [25]
P10	Xiao et al.	Mashup-Based Web Page Adaptation for Small Screen Mobile Device [26]
P11	Paternò, F.	MARIA: A universal, declarative, multiple abstraction-level language for service-oriented applications in ubiquitous environments [27]
P12	Ueyama et al.	Exploiting a generic approach for constructing mobile device applications [28]
P13	Paternò et al.	Desktop-to-mobile web adaptation through customizable two-dimensional semantic redesign [29]
P14	Armenise et al.	A tool for automatic adaptation of web pages to different screen size [30]
P15	Chmielewski et al.	Mobile interfaces for building control surveyors [31]
P16	Guirguis et al.	A smart framework for web content and resources adaptation in mobile devices [32]
P17	Li et al.	Web page layout adaptation based on WebKit for e-paper device [33]
P18	Koehl et al.	M.Site: Efficient content adaptation for mobile devices [34]
P19	Macbeth et al.	A Middleware Service for Image Adjustment and Filtering for Small Screens [35]

(*continued*)

Table 3. (*continued*)

No.	Author	Title
P20	Rajkumar et al.	Dynamic web page segmentation based on detecting reappearance and layout of tag patterns for small screen devices [36]
P21	Challiol et al.	Crowdsourcing mobile web applications [37]
P22	Shaari et al.	Achieving "One-Web" through customization and prioritization [38]
P23	Amendola et al.	Adapting CRM systems for mobile platforms: An MDA perspective [39]
P24	Chen et al.	Organization and correction of spatial data in mobile GIS [40]
P25	Albasir et al.	Smart mobile web browsing [41]
P26	Yun et al.	MobiTran: tool support for refactoring PC websites to smart phones [42]
P27	Sumit Pandey	Responsive design for transaction banking - a responsible approach [43]
P28	Coondu et al.	Mobile-enabled content adaptation system for e-learning websites using segmentation algorithm [44]
P29	Toile et al.	Adaptation of composite E-Learning contents for reusable in smartphone based learning system [45]
P30	Badam et al.	Polychrome: A cross-device framework for collaborative web visualization [46]
P31	Yang et al.	Panelrama: Enabling easy specification of cross-device web applications [47]
P32	Kovachev et al.	Direwolf: A framework for widget-based distributed user interfaces [48]
P33	Xiang et al.	Effective Page Segmentation Combining Pattern Analysis and Visual Separators for Browsing on Small Screens [49]
P34	Yin et al.	WebC: toward a portable framework for deploying legacy code in web browsers [50]
P35	Tseng et al.	Migratom.js: A JavaScript migration framework for distributed web computing and mobile devices [51]
P36	Sarkis et al.	MSoS: A Multi-Screen-Oriented Web Page Segmentation Approach [52]
P37	Wang et al.	Towards Web Application Mobilization via Efficient Web Control Extraction [53]
P38	Bouzit et al.	Evanescent Adaptation on Small Screens [54]
P39	Miján et al.	Supporting personalization in legacy web sites through client-side adaptation [55]
P40	Favre et al.	Modernizing software in science and engineering: From C/C + + applications to mobile platforms [56]
P41	G. Huang et al.	Programming Situational Mobile Web Applications with Cloud-Mobile Convergence: An Internetware-Oriented Approach [57]
P42	H. Li et al.	Extracting Main Content of Webpage to Enhance Adaptively Rendering for Small Screen Size Terminals [58]
P43	Bosetti et al.	An approach for building mobile web applications through web augmentation [59]
P44	Sarkis et al.	A multi-screen refactoring system for video-centric web applications [60]

The main results of this mapping show a total of 824 works was obtained out of which 681 were found out of topic, 25 as duplicate studies, 8 as conceptual frameworks, 7 as mappings or reviews considered in the related works section, 59 as papers that were purely directed to the development of mobile applications without considering migration. Therefore, 44 studies were considered relevant works for the mapping: 28 from Scopus, 7 from IEEE, and 9 from ACM, which corresponds to 5.4% of the search. This can be justified because SCOPUS is an indexing system, so its engine is more advanced and it includes a series of digital sources including IEEE and several ACM publications, for this reason, there were repeated studies when conducting the search also in IEEE. As for ACM and IEEE, the majority of studies resulting were the improvement of hardware and networks to mobile applications, for this reason, were excluded. Figure 1 presents the type of document: article, conference, and journal. These results show that International conferences are the most recognized events, in which researchers can propose their solutions for the remapping of mobile devices, at the other end, there are publications in journals that because of their high impact have a degree more demanding. Figure 2 shows the area of the studies: industry, academy and mixed. The predominate strategies come from the academy, being traditionally the cradle of entrepreneurship, then the industry, since the sector, both public and private, is the one that moves the economy of the countries. There are also joint works between these two Scopes of activity.

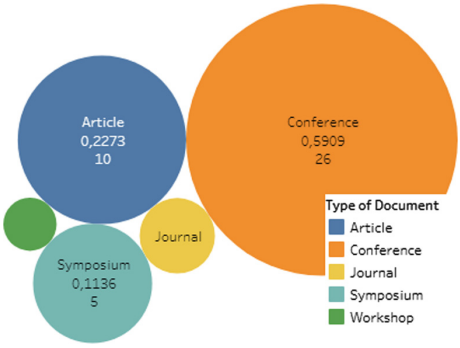

Fig. 1. Type of document

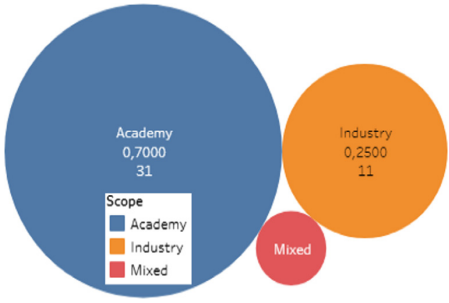

Fig. 2. Scope

Table 4 shows that: (i) 86,4% of the research efforts have been directed towards proposed solutions, (ii) 22,73% in process evaluation, (iii) 6,82% in adaptability process, (iv) 56,82% in verification and validation process, (v) 6,82% corresponds to studies based on experience, (vi) 4,55% with process evaluation, and (vii) 2,27% in verification and validation process. Also, there are validation studies in 6,82%, with adaptability process in 2,27% and modeling process in 4,55%. The main contribution of the studies is summarized in the following way: 45,45%, correspond to contributions that deliver tools, 22,7% correspond to frameworks, 15,92% are techniques, and 15,91% are prototypes.

Table 4. Scope Vs facet of research and contribution

	Experience	Proposed solution	Validation	Framework	Tool	Technique	Prototype
Process evaluation	4,55%	22,73%	0,00%	6,82%	11,36%	4,55%	4,55%
Adaptability process	0,00%	6,82%	2,27%	0,00%	4,55%	4,55%	0,00%
Modeling process	0,00%	0,00%	4,55%	2,27%	2,27%	0,00%	0,00%
V & V process	2,27%	56,82%	0,00%	13,64%	27,27%	6,82%	11,36%
Total	6,82%	86,37%	6,82%	22,73%	45,45%	15,92%	15,91%

Table 5 shows the grouping according to the contribution of each paper where the majority represents tools because allows testing the proposed methodology or solution. Then frameworks, which are a standardized set of concepts, practices, and criteria to approach a type of problem. After that are the techniques, which define procedures to perform software production tasks, and the prototypes are a limited representation of a product, it allows the parties to test it in real situations or to explore its use.

Table 5. Type of contribution

Contribution	Papers
Techniques	P1, P20, P23,P24, P29, P36, P42
Tool	P2, P3, P6, P7, P8, P9, P11, P13, P14, P16, P17, P19, P26, P34, P38, P39, P43, P44
Prototype	P4, P10, P12, P25, P27,P33, P37
Framework	P5, P15, P18, P21, P22, P28, P30, P31, P32, P35, P40, P41

Figure 3 summarizes the approaches to solve the portability problem of the applications, partially or in totally. Most of the researches propose a solution based on DOM restructuration (Studies P1, P6, P17, P18, P20, P25, P30, P33, P37, P39, and P43), then there are solutions based on Model Driven Development (P9, P13, P22, P23, P40). Then, the most used solutions implement Translators (P11, P12, P26, and P34), XML (P3, P4, P8, and P36), Specific Migrations (P2, P24, P29), and Multiscreen development (P7, P16, P31, P44). Only two studies present solutions about SOA (P5, P15). Finally, in the same number there are other solutions like Mashups (P10), Genetic Programming (P14), Artificial Intelligence (P19), Augmentation (P21), Prototypes (P26), Middleware (P28), Widgets (P32), Architecture (P35), Visualization Techniques (P38), cloud computing (P41) and Algorithms (P42).

Figure 4 presents a diagram XY in the category intersections that allow considering several categories at the same time and providing a quick overview of a field of study, scope of the research vs. type and contribution. The most common strategy like the proposed solution responds to how to create, delete, update, and move elements and content of the DOM tree of the pages to achieve personalization according to the

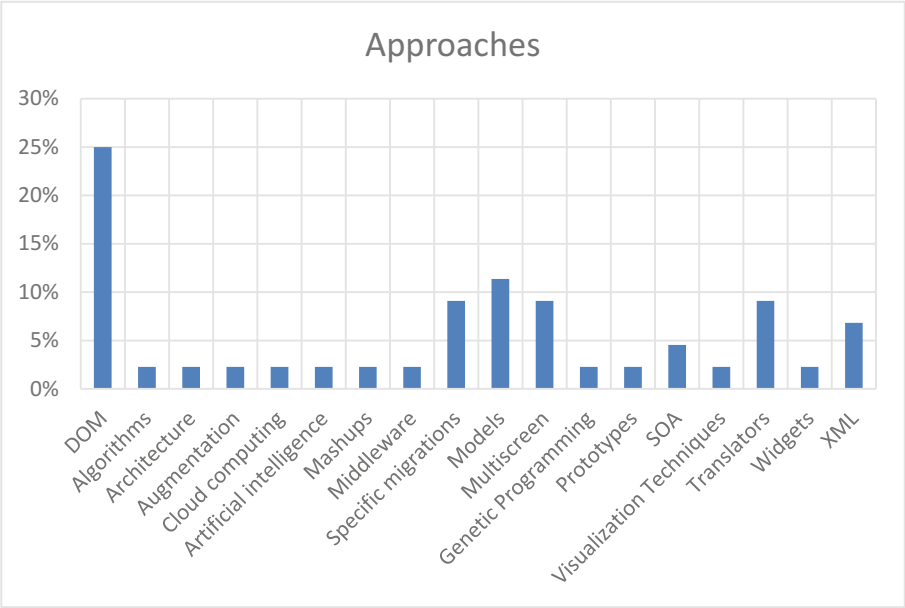

Fig. 3. Approaches

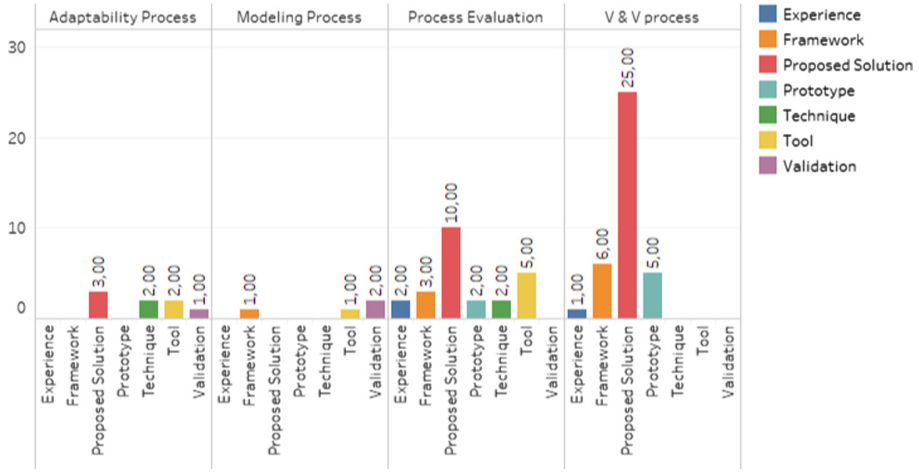

Fig. 4. Research scope vs. contribution

device. Model-driven engineering work (MDE in English) where contributions use metamodels to represent the problem to be solved and model transformations to obtain software applications. This is an efficient solution but it is semiautomatic because requires the programmer's assistance to complete the model whenever something new

is urgent. In the following section, the findings of the mapping are discussed, comparing and summarizing the results of the study and the related works.

5 Discussion

The portability for mobile applications has increased during the recent years, for this reason, the present study was designed to determine the existing approaches from 2006 to 2017 used or generated for the portability of web-to-mobile legacies applications. For being the study the first systematic mapping of legacies applications to mobiles and opposing other investigations and after reviewing the scientific evidence available to date, described in related work Zimmerman et al., it is a literary review and then it investigates the problems of applications on small screens, but not the migration or adaptation of legacies. Zhang et al., it analyzes approaches to adapting web pages to mobile devices, it does not focus on legacies, nor is it a mapping. Alshahwan et al., it focuses on offloading and migration mechanisms in complex environments. Also, it does not focus on legacies. Deuschel et al., is an evaluation of applications adapted to mobile focus on the interface and navigation errors, no legacies are mentioned. Younas et al., these are surveys that cover model-driven development, but others approaches remain outside. Also, it does not focus on legacies. Siebra et al., it is a mapping aimed at detecting errors and requirements in mobile applications for people with some type of disability. In addition, in which no data have been found on the association between the validation field (academy, industry, mixed), the specific contribution of each study (framework, tool, technique) has not been specified. The type of research (opinion, personal experience, philosophical, proposal of a solution, validation of the proposal and evaluation).

The results of this study show that most of the contributions come from conferences papers 59,1% and 4,5% from journal papers. The growth in both mobile devices and social networks has changed the behaviors at the economic and cultural level, especially from 2012. In addition, the years 2009, 2013, 2014 shows on average a percentage of studies correspond to 15% for each one. The distribution of the investigations is mainly found in SCOPUS 64%, in ACM 20%, and in IEEE 16%. This can be justified by the fact that SCOPUS is a database that indexes the work published by various publishers [61] including IEEE and ACM. For this reason, some studies were repeated. In relation to IEEE, it was found that most of the studies framed in the portability to mobile devices with an emphasis on the improvement of hardware and networks, which were excluded for this review. In addition, it can be observed that the majority corresponds to contributions that provide tools 45,5%, then frameworks 22,7%; and with a lower percentage to techniques and prototypes 15,9% for each one.

The approaches are predominantly based on DOM manipulation with 25%. In the second position, the development of model-driven software (MDD) with 11,4% which produces only partially successful proposals, since they cannot guarantee a fully automatic process (a programmer is always required to code the modifications or details that have not been considered or situations that appear). Then, there are specific migrations, multiscreen development, and translators with the same percentage 9,1%. In fourth place come XML configurations. Solutions through SOA services comes

next. Finally, in the same proportion, 2,3% are the algorithms, architecture, augmentation, cloud computing, artificial intelligence, mashups, middleware, genetic programming, prototypes, visualization techniques, and widgets. However, a design with the correct visualization on the screen of the mobile device does not solve all the problem that entails the adaptation to this type of applications. Some factors like the connectivity, speed of response, navigation, information, type of controls supported by the platform (Android vs. iOS) should be considered because an incompatibility on the controls affects the efficiency of the data entry.

The portability is varied; however, there is more emphasis in the adaptation of desktop web applications to mobile web applications, HTML, CSS, JavaScript or Jquery and to HTML5 with the corresponding variants in the types of file. On the other hand, there are improvements to existing technologies such as visualization technologies, genetic programming, among others. Additionally, it is observed that some innovations have been included in the adaptations. For example, the introduction of augmented reality, 3D, and the specific migrations, for example, C/C ++ to Haxe, Cobol to Java Web, Mario Kart 64 of Nintendo to Android, web applications to Python and Php. This study did not detect any evidence about the methodologies for the portabilization or migration of applications developed in licensed tools.

Finally, most of the research efforts have been directed towards solutions that contribute with tools, scope cover assessment processes, adaptability processes, and modeling processes. Additionally, half of the studies propose frameworks for the assessment and modeling processes. The minority of the studies contributes to techniques and prototypes that perform assessment processes and are in adaptability process. In addition, of the items included in the mapping, it can be mentioned that the research and validation methods used correspond to case studies, experiments with users, and also the development of prototypes or pilots. The case study facilitates the validation of the proposed solution when there are several applications in which the methodology was implemented, on the other hand, the evaluation with users generally corresponds to the validation of usability issues and determination of compliance with tasks, prototypes or simulations are suitable when you want to perform a partial test of the methodology or do not have the availability of the required hardware. The problem of threats of study validity and limitations is discussed in the next section.

6 Limitations

The main limitation lies in obtaining results that depend on the use of search tools integrated into the SCOPUS indexing system. Also the scanned digital libraries: ACM and IEEE. Searches were made using search strings defined by terms derived from the research question connected by Boolean operators in the range from 2006 to 2017. During the keyword search process, some sources may have been omitted, because the keywords used by some authors are synonymous with those used in this study. In order to reduce the validation risk of the analysis, the review of the articles was conducted independently by investigators and validated in a cross way. In this way, it was possible to control both false positives and negatives. Another limitation is that the negative results take longer to be published or cited in other publications to a lesser extent,

Kitchenham [19]. The next section provides a series of conclusions drawn from this study from this mapping and recommendations for future studies.

7 Conclusions and Future Work

In the last years, mobile applications have grown exponentially in all kinds of areas worldwide. These applications are part of the everyday life. This study represents the first systematic mapping that encompasses the portability methodology of legacy web applications to mobile devices during the last decade, selecting 44 papers according to their relevance to the topic. The main result shows that researches are required in order to: (i) have rich interfaces and not just get reformats with basic results; (ii) deepen the creation of tools that apply visualization strategies; (iii) get more use of hardware and intrinsic resources such as camera, geolocation, tactile and non-tactile commands, voice recognition, voice-to-text, mobility, haptic interfaces, holograms with adaptations that improve usability and access.

On the other hand, there is no evidence of any study on methodologies for the portability or migration of applications developed in licensed tools. The management of reports is not studied either, except in the case of visualization strategies of mobile cartography. Instructions must be created to standardize some topics related to the type of letter and other visualization aspects. It is also necessary to strengthen the security of mobile applications that manage core business with sensitive data. It was not observed the use of sensitive analysis tools or the adaptability of business workflows to mobile workflows or Markov models [62]. Finally, there are the need to create emergent protocols that can achieve connectivity without the Internet, that is, sustainable, ecological and progressive applications. In addition, there is a future planning to make a revision systematic of the literature to can describe plus deep each study with his efforts and gaps. To end, it is recommended to follow up the works that leave guidelines or conceptual frameworks to determine if already they were actually used or are pending implementation.

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