

# Management of Knowledge –Base Systems in Desktop and Mobile Learning Environments

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## Abstract

*The authors present a comparative approach between the user interfaces of knowledge databases developed for desktop and mobile access, underlying the main similarities and differences, with the purpose of sustaining sound practices and increase transfer and accessibility to the mobile arena.*

*Collaboration is a key element in providing improved performance and quality of activities both in educational and business settings. As result of the work for MOBNET-Learning research project, this article explores the dimensions of building collaborative systems based on mobile technologies as a tool for sustaining interactive environments that comprises wireless communication technologies and mobile terminal devices for the real time access to knowledge database.*

**Keywords:** Knowledge creation and dissemination, Mobile Knowledge Management Systems, Mobile user interface design

## 1 Introduction

Knowledge management (KM) emerged from the world of academia and became a burning issue for business and technology leaders in the last decade. Although a factor of improvement, knowledge management has not been largely embraced by organisations. This paper explores the importance of creating a dynamic management system, not just a storage capacity for accumulated knowledge, although at times useful. KM enables taking informed action in previously unencountered/ unknown circumstances. MOBNET-Learning is a research project developed by “Carol I” National Defence University in Bucharest in partnership with Advanced Technology Systems, the Research Institute for Artificial Intelligence of the Romanian Academy and other 2 private companies. MOBNET-Learning Project explores the potential of knowledge in the mobile learning environment. In this paper the authors examine the shift to mobile knowledge. In recent years there has been a major transformation in how formal and informal communication is disseminated by electronic means and the mobile learning environment is already based on standards (O’Connel and Smith, 2007).

MOBNET-Learning Project comprises a learning management system and a knowledge management system (Roceanu et al, 2009).

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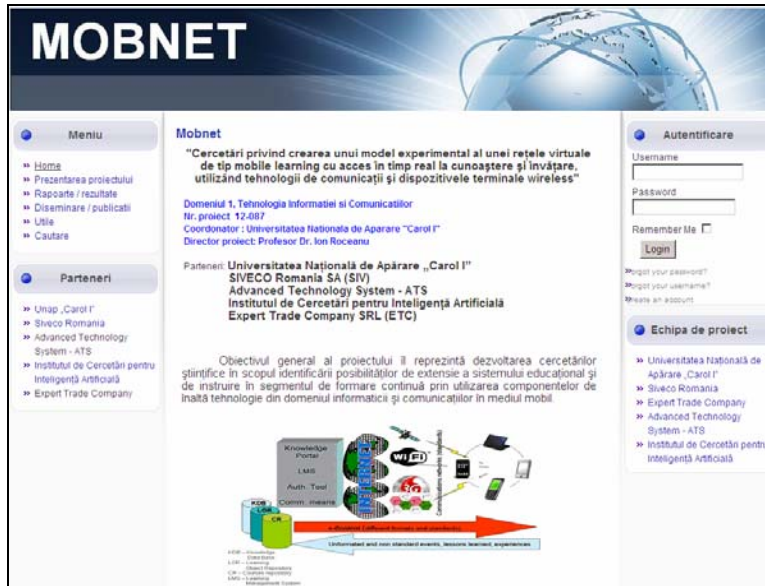


Figure 1. The Web site of MOBNET-Learning Project

## 2 The potential of Mobile Environment for Knowledge Organisations

Knowledge management has slowly matured mainly within global organisations, sometimes as executive information portals, content management or intellectual capital. Successful KM practices came to include *portals*, *e-learning*, *e-analyses and content management* (Guy, 2009). In the current economic climate, organisations are realizing that leveraging the already accumulated corporate intellectual property is by far the lowest-cost way available to increase their efficiency and competitive stature, in the case of companies. In a knowledge-based society and economy, knowledge management is the critical element in the strategy of organisations that will allow them to accelerate the rate at which it handles new challenges and opportunities, and they do so by leveraging the most precious of resources, collective know-how, talent and experience – intellectual capital.

Organizations are no longer valued solely for what they have done – but the potential of what they might be able to do. The promise and interest in knowledge management is not in knowing, but in being able to act creatively based on what you know and you are able to access. Innovation results from knowledge that it why it is important to consider the infrastructure behind knowledge management. The raw goods of intellectual property – experience and know-how – must be channelled and made available. This is a very real problem for many organisations.

Consider the issue that NASA faces. Virtually the people involved with the Apollo projects are not active anymore. With them went the know-how on how to land a man on the moon. While the planned approaches were captured, the dynamically acquired knowledge base that emerged through facing the challenges that each Apollo mission

presented were not captured anywhere (Frappaolo, 2006). Knowledge management systems answer to the need to capture and monitor ever-developing bodies of intellectual capital, and to promote its leverage by communities of practice. The advent of Internet as a worldwide common interface is making this vision possible, but it also raises the bar on the scope of success and failure. Knowledge has become the key economic resource and the dominant and perhaps the only source of competitive advantage in a developing knowledge society (Toma et al, 2009). At the same time, the practices in accessing knowledge and information have changed, particularly in the use of search engines, digitized resources and mobile environments. The authors consider that the simple growth and proliferation of outputs does not lead straightforwardly to a richer and more diverse information and knowledge environment. This paper defines the settings for the implementation of the knowledge and the considerations for achieving a comprehensible knowledge infrastructure.

### 3 The Development of the Mobile Knowledge Management System

Information and communication technologies provide tools to optimize the use and to increase the value of captured knowledge. Contextual learning requires specific, timely knowledge and, at the same time, generates valuable input data. Most of the times this contextual knowledge cannot be accessed or is lost due to the lack of adequate access/collection systems available in the mobile environment (Stănescu and Ștefan, 2008). One of the goals of the MOBNET-Learning Project is the development of a knowledge acquisition and retrieval system that operates as a mobile learning assistant, allowing users to access mobile knowledge when and where they need it, filling the present gap in the access chain. Learners will use the mobile knowledge management system in order to be able to fulfil their tasks quickly and more efficiently, as the system filters information by various criteria, facilitating access to specific knowledge.

#### 3.1 Mobile Knowledge Management Systems Architecture

The system uses a common database for both the knowledge management system and the learning management system. This improves the results of the search and allows an easy administration of knowledge and learning objects and a unified access from the users' standpoint.

The knowledge is accessed via a mobile Graphical User Interface built according to best practices issued by the World Wide Web Consortium (W3C). The mobile website is developed based on the Microsoft .NET Framework using ASP.NET and C#. For the backend, the developers have used Microsoft SQL Server 2008 as the database engine.

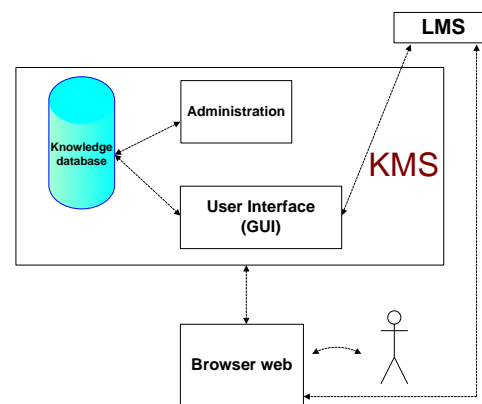


Figure 2. Mobile Knowledge Management System for MOBNET-Learning Project

### 3.2 Mobile Knowledge Management Systems Main Functionalities

The Mobile Knowledge Management System (m-KMS) provides access to information via a Web-based Graphical User Interface available in desktop and mobile environments. Access rights were considered as follows:

- *A private section*: in order to be able to benefit of the full potential of the KMS, users need to create an account; thus, the uploaded content and the related added comments can be user-related and reader rated as competency in concerned; users and content can be rated; this increase the trust level for the accessed knowledge.
- *A public section*: the application manages a public section that comprises general information of public interest (news, articles, etc.) and access to certain bodies of knowledge, declared as public by the issuing party; the information can be accessed directly, without being logged into the system.

Management of knowledge includes management of users, management of data classified by domain, author, date, relevance, management of knowledge acquisition.

The m-KMS provides advanced searching options: by *keyword*, *full text search*, by *topic* and by *similar articles*, to target the preferences of a larger group of mobile users. To improve the user experience, the systems allows refining of search results by applying search criteria progressively, against the current result set.

While reading an article, users are provided with links for terms on which the system can provide further information. This feature is valuable especially for mobile users which are constrained with regards to the input methods that their device provides. At the end of an article, users are also provided with links to other related articles and information on where to obtain further data. Over time, users are likely to refer to the same articles multiple times. This is particularly valid for articles that include mathematic formulae and large tables that are impractical or hard to memorize. To speed up access for these articles, users are provided with a complete history of previously visited articles as well as with the possibility of creating multiple article favourite lists based on topics of interest.

The m-KMS also allows learners to capture new information by providing different forms of input such as text, sketches, recording of messages or photos. To use the potential of this data collection process, the system allows the user attach feedback to existing articles and also to create new articles. The user also has the option to automatically attach relevant information such as localisation, or a history of the most recently accessed articles.

### 3.3 Mobile Knowledge Management Systems Technologies

These are a few of the key features of the mobile knowledge management system that is developed by the MOBNET-Learning Project. The system aims to build adaptive learning resources reconfigurable based on the device attributes and users' preferences and to provide mobile learners with knowledge in the Romanian language, becoming a start-up project in this domain.

The m-KMS is developed using Java Enterprise Edition (Java EE). Unlike native applications that access the operating systems and the hardware resources directly, Java applications are executed by a virtual machine (JVM - Java Virtual Machine). Thus, they are isolated from native access and they can access only Java libraries or the functions of

the virtual machine. The virtual machine contains the Java Runtime Environment that represents all the standard functions and libraries provided by Java.

Java desktop applications (Java SE) are executed directly and function similar to any desktop application, while Java EE Application require an application Server (JBoss) than acts as a Web server.

#### 4 Building Mobile Graphical User Interface

The research within the MOBNET-Learning Project focuses in the area of mobile learning environments. Regardless of the settings they operate, users constantly want new features on their mobile phone, such as texting, voice memos, browsing, cameras, music and television, because they would like these things in their pocket and the phone is already there. MOBNET-Learning Project aims to improve the experience of the mobile learner by identifying a flexible blend of devices, technologies and skills required for a better performance.

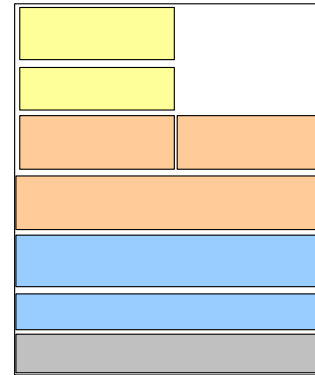


Figure 3. Development platform for m-KMS

##### 4.1 Capabilities and Restrictions of Mobile Devices

Mobile devices represent a key performance factor for accessing mobile knowledge. In the last years, the mobile market provides a wide range of devices from mobile phones, smart phones, XDAs, PDAs, Media Players, notebooks and laptops. The MOBNET Project aims to provide access to specific content and develop optimised knowledge delivery for devices that present significant restrictions in terms of screen size, keyboard access and processing power (Shearer, 2007; Ştefan and Stănescu, 2009).

In order to obtain an enriched user experience when accessing mobile knowledge, the users need to understand *the capabilities* and the technology that their mobile device provides. The large range of mobile devices available on the market today implies that it is basically impossible for developers to target each and every one of them (Lindholm and Keinonen, 2003). This requires future mobile users to consider certain features when purchasing a mobile device. When users intend to access web content on their mobile device, they will benefit most if they choose a device with a web browser based on the same libraries as a desktop browser.

For example, iPhone OS uses Mobile Safari, which is based on the same WebKit libraries as Safari and Google Chrome. The same applies to the Series 60 3<sup>rd</sup> Edition web browser, which is also based on WebKit.

Mobile devices have such a precious screen estate, and developers need to follow the best practices recommended by the W3C and avoid adding extra user interface elements. Given the same URL, one can easily observe the difference between:

1. Mobile browser configured in mobile view mode;
2. Mobile browser configured in desktop view mode;
3. Mobile browser configured in one column mobile view mode with full screen.

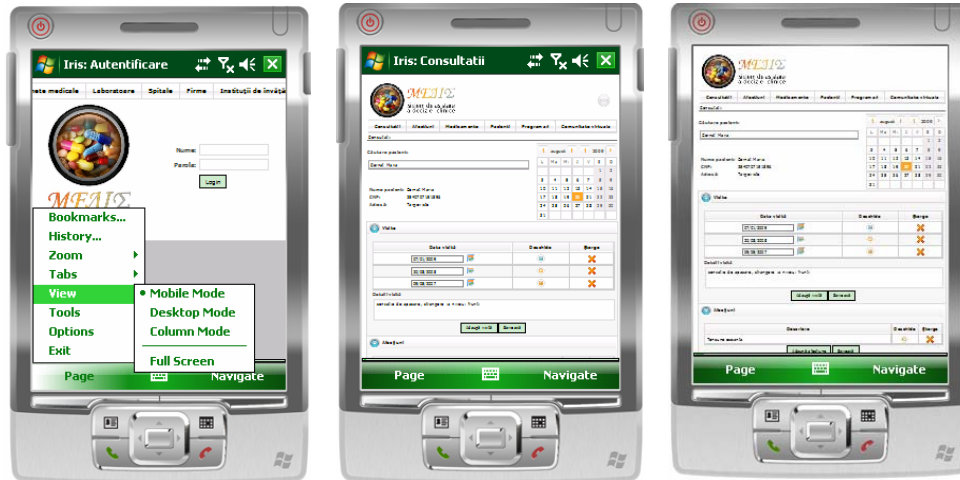


Figure 4. Comparison between different view modes<sup>ATS</sup>

For example we present this figure from a demo knowledge-based decision support system that Advanced Technology Systems has recently developed.

The best experience can be obtained by removing the application's title bars and adapting the content to just one column to allow users to scroll in just one direction.

#### 4.2 Particularities of Mobile Content Delivery

The particularities of mobile devices require solid customization of delivery in comparison to the desktop computers in order to encourage users to become mobile. This is even more to be considered in the learning environment from the perspective of setting course to good practice and implementations of mobile developments.

This section comprises a set of best practices (Rabin and McCathieNevile, 2008; Lumsden, 2008; Shneiderman et al, 2007), that base the design and development of the m-KMS:

-“Content provided by accessing a Uniform Resource Identifier (URI) should yield a thematically coherent experience when accessed from different devices”.

The content should remain the same, regardless of the means used to access it. At most, parts of the content may be missing, if they cannot be made compatible with the client devices.

-“Device capabilities should be exploited to provide an enhanced user experience”. Different devices provide different functions, and these should be exploited to a maximum in order to provide the best possible experience for the mobile user. Adapting the system and/or the content to support specific functions of a device or group of devices allows the user to obtain a better experience.

-“Tests on actual device”s. Because of the vast number of differences between mobile devices, it is best to test the website of as many different phone models as possible. Sometimes the browser implementation can differ greatly for the same phone model, depending of the firmware version installed.

- *“Keep the URIs of site entry points short”*. The web site should be designed with quick URIs that can take the user to a specific page based on content ID. For example, the user can access the address <http://news.mobi/40652> and be automatically taken to the article with ID 40652.

- *“Provide minimal navigation at the top of the page”*. The navigation menu should be designed in such a way to occupy little space but at the same time provide links to the most important pages. It is probably best if content is structured hierarchically to provide the content hierarchy leading to the current page.

- *“Provide a balance structure between having a large number of navigation links on a page and the need to navigate multiple links to reach content. Mobile web pages should include as much content as possible without requiring the user to switch between multiple pages to find the rest of the information.*

- *“Provide consistent navigation mechanisms”*. Use the same navigation mechanism across a service to allow users to identify them easier.

- *“Assign access keys to links in navigational menus and frequently accessed functionality”*. This would improve the mobile experience and will allow users to enjoy it with the help of a single key acting as a single click.

- *“Limit scrolling to one direction”*. This allows the user to experience all the content of a web page without having to switch in all directions.

- *“Avoid large or high resolution images”*. If used, images should be resized at the server. Mobile devices have limited capacities and waiting for a web page to load it is not a welcomed experience.

- *“Do not use frames”*. As many mobile devices do not support frames, the web site becomes inaccessible and the target group is severely and uselessly restricted.

- *“Provide informative error messages and a means of navigating away from an error message back to useful information”*. It is always helpful to know that something went wrong, then to simply get stuck without an obvious reason.

- *“Avoid free text entry where possible, and provide pre-selected default values where possible”*. When referring to online mobile tests or evaluations, free text can be replaced with access keys that point to the correct answer. Also, in designing for small devices, speech input is a viable alternative for devices too small for extra buttons.

When designing for multiple and dynamic contexts the developer needs to consider the environmental conditions where the learner activates, to provide enriched user experience.

## **5 Conclusions**

MOBNET-Learning Project promotes the values and the opportunities that the mobile technologies can bring to the learning environment and the knowledge communities. The Project represents an innovative practice-driven approach for the Romanian research area and aims to become a significant contribution to the implementation of mobile knowledge management. MOBNET Project develops mobile content and systems that teachers, trainers and students can use to complement or as an alternative to course activities whether they occur or not in traditional classroom environments. This paper examines the

implications of the transition of knowledge to the mobile environment in terms of graphical user interface and mobile devices restrictions. A demo version of the m-KMS shall be available online at the completion of the project and users shall be able to provide feedback on their mobile experience.

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