Literature review

**Evaluating User Interface Aspects in ERP Systems – An empirical user study**

This conference report examines the user interface aspects of ERP systems and how these affect the usability of the applications. This is mainly related to how the user interacts with the system and how quickly and efficiently they are able to find the required functionality. Apparently, this problem comes from high “system complexity and difficulties in finding required information”. According to this report’s results, there are “shortcomings in ERP usability” which comes from the past and are still present today. These results also show how users struggle and are in need of an easy to use the navigation system to be able to use these systems more effectively (“information is hard to find”, “there is no guidance within the system”). In such cases, user involvement in the design and implementation process is essential to the “perceived usefulness of the system”. This is supported by the fact that some tests have revealed that the most common problems are visual appearance and unsatisfactory navigation, large memory load and steep learning curve. Such problems “might decrease the enterprise performance significantly”. Additionally, this report shows how different types of menus might impact the user's experience with the application and how effectively execute business functions. There was an investigation showing how different kinds of users and non-users interacted with different kinds of menus and how they affected their experience. However, this does not mean that the findings reveal all the problems related to ERP systems, as it looks only in usability problems related to the user interface. As the authors mention “its reliability and validity are limited: The findings rely on one item per construct only and have not been validated with an independent sample so far”. Despite that I believe it addresses and analyses a very important part of an ERP system.

**Implementing Deign Principles for collaborative ERP systems**

This report by Lucas and Babaian agrees with the previous source about how ERPs have limited usability and need improvement: These systems are “notoriously difficulty for users to operate”. A presented framework which includes a data model and algorithms “that serve as foundation for implementing design principles” addresses the need to provide users with a context in each user interaction. As ERP system have the objective to automate tasks in businesses, usability in an important part of their development. Therefore, it is important to maximize the benefits of automation using a good user interface. This report suggests that it should be possible to easily train users about the usage of the system without them having any prior experience in similar systems. Several similar problems are cited to prove that existing ERP systems have poor usability. Two design principles are used to server as a foundation for several tests. These principles are related to application context and navigational complexity as well as guidance to the user. The tests use a framework to capture and store user interactions with the system as well as recording keyboard and mouse input details. The analysis of these results “provides the larger picture of the many possible ways that users can complete processes within the system”. A limitation of this framework is that tasks have one output whereas real life ERP system tasks may have multiple outputs.

**Android User Interface Design: Turning Ideas and Sketches into Beautifully Designed Apps**

The Android learning book by I. Clifton provides many useful examples for creating beautiful Android applications. One of these sections talks about splash screens and their purpose in mobile applications. Firstly, the author talks how splash screens work by giving feedback to the user “that the system has responded to the user’s action of opening the application”. However, the author also argues that splash screens are usually used when applications are large and have long loading times. This helps the user not feel like the computer has locked up or failed to respond”. Given this argument, my application will be very small, so this would not be necessary. However, I believe a splash screen will still be necessary since my application will have to connect to the internet to retrieve some data before starting. This means that a start time delay (in which the splash screen would be shown) would be beneficial. This is supported by the same author: “if you cannot show any UI until some loading takes place, then it makes sense to show a splash screen”. Lastly, in this section the author shows an example of loading data asynchronously using Android’s AsyncTask, which includes a good example of how to use the splash screen while getting data from the internet.

**Impact of Enterprise Resource Planning Systems (ERP) on Management Accountants**

This is a management and administrative science review written by Etemadi and Kazeminia which evaluates how an ERP system can affect the accounting section of a business. An ERP system can lead to an increase the business savings by providing "a powerful management of planning and administering for a great organizational change needed."

To achieve having successful results of these systems there is an important group of people, from each company which are called the management accountants. The management accountants must get involved with the system. They have to discover how to manage it otherwise, "the success of these systems will be threatened seriously."

This investigation shows how an ERP can change the management of the accountants. The first important aspect showing the changes were the "change in the time spent for data collection." This is an advantage for the management accountants that they will have to spend less time to gather the data because the data will be implemented by the ERP system. However, in the aspect of time, the management accountants will also spend less time for "analyzing and interpreting data."

On the other hand, this investigation demonstrated the aspect of "focus on internal reporting" meaning that the system will expose reports how the enterprise can control the performance and the decrease the issues. Lastly, they "focus on cross-functional analysis instead of special-area analysis" meaning that by collecting data related to logistics and costs the system can determine "how much the product will cost and how much their approximate profit will be." By using the cross-functional analysis the enterprise can improve the synchronization and the integration of the employees.

**Application security framework for mobile app development in enterprise setup**

This report discusses the security aspects of an Android application and how simple it is for enterprises lose data or be attacked. In addition, it explains the approaches that can be taken to protect applications at the mobile application layer and how to reduce the chances of such attack on enterprises and how to minimize their impact. The authors have identified four main areas of security that need to be discussed:

1) Data Protection:

"Losing ... data ... may have direct or indirect impact to [a] company's revenue and/or reputation." This can result in loss of business and legal issues. There are relevant mobile-specific issues that are discussed such as local data stores in mobile phones, caches, data sharing and data on transit, especially when it comes to wireless data streaming.

2) Intellectual property protection:

This is when there is a "loss of information through unauthorized access to the application code base", because the binaries of the installation files of applications are available, they are subject to reverse engineering attacks. When critical information about the application is hardcoded, it may be possible for attackers to obtain sensitive information.

3) Secure Authentication:

"Authentication of the user at the mobile end needs to be planned keeping security in mind". Session management needs to take place on any servers and sessions need to be "handled carefully to avoid session hijacking attacks".

4) Code vulnerability

"Vulnerability in the application design may lead to massive security issues". The authors discuss three main areas of vulnerabilities including validation of the data being inserted, mostly through scripting languages and SQL, to prevent invalid actions (such as SQL injection attacks). Moreover, exception handling is important as sensitive information may leak out when an exception dump is displayed, "exposing business logic" to the user. Lastly, third-party libraries contain unknown code that needs to be checked for security standards before being used.

The report discusses in detail the approaches taken to mitigate these risks using detailed examples, and concludes that operating systems like Android "provide a system security model". However, it is important to have a plan at the design level of the application to avoid several other issues such as data loss, intellectual property violation and more. Therefore, certain coding standards need to be followed to maintain a secure application.

**Mobile integrated enterprise resource planning system architecture**

In this report, Gelogo and Kim show how an ERP system can be "mobilized" by constructing it in a cloud-based software-as-a-service architecture. They define an ERP system to be a "business management software that allows an organization to use a system of integrated applications to manage the business and automate back office functions". As the authors say, the core business processes should be supported by an ERP system, such as: tracking business cash, raw materials, product and the status of the businesses' commitments such as orders, purchases and payroll. Lastly, an ERP system should "manage connections to outside stakeholders". Furthermore, the report argues that "organizations perceive ERP as a vital tool for organizational competition". However, they argue that while many companies choose to implement customized ERPs that incorporate stand-alone solutions, they sacrifice scalability and efficiency that are mostly found in cloud-based SaaS systems.

The authors argue that "mobile device use for CRM and ERP functions is an inevitable extension of our increasingly connected wireless society and offers a wealth of advantages". They argue that using a mobile-based ERP solution, employees can do "any or all of the following":

1) Access email

2) Manage projects

3) Manage documents

4) Provide customer relationship management

5) Conduct enterprise resource planning

6) Fill out invoices and receipts

7) Make work orders

8) Manage a calendar and address book

and more.

Lastly, the report provides several advantages or cloud-based mobile ERP system:

1) Increased productivity and better decisions - through up-to-date information

2) Empowered employees – by accessing information anywhere

3) Improved customer engagement – using real-time sales information

4) Streamlined supply chain – by accessing supplier and inventory data any time

5) Always accessible – even when not connected, applications can work offline

6) Leverage existing skills – skills in other fields can be used to create mobile ERP systems

7) Simplify development – use the component architecture to simplify and speed up development

8) Empower your customers – letting customers choose whatever device they want and allow them to have the same user experience

9) Integration – message, sensors, notifications and other components can be integrated.

**Towards improving the usability of mobile ERP**

This research paper by Omar discusses how business owners remain reluctant in adopting mobile-based ERP systems and prefer the conventional ERP packages. A reason for this is the fact that conventional ERP systems are based on desktop computers which provide a more usable interface and better user experience to allow handling important functions of the software. As the author says, “the user interfaces of mobile ERPs directly affect its usability”. In addition to that, mobile ERP solutions have to work in different contexts, so this research proposes adaptive user interfaces as a solution to these problems and provides a model to design these interfaces to improve the usability of mobile-based ERP systems.

In his report, Omar mentions the five attributes of usability identified by Nielsen in 1994:

1. Efficiency
2. Satisfaction
3. Learnability
4. Memorability
5. Errors avoidance

Furthermore, this research is also based on a usability model proposed by Harrison et al. which identifies attributes that reflect the usability of applications:

1. Effectiveness – the ability to complete tasks
2. Efficiency – the ability to complete tasks with accuracy and speed
3. Satisfaction – the comfort and pleasantness
4. Learnability – the ease of learning to use the application
5. Memorability – the ability to remember how to use the application
6. Errors – lowering error rate and recovering from any catastrophic errors
7. Cognitive load – the amount of processing required to the user to execute a task

Omar also identifies some issues related to smartphones and tablet PCs, which are different from desktop computers:

1. Limited screen size
   1. Means limited information can be available to the user at the same time.
   2. If a lot of information is displayed, it can lose its meaning
   3. This contributes to user satisfaction.
2. Limited processing and power capabilities
   1. Since “mobile devices are less powerful than desktop computers” some business functions and features will have to be removed.
3. Data entry methods
   1. Mobile devices used touch-based interactions for input. The speed at which users type on a mobile device is about 1/3 of that on a desktop computer.
   2. Therefore, efficiency and effectiveness attributes will be lower due to the slower input and the chance of making more mistakes.
4. Diversity of mobile operating systems
   1. If users are forced to use a specific operating system other than what they prefer, they may not like the application.
5. Security
   1. “Securing valuable data in ERP systems and devices from unauthorized access is compulsory”. The mobility of mobile-based ERPs makes it harder to avoid any security issues without lowering user satisfaction.

The question this research tries to answer is “how can adaptive user interfaces be exploited for improving the usability of mobile ERP?”. Finally, in his conclusion the author says that “AUIs (Adaptive user interfaces) are proposed as a solution to improve the usability of a mobile ERP” and points at his methodology to provide a model for developers to use in their solutions.

**Mobility Integration of ERP systems**

The following report discusses how enterprises nowadays develop mobile applications to work and “communicate with more than one ERP system because each one has its own communication methods”. Using ERP systems an enterprise can manage numerous tasks on a daily basis, in different fragments such as sales, production, suppliers, etc. In this way, a mobile application can manage all these tasks outside the office which can be more effective.  In this report shows how to “unify different linking methods of the different ERP systems by developing a standard of communication and information and adapting this information of every system to the standard”.

The mobile application has the same interface, but they can be compatible with different systems.

The way that they can combine the mobile application and the ERP system is to use an adapter which the information from the ERP can be transformed to the mobile application and the other way around. This is homogeneous communications are using the REST services for these applications which there are two poses for this development. Firstly, is how to combine the information to be accessible between the ERP system. Secondly, to make the communication homogeneous, accessible and fast for the mobile devices. To achieve this they need to create different entities covering different parts of the system. The information that is transferred through the system and the application is converted to an XML file which this makes the processing more efficient. The adapters are using REST services which these services operate on the ERP system. In conclusion, the communication is dependent on the adapters to connect the application to the ERP systems and to make all the operations that they need at the same time.

**Client-Server Model**

This the report explains what the Client-Server system is and what are the challenges that can occur. According to this report the Client-Server system “is a software architecture made up of both the client and server, whereby the clients always send requests while the server responds to the requests sent” whereas the communication that is being used is File Transfer Protocol (FTP), or Simple Mail Transfer Protocol (SMTP) and Hypertext Transfer Protocol (HTTP). Using this client-server model, it is easier to share the information and the processing can be used by several machines. An example of this communication is the File Transfer Protocol, which allows the client to store media files such as images or music to the server. If the client, wants to send email can use the Mail Transfer Protocol.

The client-server a system has an architecture which is consisted of the database of the server and the PC and the application server. There are two main architectures of the client-server system which are the 2-tier a 3-tier.   For the 2-tier architecture the users “run applications on their PC (Client), which connects through a network to the server”.   In this case, the client side (thick client) has the access to send requests to the database which manages the requests and it responds back to the client. For the 3-tier includes only the database server and the application server and this tier can be extended to the N-tiers which includes more of the application server. This architecture has the middleware which is between the database and the client. This middleware “is separate software running on a separate machine and performs application logic”.

In nowadays the companies are using the different type of services such as a cloud computing service. This service is a “group of a distributed computer that provides services and resources through the internet” whereas it consists of three services. These parts the IaaS (Infrastructure as Service), Paas (Platform as a Service) and Saas (Software as a Service).

**Mobility Integration of ERP systems**

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