

# Analytical Expense Management System

Zeki Bozkus

*Kadir Has University*

*Department of Computer Engineering*

*zeki.bozkus@khas.edu.tr*

Christophe Bisson

*Kadir Has University*

*The Program of Information Technology*

*cbisson@khas.edu.tr*

Taner Arsan

*Kadir Has University*

*Department of Computer Engineering*

*arsan@khas.edu.tr*

## Abstract

*Although the development of communication technologies (e.g. UMTS, ADSL) allowed the elaboration of multiple users' web applications (e.g. information storage), there are still many improvements on many applications to be done and uncovered areas. Expense management systems on web application area are still in their infancy.*

*Expense management software is widely spread in companies and most of time supported by their intranet. These solutions are quite simple as they mainly collect the information related to the expenses and may propose a simple aggregation of these figures. The result is close to what an excel sheet provides.*

## 1. Introduction

During the last years, the rhythm of innovation concerning Information and Communications Technologies (ICTs) has increased tremendously. We gradually move from physical interactions to digital interactions at the pace of the improvements, developments of ICTs. Thus, Internet access and mobile access technologies increased their capabilities allowing various web applications especially thanks to the appearance of ADSL and UMTS. In such conditions, the geographical borders are abolished and all business activities go much faster. "The Internet and the web have had a profound impact on the business world [1]."

Companies web applications adoption change their way of working. They become more flexible as these

applications are available, reachable online all the time everywhere. It permits the empowerment of their employees. Thus, all the actions are done much faster by a more efficient way. "Web applications are so widely accepted and employed that they have become crucial to the success of many businesses [2]."

Companies can get a competitive advantage by being web applications innovators, adopting them early and/or by using them by a better way.

If web applications were applied to many systems, there are still many uncovered areas. A particular subject which is an interesting application concerns expenses. In the 2009 economic crisis context, expenses must be managed scientifically in order to be minimized. Some expense software exist mainly Intranet based but the new ones are web based. A web application procures several benefits to all type of users, organizations. Nevertheless, more or less of the existing expense management solutions are just allowing the employees to make reports.

This paper deals with an expense management tool which is a complete solution to send, receive, request, process on the Internet from every type of Internet device (PC, handheld, mobile phone) all information related to expenses. The 3G technology allows our application to be ubiquitous. Our target is to both empower and satisfy decision makers and employees. This intuitive, user friendly solution will help to decrease the expenses by providing new ways to visualize these costs and full decision support, while employees will receive in a fast manner their money back.

From a scientific perspective, expense management systems are still in their infancy.

In this paper we examine the elaboration of a new Analytical Expense Management System. The reasons which explain why expense management programs are vital for companies will be the first part. The Benchmark of existing expense management solution constitutes the second part. The model of the expense management solution is presented in the third part. The fourth part deals with the LAMP choice. Finally the layouts and software architecture will be detailed.

## 2. Why companies need expense management programs?

One of the oldest methods for the filling expenses is to fill out papers manually and to try to catch managers to get an approval for the trip you have done a month ago. This was causing a lot of waste of time by chasing paper around the office. In addition, these manual, paper-based processes provide little or no ability for expenditure policy enforcement. Manual expense control processes can result in other operational expense problems as well.

Companies are turning to automated expense control software to create a nearly paperless approval routing and expense management system. These expense automation systems provide: online invoice approvals and workflow, process company purchases, track approvals and manage travel and entertainment expense reports.

Another question is to answer whether the software solution will be web based or not? To answer this question, we can look at the modern work team at multinational companies. We will see that distributed work teams are increasingly being implemented to enhance organizational flexibility and competitiveness in today's complex and rapidly changing work environment. "Web based are frequently multi-functional systems. The multi-functionality of many systems forces organizations to transcend traditional functional boundaries [1]." An increasing number of employees work cooperatively with individuals in a variety of different locations and types of virtual work environments. Sometimes employee may not live in the same city with his or her managers and may be even not the the same country with recent outsourcing activities. This forced us to provide our solution to be web based. In addition, we know that companies do not like software installation, software upgrade and maintains processes because of cost. Web can provide software-as-a-service (SaaS) technology. With on-demand, small and midsized companies are quickly seeing how an automated operating expense control system can provide visibility and control, and are adopting it at a rapid pace.

Our solution differentiates itself from the rest of expense management programs by providing a strong spending analyzer. Spend analyzer will categorize and classified employee spending. Our tool will instantaneously slice, dice, and analyze employee spending to identify greater savings opportunities with multi-dimensional analysis.

The second part enhances the innovation of our expense management solution.

## 3. Solution providers

Globalization created a dynamic mobile work force. Many employees have to take business trip to respond to customers' needs which may be worldwide located. This has increased the need for cumbersome process of filling an expense report. The urgent need for the automated expense reporting process created young companies specialized in expense management solutions. We made a benchmark of these companies (see Table 1). The market is less and less volatile and gradually consolidates among a few big ones just like any young industries historical faiths. Most of them shifted from a traditional license business strategy to a service with software-as-a-service (SaaS) model. For SaaS [3] they provide a Web application of their technology; via a login and password, any company can access to the online service. These web applications are moving from a fix device (desktop) to mobile devices (laptop, PDA, smart phones, Blackberry) [4]. They are flexible and any type of company can afford such a solution.

Most of them are giving the benefit of paperless expense reporting and payment process capabilities. These automated expense management systems are designed to keep you on budget and make expense report processing run efficiently throughout your company. Everything is managed electronically, from expense report creation through reimbursement, reducing or eliminating the need for paper. Company policy is automatically applied and compliance ensured.

Few solutions allow the clients to send alerts to employees regarding the respect of policies, spending and time limits. By the same way, most of the solutions on the market do not propose any customization option.

The main difference between them and our project is that we do not only provide expense management software to help to streamline employee expense reporting just like others. But we also use the expenditure analyzer on these data with sophisticated statistical packaging to derive intelligent business decisions. We enriched our system with early alert system which catches any mistake or early fraud detection. Our goal is to help employees, managers and companies so that our project will not just be

another tool but a solution for the employees spending which becomes the big item on the business cost.

The following section will explain the process of our expense management solution.

applications. “Customization and personalization are considered as new fields and many authors have provided various definitions of these concepts [6].”

	Expensable Enterprise	Infor FMS	GetMyExpense.com	CyberShift	Concur Expense	Expense watch	Web2Expense
Internet	√	√	√	√	√	√	√
Intranet	√			√	√		
Mobile devices			Smart phone, PDA	Blackberry			
All size of organizations	√	√	√	√	√	√	√
Alert users of spending limits, time limits or policies...	√			√	√		
Corporate Card Pre-Population	√			√	√	√	√
Customization	√			√	√		
Receipt Image Attachment	√	√		√	√	√	√
Web-based Software-as-a-Service (SAAS)	√	√	√	√	√	√	√
Traditional license	√			√			
Multicurrency	√			√	√	√	

Table 1. Benchmark of companies proposing expense management solutions.

## 4. Modelization of the expense management

### 4.1. Collection of the expense data

A login and password will be given to each employee of a company. The data collected concern employees’ travel and entertainment expenditures. A web interface has a menu allowing the employee to choose the expense topic i.e. food, transport, communication, etc. The scrolling menu will provide many possibilities streamlining all travel and entertainment expenditures.

We will focus on the “three aspects of a web site affect its utility in providing the intended service to its users: The content provided on the web site, the layout of the individual pages, and the structure of the entire web site [5].”

In addition, customization and personalization are increasingly becoming important issues for web

We will concentrate on customization to increase the satisfaction of all users by allowing them for example to change the colors of the site, keep in memory the most important topics. Our solution will evolve according to the requests received from users and will be able to be personalized. “Both customization and personalization refer to content delivery, layout and services tailored to users needs and preferences. However, the two notions differ in several aspects. Customization stands for controlling interface attributes directly by the user. Personalization, on the other hand, refers to processing and presenting web content desired by individual users based on certain interpolations by web site providers [7].”

All the data collected from employees will be sent and stocked in a database, allowing decision, statistics, etc. “Web applications are becoming increasingly database-centric. Many new web applications require that a user be able to interactively explore these databases over the Internet or an external network [8].”

As soon as some expense data will be sent, an e mail will arrive to the decision maker for the reimbursement. This task is tedious and should be automated to increase the productivity.

The database constituted for one company will be the expense memory. Some analysis can be submitted on-demand or automatically and will be part of the expense management workflow.

#### 4.2 The expense management workflow

The expense management software should automate the process of planning travel and then submitting, routing, processing and reimbursing expense reports. Our 100% Web-based software can either reside on the organization's computers or on a 3rd-party's computers in a secure, hosted on-demand environment. Figure 1 is showing this workflow. Employee enters his or her expenses on the Web. During this process, our software will guide employee thanks to its user-friendly interface. It will help the employee to categorize expenses with a pull down menu. For example, employee used his or her car for airport transformation the tool will help to calculate the cost. It will ask to name the expenses, date the expenses and ask for the cost center to bill and more.

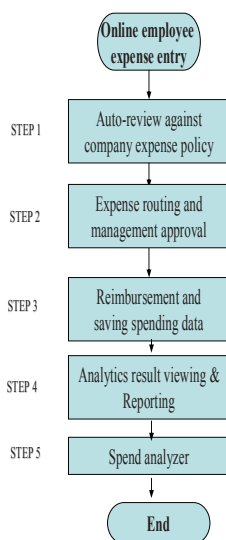


Figure 1 shows the work flow of our expense management solution.

When an employee is filling the online data entry, our tool as a first step performs auto-review against company expense policy (the tool can be configured

by a request from the company). For example an employee can pay the high speed Internet subscription in the case of an employee who works at house. If the company's policy about it is that such fees are not over 50 EUR, then it will alert the employee to reenter the data before alerting the managers.

The second step of the workflow is to route the expense to the manager of the employee by email notifications with embedded links to the actual report to ensure timely approvals. Manager can approve or disapprove the expenses. If the expenses are disapproved, it will inform the employee by email to reenter or review the rejection reason put by the manager. If the manager has approved the expense, the expense will flow to the next step. There is also the auto approval option which is based on the company's existing policy. This option may be used for the small amount expenses to save the valuable manager time.

Step 3 will be the reimbursement of the expenses by the company's accounting department. The employee will get the money to his or her bank account by wire transfer done by the accounting of the company or payroll system through an automatic interface. Our system will post these expenses to keep updated our database which will be queried by the managers and accounting at any time, anywhere in the world. This database will also be used by our spend analyzer to drive better business decisions.

Step 4 will provide results viewing and reporting environment coupled with a statistical module which will be developed: request by person or department according to the year, means, variances, pie chart, histogram, curve, etc. This step helps managers to visualize the expenses.

Step 5 will perform our spending analyzer solution on employee's expense data to identify greater savings opportunities with multi-dimensional analysis.

#### 5. The LAMP choice

“A web application is a large and complex software system comprising of many components, which are written in different programming languages and distributed over the network. A large number of applications utilize a Database Management System and one or more databases. . . . A program in a web application normally interacts with database through statements which execute the SQL data manipulation language [9].”

We are implementing our projects on open source software platform known as the LAMP architecture [10]. The LAMP architecture has become very popular as a way of deploying inexpensive, scalable, secure web applications [11]. The LAMP architecture uses Linux for operating system, Apache for web server, MySQL for databases and PHP for dynamic web programming.

The choice of web programming language between PHP [12] and ASP.NET [13] based on their functions is a difficult task. Albeit the Integrated Development Environment (IDE) for ASP.NET provides a fast and powerful programming, we selected PHP. Indeed, PHP is also a powerful programming language and works well with MySQL and a large number of relational database management systems. In addition it runs on the most popular web servers, and is available for many different operating systems.

We chose MySQL as a relational database management system (RDBMS). The open source database system MySQL is robust, flexible and scalable enough [14]. The main reason for MySQL choice is the cost comparison with the commercial counterparts.

There are two parts in LAMP architecture which will be easy to change by design in our project. Linux can be replaced by Microsoft Window and Apache web server can be replaced Microsoft Internet Information Services (IIS) if a need arises.

The programs developed will make the modules of our software and constitute its architecture.

## 6. Software architecture

Our architecture of expense management system consists of many sub modules just like any other complex system. The Figure 2 shows our modular and layered architecture. The main advantage of the modular approach is the simplicity of the construction and debugging. Each sub system can be tested separately. Each system can communicate with each other by using well defined application programming interface (API). By this way each module can hide implementation details by having well defined interfaces. The modules communicate with each other only with an interface. This approach simplifies debugging and system verification.

Our goal is to provide a 100% Web-based software which can either reside on the organization's computers or on a third-party's computers in a secure, hosted on-demand environment. So all the communications done with the software are through the web interface. The users (employees and managers) can both give information to and get information from the web pages. We have a front-

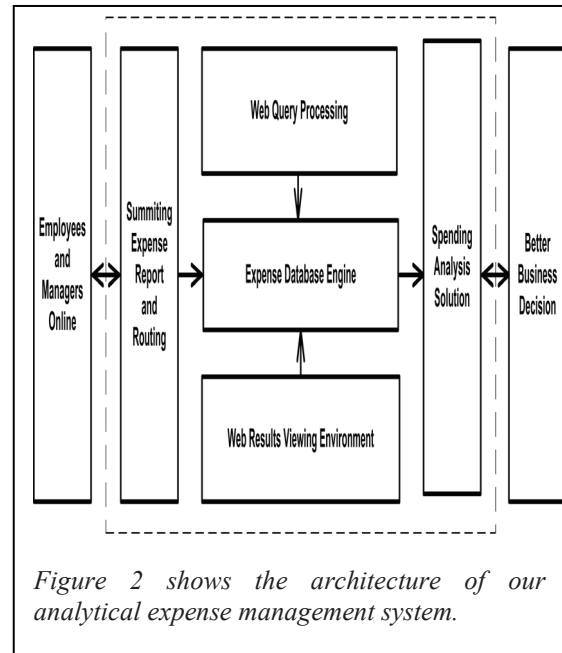


Figure 2 shows the architecture of our analytical expense management system.

end module which gets expenses from employees, submit the system and route to the correct managers and get paperless approval from managers. We have another module which submits the expenses to the expense database engine which will be used by every other module in the system. Database will maintain a complete audit trail for the transactions related to reimbursement.

The Web based query processing module allows reviewing back to time employee spending per employee or per expense based to help the managers to reduce cost and help for better planning for the future expense planning. Yet, our goal here is to get query user-friendly not to bore managers to learn complex query languages. The Web based result viewing environment can allow managers to visualize employee expenses costs per employee base, per department base or per spending base. Our statistical tool can reduce huge amount of data to more compact and understandable format by using charts, and histograms.

We completed our expense management system by providing a spend analyzer solution. The spend analyzer provides multi-dimensional analysis for users to quickly and dynamically analyze their spend data to drive better business decisions. The spend analyzer will classify and categorize the expenses and compare present and past expenses to identify abnormalities and micro-analyze many savings opportunities simultaneously. User can ask system questions to identify new savings opportunities.

## 7. Conclusions

The young and emergent expense management technology will be rapidly deployed by many organizations. Our expense management solution

provides clear benefits to businesses by empowering both lower level and higher level at the organization chart. It will help employees, managers, and companies. It will reduce the time for an employee to complete an expense report. Employees will receive in a fast manner their money back. Managers will use the large amount of data to monitor expense activities and detect trends by employee, group, location, cost center among others for better business decisions. The company will benefit from the costs cutting found by the spend analyzer. Companies will stay out of legal trouble by maintaining a complete audit trail for transactions related to reimbursement.

Currently our expense management solution is being developed. The completion of the program, its test, implementation and maintenance will provide answers to scientific problems as well as future directions for researches.

## 8. References

- [1] Craig Standing, Methodologies for developing web applications, Information and software technology 44 (82002) 151-159, December 2001.
- [2] Yu Qi, David Kung, Eric Wong, An agent-based data flow testing approach for Web applications, Information and software technology, 2006, pp 1159-1171.
- [3] HanCheng Liao, ChangQi Tao, An Anatomy to SaaS Business Mode Based on Internet Management of e-Commerce and e-Government, 2008. ICMECG '08. International Conference on 17-19 Oct. 2008, pp 215 – 220.
- [4] Dongsong Zhang, S. Shijagurumayum, Personalized content delivery to mobile devices Systems, Man and Cybernetics, 2003. IEEE International Conference on vol. 3, 5-8 Oct. 2003 pp :2533 – 2538.
- [5] M.Mulvenna, S.Anand, A.Buchner, Personalization on the net using Web mining, communications of the ACM 43(8), 2000, pp 122-125.
- [6] J.Kramer, S.Noronha, J.Vego, A user- centered design approach to personalization, Communications of the ACM 43 (8), 2000, pp 44-48.
- [7] Hassan. A. Artail, A client-based customization framework for web applications using JNLP, Computer standards & Interfaces (26), pp 411-422, 2004.
- [8] John C. Shafer, Rakesh Agrawal, Continuous querying in database-centric Web applications, Computer networks (33), 2000, pp 519-531.
- [9] Minh Ngoc Ngo, Hee Beng Kuan Tan, Applying static analysis for automated extraction of database interactions in web applications, Information and software technology (50), 2008, pp 160-175.
- [10] Roger Evans, Delivering sizzling services and solid support with open source software, IFLA Journal, March 2006 vol. 32 pp 19-27.
- [11] George Lawton, Lamp lights enterprise development efforts, Computer , September 2005, vol. 38, pp 18-20.
- [12] Kevin Yank, Build your own database driven website using PHP & MySQL, 2003. pp 1-200.
- [13] ASP.NET Site: <http://www.asp.net>
- [14] L.D. Paulson, Open source database move into the marketplace, Computer, July 2004 vol. 37, pp 13-15.