

Timesheet Management System Project

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Abstract — The Timesheet Management System (TMS) is a web application composed of an n-tier architectural design that use ASP.NET framework and best practices in software engineering. Its purpose it's to maintain track of clients, projects and their resources. IT Developers Group (ITDG), as a client in need of a management tool, required, not only to manage projects, but to improve the software development lifecycle (SDLC) process. Therefore, TMS allows ITDG to identify potential problems on time in the SDLC and complete their client projects on time. The application requires an invoice system to facilitate the finance department labor. Hence, hours consumed on the projects must be well documented for each employee (Developers, Analysts, Project Managers, Project Coordinators among others) to state milestones, progress and budgeted time which the systems provides through the use of different reports. All reports are carefully managed by stakeholders to ensure that ITDG clients receive quality service and a quick return of investment (ROI).

Key Terms — Portfolio, Project Management, Timesheet, Web Application.

INTRODUCTION

Currently, ITDG's Management Process is completely manual. Due to the burden of the manual process, the financial and management department required a new system to optimize their operations, automate administrative and billing process and provide a way to handle their workflows increasing productivity by tracking current project's needs. The system must also be web accessible and adapt to mobile or table devices.

High Level Model

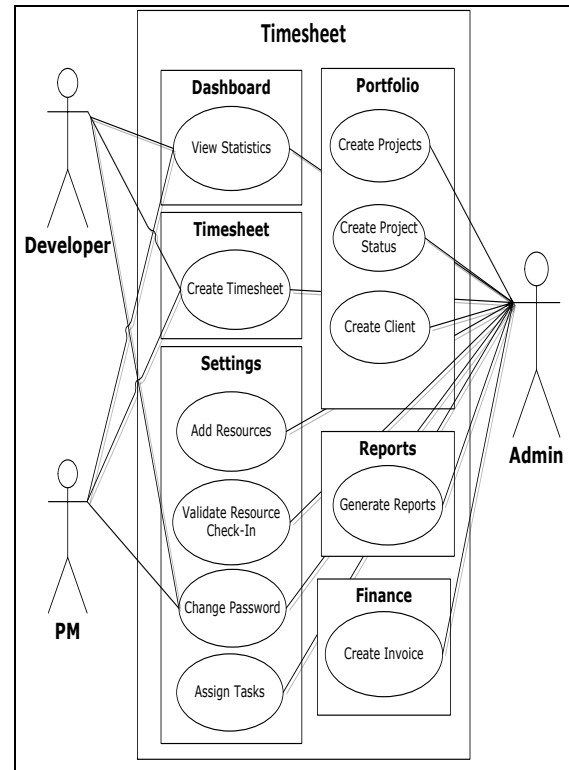


Figure 1
Use Case Diagram

TMS's model is constructed based on an object-oriented design, and use the Unified Modeling Language (UML) [4]. The logical model is directly derived from the user requirements. Figure 1 describes the ways users interact with the system. User's roles are as follows: system administrator, developers and project managers. Each of which are discussed in detail below.

- **Developers:** A developer will be able to see the projects progress through a dashboard. He will be able to create timesheets with detailed progress. Additionally, he will be able to reset their password following company standards.

- **Project Manager:** A project manager is capable of performing all developers' tasks with the addition of project status, reports and invoices generation.
- **System Administrator (SA):** The SA will provide full access to the system, allowing the additions of: resources, projects, and clients. It can also reset all resources passwords and control user credentials.
- **Mobile Design:** The application has a responsive design to adapt to a mobile or table device for a better user experience and a higher ROI.

Purpose

The purpose of this document is to present the overall approach of all aspects that support the implementation of the new TMS. This project entails the replacement of the current manual process of the Management and Financial Department Staff with a new solution that automates the collection process of billing information and project details.

Scope

The general scope of this project is to develop a TMS capable of tracking clients, projects and resources throughout the company. All data of clients, projects, resources and time consumed on the projects are stored in a database using web application forms that generate invoices and reports. The software validates all data entered to assure information integrity. A security authentication form is in placed to validate user credentials for system access.

REQUIREMENTS

The product adheres to the following functional and non-functional requirements. Each of the requirements has a unique identifier so it can be traced throughout the entire project.

Functional Requirements

- **Resources:** A resource form can add resources to the system and determine its roles and access. The form allows assigning projects to the Developers, Project Managers and Administrators.
- **Client:** A client form is created so that ITDG's customers can be added and start creating projects.
- **Projects:** A project form can add a client's project when a contract is signed. After the project is created, we can add project resources and track its progress.

Core Components

The following core components are essential to complete the process of TMS. These modules allow the data entry and the display of specific requests by the user.

- **Dashboard:** This component is used to provide management and end users with a quick tool to check Key Progress Indicators (KPS).
- **Portfolio Management:** This part of the solution will be used by the Project Management to maintain clients and projects. Additionally, provides for status updates to feed the Dashboard with resources and progress details.
- **Time Sheet Management:** This component tracks resources, tasks and time management allocations.
- **Invoices and Reports:** This component will allow end-users to automate the generation of invoices and detailed reports needed for billing process.
- **Settings:** This component will allow maintenance of resources, tasks, passwords, user timesheets, check-in log, and assigning new task types to resources as necessary.

Interactive Components

The interactive components in TMS provide accessibility and handle user interaction and communication within the application.

- **Interfaces:** The development and usability design of interfaces needed to support the functionalities of the new TMS for end-user interaction.

- **Project Status:** For each project, a status is created to compare actual time vs budgeted.
- **User Timesheet:** The resource can add project time spent for each project assigned and the system will calculate its projects summary, accordingly. The timesheet range by default shown will depend on the pay period (monthly, biweekly, etc.).
- **Invoice:** The invoice system allows generating formatted invoices of the resources assigned. Invoice number is generated based on the date and client number. Additionally, the invoice total can be displayed by project or for a specific resource. If a resource is chosen, it will calculate the invoice amount based on the date range specified.
- **Reports:** A report can be generated for a project or resource. These reports can be a summary or highly detailed, and can provide time consumptions.

Non-Functional Requirements

- Security permissions at database and server levels shall be defined [4].
- All password files must be encrypted.
- All user passwords must have a minimum of six (6) alphanumeric characters.
- Login should be locked out after three (3) unsuccessful login trials.
- Provide immediate password reset.
- The web application developed will run on the following software platforms; Windows Server 2008, Internet Information Services (IIS) 7.0, and MS-SQL Server 2008 r2.

METHODOLOGY & DESIGN

The following considerations were made when designing the TMS and were key to the strategic development of the core application. TMS has to be a web application so that it can be accessed anywhere in the world through a simple browser. The design has to be scalable as new components can be added to future versions. The system would also have to be a responsive design (adjusts depending

on the screen size) so that mobile and tablet end-users can benefit from the platform [2].

Dependencies

ITDG required that Visual Studios 2010 be used for the TMS development process [3]. A windows 7 enterprise would be used to store the database and web application. Additionally, an SQL Server 2008 r2 database would store end-user information. Nevertheless, an internet connection and a browser are needed to access and use the TMS.

Assumptions

ITDG's stakeholders support was required during the analysis and design phase of this project. Any change requested in the requirements and/or design was evaluated to determine its impact on scope, time and cost. All system and procedure documents were evaluated, as they could be affected by the projects implementation. The mobile application is not a standalone product; a responsive design would be implemented. The application does not have the intelligence to determine user tasks so the system will rely on employee's deliverables and course of actions. In addition, resources rates per hour will not be added to the system as management and stakeholders prefer not to disclose this information.

General Constraints

Table 1 shows the category of the constraints and the description for each category that supports either software or hardware. These constraints limit the application to a specific environment that lead to the decision of development tools and architectural design.

Table 1
TMS Hardware/Software Specs

Category	Description
Software Environment Server Side:	The software requires an SQL 2008 r2 Database, 4GB HDS Required*, IIS, FTP Server
Software Environment Client Side:	Browser Application (i.e., Chrome, Safari,

	Internet Explorer or Firefox) Internet Connection
Hardware Server Side:	+2 Ghz Processor* +1Gb RAM* +4 GB Disk Space Network Connection
Hardware Client Side:	+1 Ghz Processor* +1Gb Ram* Network Connection
Availability	System will be available 24/7 unless server connection is down.
Data Repository	SQL Server will hold all system data.
Redundancy	Backup of this data will be done at regular intervals by database administrators (DBA).
Performance Requirements	System must be scalable for distribution.

*May increase depending on company growth.

Development Methods

In the TMS we used the traditional waterfall with prototyping model since we had most of the functional requirements and system goals clear from the beginning [4]. Although, for future release we would follow agile methodology to add additional functionality as the project expands.

ARCHITECTURAL DESIGN

TMS is a four tier system composed of a presentation, business, data, and entity layer as shown in Figure 2. In order to keep the system components separated, we use layers and interfaces to improve maintainability. The development process using layers, adds complexity and impacts the initial development time. On the other hand, if future changes were to be assigned to the development team, the separation of layers allows replacing components with minimum changes to the system [4].

Presentation Layer

The presentation layer provides users, a graphical user interface (GUI) using ASP .NET Web application framework to create a standard-based

web solution [5]. Additionally, bootstrap framework is integrated, to create a responsive design and flexible structure that can adapt to any display size [2]. These frameworks are handled on Visual Studio 2010 [3]. All data transfers and retrievals are made throughout the business layer.

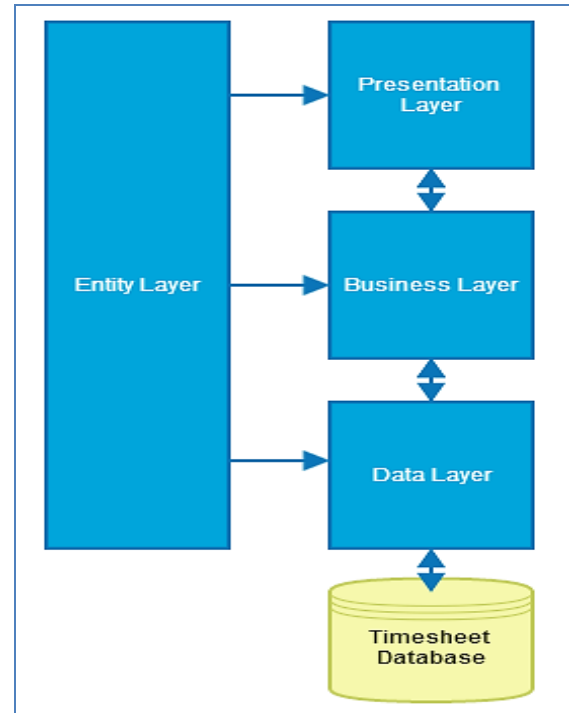


Figure 2
Four Tier Layer

```

namespace ITDG.BusinessLogic
{
    public class ContractManagement
    {
        public static List<ITDG.Entities.Contract> GetContractList()
        {
            return DataLayer.Contracts.GetContractList();
        }

        public static ITDG.Entities.Contract GetContract(int ContractId)
        {
            return DataLayer.Contracts.GetContract(ContractId);
        }
    }
}

```

Figure 3
Business Layer Class

Business Layer

In the business layer, we work on the retrieval, processing, transformation, and management of application data. The application business rules and policies are programmed in the business layer as shown in Figure 3 on the code segment below. The encapsulation of rules ensures data consistency and integrity. It also provides management reusable functionalities that can be accessed by the presentation layer.

Data Layer

All queries to the database, as shown in the code segment below in Figure 4, are made from this layer. Data is transferred from one layer to another using entity objects defined in the data layer [1]. All queries are programmed using Language-Integrated Query (LINQ) that extends queries capabilities [3].

```
public class UserTimeSheet
{
    public static List<ITDG.Entities.TimeSheet> GetTimeSheetList()
    {
        using (var context = new ITDG.Entities.TimesheetEntities())
        {
            var query = (from c in context.TimeSheets
                        orderby c.Resource ascending
                        select c);
            var TimeSheetList = query.ToList();
            return TimeSheetList;
        }
    }
}
```

Figure 4
Data Layer Class

Entity Layer

Objects are defined following the tables in the database such as a client or project [1]. The entity framework shown in Figure 5 shows SQL Server database schema that used objects to move information from one layer to another as a single param-

eter. It is a mean of encapsulating data through data objects from the logical structure of the system [5].

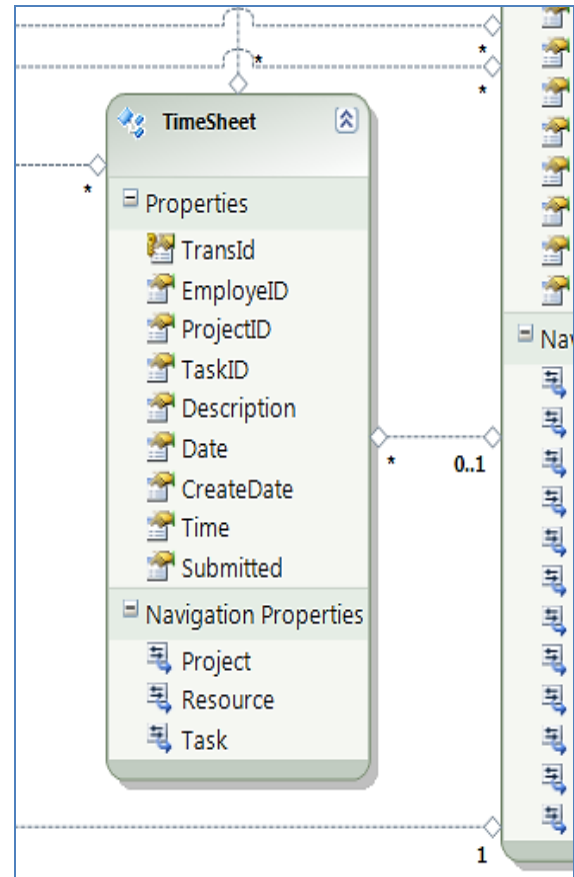


Figure 5
Entity Framework Design

RESULTS

TMS is now being used by ITDG as the central processing application for financial and management processes of projects. All clients' projects are handled by their respective project managers and developers assigned. The system is composed of views which are *Login*, *Dashboard*, *User Time-sheet*, *Clients*, *Projects*, *Resources*, *Status*, *Invoices and Reports*. Each of which are discussed in detail below.

Login

In the login form shown in Figure 6, the user will need to use an e-mail address and password as credentials. If credentials do not match, TMS will alert to try once again. If credentials match, it will

allow the user to continue to the default homepage based on the user role.

Figure 6
Login Form

Resource	Resource Type	Hours	Hours (%)	First TS. Entry	Last TS. Entry	Active
Pedro Alicea	Developer	526	100.00 %	12/1/2013	5/7/2014	Yes

Figure 7
Dashboard interface

Dashboard

In the dashboard interface shown in Figure 7 a user can find client information, hours and resources assigned for a specific project. On the top left part, a user can select a project and the page

will reflect all the project details to the left, including client name, project manager, start date, estimated end date and the project phase. On the top right, a user can find a graphical display that specifies the worked hours of all resources and the budget hours comparison, to estimate if the project is on track. At the bottom, the user will find all the resources associated with the project. Additionally, the table provides the position in the company, hours consumed, duration in the project and if the resource is still active.

Figure 8
User Timesheet Form

User Timesheet

After selecting the User Timesheet option on the menu, it will grant access to the timesheet form shown in Figure 8. First, the user will select the Project dropdown menu where it shows the project a user is assigned. Second, select the task type in the dropdown menu, which describes the users work within the project. Third, under the project menu we have the Date option. This option lets the

user enter the working period for the project. If the user selects the calendar icon, it will appear a calendar where a date range can be selected. Fourth, user can enter the hours and minutes spent. Fifth, when all these fields are completed, the user can move to enter the description for the task in the project. Here, a user can enter important details of the task on the date selected. Finally, after completing the form, a user can save all the information entered, with the Save button located under the description text field.

Figure 9
Project Form

Projects

To add a project to a client, use the project form shown in Figure 9. First, select the client's name from the Client dropdown. Second, enter the project's name and select from the Project Manager

Dropdown, the name of the PM selected for the project. Third, a user can select the Start Date and the Estimated Finish Date for the project. Fourth, enter the quantity of the budget assigned to the project. This is tracked by the Estimated Total Hours. Fifth, the Active Project option is selected by default and determines if the project is still open. Sixth, select the In-Office option to know if the project is in or out of the office. Then, press the Save button to store the form information.

Figure 10
Project Status Form

Project Status

The Project status form shown in Figure 10 allows updating a status for a project. The required fields are Project Name, Date, Status and Status Description. To select or edit a status on a project:

- Select the Project Name.
- The Date field is selected by default as the current date.
- Choose the Status for the related project.

- In the Status Description field enter all the details about the current tasks status associated with the project.
- We proceed to select the save button to store the Project Status information.

Figure 11
Client Form

Clients

The users can register a new client in the client form shown in Figure 11. First, to register a new client, a user has to enter the client's Name. Second, assign a three (3) digit client's Number used for invoices. Third, we enter the client's Email that will be used as the username. Fourth, the client's Telephone and a Note with any information about the client. Finally, when we have all the necessary form information, we press the Save button.

Figure 12
Invoice Form

Invoices

The Invoice form shown in Figure 12 lets the user generate an invoice for the client. To add a new invoice:

- First, enter the Project Name by selecting the name from the dropdown menu.
- Select the Invoice Date by selecting the date in the calendar icon.
- The Invoice No. is generated by default.
- The paid check box is used to track payments received.
- The Contact field contains the person to whom this invoice is addressed.

- The Position Field determines the role position of the contact within the company.
- In the Department field, a user can enter the department assign to the contact.
- The Invoice Details field lets the user enter additional detailed description for the invoice.
- Choose between the Project or Resource radio button.
- The Project radio button activates the Live Date, Amount and Invoice Total fields.
- The Resource radio button activates the Resource, From and To date, Totals Hours, Project Rate/Hour and Invoice Total.
- Finally, the Invoice total is calculated at the end and the user can press the Save button to create the invoice.

users will have a Project dropdown or a multiple select list and date range filters. On resources, the user can also choose a resource for a selected project and optional (pay period). After the parameters are set, press the generate button and a new tab will display the report. The reports can be generated from the application and printed out as a PDF or Excel document

Figure 13
Reports Form

Reports

The Reports form shown in Figure 13 starts with a Report Name dropdown for the selection of the report needed. Once the report is selected, a series of parameters will filter the report depending on the needs of the end-user. All reports are based on either projects or resources. In project reports,

Figure 14
Resources Form

Resources

The Resources form shown in Figure 14, allows user additions to the system following the steps below:

- First, enter the employee's First and Last Name.

- Enter the employee's Telephone with the following number format (787) 123-4563.
- Enter the employee's Email that will be used as the authentication username.
- Select the Resource Type or employee position from the dropdown list.
- Select the Pay Period (Biweekly or Monthly), so that the timesheet page will automatically bring the From and To dates already filtered.
- By default, the User Type is User. Users can select Admin to have privileges like creating invoices, project, clients, resources, task assignments, and changing all user passwords.
- By default the Active, specifies the user that is still working in the company. If the user inactivates it, the employee will not appear on related resource dropdown lists.
- **Optional:** Enter a Note or comment about the new employee.

In the Assign Projects Lists, the items on the left are all the active projects in the system. Carefully, select all projects that the employee will be working on. A user can filter the projects by using the search on the top of the left lists. Once an item is selected, the item is moved to the appropriate list which are the projects an employee is assigned. Users can also click on a selected project to remove it from the employees list.

FUTURE WORK

TMS concept in the future would be to support a calendar so that employees can follow company events, or verify if they have missed timesheet due dates. Additionally, the monitoring of contracts will be added to support non-permanent employees, so that the system can notify management before their contract expiration. Similarly, a task tracking feature will be added to follow requirements, determine status of projects more precisely and use Verification & Validation (V & V) process [4] throughout the projects SDLC. In the end, the software can also be integrated with other tools by using Windows Communication Foundation (WCF) that support communication services between products.

CONCLUSION

The development of the Timesheet Management System has been successfully completed and all requirements were met during the acceptance testing. The continuous feedback from IT Developers Group has led to a highly efficient product and will reduce time and effort when creating timesheets, invoices and reports. Additionally, making the application a responsive design, allows for mobile end-users to experience a rich application environment. Also, management will have a higher ROI, as they are planning to sell the application to future clients. In the end, IT Developers Group CEO and owner, Robert Negron, is pleased with the results and would be looking forward to see future additions.

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