



Developing a customized web application for Competitiveness Evaluation

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EXAMENSARBETE	
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Arbetets namn:	Developing a customized web application for Competitiveness Evaluation
Handledare (Arcada):	Dennis Biström
Uppdragsgivare:	Nokia
<p>Sammandrag:</p> <p>I detta arbete kommer det att förklaras hur en webbapplikation menat för konkurrensvärderingar läggs upp samt vad man skall installera för att lägga upp en sådan.</p> <p>Nokia gör konkurrensvärderingar på olika företag som är inom samma bransch, och sättet värderingarna görs nu, är föråldrat. Personerna på Nokia som gör konkurrensvärderingarna måste nu använda sig av Microsoft SharePoint, Microsoft Excel samt SQL Server Management Studio.</p> <p>Syftet med detta arbetet är att försöka kunna överge dessa tre steg, och flytta sig helt och hållet till att använda webbapplikationen. Applikationen skapas med HTML, PHP, CSS, JavaScript samt SQL. Appen skall spara tid och vara lättanvänd. En liten grupp av människor prövade webbapplikationen och har kommit med feedback. Gruppen tyckte generellt att appen underlättade deras arbete.</p>	
Nyckelord:	HTML, Nokia, PHP, SQL, Active Directory, AD, Windows, CSS, JavaScript
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Title:	Developing a customized web application for Competitiveness Evaluation
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<p>Abstract:</p> <p>This thesis will focus on how to develop a web application meant for competence evaluation. It will be explained how to setup and install the needed environments for the application.</p> <p>Nokia does competence evaluations on different companies, and the way the evaluations are done now, is outdated. Users need to use Microsoft SharePoint, Microsoft Excel and SQL Server Management Studio.</p> <p>The aim of this study is to get rid of having to use these three steps and start using only one application, written in HTML, CSS, PHP, JavaScript and SQL. This new method of performing evaluations should make the process easier, simpler and more time efficient.</p> <p>A small group of people have also tested the interface and given feedback on it and whether they would use it. The group in general, considered the app to be faster and easier than using the previous methods.</p>	
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<p>Utveckling av en webbapplikation för konkurrensutvärdering:</p> <p>I arbetet berättas samt förklaras hur en webbapplikation gjord för konkurrensutvärdering utvecklas. Arbetets mening är att kunna ersätta Microsoft Sharepoint, Microsoft Excel samt SQL Server Management Studio. Dessa tre steg skall ersättas eftersom de kräver onödigt mycket tid att utföra. Med hjälp av en ny applikation kan detta åstadkommas. Applikationen är utvecklad med hjälp av språken PHP, HTML, SQL samt JavaScript. Med HTML får vi gjort ett formulär som ersätter de tidigare gjorda med Sharepoint. Med hjälp av PHP samt SQL får vi de ifyllda formulären skickade direkt till databasen, vilket betyder att Sharepoint eller Excel inte mer behövs. Användarna av applikationen har och får olika uppgifter gjorda just för dem, vilket betyder att roller och grupper måste implementeras. Med hjälp av Lightweight Directory Access Protocol (LDAP) får applikationen kontakt med bolagets Active Directory, där rollerna för varje anställd syns, liksom vilka grupper den anställda hör till. Med hjälp av LDAP kan administratören som gör uppgifterna lätt välja för vilken grupp av användare uppgiften görs. Det finns mycket som måste tas i beaktande då man överför information från, och till databaser med tanke på säkerhet. Det finns alltid människor som hittar ett sätt att få information från en databas via webbsidan, vilket gör det mycket viktigt vid utvecklingen av applikationer att implementera bra säkerhet. Windows kommer med sina inbyggda metoder för inloggning av användare, men vid användning av manuellt gjorda metoder (t.ex LDAP) är säkerheten på utvecklarens ansvar. Dock, eftersom denna applikation bara kan användas inom bolagets intra, är risken för attacker inte lika stor. Med HTML, PHP samt SQL lyckas applikationen ersätta de tre gamla metoderna utan desto större problem. Enligt feedback från användare är applikationen en mycket bättre lösning p.g.a. användarvänligheten och smidigheten. Applikationen underlättar definitivt arbetet och sparar tid, vilket i stora bolag är väldigt viktigt.</p>	
Nyckelord:	PHP, SQL, LDAP, Active Directory
Sidantal:	38

INNEHÅLL / CONTENTS

1	Introduction	9
1.1	Context.....	9
1.2	Goal and aim.....	9
1.3	Methods	10
1.4	Definitions	10
2	Technology selections	11
2.1	PHP.....	11
2.1.1	<i>PDO</i>	11
2.1.2	<i>MySQL</i>	12
2.2	SQL.....	13
2.3	Front-End	14
2.3.1	<i>Bootstrap</i>	14
2.4	Authentication method	14
2.4.1	<i>LDAP (Lightweight Directory Access Protocol)</i>	16
2.4.2	<i>Groups and authorization</i>	17
3	Application architecture	18
3.1	Database Structure	19
3.2	User Interface	20
4	Development Environment.....	22
4.1	Integrated Development Environment	22
4.1.1	<i>Visual Studio Code</i>	22
4.2	SQL Server Management Studio	23
4.3	Servers.....	24
4.3.1	<i>IIS</i>	25
4.3.2	<i>Development Server</i>	26
4.3.3	<i>Testing Server</i>	27
4.3.4	<i>Production Server</i>	28
5	Stages Of Development.....	28
5.1	Proof of concept.....	28
5.1.1	<i>Use Case</i>	29
5.1.2	<i>Estimations</i>	30
5.2	Prototype.....	30
5.3	Pilot	30
5.3.1	<i>Testing</i>	31

6	Business Case	31
6.1	Net Present Value.....	31
7	Discussion and Conclusion	32
7.1	Further Development.....	33
	References	36
	Appendices	39

Abbreviations

HTML	Hypertext Markup Language
CSS	Cascading Style Sheets
PHP	Hypertext Preprocessor
SQL	Structured Query Language
IIS	Internet Information Services
PDO	PHP Data Objects
MySQL	My Structured Query Language
MySQLi	MySQL improved
LDAP	Lightweight Directory Access Protocol
IDE	Integrated Development Environment
AD	Active Directory

Definitions

UI	User Interface
----	----------------

FOREWORD

To start this topic, I would like to thank Nokia for giving me the opportunity to write a thesis while working at them. This thesis is based on a project that I have made during the summer. This project has thought me a lot about how to manage different things when for example setting up servers and building interfaces with authentication and authorization. Working with the people here has shown me how important small details (in interfaces) can be, and how important security and authentication is. I would also like to thank Arcada for giving me a green light with this thesis.

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Aleksi Suoknuuti

1 INTRODUCTION

This thesis was done at the company Nokia, as a development project. The applications task is to replace Microsoft SharePoint, Microsoft Excel and SQL Server Management Studio, and speed up the process of competitiveness evaluation

1.1 Context

Nokia has a department named Portfolio Management, which' task is to keep Nokia as competitive as possible, and that department is willing to make changes to the current methods. Competitors in this case are companies such as Huawei, Ericsson, HTC and more. The way people evaluate competitors now is outdated and uses unnecessarily many steps (Microsoft SharePoint, Microsoft Excel and SQL Server Management Studio), and by creating one application the aim would be to be able to replace these steps.

Nokia has a template on SharePoint, which evaluators have to fill out, export, import to excel and then send the excel file to someone who puts the file in to a database where all evaluations get stored. A web application was created for Nokia as a project trying to replace the old methods. The application will be used for evaluating different companies and evaluating how Nokia manages to keep up the competition. The application was made using PHP, HTML, SQL and JavaScript.

1.2 Goal and aim

The goal of this thesis is to be able to create a web application that would replace old software and therefore make Nokia's competence evaluation easier and simpler.

The aim is to show how the application is created, and how the goals were achieved.

1.3 Methods

Users at Nokia currently use Microsoft SharePoint to fill out forms that are given to them as tasks, and this method is something Nokia is willing to make a change to. By creating a web application, that could be achieved.

The application will be developed using languages such as PHP, HTML, SQL and JavaScript. With PHP, information filled into forms and websites can be sent directly to a database, which would speed up the process. With SharePoint, users now must do the evaluation, then export it to excel, and then import it to the database, which takes an unnecessary amount of time. This thesis will illustrate what methods are used to develop a web application like this, and how everything comes together.

Important things in projects such as these are security and authorization. With the lack of good security, confidential information could be in danger. Authorization also plays a big part as confidential information could not be shown to everyone. That is why it will be shown how to authorize users to access only the tasks they are supposed to see.

With a small group of people from the Portfolio Management department an overview of the project was created, and the languages as well as environments were chosen. The development environment was free for me to choose as long as the project managed to proceed.

The chosen tools for this project were Visual Studio Code and SQL Server Management Studio, which we used for testing purposes.

1.4 Definitions

The focus of this thesis is to develop a web application and get an answer whether it is faster to use the web application and whether it is worth to move on from old methods. Users are comfortable with using old methods, and that's why moving on to new methods will take some extra time. Learning new ways will take time etc. That is why the new UI

is made to be as simple as possible to use. The simpler it is, the more time will be saved, and the time saved has a big role in the end.

2 TECHNOLOGY SELECTIONS

The technologies used in this project are chosen based on their usability when creating forms and communicating with databases. The languages used in the project are some the most used ones, when creating web interfaces.

2.1 PHP

PHP is a common web programming language used for connecting to servers. PHP is usually included on websites which have forms to fill or login-systems for example. If you create an account on a webpage, the information you fill in for your account, will be sent to a database. How the information gets from the website to the database is with the help of PHP.

PHP has different drivers used to connect to a database. These drivers are PDO, MySQL and MySQLi where the i in MySQLi stands for improved. They have their own benefits, but in this project PDO is used, as it is compatible with a wider range of databases while MySQL only is compatible with MySQL databases.

2.1.1 PDO

PDO is an extension for PHP and is a way to access databases. PDO is the extension you should be using these days (Diwaker M, 2018) as it is compatible with almost all databases. The way PDO is written differs a bit from MySQL but is easily learned if you're comfortable with MySQL. To connect to a server and its database using PDO, these lines must be written:

```
<?php
$conn = new PDO("sqlsrv:server = tcp:your_server; Database = your_database", "your_login_name", "your_login_password");
$conn->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);
?>
```

Figure 1. An example how to connect to a database using the PDO-driver

PDO offers attributes as shown above (PDO::). The attributes above will show specific error handling if an error happens.

PDO also has better security attributes in case someone tries to do injections onto a website.

An injection is when someone tries to write an SQL-command somewhere on a website. If the website has a field where a person can search for information from a database, that field is where the person can write the SQL-command. If the injection goes through, the person could do whatever he/she wants to the database. In the worst case the user doing the injection could delete all data from the database.

In this case PDO is used for the project. It is used because the databases are on a database platform called SQL Server. To connect to an SQL Server platform, you cannot use MySQLi. This rules out the previously mentioned MySQLi alternative.

2.1.2 MySQL

MySQL used with PHP is also a way to access the databases of a server. MySQL is good to know but is more restricted than PDO.

MySQL is not included in the newer versions of PHP as PDO is more efficient these days (Diwaker M, 2018). Although MySQL has been removed, MySQLi still exists with some improvements from MySQL. The way to connect to a database reminds of the way you connect to a database with PDO.

```
<?php
$con =
mysqli_connect("localhost","my_user","my_password","my_db");
```

Figure 2. An example how to connect to a database using the MySQLi-driver

2.2 SQL

SQL is a language which has the role to let you modify and access databases. SQL stands for Structured Query Languages. SQL works with queries which execute the commands the user wants. The commands, like in this case INSERT INTO, are called SQL queries. The queries tell PHP what to do when communicating with the database.

```
<?php
try {
    //CONNECTING TO THE DATABASE
    $conn = new PDO("sqlsrv:server = tcp:your_server; Database = your_database",
        "your_login_name", "your_login_password");
    $conn->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);

    //INSERTING THE VALUES INTO THE TABLE IN THE DATABASE
    $sql="INSERT INTO your_table (ID, Firstname, Surname, Age)
    VALUES ('1', 'John', 'Doe', '50')";

    //PREPARING THE CONNECTION TO THE DATABASE WITH YOUR QUERY
    $stmt = $conn->prepare($sql);

    //EXECUTING THE QUERY AS THE CONNECTION IS WORKING, COLUMNS AND
    //NAMES MATCH WITH THE TABLE IN THE DATABASE
    $stmt->execute();
}
catch (PDOException $e) {
    print("Error connecting to SQL Server.");
    die(print_r($e));
}

//YOU SHOULD ALWAYS CLOSE THE CONNECTION
$conn = null;
?>
```

Figure 3. The picture shows how PHP works using SQL queries.

In the picture above, you see the SQL query which lets you insert data into the database. The insert method is called INSERT INTO. There are a lot of commands like SELECT FROM, DELETE FROM, UPDATE to name a few.

SQL is used in this project because that is the way information from the website will reach the table in the database.

2.3 Front-End

HTML together with Cascading Style Sheets (CSS) and JavaScript are the main language for creating and configuring web pages and web applications. CSS is the language used to edit colors, styles, sizes, positions and basically everything on the web page, while JavaScript makes things more dynamic. Pop Up- windows for example can be made using JavaScript.

HTML is used in this project as it is easy to learn and one of the best methods to create web sites the way one wants. Ready-made tools could be used but writing HTML yourself gives you more freedom for editing and managing (Amberd, 2017).

2.3.1 Bootstrap

Bootstrap is a popular framework used for developing dynamic, responsive and mobile-friendly web pages. Bootstrap makes the developing a bit easier as it comes with its readymade functions and even CSS. Bootstrap offers readymade themes and templates to use as well. The websites offering these templates usually have open source code which makes it easy for anyone to go and copy the code from the website in to your development environment, and you got yourself a nice web page which you can edit to get the final look you want. When taking open-source themes from a website, it is often required to provide a link to the library files in your html file. These library files include the CSS needed for the Bootstrap.

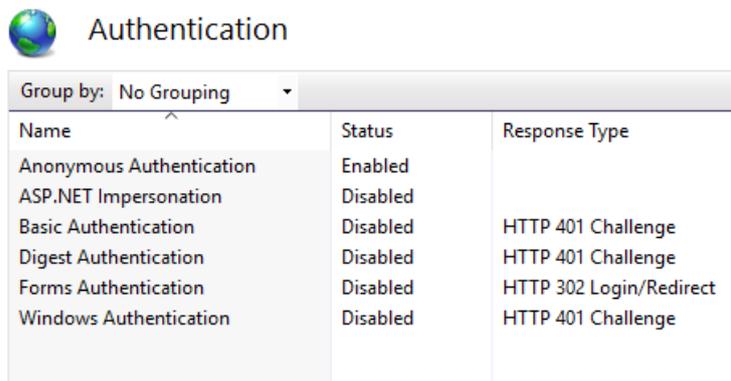
Bootstrap got chosen for this project as it a wide range of options when working on the front-end.

2.4 Authentication method

As only certain users and members of certain groups in Nokia are supposed to be using this project, authentication should be used. Usually Windows Authentication is used in companies as that method will login the user automatically to the web page with the same credentials used to log on to the computer. Because of this, no new login credentials need

to be made. This method is good, but if you want to authorize users with roles and groups, you need LDAP, which is something that will be introduced in the next topic.

If the web page is running on Internet Information Services (IIS), which will be introduced later, you can easily choose your authentication method there.



Name	Status	Response Type
Anonymous Authentication	Enabled	
ASP.NET Impersonation	Disabled	
Basic Authentication	Disabled	HTTP 401 Challenge
Digest Authentication	Disabled	HTTP 401 Challenge
Forms Authentication	Disabled	HTTP 302 Login/Redirect
Windows Authentication	Disabled	HTTP 401 Challenge

Figure 4. A view in IIS of different authentication methods which can be implemented on a web page running on IIS.

If a web page needs to have an authorization method to see whether a certain user or group has the rights to view a specific thing, a good choice would be to use Lightweight Directory Access Protocol (LDAP). LDAP needs to be implemented in the code manually. In this case Anonymous Authentication (which lets anyone on the web page) is the only method enabled on the web page as LDAP uses its own authentication. If LDAP is used, a readymade authentication should not be, as the two would collide. By using Anonymous Authentication we make sure no readymade authentication is colliding with the manually made authentication. Readymade authentication is good to use, but in this case as a more specific authentication method was needed, a method provided by IIS was not used.

Using authentication methods offered by IIS is a safer way to ensure security of credentials moving on the website, but if you need a specific way to authenticate and authorize people, manually created methods are probably needed. Manually created authentication methods are less safe as hashing and securing credentials is completely in the hands of the developer (Tom Leek, 2014).

2.4.1 LDAP (Lightweight Directory Access Protocol)

An AD (Active Directory) is commonly used as a place to store all users' information that work in the company. Usually usernames, passwords, email etc. are stored in the AD. This allows different applications to use LDAP for example as an authentication method, to validate users. LDAP searches for the information of the user from the company's AD. The web page where LDAP is implemented checks whether the user belongs to the company, and then fetches the desired information needed for the authentication.

```
dn: cn=John Doe,dc=example,dc=com
cn: John Doe
givenName: John
sn: Doe
telephoneNumber: +1 888 555 6789
telephoneNumber: +1 888 555 1232
mail: john@example.com
manager: cn=Barbara Doe,dc=example,dc=com
objectClass: inetOrgPerson
objectClass: organizationalPerson
objectClass: person
objectClass: top
```

Figure 5. When fetching information about a certain user with LDAP, the form which the information comes in, looks like this.

In this project the user must log on to the page with their Windows username and password. When the user logs in, the Windows credentials are passed on to LDAP to check whether the user exists in the system. If the user exists, he or she will be directed to the main page.

```

if(isset($_POST['username']) && isset($_POST['password'])){
    $adServer = "ldap://your_domain.net";

    $ldap = ldap_connect($adServer);
    $username = $_POST['username'];
    $password = $_POST['password'];

    $ldaprdn = 'your_domain' . "\" . $username;

    ldap_set_option($ldap, LDAP_OPT_PROTOCOL_VERSION, 3);
    ldap_set_option($ldap, LDAP_OPT_REFERRALS, 0);

    $bind = @ldap_bind($ldap, $ldaprdn, $password);

    if ($bind) {
        $filter = "(sAMAccountName=$username)";
        $result = ldap_search($ldap,"dc=your_domain,dc=net",$filter);
        $info = ldap_get_entries($ldap, $result);
        for ($i=0; $i<$info["count"]; $i++)
        {
            if($info['count'] > 1)
                break;
            $name = $info[$i]["givenname"][0]. " ".$info[$i]["sn"][0];
            #$group = ".$info[$i]['memberof'].";
            #print_r($group);
        }

        $_SESSION['fullname'] = $name;
        header("Location: viewer.php");
        @ldap_close($ldap);
    }
}

```

Figure 6. The code used to authenticate with LDAP.

The function in the picture above shows how a user gets authenticated with LDAP. The site connects to the domain server, which then checks the user's credentials. If the user's credentials are correct, his or her "givenname" (first name) and "sn" (sur name) will be returned and then stored as \$name, so that it then can be used later. The \$name will then get stored in a session variable. A session variable is a way to store information to be used across multiple pages. The name of the user is important to store in to the database during the evaluation process so that admins can later see who has done what.

2.4.2 Groups and authorization

When creating an application for many users who should have different rights, it is smart to create user groups and give those groups different access rights.

Certain groups and rights were created into Nokia's Active Directory meant specifically for this project so that users could get authorized whether they have access to different sections of the application. A group for admins was created, so that those users could be the ones creating the tasks for evaluators. A group for users who are allowed to view everyone's evaluations was created as well. Finally, a group was created for users who are just doing the evaluations and nothing more.

3 APPLICATION ARCHITECTURE

It is important to create a drawing of the architecture of a project, as this will paint a clearer picture of how everything should work. In this case the architecture is not that complex, while in other projects there could be a lot more components.

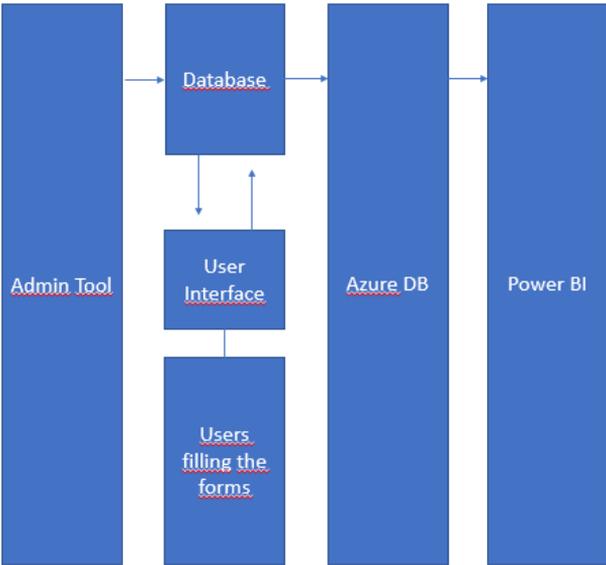


Figure 7. A picture of the architecture on how everything works and connects.

3.1 Database Structure

The structure of a database is preferable to keep as simple and easy to understand so that developers could find things easily. In this case we have used ID's, which makes it easier to connect and link different tables.

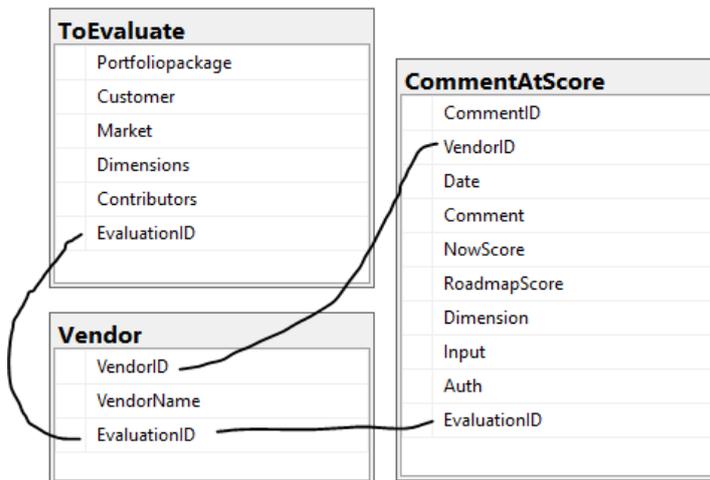


Figure 8. The structure of the database used in this project.

As seen in the picture, the structure is simple, as everything connects with ID's. It is always good practice to create a database structure as it will clear things up in a lot of cases and give a better picture of how all tables are connected. The tables can then be shown on a web page together in a merged table by the help of SQL queries. Merging different tables by their linked ID's can for example be done with the SQL query named INNER JOIN. With INNER JOIN you choose the columns and tables you want and then merge those columns into one table. When doing this, the tables must have a linking column, and that is why it is good to make an auto-incremented (auto-increment generates an ID automatically to each row created) ID column into each table.

Usually database structures in big projects tend to have dozens of tables linked with each other. Those structures can be hard to understand when trying to work with the database and web page. In this case though no more than three tables were needed.

3.2 User Interface

The interface is where all companies will be evaluated and where all the data gets created which then can get passed to power BI, which is a tool where data can be visualized using charts and diagrams.

The data created on the admin page will be visible on the interface for users, and as the users do the tasks given to them, the data will be sent back to the database.

The table named ToEvaluate (as seen in the picture under Database Structure) is what the admin fills on the admin page with a tool. The admin tool is a part of the whole web interface, but this page is only accessible by the admins of the web application.

The admins of the web application create new tasks for users, which then show up on the main page. The tasks made on the admin page determine what the users should be evaluating, who this specific task should be for and when these evaluations should be done. When the admin has created the task, all information will be sent to the database, from where the webpage then reads the data and shows it on the main page for the users.

The table named CommentAtScore is the table which will be filled with evaluations done by users. Users will know what they are evaluating with the help of the table, ToEvaluate, which has all the information needed. The table, Vendor, has all the vendors available for competence evaluating. A vendor in this case is a company, for example Nokia, Huawei or Ericsson. When users have chosen a vendor or two, they get to the evaluation page.

Pick dimension(Available: 2,4):	Vendor	Now Score	Roadmap Score	Comment
What dimension are you eval	Nokia	8	4	Your comment here..

Figure 9. This is where the user gives scores to whatever vendor he or she has chosen to evaluate.

As mentioned earlier about INNER JOINS, the table above has columns from two different tables. All columns are from CommentAtScore except the column Vendor, which is from the table named Vendor.

When a user has done their evaluation, the evaluation will be stored on another page for the user to find and update later. If the user chooses to “Submit” the evaluation, the input will get marked as completed (column shown in picture below), and if the user wants to edit his or her evaluation later, the this is also possible.

Vendor	Now Score	Roadmap Score	Comment	Last Updated	Input Complete?(Yes/No)	Evaluated by:	Update
Nokia	Score: 6	Score: 6	latest update	2018-09-14	<input type="checkbox"/>	Aleksi Suoknuuti	<input type="button" value="Update"/>

Figure 10. One example of all the evaluations the user has made. This table can be very long as all evaluations get stored in this table.

When the user does an evaluation, the date and who it is done by will automatically be added to the row in the table, as seen above. The name of the user will get added as we have the name saved from earlier with the help of LDAP. The user can make updates on earlier evaluations by changing scores, comments etc. By pressing Update, an updated version will be added to the table with the new information, while the old remains.

4 DEVELOPMENT ENVIRONMENT

The development environment is a set of tools and applications used for developing, testing and debugging. In this case a few has only been needed. As the Integrated Development Environment (this will be explained in the next topic), Visual Studio Code has been used as it is easy to understand and has a lot of extensions that will make the writing easier. For the server-side part where SQL queries will be tested, SQL Server Management Studio has been used, as it is clear and easy to use. You write the query, run it from a button and the result will be shown in a window.

Usually the development environment needs different stages for testing purposes. To keep things clear and have room for mistakes, a development server, production server and testing server is good to have (Vikas Munjal, 2018). The development server is for the developer to write new code on, so mistakes and testing is fine here. When the developer then feels comfortable with the code, the code can be moved on to the testing server. At the testing server, everything should simulate the production server, except here final approvals are the only thing keeping it from moving on to the production server. If the code needs editing, it will be moved back to the development server, but if it gets approved, it will get moved to the production server, and get published.

4.1 Integrated Development Environment

An integrated development environment (IDE) is the tool or software application used for writing the code. Different IDEs have different benefits and downsides. Some do not for example have a debugger, which is almost critical for writing code, as some minor dot or letter could stop the code from working. The marketplace of Visual Studio offers debuggers for almost all languages, which can be downloaded as extensions.

4.1.1 Visual Studio Code

Visual Studio Code is an IDE that is one of the most popular ones. Visual Studio Code is developed by Microsoft for Windows, Linux and MacOS. Visual Studio Code has all the things one needs from a source code editor, as it offers debugging, embedded Git control,

intelligent code completion, syntax highlighting, snippets and code refactoring. Visual Studio Code also has its own marketplace where the user can download extensions that make the programming easier.

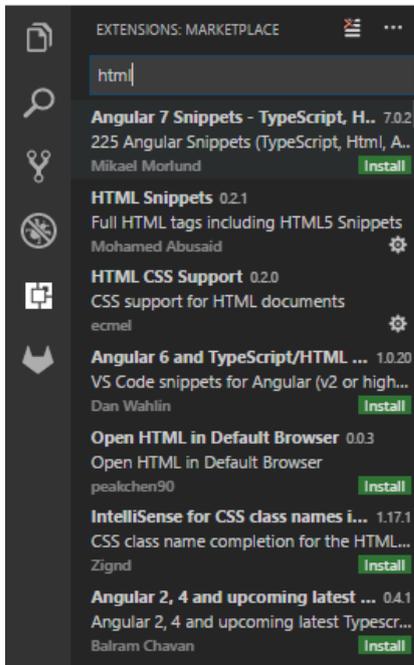


Figure 11. The marketplace of Visual Studio Code. A few extensions that show when searching with “html”.

4.2 SQL Server Management Studio

SQL Server Management Studio (SSMS) is a good application to use if you want to connect to a database and manage, configure or develop components. SSMS offers a lot of tools and scripts which will make the users work easier. In this project SSMS is used for checking how the tables look, what type the columns in the tables are (INT, VARCHAR, DATE or TEXT etc.) and searching for errors.

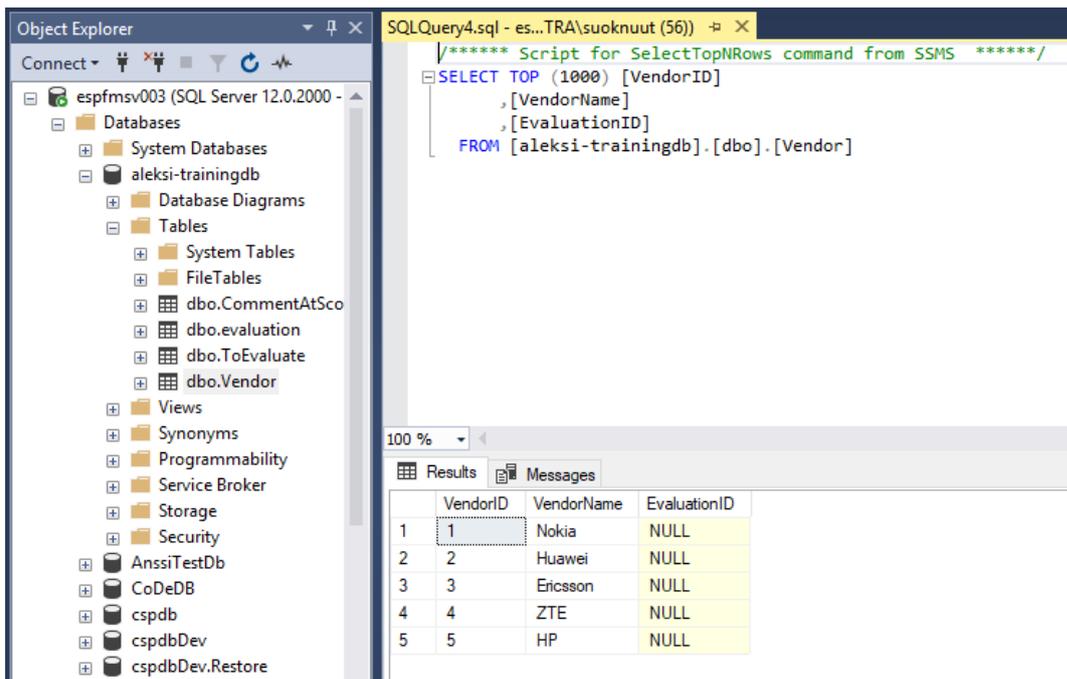


Figure 12. A picture where a query, “SELECT TOP (1000)”, is executed on a table named “Vendor” (although it only has 5 rows).

Selecting the top 1000 rows will show you what the table holds on the 1000 first rows. This is a good way to see if there are unnecessary columns holding a lot of NULLS for example. If there is an error on the website which has something to do with SQL, it can sometimes help to execute the same query in SSMS as it will, in a way, give you more space to play with, and you do not have to run the website over and over to try and solve the error.

4.3 Servers

For your web page to be able to go online, servers are needed. A single server can serve multiple clients, and a single client can use multiple servers. Typical servers are database servers, file servers, mail servers, print servers, web servers, game servers and application servers. In this project, database servers and web servers are used. Servers used in this project are in the intranet of Nokia, which means that the user must belong to the company to login on the computer or access it via the browser. In this case, a development-, testing- and production server is used as the web server. A development server is good for early stages of the development where mistakes are allowed. A testing server is for demos and

final stages of the development. If everything goes well and no errors occur at the stage of the testing server, the project can be moved on to the production server. This method with three stages of servers are used in this project because when showing demos to people at Nokia, no errors are wanted. This gives the developers room to make and keep the errors on a separate server; the development server.

4.3.1 IIS

Internet Information Services (IIS) is an extensible web server created by Microsoft, which does not come on all Windows editions by default but can easily be enabled. IIS's tool, which lets you run a website, is user-friendly as it will ask for everything needed.

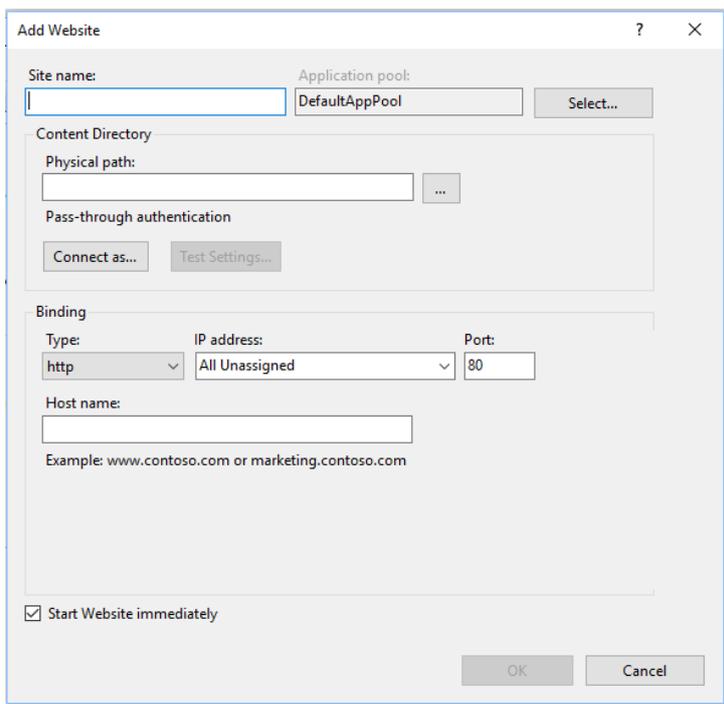


Figure 13. Adding a website to IIS.

After adding a website to IIS, a path to the files of the user's code can then be linked.

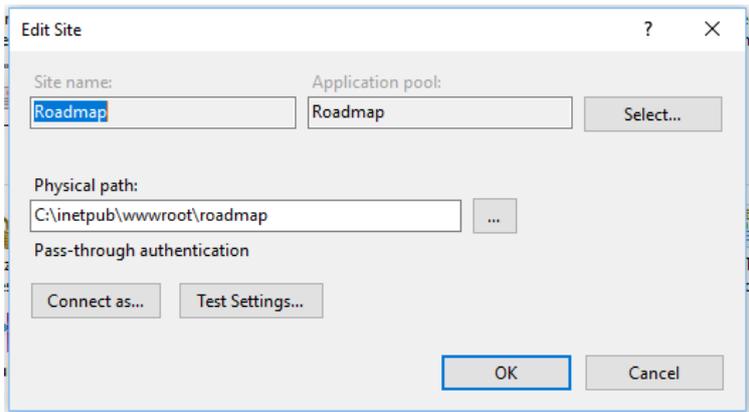


Figure 14. By changing the physical path, the user can locate the folder of the files used for the web page.

IIS comes with many features such as different authentication methods which are easy to enable so that restrictions and authorizations for the web page could be made. The methods are mentioned earlier in this thesis under the topic named “Authentication method”.

4.3.2 Development Server

As the development server in this project, localhost was used. Localhost is good to use for testing and development purposes as everything will be locally on the developer's computer. Localhost can be set up on any computer. The development server is where all the code writing, debugging and error searching happens. A server running on localhost can be set and deployed with IIS.

HTML-files can also be displayed by writing the path to the files in the address bar on the browser. Most modern browsers can recognize file paths when they are written in the address bar. Due to the diversity of files that can be opened with a modern browser ap-

plication, most browsers can also display the contents of local files even though the information is not transferred using traditional protocols. This method does not require localhost to be running.

4.3.3 Testing Server

As the testing server, a separate virtual machine only meant for server purposes, is used. No editing of the code is done on the testing server, only demos and final testing. If errors are found on the testing server, the errors will be fixed on the development server. When the errors are fixed, a version with the fixes is then pushed on to the testing server for new demos. As mentioned earlier, the testing server is on a virtual machine, which, in the case of Nokia's hardware setup, requires one to use a remote connection.

The remote desktop connection can be established using an application which comes as a default program on Windows. This application lets the user log in on to other computers remotely.

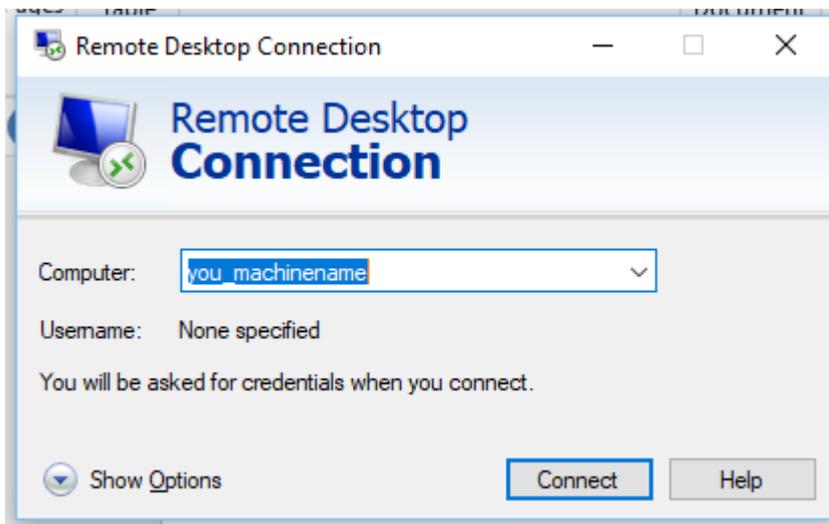


Figure 15. Remote Desktop Connection.

In this case the machine used as a server is running Windows 10.

The code on this server is also tested with IIS. In this case, the IP-address of this server is given to users and managers for testing.

4.3.4 Production Server

If the project gets approved by the project manager when on the testing server, it will get moved to the production server, where it will get published. The code on the production server should not be edited as no errors should occur in the code on this server. As the production server, another virtual machine is used in this project. The web page on this server is also running on IIS.

5 STAGES OF DEVELOPMENT

5.1 Proof of concept

A proof of concept is the realization of an idea to demonstrate whether the idea has practical potential. In this case the answer is clear as the web application fulfills its purpose, which is to replace Microsoft SharePoint, Microsoft Excel and SQL Server Management Studio and therefore reduce the amount of work users must do in order to complete a competence evaluation.

The business case of this project is for the web application to save time which therefore will save money. In other words, a thing we also want to know when the web application gets developed is whether the effort is worth it and is the net present value positive, which will be explained later in a topic. Even though no exact times have been calculated using the new interface, it has been tested through demos that time will be saved as users now only have to use one application.

An early stage demo was created for users to give a picture of how the User Interface would look like. The demo did not have the key components the final version has but gave the feeling of what to expect. When the demo was shown to the users in a meeting, different questions about the elements of the interface were asked. They focused a lot on

whether to use numeral scales or sliders, and most testers felt sliders would be easier to use. Sliders were then to become one of the key elements to visualize the score that users gave to vendors.



Figure 15. HTML Range Input Slider.

5.1.1 Use Case

A use case is a list of actions which should lead to the wanted goal by showing the steps of the different roles in a project. The role could be a human or an external system. In this case the acting roles are all human. For the use case to achieve the goal, we need an admin and users to use the interface. The admin will make evaluation tasks for the users, and the users will then get notified to do these evaluations. By evaluating the required companies, the goal of the project is achieved.

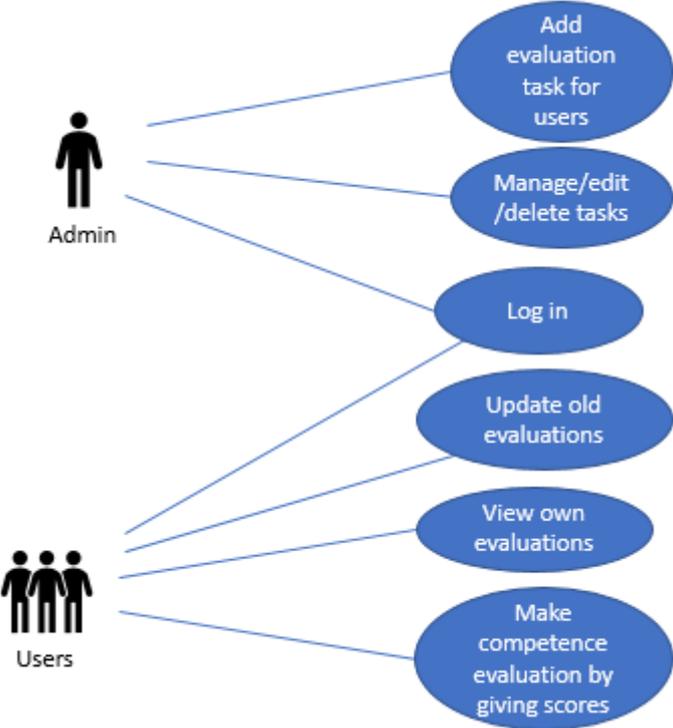


Figure 16. A Use Case.

5.1.2 Estimations

The goal of the application is to save time and therefore money. Although this is the goal, no actual time has been counted for how long it takes for a user to do an evaluation with the new web application, as the exact amount of time is not the main concern. As long as the application is faster and simpler, the goal has been achieved.

5.2 Prototype

A prototype is a more advanced version of the early version during the proof of concept, which means that at this stage the web application will be ready for testing. At the prototype stage the web application has almost everything it should have but is still lacking the final improvements. In this case, the prototype should include the abilities to let users log in, see only the tasks made for them, do the tasks and then be able to edit them. During this stage a lot of new ideas were invented as when something was added, a new view and perspective of the User Interface was created.

The prototype got a warm welcome, and tests were done by a few users in our group. The group was gathered in a room and everyone got to do a sample evaluation with their own computer, while one of the admins showed how it is done. The application got mainly positive feedback and some requests to change a few things. The requested changes were minor. One change for example was a text field they wanted to be changed for a checkbox etc..

5.3 Pilot

“Pilot testing is a rehearsal of your research study, allowing you to test your research approach with a small number of test participants before you conduct your main study. Although this is an additional step, it may be the time best spent on any research project.” (Matt Wright, 2018)

When piloting we should have the project in a state where the interface can be tested by the general intended audience for final feedback and possible bug fixes. At this stage the project should be in a phase it would be in upon releasing. The key components are the most important ones to test here, and as this User Interface does not have that many features, and the users already are familiar with the interface from earlier demos, it was straight forward and easy to test the improvements.

5.3.1 Testing

Although the web application never went through any official testing procedures, five of my colleagues tried it for a few weeks and gave me positive feedback on both the interface and the usability. A few minor bug fixes were requested as some features worked on Google Chrome but not on Internet Explorer. Google Chrome is mainly used at Nokia, but since people also use Internet Explorer, the features must work on both browsers. The interface's main features worked which is the important thing. The testing showed everyone that the new method is much faster, and lets the user skip all the steps with Share-Point and Excel, which was the original intent of the project.

6 BUSINESS CASE

6.1 Net Present Value

$NPV = (\text{Today's value of the expected cash flows}) - (\text{Today's value of invested cash})$

Net Present value is the difference between the expected cash flow and the invested cash and is used mainly for analyzing the profitability of a project. An NPV with a positive result is assumed to be a profitable project, while a negative NPV will result in a net loss.

The Net Present Value is one of the questions in this project that we also are interested in. The business case in this project is whether it has been worth spending time on, and whether this project will get profitable at some point. The invested cash on the project has been the salary of few months of a summer trainee, which approximately is 10 000€. As the new web application is a lot faster to use, time will be saved, which then will speed up the whole process of the competence evaluation. No exact results of time savings are proved as the interface has not yet been tested in a real use case scenario, as this was not considered a priority by my superiors.

7 DISCUSSION AND CONCLUSION

When I first started at Nokia, I heard that the department I was working in wanted to build a web application which has the same features as SharePoint, but a better version. We then started to look out for options, what language we should use, and then came to an outcome that PHP would be the easiest solution. I then started working on the project using PHP, HTML, SQL, JavaScript and CSS. The result turned out to be good as I had studied PHP in school, so it was not a completely unfamiliar language.

I managed to build a new User Interface over the summer. I faced a lot of problems when creating the interface, but I managed to solve them.

The project turned out to fulfill its purpose, which was considered more important than testing, at least for now.

We gathered users who will be using the application in the future and came to a mutual understanding about the layout and how the evaluations should be done.

Users were happy with the features and all in all the whole interface. The old methods can now be put to side as the new one makes competence evaluations easier.

I have learned a lot by doing this project. You think you know everything at some point, but new challenges face you all the time, and then you have to re-evaluate your knowledge. I am doing a similar project for Nokia at the moment, but this time the application has a lot more features, which makes it an even harder challenge. When working

with PHP and SQL, I have learned that security is very important as it is very easy to get information from a database if the web application is not correctly secured.

These days there are a lot of tools for making your web application forms by just dragging and dropping, without having to write a single line of code yourself. These applications are easy to use as you do not have to be able to write code yourself, but they usually lack the options of editing the details you would need to edit in some cases. There are many languages you could choose from to achieve the same results, but since PHP was preferred at Nokia, that language was chosen to be used for this project.

If someone asked me to make a web application like this, I would use the languages I used in this project as they are the most familiar ones for me.

7.1 Further Development

I have also learned that projects in big companies aren't always as simple as in this case. The project was not thought through that well, or at least I got that feeling. At the beginning I got some specifications on a paper what it should include, but those were not that specific. It was almost two months later that I got a PowerPoint-file showing everything the web application should include. This had been a misunderstanding since they at Nokia thought they already had given me the file.

As the web application neared its final phase, new ideas kept appearing, which gave the feeling that the application would never be finished. The application got to a point where I had completed everything they asked me to complete. They still wanted minor fixes done and that is why I left the code easy for them to edit. As I left Nokia, I saw them changing some minor things in the interface. I hope they will get it to a point where they want it to be.

EXAMENSARBETE

Arcada

A longer summary in
swedish:

I arbetet berättas samt förklaras det hur en webbapplikation gjord för konkurrensvalue-
ring utvecklas. Arbetets mening är att kunna ersätta Microsoft SharePoint, Microsoft
Excel samt SQL Server Management Studio. Dessa tre steg skall ersättas eftersom de
kräver onödigt mycket tid att utföra. Med SharePoint, måste användarna nu fylla i eva-
lueringen i ett formulär som finns i SharePoint, sedan exportera det ifyllda formuläret
till Excel varefter någon med kunskaper i databaser måste importera informationen från
Excel till databasen. Med hjälp av en ny applikation kan detta ändras.

Förväntningarna är att applikationen skall spara tid, vilket där med sparar pengar.
Fastän detta är målet är en exakt tid för snabbheten av nya applikationen inte räknad ef-
tersom det inte är ett huvudsakligt bekymmer. Så länge applikationen är simplare samt
snabbare är målet nått.

Metoderna för framgång i detta arbete är att en liten grupp med anställda tas med i pro-
jektet för att pröva applikationen. Gruppen kan sedan säga vad de vill ha ändrat etc. Va-
let av språken är i mina händer så länge som applikationen gör framsteg. Dock, hade de
anställda önskemål för val av språk.

Applikationen är skriven i PHP, HTML, SQL samt JavaScript. Med HTML får vi gjort
ett formulär som ersätter de tidigare gjorda med SharePoint. Formuläret skapas med
som är ett ramverk gjort för HTML. Ramverket underlättar utvecklingen med att t.ex.
ge färdigt gjorda egenskaper som utvecklaren sedan kan använda istället för att skriva
kodsuttag själv. Ifall man t.ex. vill lägga in en navigations meny på sin webbsida behö-
ver man inte skriva in en massa CSS-kod, utan Bootstrap har det redan gjort för en. CSS
(Cascading Style Sheets) är ett språk som används för att definiera utseendet på webbsi-
dor.

Med hjälp av PHP samt SQL får vi de ifyllda formulären skickade direkt till databasen,
vilket betyder att SharePoint eller Excel inte mer behövs. PHP är ett programmerings-
språk gjort huvudsakligen för att ansluta webbsidan till servrar. PHP finns ofta på
webbsidor där man skall logga in eller registrera sig. Det du fyller i formuläret på webb-
sidan skickas till en databas. Hur informationen tar sig från webbsidan till databasen är
med hjälp av PHP. PHP har olika drivrutiner den kan använda för att koppla sig till da-
tabaser. Till dessa drivrutiner hör PDO, MySQL samt MySQLi där bokstaven i står för
improved. I detta arbete används PDO eftersom det är mer kompatibelt med olika serv-
rar, medan MySQL bara fungerar med MySQL servrar. PHP använder sig av språket
SQL för att kommunicera med databasen. För att kunna föra samt hämta information
från och till databasen måste man skriva in en query åt PHP. En query är ett kommando
i SQL där du skriver det du vill att skall hända. Det finns olika slags queries som t.ex.
INSERT INTO, DELETE FROM eller SELECT FROM som för, hämtar eller updaterar
information till eller från databasen.

Användarna av applikationen har och får olika uppgifter gjorda just för dem, vilket be-
tyder att roller och grupper måste implementeras. Med hjälp av Lightweight Directory
Access Protocol (LDAP) får applikationen kontakt med bolagets Active Directory, där

rollerna för varje anställd syns, liksom vilka grupper den anställda hör till. Stora bolag brukar använda AD (Active Directory) eftersom det underlättar vad anställda får se och vad de kan göra i sin roll. Ifall det t.ex. ordnas ett möte bara för anställda som hör till en viss grupp, kan man skicka ett mail åt en grupp vilket då gör att alla som tillhör den får en inbjudan. LDAP är ett bra sätt att autentisera användare eftersom personer som inte finns i bolagets Active Directory inte kan logga in på webbsidan. Med hjälp av LDAP kan administratören som gör uppgifterna lätt välja för vilken grupp av användare uppgiften görs.

Det finns mycket som måste tas i beaktande då man överför information från, och till databaser med tanke på säkerhet. Windows kommer med sina inbyggda metoder för inloggning av användare, men vid användning av manuellt gjorda metoder (t.ex. LDAP) är säkerheten på utvecklarens ansvar. Eftersom denna applikation bara kan användas inom bolagets intra, är risken för attacker inte lika stor.

Användargränssnittet är var all konkurrensutvärdering utförs. Det finns ett skilt gränssnitt för användare och administratörer. Administratörerna skapar uppgifter, som sedan syns för användarna på huvudsidan. Alla uppgifter syns dock inte för alla användare. Då administratören skapar en uppgift kan den välja för vilken slags roll av användare eller vilken slags grupp uppgiften görs åt. Utvärderingen utförs med att ge poäng från 1 till 10 och med att lämna en liten kommentar. Poängen definierar hur bra bolaget gjort av sig mot sin konkurrent under året.

Ett utvecklings sätt med tre servrar har använts i detta projekt: en utvecklingsserver, en testserver och en produktionsserver. På utvecklingsservern utförs all utveckling vilket innebär att programmeringsfel och buggar får uppstå här. Utvecklingsservern körs i detta projekt lokalt med IIS (Internet Information Services) på utvecklarens dator. IIS är en webbserver gjord av Microsoft som låter en köra en webbsida datorn. IIS kommer med färdigt inbyggda autentiseringsmetoder, vilket gör det lätt att implementera begränsningar på en webbsida. Ifall utvecklingen kommer till ett skede där applikationen kan presenteras och testas, kan man överföra den till testservern. På testservern är det meningen för användare att testa samt hitta möjliga ändringar. Ifall ändringar krävs, fel eller buggar hittas, gör utvecklaren ändringarna på utvecklingsservern och laddar upp en ny testversion. Ifall alla då är nöjda med produkten och inga fel hittas, kan projektet flyttas till produktionsservern, där bara den slutliga produkten borde finnas. Under utvecklingen av detta projekt, blev produkten på testservern eftersom små ändringar ännu krävdes innan man kunde flytta applikationen till produktionsservern.

Med HTML, PHP samt SQL lyckas applikationen ersätta de tre gamla metoderna utan desto större problem. Enligt feedback från användare är applikationen en mycket bättre lösning p.g.a. användarvänligheten och smidigheten. Testgruppen påstod att applikationen underlättat deras arbete och sparar tid.

Jag har lärt mig en massa under arbetets lopp. Man tror man vet nästan allting men alltid kommer det ny information som överraskar en. Många hinder uppstod som jag ändå lyckades hitta en väg att komma förbi. Ifall någon begärde mig utveckla en likadan applikation nu skulle jag använda samma språk som i detta projekt.

Språk:	Svenska
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APPENDICES

Appendice 1

An example of how to connect and insert data into a database with PDO. In this example we are inserting ID as 1, Firstname as John, Surname as Doe and Age as 50. If errors occur, the code will go into the “catch” function which then returns the error that is occurring.

```
<?php
try {
    //CONNECTING TO THE DATABASE
    $conn = new PDO("sqlsrv:server = tcp:your_server; Database = your_database",
        "your_login_name", "your_login_password");
    $conn->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);

    //INSERTING THE VALUES INTO THE TABLE IN THE DATABASE
    $sql="INSERT INTO your_table (ID, Firstname, Surname, Age)
    VALUES ('1', 'John', 'Doe', '50')";

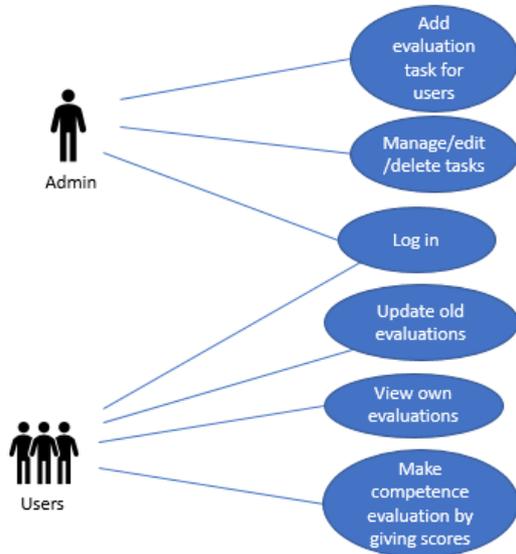
    //PREPARING THE CONNECTION TO THE DATABASE WITH YOUR QUERY
    $stmt = $conn->prepare($sql);

    //EXECUTING THE QUERY AS THE CONNECTION IS WORKING, COLUMNS AND
    //NAMES MATCH WITH THE TABLE IN THE DATABASE
    $stmt->execute();
}
catch (PDOException $e) {
    print("Error connecting to SQL Server.");
    die(print_r($e));
}

//YOU SHOULD ALWAYS CLOSE THE CONNECTION
$conn = null;
?>
```

Appendice 2

An example of a use case. This example is typically used on webpage with admins and users. The users do the tasks and the admin can see what the users have done, manage, edit and delete features. These features are usually limited to administrators.



Appendice 3

An example of a case how to get the top 1000 rows of a table in SQL.

The screenshot shows the SQL Server Enterprise Manager interface. The Object Explorer on the left displays the database structure for 'espfmsv003 (SQL Server 12.0.2000 -)'. The 'Databases' folder is expanded, showing 'aleksi-trainingdb' with tables 'dbo.CommentAtSco', 'dbo.evaluation', 'dbo.ToEvaluate', and 'dbo.Vendor'. The 'SQLQuery4.sql' window on the right contains the following SQL query:

```
/****** Script for SelectTopNRows command from SSMS *****/
SELECT TOP (1000) [VendorID]
, [VendorName]
, [EvaluationID]
FROM [aleksi-trainingdb].[dbo].[Vendor]
```

The Results pane at the bottom shows the output of the query:

	VendorID	VendorName	EvaluationID
1	1	Nokia	NULL
2	2	Huawei	NULL
3	3	Ericsson	NULL
4	4	ZTE	NULL
5	5	HP	NULL

Appendix 4

An example of how to fetch a user's full name from the intranet's active directory. In this case \$name is a variable that is created by fetching "givenname" (firstname) and "sn" (surname).

```
if(isset($_POST['username']) && isset($_POST['password'])){

    $adServer = "ldap://your_domain.net";

    $ldap = ldap_connect($adServer);
    $username = $_POST['username'];
    $password = $_POST['password'];

    $ldaprdn = 'your_domain' . "\\\" . $username;

    ldap_set_option($ldap, LDAP_OPT_PROTOCOL_VERSION, 3);
    ldap_set_option($ldap, LDAP_OPT_REFERRALS, 0);

    $bind = @ldap_bind($ldap, $ldaprdn, $password);

    if ($bind) {
        $filter = "(sAMAccountName=$username)";
        $result = ldap_search($ldap, "dc=your_domain,dc=net",$filter);
        $info = ldap_get_entries($ldap, $result);
        for ($i=0; $i<$info["count"]; $i++)
        {
            if($info['count'] > 1)
                break;
            $name = $info[$i]["givenname"][0]." ".$info[$i]["sn"][0];
            #$group = ".$info[$i]['memberof'].";
            #print_r($group);
        }

        $_SESSION['fullname'] = $name;
        header("Location: viewer.php");
        @ldap_close($ldap);
    }
}
```

Appendix 5

An example of a database structure. Every database has its own structure and the creator makes a structure most logical for him/her. As seen below it is highly recommended to make auto-incrementing ID's for every table, so that it then is easy to link with other tables. Auto-increment means that the database generates ID's automatically so that no ID's will be the same.

ToEvaluate	
Portfoliopackage	
Customer	
Market	
Dimensions	
Contributors	
EvaluationID	

Vendor	
VendorID	
VendorName	
EvaluationID	

CommentAtScore	
CommentID	
VendorID	
Date	
Comment	
NowScore	
RoadmapScore	
Dimension	
Input	
Auth	
EvaluationID	

