

Web based training system.

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# 1 - Introduction

## 1.1 - Project Aims (Objectives)

One aim for this project is to create an intuitive UI (User interface) based on user needs and HCI principles (Human – Computer interaction) and do this whilst researching current systems in the marketplace to analyse and understand the thoughts and ideas that created these current systems. Another aim of this project is to research how online training affects learning and how the system can help to either improve learning or how to reduce the negative side effects of online training. There is also the need to research into broader training needs and analyse what is required in an online learning tool to make it efficient and effective. I also aim to create a system based on derived requirements to add efficiency to existing business processes and to conduct testing of the system to validate overall effectiveness on those business processes. The final aim of the project is to compile associated documentation and produce a set of heuristics to support training management.

* OBJ1: Create an intuitive UI (User interface) based on user needs and HCI principles (Human – Computer interaction) and do this whilst researching current systems in the marketplace to analyse and understand the thoughts and ideas that created these current systems
* PDO1: To work in an agile methodology format (agile reference), and work with a real company and tailor the design and function of my project to match with the stakeholders views and opinions
* PDO2: adhere to the GANNT chart
* OBJ2: To create a system based on derived requirements to add efficiency to existing business processes and to conduct testing of the system to validate overall effectiveness on those business processes.

## 1.2 - Motivation for the work

The motivation of this project is that a Silver Oxide and Silver Nitrate manufacturer called Ames Goldsmith, is in desperate need of a new, modernised training system as the old system of excel files is quickly becoming outdated and unmanageable. With multiple iterations of the same excel file being used, many missing information or entries, and the need to print of documents, the old system is costing the company valuable time and resources that as a small – medium sized branch of a larger company they cannot afford as it is already taking very busy staff away from their specific roles to update and fix the old system. There were discussions about buying a new system but ultimately the decision was that it wasn’t worth the money buying a whole new training system would cost and as such the idea for this project was proposed. The system could also be expanded to help meet more general training needs, outside of the specific needs of Ames Goldsmith, by using more general techniques and design. This could allow many companies in Ames Goldsmith’s position to use the system to improve their efficiency whilst also not cutting into already tight funding.

## 1.3 - Personal Development Aims

The personal development aims for this project are to deepen my knowledge of how a company or individuals plan a development project, to understand how and why certain choices are made and the motives behind these decisions, whether they are financial or artistic choices and how to incorporate stakeholder opinions and requirements into those choices. Another aim is to be punctual and deliver consistent and quality code meeting my stakeholders requirements in a timely fashion and adhering to the GAANT (reference for a GAANT Chart?) chart that was created for this project. Also, a vital aim is to work in an agile methodology format (agile reference), and work with a real company and tailor the design and function of my project to match with the stakeholders views and opinions, keeping a consistent and frequent dialogue between myself and the company to ensure that the system is developing into what the users need. This will give invaluable experience for future employment as this simulates a real-world scenario.

# 2 - Literature Review and Fact Finding

## 2.1 - Research Objectives:

O1: Evaluate the effectiveness of Online training in a professional setting.

O2: Research online training techniques and understand how these techniques are used to maximize outcomes in industry.

O3: Explore how and why are current systems using the techniques researched.

In today’s technological landscape with its ever-evolving needs and opportunities it is often difficult for companies to adapt and implement new ideas into their workflow and their training. However, as these advancements and changes arrive it has become clearer that so too must training adapt, to allow companies to keep up with the new demands of industry and provide their employees with the greatest tools available to ensure that all employees are trained to a high level to reduce chance of failure or injury. This can be achieved by implementing online training courses as show by (Trifu et al., 2024) where in their study workplace accidents dropped by 22% due to engaging online training, across 10 companies in a 24-month period, just showing the potential benefits of an effective online training program.

Online training is used as it is a very effective way to provide training without some of the short comings of in-person training such as the impact of Covid 19 halting in person trainings, leaving employees under-qualified and in certain industries unsafe. This is where online training is effective as it allows for flexibility in delivery, as the: videos, PDFs and audio clips can be played anywhere at any time, meaning high quality training can be done outside of the classroom. This has huge benefits as told by Clarke "Within a self-paced instructional program, an employee may review specific topics on which he/she needs clarification. Or, if familiar with the topic, the employee may quickly complete the course and progress at a faster rate. This is in stark contrast to classroom instruction, in which a group of employees is trained based on a predetermined time and are individually expected to master the topic during that time." (Clarke, S & Flitcroft, 2011), Online training can lead to more expert knowledge and faster results if employees are able to grasp the content and move through it at their own pace. Another area where online learning can be very effective is in its use of interactive multimedia as a way ensure the trainee is engaged with the content they are learning, this is shown to have increased content retention by as much as 60% as stated by (Prince Ololube, James Kpolovie and Ndiku Makewa, 2015), in the same vein, if an employee is finding an area of training particularly difficult they can work through it at their own speed ensuring that the knowledge is understood and can move on when ready, unlike in an in-person training sessions where the trainer may want to move on before the trainee is ready and still feels unsure about that area of content. The ability to monitor and evaluate the training being completed is also highly useful to managers as they can see exactly how the trainees are doing and how they are being scored, this can show insight into areas which require amendments to allow even greater benefits of the online training tools.

Many different techniques exist as an adaptation of in person training, with some being brand new and still evolving due to the demands of the Covid 19 lockdown. However, the most common training technique is the ADDIE method (Quigley, 2019), the ADDIE method has 5 steps: Analysis, Design, Development, Implementation and Evaluation. Each stage is met with iteration and reflection and as a result a focused, streamlined and effective approach providing feedback for improvement implemented alongside other techniques allows for greater retention of information and greater engagement in content as shown by (Pears and Konstantinidis, 2021),as this study shows participants skills increased by 30% after the workshop using the ADDIE model and had the workshops been longer and more detailed the researchers suggested the improvements would have been even greater. The first step in the ADDIE method is to analyse training needs, why does training need to take place and what outcomes are desired? This creates a foundation for the rest of the model to be based off, as well as a platform to implement other online training techniques such as stimulating old knowledge as this gives the trainees a ledge to build onto knowledge they already have. This can be accomplished by using techniques like quizzes as this stimulates prior knowledge and improves engagement in the content of the training and as stated by (Huang and Hung, 2022), “The selection of the most appropriate teaching media to achieve teaching goals is an important direction to follow”, showing just how important the use of multimedia is when applying online training models to maximize industry output. Also in the same paper the discussion of multimedia online training is further explored and it is detailed that in cases where your trainees have different backgrounds and levels of knowledge, as like in industry, it is most effective to use videos, audio, text, quizzes to help branch and connect any knowledge that might be missing as well and remove any cultural barriers that may be making the training less effective as this way all trainees have the same resources available just in different formats that help them learn best. The next step in the ADDIE model is to design your training and make practical decisions on the methods and delivery of your course, here the adaptation of using the ADDIE model in an online context can truly maximize the training outcomes, as here with the flexibility of online training as mentioned before, the online courses lend it’s better multimedia capabilities meaning you can have much more control over the content and delivery of the course than otherwise would be possible, this will maximise outcomes as the course can be specifically tailored to the needs of the people in the specific company, more than a broad range of topics, resulting in reduced cost of training as well as better returns in knowledge. Development and Implementation are the next two steps in the ADDIE model as these are all about ensuring that what you develop and put in place for the training is appropriate and correct to ensure that the trainees are not being presented with incorrect information. In development, the decision of how to present your information must be considered. There are 3 main ways to present your information one being storytelling, storytelling involves creating an engaging narrative as this will engage the trainee. There is also the style of Gamification, this involves using rewards and challenges to help motivate and engage the trainee whilst also providing them the important information of your training course. Lastly interactive video is another technique used as this can help convey abstract ideas and allow them to see the outcomes, an example of this is Lifesaver (Percy, n.d.),as in this interactive online training system detailing how to save people’s lives it uses “Interactive Films” with choices to help engage and train its users on the correct way to for example save someone who is choking, this is a great example of how serious and important information provided in an engaging format can be used effectively for industry purposes. Finally, Evaluation, evaluation is vital in this space as it allows you to reflect on the training outcomes and if your online training program allowed your trainees to accomplish those goals, here feedback is received as the model is started over to provide the best possible program for the next round of training.

It is also important to view what current training systems are being used in industry and to understand why they are being used and how they were created. One example of an interactive system using Gamification is the system currently in place at McDonalds to train their staff in the kitchen and on customer service. The idea in the development of this online training course is to give the trainees the necessary basic understanding of the kitchen and personal side of their job as to speed up the training of new employees. On their website it says this about the system “Working together, Kineo and McDonald’s created a till training game to make it addictive, purposeful and fun. Using an innovative approach, a game was designed to target skill and knowledge – using a simulation of the new till system so that learner’s ability to take orders could be tested and using questions to assess knowledge on how to deliver the best customer experience.” Here we can see a system that has used the techniques and methods mentioned earlier to maximise the outcome of their system. They chose to create a training system using engaging content and using the fun aspect of the game to increase replayability which in turn lead to further training and learning. McDonalds announced since the introduction of their till game it has led to a reduction of 7.9 seconds for each till service leading to an increase in their “average cheque by 15p (totalling an increased average of £18,000 per restaurant). That’s £23.7 million in the UK alone”, showing just how vital and important and engaging online training system can be to industry and profits (Kineo, n.d.).

Another great example how different techniques are being used in industry today is SafetyOn, this is a health and safety company for wind turbines in the UK. In 2020 they did research within the company and discovered the most common types of injuries, to combat these common types of injuries they decided use video storytelling to show the “why” behind the need for a change in approach for their employees, they did this by using a video of a “sensible and careful guy that everyone can relate to”, to impart the importance of the health and safety of their operators. They did this as it makes a bigger impact on people to see and relate to someone than simply read about the need to be more careful. This again shows how different formatting of online Training can be used to get the maximum output in your area of training.

However, despite the clear and many advantages of online training it is also important to consider the negatives and the potential downfalls of this form of training. The main negative is the lack of hand on training as stated by (Trifu et al., 2024)” not every topic can be addressed conceptually” and certain topics of training lend themselves much better to online than others, such as basic fundamentals of health and safety as this is all theoretical knowledge that doesn’t require in person repetition to learn. And so, in this context companies must be warry of where they apply their online training as in some cases there is no substitute for hands on training. There is also the need to technological knowledge to access and use the online training tools to the best of their capabilities, which some employees (especially older employees, and people with personal beliefs around technology), may not be able or willing to use the online training resources, and this creates a barrier between the employee and the training they require to complete their job, as such in these situations in person training may be required which could be shown to make the online training resources redundant.

Studies have also shown that in person training can lead to greater knowledge gain as show by (Gross et al., 2022), these results suggest that whilst online training is viable it does not have the same level of impact in knowledge as tradition in-person training has. This may have been caused by other disadvantages of online learning, as stated in the article many technical difficulties were present with examples being internet stability, less-controlled environments as well as “Zoom fatigue”, with the latter being exhaustion in mind and body from being on video conferencing applications (not just specifically Zoom) with the theory being it is caused due to “Excessive amounts of close-up eye gaze, cognitive load, increased self-evaluation from staring at video of oneself, and constraints on physical mobility.” Essentially making training from home much harder due to insufficient brakes and a lack of nonverbal communication making discourse much more exhausting and difficult. (Bailenson, 2021)

Arguably the biggest deterrent for using online training more commonly in industry is the reliance on technology and the inevitability that that technology will break and not work from time to time. This can be seen by (Fernandez et al., 2021), as in this paper we learn that the self-reported gains in online training and in person training is very similar and the positive themes of the training course have been felt over both kinds of training, however despite the self-reported gains being very similar the online training had many more complaints due to constraint issues (such as too much content for a session) as well as significant technical difficulties and a loss of social connection with fellow participants compared to their in-person training counterparts. As such despite the purpose of the training being the improvement of the trainees knowledge being achieved to a similar standard as the traditional in-person training, the virtual synchronous learning platform has practical costs outside of the learning such as competency and a sacrifice to camaraderie, which affects how well the trainees will function within the industry after their training.

## 2.2 - Summary:

In summary, Online training can be an incredibly effective tool for a company to use, if used correctly and carefully conceived, as this is a major downfall of many online training courses as they often try and teach the in-person training session in the different environment and it does not work in many cases. It is clear that the satisfaction of the training content itself is usually on par with in-person counterpart meaning there is clear evidence that on a practical level online training is very viable. However, it is equally clear that online training does not work with every-single type of industry training as in cases where hands on training is required there is simply no way to provide the online trainees with that same experience with videos and interactive content as they can only take you so far. Despite this it is clear that in the carefully selected areas of training, that online training can be a very effective and efficient use of company resources especially, in areas such as health and safety.

# 3 - System Design

## 3.1 - Problems and objectives of the system.

The problems that the system has been designed to alleviate are as described by Helen Wall training manager at Ames Goldsmith as “Firstly, it's just a bit clunky and basically the business has grown quite a lot in the last two years. So, we have, a great big, massive, Excel spreadsheet with everything listed that in its own, is just massive to keep up to date. Uh, we have some training that's done face to face from people first start. And then we have a number of training sheets which is all the refresher training.” (Appendix 7.2). Another problem area in the current “clunky” system is it takes a huge amount of time to organise, mark and update the spreadsheet mentioned, and in a company that is continuing to grow the demand on the employees is growing as such the time completing these training sheets is much needed elsewhere within the company. As a result of these problems within the company, my objectives for the system were to design a system which will reduce the workload in an efficient and effective way with intuitive design practices that will also reduce the time consumed by the current system, whilst also keeping as close to the original system as possible as to ensure the transition between systems would be as seamless and productive as possible.

## 3.2 - Major aspects of the product.

### 3.2.1 - Design Pattern

The first decision that had to be made in the creation of the system was to decide which programming language and design patterns were to be selected that would allow for scalability for the rapidly growing Ames Goldsmith. As well as this the need for easy maintenance on the system was required to ensure that the system as a whole wouldn't be made redundant whilst maintenance was being applied. As a result of these requirements the system was built in: HTML, CSS, PHP as well as MySQL and Apache via XAMPP in an MVC design pattern. An MVC(Model-View-Controller) design pattern was selected as MVC allows for logic,UI and user input to kept separate, which allows the use of prepared statements increasing security against attacks such as SQL injections because on top of prepared statements the use of validation of inputs reduces the risk of attack. (Orr, 2013)

### 3.2.2 - Database

The database for my system consists of 3 tables: user, training and q\_a. The “user” table is used to store the details of the users of the system, this table contains user\_id (primary key), user\_first\_name, user\_last\_name, user\_email, user\_hashed\_password, user\_role and user\_admin. The column user\_id is used to uniquely identify each instance in the table, as each instance represents a unique user of the system, which is determined by their employment at Ames Goldsmith. The user’s first name and last name are also stored to further help identification and in future will be used in the matrix view to select whose expiry dates to view. The user’s email is stored so that when using the login system such that a person’s email is a unique identifier which is easier to remember that a user\_id which is only viewable within the database table. A user’s hashed password is stored as well, firstly it is hashed to increase security of that person’s account should a bad actor gains access to the raw database table they will only be able to see the hashed password and not the raw password effectively making them unable to read the password. On top this similarly to the email the password is stored so that the users are able to login to their account. The user’s role is also stored as this determines which training courses they are expected to have updated and in date as some roles don’t require the same training as other roles. Finally, in the user table there is a column which is used to set if a user’s account is an admin account and it does this by holding a Boolean value of either 1 (indicates an admin account) and 0 (indicates it’s a normal user account), this is done so that unauthorised users are unable to access the training matrix and the create account screen as these functions are designed solely for the admin to be able to control.

The training table is a static table which only consists of two columns training\_id (primary key) and its related course. This table purpose is to allow the q\_a table to pull through the course name to display in the matrix view and to use the training\_id as its foreign key.

Finally, the final table is the q\_a table. This table is used to store the training\_id (foreign key), user\_id (foreign key) both of these are used together to create composite key to create unique instances within this table. Also stored in this table is question\_1 and question\_2 both of these are in relation to the questions posed at the bottom of the training pages which have droboxes as their answers, this is used to store the users answers and if time had allowed to validate if the answers are correct, finally the column date is used to store the date of expiry of the training that has just been completed and this is used within the matrix view displayed next to the course name to indicate which course trainings are expiring.

### 3.2.3 - Framework

Within the framework there are certain classes which are incredibly important in the creation of my system that without the system would be less secure and much less efficient.

#### 3.2.3.1 - Database wrapper

The database wrapper class is used to safely connect and execute SQL statements and pass parameters from the models to the database, it does this by using a function to check if the parameters entered by the SQL statement matches the number of required parameters and ensuring NULL isn’t passed. This class have been used to ensure that any connections to the database is safe and properly formatted.

#### 3.2.3.2 - Router and Validate

The router and validate go hand in hand through the system, particularly using both to select the route and verifying that the route exists. This allows the system to build the correct route and the correct controllers which in turn build the view and model if one is required.

#### 3.2.3.3 - WebPageTemplateView

The WebPageTemplateView creates a basic view output that is used all across the views as it contains the menu bar as well as functions to create the webpage meta headings as well as the insertPageContent method which sets up a template to be used in the views. This was used to reduce code duplication, and it means that there is no need to manually put the HTML into each view that requires the menu bar instead the menu bar class can be called by extending the WebPageTemplateView in the view of which ever page it is needed.

### 3.2.4 - Login

My system uses a typical login system which allows a user to login to their account within the system. When a user logs in a session is created, this is done because it allows for the passing of the user details across the system whilst the user is logged in, and this feature I used extensively throughout the project as it made accessing other tables and user information much easier and more streamlined than using multiple SQL statements and verification on the data as it is all readily available through the session. In particular this feature is used to select the user’s ID using the logged in email in the SQL parameter instead of asking for the user to enter their email again. With in the login view the data inputted by the user is then sent to the model via the controller and is sent in the form of a POST to ensure that the data entered is secure an unviewable within the webpage. The email and password are then verified to check that there are records in the database currently that match the information submitted, to do this the password must be hashed and compared to the already hashed password within the database. Once the email and password entered has been verified and is in the database then the session is started, and the user is directed the homepage this is done to signify to the user that their login was successful.

### 3.2.5 - Register

The register page works in a reverse of the login, as it receives the data through a form in the view that the user completes, then a check is made to see if any rows in the user table contains the entered email, if the return of the SQL query is zero, the password class in framework will hash the password and enter it into the database alongside all the other information required for a new record to be set in the user table. The user is then directed to the login page to allow them to login the new account they have just made this also signifies success in their previous actions.

### 3.2.6 - Training

To keep the training as simple and as close to the original paper versions that have been used at Ames Goldsmith in the past, they are designed to contain all the information that is necessary and in a format that is easy to follow with the information in titled sections and then two multiple choice questions at the bottom of the page. The formatting for each page is very similar as to allow for the learning to focus on the information and not how the page looks, I did this by writing the html and CSS such that each page uses the same styling and layout. I chose to use drop boxes for the answers to the questions as it would have made verification of the correct answers more straightforward however this was unfinished during the time frame given to me, given more time some questions would have been given more freedom in their answers. As well as the questions at the bottom of each of the pages, there is a date to be filled in with the date of expiry for that training when it is completed, this is then stored and used in the matrix page.

Once the answers and the date have been inputted the user presses the “go” button and this submits the data into the q\_a database table and takes the user to the answer page. There is an answer page for each training [page as this allows the user to reflect on if they got the question right or wrong and as such relies on self-marking. Given more time the system itself would mark the work and only allow the user to get to the answer page once both questions were answered correctly however due to time constraints this feature was not implemented.

### 3.2.7 - Matrix

The Matrix page is the coming together of the rest of the system it makes use of all the previous components and gives a simple output easy to understand and interpret giving the information of the expiry dates of the trainings for the users whose user\_id is entered. The table displayed is easily interpreted and uncomplicated. It produces this table by checking the database for records in the q\_a table based of the user\_id entered and the training\_id, the training\_id is selected by cycling through a for loop to ensure that all the training\_ids are used to ensure no expiry dates are missing. The rationale behind this decision was to keep the data entered by the user to a minimum as to reduce the complexity as if the user has to remember the user\_id as well as all the training\_ids that need checking it would become very confusing. To increase the usability, the system also uses the for loop of training\_ids to collect the name of the course, from the training table in the database, and displays this instead of the training\_id to make it easier to make sense of the output.

# 4 - Development lifecycle

## 4.1 - Methodology Selection

The software development methodology selected for the project was the Agile methodology (Kate, Shilpa Bhalerao and Sharma, 2023), with the key principles of this methodology being: iterative development, rapid feedback and flexibility. This methodology was selected as it allows for the steps in the development to be much more flexible which means that during the development process, I was able to dynamically change how much time and concentration that was being put into certain areas of the project which only became clear when in the development life cycle. This meant that during development the project was not being restricted to set plans and time crunches for each part of the system to be finished which results in rushed development and a weakened system. Also, with my development being alongside the needs of Ames Goldsmith, it allowed me to keep conversations open with those who I was developing the system for and to ask for clarification on requirements whist developing the system. Evidence of these conversations are the interview and questionnaire conducted at the Ames Goldsmith offices(Appendix 7.1,7.2), which allowed me to communicate with the stakeholders over what they thought of my designs and prototype and to ask for any clarification and further explanations on any requirements I was unable to implement or had to adjust to fit the time constraint of the project, and whether these adjustments were appropriate for eh system and the stakeholders needs.

## 4.2 - System requirements with validation and verification

### 4.2.1 - Choosing the scope of the project

The first stage in the development of the project was to discuss with Ames Goldsmith and its management about what specific pieces of their current system would be most effective at reducing workload if it was to be digitalised, as much of their current system is in need of updating however with my limited resources and time a selection of a few pieces of the old system needed to be selected. And as such after discussions with many of the managers including the training manager it was decided that the training matrix and the training programs would be the most effective to be updated as this was the areas in which the majority of the time was being absorbed. The validation of this decision comes in the form of that I have been able to implement the features necessary such that if the system was implemented today it would work for the company needs in the systems current state.

### 4.2.2 - Creation of HTML and CSS in visual studio

The next part of the development came with creating the HTML and CSS elements in visual studio code to allow for the back-end creation at a later date without having to change the front end. A week in total was spent in creating the front end with all pages going through many different states of completeness and change. The rationale behind the design of the design was that of simplicity to allow the stakeholders at Ames Goldsmith, who struggle on the whole with technology, to use the system without complication. As such I took much inspiration from other websites that are used in peoples everyday lives to create a layout that isn’t required to learn as it is similar to systems used before. The decision behind the CSS and colour scheme was based of Ames Goldsmiths own company colour scheme as the scheme is white and blue and allowed for a simple yet sleek colour scheme and design. The validation and verification in this section is simply based of how the system looked and felt to use at a very basic level to be able to intuitively follow the system through the pages and understand how the system flowed, which was accomplished by allowing the head of training at Ames Goldsmith to traverse across the system without assistance from myself.

### 4.2.3 - Creating the database

Creating the database was a vital stage within the development cycle as creating a poorly set up database would hinder my development going forward as time would have to be spent correcting any errors made or altering tables to fit new designs. As such a lot of time was spent creating the tables within my system to allow for expansion or change within the system itself. Many iterations of the database were created until the finalized database and its tables was settled upon and implemented. Verification and validation were applied here as I wasn’t required to change or manipulate the database after it was initialised and my pages were able to connect to the database and make use of SQL queries to the database during operation.

### 4.2.4 - Full Development

This stage consisted of creating a skeleton for which the MVC pattern could be implemented as such it required the creation of the framework and the setting file to ensure that the CSS and database would connect correctly. Once the skeleton was created, development was able to commence. At first development was slow as building the system from ground up had many challenges with the largest being unable to get an output, then once that was fixed creating the methods and classes in an object-oriented programming format was a challenge however as development continued and the system began to grow and develop these issues began to become easily to deal with and solve. Testing was implemented throughout ensuring that the system was handing data as expected using echo’s to track how data was being passed through the system and understanding the errors I was being passed and being able to track down the problems and fix them. Understanding how the database works and how it connects to each section of the system also allowed me to complete testing by viewing the inner workings of each table to ensure that the insert statements and update statements were being applied correctly.

### 4.2.5 - Validation and testing

The testing methodology I decided to use for my system was functional testing; this is because the system is being used in a very specific situation in which the system is being used within and only within the company. As such using functional testing allowed for the user requirements from the stakeholders to take a larger role within the testing, as the testing was to validate if these requirements had been achieved. This was done using a questionnaire and an interview (see appendix 7.1 and 7.2) with an expert user, that being head of training at Ames Goldsmith Helen Wall. At first, I gave Helen 30 minutes to use the system with very minimal input from myself to test if the intuitive user UI had been achieved which as seen by the questionnaire completed it was “somewhat” achieved. After this time, I showed Helen around the system myself and cleared up any uncertainties she had about the system. After the 30 minutes I conducted a questionnaire and an interview. With the questionnaire I used a mixed methods approach of both qualitative and quantitative questions, this was to assure that I received the maximum amount of feedback possible, the questionnaire has not been cleaned. As we can see from the results of the answers given in the questionnaire the system is successful in achieving its main purposes and passing the validation of the expert who would use the system. The interview was conducted immediately afterwards, the purpose of the interview was to understand the problems with the current system and then discuss whether the new system has solved these problems and as such been validated, this can clearly be seen by “(J)Thank you very much. Do you believe in its final form when completed and implemented can reduce the constraints on the current system?  (H)Yeah. It will be much faster; it'll be loads faster.”, from this we can see that the system would be effective if put into the workflow and as such has been validated. The results from the interview transcript have been cleaned for easier reading (appendix 7.2)

# 5 - Results and Critical Analysis

## 5.1 - Objectives

During the creation of the project, there were personal development objectives as well as project objectives that during the course of development should be met. I believe I have done well to meet these objectives.

OBJ1: I have achieved this project objective as shown by the interview and questionnaire the system is “Somewhat” intuitive, this was achieved by the implementation of the menu bar as well as well labelled transition buttons in the pages to indicate the user where to go next in the system. As well as this in the questionnaire we can see the system “Somewhat” has the functionality required, and as the functionality that was lacking is the details of certain pages as shown by the response in the questionnaire and in the interview, these are smaller pieces of functionality that would aid in the usability of the system being better however the system is still functional as “somewhat” intuitive and as such this objective has been met.

OBJ2: This objective has also been met, this is because as seen in the questionnaire, completed by the head of training at Ames Goldsmith, she would “agree” that she would be confident implementing the system into the business workflow, as well as this in the interview states “Yeah. It will be much faster, I think it'll be. It'll be loads faster”, showing to the efficiency of my system compared to the old system this was achieved by ensuring the system has an easily followed flow and as such it is clear where the next part of the system is and its purpose to the user, as such this objective can be considered fulfilled.

PDO1: This personal development aim has also been met as I have applied the agile methodology, having to adapt and be flexible in my delivery of my code as well as the production of the code. This can be seen in the results of the testing as the pages where improvements were suggested I had to adapt how to create these pages away from their first designs due to time constraints and coding inexperience, however the ability to adapt to these issues and still produce a system which is still usable and effective shows success in this personal objective. I also have been able to design the system to be what the stakeholders required as during my time at Ames Goldsmith before starting the project I was able to get a real idea for the project and what was required for it visually and as such believe I have met this objective.

PDO2: Another personal development objective was the adhere to the GANNT (appendix 6.3) chart that was created before starting development to help give an overall idea of the development of the project. My objective was to adhere to this chart to the best of my ability and continuously work in a timely fashion and produce good unrushed code. I believe that some extent I have successfully fulfilled this aim as I was able to adhere to the chart at the begging and had my Language and database selected on time, however as I began to work on the development of the project I came apparent that the order in which development needed to be done was in contrast with the GANTT chart and its ordering, as a result using the agile methodology I had to be flexible and change the plans created at the start to fit a much more organised development lifecycle. I was then due to my changes able to get back on course with the GANNT chart for the user testing and final adjustments as the development did not overrun.

## 5.2 - What went wrong

The biggest 2 things that have gone wrong in my development of the system was the output of the matrix page and the functionality of the training pages.

### 5.2.1 - Output of the matrix

Firstly the output of the matrix page was a struggle from the start as I was unsure how to conceptualize the page itself, the other pages in the system I had a good idea as to what the design of the page would be and its functionality however the matrix page all I had to work with was the old systems matrix page which is described as “clunky” and “massive”. As such I was unsure how to tackle this page as my methodology of trying to keep my system as close to the original for simplicity for the user was going to have to take a second priority to my coding abilities. This is because the original idea was to have all the training pages (i.e asbestos) all across the top with the users name and role and simply display all the date for each person stored in the database. However, as the matrix was the last page I can to work the back and front end into I was acutely aware of the timeframe I had left and on top of this having very little idea as to how to pull all the data through the model, I had to pivot to the current system which requires an input from the user of a user\_id for which they would like to see the expiry dates. This made the demand on the search easier as it was not being asked to pull through all the information from multiple tables which was giving me many errors I couldn’t fix at the time. All of this resulted in a page which does show the information however it requires knowledge of the inner working database, so it is far from perfect. I have received feedback from this as seen in the interview transcript (Appendix 7.2), and as such given more time I would have made this page work with the users name to keep the page working in the same fashion whilst being more user friendly or alternatively would work through my original idea and attempt to make that work as intended.

### 5.2.2 - Functionality of training pages

Secondly the functionality of the training pages was also brought up in the interview with Helen Wall as she correctly pointed out that as the system currently is there is no verification on whether the user got the answer right or wrong as such this could cause the company if installed problems as they would be seeing an employee having completed their training even if the answers they had selected were incorrect which is a safety hazard. In an attempt to solve this problem, I designed an answer page after the submission where the correct answers were displayed in an attempt to let the users self-mark their answers. However, during discussions, it was pointed out that this approach isn’t sufficient to ensure that the training is completed and the safety standards are upheld. In hindsight I would have made sure that validation and verification was performed on the answers as a vital part of the development as at the time of development I did not realise the importance of this necessary feature.

## 5.3 - What went right

Overall, I believe that my system was a success with many things going well, mainly: the use of MVC correctly, the theming and design of the system as well as the login and register pages working correctly.

### 5.3.1 - The use of MVC

Firstly, the use of an MVC pattern went very well as it meant that during development I was able to work on separate parts of the system without affecting the rest of the system and this also made discovering and debugging the system much easier and more streamlined as it meant I knew where to look for the errors. This pattern allowed for much faster development and more confident development of the system.

### 5.3.2 - Theming and design of the system

The theming and design of the system went well in this project as it has a professional yet simple design with ease of use as its driving force. The simple yet elegant white on blue colour scheme that runs throughout the program keeps to company colours and as this system is an inhouse system there is no need for an overly complicated or over the top layout as it is simply the employees of Ames Goldsmith that would be using the system. The consistent look and feel of the system I think is a positive to take away from the system.

### 5.3.3 - Login and register pages

Lastly, the login and register pages went well for me within the system as these were the first pages I attempted to take as I was not confident when begging the project however whilst developing the login page in particular, I began to feel more confident in what I was doing and began to make real progress. Despite the login page being a fairly small component in comparison to the training or matrix pages the importance in getting the login working was incomparable for the confidence for the rest of the system and its development.

## 5.4 - What would be different next time

If I was to do the same project again, I would have some things to change. Firstly, I would begin development of the back end earlier and would have properly designed my database from the start to cut down on development changes whist making the back end as this cost me a lot of time. I would also have liked to have had the chance to speak to the stakeholders earlier to allow myself more time to implement their concerns and suggestions and despite now having this feedback there is limited time to implement them. As mentioned earlier I would also have liked to start development of the matrix page earlier which would have been difficult as it requires the rest of the system to function to allow for the user to input data, which was my rationale for doing it last however in hindsight I realize using dummy data in the database would have been a more than effective way to simulate the kind of data that would be required and this added time would have allowed me to get the matrix to work more as intended.

## 5.5 - Analysis of software and approach used

My analysis of the approach taken is that it was the correct approach. This is due to my experience of using PHP in an MVC model in the past, and as such allowing me to much faster build on my knowledge than if I was to choose a new approach I have never done before. This allowed me to keep up with the timings given in the proposed GANNT chart (Appendix 6.3) and produce a functioning system for the stakeholders.

The main software tools using during development were: PHPStorm, Visual Studio Code and XAMPP. Using PHPStorm to develop the back end of the system was a good selection as it allowed for an uncomplicated view of the system and its directories and its ability to link with GitHub allowed me to create online backups should a hardware error occur. Visual Studio Code was selected to develop the front-end HTML and CSS the system needed as with its ability to run offline and without a backend allowed for quick and dynamic alterations of both the HTML and CSS to allow me to get the desired look of the system. The choice to use XAMPP over other alternatives was the best decision made in the systems development. The ability to build and have your database stored externally of the system and the dynamic ability to add and delete rows within the database made testing the system far easier and more streamlined as inputting dummy data was much faster and seamless.

## 6 – Conclusions and Future Work

In conclusion, the system is fully functional and able to be placed into the workflow at Ames Goldsmith, as such it is clear that the purpose and aims of the system have been met, the use of an MVC architecture as well as an agile coding methodology has given invaluable experience in my knowledge of coding, on top of this my understanding in how companies make certain decisions in their development of internal web systems has been developed and has given me valuable experience. I have been given the opportunity to continue to develop the system for Ames Goldsmith as they look to implement the system and begin to use it in their business operations, when I come to do this I will ensure that I make the requested changes in the matrix view and in the training pages to ensure the stakeholders are receiving the system which they require, I will also further develop the admin role and ensure that the system only allows users that are admins to use the full system. Should I choose to develop my system further there is possibility to continue the development of the training system into broader fields of online training which other companies in other fields of industry and expand outside of Ames Goldsmith.

# 7 - Appendix

## 7.1 - Questionnaire with Helen wall head of training at Ames Goldsmith.

A piece of paper with writing on it

AI-generated content may be incorrect.

## 7.2 - Interview with Helen wall head of training at Ames Goldsmith.

Interviewer = James (J)

Interviewee = Helen(H)

(J)So the first question is, please tell me about the types of training. That are required to be put onto this training system.

(H)Okay so it's mainly our internal training, it's mainly training that they've had before. So, this is a refresher of your training, which we have done with sheets that people read and answer and it's mainly all related to safety or safety and the environment so it's compliant. So, it's stuff like asbestos confined, space manual handler.

(J)Perfect. Please tell me about the current system that's in place to complete this training.

(H)So firstly, it's just a bit clunky and basically the business has grown quite a lot in the last two years. So we have a great big, massive, Excel spreadsheet with everything listed that in its own, is just massive to keep up to date. We have some training that's done face to face for people first starting. And then we have a number of training sheets which is all the refresher training that we're proposing. We put on the database that you've created for us.

(J)Thank you. Now please tell me about the current constraints of the system and particularly about the time that it takes for the training to be logged and completed.

(H) Okay. Well basically, it feels like it takes an age, and we do a great deal of printing things out to sign them off and then scanning them back in and then shredding the original piece of paper. So, what we do now just really does take a long long time. Because, because we have to verify. So, I have to sign it off at the bottom and update the Excel spreadsheet. And then we save that sheet that they've done back into the HR file. So, it just feels like a lot of duplication that kind of works. It's just the amount of time it takes to process.

(J)Thank you very much. Do you believe in its final form when completed and implemented can reduce the constraints on the current system?

(H)Yeah. It will be much faster; it'll be loads faster. You know, it's all in one place and we will prevent this printed off and scanning in, to shred again. Um, and it just moves us forward really, to where we want to be with lots of other things, you know, the whole concept of digitization.  I just think that we're kind of in that situation where we're doing what we've always done and it's just making it bigger, but with making it bigger, it also makes it more time consuming

(J)Thank you. And would you please explain the reasoning behind the features and functionalities? You would like to implement or change.

(H)Okay. So I've asked for a change from the ID to people's names because obviously if we give the system to people, we'll have to tell them what the number is and they'll have to remember it and I know they won't, but you know with a bit of good luck I think they can remember their own name so that'll just save me a bit of faff really. It's not I suppose massive, but it would help.

(J)Perfect. Thank you very much for your time.

(H)My pleasure James.

## Picture7.3 - GANTT Chart

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