**UNIVERSITY OF HERTFORDSHIRE**

**Faculty of Engineering and Information Sciences**

**Modular MSc Honours in Computer Science (Software Engineering)**

**7WCM0031 Software Engineering MSc Project (Online)**

**Final Project Report**

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***Development of a distributed data and document management system for ‘MSc Properties’***

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Abstract

Acknowledgements

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1. Introduction
   1. Introduction to the project

For my MSc Computer Science Dissertation (Software Engineering), I decided to solve the problem of data and document management through the implementation of a distributed system for a fictional estate agent called ‘MSc Properties’.

The reason for me undertaking this project is that there is an ever increasing demand for private rented accommodation due to changes in the social housing market, social benefits offered, and unemployment rates, resulting in less social housing being available and reduced benefits for people on a low income, who would normally need to make use of social housing and/or benefits offered by the government.

* + 1. **Report Structure**

During this report I will document the problem background in more detail, looking at the different factors that contribute to the problem identified, and then document the aim and objectives of my project.

I will then document the research and literature review I carried out in order for me to identify the different software engineering techniques and technologies available to solve the problem.

I will then go on to document the design of the distributed system, outlining the different software engineering techniques and how these were used to enable me to structure and manage the project, and just as importantly allow me to produce diagrams that virtualized the structure, behaviour and interaction of the distributed system.

Furthermore, I will document the implementation and testing of the distributed system, explaining which techniques and technologies I chose, and why they were the best solution for this project, given the available resources. I will then go on to provide an analysis of the test results to draw some conclusions on the validity of the software produced.

Lastly I will document my evaluation of the project as a whole, outlining what went well, what didn’t go so well, and what I would do different if I was to do the project again. I will then go on to stating whether or not I have successfully achieved the project aim and objectives.

* 1. Project Aim

The aim of this project is to tackle the issues of data and document sharing across the Internet by developing a distributed data and document management system for a fictional estate agent called ‘MSc Properties’.

The distributed system should allow ‘MSc Properties’ to share business data and documents across the Internet, whilst providing data security and integrity. ‘MSc Properties’ requires the distributed system to be maintainable, dependable and usable, which means I will explore the different techniques that support program specification, design, validation and evolution of software.

* 1. Project Objectives
     1. Core Objectives
     2. Advanced Objectives
  2. Project Background

‘MSc Properties’ is a fictional estate agent with a number of sites nationwide across England. Due to the current unemployment rates and recent legislation changes resulting in local councils being able to house homeless families outside of the local borough [25] and benefit caps [23] meaning families have to move out of their local borough due to not being able to afford local rents [25], ‘MSc Properties’ require the need to be able to transfer customers between sites, meaning the transfer of data across sites that could be 100’s of miles apart.

‘MSc’ Properties currently have a paper filing system, where customers and/or the landlords of properties fill out an application form to request a service from ‘MSc Properties’. Customers will have to provide their personal information, along with the properties they have an interest in letting. Landlords will have to provide their personal information, along with the property information for the property they would like managed. Part of the landlord/customer sign up process is to bring in a number of documents confirming their information, and once customers have agreed on a property to let, and once ‘MSc Properties’ have agreed to manage a property for a landlord, contracts will be drawn up and signed respectively and all documents stored on file.

‘MSc Properties’ currently advertise their property portfolio through pictures in their store windows for properties for that area, and store managers carry out a revenue monitoring exercise each month, going through each file for the store and carrying out budget monitoring and cash flow forecasting, along with reports for the months business activity. Also there is a staff hierarchy within ‘MSc Properties’ where specific tasks and responsibilities are assigned to certain staff roles meaning that not all staff can carry out each task due to privileges.

For this project I am going to develop a distributed system for ‘MSc Properties’ to create and manage their property portfolio and their customer accounts, as well as creating and managing both tenancies and rent accounts. This means that data can be stored on a server or locally and all the different sites of ‘MSc Properties’ will be able to access this data. The system will have a login facility to provide restricted access for users, and will also allow managers of ‘MSc Properties’ stores to manage their employee accounts. The system will also allow ‘MSc Properties’ managers to report on business data.

NEED TO EXPAND ON MY BACKGROUND TO ENSURE I HAVE ALL OF THE BACKGROUND INFO WHICH I AM GOING TO REFER BACK TO WITHIN MY DESIGN, IMPLEMENTATION AND CONCULSION.

* 1. Literature Review

As previously outlined, I will now document the literature reviews I undertook to allow me to understand the different options available to me to enable me to successfully achieve the project aim and objectives.

* + 1. **Design Methodologies**

The problem I am trying to solve by undertaking this project, requires a piece of software to be developed for me to successfully achieve the project objectives surrounding data and document sharing. But as well as trying to solve the business problem surrounding data and document sharing, there is also the problem of producing software that is maintainable, dependable and usable, which will require me to undertake literature reviews into different design decisions I will need to make when designing the system.

* + - 1. **Software Development Approach**

The first design principle I am going to discuss is the software development approach. This is because as this is a large project, it requires the project to go through a structured development process to give the project the highest possibility to be a success.

The first piece of literature I am going to review for software development approach is the article called *“Software Quality & Agile Methods”* written by *M. Huo, J. Verner, L Zhu and M.A. Babar.* This article looks at the quality of software produced when comparing the Waterfall Model and Agile methods, and specifically how agile methods can achieve high quality software even if the process is not linear and a complete requirements specification has not be developed prior to the design and implementation stage of the development.

The article then goes on to conclude that “agile methods do have practices that have Quality Assurance abilities, some of them are inside the development phase and some others can be separated out as supporting practices. The frequency with which these agile Quality Assurance practices occur is higher than in a waterfall development and lastly, agile Quality Assurance practices are available in very early process stages due to the agile process characteristics”. The below diagrams show the different methods and Quality Assurance techniques undertaken within the Waterfall Model and Agile Methods.

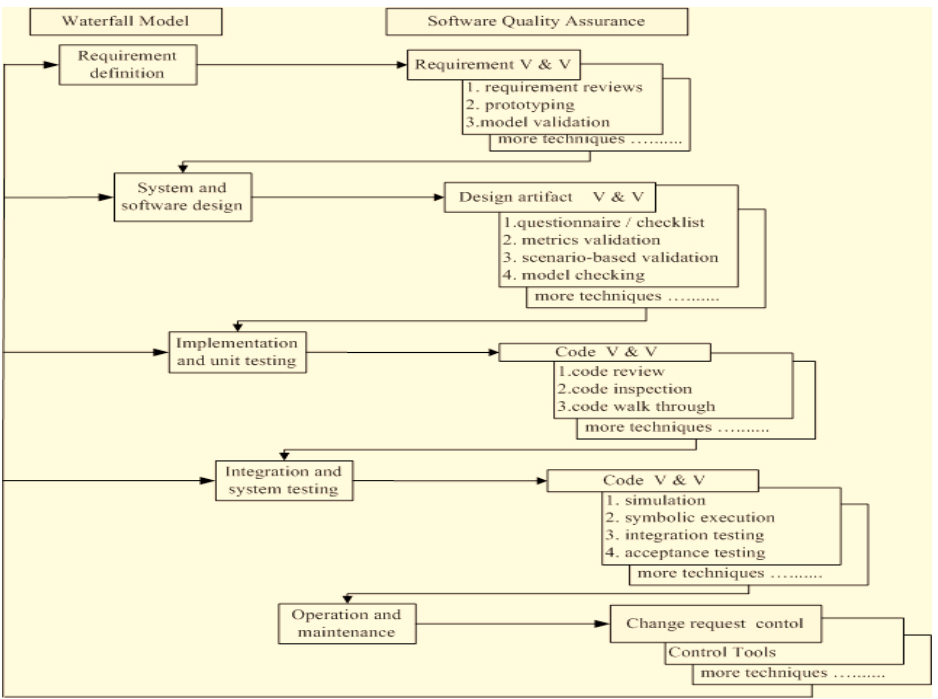


Fig 1 – Waterfall Process Model with Quality Assurance Techniques

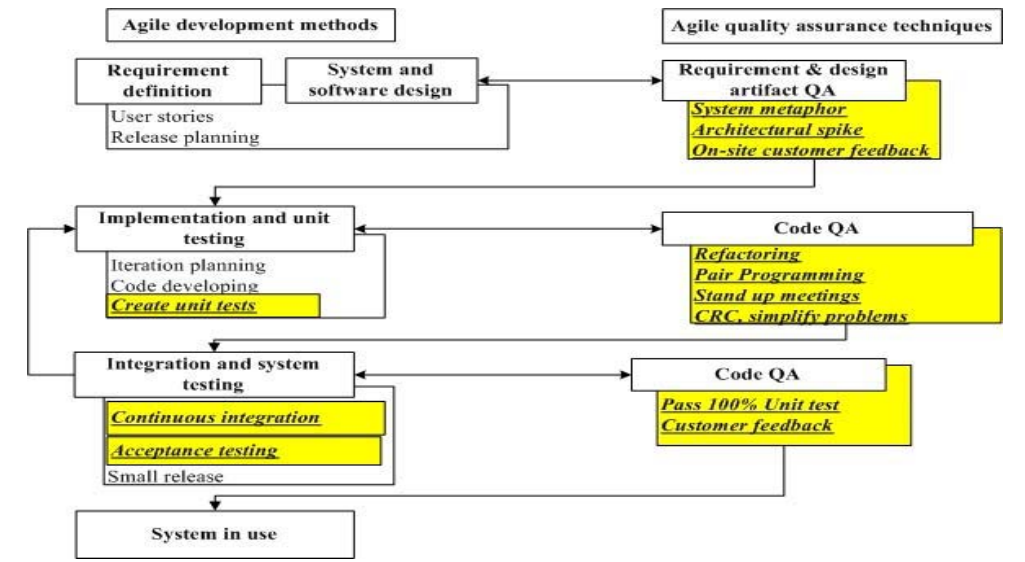


Fig 2 – Agile Development Methods with Quality Assurance Techniques

* + - 1. **Modelling System Behaviour**

The next design principle I am going to discuss is modelling system behaviour. This is because this project centres on software development, and part of the aim is to produce software that is maintainable, dependable and usable, so it will require me to produce high quality software, and by modelling system behaviour and understanding to the best of the project resources ability, how the elements of the system will interact with each other.

START OFF FROM HERE – NEED TO FIND A UML ARTICLE

* + - 1. **Design Patterns**

The last design principle I am going to discuss is design patterns, and most importantly the design patterns I can employ within the software I am going to produce. Again as with modelling system behaviour previously, this project centres on software development, and part of the aim is to produce software that is maintainable, dependable and usable, so it will require me to produce high quality software, and by implementing design patterns, it will allow me to produce software with high cohesion, low coupling, encapsulation, and other metrics of software development which indicate high quality software.

Ian Sommerville explains design patterns as a description of accumulated wisdom and experience, a well-tried solution to a common problem, and the Hillside Group puts it as “Patterns and Pattern Languages are ways to describe best practices, good designs, and capture experience in a way that it is possible for others to reuse this experience”.

Below is some design patterns I have come across during my research for this project:

* Observer pattern –
* Singleton pattern –
* static modifier –
* Strategy pattern –
* Creational pattern –
* Iterator pattern –
* Composite pattern –
* Inheritance –
  + 1. **Development Methodologies**

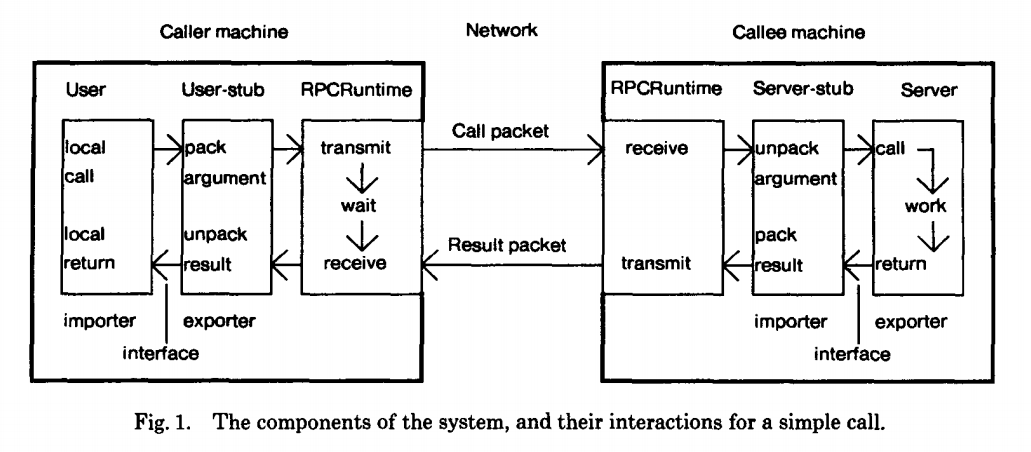
I am now going to discuss the different development methodologies I uncovered during the course of the project, whilst undertaking the literature review.

* + - 1. **Networking**

f One of the major problems I am trying to solve by undertaking this project, is to be able to produce a system that allows ‘MSc Properties’ to share data and documents across the Internet, whilst ensuring that the validity of the data and documents being shared are maintained. For me to do this, it has meant that I have had to undertake a literature review into the different networking technologies that will enable me to successfully achieve the project objectives related to networking.

The first piece of literature I am going to review for Networking is the article called *“Implementing Remote Procedure Calls”* written by A.D. Birrell and B.J Nelson. This article talks about the options that face the designer implementing a remote procedural call (RPC) facility and the considerations that need to be made when making decisions on this type of system.

The article states “when making a remote call, five pieces of program are involved: the *user*, the *user-stub*, the RPC communications package (the RPCRuntime), the *server-stub*, and the *server*… When the user wishes to make a remote call, it actually makes a perfectly normal local call, which invokes a corresponding procedure in the user-stub. The user-stub is responsible for placing a specification of the target procedure and the arguments into one or more packets and asking the RPCRuntime to transmit these reliably to the callee machine. On receipt of these packets, the RPCRuntime in the callee machine passes them to the server-stub. The server-stub unpacks them and again makes a perfectly normal local call, which invokes the appropriate procedure in the server. Meanwhile, the calling process in the caller machine issues pended awaiting a result packet. When calling the server completes, it returns to the server stub and the results are passed back to the suspended process in the caller machine. There they are unpacked and the user-stub returns them to the user.” This process is represented in the below figure.



The second piece of literature I am going to review for Networking is the article called “*Push vs. Pull in Web-based Network Management”* written by *J.P. Martin-Flatin*. This article talks about two models of network management, which are “The Pull Model” and “The Push Model”, which represent two well-known approaches to exchanging data between two hosts with a distance between them.

The article states “The pull model is based on the request/response paradigm, the client sends a request to the server, then the server answers, either synchronously or asynchronously. This is functionally equivalent to the client “pulling” the data off the server. In this approach, the data transfer is always initiated by the client, i.e. the manager. The push model, conversely, is based on the publish/subscribe/distribute paradigm. In this model, agents first advertise what MIBs they support, and what SNMP notifications they can generate; the administrator then subscribes the manager (the NMS) to the data he/she is interested in, specifies how often the manager should receive this data, and disconnects. Later on, each agent individually takes the initiative to “push” data to the manager, either on a regular basis via a scheduler (e.g., for network monitoring) or asynchronously.” The article then goes on to state that “the pull model, well suited to ad hoc management, and the push model, well adapted to regular management”.

* + - 1. **Document Management**
      2. **Task Scheduling**
    1. **Testing Methodologies**
  1. Project Plan

As this is a large project, it is very important that I plan, monitor and manage the project smoothly from start to finish. I have used a Gantt chart, which provides a graphical illustration of the schedule of the project, broken down by project objectives, with completion dates for each objective, which will help me track the activities in the project and make changes to work being carried out if necessary. This tool will be used to manage my time and allow me to stay on schedule as there is a lot of tasks that need to be completed in a limited time frame. This is outlined in a software management article [5], where the article identifies “a recent update of the Chaos Report from the Standish Group, outlines a recipe for success that includes 10 items. The first three items are executive support, user involvement, and experienced project management.”, so project management is one of the 3 key factors to successful projects.

My project Gantt chart is below:

ADD GANTT CHART

I am now going to explain how the project objectives will be completed by the project deadline date of 11 Jan 2015.

1. Write a project document outlining the details of the project, defining project objectives, scope, risks and approaches. I can constantly refer to this document to ensure the project progresses in the correct direction.
2. Write a work plan outlining the project objectives, with deadlines for each objective.
3. Define relevant resources for the project, outlining decisions made on technology, equipment and software applications to use, ensuring that I have tested equipment and software applications, and am competent with the use of the selected technologies, prior to the start of the development.
4. Keep an eye on the project plan ensuring that objectives do not overrun past their completion date.
5. Stay vigilant and alert for early warning signs of problems occurring in the project that could result in the project being delayed and not meeting project deadlines.
6. Safeguard against my project creeping outside of scope, so as new requirements are introduced during the development process, I should ensure these are all still within available resources and overall aims of the project.
7. Manage risks as the project progresses, and as new risks unfold, evaluate them to ensure they do not cause a major problem to the project.
8. Keep my project supervisor informed of any major problems occurring during the project, and seek advice where necessary, to resolve major problems as early as possible.
   1. Relevance to target award

Software Engineering is defined by Ian Sommerville as an engineering discipline concerned with all aspects of software production (specification, development, validation and evolution), and goes on to say it is concerned with the practicalities of developing and delivering useful software [1].

My project aim is to develop a distributed data and document management system, and to do this I had to explore the different software engineering techniques and decide which are best suited to tackling the software engineering task, and then develop and implement a piece of software that successfully meets the aim and objectives of the project.

This means the work I am planning to do during this project fits in with my target award MSc Computer Science (Software Engineering), because I will be applying software engineering models I have studied during my course such as agile to my software development. I will also be applying software engineering methodology I have studied during my course such as Inheritance and Interfaces to my software development. I will also be applying the software engineering tools I have studied during my course such as unified modelling language (UML) to my software development. Lastly I will be applying metrics such as cohesion, coupling, bugs etc. to my software development. By me exploring and applying these different software engineering techniques it will allow me to deliver useful software to ‘MSc Properties’ which in essence is Software Engineering.

* 1. Project Deliverables
  2. Ethics Approval

Ethics Approval is when a committee of University of Hertfordshire staff approve “any student undertaking a study involving the use of human participants which is undertaken as part of a programme of work for which the University of Hertfordshire is responsible for” [25].

My project will not require ethics approval because I am not undertaking research that involves collecting data from human participants, and although my system will store business data which includes personal information, I will use dummy information which replicates the personal information throughout the development.

1. Design
   1. Introduction
   2. Software Lifecycle

From the above project goal, I believe an agile method is the best software process model to choose from, this is because in a fast moving business environment, software needs to be ready and available as quick as possible, and as original software requirements can quickly become out of date, it makes software developed useless very quick.

This means software process models need to provide rapid development and delivery of software, and with the conventional plan driven software process models it can be difficult to do this because of the documentation that needs to be created and signed off, and the lack of interleaving development stages makes it difficult to cope with quickly evolving requirements.

* 1. Modelling System Behaviour
     1. Use Case Diagrams
     2. Data Flow Diagrams
     3. Class Diagram
     4. Enhanced Entity Relationship Diagram
     5. Sequence Diagrams
     6. Storyboard

1. Implementation
   1. Introduction