

Working as a software developer in a small size company

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<p>The thesis consists of 12 weeks covering the period starting from 4.9.2017 until 26.11.2017. The thesis is written in a diary format and its scope is to both describe the responsibilities and varying tasks of the author in a small size company called PLM-Zone Oy, and evaluate the vocational development of the author during the process. The responsibilities and tasks are mostly related to an ongoing project.</p> <p>The goal of the thesis is to analyse the problems that occur while carrying out the varying tasks and provide information on how the problems were solved and if possible, how to prevent the same errors in the future.</p> <p>The content of the thesis would be useful for individuals whom are wondering what it could be like to work in a small size company. Descriptions of various technologies, tools, best practices, and approaches utilized during the development tasks might provide useful information for software developers. Also comprehensive descriptions and analysis of the problems and found solutions might provide invaluable information for any software developer who is working with the same technologies and facing similar problems.</p>	
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List of abbreviations

PLM	Product lifecycle management
HTML	Hypertext markup language
ERP	Enterprise resource planning
HTTP	Hypertext transfer protocol
JSON	JavaScript object notation
API	Application programming interface
URL	Uniform resource locator
XML	Extensible markup language
Ajax	Asynchronous JavaScript and XML
VSTO	Visual studio tools for office
FTP	File transfer protocol
BOM	Bill of material
JSP	Java server pages
XHR	XMLHttpRequest
IDE	Integrated development environment

1 Introduction

This diary thesis covers overall 60 working days starting from 4.9.2017 until the estimated completion date 26.11.2017. It is a total of 12 weeks where the first week is dedicated for writing the introduction, the next 10 weeks after that are the reporting weeks and the last week is dedicated for reviewing.

In the introductory part during the first week I will describe my current job situation and the skills that are required to carry out the tasks. After the first week, the next 10 weeks I will be reporting and discussing the daily tasks working both as a developer and consultant in a company called PLM-Zone Oy. The last week then is dedicated for analysing how I have improved my skills and working methods during the reporting period, when comparing the results to the starting situation.

1.1 Background

The knowledge and skills that I have acquired during my studies in Haaga-Helia have been very useful and I have been able to utilize them in varying tasks throughout the entire time that I have been working at the company. PLM-Zone also offered me a possibility to take part in a training program regarding a cloud-based PLM solution called Fusion Lifecycle, which is developed by Autodesk. During the training, I acquired comprehensive skills and knowledge about the functionalities of the solution and its configuration possibilities. At the end of the training, I got certified as a Fusion Lifecycle implementer.

Fusion lifecycle provides a wide range of different capabilities, that are essential for product lifecycle management. It helps companies to make their product development processes more efficient, release products to market earlier and improve collaboration between departments. And because it is in the cloud, it enables everyone access to the data whenever and wherever (Autodesk Inc, 2017).

There are currently a few parallel projects in which my responsibility is to configure the customers Fusion Lifecycle systems based on their requirements and the configurations mostly require skills in JavaScript, which is used in both creating new scripts and modifying existing scripts in the system. Every now and then also skills about PostgreSQL formulas and HTML is required.

In one of the ongoing projects in addition to configurations, one of my tasks is to develop an add-in for Word, so especially now the prior knowledge of Visual Studio and C# obtained during studies is crucial. Although some of the functionalities in the add-in will be tailored according to the needs that the customer has, most of the functionalities will be developed in a more general manner so that other customers could also benefit from the final solution.

In the same project, I will also be responsible of establishing an integration between customer's Fusion Lifecycle system and their ERP system, so knowledge about RESTful web services, HTTP methods and JSON is required.

1.2 Company and working environment

My employer company is called PLM-Zone Oy. PLM-Zone's goal is to "accelerate customers' operations with productized solutions". All the experts in the company have a long history in the IT-industry, especially in the PLM side, and high knowledge about different technologies and modern application architectures. PLM-Zone provides services to companies that seek expertise in application development side with lean and agile approach and PLM architecture services (PLM-Zone, 2017).

PLM-Zone is located in Espoo and it currently has a total of 9 employees. Since it is a small size company yet, all employees including the management are working closely together to achieve the goals with best results. There are usually 2-3 people working per project, but sometimes some employee rotation is required depending on the situation. Employees do not have any specific areas where they are working, so diversification of skills is required every now and then depending about the case.

A lot of the work is done by working remotely, in customers premises or via Skype since the company has customers both in Finland and abroad. When crucial decisions are required, we usually meet at the office and share ideas and opinions.

The company currently has 3 own cloud-based products. In addition, PLM-Zone is a part of Autodesk partner community and resells Autodesk's cloud-based PLM solution called Fusion Lifecycle that I mentioned in the background section.

2 Starting situation

2.1 Current job situation

Currently my day to day tasks include the following:

2.1.1 Data imports and configuration of customers' Fusion Lifecycle systems

We are currently transitioning from development into production in one of the projects, so one of the tasks is to import the actual production data into their Fusion Lifecycle system so they can start using the system.

Fusion Lifecycle has a built-in import tool, which can be used to make mass imports or updates in the system using excel files. In the import tool, I need to map the Fusion Lifecycle system fields to corresponding excel columns, so the system knows which fields to fill with data. The import tool raises errors if any validation or constraint errors occur, and provides feedback on what kind of error it is, and in which rows the errors occur, so basically you do not need any major skills because the tool itself describes the error.

I am currently involved in a few parallel projects, where I handle most of the configurations that are done into customer's systems. The easier configurations that can be done in the system and are doable even by individuals that might not have any technical background or programming skills are when creating fields for workspace items and setting up user rights. All the configurations that can be done in the system can be found from the administrative side.

Creating or deleting the fields is basically drag and dropping the fields back and forth, giving a name for the field, and setting its data type. It is also possible to set different constraints or format validation for the field. In the security section, user management and access are done by adding users into groups, and giving groups different kind of roles with permissions. There is no limit how many groups or roles can be created.

The more advanced configurations require JavaScript skills. It is possible to create 4 different kind of scripts in the system which are action, condition, validation, and library scripts.

In this task, I must possess good communication skills and knowledge about the system. Customers provide the requirements about different functionalities that they require to be

added in to the system and I need to be able to tell them right away if something cannot be implemented and suggest an alternative approach if possible.

2.1.2 Establishing integration between customer's Fusion Lifecycle system and ERP system

I have only recently started investigating Fusion Lifecycle's REST API documentation because I need to have clear understanding about the different endpoints and which HTTP methods are used before I start creating anything.

On this task, I must work closely with the customer's ERP consultant to achieve a common understanding about what kind of JSON structures do both the ERP end and Fusion Lifecycle end accept and which HTTP methods will be used to create, update, and delete records.

I fortunately have some knowledge about JavaScript's JSON capabilities, so I do not expect that I will have any major problems to create the JSON objects in the scripts after the structure has been defined.

2.1.3 Developing a Word add-in

The solution is being developed using Visual Studio and C#. Since these are the main technologies that I have used during my studies I am quite confident that my knowledge is at the required level to develop a well-functioning application.

The purpose of the add-in is to both automate the customer's process of creating different kind of forms that they are sending to their manufacturers and enable a way to manage documents that they have in their Fusion Lifecycle system. The data that will be used to fill the form templates and documents will be retrieved from the system using the REST API, so I need to investigate and decide not only the most efficient approach on how I will implement the HTTP client in the application but also how I will handle the responses which will be in JSON format. This is a new challenge for me since I have not developed anything similar before.

I also need to familiarize myself about the Word object model to be able to create and manipulate the different form templates that the customer has and fill them with the correct data.

During this task, I must be able to find the correct information about the issues fast and utilize it in the best possible way. I think that I possess good problem-solving skills and especially in this task it will be a big benefit, since I am solely responsible about developing the add-in, because other employees do not have any previous experience about Visual studio, C# or developing a Word add-in.

2.2 Evaluation

Regarding the different tasks related to Fusion Lifecycle, I consider myself as an experienced expert and that my knowledge about the system is on a prime level. During my time at the company I have in most cases been solely responsible about implementing almost all the configurations and functionalities, and my colleagues usually ask me what is the right approach to implement certain functionalities.

Also, I have been able to solve all the problems that I have encountered, either by searching the forums, reading blogs, or consulting a few contacts that I have in Autodesk. Since the software is quite new, it was released only a couple of years ago so, it has sometimes been hard to find solutions to exactly same issues that I have faced, so quite often I have had to come up with my own solution on how to work around the problem.

Regarding the task of developing the Word add-in, I consider myself as a skilful performer. I already have a quite good understanding about how the application should be developed, but since there are certain aspects that are not familiar to me yet, I expect that there will be a lot of problem solving and self-studying ahead on the development.

I have received a lot of positive feedback from both the managers and from customers about the different tasks that I have done during my time at the company. My confidence is on a high level and I feel that even if I would have assignments that are entirely new for me, I can quickly catch up and learn new things to complete the assignment.

2.3 Vocational Development

Regarding the tasks that I mentioned in current job situation section, I feel that my skills and knowledge are at a great level. I can come up with a solution of my own to different tasks without any help from my colleagues or browsing the forums, blogs, or books.

Naturally every now and then I ask guidance from a few colleagues who have both deep understanding and long background in programming and different technologies. They usually provide invaluable information how they would approach the issue that I am having,

but eventually I have had to find a way to develop the final solution because I am mostly working with different technologies than they are.

I am always looking new ways to improve my skills and knowledge in the areas that are not so familiar to me yet. Although my skills might be at excellent level regarding the most common assignments that I have in my daily work, I will not hesitate to seize new challenges if an opportunity comes. Thankfully the company has many kinds of customers in different industries so there are quite frequently possibilities to work with different technologies.

2.4 Interest groups

Internal

- Management
- Employees

External

- Customers
- Partner organizations
- Governments

As said earlier, PLM-Zone is yet only a small size company, so the list of stakeholders is not so broad. Obviously the most important stakeholders are the customers and the partner organizations. Because PLM-Zone has customers both in Finland and abroad, governments can be counted as one stakeholder since the company needs to operate based on the regulations and laws.

2.5 Interaction skills

A lot of work is carried out by working remotely, so much of interaction is done via Skype or email. When there are bigger decisions to be made we usually discuss the topics face to face in the office and come up with a decision.

Besides from project start-up meetings and workshops, Skype and email are used to communicate with the customers, because many customers are located outside of the Helsinki metropolitan area in Finland or abroad. Workshops and project start-up and end meetings are usually held in customers premises.

3 Diary entries

3.1 Week 1 (11.9.2017 – 15.9.2017)

3.1.1 Monday 11.9.2017

During the weekend, I have gone through and modified multiple excel files containing customer's production data, since the goal is that the customer will start the production use of their Fusion Lifecycle system during this week. The reason some of the data needs to be modified is that the data that will be imported into Fusion Lifecycle is coming from the customer's ERP system, and there are slight differences between the values in both systems.

My goal is that I will try to finish the data loading already today and to achieve that goal I should receive the remaining few files from the customer during this morning, so I can modify the data in to correct format. The remaining few files contain most of the crucial data that needs to be imported first into the system in order that I can establish relationships between items which belong to different workspaces.

At the end of the day, I have managed to import all the production data in to the system and the customer's responsibility now is to review that the data is valid. I was able to spend a couple of hours in the morning to study the REST API reference of Fusion Lifecycle before I received the remaining files just before midday.

I was able to go through the files and modify the data quickly since I knew beforehand which data I needed to modify in the files. When I started importing the modified data into Fusion Lifecycle, the validator of the import tool gave me an error for a few dropdown list values that I had in the file. I had faced similar error before, sometimes the defined values in the dropdown list have excess whitespace after the value and if the excel file does not have the whitespace, the system thinks that it is a non-existing value.

I went through the dropdown list values and could not find any excess whitespace after the value which was raising the error, so I tried to run the import again, but the error reproduced. I started asking my colleagues and browse the internet if anyone had had similar issues, but could not find any solutions or even threads about the issue. Only when I started copy pasting the dropdown list values into notepad, I noticed that in the middle of the value there was some strange character that cannot be seen in the UI. After fixing the value I was able to run the import without any problems. I have not encountered a similar issue before, so now I know a little bit more about the system than I did at the beginning of the day.

3.1.2 Tuesday 12.9.2017

Today I am going to continue the development of the Word add-in. I started the development already last week, but after investigating the Microsoft documentation and reading different forums about the subject, I decided to change my approach regarding declaring classes.

My plan is to exploit class inheritance so that I will at least for now have one base class which holds authorization information and user credentials and one derived class where I will implement the methods that will handle the HTTP requests to different endpoints of Fusion Lifecycle's REST API.

I chose this approach because at some point there might be a need to increase the functionality in the application, so it will be a lot easier just to extend the functionality of existing classes instead of creating entirely new ones that might have duplicate code. My goal is to create the classes today and start already building some functionality.

Today I have not faced any major problems although the concept of class inheritance is something that I have not worked with during studies or at working life. The concept is eventually very simple and easy to understand, and a lot of information can be found about the subject from different forums, blogs and Microsoft documents.

Creating the classes, constructors and properties did not require too much time and I already created one method to the child class which accepts username and password as parameters. The amount of methods will increase rapidly during development, because there will many different requests that will be sent. I also managed to create a form that users will use to authorize themselves into their Fusion Lifecycle system, since every HTTP request needs to be authorized with the given session token that is returned after successful login.

The form itself is very simple it only has two textboxes for username and password and a button that will call a method in the child class and execute a login request to the user's Fusion Lifecycle system.

3.1.3 Wednesday 13.9.2017

The plan for today is to continue the development of Word add-in. I should be able to create most of the functionality into the login form, to the point where the actual HTTP login request will be formed.

To continue development, I must browse the internet and search the most suitable and efficient way for creating all the HTTP requests and handling the responses. I must also find a way to process the content of the responses, which will be in JSON format. If I can find solutions quickly, I will most likely be able to start creating the first request.

I could finalise the remaining functionality to the point where I will start creating the HTTP request. I added a ribbon to the solution, which will be visible for the users as a separate tab when opening the Word. I also added one login button to the ribbon which opens the login form where the user will fill in username and password for their Fusion Lifecycle system.

My original plan for the day had a slight change since the customer that are starting the production use of their Fusion Lifecycle system informed me that they have reviewed the results of the data load and are pleased with the results. They wanted to have a Skype meeting where we discussed about the next steps of the project.

The meeting lasted almost three hours and therefore I did not have as much time as I would have wanted for seeking and exploring different options on how to handle the HTTP requests and JSON objects in the application. I was able to find a few examples about both and will continue doing additional research tomorrow.

3.1.4 Thursday 14.9.2017

This day will be dedicated for information seeking and continuing the development of Word add-in if any urgent issues related to other customers do not come up.

I found two open source libraries intended for .NET development, Json.NET for handling JSON serialization and RestSharp for creating the HTTP client. Both are available for download from .NET's NuGet gallery, Json.NET can be installed in the package manager console using the name Newtonsoft.Json and RestSharp using RestSharp.

Using the libraries, it was eventually easy to finish the login functionality in the application. With RestSharp, it was easy to create the HTTP client and set the request method, header values and the body content for the request. After receiving response from the server, I used Json.NET library to parse the response's raw content, which is just a string that contains the JSON object, into a JSON object. After that I was able to access the values that I need to store in order to authenticate all the other requests that will be sent.

3.1.5 Friday 15.9.2017

Today I focused on seeking information about best practices and suggestions on how I should organize my code to keep the application simple, readable, and manageable. Since I will eventually have many forms in the application because there are many different operations that the add-in will perform, I must find a simple approach, or the result will look very confusing and managing it requires a lot of effort.

I have learned a lot regarding different class definitions today since I have not utilized any of them earlier. Although with a quick look it seems that exploiting any of the different possibilities do not apply to my needs, I have gained a lot of invaluable information that will be helpful in the future.

I did not make much progress today with the actual development of the add-in, but now I have an idea on how I will proceed from now on. This issue is something that I need to decide on during these early phases when it is still easy to modify the code without breaking any other functionalities and I do not want to make any hasty decisions, so I will most likely still do some additional research.

3.1.6 Week 1 analysis

This week's tasks have provided a lot of useful information and skills that are mostly related to C# and .NET, but there was also the data load issue in Fusion Lifecycle which I had not encountered earlier that caused some problems for a while. There were no other major problems during this week since I have mostly been looking for the best approach for the Word add-in development.

Since my tasks before this week have been mostly related to configuring customers' Fusion Lifecycle systems, I have not for a while encountered many new things that I did not already know about the system or its functionalities. If similar issues with data load come up in the future I can solve the problem faster since I know where the problem could exist, and I also can provide information to the customers about the issue.

I feel that not only my knowledge and skills regarding C# and .NET have improved a lot during this week, I have also learned completely new things like how to create HTTP client and requests and how to handle JSON data, which will be useful in the future.

When I was seeking information about how should I create the HTTP client and JSON handling in the application, a lot of information can be found from both Json.NET and

RestSharp on different forums and blogs. It seems that a lot of developers are utilizing these open source libraries on their projects and I assume if at any point I face problems or need to find a solution related either in Json.NET or RestSharp, it should not be too hard.

Regarding Json.NET, as one of the biggest benefits can be seen that it is not only significantly faster but also a lot easier to use than .NET's own serializer classes. It also has capabilities to convert between XML and JSON, which is very useful since both are still used a lot in working life. It is also stated on their website that it is currently the most popular .NET library with over 15 million downloads (Newtonsoft, 2017).

With RestSharp's comprehensive library and simple interface it is possible to create HTTP client efficiently. Because in RestSharp such tasks as URI generation, payload parsing, and authentication details are configurable, the developer no longer has to worry about low-level tasks that there might usually be when setting up the HTTP client. When programming on Windows platforms where asynchronous request handling is one of the major requirements, the fact that RestSharp supports not only asynchronous but also synchronous requests makes it one of the most popular tools (Stackify, 2017).

Since it is coming increasingly popular to use open source libraries, there are a few things that are good to know about open source. In order to be approved by the open source initiative (OSI), the license goes through a review process where it is determined whether the license complies with the open source definition or not. If the library or software that you are using is under an appropriate open source license, you can not only freely access, use, change and share it, but it can also be freely used for commercial use. Json.NET is under MIT license and RestSharp under Apache License 2.0 and both licenses can be found from OSI approved list and are very popular (Open Source Initiative, 2017).

There are many different benefits regarding open source libraries and software. The biggest benefits most likely when comparing open source to closed source can be seen security and quality of open source. The reason behind this is that the number of contributors is much higher with open source, which means that there are more people who can see and modify the code and therefore the possible bugs are found and fixed faster. Obviously one major benefit is also that it is free (IDG Communications, Inc, 2017).

According to Entrepreneur Handbook (Entrepreneur Handbook Ltd, 2017), the problems that you might encounter when favouring open source software is that the result might be

developed based on developers' own thinking and not based on any end user requirements. The same reason also leads to the point where the final solution is not user friendly. In case of possible problems, you mostly rely to the developer community to provide the answers and solutions which might take even days since they do not have the responsibility to be on reach almost right away unlike customer support for which you are paying for.

3.2 Week 2 (18.9.2017 – 22.9.2017)

3.2.1 Monday 18.9.2017

The goal for today is to do some additional research related to Word add-in and continue the development. Although I have an approach in mind that I will follow, I want to do some research still if I can find even better solution, but I am not going to spend the whole day for it.

My objectives for today changed drastically at the beginning of the day, since I noticed that I had received the remaining specifications about configurations that a customer wants in their Fusion Lifecycle system during the weekend. The implementation of the remaining configurations has been stalled for a couple of weeks now because of the missing specifications.

The added functionality will now automate certain tasks that the customer has been doing manually before. Especially with this customer it has been possible to automate a lot of different tasks regarding their business, since they are operating in a highly regulated industry where they need to repeat same processes every time.

The skills and knowledge that were required for completing the tasks were not new to me since I have done similar configurations before in other projects, so I could right away see that the changes can be implemented as wanted. Although the system is highly configurable, sometimes the customers want functionalities on which we cannot affect to because of certain restrictions that we have regarding configurations. In that case, I need to find and suggest an alternative approach which would lead to same result.

3.2.2 Tuesday 19.9.2017

Today afternoon I will have a Skype meeting with customer's ERP consultant, and during the meeting we should decide on what kind of JSON object we will send whenever we must update or create a record in the ERP system. I will also demonstrate how the Fusion

Lifecycle's REST API works, so that the ERP consultant gets an idea how to authenticate, find and update the record in Fusion Lifecycle and then logout.

In the morning, I used my time to create a script in the system which will first form a JSON object of the item's values and then create a HTTP request to the endpoint that is used when updating or creating new records into the ERP system. It was not clear before the meeting whether there already exists an endpoint which we could test, so I created the functionality just in case.

Since there was not an endpoint available for testing the ERP side, I used most of the meeting instructing and demonstrating what kind of requests are needed when there will be an update from ERP to Fusion Lifecycle. This was not a hard task since I have studied and tested the REST API of Fusion Lifecycle a lot, so I was able to tell such things as how-to login and authenticate the requests, what are the ID's required in the resource URL's and what is the structure of the JSON object in the body of the request when updating a record.

3.2.3 Wednesday 20.9.2017

Today I should be able to fully concentrate on continuing the Word add-in development. My goal is to finalise the more basic functionalities such as ending the current session and how the users can add the URL into their system in to the application. Regarding the approach that I have in mind, I could not find any better solutions that would suit my needs yesterday evening when I did some additional research, but I am confident that the current approach is both simple and reasonable.

I was able to reach my goals today by adding the log out functionality that will end the user's current session. It is even more simple than the login request, since after successful logout I do not have to store any values from the response.

I noticed one thing that I had missed and had to change regarding the way how I check if the response was successful or not. Previously I was checking the status code of the response with the following if statement: `if (response.StatusCode == System.Net.HttpStatusCode.OK)`, but I noticed that the status code will be OK even if the credentials are wrong in the request and the actual value that I should be checking is inside the response content. I needed to change the logic in a way that after receiving the response I will parse the content as JSON object and after that I can use the following if statement: `if(responseContent["authStatus"]["id"].Value<string>() == "200")`. If I would not

have had noticed this error, the user would have gotten a message telling that login was successful although they had provided wrong username and password.

Another new thing that I learned today was how I can store a value permanently in the application without hard coding it. I added a form to the application where the user will provide the URL for the system which will be then saved to the application's settings file. After that it is possible to read or modify the URL if there is a need for that. It is not very common for the user to have access to multiple systems, but it is a possibility, so I had to find a solution and utilizing the settings file is the perfect option in this case.

3.2.4 Thursday 21.9.2017

I continued the development of Word add-in from where I left yesterday and quickly noticed that it would not be possible to utilize the approach that I had in mind in a way I originally thought.

My goal was that I would have one central location where I would have an instance of the class that has the methods on calling Fusion Lifecycle's REST API and I would only call the methods from that one location. The location would have been the ribbon class, which holds all the buttons that open different forms based on the actions that the user wants to do.

As I started developing a new form that has two list boxes, one which will be populated with items when the form is loaded and another which will be populated based on the selection that the user makes in the first list box, I realised that it would not be reasonable to follow the initial approach, because all the values in the form will be fetched from the user's Fusion Lifecycle system. Instead of declaring a new instance of the class or returning values back and forth between the form and the ribbon class, I will pass the class instance from the ribbon class into the form using the form's constructor. This way I have the same object in the form and can make the calls from there. This did not require any special skills or knowledge, just a slight change to original approach.

For populating the list boxes with key and value pairs, I used the Dictionary class which I have not utilized before. Dictionary is a simple collection of key and value pairs, which is something I need since in the list boxes I will display the name of the item for the user and the actual ID will not be visible.

3.2.5 Friday 22.9.2017

Last couple of days have been a bit of going back and forth with the logic of the application. I had to modify the form which had two list boxes, one which is populated when the form is loaded and another that is populated based on the selection that the user makes in the first one. Thankfully I did not yet have any logic behind the list box that I removed because it could have been a possibility that it would have affected other functionalities.

The reason I chose to remove the second list box is that it would have shown items from the workspace which is selected in the first list box, and there can be thousands of items in a workspace. It would have been too complicated to manage large amounts of items in that list box and I think it is not user friendly either that the users' need to scroll a long list to find what they are looking for.

In my new approach, I assume that the users know either the ID or the name of the item that they want to find, so I added two text boxes, one for the ID and one for the name, and buttons under the text boxes which will then execute different requests to the Fusion Lifecycle REST API based on which option the user chooses.

The request which is executed if the search is done with the name is a bit more complicated than the usual requests and it took me the whole afternoon to figure out how it works, because I have not used that request earlier. I eventually got it working by using Postman, so next week I should be able to build the functionality into the application.

3.2.6 Week 2 analysis

Although I did not progress with the development of the Word add-in as much as I would have wanted, the research that I did while trying to figure out the best approach and different issues and problems that I had to solve have greatly improved my skills and knowledge as a developer. I am now more aware of different possibilities that exist, and I can utilize them in the future.

One thing that helped me to refresh my memory about the usage of XMLHttpRequest object was when I built the integration functionality to the customers' Fusion Lifecycle system. I have used XMLHttpRequest earlier in some of the courses during my studies, but at that time I did not understand it as well as I do now. I think that because I nowadays have better knowledge about the whole REST API concept and how it works, it is easier to grasp the things related to it.

XMLHttpRequest is a JavaScript object and although the name might sound that it is only possible to retrieve XML data, it can retrieve other type of data also. Because the object is present in all major browsers, it makes it one of the most popular technique used, especially when creating Ajax-enabled applications. Ajax enables a way to refresh only parts of the web page instead of reloading the whole page, but because the scripts in Fusion Lifecycle always run on the server, it is not possible to utilize this technique in this case (Wilton & McPeak 2009, 491-494).

The task of establishing the integration functionality also provided a lot of useful information about JavaScript's JSON possibilities.

JSON is a very popular data format used in data exchange between clients and servers. It is text-based and lightweight format and although it is derived from JavaScript, it is also language-independent, and all the popular languages have support for it. When comparing it to XML format, for XML you must build an XML DOM implementation to the client side to parse the XML message, but in JSON the JavaScript engine in the browser handles the JSON parsing so any specific implementations are not required (Sriparasa 2013, 31).

When receiving a response from the server using JSON format, the actual response is a string which contains JSON data. I can use the `JSON.parse()` method to convert the JSON string into JavaScript object, and then the values can be accessed like you would access in any JavaScript object. To convert a JavaScript object back to JSON, I can then use the `JSON.stringify()` method (Rischpater 2015, 17).

These two methods will most likely be the most important ones in my case. The parse method will be used when a response is received from customers' ERP system to provide information for the user about the status of the request, meaning whether it was successful or not and stringify method will be used to convert the JavaScript object in the Fusion Lifecycle into JSON format before it is sent to the ERP system.

Regarding the method of saving a value permanently to the application without hard coding it, .NET provides a way to create and access values that are kept between application execution sessions and these values are called settings. Settings are especially useful in my case, since I can store the system URL of the user to the settings and provide a possibility to change the URL if needed, which I would not be able to do if the URL would be hard coded (Microsoft, 2017).

Regarding the few times when I had to re-think my approach, there exists a lot of different options on how I could achieve the same result, but most of them would require changes to some classes and other functionalities that I already have in place, so I decided to follow the one that makes the most sense to me and which I think is the simplest one when comparing to the other possibilities.

I also should remember from now on to start thinking few steps ahead instead of thinking just the next functionality, since short sightedness was basically the reason I had to adjust my approach so many times. Since there will be a lot of functionalities which are connected, in the future I must first think the whole process through instead of thinking each step separately.

One of the most useful and comprehensive tools that I have used in the tasks that are related to REST API's is Postman. Whenever I must call an endpoint which I have not tested before, I first create the request in Postman to see if I can successfully call the endpoint and what kind of responses I receive and after that it is easier to implement the request to the actual application. Postman has a clean and simple user interface, which in my opinion makes it easier to first test there instead of first writing the code for the request in the application and then debug step-by-step each line to see the results.

3.3 Week 3 (25.9.2017 – 29.9.2017)

3.3.1 Monday 25.9.2017

The goal for today is to finalise the form that I started developing last week. There are not too many tasks left, but there are a few new topics related to couple of those tasks that I must study to be able to finalise the form.

One task is related to file handling, in this case I need to prompt the user to select a folder where a file that will be retrieved from Fusion Lifecycle will be saved. Another task is related to creating a HTTP request with body content which I have previously done in Postman, but not in the application. In addition to these, there are a few more general tasks such as populating one list box and using then the selected value as a parameter in a HTTP request.

I was not able to finalise the whole form today, but there are only a few trivial tasks left to complete it. I did the tasks related to topics that were new to me, although I faced an issue at first when adding the body content into the request. I kept getting bad request errors from the server, but after a while I found the solution and fixed the issue. Prompting the

user to select a folder was not hard since a lot of examples can be found from different sources.

3.3.2 Tuesday 26.9.2017

Today I basically succeeded to finalise the form, but there is a possibility that I need to add a few additional search possibilities to the form in addition to the completed one, but I decided that I will add those later because it should be a quick task since they will re-use existing methods.

One of the new things that I learned today was how I can get the actual file out from Fusion Lifecycle using REST API, and not just the metadata of the file. The task was simple since the only change that was required was to change a header value in the HTTP request to get the binary stream of the file in the response.

After checking and testing that I was receiving correct data from Fusion Lifecycle, I started investigating material related to the next step in the process, which is the actual file management and manipulation functionality. At the end of the day I managed to implement one simple method which checks if a file with the same name already exists in the folder that the user selected in the form.

3.3.3 Wednesday 27.9.2017

Today I will study the materials related to Word object model that I must understand to be able to manipulate the document content programmatically. I also have a quick follow up skype meeting with our customer before mid-day.

I learned a lot about document manipulation today, mostly by first reading the documentation about different objects that there are, then manipulating their properties and trying the methods in the application by debugging line by line having the document open so that I could see the changes happening.

Regarding the files that are retrieved from Fusion Lifecycle, I managed to create a few methods where the actual file is first created to the folder that the user selected in the form, and after that the content is written to the file. Both tasks were easier than I expected, I initially assumed that these operations would be a lot more complex than they eventually were.

The meeting with the customer went pretty much as I expected. Since they have now been in production with their Fusion Lifecycle system for a few weeks, they were able to provide feedback about the functionalities that we have built. Any critical errors or problems had not occurred, but they had a request that one of the functionalities should be implemented differently and we agreed that I will develop the modified functionality to their sandbox environment and after testing they will give feedback if it should be changed to production also.

3.3.4 Thursday 28.9.2017

Today I must develop one modified functionality to the customer's Fusion Lifecycle sandbox environment so that they are able to test first if it fulfils their requirements before implementing it to the production environment. I will also have a skype meeting in the afternoon with the same customer but related to different topics. If I have any extra time between or after these, I will use it for developing the add-in.

The requirements that the customer had relating to the modified functionality was something that I have not previously implemented using the same approach, so I had to do some additional testing because I did not know how the system would behave. I had to do a couple of minor workarounds to avoid errors that the scripts were raising in the first few solutions that I tried, but eventually I managed to find a solution that works.

The meeting was related to the next steps of the project in which we will start adding the remaining workspaces and functionality to the system. They are currently doing the tasks manually, so we discussed how we can implement the processes in the system and how we can automate certain steps and we agreed that during the following weeks I will build a preliminary suggestion to the sandbox environment which we can then review and start modifying.

I had some time at the end of the day to continue the development of the add-in, but I was not able to add anything to the application because I encountered an issue related to modifying both the custom properties and variables of the document. Both have the same problem, if I am trying to get a property or variable that does not exist, or set a property or variable that already exist, both raise an exception. This is something that I need to solve, since the application will always add properties and variables to the document if they don't exist or modify property and variable values if they exist.

3.3.5 Friday 29.9.2017

During today I have made the most progress in the add-in development when comparing to any of the previous days. In the morning, I could develop a workaround to avoid the exception problem that I ran into yesterday afternoon.

After fixing the problem I ran a few tests and debugged through the file download functionality to see that everything is working as it should. After that I started developing the functionality of uploading the file back to Fusion Lifecycle.

My goal was to have a simple and fool proof upload functionality, where the actions that the user needs to perform are minimized. At the end of the day I have developed a series of methods that ensure that by clicking just one button, the file that the user has open in Word will be uploaded back to Fusion Lifecycle. At this stage, it obviously requires that the same file was downloaded from the system using the add-in, otherwise it won't have the required metadata that is required in the request.

One of the reasons why I could progress so well today was that in most of the methods that I created I just applied the knowledge and skills that I had learned earlier this week.

One of the new things that I learned while doing the tasks was how to read the file bytes, because the file information will be sent to the server as file byte array instead of using just a single file object. Getting the file bytes was really easy by using the .NET's File classes `ReadAllBytes([file path here])` method, which returns the byte array.

Another new thing was related to the actual HTTP request, since it was a bit more complex than most of the requests that I have previously done. RestSharp however makes a lot of the hard stuff for me, I only need to make sure that I am using the correct parameters and the RestSharp client handles the rest.

3.3.6 Week 3 analysis

Since the tasks that I have been doing this week have mostly been related to topics that are new to me, I can say that this has been one of the most lucrative and interesting weeks for a while. Because I have been able to complete many different kind of tasks and solve new problems, I feel that my knowledge and skills have improved a lot during this week.

All the problems that I faced regarding this week's tasks I was able to eventually solve. The problem that I had when I had to send a HTTP request with body content was related to serializing an object into JSON format. I was serializing the object two times, first in my own code and then in the request, because I did not notice at first that RestRequest, the class that I am using to create the HTTP requests, AddBody([object here]) method automatically serializes the parameter object to data format which is specified for the request. Bad request most likely occurred because the receiving end could not parse the object because it was in invalid format.

Most of the requests that I currently have in the application are simple requests with content type header set to application/json, but the request that is related to file uploading is a bit more complex, because in that I must use content type header of multipart/form-data. The information is sent to the server in two parts, the first part is the metadata, which has content type of application/json and the second part is the actual file in bytes, which has content type of application/octet-stream.

Another problem that I had was the exception issue related to creating or modifying the document properties and variables. I solved the problem by adding a method that checks if the document has properties and variables. If they exist, the application loops through them and first deletes every property and variable that match the naming that I am using and after that creates them again. This way I make sure that no exceptions are raised if I am trying to create a property or variable that already exists, or trying to modify a property or variable value that does not exist.

At first, I thought that I would handle the problem by using the catch block where I would catch the exception which is raised and based on that develop the logic. According to Wagner (2016, 225), the developer should provide other public methods to handle the error rather than using exceptions as general flow-control mechanism.

The reason I am utilizing properties and variables is to store some metadata into the document that is needed when the user will upload the file back in to Fusion Lifecycle using REST API.

I am adding the metadata to the document properties to enable a way for the user to select the values from the properties and insert them somewhere in the document if it is required. The problem with properties is that users have access to them and they can modify the values and that's why I am also using document variables because they are unreachable and unmodifiable outside of code.

If the application would not add the properties and variables, it would not provide any additional value, because then users should log in to their Fusion Lifecycle system first and find all the required information there to upload the file back.

Manipulating the properties and variables are related to the Word object model, which is new thing that I have learned this week. There are two different project types that you can develop, and Word object model applies to both: document-level projects and VSTO add-in projects. There are hundreds of different objects that follow the structure of the Word user interface, and all these objects have many methods and properties that can be used to manipulate the object (Microsoft, 2017).

The solution that I am developing is a VSTO add-in. Document-level solutions are only associated to specific documents, but VSTO add-ins are associated to the application, meaning that the add-in will run when the Word application is started (Microsoft, 2017).

Tasks related to customer's Fusion Lifecycle development, since they are in production currently we are now implementing every new functionality and modification to the sandbox environment first.

Sandboxes can be also referred as development servers, and their purpose is to enable the developers a safe way to directly test code and new functionalities in a real-time environment. When testing of new functionalities has been completed, the changes are usually then updated to the production server (Nexcess.Net, 2017).

According to Felker (6 October 2007), it is expected from the service providers that they have a sandbox environment available for testing. One of the major reasons is that if you do not have an opportunity to test your code before taking it to production, you probably won't find errors before they are starting to cost money for the company.

3.4 Week 4 (2.10.2017 – 6.10.2017)

3.4.1 Monday 2.10.2017

I will start the week by preparing some example workspaces and functionalities to customer's Fusion Lifecycle sandbox environment. We are now moving onto the next steps in the project, which include creation of the remaining workspaces and their functionalities.

The tasks related to the remaining workspaces and functionalities will be a bit more complex and difficult than the previous tasks, because we are dealing with broader concepts that product lifecycle management encompasses. I haven't implemented most of the functionalities that we have left before, I have only done some trivial testing related to them but nothing customer related, so this will be a valuable lesson about the system.

I managed to create some examples about few of the workspaces and their functionalities, because we do not have any detailed requirements or descriptions related to them. These tasks did not require any advanced skills, I just had to create a few fields and use the out of the box functionality since we do not have information about any custom configurations yet. We have a workshop next week in customer's premises related to these topics and the built drafts work as a good starting point for the conversation.

I faced one major problem related to one of the new functionalities that I could not solve today. The preliminary information that I have related to this functionality seems that the customer wants to implement it in a way that might not be feasible from the system point of view. I must do some additional research to find out if someone has had a similar requirement and how they have solved it. If I cannot find a solution, then I must try different approaches to see if it is feasible, but there are not too many options, because this is one of the functionalities that we are not able to configure as much as hoped.

3.4.2 Tuesday 3.10.2017

Today I will have a meeting with my colleague about the next week's workshop. The objective of the meeting is to review the examples that I created yesterday and decide whether they are sufficient or if I should add something to them. We will also review the problem that I faced yesterday and decide how to proceed with it.

We came into conclusion that the created examples are sufficient, including the one which I could not solve yesterday, since we do not have enough requirements or information about the topics to develop any functionality further. We also created an initial agenda for the workshop, because there are quite many topics which we should discuss about during the few days that we will spend there.

If everything goes well and according the agenda at the workshop, there might be a possibility to talk about secondary topics that are not as timely right now, but will be quite soon when we are progressing with the primary topics. We decided that I will create examples related to the secondary topics also, so if there will be a possibility we will then suggest if we could discuss them.

3.4.3 Wednesday 4.10.2017

Objectives for today include creating the remaining examples related to the secondary topics that I mentioned yesterday. I will also have a short skype meeting with the customer related to one of the primary topics. The purpose of the meeting is to inquire if they could provide additional information that I can use to create better examples about different implementation possibilities.

At the beginning of the day I received a request from another customer to review what might be the issue related to one of the functionalities that I built a while ago in their Fusion Lifecycle system. I managed to solve the problem quickly, since based on the description given by the customer I knew instantly what was the problem.

Right after I had fixed the problem I had the skype meeting with the other customer. With the information that I received during the meeting I could refine and create a few additional examples about the implementation possibilities. I also managed to create the remaining examples related to the secondary topics.

The tasks were simple and did not require any advanced skills, since none of the example workspaces and functionalities is finalised at this point. The purpose of the examples is to illustrate to the customer both how the different options look like in the user interface and what actions are required from the user, since the amount of user interaction may vary drastically between approaches.

3.4.4 Thursday 5.10.2017

For today I do not have any tasks that I should complete, but I will go through few documents that the customer had sent yesterday evening. The documents are related to one of the primary topics that we are going to discuss next week in the workshop.

The documents provided both valuable information about different sub processes that the customer is having and helped to perceive how many smaller things are related to the topic. I cannot prepare or make additional modifications to the functionalities based on the documents although they contain new information, because the documents describe how the customer is working now but they have not yet decided if they will follow the same processes or redefine them.

At the end of the day when I had investigated the documents, I decided that I will add some additional logic behind one of the functionalities. This will help the customer to see

how the functionality works with the added logic in the system, which should be more illustrating than trying to explain it to them. I created a new script for the additional logic, but I did not finalise it since only a part of the full logic will be enough for demonstration purposes.

3.4.5 Friday 6.10.2017

I spent the day preparing for next week's workshop. I have gone through my own notes and materials that the customer has provided, because it is important that I have a decent understanding about the topics that we are going to discuss in the workshop.

In the afternoon, I received an email about different remarks that have emerged while the customer has been using the system. They were mostly related to the workspaces and functionalities that we have created in the earlier stages of the project, but there were also few additional questions that are related to reporting functionalities. We added a time slot to the agenda when we can discuss about the remarks and decide whether there is a need to modify the workspaces and functionalities or not.

3.4.6 Week 4 analysis

Many of the tasks that I have been doing this week have provided valuable information about how all the functionalities in Fusion Lifecycle are related to each other. Although in previous cases I have not implemented these functionalities, for now it did not require any advanced knowledge to create the examples, because I mostly utilized the out of the box solutions without any additional logic.

Out of the box functionalities are available right away for the user when purchasing the software or product. Usually the functionalities are simple and follow best practices that there exists, since each customer that buys the software or product usually have their own working methods or approaches related to the subject. That's why the out of the box functionality should be something that can be configured easily even by individuals who might not have any IT background (Littlefield 30 January 2015).

The script that I created to one of the new workspaces was a condition script that is used to control which users have the permission to make transitions in the workflow that is associated to the item. When you have a workspace in Fusion Lifecycle that is using a workflow, all the created items will inherit the workflow that has been created, so you cannot create a new workflow each time you are creating a new item in the workspace.

Although at first, we decided with my colleague that creating the additional logic was not necessary, I thought that it would be easier for the customer to understand if they can see how the logic works in the system.

Creating the script was not hard since I have done similar scripts in other cases and it did not require too much effort since I only created part of the full logic, but the problem was that I only had a vague description about the topic and no detailed information, so I had to come up with my own solution.

Overall in this week's tasks related to the new workspaces and functionalities, when I have created the examples I have had to come up with my own approach in each example. Reason for this is that the customer has not previously had a similar tool in use like Fusion Lifecycle, but most of the work has been carried out manually and they have not had unified processes that everyone would follow.

Due to this we have not been able to acquire detailed information related to the topics, because we are creating the suggestions on how the process could be implemented in the system and the customer will then refine their process so that it follows the selected approach.

Regarding the workshop, it is important that certain steps are taken which will ensure that the workshop is a success and not a waste of time and money for the participants. In general workshops are great places for brainstorming, establishing relationships, learning and problem solving. To get the most out of the workshop, clear goals should be defined and key users whose work is influenced by the decisions made in the workshop should be invited. After that it is possible to create an agenda for the workshop which will ensure that the set goals are achieved (Mind Tools Ltd 2017).

3.5 Week 5 (9.10.2017 – 13.10.2017)

3.5.1 Monday 9.10.2017

Objectives for today include going through the remarks and questions that I received from the customer on Friday. The remaining time I will most likely use for preparing to the workshop that will start tomorrow.

There were not any tasks that I should complete relating to the remarks, but I had to think about possible alternate solutions to the functionalities so that I can suggest them in the

workshop, if the customer feels that changes need to be made. The remarks are not related to any critical errors that would prevent the customer from using the system.

The additional questions related to reporting functionalities is something that I cannot build or configure so much in the system, so I created a few reports as an example that I can show to the customer.

In the afternoon I received an email from another customer related to a workspace and its functionalities that I built in their Fusion Lifecycle system while ago. There were only few minor changes that the customer wanted which included removing certain fields from the workspace. The task was simple and easy to do since the fields were not linked to any scripts or other functionalities.

After completing the tasks, I had to leave to the airport, so I did not have time to do additional preparations for the workshop, but I am not worried since I feel that the created examples and my knowledge about the workshop topics are sufficient.

3.5.2 Tuesday 10.10.2017 – Wednesday 11.10.2017

Past few days have been very intense and very lucrative. Although the timetable was strict, we managed to gather a lot of valuable information related to the topics that we have been discussing in the workshop and both the customer and we have a clear understanding about what are the next steps.

The remaining workspaces and functionalities are a bit more complex and not as straightforward as the ones that we have created in the earlier stages. Third party users will eventually have access to some of the new workspaces and functionalities, which makes things a bit more complex and decision making slower, but it is important to include the third parties in to the discussions so that they can share information about their working methods and what kind of things would benefit them.

A lot of internal discussions are also required from the customer, because they did not have a clear vision and common understanding on how they will start working in the future. They knew what functionalities they want to automate and what they want to do in the system, but it requires that they must standardize some of their working methods in order it can be automated.

At first, we were not supposed to discuss the integration, but on Tuesday the ERP consultant was able to join the workshop so we had quick recap what has been done and

what needs to be done. From my part nothing has changed, I have everything ready for testing but some functionalities are still missing from the ERP end, so we will wait that those are created.

What comes to the discussion about previously created functionalities, we agreed with the customer that I will create alternate solutions that I have in mind to the sandbox so that they will be able to test and decide whether the solutions would be better. They had also a few new remarks that had come up before the workshop and they asked me to investigate, if I can come up with an alternate solution for those.

3.5.3 Thursday 12.10.2017

Today I will start by first modifying the previously created functionalities in the sandbox environment. After that I will go through the couple of new remarks that had come up before the workshop to see if I can come up with alternate solutions.

The tasks related to the previously created functionalities were not too hard, since there was no need to build the functionalities again from the start with a new logic. Few of the modifications were related to changing values after an item is created, which previously was not possible since the field settings were set that the value can only be set when creating the item, so I only needed to modify the field settings which is a trivial task.

The remaining tasks required minor changes to the scripts, since there was a need to remove and manipulate field values after certain workflow steps are taken. I have done a lot of similar scripts earlier based on similar requirements, so I did not have problems to finish the tasks.

While investigating alternative solutions to the functionalities in which the new remarks were related, I was not able to solve all of them today because some of them were more problematic than I initially thought.

3.5.4 Friday 13.10.2017

I should be able to solve the remaining problems today, since there are only few left. In addition, I will review the integration functionalities because I received additional information from the customer related to the integration.

It seems that the remaining problems that I could not solve yesterday cannot be solved either in a user-friendly manner or at all. The problem which could be solved by adding a new field and logic to the scripts would eventually require more actions from the user than

it currently does. I informed the customer about the issue and it is now up to them to decide if they want to add the functionality to fix the problem nevertheless.

The problem that cannot be solved is because it requires item information that cannot be accessed, although the information is visible in the user interface. I had not noticed the limitation before, although I have created similar automation operations before, but they have required information that can be accessed.

Additional information about the integration was related to the fields and values that will be sent to the ERP system. There were a few fields that were required, but were missing from the script in which the JSON object is created. I needed to add the fields into the script where the object is created and into another script which checks that there are no empty values in the fields that are required.

3.5.5 Week 5 analysis

The tasks that I have been doing this week which have been related to Fusion Lifecycle configurations have been similar that I have been doing for a long time now, so there have not been any major leaps in my skills on that area.

There was one new thing that was related to scripting in Fusion Lifecycle that I learned, which was that I cannot read whether the item is deleted or not in a script. The requirement was that there was a need to automate the process of removing the items that are deleted from the item which they are related to.

There is a parent – child relationship between the items and when a child item is deleted, it should be removed from a tab in the parent item. The delete that can be done in the user interface is a so called soft delete, meaning that it is not deleted from the database. Deleted items can be undeleted at any time.

The workshop was a very instructive occasion and I feel it taught me a lot of new skills and increased my knowledge on what are the best practices related to workshops. Although I have participated to quite many workshops and customer meetings, there are a few mistakes that I tend to repeat in them.

Sometimes I am a bit too confident, that I can resolve a certain issue related to some created functionality right away while discussing about it. This usually breaks the flow of conversation, because everyone is waiting for me to fix the issue and show that it works.

Quite often in these situations I notice that the issue was not actually as straightforward as I thought, and I could not fix it, so it only caused an unnecessary pause to the discussion.

Another problem is that sometimes when discussing a new functionality, I start describing different solutions on how it could be implemented in the system. This usually leads to a point, where the customer is confused because of all new information. Often the customers then start asking additional questions, because they could not understand how it would work, since there was no concrete example that I could show in the system. This reduces the time that is reserved for discussion about other topics if we get stuck to the current subject.

In both cases, I need to remember to listen and take notes about what the customer is telling me and instead of trying to solve a problem or provide all the information about different solutions right away, I should remember to say that I have understood the problem and I will come up with a solution after the workshop or meeting.

My colleagues often tell me tips and tricks on how to handle different issues that might occur. Since the workshop contained many topics that were unclear, my colleague advised me that in these cases instead of leaving the topic open, actions that will solve the issue need to be defined. If there are many topics that are open, it will most likely cause delays to the project plan.

My responsibilities so far have been mainly related to the development side, but one of the reasons why I attend the workshops and customer meetings is to prepare me so that I can start working independently in customer cases. My social skills have improved a lot during the time that I have been working in PLM-Zone, but I feel that my knowledge and skills are not yet in the required level. Although I have gradually gained more responsibility which has increased my self-confidence, I feel that there is still much to be learned and more experience to gain.

3.6 Week 6 (16.10.2017 – 20.10.2017)

3.6.1 Monday 16.10.2017

I do not have any specific tasks for today, but there are couple of issues that have come up recently which need to be solved. One issue is related to user's credentials and another is related to a field type in the system, which is not behaving as it should.

Tasks did not require other actions from me than providing the description of the field behaviour to the customer, since I cannot open support tickets to Autodesk's support forum, because I have a different type of account than regular customers have.

The rest of the day I spent reviewing the Word add-in. I went through the code and ran a few tests in debug mode to make sure that everything is working as it should. At the end of the day I simplified a method that reads the document's properties, because it had unnecessary lines of code.

3.6.2 Tuesday 17.10.2017

I had received an email from the customer yesterday evening about one of the new workspaces that will be built into the system. I will start by checking the email to see if there is something that I can develop and after that I will continue the development of the Word add-in.

The email contained a document in which the data that is required in the workspace is described. The required data will be retrieved from multiple workspaces and because many of them are still under development, it was not possible to start developing the workspace yet.

As the customer has begun to take more responsibility for trivial tasks related to the development, such as creating workspaces and adding fields into them, I received a lot of questions and requests to review problems that they had encountered during the day. The questions and problems did not require any advanced skills, I explained how the fields work and what was the reason behind the problems that they had encountered.

Regarding the Word add-in, I made a modification to the HTTP request that is used for searching items in Fusion Lifecycle. I changed the filter type value used in the request body, because the previous filter type value would return an item only if the search parameter given by the user matches totally the field value in Fusion Lifecycle. The new filter type value will return an item if the field in Fusion Lifecycle contains the given search parameter.

3.6.3 Wednesday 18.10.2017

Today I have a Skype meeting about the integration and I will also meet up with my colleague, so we can discuss and review the topics related to the next steps in the project.

The goal of the integration meeting was to discuss and reach an agreement about how the authentication and connection from customer's Fusion Lifecycle system will be established to the ERP system. Because my knowledge of the subject is not at the required level, my colleague who has implemented many integrations participated to the meeting so that he could discuss with the other party about the details. We reached an agreement about the details and the other party promised to contact me when we can start testing the integration.

After the integration meeting, we started reviewing other topics related to the project with another colleague. We came into conclusion that it is not necessary to start creating the remaining workspaces and functionalities yet, but there is one functionality requirement that is related to one of the new workspaces that needs to be investigated.

3.6.4 Thursday 19.10.2017

I spent the day by trying to find solutions to one of the new functionalities. The customer has a specific requirement about the layout of a document which contains the details of a product and once they want to export the product data out of the system, the document should be automatically created and filled. The document in this case is a specification, that will be sent to their manufacturers.

The requirement that the customer has is quite complex and although there is one option on how this could be achieved using one Fusion Lifecycle's out of the box functionality, it is a possibility that it cannot be utilized in this case, because there are some limits on what can be achieved with it.

3.6.5 Friday 22.10.2017

Today I will do some additional research to see, whether it is possible to utilize one functionality in Fusion Lifecycle to fulfil the requirement that the customer has for a workspace. In the afternoon I have a meeting with my colleague related to the same workspace, but about its other functionalities and fields.

When I had investigated the functionality for a while, I came into conclusion that it cannot be utilized in this case because of certain restrictions that it has. I explained the problem to my colleague and we decided that we would discuss and decide an alternate solution.

During the meeting with my colleague we went through the documents and information that we have related to the workspace. Although there is still a lot of required data missing

from the system that is required in the workspace, we decided that I should create a simple example of the workspace using the information that is currently in the system.

3.6.6 Week 6 analysis

Overall, it has been an unusual week when thinking the tasks that I have had. I do not recall that I would have had a similar week during my time at PLM-Zone, when I have had so few development tasks. Most of the week passed by trying to find solutions from various sources to the challenge that we are facing with one of the requirements.

One out of the box functionality that can be utilized to create custom documents in Fusion Lifecycle is called an advanced print view and it is possible to create many of them for a workspace. In the advanced print view editor, it is possible to select the item data that you want to show in the print view and edit the layout.

There is one restriction which prevents the usage of advanced print views in our case, which is that it is not possible to read fields of an item that belong to another workspace. To solve this problem, we will suggest that the document would be created using the word add-in, because the document manipulation would get easier and it is possible to retrieve the data that is required without any similar restrictions.

The reason there has not been development tasks is that many of the topics are still open and due to this we have been actively contacting the customer with my colleague about the topics. We hope that this will ensure that the decisions are made within a timely manner to keep the project on schedule. According to Anderson (21 August 2015), one of the most important strategies to keep the project on track is communication.

Regarding the integration, in this week's meeting we could reach an agreement on the remaining topics, which included the authentication method and the protocol that will be used when sending data from the customer's Fusion Lifecycle system to the ERP system.

If it would have been solely my responsibility to discuss with the other party and decide with them, it could have been possible that because I do not have any previous experience about the subject, I would have agreed on using an approach that would not eventually be usable. For that reason, I think it was the right decision to let my more experienced colleague to discuss the topic, because he has better knowledge of different authentication methods and protocols.

Eventually we decided that the authentication will be done using Windows authentication and the data transfer will be carried out using HTTPS protocol, because it is then possible to send the credentials in the header of each request and the data in JSON format in the body of the request. Other methods, such as using a certificate as authentication method or sending files over network using FTP protocol would have been impossible, because it is not possible to create files in Fusion Lifecycle using the scripts or store a certificate.

Although there are several benefits that a company can achieve by system integration, quite often it is not considered as important as other topics. By integrating its business software applications, a company can enhance its process efficiency across the organization, access the data in real time almost everywhere, accelerate growth and decrease the operational costs of maintaining multiple systems (Oracle, 2017).

3.7 Week 7 (23.10.2017 – 27.10.2017)

3.7.1 Monday 23.10.2017

The only objective that I have for today is to create the first draft of one of the new workspaces. There are only trivial tasks such as creating some fields to the workspace and setting up relationships to other workspaces because the out of the box functionalities can be utilized in this case as they are and there is no need to create new scripts.

I did not face any obstacles today to achieve my goal, because there were not so many fields that I needed to create into the workspace due to the lack of information. Eventually I used most of the day to modify fields of another workspace, because I received additional information from the customer related to the data that is required.

3.7.2 Tuesday 24.10.2017

Customer has asked me to do a short manual about the workspace that I created yesterday. The purpose of the manual is to illustrate the preliminary thought that me and my colleague have about the workspace and its functionalities, because the customer will be busy for the next few days and will not be able to have for example a skype meeting about the subject. If they have time at some point, they will use the manual as guideline to make tests in the system.

The manual mostly consists of screenshots that I have taken from the workspace and explanations regarding different fields and tabs that will be used. Since there is no added functionality yet, such as field value manipulation when the user makes certain actions, in

the explanations I have wrote a description how the field values change in each case so that the customer can get an idea how the automation would work when implemented.

The rest of the day I spent investigating the new modern interface which is available for Fusion Lifecycle. It is still a bit under development because it does not yet cover all the functionalities that the classic interface has. Users can select the interface that they want to use in their user profile in the system, so it is possible to return to the classic interface in case they find the modern user interface unfinished.

3.7.3 Wednesday, Thursday, Friday 25 – 27.10.2017

The remaining days have been quiet and since there were no immediate goals, I have combined the days because the tasks that I have been doing have been either trivial or related to the same topic.

There were a few questions that the customer had related to their Fusion Lifecycle system. One question dealt with dates that were causing a bit of confusion because the customer could not understand where the dates that they saw were coming from.

Another question was related to an actual problem, because there was a need to download all the pictures from the image fields in one workspace. Because there are more than 3000 items in the workspace and each have their own picture, they wanted to know if there is a functionality that could be used instead of doing it manually. The questions did not require additional investigation from my part, because I was able to answer both questions.

The remaining time I have used for the development of the word add-in, because while I reviewed the form templates and requirements provided by the customer, I noticed that it would be possible to create few functionalities that were not dependant on the open topics that there currently are in the project. Because the tables and other text in the form templates are static, I could develop the document manipulation side of the add-in further. It required some research regarding the word object model and different methods that I need for the operations, but eventually it was not as complicated as I initially thought.

3.7.4 Week 7 analysis

Another quiet week due to the open topics. In my opinion, the most beneficial tasks this week which have enhanced my abilities as a developer have been related to the word

add-in, because completion of the tasks required new skills and knowledge that I did not previously have.

One requirement for the add-in was that there can be multiple products that will be added to the form template during a single execution. Each product will obviously have its own data, so I needed to find a way to copy the content of the form and in case there are multiple products, to paste the content in a new page.

I decided that the application will copy the content before any of the form tables are filled with data and if there are more products, a page break will be inserted and the content will be pasted to the next page. The following figure shows the lines of code on how each operation can be achieved:

```
//Copies the content of the document into clipboard
Application.ActiveDocument.Sections[1].Range.Copy();
//Below line selects the last paragraph in the document and inserts continuous pagebreak to location
Application.ActiveDocument.Paragraphs.Last.Range.InsertBreak(WdBreakType.wdSectionBreakContinuous);
//Pastes the content from the clipboard
Application.ActiveDocument.Paragraphs.Last.Range.Paste();
```

Figure 1. Code to copy, insert page break and paste content to new page (Stackoverflow 2017; Microsoft 2017)

Another task that I could do in advance was to map the table cells which will be filled with the data coming from the system. Since there are multiple tables and each table has multiple cells, now that I have the statements ready, it will save a lot of time because I only need to map the corresponding data to the cell when it is timely.

The following statement can be used to access and manipulate a cell's text in a table: `Application.ActiveDocument.Sections[index].Range.Tables[index].Cell([row number], [column number]).Range.Text = "value"`. Sections collection in this case is the section from where you want to find the table, for example if you have two pages and there is a section break between them, setting the index as 1 will select the range of the first section. Tables collection is similar, by changing the index you select the table and by using the `Cell` method which requires two parameters, row number and cell number, you can access a certain cell's range and manipulate the value. Some of the table cells in the form templates also contain form fields, and they can be found with the following statement: `Application.ActiveDocument.Sections[index].Range.Tables[index].Cell([row number], [column number]).Range.FormFields[index].CheckBox.Value = false` (Microsoft, 2017).

As it can be seen in the previous examples, the range object is used in every statement, in some cases even multiple times. This is due to that the range object is one of the main ways to interact with the document's content. There are several different ways how to get

a range in addition to my earlier examples where I have utilized different collections that there are in the document, but one of the most common way is to use the range method on the document object. Range method has two optional parameters that define the start and end position of the range that you want to get and if either of the parameters is omitted, the default for the start is 0, which is the first position in the document, and the default for the end is the last position in the document. The range method eventually returns a range object (Carter & Lippert 2006, 335-336).

```
Set myRange = ActiveDocument.Range(Start:=0, End:=10)
```

Figure 2. Using the Range method (Microsoft, 2017)

3.8 Week 8 (30.10.2017 – 3.11.2017)

3.8.1 Monday 30.10.2017

Today we will have a skype meeting about the integration, where we should be able to test sending requests to the ERP endpoint and see whether the data is registered or updated in the ERP.

The meeting turned out to be vain, because we were not able to test the communication since the authorization and other configurations were not in place. We agreed with the other party that as soon as the missing parts are in place we will arrange a new meeting.

Rest of the day we spent reviewing the open topics with my colleague. We decided that I will start investigating one functionality beforehand although most of the information is still missing and the customer has not yet decided which approach they will follow.

3.8.2 Tuesday 31.10.2017 – Wednesday 1.11.2017

The objective for the next couple of days is to familiarize myself on one of the most complex functionalities that there are in Fusion Lifecycle, BOM management. I have not done implementations where customer has taken the BOM into use, so most of it will be new to me.

I started by doing trivial tasks to refresh my memory about the basic BOM functionalities. The tasks mostly consisted of first adding items into the BOM and then manipulating values of the BOM fields in the default view which is an out of the box view. After that I started creating different views and added custom fields into them to see how the system behaves while using different views and manipulating the values in them. I noticed one

major difference, which can cause problems at some point, in the BOM view and field behaviour when I was doing comparisons between the modern and classic user interfaces. Otherwise I did not face any major difficulties while testing that would have required any investigation.

After the trivial tasks I moved on to create a few views that were based on some examples that I requested from the customer. In the views I tried to mimic the BOM structure that the customer has in their ERP system, because their wish is that they would look similar in both systems. Creating the views was not hard, but it seems that with the current functionality and logic that we have already implemented might cause some problems on getting the structure to seem the same in Fusion Lifecycle as in the ERP system. Nevertheless, I came up with a few ideas and created the examples on how to get it working with the current implementation, although the structure would then differ a bit between the systems.

3.8.3 Thursday 2.11.2017

The objective for today is to have a skype meeting with the customer about one workspace that will be created during the next steps in the project.

Since the customer has taken responsibility of doing some of the trivial tasks on their own when they are making decisions in their internal discussions, the purpose of the meeting was to review one workspace that they have created and discuss whether the approach that they have come up with is feasible when the necessary automation is created.

The automation tasks that they require in the workspace were similar that I have created many times before, so we decided that once they have discussed a few minor topics that are still open related to the workspace, they will send me the details so I can start finalizing it.

3.8.4 Friday 3.11.2017

At the beginning of the day I did not have any specific objectives, but when I received some information related to the integration I could do some trivial tests to see whether I was able to send requests to the endpoint that was provided for me.

In this task I needed to do quite a lot of testing, problem solving and research on my own, because the contact could not provide any specific details about how the communication

works. Eventually I could get a response from the server using the appropriate authentication method and credentials that were provided for me, but the actual endpoint that will be used in the integration was not available.

3.8.5 Week 8 analysis

The tasks that I have done this week related to the BOM functionality in Fusion Lifecycle have not required any advanced knowledge or skills, because the basic knowledge that I have about the functionality was sufficient to carry out the tasks.

Bill of material or BOM describes how the actual product has been built. It includes all the items, parts, assemblies, and other materials that are required for manufacturing the product. There can also be multiple sub-assemblies, because each part might have its own BOM which describes how that part is assembled (Arena Solutions Inc, 2017).

One major anomaly that I noticed while testing the BOM functionality in both modern and classic user interfaces was that the BOM view fields in classic were behaving strangely. In the modern user interface, when the user is in the edit mode in the BOM view, the only fields that are visible and can be edited are the ones that belong to the view that is open, but when doing the same thing in the classic user interface, there are additional fields that the user can edit that belong to the other BOM views. Also, the column order in the classic user interface changes so that they are not anymore in the right order when opening the edit mode.

With the acquired information about the differences between the user interfaces when it comes to BOM functionality, I will be able to tell the customers what are the advantages and disadvantages between the two. Since the behaviour is something that cannot be fixed by me, I will most likely contact the Autodesk to inquire whether someone else has already reported about the issue, because at least in my opinion the behaviour in the classic user interface might greatly affect to the usability and user experience.

Regarding the wish that the customer has about the BOM structure, the reason it is not possible to mimic it in Fusion Lifecycle with the current functionality and logic is that the way how items are created is different between the systems. In the ERP system, the items are differentiated using composite key approach, for example the same product number can occur multiple times in a table, but some other attribute then makes the row unique. In Fusion Lifecycle the current already implemented logic goes that in a workspace, which can be considered as a table in database, each item is made unique by using one primary key, for example a product number.

It is up to me to explain to the customer the amount of work that it would require making the changes and demonstrate the few examples that I have created for an alternate solution. I assume that the customer will realise that if the entire logic would be changed, it would stall the project and increase the budget greatly.

Regarding the integration, the biggest problem that I faced was finding out the authentication method that will be used when communicating with the server, because the contact who provided the credentials was not able to tell which method is used. Because in one of the previous meetings that we had related to the integration I recalled that we had agreed that Windows authentication will be used, I started browsing the internet to find out how it works, because I did not have previous experience about it.

Windows authentication, previously known as NTLM or Windows NT Challenge/Response authentication, supports two authentication protocols, Kerberos and NTLM. Since the username and password are hashed before the request is sent to the server, it makes it a secure form of authentication. There are also other methods can be used, for example basic or certificate authentication (Microsoft, 2017).

I also noticed that if there is a need to find out the authentication method that the server is using, in Postman it is possible to find the method in the response headers that the server provides. The figure below is taken from the Postman user interface where I have set the authentication method of the request as basic authentication and received Unauthorized status code from the server. In the server response headers, the authentication method of the server is its own value.

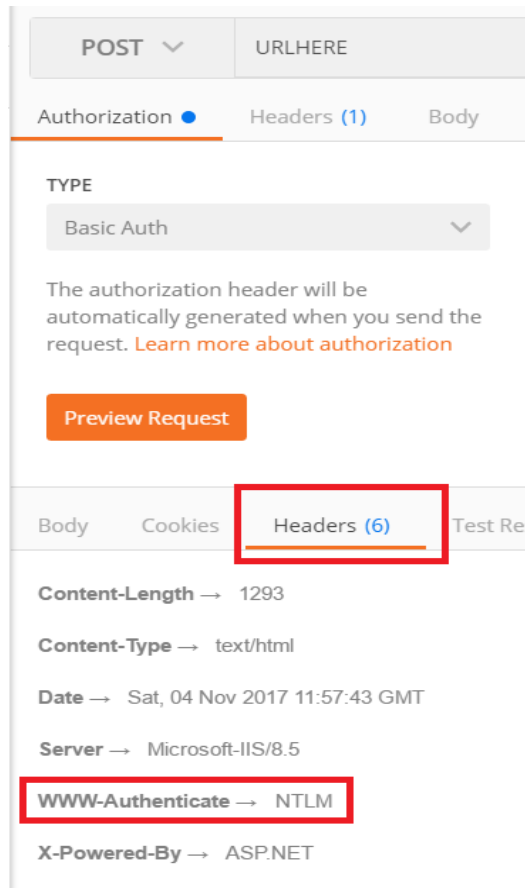


Figure 3. Authentication method from server response headers in Postman

3.9 Week 9 (6.11.2017 – 10.11.2017)

3.9.1 Monday 6.11.2017 – Tuesday 7.11.2017

I combined the days because the tasks that I have been doing are related to the same subject. Since there were no objectives set, I decided to investigate a bit more about exception handling, because my knowledge in this area is not at the required level. In the word add-in, especially in the document management side there are multiple statements that can raise different kind of exceptions, so I must make sure that all the exceptions are handled to prevent the application from crashing.

I started by searching information from various sources regarding the exception handling to find out the best practices. It was harder and took more time than I initially thought, but eventually I felt that I had found the answers I was looking for to start adding the handlers into the add-in.

Adding the handlers was easy, the harder part is to figure out what kind of operations should be performed after each exception. I decided that I will finalise the handlers after the customer has made decisions regarding the open topics in the project.

3.9.2 Wednesday 8.11.2017

Today's objective is to clone the source code of one of the applications owned and developed by PLM-Zone, ZoneSight, from the git repository into my virtual environment. I also need to deploy the application into the tomcat server, which I have not previously done.

Cloning the application's source code from git was simple and quick task to do and did not cause any troubles, but the deployment of the application was a lot harder than I initially thought. During the task I learned a lot about what is the purpose of the files that I had to configure in tomcat and how some of the files in application level are connected to the deployment process.

3.9.3 Thursday 9.11.2017

The objective for today is to review ZoneSight's source code which I cloned from git yesterday. I need to understand how it has been built, so that I can do further development when changes or new functionalities are required.

The application is written using Java and since my skills in Java are on a basic level, I have mostly been searching for information about JSP and Java servlets and how they work together, because I do not have any previous experience from either of them.

I also made another clone project of the same application which I will solely use to make my own views, JSP's, servlets and classes for learning purposes. The other project will then be used to commit the relevant changes into the git repository when the time comes.

3.9.4 Friday 10.11.2017

I had received a request to make a few minor changes to the customer's Fusion Lifecycle system yesterday evening and my objective is to finalise them today. If any additional tasks do not come up, I will continue to investigate the source code of ZoneSight application.

The tasks related to the changes in customer's Fusion Lifecycle were straightforward and I did not encounter any problems while completing them. First, I needed to import some additional data into the system to one of the new workspaces that customer had created, then I had to make a few minor changes to field types in another workspace. The fields that I changed will be used to source information from the workspace where I imported the new data.

There was also one script that was raising errors because the script was trying to manipulate fields that were no longer used in the workspace. The script is part of the out of the box functionality, so I disabled it because it was obsolete anyway since the workspace functionality will eventually follow different logic when compared to the out of the box implementation.

After completing the tasks, I spent the remaining time to study the source code of Zone-Sight.

3.9.5 Week 9 analysis

Most of the tasks which I have been doing this week have provided a lot of useful skills which will be beneficial in the future. Searching information about exception handling improved my knowledge greatly, since before this week I only had a generic understanding about the subject.

The reason it took some time to find answers regarding exception handling was that it was hard to find a single opinion on what are the best and worst practices related to it. After a while however it was possible to form some kind of idea about the do's and don'ts by comparing the information between sources.

Exceptions can be handled by utilizing the try and catch blocks in your code. If any statement that is inside the try block raises an exception, the program will jump to the catch block and execute the code inside it. It is possible to have more than one catch blocks after the try block (Microsoft, 2017).

There is an additional block called finally block, which is useful if the program has code that should always run, no matter what happens in the try and catch blocks. Finally block comes after the try and catch block and the code in the finally block is always run, whether exceptions are raised or not (Stellman & Greene 2010, 484).

According to Stellman and Greene (2010, 472-484), catch blocks should be always used to catch specific exceptions, because it is a bad practice to have a catch-all exception handler. Exception is the base class for all the other type of exceptions that there are, and since it is a class like any other, it is possible to create own exception classes that utilize the properties and methods of the Exception class. However, it is also a good practice to use the already existing exceptions whenever it is possible.

```

catch (DivideByZeroException)
{
    //GOOD. Specific exception caught. Easier to track/fix
}
catch (Exception)
{
    //BAD. Catches all exceptions, harder to track/fix
}

```

Figure 4. Catch block for specific exception type vs catch block for all exception types

The hardest task was when I needed to deploy the ZoneSight application in the virtual environment into the tomcat server. I needed a lot of help from my colleagues, because I did not know which files I needed to modify to get the application up and running in my own environment. Even with the help of my colleagues it took almost the whole day before I could deploy the application into the tomcat server.

Because I had not deployed an application before, different configurations that were required provided a lot of new skills and knowledge. Since tomcat is one of the most popular web servers that is widely used, the configuration and deployment skills will be very valuable in the future.

3.10 Week 10 (13.11.2017 – 17.11.2017)

3.10.1 Monday 13.11.2017

Today I will have a Skype meeting related to the integration between customer's Fusion Lifecycle system and ERP system. The purpose of the meeting is to test whether it is possible to send data from Fusion Lifecycle to the endpoint in ERP system.

The results of the integration test session were promising, since this was the first time when we have successfully sent data straight from Fusion Lifecycle to the ERP system. The ERP system was also able to process the data without any problems, so it seems that we are getting close to implementing the functionality to the production environment and start utilizing the integration.

The only missing part is defining the authentication type that will be used, because the requests today were sent anonymously. Once the type has been defined, I can implement the functionality into the production environment. Once I get informed of the chosen authentication type, I need to add the required headers to the XHR object that is created in the scripts, which is a trivial task.

3.10.2 Tuesday 14.11.2017

There are not any specific objectives set for today, so I will continue to investigate the source code of the ZoneSight application. I will try to enable debugging through Eclipse while the application is running in the tomcat server.

I had to make a few additions to the batch file which is used to launch the tomcat server to debug the application. Although a lot of information about the subject can be found from different forums, the task was not as straightforward as it seemed while reading the instructions. After numerous attempts I got the debug mode to work in Eclipse IDE.

3.10.3 Wednesday 15.11.2017

I will participate to a ZoneSight user training session in customer's premises this morning. After the training I will meet my colleague at the office to do some preparations for a customer meeting that we have on Friday.

The user training went without any problems and the users seemed satisfied with the solution. The reason I participated to the training session, although my colleagues were responsible of the actual training, was that it is important for me to know how the customer works with the system and how their processes go.

The customer that we will meet on Friday is looking for a PLM solution to support their business and they have asked us to show Fusion Lifecycle. To create an agenda for the couple of hours that has been reserved for the meeting, we had to decide which of the functionalities we will show, since we do not want to confuse the customer with too much information.

I will show the chosen functionalities a bit more comprehensively and the other functionalities will then be described on a general level. Based on the knowledge that we have about the customer's business, we tried to select the functionalities that would provide the most added value for the customer's business.

3.10.4 Thursday 16.11.2017

I received a long list of questions from the customer yesterday evening related to Fusion Lifecycle configurations and my objective is to answer all of them today.

I did not face any problems related to the questions, but I learned one new thing related to field's picklist modification that I had not encountered before.

During the production use, the customer has noticed that there is a need to modify one picklist that is being used in multiple fields in different workspaces. The question was related to the potential risks that there exists related to the modification and because I had not done a similar modification before, I ran a few tests to make sure that I will not end up giving false information for the customer.

After I had replied to all questions, I decided to do some additional preparation for the customer meeting tomorrow. Every functionality that we will show during the demo worked as they should, but while I was testing some of the BOM functionalities that are not part of the demo, I noticed a couple of bugs. Since these functionalities are essential for the BOM, I reported them to Autodesk.

3.10.5 Friday 17.11.2017

In the morning I will have a couple of Skype meetings with the customer about separate topics and in the afternoon, me and my colleague will have the customer meeting.

The first Skype meeting was related to the integration functionality that is currently implemented in the customer's sandbox environment. The ERP consultant had tried to do some testing, but could not get the data transferred from Fusion Lifecycle to the ERP system. After I explained when the integration is triggered, and which values are required to pass the validation, the data transfer worked fine.

Me and my colleague will have a workshop again next week in the customer's premises, so in the other Skype meeting we decided the topics that we will cover during the couple of days that we will spend there.

The customer meeting in the afternoon differed slightly from the previous meetings in which I have participated during my time at PLM-Zone. In the previous meetings the participants from the customer side have not had as comprehensive knowledge beforehand about PLM as the participants had today. They had clear needs that the future solution should cover and the functionalities of Fusion Lifecycle that I demonstrated matched to their needs.

3.10.6 Week 10 analysis

To remotely debug an application that is deployed in tomcat, there are a couple of configurations that must exist in the batch files that are executed when tomcat is started and a setting change in Eclipse IDE. The following instructions apply to tomcat's version 7.

The file that should be checked first is the Catalina.bat file, which can be found from tomcat's bin folder. Open the file with notepad or any other text editor to see the configurations and find the section that has the following variable declarations: set JPDA_TRANSPORT=dt_socket, set JPDA_ADDRESS=8000, set JPDA_SUSPEND=n and set JPDA_OPTS=-agentlib:jdwp=transport=%JPDA_TRANSPORT%,address=%JPDA_ADDRESS%,server=y,suspend=%JPDA_SUSPEND%. The declarations should exist in the file by default, but if not, then they must be added (Tien 3 May 2010).

These settings enable the remote debugging of the application when it is running in the tomcat server. The JPDA_TRANSPORT variable is the communication protocol that the running application and debugger use, JPDA_ADDRESS determines the port, server=y indicates that the JVM that should be debugged is this one and JPDA_SUSPEND tells to the JVM whether to execute right away or wait for an attached debugger. Setting suspend to "n", JVM will execute right away and by setting it to "y", the JVM will wait for the debugger to be attached before running (Aderemi 14 July 2014).

When Catalina.bat configurations are in place, it is possible to go and do the necessary changes to the Eclipse. After opening Eclipse, find and click "Run" from the toolbar and select "Debug Configurations" from the menu. Select the "Remote Java Application" option from the panel that opens and click "New" button found above the list. This should open another panel that has "Host" and "Port" setting fields. The "Host" setting must be the same as the hostname of the tomcat process, and the "Port" should be the same as previously set to the Catalina.bat file. After applying and closing, execute the following command in the command prompt and everything should be ready to start debugging the application once the tomcat server has started: Catalina.bat jpda start (Stackoverflow 2017, Stackoverflow 2017).

The "Failed to connect to remote VM. Connection Refused" error is one of the most common errors that occurs when trying to remotely debug an application using Eclipse. If the error occurs, there are a couple of things that most likely cause the error. First, check that the port that is reserved for debugging is open and the firewall is not blocking the connection to the port. If it is not a firewall and network issue, then make sure that the application is running, the host and port combination is correctly set and that the debugging settings in the Eclipse are correctly set (Paul 27 February 2004).

4 Discussion and conclusions

4.1 Progress and development

When comparing the different tasks that I have done during the time period that the thesis covers, there has not been any major surprises, and everything has gone almost like I anticipated at the beginning.

My knowledge and skills related to Fusion Lifecycle configuration tasks were at the start of the thesis already on a high level, since in every Fusion Lifecycle implementation project it has basically been solely my responsibility to create the necessary automations and configurations into the customer's system.

Although most of the tasks that I have done have been related to functionalities and requirements that I have faced in the previous implementations, I was happy to see that some of the tasks provided new knowledge about the system and its functionalities. The main reason for this is that the implementation of the current project is a lot more comprehensive than the previous ones have been, so I have had a chance to familiarize myself with functionalities from which I only had a general understanding beforehand.

The tasks that I enjoyed the most were related to establishing the integration between customer's Fusion Lifecycle system and ERP system and the development of the Word add-in.

I feel that the tasks related to these topics have been the most beneficial for me and have improved my skills in every aspect, especially as a programmer, since I had an opportunity to work with new concepts and technologies from which I did not have previous experience. I also had to do a lot of self-studying to find the most suitable approaches and a lot of problem solving whenever I faced an issue, which helped me to broaden my understanding about the topics in a deeper level.

4.2 New approaches or methods for work

During the thesis I have not noticed any major reasons to make changes to my working methods regarding Fusion Lifecycle tasks. Since I have previously already been involved in a couple of implementations, during them I have been able to refine my working methods and I am quite confident about my knowledge and skills in this area.

In the future I must remember that I should not follow the same working methods in every distinct case in which I am involved that is not related to Fusion Lifecycle. I quickly noticed that when I started the development of the Word add-in and I was following the same approaches and methods as in Fusion Lifecycle cases, after a while I started running into problems because of that.

The reason most likely was that I should have thought about the logic and functionalities a bit more comprehensively beforehand, but I was only concentrating on one functionality and its logic at a time. This led to a situation where the created functionality was not compatible with the next functionality that should be developed.

4.3 Things learned during the thesis

Like I mentioned before, the most beneficial tasks that have helped me to enhance my knowledge and skills have been the tasks related to the integration and Word add-in development.

My knowledge especially about restful web services, API's and communication protocols have improved greatly when compared to the knowledge that I had when I started doing the thesis. There is obviously still a lot to learn, but I feel more confident to discuss about these topics in the future with the current knowledge than I previously did.

The development tasks of Word add-in in turn have improved both my skills and knowledge as a programmer. I have utilized techniques that I have not been using previously, such as the class inheritance and learned how to store crucial information between sessions by storing them into the application settings. I have also learned a lot about the System.IO namespace and how to use the classes that it contains to file management and manipulation, because that is the main purpose of the add-in.

Since I am in contact with the customers if not daily then weekly, it has helped me to improve my social skills and boost my confidence in workshops or customer meetings where I am demonstrating how the Fusion Lifecycle system works and its functionalities.

4.4 Future development ideas

It has been nice to work in Fusion Lifecycle cases, because my skills and knowledge about the system are on a high level. During the cases I also must be in tight contact with

the customers and it is refreshing occasionally to participate in workshops or other meetings. It ensures that the work is variable since I do not have to only sit at the office or at home waiting for instructions from someone else on what to implement next.

On the other hand, since there are strict boundaries in the system related to the configurations that I can create, I feel that most of the tasks are quite trivial and not challenging enough.

Therefore, in the future I hope that I will have a chance to start working more with PLM-Zone's own products, because in those tasks I would face new problems and challenges and I would work with new technologies and languages that I have not previously used. It would provide invaluable skills which would be a huge benefit in the future.

4.5 Advantages of work analysis

During the writing of the thesis I have noticed that one major area where the analysis has provided surprising benefits is problem solving. There have been many times when I have struggled with some problem during a day or week and when I have analysed the situation afterwards, I have gotten new ideas on how to solve the issue. I think it is because in that moment when a problem occurs, because of the frustration it is hard to think out of the box and try to find an alternative approach to the problem.

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