Web Services-based Report Generation System from Big Data in the Manufacturing Industry based on Agile Software Development

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Abstract: In the manufacturing industry, there are many information technology (IT) systems and machines connected to different databases with complex big data. In this study, the web service system is developed by using different programming languages consisting of C#, Javascript, HTML, CSS, Ext JS and structured query language (SQL). In addition to these programming languages, model view controller (MVC), a software design pattern is also used for developing a database interface. The development of this system allows the web service system to search for reports that meet the user needs and also has the user interface (UI) for convenience and speed. In this study, agile software development method is used in accordance with scrum framework, which consist of 4 steps: 1) product backlog creation, 2) sprint backlog creation, 3) sprint or the system development and testing and test case writing and 4) daily scrum. Sprint review is held to report the results of unit test, functional test, integration test and user acceptance test (UAT). This sprint review enables the development of an appropriate and comprehensive system and results in collaboration and understanding among stakeholders, including technology adoption among users.

1 INTRODUCTION

At present, the manufacturing industry uses information technology (IT) systems for production management and machine control. Each machine records an event log of each transaction. There are also information technology systems for other operational processes within the organization (Wilschut et al., 2014), resulting in massive amounts of data stored in a variety of databases with separate independent database management system (DBMS). When information is needed for organization operations such as detection of processing errors, evaluation of production costs or profits, production planning decisions, financial decisions, warehouse management for both raw materials and products obtained from production process, etc., (Neves and Bernardino, 2015) this makes it impossible to search for related reports. This is because there is no connection between different databases (Gu et al., 2019). Therefore, the data cannot be processed in combination across these databases. For this reason, a web services-based report generation system from big data is developed to meet the information requirements from the operational level to the top executives in the manufacturing industry.

2 SYSTEM DEVELOPMENT

This study aims to study the development of a web services-based report generation system to facilitate the searching between different databases which contained big data. To achieve the objectives of system development process, agile method is used in the development of an appropriate and comprehensive system so that system errors can be resolved in time (Miyachi, 2011).

2.1 Big Data

Big data is a collection of data sets that are too large or complex to be dealt with by existing DBMS (Emmanuel and Stanier, 2016), including recording, storage, search, sharing, and trend analysis of various data sets (Neves and Bernardino, 2015) in order to process a large set of related data by compiling several separate data subsets (Podhoranyi and Vojacek, 2019) which requires software or platform to dealt with large amounts of data. In this study, web service is used in the processing (Borkar et al., 2012) of big data in the manufacturing industry.

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2.2 Web Service

Web service is a software system designed for data exchange between computers via a network. It uses various programming languages to communicate between computers (Hu et al., 2007) based on HTTP and XML to exchange information over the internet. In addition, in the development of web service, C# is used as the main programming language to develop the primary structure of the web services-based report generation system from big data. C# provides full support for object-oriented programming. In addition, javascript is used in script coding on the Internet in combination with HTML and CSS for the development of this system (Cho, 2013). Ext JS, a javascript framework (Ni et al., 2012) is used to manage the user interface (UI). In addition, structured query language (SQL) is used to manage the data in the relational database management system (RDBMS) (Witkowski et al., 2005) with an ability of SQL data manipulation language (DML) for insertion, query, updating and deletion (Polster, 1978) of data contained in the table.

In addition to the use of programming languages in system development, model view controller (MVC) is also used. MVC design pattern technology is used to separate the functions of the application for convenience, speed and ease in developing and expanding additional systems (Charoenporn, 2019). MVC consists of model for communicating with the databases (Selfa et al., 2006); view for displaying the data from model; and controller for receiving the input and commands view and model to run data processing (Jailia et al., 2016) as shown in figure 1.

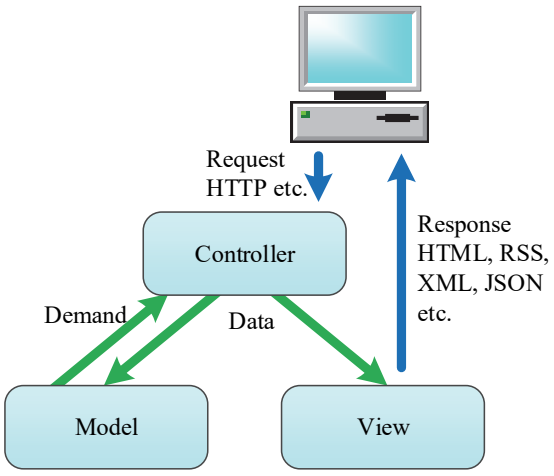

Figure 1: MVC technology architecture.

2.3 Agile Methodology

Agile refers to a group of software development methodologies based on system development, especially in IT, technology and software (Gelperin, 2008). It is an alternative to the original concept, like waterfall. Agile is centered around the idea of iterative development (Houston, 2014), where the project is divided into sections and each section is progressively developed through the next section. Each iteration must result in a working software, which will be further developed (Hoda et al., 2010). Agile methodology is based on scrum framework involving cross functional team, which is a group of people with different functional expertise working toward a common goal of producing product from the software. Assignment of specific tasks to team members is not necessary because members are simultaneously responsible for their cross-functional team duties (Quaglia and Tocantins, 2011). The workflow of scrum framework is shown in figure .2

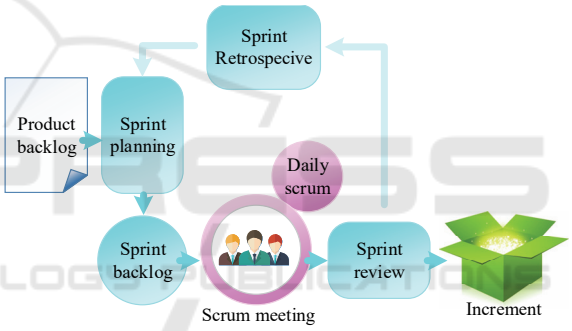

Figure 2: Scrum framework (Maier et al., 2017).

As shown in the figure, scrum framework divides the development into 4 steps as follows (Maier et al., 2017):

1) Product backlog is the creation of a list of features or requirements to work on based on user needs that is known to be needed in the product (ambition) (Boerman et al., 2015). The product owner is responsible for deciding and assigning different tasks in the sprint process based on their priorities.

2) Sprint backlog is a list of tasks identified by the team to complete a feature. The development team is responsible for planning and deciding on what features are required.

3) Sprint is to deliver the tasks based on what the product owner has prioritized to deliver to the end user within a period of time.

4) Daily scrum is a stand-up meeting held by the team to obtain feedback from stakeholders and to update the project progress with sprint review by

focusing on what each member accomplished yesterday and will accomplish today and the problems encountered for smoother operation and constant and comprehensive troubleshooting.

3 AGILE DEVELOPMENT

The development of web services-based report generation system from big data in the manufacturing industry using agile software development process are as follows (Gelperin, 2008):

3.1 Requirements Gathering

By gathering problems and requirements for report generation from big data in the manufacturing industry, it is revealed that the web services-based report generation system must be able to query the data from many sources with different storage methods and DBMS. In addition, the existing systems include both non-windows applications and windows applications, so users have to search for the reports on the client with software installed, causing inconvenience. The new system must be able to operate via a web browser for speed and consistency with existing corporate environments and has an ability to process and display the reports that meet the needs of users from the operational level to the top management. In addition, strict control of access rights is necessary to prevent unauthorized access to information.

3.2 System Analysis

The diagram of web services-based report generation system from big data shows the creation of report profile. The report center function is responsible for adding and managing reports as well as managing the schedule of report function. The schedule information must also be added to the 24x 7 function. After that, the 24x7function commands the report manager function to run the report programs function and to receive and store the operational information from report function on the database. Then, the auto resubmit function reads the operational information of the report function. When an unsuccessful report is detected, this function automatically commands the report manager function to reprocess such report. In addition to using the auto resubmit function to command the report function to automatically re-execute the failed report, users can also use the report center function to manage and complete the reports as shown in figure 3.

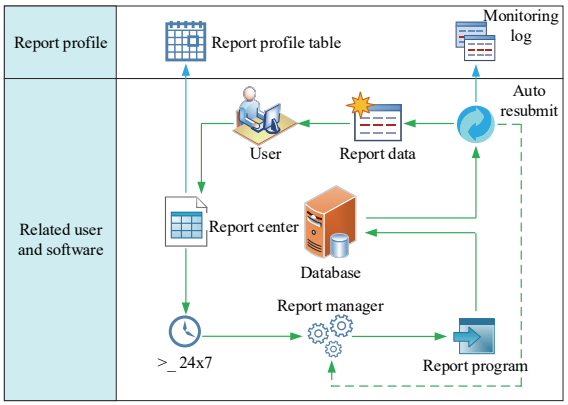

Figure 3: System diagram of report profile generation.

3.3 System Design

The design of web services-based report generation system from big data is based on the context diagram according to the design principle of the data flow diagram (DFD) in order to represent the external entity related to the system and data flow at the input and output of the system as shown in figure 4.

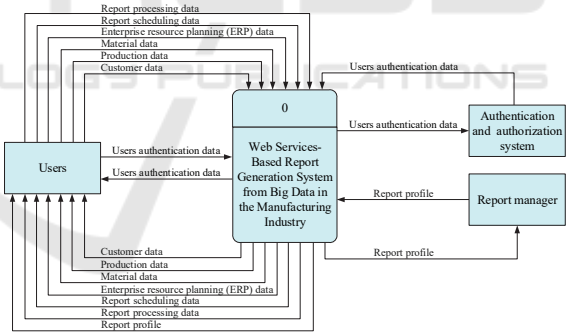

Figure 4: DFD level 0 context diagram.

The operation of this web services-based report generation system is divided into 3 parts as follows:

1) Users: users can access different types of report such as customer information, customer group information, operational information, etc. In addition, users can check the priority of the report as well as export data in various file formats such as .pdf, .xls and .csv, etc.

2) Authentication authorization system: it is a function used to determine the access rights, including the abilities to use the system and manage report access.

3) Report management system: it is a function used to command the report processing, collect the data related to production process and store the obtained data on the database. Report manager function can access the report data to be used to manage the Report Profile process and display the report results.

3.4 Scrum Development Process

From the concept of software development based on the scrum framework and the use of the model view controller in this system development, the system development process can be divided into 4 steps as follows:

Step 1 Create product backlog or an ordered list of items to be programmed. The product backlog is divided into 2 parts, the first part shows the numbers, names, priorities of the main tasks as well as the names of the person responsible for such tasks and the status of the tasks while another part shows the sub-tasks and details of each task, priorities, names of person responsible and status of the task, etc.

Step 2 Sprint backlog: a total of 10 sprints are defined from the sub-tasks based on the number of functions of the system with an agreement with the users to deliver the tasks in each sprint. The development period for each sprint is set at 2 weeks.

Step 3 Sprint: a system is developed base on the sprints in order to develop the software. Within 2 weeks of system coding, programming languages are stored in subversion software (SVN) in order to store various versions of the system and record changes in programming languages for each sprint. After the development of subsystem, test case is performed to prepare sprint review in the test case document.

Step 4 Daily scrum: the system development results are presented in the meeting using sprint review in order to assess the results of step 3 and progress into the next sprint immediately after the previous sprint is finalized. Step 2-4 is repeated until the software is complete.

3.5 Software Testing

With the use of scrum system development with Sprint behavior, test cases are used in every development iteration according to the system design with DFD for both input, process and output of the system.

4 RESEARCH RESULTS

The workflow of web services-based report generation system from big data in the manufacturing process begins with the user login as shown in Figure 5.

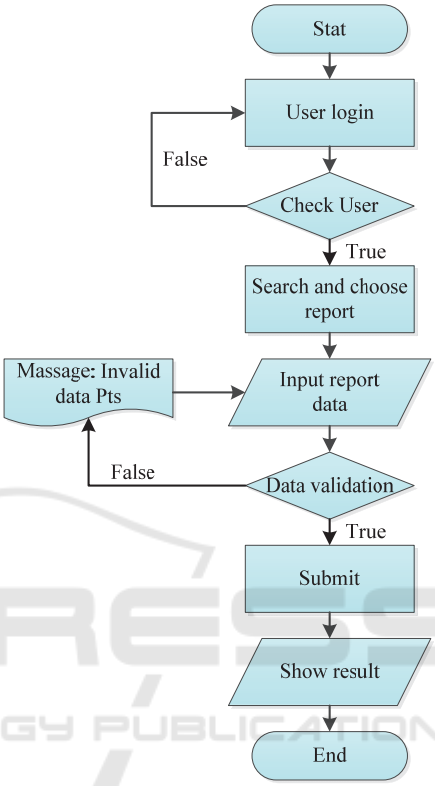

Figure 5: Workflow of the web service-based system.

According to the figure, user login requires username and password. The access right is determined by creating the group policy. Each group has different access right to the reports. The members of each group are the users who are entitled according to group policy as shown in figure 6.

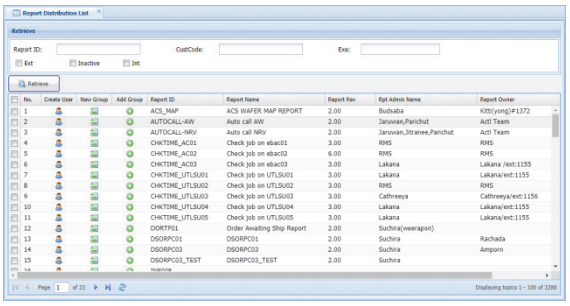

Figure 6: Authentication authorization.

The system consists of 3 main parts. The first part is the header of the window for displaying the information of the application such as application name, names of connected databases, username and group. The second part is the menu bar located on the left side of the window showing the entire menu of the report management system application. The last part is the content for displaying data obtained from the database. These three parts are shown in figure 6.

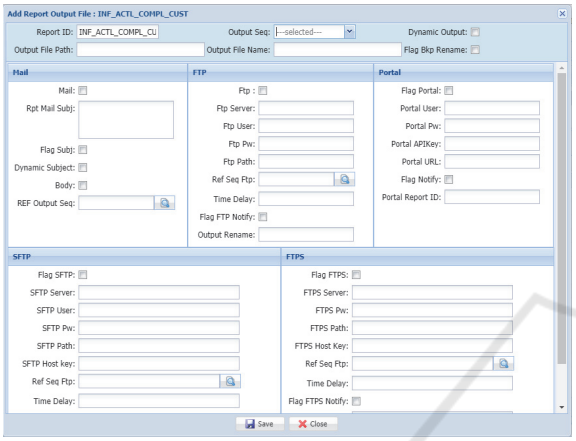

Figure 7: Performance display of web services-based report generation system from big data.

This web service-based system has 9 menus, including report profile, report distribution list, manage user, mange group, user hold profile, report hold profile, report priority profile, report monitor seq and report monitor. each menu is displayed as grid or table and form which is a remarkable feature of the software development using Ext JS as shown in figure 8.

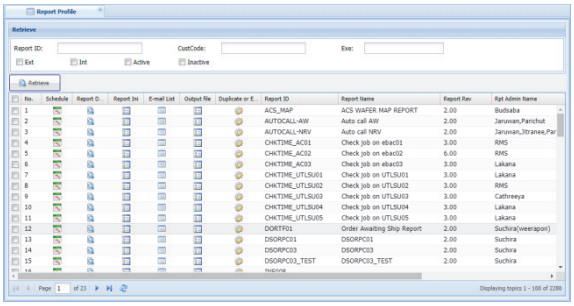

Figure 8: Menu display in tabular form system test results.

For test case in each sprint where the unit test is performed by the programmer, the tester performs the functional test, integration test and the user acceptance test (UAT) and the results reveals that the system can operate according to the requirements of users, where 1 = passed and 0 = failed as shown in table 1.

Table 1: Test case of each function.

ID	Test Case	Unit Test	Functional test	Integration test	UAT
1	Log in testing	1	1	1	1
2	Report information testing	1	1	1	1
3	Report ini, report db table and email list testing	1	1	1	1
4	Report schedule testing	1	1	1	1
5	Report output file testing	1	1	1	1
6	Report user testing	1	1	1	1
7	Report distribution testing	1	1	1	1
8	Report group testing	1	1	1	1
9	Hold profile and priority report testing	1	1	1	1
10	Report monitor and report monitor seq testing	1	1	1	1
	Total	10	10	10	10
	Percentage	100	100	100	100

From the test case of each function based on agile software development method, it can be observed that in the testing process, feedback is received from the stakeholders to edit the task with value 0 = failed until the test is complete as required and then replaced with value 1 = passed. A short meeting of about 10 – 15 minutes is held at every morning for sprint review and the operation in each sprint stops when each function passes the test case.

5 DISCUSSION AND CONCLUSION

In this study a web services-based report generation system from big data is developed by using various programming languages and technologies. For complete and effective development process, agile method is used. According to the results, it can be summarized in following 2 aspects:

1) Programming: different programming languages are used to develop the web service-based system by using HTTP protocol and XML is used to exchange data over the Internet. In addition, C# is used as the main programming language to develop the primary structure of the report generation system from big data and javascript is used in script coding on the Internet in combination with HTML and CSS. Ext JS is used to manage the UI and SQL is used to manage the data in the RDBMS. MVC, a software design pattern is also used for developing a database interface and display to meet the needs of users and to solve the problems in adding new entries to the database. The result is an easy-to-access web application that is accessible via a web browser with a copy function for creating new report corresponding to user behavior. There is also the user interface, which can add and update the data on the database. This application has a simple structure and is easy for further development.

2) Agile software development method: in this study, 5 agile processes are used, consisting of requirement gathering, system analysis, system design, scrum development process and software testing. The scrum development process is based on the scrum framework, in which daily scrum is held for the sprint review. This process provides the feedback on needs and outstanding issues and allows the team to summarizes and finds an agreement on the operation. With daily scrum, the problems found in the system development process can be resolved faster. In addition, sprint review allows the stakeholders to see the progress of each task and fix it on time, resulting in a comprehensive system that meets the user needs. It allows the users to understand the system development process, focus on cooperation, understand the problems and solve the problems the programmer encountered after sprint is completed which resulting in technology adoption and acceptance.

6 FUTURE WORK

This study aims to develop a report generation system from big data by using various web service techniques that allows the manufacturing industry to search for the reports from different databases. In further work, different query methods may be used to determine the relationship of the data to be used in an analysis in order to support and facilitate the production process using data science techniques.

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