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2020 Population Census Data Recording in Indonesia: Flexible, Effective and Efficient Software Development (Case Study: Population Recapitulation Data Recording)

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Abstract. *Implementation of the Population Census during the Covid–19 pandemic is a challenge that has never been faced by BPS before. These challenges are not only felt in the field, but also have an impact on the processing stage. A quick population recapitulation calculation, which is by implementing the Covid–19 protocol, demands that organizers adapt quickly. The current system is considered to have weaknesses that make processing less effective. In this study, research and system development were carried out to assist the processing of the population census in the population recapitulation data recording section. This system will take advantage of various available technologies, such as Bootstrap, PostgreSQL, PHP and Codeigniter. Utilization of this technology is expected to increase the effectiveness and efficiency in problem solving. The system development method applied is the Agile Model Personal eXtreme Programming Method. The system can quickly accept changes and can be adapted quickly by staff. With this system, the recording of population recapitulation data, especially in West Kalimantan Province, can run effectively.*

Keyword: SP2020, Personal Extreme Programming, Agile Method, Covid–19, system design and development

Introduction

The population census is one of the major activities of Badan Pusat Statistik – Statistics Indonesia (BPS, 2020). This activity, which is carried out once every ten years, has many challenges in its implementation. One of the biggest challenges in collecting population data is fast and efficient data recording.

BPS uses various methods. In 2020 it will be carried out using a combination of two methods, namely online and interviews (BPS, 2020). The online method is carried out by residents directly using web browsing then filling in data. The interview method was conducted using the method of filling out the Population List (DP) by a census officer accompanied by the Head of the local RT or equivalent.

The use of the interview method requires a long data processing. This is due to the wide coverage of the work area and the large number and burden of officers. Therefore, a system was created to help carry out a quick calculation of the population through the DP recapitulation.

BPS created an Android-based system using handwriting recognition technology to collect DP recapitulation data. However, there are several weaknesses in this system. Handwriting Recognition provides difficulties and errors in handwriting translation. Errors can occur when the text overlaps, the characters are different, and some methods require a lot of training data. The same thing was conveyed by related research (Vashist et al., 2020).

The Covid-19 pandemic also has serious impacts that need attention. The interview method that forces officers to come face-to-face with respondents has a very big risk. Kalimantan Barat Province as one of the organizers of this census activity faces quite a difficult challenge. The addition of Covid-19 cases in this province is increasing significantly every day. Each patient may infect 1.15 people. This prediction is calculated using the SIR model (Teguh et al., 2020). Land borders with

neighboring countries also make the spread from abroad quite difficult to predict and control. Wide working area and the number of officers who many also be a challenge. In this census, there are 4,421 officers in this province consisting of 359 sub-district coordinators and 4,062 Local Environmental Unit (SLS) officers (BPS, 2020). With this massive number of officers, adherence to the Covid-19 health protocol will be a very important point to implement.

Amid the rapid changes in information related to the Covid-19 health protocol, changes in the procedures for conducting the interview population census continue to change dynamically. This change requires a system capable of responding to the processing needs of DP recapitulation quickly. The new system is also expected to be able to overcome the weaknesses of the existing handwriting recognition method. With the application of system development methods and the use of appropriate technology, it is expected that the system can adapt to rapidly changing needs. The wide coverage of the work area, the limited time and the number of personnel, force the system to be used without technical guidance or complete usage training.

Literature Review

Population Census

Mandate Law No. 16 of 1997 appointed the BPS - Statistics Indonesia to implement the Population Census at least once in ten years. Based on history, BPS was established during the Dutch colonial era under the name *Centraal Kanoor voor de Statitiek* (BPS, 2008). The first census was held in 1815 and has been held 10 times until 2020 (BPS, 2020).

In the 2020 Population Census, a fundamental change was made compared to previous censuses. This difference is the unification of administrative data with census data. In previous censuses the population census was separated from administrative data due to various obstacles. The main obstacle is incomplete administrative data and a lack of public awareness in updating population data. Administrative data recognized by de jure are also considered to be less representative of the actual conditions in the area or the usual residence (BPS, 2011). For this reason, data collection is also carried out to produce de facto data as a basis for more accurate decision making.

Satu Data Indonesia (SDI) in accordance with Presidential Regulation No. 39 of 2019 is also one of the main bases for the use of administrative data as the basis for this census. The objective of SDI is to create quality data, easily accessible and that can be shared between agencies (Wicaksono et al., 2018). In the population sector, the Population Census can be used as a strategic step in accelerating the achievement of SDI goals by integrating with population administration data.

PHP, CodeIgniter, Bootstrap, PostgreSQL

PHP (Hypertext Preprocessor) is a scripting language that is generally used for website development. PHP scripts run on a server or more specifically a web server. This programming language has been in development for more than 25 years. The latest version has entered the 7th stable version (*PHP.Net*, 2020).

CodeIgniter is a PHP based framework or framework. This framework contains commands that are commonly used. The use of frameworks is intended to accelerate application development (Prokofyeva & Boltunova, 2016). By using a framework, developers can focus directly on solving problems. Developers do not need to create general functions because they are provided by the framework.

Bootstrap is a framework based on Cascading Style Sheet (CSS) (Spurlock, 2013). This CSS is a collection of commands used to manage a website programming language. Like the main function of the framework, Bootstrap is also used to shorten development times. The main advantage of this framework is the ability to manage web views so

that it can be opened using a desktop or smartphone or mobile device. The web view can adjust to the screen size making it easier to operate even though it is accessed from various types of devices.

PostgreSQL is an Open Source database system. PostgreSQL is a popular database system. This is because in addition to being free, this database system also has very complete features and excellent toughness and ability to manage databases (Worsley & Drake, 2002).

Agile Method and Personal Extreme Programming

The software development method uses the Agile method which literally means agile. This method makes the development process of a software more focused on customer satisfaction, can support fast changing needs and collaboration between solid teams. This is also conveyed by related research (Anwer et al., 2017). The focus on these points makes this method flexible while maintaining simplicity in the building process. This method also makes the product suitable for today's needs.

XP itself is a model of the Agile Method that focuses on product release speed, fast feedback, and continuous program improvement iterations. The basic values of this model are Communication, Courage, Simplicity, Feedback and Quality Work. These values produce a software development model that is efficient, flexible and adaptive to change. Because of this, XP carries a low risk of producing a failed product.

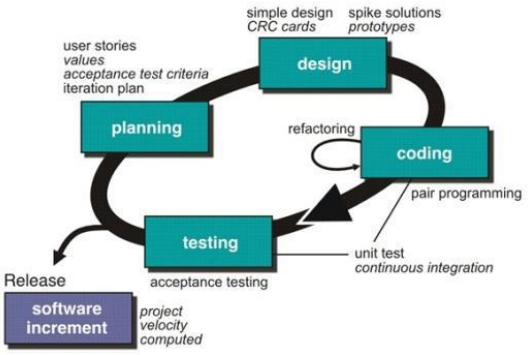

Figure 1. Agile Method with eXtreme Programming Model

Personal Extreme Programming (PXP) is a modification of Extreme Programming (XP), while maintaining its basic values (Agarwa & Umphress, 2008). The main difference is the number of teams which usually consists of only one person, making the quality of the product very dependent on the capabilities of the programmer. On the other hand, communication issues are no longer considered because they only depend on one person.

Research Method

Type of Research

Type is Research and Development (R&D). This type of research focuses on the design of a product. The product is expected to be a solution to the problems faced. Products can be hardware or software. In this research the product will be focused on the resulting software product.

Data Collection Method

Primary Data

Primary data was obtained by conducting interviews with stakeholders at the BPS of Kalimantan Barat Province from August to September 2020. Observations were also carried out by observing field implementation carried out in several urban districts in Kalimantan Barat Province such as Pontianak City and Mempawah Regency.

Secondary Data

Secondary data was obtained by collecting information related to the Standard Operating Procedure for the implementation of the 2020 Population Census. Information is obtained through the Enumeration Manual, Training

Materials for Enumeration and Processing Manual.

Software Development Methods

The system development method is carried out by the Agile method. This method was chosen because it focuses more on product delivery and a fast response to changing needs. One of the Agile methods used is Personal Extreme Programming (PXP). PXP provides flexibility in fast requirement changes, the advantage of release speed, and the number of teams that are small or even one person.

Result and Discussion

System Requirements Analysis

In the early stages of development, a needs analysis is made in the form of a User Story Card.

System development using the Agile method with PXP demands a quick response in product development to changing needs. In PXP, User Story Cards are used so that changing system requirements can be explained in detail (Patel & Ramachandran, 2009). The developer can also determine which features should be prioritized. Changing needs can also be accommodated quickly using this tool.

Use Case Diagrams and Activity Diagrams are used to complement system requirements (Aleryani, 2016). The Use Case Diagram shows the actors and their respective duties. Each actor interacts with the system according to his duties. The system identifies these actors based on the accounts used when logging into the system.

Activity Diagram displays the

Table 1. User Story Card

Task	Description	Acceptance Criteria
Input Data	As an officer, I want to input my work area data so that the population recapitulation data is stored	There is a menu to input the officer recapitulation data according to the task area
Updating Data	As an officer, I want to make improvements to my work area data so that the population recapitulation data is stored	There is a menu for editing and correcting the data inputted by the officer
Monitoring Progress	As a supervisor, I want to see the progress of my work area so that I can monitor the performance of my officers	There is a menu that displays the progress in the work area and the percentage of progress that has been inputted
Download Data	As a supervisor, I want to get a summary of the results of data input in my work area	There is a menu for downloading data that provides the latest data in a spreadsheet format
Feedback	As an operator, I want to be able to provide feedback on the system	There is a menu for sending feedback on the system that can be accessed by the user
Responsive	As a user, I want responsive displays to be accessible via computers and mobile devices	The system is designed responsively according to the device used

process flow in the system (Lin et al., 2019). The process starts from the Initial State to finish at the Final State. In the Activity Diagram, process flows such as Activity and Decision are displayed. In Figure 4, system and officer activity is displayed as well as decision making by the system when validating input from officers.

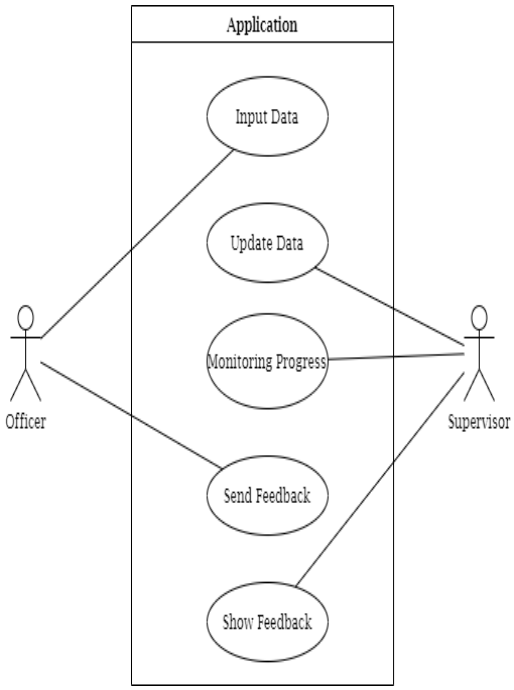

Figure 2. Use Case Diagram

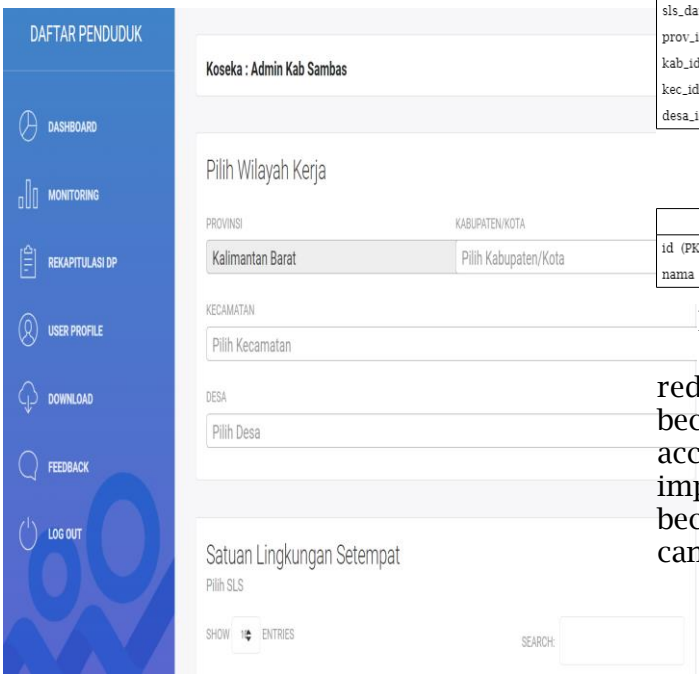

Figure 3. Computer Desktop Interface

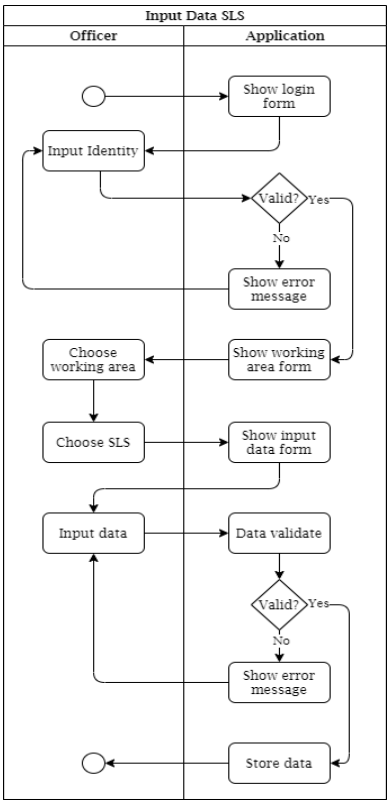

Figure 4. Activity Diagram

Database Design

Database design uses tools, namely Entity Relational Diagram (ERD).

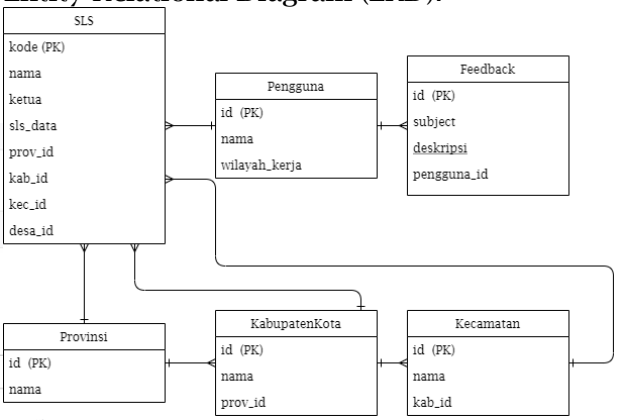

Figure 5. Entity Relational Diagram

The database used has redundancies on the SLS entity. This is because these entities are frequently accessed. Making redundancies also improves overall system performance because the join process to the database can be significantly reduced.

User Interface.

This system focuses on recording data recapitulation so that the start page will be directed to the data input menu. The display is also optimized for access via personal devices such as tablets or smartphones.

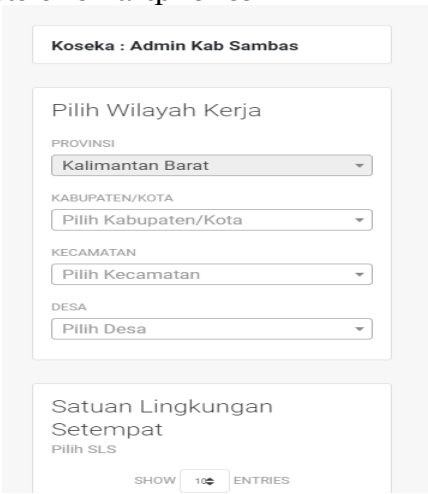

Figure 6. Smartphone User Interface

System Testing

This system is tested using the Black Box Test and User Acceptance Test (UAT). The Black Box test is conducted to detect fundamental aspects of the system. Knowledge of how the system works internally is not required in this test. This has been explained by previous research (Mohd. Ehmer & Farmeena, 2012).

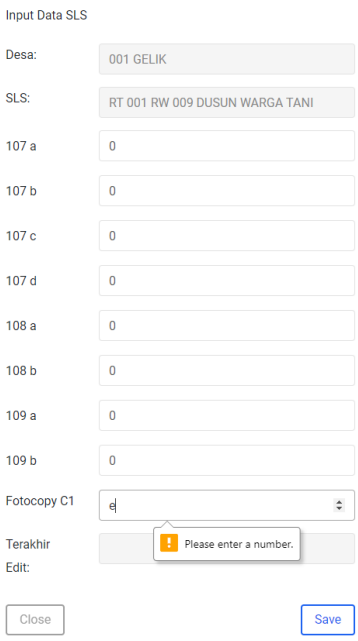

Figure 7. Black Box Test Screenshot

Table 2. Black Box Test

Cases and Trial Results	
Input Data (True)	
Input data	Enter the population list recapitulation data in numeric form
Expected Output	The system stores data into a database
Actual Output	The system displays the message data has been stored and the data is stored in the database
Conclusion	Accepted
Input Data (False)	
Input data	Entering the population list recapitulation data in alphabetical
Expected Output	The system rejects input data
Actual Output	The system displays an error message and refuses to save to the database
Conclusion	Accepted

In the Black Box Test, the system is tested with five main activities which are the requirements of the system. The result of the test is that the system can work properly. The response given by the system to various inputs is in accordance with predetermined specifications.

Table 4. Black Box Test Result

Acceptance Requirement	Conclusion	
	Accepted	Refused
Input Data	√	
Updating Data	√	
Monitoring Progress	√	
Download Data	√	
Feedback	√	
Responsive	√	

Another test being tested is the User Acceptance Test. This test aims to ensure that the solution given is acceptable to the user. Testing focuses on the user experience when interacting with the system (Sandin et al., 2016). This test is carried out by distributing questionnaires to system users. The respondents were 60 officers involved in the 2020 Population Census Interview in Kalimantan Barat Province.

From the UAT results, the system can be accepted by the user. The highest points were earned on the ease of understanding the system. This is very good considering that this system is not equipped with a user manual due to limited time in manufacturing. The use of Agile and Personal Extreme Programming approaches that focus more on product delivery also makes the priority in compiling the user manual lower.

Table 3. UAT Test

	Question
A	Is this web interface easy to understand?
B	Is this website easy to use?
C	Does it make it easier to monitor progress?
D	Is it easy to download data?
E	Does it help in processing the 2020 Population Census Interview?
F	Is it easy to use on personal computer and mobile devices such as tablets or smartphones?
G	Is it easy to send feedback?
H	Does this website help in the 2020 Population Census quick count process?

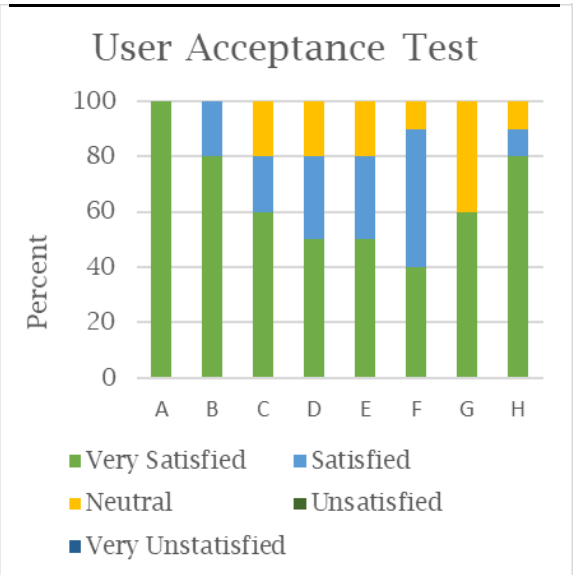

Figure 8. UAT Result

CONCLUSION

The system development can be used to assist the processing of the population census in Kalimantan Barat Province. System development using the Agile method and the PXP model helps accelerate software production. Various technologies that are implemented into

the system can be built more quickly by only focusing on the problem at hand.

Users of this system can understand and adapt quickly. The use of technology such as Bootstrap impacts the familiar appearance of the system to the user. The focus on the needs and feedback from users in developing systems also supports this.

The use of recording via a web application also makes it easier to record data. This is because it does not require handwritten translation or training data. Input result data can be directly stored into the system.

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