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APPLICATION OF COMMON DATA ENVIRONMENT (CDE) AS A METHOD OF DESIGN REVIEW IN CONSTRUCTION PROJECT

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Abstract. The development of technology in construction projects produces a method known as Building Information Modelling (BIM). Common Data Environment (CDE) is one of the cloud technology adoption systems that can effectively convey various data information from several BIM softwares without having to download the softwares. Searching for accurate project information according to the latest version takes a long time if the document or information is not well structured. This study aims to analyze the application of CDE to the project in the design review and to determine the criteria that affect the success of the implementation of CDE in the design review and the biggest obstacles in the use of CDE. This research was conducted using a survey method which was distributed to representative respondents. The results showed that the implementation of CDE as a design review on the project was in accordance with CDE standards with an average respondent's level of achievement of 83.28%. The most influential criterion on the success of CDE implementation in the design review is data security. The biggest obstacles are in the form of lack of cooperation between CDE users, undisciplined use, and data that is not always updated.

Keywords : common data environment (CDE); BIM 360; CDE implementation; review design.

1. INTRODUCTION

CDE platform as the management of all BIM data both in collecting, managing, storing, and disseminating data and information for the entire project team [1]. Problems in project management that often occur in conventional construction are poor communication and coordination between project teams. Timeliness, accuracy, and completeness of information are causes of successful project completion on time and within budget [2]. There are several versions of the documents on the projectand status required for the aquracy of the project documents to be used. Searching for accurate project information according to the latest version takes a long time if the document or information is not well organized. The many versions of documents and the spread of documents in various storages are some of the causes to take time to search the right documents. To find data on common companies takes about 13% of time uses [3]. In the construction industry the situation is worse, it takes about 30% for the Project Manager to find the information needed [3]. If this happens frequently, other processes such as approval, signing, ratification, and information distribution will be delayed.

Common Data Environment (CDE) is a collaborative platform that connects various project data with cloud technologies [4]. By using CDE, everyone involved in the project can take part in handling problems on the project and collaboratively digitally [5]. CDE is an opportunity to increase collaboration and efficiency in the construction industry [4]. BIM 360 is one of the CDE platforms from Autodesk that can be used for communication and coordination with construction actors in review design.

The implementation of the Common Data Environment (CDE) with a survey method has been carried out by Aska to determine the implementation of CDE in the project and the influencing factors and obstacles in its implementation. The results of his research indicate that the factors that influence the implementation of CDE are the readiness of its implementation and the obstacles in the use of CDE are socialization, gadgets and internet

connections, cooperation between users, and the absence of applicable regulations [1].

This research used a survey method [6] to find out the success criteria that affect the implementation of CDE and the obstacles based on survey results from representative respondents. CDE is used for the project life cycle, start from design, delivery, and management until its maintenance. The CDE platform implements the exchange of information between various systems. CDE can be used to monitor work progress, validate incoming data, record all activities carried out by various team members, improve collaboration, and avoid errors such as duplication of data or documents [7].

2. METHODS

The method used in this study is a descriptive survey. Descriptive surveys are used to explain current conditions or attitudes [8]. The instrument in this study is a questionnaire which is a set of questions to obtain information from respondents based on their personal perceptions and other matters related to the research material [9]. The questionnaire in this study was divided into 2 parts, part 1 questionnaire contains the criteria for success in implementing CDE and part 2 questionnaire contains obstacles in the use of CDE. This research questionnaire uses a Likert scale of 1-5 [1],[10]. Before the questionnaires are distributed to respondents, the indicators or statements that have been prepared by researchers based on CDE standards and CDE E-books have been validated by experts first [11].

Primary data were obtained from respondents with a sample of 20 people. The respondents of this study are people who have implemented CDE in projects but it has not been proven that the respondents understand the CDE platform as a whole and have certificates. The sampling technique used in this study was purposive random sampling by considering the representation of the total project employees [12]. The data were processed and analyzed using SPSS Version 26 software. The data must be valid and reliable to be used in this study. So the researchers tested the validity and reliability as a research instrument test [13].

Descriptive statistic analysis was used to find out the description of the Y variable (the application of CDE in the review design) by the value of the respondent's level of achievement (TCR) using a Likert scale [14][15]. The Likert scale according to Sugiyono (2015) is a tool used to measure the perception or opinion of a person or group of people on the potential and problems of an object. Multiple linear regression analysis is used to test the relationship between two or more independent variables that affect the dependent variable [16]. To find out the success criteria that affect the implementation of CDE in X Project, multiple linear regression analysis is used [11]. This analysis was carried out after the regression model met the requirements of the classical assumption test (normality, linearity, heteroscedasticity, and multicollinearity) [17]. To find out the biggest obstacle in using CDE, a descriptive analysis was carried out by looking for the mean value of the research data [14].

3. RESULTS AND DISCUSSION

3.1 Validity Test

The validity test was carried out using SPSS Statistics 26 by comparing the Pearson Correlation value from the SPSS output results. The instrument was tested by involving 20 respondents (n=20) and an error tolerance value used 5% so the r-value from the table is 0.444. Each statement is declared valid if the Pearson Correlation value of the SPSS output is greater than 0.444. The results of the validity test on the questionnaire part 1 all variables in this study are valid. The results of the validity test in the questionnaire part 2 contained 1 invalid statement so that statement was not used in this study. The data is re-tested to ensure all statements are valid.

3.2 Reliability Test

The reliability test was carried out using SPSS Statistics 26 by seeing Cronbach's Alpha value from SPSS output. Tthe value from Cronbach's Alpha must be greater than 0.6, so this instrument is reliable.

Table 1. The Result of Reliability Test

Questionnaire Part 1		
Variable	*Cronbach's Alpha*	Description
Team (X_1)	0,765	high level of reliability
Roles and Responsibilities (X_2)	0.669	moderate level of reliability
Approval Workflow (X_3)	0.608	moderate level of reliability
Common language and data availability (X_4)	0.698	moderate level of reliability
Data Security (X_5)	0.627	moderate level of reliability
BIM (X_6)	0.670	moderate level of reliability
CDE Implementation in Review Design (Y)	0.840	high level of reliability
Questionnaire Part 2		
Variabel	*Cronbach's Alpha*	Description
CDE Usage Obstacle	0,750	high level of reliability

Table 1 is the reliable test results of each variable in the questionnaire. Part 1 of the questionnaire contains the criteria for the successful implementation of CDE and the implementation of CDE as a design review. part 2 of the questionnaire contains the obstacles in implementing CDE.

3.3 Respondent's Level of Achievement (TCR) Analysis

Based on the questionnaire data part 1, the data was processed using a Likert scale for each statement. The steps to analyze the TCR value are as follows:

1. Calculate the rating index

$$I = \frac{100}{Jumlah\ Skala\ Likert} \quad (1)$$

Refer to Eq. (1), the evaluation of Calculation of the index value that will be used as a category determination

$$I = \frac{100}{5}$$

$$I = 20$$

Based on the results of the calculation of rating index (I) it was obtained for the percent category for each scale is 20% with the following intervals:

0-20% : Strongly disagree
21-40% : disagree
41-60% : Neutral
61-80% : Agree
81-100% : Strongly Agree

2. Calculate maximum value (Y).

$$Y = Skor\ Maksimum \times n \quad (2)$$

Refer to Eq. (2), the evaluation of maximum value calculation

$$Y = 5 \times 20$$

$$Y = 100$$

Calculate the total score for each statement and calculate the Respondent's Level of Achievement (TCR) value to get the percentage score per statement.

$$TCR = \frac{Total\ Skor}{Y} \times 100\% \quad (3)$$

Refer to Eq. (3), the evaluation of respondent's level of achievement (TCR) value.

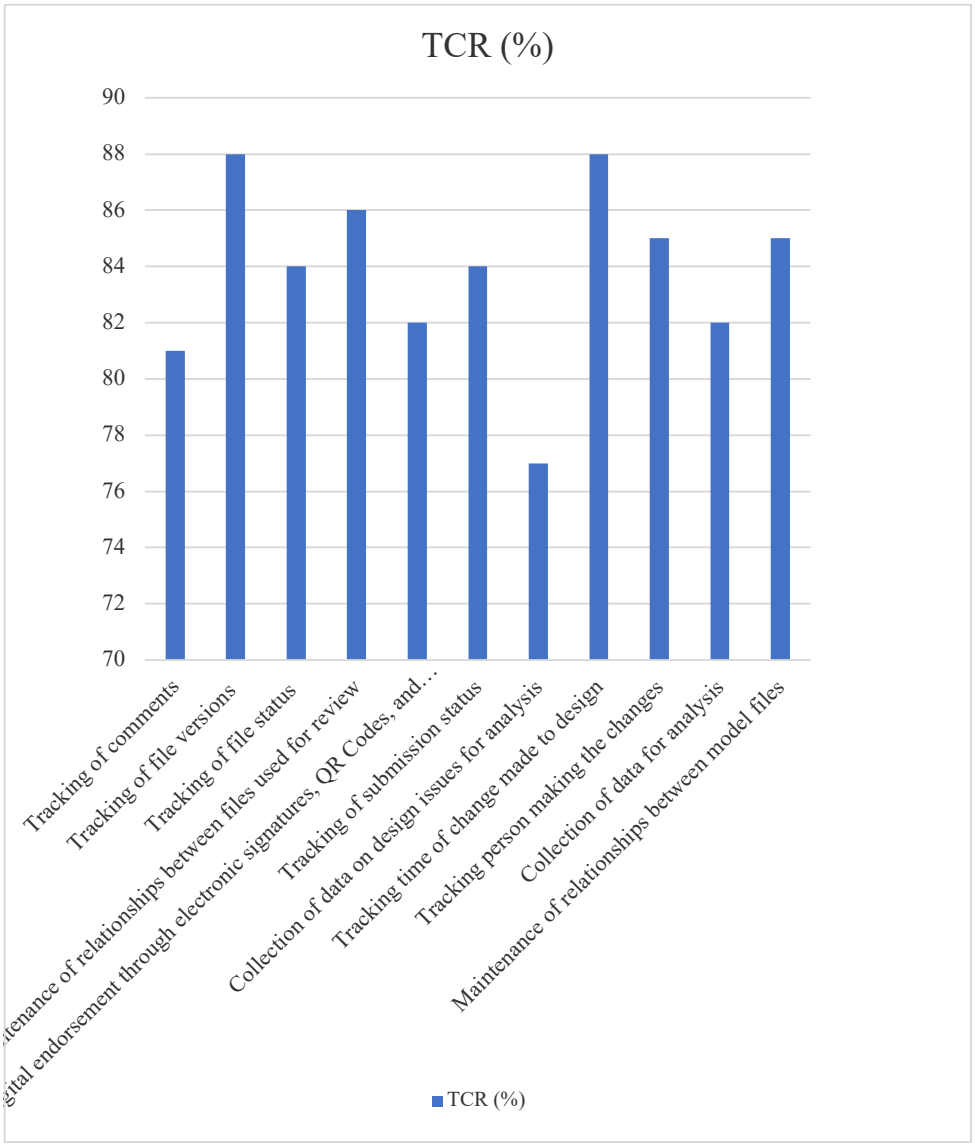

Figure 1 Recapitulation results of Respondent Achievement Level (TCR)

Figure 1 is a recapitulation results of the Respondent Achievement Level (TCR) value on variable Y in the questionnaire part 1 which contains statements regarding the application of CDE as a design review. Based on the recapitulation of the TCR value in the questionnaire part 1 on project X, an average value is 83.82%, this means that most respondents agree that the implementation of CDE on the project is in the design review. Is in accordance with the CDE standard.

The application of CDE in design reviews that is most applied to projects based on the level of achievement of respondents is to track the version of the drawing and track the time team members make changes to the design. The application of CDE in design reviews, especially to track versions of drawings and the time team members make design changes, can minimize the field team from being too late to notice changes in the design [18].

3.4 Analysis of Criteria Affecting the Success of CDE Implementation

Questionnaire data in part 1 regarding the application of CDE in the review design was analyzed by multiple linear regression to determine the criteria that significantly affect the implementation of CDE (Y), namely Team (X1), roles and responsibilities of team members (X2), Workflow approval (X3), Common Language and data availability (X4), Data security (X5), and BIM (X6). The data to be analyzed by multiple linear regression must meet the requirements of the instrument test and the classical assumption test. If the value of sig. Less than 0.05, it can be interpreted that there is a significant influence between the independent variable and the dependent variable.

Table 2 Multiple Linear Regression Test Results

Variabel	*Unstandardized Coefficients* B	*Sig.*
Costant	15.309	0.005
Team (X_1)	-0.625	0.049
Roles and Responsibilities (X_2)	0.138	0.663
Approval Workflow (X_3)	0.620	0.044
Common language and data availability (X_4)	-0.329	0.207
Data Security (X_5)	2.887	0.000
BIM (X_6)	0.720	0.030

Table 2 is the result of multiple linear regression test from the SPSS application. these results can be arranged as follows:

$$\hat{Y} = 15.309 - 0.625\ X1 + 0.138\ X2 + 0.620\ X3 - 0.329\ X4 + 2.887\ X5 + 0.720\ X6 \quad (4)$$

Refer to Eq. (4), the evaluation of multiple linear regression equation

Based on the equation above, it can be concluded that there is a negative value in the team criteria and common language and availability, this states that the X1 variable has no influence on the implementation of CDE as stated in the study entitled "Implementation of the Use of the Common Data Environment in Project X" states that the more the higher the quality of the existing human resources on the project, does not mean the higher the success of its implementation [1].

The T test was conducted to determine whether or not there was a significant effect of the independent variable (X) on the dependent variable (Y) partially with the research hypothesis:

Ho : Variable Xi does not have a significant effect on variable Y partially

Ha : Variable Xi has a significant effect on variable Y partially

The level of significance (α) in this study is 0.05, if the significance value is less than 0.05 and the t value is greater than the t value based on table (2.132), it means Xi variable has a significant effect on the Y variable partially.

Table 3 T Test Results

Variabel	t	*Sig.*
Team (X1)	-2.171	0.049
Roles and Responsibilities (X2)	0.445	0.663
Approval Workflow (X3)	2.229	0.044
Common language and data availability (X4)	-1.328	0.207
Data Security (X5)	7.718	0.000
BIM (X6)	2.428	0.030

Table 3 is the result of the t-test or test conducted to determine whether or not significant effect on each independent variable. The results of the t-test can be seen from the t value obtained compared to t in the table (2.132). Based on the table above, the variables that have a t value greater than 2.132 are the team variable, approval workflow, data security, and BIM with a significance value of less than 0.05. Thus, team criteria, approval workflow, data security, and BIM are criteria that have a partially significant influence on the success of implementing CDE in the design review. The negative sign in t value means that it has the opposite effect on the success of the CDE implementation.

The F test was conducted to determine whether or not there was a significant effect of the independent variable (X) on the dependent variable (Y) simultaneously (together) with the research hypothesis:

Ho : Variable Independent (X1, X2, X3, X4, X5, dan X6) does not have a significant effect on the Y variable

simultaneously

Ha : Variable Independent (X1, X2, X3, X4, X5, dan X6) have a significant effect on the Y variable simultaneously.

If the value of F is greater than F value based on table (3.24), then the variable X has a significant effect on the variable Y simultaneously.

Table 4 F Test Results

F	30.061
Sig.	0.000

Table 4 is the result of the F test to determine is there a significant effect on the independent variables simultaneously. F test results can be seen from the F value obtained compared to F in the table (3.24). F has a value of 30,061 more than 3.24 and a significance value is 0.000 less than 0.05 so it can be concluded that Ha is accepted and Ho is rejected. In other words, it is concluded that team criteria, roles and responsibilities of team members, approval workflow, general terms and data availability, data security, and BIM simultaneously have a significant influence on the implementation of CDE in the design review.

Determination test is carried out to determine the percentage of the influence of the independent variable (X1, X2, X3, X4, X5, dan X6) on the dependent variable (Y) by using the coefficient of determination (R Square). The coefficient of determination (R Square) obtained in this study is 0.933 or 93.3% which means that team criteria, roles and responsibilities of team members, approval workflow, general terms and data availability, data security, and BIM have an effect of 93.3% on the implementation CDE in design review. While the remaining 6.7% is influenced by other factors that are not in this study.

3.5 Analysis of the Biggest Obstacle in the Use of CDE

The biggest obstacle in using CDE was analyzed based on the mean value in the questionnaire part 2.

Table 5 Recapitulation of Mean Values from Questionnaire 2

Rank	Statement	Mean
1	Lack of cooperation between CDE users	4.25
2	Undisciplined in the use of CDE	4.15
3	Difficult to adjust to new technology	4.15
4	Data on the CDE platform is not always updated	4.10
5	Users are still confused about the features available on CDE	3.15
6	Lack of training	3.10
7	Server is often down when using CDE	2.90
8	There is no regular monitoring from experts	2.75
9	There are no official regulations or Standard Operational Procedure regarding the use of CDE	2.35

Table 5 is a recapitulation of the average value in the questionnaire part 2. The average value can be used to find out the obstacles experienced by the user. The biggest obstacles in the use of CDE in Project X are the lack of cooperation between CDE users (4.25), undisciplined in the use of CDE (4.15), difficult to adapt to new technologies (4.15), and data on the CDE platform that is not always updated (4.10) [19]. The journal entitled "Factors of Effective BIM Governance" states that the obstacles in the adoption of BIM are human, cost, technical, and legal resources [20].

4. CONCLUSION

The implementation of CDE in the design review on project X is in accordance with the standards for implementing CDE, as can be seen from the calculation of the Respondent Achievement Level (TCR) of 83.82%. The criteria that have a significant influence on the partial implementation of CDE are team, approval workflow, data security, and BIM. Team criteria, roles and responsibilities of team members, approval workflow, common terms and data availability, data security, and simultaneous (shared) BIM have a significant impact on the implementation of CDE. The most influential criterion on the implementation of CDE in the design review is data security. The biggest obstacle in using CDE in project X is the lack of cooperation between users, undisciplined

in the use of CDE, and data on the CDE platform that is not updated. Research related to the implementation of further CDE in a project is recommended to test in other fields such as monitoring in the field and reviewing project management variables, especially the competence of the team and the roles and responsibilities of its members.

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