Implementation of Design Thinking in Data Integration System Design PT X

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ABSTRACT

In today's fast-paced and sophisticated era, companies that want to progress and develop will adapt information systems. The information system that is widely used by large companies is data integration. Data integration can provide many positive things to companies such as cost efficiency, time efficiency, security, accuracy, and so on. Data integration in the finance section, for example, can provide real-time data for operational costs that can be seen by other departments and even leaders. Integration can also make the approval process faster because it can be done online, so that the data integration system must be taken by companies that want to continue to progress and develop. PT X, which is engaged in the construction sector, has not yet implemented an integrated system. PT X still uses traditional methods internally such as still using hard files for submitting and recording operational needs, where several frauds have occurred. Design thinking is used to assist the development and manufacture of an information system according to the wishes of the user. In several previous studies, information system developers found an increase in user satisfaction compared to information system developers who did not use design thinking. PT X wants to develop an information system that can record operational costs for each project and factory owned in order to make it easier to check data and improve data accuracy, so as to reduce fraud that occurs in operational reports on projects. The expected result of this research is a data integration application design.

KEYWORDS: Iata integration, Design Thinking, Operational Reports

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1. INTRODUCTION

The development of digital technology is moving very quickly, especially with the Covid-19 pandemic. These conditions have influenced and accelerated digital transformation in all fields ranging from information technology, politics, economics, socio-culture, defense and security. The Indonesian government continues to promote digital transformation in various sectors to encourage national economic recovery. Digitalization has changed the world of work better, everything is automatic and fast. One example of document digitization is basically changing documents that were originally in paper form into a digital format using various tools and techniques using a series of computer systems to automate processes or workflows. Digitalization also has several advantages, one of which is saving time, we no longer need to dismantle filing cabinets to look for a file. Information system integration is also a form of digitalization. The information system integration process occurs in line with the development of business processes and the needs of information users in an organization. There are several types of information systems integration, namely, data integration, application integration, business process integration, and presentation integration ('Juric et al., 2007) Of the four types of integration, the most basic in integration is data integration. Data integration is an exchange of data between databases located in different places.

PT X In the beginning, construction drawings were done manually to using computers, and bidding from the beginning was done manually until now where via the internet the government has even created a marketplace for contractor companies to sell their products to the government. PT X As PT By expanding its reach in working on projects, PT

In today's fast-paced era, the existence of an integrated information system has become normal. Every business and company that wants to develop or progress must have this, so that the company can focus on the targets it wants to achieve. Data integration is the initial thing that must and must be taken, so that all resources owned by the company can be processed optimally ('Lenzerini, 2002). In the financial sector, integration within companies is no longer inevitable. Optimization of trusted data in the financial sector must be carried out for the convenience of transactions, as well as for the security of all types of data held. Data integrity can be interpreted generally to be understood as the process of combining data from several different places or sources. By unifying this data, it is hoped that there will be a single, integrated view that can be used by users, in this case companies, to optimize the necessary work processes. Integration also has the definition of the act of uniting smaller components into a large system, so that it can function as a unified whole. In this way, the use of existing data can be more optimal, because every part that needs data can access it quickly. Some of the advantages of using an integrated system are centralized data and information, documentation of each business stage, optimal cross-departmental collaboration, cost and storage space efficiency, and protection of all data owned. To find out user needs in

terms of what is needed to become an integrated system, this research will use the design thinking method to help design an application to integrate data..

Although design thinking was originally intended for designers, currently the design thinking method is suitable as a type of methodology in product development. Design thinking is a new procedure and produces profitable possibilities for developing better results from products, services or strategies. This serves as an analysis process for ambiguous problems (Ben Mahmoud-Jouini et al., 2016). In this research, the five stages of the design thinking model proposed by the Hasso-Plattner Design Institute at Stanford were used, namely empathize, define, ideate, prototype, and test (Plattner, 2018). This model is used because it can help create applications or software that suit user needs. In several studies that use design thinking to create applications or software, it can narrow the gap between the project team and the recipient of the project results, in this case, the software being developed, examining non-technical and technical factors (Pereira & Russo, 2018). Design thinking can also provide early analysis and user feedback across all iterations offering a better understanding of what problems need to be solved and what the best solutions are to meet user needs resulting in increased productivity satisfaction resulting in time and resource savings as well as growth in the user base for services provided (Lucena et al., 2017)

2. LITERATURE REVIEW

An research conducted by (Pereira & Russo, 2018). In this research, design thinking is an approach that promotes understanding customer needs by considering what is technically and economically feasible. To evaluate how the design thinking approach was used integrated with agile methodology, they applied a systematic literature review, which collected, categorized, and reviewed 29 related articles on similar topics. The results show that most modern integrations between design thinking and agile are applied throughout the software lifecycle, noting that a DT approach can improve software quality and usability.

In research conducted by (Lucena et al., 2017) they stated that the importance of understanding end user needs and involving them in software development is widely known in software engineering. Agile software development methodologies have incorporated user feedback in different ways. User stories should represent user needs, but often express the views of the product owner or software development team. Several works have investigated integrating IBM design thinking with agile methods to meet end-user needs. The result of integrating the two methods is an improved user experience associated with increased productivity resulting in time and resource savings as well as growth in the user base for the services delivered.

Research conducted by (Stevenson et al., 2018) summarizes the progress towards developing the integration of New Zealand's resilience data and the Visualization En Masse Platform, otherwise known as DIVE. The DIVE platform is a prototype for online data cataloguing, sharing and collaboration. It is being developed to enable integrated and engaged research that will increase New Zealand's resilience to hazards.

The development of this platform is intended to interact with, and complement, other efforts to integrate data sharing across New Zealand and beyond. The results of this research data integration can improve and understand security from all regions of New Zealand and enable better resilience research that tends to be enhanced by problem focus, rather than divided by funding or disciplinary constraints.

Research conducted by (Baharuddin et al., 2022) explains that a web service is software that is used as a link that allows various systems to communicate without being affected by differences in platforms and is not directly connected to the database they own. This research will explain the creation of a web service that can integrate web applications and mobile applications in the COVID-19 Development Information System in South Sulawesi using restful technology to exchange data in JSON form via URI. As a result of this research, the researcher produced a centralized website by utilizing the REST API web service method in the data retrieval process which aims to combine or unite the data even though it comes from different databases.

Research conducted by (Buhl et al., 2019) states that sustainable innovation is very necessary to enable sustainable consumption and production. However, their multidimensional character makes the development of sustainable innovation often a difficult task for companies. This research addresses four main challenges specifically related to the development of sustainable innovation, including determining the adequate scope of innovation, considering various stakeholders and sustainability effects.

This research explores why and how design thinking can drive the development of sustainability innovation. For this purpose, the concept of DT with its five main principles (i.e., problem framing, user focus, diversity, visualization, experimentation and iteration) is presented. As a result, researchers found that the DT concept can help obtain sustainable innovation that is good for companies.

Research conducted by (Prestes et al., 2020) states that DT has been chosen as an approach to support problem solving by many software development companies. However, there are differences between the professionals of these companies regarding what techniques are carried out, which steps are followed, and the way to implement this approach, as he proposes , being different to generate many alternatives and, also, converging, to find a solution . This research presents the results of a survey of 127 professionals from the software industry in Brazil. The results report various scenarios in which DT has been applied: more than ten different models (sets of steps) followed by professionals; more than 50 techniques have been used, mainly to meet needs in the process, according to the context of use and based on previous experience, and show that ¾ of companies integrate DT methods with agile methods, enabling them to generate ideas and solutions, to explore and understand problems.

Research conducted by Alqarni (2021) found that the benefits of using cloud computing services enable individuals and organizations to store and process data in the cloud. Security issues arise when data generated from different sources like iot, mobile phones, and software to be stored in the cloud is attacked in transmission and

maintaining data privacy is compromised. Several approaches have been studied to address data privacy and integrity based on different encryption schemes. Data loss and leaks, malware attacks, and vulnerability exploitation are still prevalent in the cloud. This research proposes the implementation of a Paillier cryptosystem, which belongs to homomorphic base encryption, to encrypt data generated from various data sources or users and process it in the cloud without decrypting it. Experimental results show that Paillier encryption performs better in terms of encryption speed, key size and CPU usage compared to DES, ADES, and Blowfish encryption algorithms.

Research conducted by (Cho et al., 2020) states that the role of data in any industry is becoming increasingly important in the current information era. However, in the construction industry, the experience and intuition of experts is still the main determinant in decision making, while other industries are achieving real improvements in paradigm shifts by adopting advanced information technology. Cost and schedule control, which are closely related, largely determine the successful implementation of a construction project. While many studies have developed methodologies for cost schedule integration over 50 years, none of the methods are used in practice, it remains a significant challenge in the construction industry. This research aims to propose a data processing algorithm for integrated cost schedule data management using big data technology. It is designed to overcome the main obstacles to the practicality of existing methods by providing integrity and flexibility in integrating cost schedule data and reducing the time to build and modify the database.

Research conducted by (Jayanti et al., 2021) states that a project management information system is a system that functions as a company's internal planning and control which includes the use of resources, document technology, and producing information according to needs. In this research, data collection was carried out by means of online observation, interviews and literature study because this research was conducted on COVID-19. This research creates a prototype software development model. Researchers hope that this system can help companies control and manage the projects they obtain. The data that will be processed in designing this system includes supplier data, financial income data, financial expenditure, and project tax reporting data

Research conducted by (Gloria Putri & Santoso, 2020) by the authors analyzed the digitalization transformation using a construction integration system application in one of the building construction projects built by PT. X with the aim of compiling an analysis of the transformation of digitalization of construction integration system applications through rearrangement of business processes to increase work productivity so as to speed up work time Quantity Surveyor and also to examine the impact of implementing the application of construction integration systems in the Quantity Surveyor. The results of this research show that with the digital transformation of the use of construction integration system applications, the procurement process becomes a more effective and efficient process in increasing productivity because it can reduce unnecessary processes in a procurement process. The impact of implementing this transformation is ease in grouping costs according to the scope of work and location, ease in creating work orders

and progressing the work, shortening the flow of work progress transactions, and ease in controlling the area of work that has been carried out. PT. X.

3. METHODS

According to (Mootee, 2013) design thinking is a process of searching for collaborative solutions, involving flexible thinking and the ability to adapt to existing challenge processes. The design thinking approach is a human-centered approach to innovation that is taken to integrate the needs of people as users, technological possibilities, and requirements for business success (Kelley & Brown, 2018). The design thinking approach combines three elements, namely business (viability), people (desirability) and technology (feasibility) as considerations in creating ideas.

Initially, the design thinking method was popularized by IDEO founders David Kelley and Tim Brown in 2018. IDEO is a design consulting agency with a background in innovation-based product design. The aim of creating design thinking by David Kelley and Tim Brown is to solve problems by focusing on user needs. From the concept presented by David Kelley and Tim Brown, design thinking became known and developed rapidly. The development of design thinking can be seen from the emergence of various design thinking approaches with different names and stages such as five-stage Design Thinking which was popularized by the Hasso-Plattner Design Institute at Stanford, Double Diamond which was popularized by the UK Design Council, to the emergence of a practical version namely Design Sprint which was popularized by Jake Knapp. Even though each method has different stages, substantially all of these methods have the same main principle, namely creating solutions based on identifying a problem that focuses on user needs.

This research uses the Design Thinking Five Stage Model which was popularized by the Hasso-Plattner Design Institute at Stanford which includes empathize, define, ideate, prototype, and test as shown in Figure 2.2. Apart from that, in its application it has several principles so that when the design thinking process takes place it can be in accordance with existing principles. There are four principles, namely (Ben Mahmoud-Jouini et al., 2016) the human rule which means that every innovation will always focus on humans and their needs, then the ambiguity rule that all problems are ambiguous and can be questioned and interpreted differently, the redesign rule that all designs are redesigned to remain relevant to basic human needs and preferences to meet needs or achieve desired results. Furthermore, the last principle is the tangible rule, which makes ideas more real in prototype form with the aim of making it easy to understand and communication between the design team more effective.

Empathize

Empathize is the stage for gaining an empathetic understanding of the problem you want to solve. At this stage, an approach is made to the user to find out what they really want. This can be done by going directly into the field, meeting them, conducting interviews and you can also act as if you were them. So that customer problems that you

really want to solve can run smoothly. In order to empathize with users, you can do the following three things, namely (Plattner H., 2010):

1. Observe

     Seeing users and user behavior in the context of their lives. In this case, you can find various new information from paying attention to what someone says and what they do.

2. Engage

     Interact with and interview users through scheduled and short meetings. In this case, it is necessary to prepare several questions that you want to ask before conducting the interview.

3. Immerse

     In this case, designers need to see what user habits are in doing things and listen to what they do. The best solutions will come from insight into human behavior which can discover the emotions that drive user behavior, uncover user needs, and identify user rights to design. From there it can be used as a basis for designing innovative solutions.

     Empathy map is a tool for getting to know the target audience in order to align business strategies and value propositions with customer wants, needs, goals and feelings. In general, the empathy map makes stakeholders think about the user and not the product to be created. Empathy maps have the benefit of helping to build a broader understanding of aspects of user needs and desires. This empathy map is useful for the earliest process of the design thinking stage, namely empathize.

Define

     Define is a process of unpacking and synthesizing empathy findings into compelling needs and insights, and includes specific and meaningful challenges and ultimately a problem statement. This define stage will be very helpful in solving user problems because the problem has been determined (Plattner H., 2010). There are two goals of define, namely to develop a deep understanding of the user and design space and to produce an actionable problem statement, where this problem statement comes from the perspective of a designer.

     A Point of View (POV) is a written, actionable statement that expresses the problem the design team is trying to address. POV at the define stage is based on a deeper understanding of the specific user, an understanding of their needs, and an understanding of the insights as a designer, especially about that user. POV captures the design vision by defining the right challenges to overcome in the ideation session. In fact, crafting a POV statement is the main goal of the define stage of design thinking. POV helps designers approach brainstorming in a strategic way. With a clearly articulated POV, the design team can create the right solution.

     After defining the design challenge in POV, you can then start generating ideas to solve the design challenge. This can start using POV by asking specific questions starting

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with "How Might We". How Might We (HMW) questions are questions that have the potential to trigger idea sessions such as brainstorming. The user base must be broad enough for the range of solutions, but narrow enough that specific solutions can be created for the user. HMW questions should also be based on observations gathered in the empathize stage of the design thinking process.

Customer Journey Map is a visualization of the process a person goes through to achieve a goal. This Customer Journey Map is used to understand and meet customer needs and pain points. The goal of a customer journey map is to gain an understanding of how the customer experience evolves over time and demonstrate that delivery can be appreciated by everyone in the company/team. This allows designers to spot potential problems that can improve the design and better meet customer expectations. In its application, the customer journey map is divided into 3 parts, where part 1 is persona, then part 2 is thoughts, actions and feelings, and part 3 is insights and obstacles.

Ideate

Ideate is the stage in the process of creating various radical design alternatives. The goal of Ideate is to explore a broad solution space, both large numbers of ideas and diverse ideas. It is important to get as many ideas or solutions to problems as possible early in the ideation phase and even think "outside the box" (Plattner H., 2010). In the ideation stage, take advantage of the collective perspective and strengths of the designer team. The ideate stage begins with identifying new solutions based on the problem statement resulting from the define phase. It is possible to change the way you look at the problem at hand to get ideas. The next step is to test the ideas that have been collected to find the best way to solve the problem or provide the elements needed to avoid problems that will occur later (Razi et al., 2018)

Prototype

Prototype is the process of taking ideas from the designer's mind and turning them into a real form. The prototype can be anything, whether in the form of a physical wall of post-its, a role-playing activity or an object. In the early stages, keep prototypes cheap and low resolution to be able to learn quickly and explore all possibilities. These prototypes are most successful when people such as the design team, users, and others can experience and interact with the prototype. Having this prototype is a good way to start a conversation within the team. What is learned from interacting with the prototype drives deeper empathy and shapes successful solutions. The prototyping process is also more directed at fulfilling the study model, so that the design team can investigate the reliability of the solution produced from the previous stage. This prototype can be tested within a team, or with several other people. When there is input, further improvements are made to this prototype, so that a prototype is produced that truly matches the solution you want to provide.

Test

This stage is the stage where the designer has the opportunity to collect input, perfect the solution, and continue to study the user, so that it can be seen that the

proposed solution meets the expectations of the designer, especially potential customers. Testing and evaluation of products is carried out on potential customers and the results will be changes and improvements made to eliminate problem solutions and gain a deep understanding of the product and its users. In this case, testing aims to create an authentic experience for users to test the prototype that has been produced. Testing is also another opportunity to build empathy through direct observation and involvement. There are two methods at this stage, namely testing with users and feedback capture matrix.

4. RESULTS

TABLE 1. Interview Results

No.	Interview Results Regarding the Problems Faced
1	Difficulty in submitting reports due to distance
2	It is difficult to tell or know details about report revisions
3	It is difficult to validate that the material sent from the factory is the same as what is written in the field
4	paper form
5	There is no information regarding who the transaction report was made by
6	Cannot see or report the availability of materials or production results from each factory directly and continuously
7	You have to flip through the report to check whether the price attached to the note is correct with what is written on the report
8	Don't understand how to use the formula from the spearsheet application

From table 1, it is converted into a feature that can solve the resource person's problems. These problems will be the main source in determining important features in a data integration system. There are also results from the solution formulation as in table 2

TABLE 2. Solution Formulation

No	Problem	"How Might We?"	Solution
1	Don't understand how to use complicated applications such as spearsheets that require formulas	How can we create a system that is easy to understand?	Create a system where you just need to enter the name of the object, unit price and price after that everything will be done automatically by the system
2	Requires additional operational costs and a long time to get to the office if you get a project outside the area and hold a factory far from the office	How can we create a system for submitting reports?	By creating an integrated system between factory accounts, projects, finance and company management, so that reports just have to be created, finance and management can check remotely. Reports can be checked every day so that

No	Problem	"How Might We?"	Solution
			financial work does not pile up over time
3	Difficulty in tracking materials sent by the factory with those written in the project	How can we create integration between various data?	Sunday.
4	It takes a long time to turn the report over and over and match the attached notes and what is written in the report	How can we optimize the way we check attached notes with what is written without having to flip through the report?	In this way, when a project orders an order in the system, it is immediately recorded as the number of deliveries from the factory and to write wages, employees can only enter the type of material and the amount of material worked on according to the irregularities in the work, manual input cannot be done.
5	Difficulty having to contact all project heads and factories who received revisions to the submitted reports	How can we make it easy for finance to provide feedback on reports?	There will be features such as attachments at the end of each item entered in the report and a description can be provided
6	The difficulty in finding a factory that has the stock needed for the project is because when writing the report you also include the amount of material taken from the factory. So it takes more time to ask about stock conditions because stock is only reported to the office once a week.	How can we display and provide updates on existing stock in the factory to project heads and company leaders?	as an explanation
7	It takes a long time to find reports that have been entered into the archive, and sometimes reports are damaged when saved.	How can we make it easier to archive and search for archived reports?	about these expenses
8	Several times it was found that several items were hidden when the number of all items was counted manually	How can we create a transparent system?	By means of each item in the report there will be a feedback feature so that when there is an improvement on the item you can write it down in the feedback feature.
9	When the previous report was checked by the leadership and there were problems, the	How can we include the name of the finance	Provides a feature that can display product quantities directly to all project heads,

No	Problem	"How Might We?"	Solution
	company leadership was confused about who did the financial acc because the name of the financial officer was not listed.	department that has approved the weekly report?	finance and company leaders. So that when goods come in, the factory head just inputs how much material is coming in and when someone orders the material, it will be done automatically

After formulating a solution, tests were carried out on users and found feedback from users as in table 3

TABLE 3. User Feedback

1	The data displayed is in accordance with requirements
2	It is very easy to search for previous reports just by searching for the name of the factory or project head, you can even search according to the name of the project you want to see
3	No data can be hidden by any party
4	The numbers are very accurate
5	The application is considered very easy to use and understand
6	Easy to create an account
7	It is easy to equate attached notes with what is written in the report because each report item has a feature for attaching notes.
8	It's very easy to provide feedback because you can write feedback on each item
9	It is easy to pay by transfer and enter the attachment of proof of transfer and press the paid button, then the name of the person who paid the written report as financial responsibility for the approved report
10	It's easy to submit reports only through the new system without having to go to the office
11	Easy to find out feedback provided by leadership and finance
12	It is easy to make material orders because the materials appear directly from each factory
13	Making workers' wages is easy because just by selecting what material is used for that type of work, the tonnage of that material will be written down and then inputting the wholesale price per ton and there will be a total of workers' wages.
14	Just input the units and the prices for each item will be totaled automatically
15	Easy to understand and understand
16	Makes it easier to report on existing stock at the factory

5. CONCLUSIONS

Based on the results of the research and discussions that have been carried out, conclusions can be drawn to answer the problem formulation and achieve the objectives of this research. Based on the results of this research, the problem found with the current system is that the distance between the factory and the office and the project to the office is very far. This very long distance increases operational costs and is less effective

because factory heads and project heads have to come to the office to submit weekly reports and submit revised weekly reports. There is no digital system that helps in reporting, everyone still uses the traditional method of using paper. When making a report for one week, the note attachments are often damaged and make the attachments difficult to identify. The finance department faces problems every day when submitting reports because finance has to check the report, make payments and provide feedback. If there is a report that has not been completed in the audit, usually 75% will be paid and they will be contacted if the report receives feedback. The current system cannot integrate interrelated data and causes difficulties in checking data. The spearsheet application used is also quite difficult for some people because they have to understand the formulas needed to create reports.

The problem obtained is the role of the design thinking method. The design thinking method helps application developers to understand the problems they face. This problem is turned into a feature that can solve existing problems. Scrum methodology plays an important role in creating efficient and fast applications. The combination of these two methodologies produces a data integration system that suits user needs. From the results of feedback from stakeholders, it was found that they were satisfied with the convenience and all the features in the data integration system design.

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