data

MDPI

Article

Designing Knowledge Sharing System for Statistical Activities in BPS-Statistics Indonesia

Dana Indra Sensuse, Viktor Suwiyanto, Sofian Lusa, Arfive Gandhi, Muhammad Mishbah * and Damayanti Elisabeth

Faculty of Computer Science, Universitas Indonesia, Depok 16424, Indonesia; dana@cs.ui.ac.id (D.I.S.); viktor.suwiyanto@ui.ac.id (V.S.); sofian.lusa@cs.ui.ac.id (S.L.); arfive.gandhi@ui.ac.id (A.G.); damayanti.elisabeth@ui.ac.id (D.E.)

* Correspondence: mishbah@cs.ui.ac.id

Abstract: Statistics of Indonesia's (BPS) performance are not optimal since there is a lack of integration among business processes. This has resulted in unsynchronized data, unstandardized business processes, and inefficient IT investment. To encourage more qualified and integrated business processes, BPS should optimize the knowledge sharing process (KSP) among government employees in statistical areas. This study designed a Knowledge Sharing System (KSS) to facilitate KSP in BPS towards knowledge sharing improvement. The KSS manifested a hypothesis that the design of qualified knowledge management can facilitate an organization to overcome the lack of integration among business processes. Hence, BPS can avoid repetitive mistakes, improve work efficiency, and reduce the risk of failure. This study generated a business process-oriented KSS by combining soft system methodology with the B-KIDE (Business process-oriented Knowledge Infrastructure Development) Framework. It delivered research artifacts (a rich picture, CATWOE analysis (costumer, actor, transformation, weltanschauung, owner, environment), and conceptual model) to capture eight mechanisms of knowledge, map them into the knowledge process, and define the applicable technology. The KSS model has perceived a score of 0.40 using the Kappa formula that indicates the stakeholders' acceptance. Therefore, BPS can leverage a qualified KSS towards the integrated business processes statistically while the hypothesis was accepted.

Keywords: knowledge sharing; knowledge management; soft system methodology; B-KIDE framework; design science research

Citation: Sensuse, D.I.; Suwiyanto, V.; Lusa, S.; Gandhi, A.; Mishbah, M.; Elisabeth, D. Designing Knowledge Sharing System for Statistical Activities in BPS-Statistics Indonesia. *Data* **2021**, *6*, 48. https://doi.org/10.3390/data6050048

Academic Editors: Paul Haskell-Dowland, A. S. M. Kayes, Indika Kumara and Mohiuddin Ahmed

Received: 25 March 2021
Accepted: 28 April 2021
Published: 12 May 2021

1. Introduction

Several nations have a specific government agency the primary function of which is national statistical activities. This function refers to the Generic Statistical Business Process Model (GSBPM) as an international standard for carrying out statistical activities in a government of a country. In Indonesia, these activities are the responsibility of Badan Pusat Statistics (BPS)—Statistics Indonesia. Some business processes carried out by BPS-Statistics Indonesia are including but not limited to formulating policies in the field of statistics, coordinating national and regional statistical activities, providing basic statistical data, and providing national statistic systems. Each business processes contains several statistical activities following the GSBPM Model as international guidance.

Unfortunately, it is found that statistical activities included in the business processes of BPS-Statistics Indonesia are not well integrated, this has an impact on the lack of the effectiveness and efficiency on different statistical activities. This fact was concluded based on reports stated on the Deputy Performance Report of BPS-Statistics Indonesia around 2014–2017 [1] revealing that the implementation of the silo statistical activities is still happening. These findings are resumed within Table 1.

Table 1. Qualitative analysis identification of the existence of silo thinking problems in BPS.

	Silo Thinking Problems			
Deputy	**2014**	**2015**	**2016**	**2017**
Deputy of Methodology and Statistic Information	exist	exist	exist	exist
Deputy of Production Statistics	exist	exist	exist	exist
Deputy of Social Statistics	N/A	N/A	exist	exist
Deputy of Distribution and Service Statistics	exist	exist	exist	exist
Deputy for Balance Sheet and Statistical Analysis	exist	N/A	exist	exist

Table 1 revealed that the integration of statistical activities in BPS-Statistics Indonesia is still inadequate and, therefore, effort is required to integrate it. The Deputy Performance Report of BPS-Statistics Indonesia 2014–2017 recommends the needs for coordination and socialization of the knowledge about statistical activities. An interview result with Head of Section for Survey Census Design Development of BPS-Statistics Indonesia concluded that the main thing that underlies the problems of integration, coordination, and socialization in the implementation of statistical activities is the absence of a culture of knowledge sharing.

Based on the interview, BPS does not officially have a mechanism of knowledge sharing across the entire unit underneath. There is no single policy or guideline that regulates how the knowledge-sharing process should be carried out. The KS process is undertaken through various local instructions led by Echelon II officials. Therefore, the use of technology also varies even for the same activities. For example, one division might use Microsoft One Drive for cloud storage, while others use Google Drive. Certain divisions might use Microsoft Share Point as collaboration tools, while others use Google Docs. Based on these findings, it is revealed that the use of technology in knowledge processes under BPS varies.

Knowledge of how to utilize the technology for specific activities is individual. Unfortunately, along with their tenure there may be employees who change positions or transfer to places other than BPS. Therefore, the knowledge of expertise possessed by BPS has been lost following the loss of these employees. To regain this knowledge, BPS must re-train its new employees. Retraining is expensive. If there are employees who have this knowledge, the search for these employees will take a long time since BPS does not yet have a knowledge map for each employee. Even so if certain knowledgeable employees have been found, another problem could arise since it is costly to share knowledge from the knowledge employee to others.

Practically, sharing the knowledge and converting it into practice is the norm to create a product or service. Not only knowledge sharing, but a statistical government agency also needs to undertake knowledge integration in statistical activities. This knowledge integration derives from different people/groups and produces high-quality data [2].

Based on previous description, BPS-Statistics Indonesia needs a knowledge-sharing system (KSS) to optimize the knowledge-sharing process (KSP). A good KSS will improve knowledge-sharing activities to avoid repetitive mistakes, improve work efficiency, and reduce the risk of failure [3]. Based on problems that have occurred, this study formulated a research question, "How to design a knowledge-sharing system of statistical activities in BPS-Statistics Indonesia?" This study was approached using design science research (DSR) with the adoption of the soft system methodology (SSM) and B-KIDE Framework to design a business process-oriented KSS of BPS-Statistics Indonesia's statistical activities.

2. Literature Review

2.1. Badan Pusat Statistic (BPS)—Statistics Indonesia

This study included BPS-Statistics Indonesia as a case study. BPS-Statistics Indonesia is Indonesia's statistical government agency which has responsibility in providing Indonesian data and statistics. Its vision, as stated on the BPS–Statistic Indonesia strategic plan is to be

"the most trusted pioneer of statistics for all" [4]. BPS aims to be the originator of the idea of a reliable statistical data provider, as well as an actor in providing reliable statistics.

The Head of BPS is the highest leader in BPS-Statistics Indonesia. The head of BPS is assisted by one main secretary and five deputies who lead each statistical sector and there is one main inspector who functions as an internal supervisor for the scope of the BPS-Statistics Indonesia both at the central office and provincial/district/city representatives in Indonesia. The Head of BPS, Main Secretary, Deputy and Main Inspector are positions led by an echelon I official [4].

BPS-Statistics Indonesia uses the Generic Statistical Business Process Model (GSBPM) as a guideline and reference in carrying out business processes for data and statistical supply activities in Indonesia. GSBPM contains a collection of the business processes required to produce statistics. In addition, the GSBPM also lists the framework and standard terminology needed in the framework of modernizing activities that produce statistical products. GSBPM consists of eight phases where each phase has its own subprocess. The eight phases consist of the requirements specification phase, the design phase, the building phase, the data collection phase, the process phase, the analysis phase, the dissemination phase, and the evaluation phase [4].

In BPS-Statistics Indonesia, the important role in organizing statistical activities based on the GSBPM lies in three parts, namely 1. Subject Matter as the part in charge of designing and conducting survey activities; 2. Methodology, which is the part that carries out tasks related to the survey method activities and statistical estimation; and 3. Statistical Information System which has the task of designing programs for processing, dissemination and all things related to the provision of facilities related to information technology [4].

2.2. Knowledge-Sharing System

Improving service quality has always been a priority in every activity of government organizations. The public sector needs to introduce relevant interventions such as knowledge management (KM) and use of ICT (information and communication technology) solutions as enablers for the knowledge sharing process [5] to achieve the improvements. The KM Process consists of four main processes: knowledge discovery, knowledge capture, knowledge sharing, and knowledge application [6]. Through a qualified KM strategy, an organization can achieve synergistic connection at the people/technology and organizational sustainability [7].

Knowledge sharing is the communication process to circulate organizational knowledge (both tacit and explicit) to fulfill individual duties [6]. Technology becomes a crucial element in knowledge sharing to enable organizations to develop business processes by facilitating knowledge sharing. Technologies that can facilitate knowledge sharing are called knowledge sharing systems (KSS) [8]. In KM science, an information system (IS) that supports the integration of technology and mechanisms in the KM process is called a knowledge management system (KMS). KMS (including the KSS) should support every KM process by integrating the KM mechanism and KM technology.

2.3. Design Science Research

Design Science Research (DSR), also known as constructive research, is a methodological approach to designing artifacts to achieve a goal. DSR takes the form of producing scientific knowledge that involves developing an innovative construction (in this study, information system) to solve problems faced in the real world and simultaneously make a prescriptive scientific contribution. Hevner et al. claimed that DSR facilitate research in information systems to generate prescriptive knowledge [9]. Nguyen et al. underlined DSR advantages to produce necessary artefacts following problem solving processes and knowledge construction [10]. Those advantages drive this study and adapt it to design a KSS since research in KM areas requires guideline to produce necessary artefacts in the KM context. Biljon et al. had experience to adapt DSR when construct a digital platform as knowledge repository [11]. It indicated DSR is reliable and suitable for this study.

DSR has five research phases: Problems Awareness, Suggestion, Development, Evaluation, and Conclusion [12]. The DSR research process begins with a Problems Awareness phase while the problem analysis came from organizations, technological trends, literature studies in specific disciplines, or other sources. The first phase delivers a system proposal. In the Suggestion as to the second phase of DSR, a tentative design should be prepared to complete the proposal. In Development, the IS development artifacts are collected with the IS development process during the analysis, design, and prototype implementation. As the fourth phase, Evaluation assesses the developed prototype to ensure stakeholders' acceptance. DSR generates the evaluation results towards the problem solution in the last phase [9].

2.4. Soft Systems Methodology

IS development should overcome sociotechnical problems that cross the boundary between human activity systems and technology involving several stakeholders with various perspectives. However, most of the problems in IS development are not clear. SSM is an action-oriented inquiry process where stakeholders formulate a solution strategy from their systemic understanding of the problem situation and correct it. SSM addresses the situation of unstructured problems ('soft'), which require consensus among stakeholders. SSM aims to accommodate various perspectives through a conceptual model of the system of human activity. These models are then used to decide interventions for resolution or improve the situation [13].

The SSM implementation consisted of seven steps: understanding unstructured problems, formulating problems holistically, developing problem definitions, making conceptual models, comparing conceptual models with facts on the ground, determining desired changes, and acting for change [14]. SSM generates three analyses to develop a system's conceptual model: intervention, social, and political analyses [15]. The intervention and social analysis generate a rich picture to illustrate the unstructured problem from research. In SSM political analysis, SSM delivers the formulation of root definition using PQR formula and CATWOE analysis. PQR formula is used as a tool in finding root definition. Letter P, Q, and R do not stand for anything, but they are only subsequent letters in alphabet order which have certain meaning, P represents "what", Q represents "how", while R represents "why". Furthermore, CATWOE stands for costumer, actor, transformation, weltanschauung, owner, and environment [15].

This phase is the first step in the SSM method. It practices collecting data through interviews, observations, and study of documents regarding government statistical agency statistical activities and the process of sharing knowledge. It relies on the intervention and social analysis of SSM. After that, this phase formulates the holistic problem using rich picture. This process utilizes input from interviews, observations, and document studies carried out in the previous stage. This stage's result is the rich picture of knowledge sharing problems in statistical activities at government statistical agencies.

2.5. Business Process-Oriented Knowledge Infrastructure Development (B-KIDE) Framework

Strohmaier and Tochtermann developed the B-KIDE (Business process-oriented Knowledge Infrastructure Development) Framework in 2005. It can develop a business process-based knowledge infrastructure (KI) [16]. From the established KI, organizations can identify the KM process in the business process more systematically. After identifying the KM process, the KM system model (knowledge sharing in this study) can immediately build a system [17].

This framework has two main components to build KMS technology: The B-KIDE architectural model and the B-KIDE method. In the B-KIDE architecture model, the analysis focuses on modeling the knowledge processes in the business process. This study also focuses on IC development based on the knowledge process identified and modeled [16].

2.6. Fleiss Kappa

When validating the proposed design on DSR research, it is necessary to measure the level of agreement from stakeholders. The inter-reliability reliability assessors can be facilitated using a Fleiss kappa statistic [18] to validate their agreement. Fleiss Kappa is the next version of Cohen Kappa. If Cohen Kappa only measures inter-rater reliability between two assessors, Fleiss Kappa can measure interrater reliability among three or more evaluators. The calculation of Kappa statistics refers to the gap between the agreement on the current situation versus the expected situation [19]. This study employs the following formula to calculate Fleiss Kappa.

$$K = \frac{\Pr(a) - \Pr(e)}{1 - \Pr(e)} \quad (1)$$

The Kappa statistic value has a range of values between −1 to 1. Negative values represent disagreement, while positive values indicate agreement. Based on Brennan and Prediger [20], the Kappa value of 0.7 indicates that the agreement level is reliable [21].

3. Methods

The research was divided into two main processes. First is the problem understanding process, while the second is the model development phase. This study combined SSM and B-KIDE Framework to help processes conducted in DSR. This idea is depicted in Figure 1.

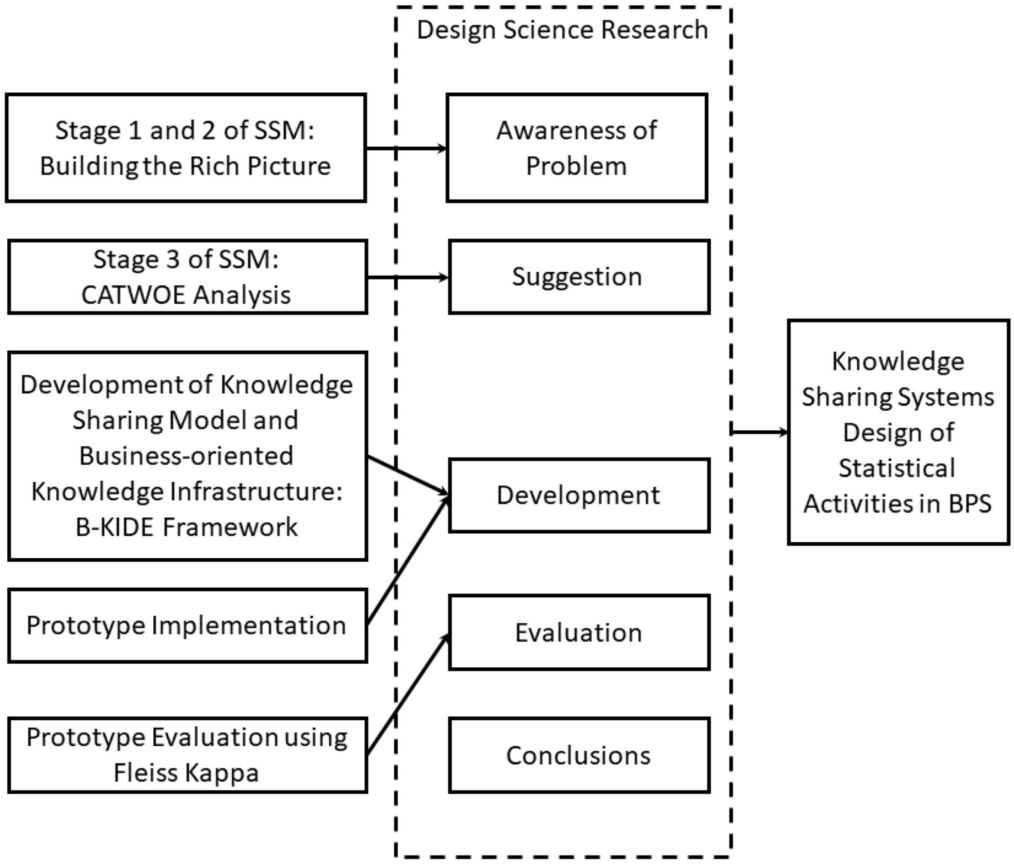

Figure 1. Theoretical framework.

DSR methodology consists of five phases starting from Problems Awareness, Suggestion, Development, Evaluation, and Conclusion. SSM itself has 7 stages, such as problem situation, problem situation expressed, root definition, conceptual model, comparison of model and real world, changes, and action [15]. However, only the first three are used in

DSR. Stages 1 and 2 are used to build rich picture of the problem, while stage 3 is used to analyze the rich picture. DSR was continued by the development of KSS model using B-KIDE Framework (Development, Evaluation, Conclusion).

Throughout the DSR processes, several interviews were conducted. The interviewees, called subject matter (SM), came from areas of statistical activity, statistical methodology, data processing, and information technology requirement gathering and validation. Table 2 describes these interviewees. The interview processes were needed for collecting information about knowledge problems and needs in every step of GSBPM. For the KM Tools selection phase in the development stage, this study conducted a survey involving 50 respondents. Figure 2 shows the distribution of the KM Tools selection survey.

Table 2. The interviewee target to collect knowledge problems and needs in Generic Statistical Business Process Model (GSBPM) processes.

GSBPM Process	Interviewee
Specify Need	Subject Matter (SM) in Statistical Activity
Design	SM in Statistical Methodology
Build	SM in Statistical Activity
Collect	SM in Statistical Activity
Process	SM in Statistical Activity
Analyze	SM in Statistical Activity
Evaluate	SM in Statistical Activity
IT Support	SM in Information Technology

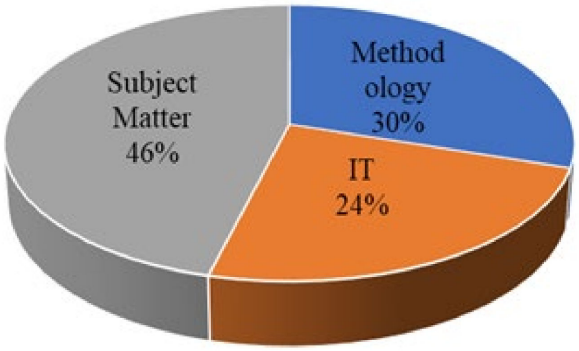

Figure 2. Knowledge management (KM) tools selection survey sample distribution.

3.1. Problem Understanding Phase

This study carried out the problem understanding through series of data collection activities such as interviews, observations, and documents review related to the BPS-Statistics Indonesia's statistical activities and the existing processes of sharing knowledge (Awareness of Problem phase). The problem understanding process relies on the intervention of SSM in undertaking social analysis to elaborate the holistic problem and then building the rich picture. After the rich picture is formed, then the study used CATWOE analysis to give some suggestions (carried out in Suggestion phase). After understanding the KSS and describing the problem holistically, this phase posed the problem to provide a clear definition regarding the system's goals by identifying stakeholders, processes, and values.

3.2. Development Phase

The Development Phase comprised two activities: (1) system analysis and design and (2) system prototype development. System analysis and design are performed by designing the KSS model and KI using the B-KIDE Framework. The KSS model development involved three phases: business process modeling, identification of knowledge domain (KD) in business processes, and the relationship between KD and business processes. The next stage is KSS design using the B-KIDE Framework. KI development was initiated from an

analysis of several recommendations for IT tools used. After developing the KI design to select IT tools, the next stage is selecting IT tools according to the user's choice through a questionnaire survey. KSS conceptual model is generated in this phase based on the KSS model, KI, and selected IT Tools. The Evaluation phase performed the KSS prototype validation to ensure whether it had met the agency's requirements using Fleiss Kappa.

4. Result and Discussion

4.1. Awareness of Problem

(1) Analysis One (Intervention)

Based on the SSM methodology by Checkland and Poulter [15], intervention analysis is a form of analysis that investigates three key roles in intervening complex systems. The three roles are:

- Clients

Clients are people/groups of people who cause interventions in SSM research. In this study, clients are government statistical agency employees who use knowledge in carrying out statistical activities, also called knowledge workers. Based on interviews with SM in statistical methodology, the problem in knowledge distribution was unintegrated processes between the survey design and results analysis. Moreover, employees know the activities in their job only. The other causative factors in lack of knowledge sharing were low work culture (department-oriented, not organizational-oriented), lack of time to share knowledge, and technology problems. From its investigation, this study underlined that a statistical government agency requires KSS that can be accessed and used anytime and anywhere.

- Practitioners

Practitioners refer to researchers who perform investigations on SSM research. Researchers should capture a current landscape and formulate necessary initiatives to achieve the research goals using relevant artifacts and collected data, such as staffing system, job description, and data life cycle in BPS.

- Issue Owner

The issue owner is the person or group of people who have an interest or are affected by the problem and resolution results. In this study, the role of the issue owner is the agency itself, BPS-Statistics Indonesia. One of the disadvantages of not having KSS was repetitive training for the same knowledge or skill, while it also needs regular funding and is quite time-consuming due to the employees' performance.

(2) Analysis Two (Social)

In the SSM methodology presented by Checkland and Poulter [15], the social analysis model in understanding problems consists of three elements: roles, norms, and values. After identified the roles in Analysis One, Table 3 unveils the norms revealed in Analysis Two following the GSBPM processes.

Table 3. Analysis two (social).

GSBPM Process	Norm
SM of Statistical Activity	
Specify Needs	Identify analytical needs related to statistical activities for which it is responsible for discussions with other ministries, experts in statistical activities, and literature review.
Design	Designing statistical outputs from the variable outputs, estimated levels (sub-district, district/city, provincial, or national), and the flow and schedule of statistical activities.
	Coordinate the statistical activity design specifications with the head of SM in statistical methodology.
Build	Establish data collection instruments (questionnaires) and rules for filling out questionnaires (validation and consistency). Coordinate the design of statistical activities and data collection instruments with the head of SM in statistical methodology.
Collect	Ensuring that technical staff's understanding through training.
Process	Coordinate with the SM in statistical methodology in data cleaning and data preparation for analysis in terms of the rules of editing, coding, and imputation of data and making data tabulation. Collaborate with the head of SM in statistical methodology in weighting and data aggregation for variable estimation.
Analyze	Prepare and conduct data analysis according to the purpose of statistical activities.
Disseminate	Make publications on data analysis results (number releases, book publications, online tabulations, etc.).
Evaluate	Evaluate the implementation of statistical activities.
Statistical Methodology Section	
Design	Design a survey design (methodology, sample allocation, calculation of weighting plans, and others) that matches the SM statistical activities and agency organization's specifications.
Process	Perform weighting calculations, sampling error calculation, and confidence level to analyze sample variables' estimation to the population.
Data Processing Section	
Build	Design and build a data collection and processing system following the design of survey activities and data collection instruments (questionnaires and data validation and consistency rules).
Collect	Troubleshooting is related to the data collection system.
Process	Problem-solving is related to data processing (editing, coding, data imputation, etc.).
	Making data tabulation for analysis purposes.

(3) Rich Picture

This study's role consisted of three roles, namely SM statistical activities, Sub-directorate of Survey and Census Design Development (PDSS), and Sub-directorate of Data Processing Integration (IPD). PDSS and IPD are two units in BPS organization. However, in rich picture (see Figure 3), detailed roles are described in the three work units. Therefore, the rich picture's role consists of a structural officer of work unit A (can be one of the SM, PDSS, or IPD), employees in work unit A, and employees in work units other than A are involved in statistical activities.

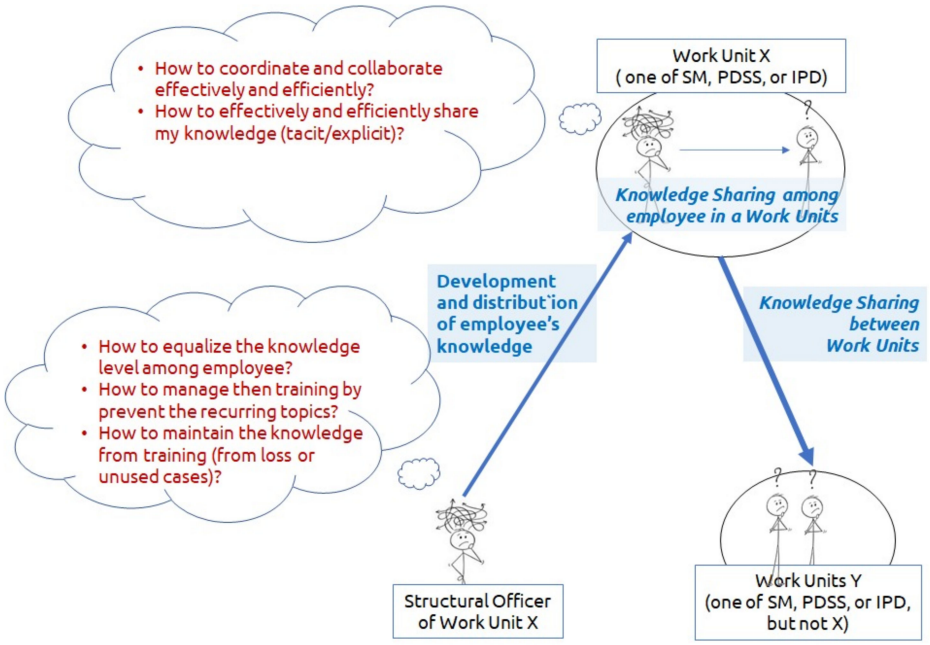

Figure 3. Rich picture.

The topic of rich picture investigations in this study is knowledge sharing activities in statistical activities. In norms of statistical activities implementation, rich pictures' roles implement norms related to knowledge sharing written in blue. In implementing norms related to knowledge sharing, roles have questions about problems found in the Analysis One of SSM and interviews.

4.2. Suggestion

(1) Root Definition

The PQR formula answered the question of what, how, and why to formulate root definition. "P" represents what, "Q" represents how, while "R" represents why. In this context, element P reflects the KSP in statistical activities. Element Q refers to KSS usage in integrated statistical activities, while element R highlighted the statistical activities that are integrated, coordinated, and socialized effectively and efficiently. From the PQR formulation, this study composed root definition as follow: "Conducting KSP in statistical activities by using an integrated KSS to help achieve integrated, coordinated and socialized statistical activities effectively and efficiently."

(2) CATWOE Analysis

In the CATWOE analysis (Table 4), the customer and owner were the agency, BPS-Statistics Indonesia since they experienced impacts of the problem and became the beneficiaries of solutions. The actors in this study were employees. Specifically, they were employees in charge of carrying out statistical activity processes according to GSBPM, except administrative and infrastructure support staff.

Table 4. CATWOE analysis.

CATWOE	Description
Customer	Statistical government agency
Actor	Statistical government agency's employee
Trans-formation	The Statistical Activity Process is ineffective and inefficient due to issues of equity and lack of knowledge, lack of knowledge sharing process (KSP) due to time constraints and training costs for repetitive topics → An effective and efficient statistical activity process supported by a KSS that facilitates knowledge sharing without time, place, and cost constraints.
Worldview	KSS supporting the process of integrated statistical activities, comfortable (in terms of time, place, and cost) is used for the process of knowledge sharing in statistical activities
Owner	Statistical government agency
Environmental Constraint	Missing knowledge (employee mutations and pensions), uneven knowledge, statistical activities budget

4.3. Development

(1) Knowledge Process Modeling

As introduced by Strohmaier [16], the B-KIDE framework contains three stages in developing knowledge-process models in business processes. The stages in developing the knowledge process model identified knowledge domains (KD) as shown in Table 5 and investigating the relationship between KD and business processes. From the KD analysis of business processes, this study found 14 important KDs (Table 5). The KDs were then analyzed based on knowledge processes (generation, storing, and transfer) conducted in each KD to identify the KM mechanism, the involved knowledge objects, and other vital components to build a knowledge-sharing system process model. From mapping the mechanism and object of knowledge into the knowledge process, a KM foundation needs to build a knowledge-sharing system that is the knowledge process's knowledge mechanism. Table 6 describes the mapping result of the knowledge mechanism in each knowledge process.

Table 5. Knowledge domain identification result.

KD	Description
Need for Statistical Analysis (A)	The SM in statistics needs this statistical analysis to identify the variables needed in statistical activities.
Variables used for analysis and concept definitions (B)	SM needs variables and concept definitions of these variables in statistics to identify data collection questions and develop statistical activity designs.
Statistics Activity Proposal (C)	When developing an activity proposal, SM in statistics should be coordinated with the statistical methodology section.
Statistics Activity Design (D)	The statistical methodology developed statistical activities, including a survey methodology, sample allocation, and analytical calculation formulas.
Business Process Design (E)	The developed statistical activities should be followed up by SM in statistics with the data processing section to design business processes for data collection and processing.

Table 5. *Cont.*

KD	Description
Data collection instruments (F)	SM in statistics collaborated with the data processing section to produce data collection instruments to simplify and improve the data collection process's quality effectively.
Data processing component (G)	SM identified the data processing component in the statistics as a baseline in the data processing.
Field officer training (H)	Agency socialized the data collection instrument and the data processing component through employee training.
Implementation of data collection (I)	Knowledge related to data collection (achievement and problem solving) should be well socialized among SM in statistics with employees in data collection.
Implementation of data processing (J)	Knowledge of data processing (achievements and problem solving) should be well socialized among SM in statistics, data processing, and employees' data processing.
Implementation of statistical analysis (K)	Knowledge of the analysis process, variables calculation, estimated variables calculation, and required tables should be well-coordinated among the SM in statistics, statistical methodology, and data processing sections.
Publication Writing (L)	SM needs knowledge of the process of statistical publication to produce quality statistical activity publications.
Evaluation component (M)	The evaluation component should be developed and assessed by the SM in statistics as input to develop an improvement plan for the next period's statistical activities.
Suggestions for improvement (N)	Suggestions for improvement are effectively built and socialized to be used as reference material for implementing other or similar statistical activities but in subsequent periods.

Table 6. Mechanisms and knowledge process mapping.

Proses Knowledge	Knowledge Mechanism
Knowledge Generation	Meetings, literature review, data exploration, collaborative document creation, collaborative IS development, collaborative statistical activity design program development, training
Knowledge Storage	Integrated Document storage, programs, and IS
Knowledge Transfer	Meetings, training discussions, problem discussions

The list of knowledge processes used the knowledge process of the B-KIDE framework. After the knowledge mechanism has been mapped, one more KM Foundation is required to create a conceptual model of the KSS, namely KM technology.

(2) Knowledge Infrastructure

KI in the B-KIDE Framework is intended to identify the KM technology that needs to be integrated with the KM mechanism to support the KM process and the technical criteria that are appropriate to the organization. Towards the KI creation, a literature review and researcher observation were carried out on KM technology alternatives appropriate to each knowledge mechanism in the knowledge process model in the previous analysis (see Table 7).

Table 7. Alternative technology supporting the knowledge process.

Knowledge Mechanism	Technology
Meeting	Electronic web discussion groups, chat messages, video conferencing, recordings, and minutes of meetings.
Literature review	Web access to providers of scientific research publications related to statistical activities or web access to internal research storage
Data exploration	Web access to an integrated database
Collaborative document creation	Partitioning and merging documents manually, Microsoft SharePoint, Google Drive.
Collaborative Information System development	The fragmented development which is compiled and stored in integrated storage and collaborated with the GitHub method.
Development of a collaborative statistical activity design program	Separate development is compiled and stored in integrated storage and collaborated with the GitHub method, or simply with an editor that supports collaborative programming, such as RStudio Server.
Training	Storage of training documents (training documents or records) and lessons learned from each participant sent
Document storage	Integrated document and File Management System (FMS)
Program storage, integrated IS	Integrated document and FMS
Training discussion	Electronic web discussion groups, chat messages, video conferencing, recordings, minutes of meetings, and training material.
Discussion of problems	Electronic web discussion groups/chat/video conferencing or just storing logs for problem-solving and resolution in the helpdesk application.

When developing KI and identifying KM technology to support the KM processes, this phase also identified KSS criteria based on knowledge-sharing values at the agency. This criterion's identification was delivered from a literature review of national government policy and the agency's strategic plan [4]. Important criteria for the knowledge systems were:

1. User login using community login (Single Sign-On);
2. The knowledge that can be accessed easily should be following the role of the user's login organizational unit;
3. Knowledge can be added, edited, and deleted according to the user's role;
4. Prioritizing the collaboration as accelerated coordination, both in intra-unit and inter-units;
5. The KSS can be accessed anywhere and anytime; and
6. The KSS uses one access portal and login to each knowledge process module.

(3) Knowledge Management (KM) Technology Selection

From the KI development analysis, this study proposed alternatives to the KM mechanism. Table 8 reveals knowledge mechanisms with KM technology. In the other knowledge mechanism, which has more than one alternative technology, quantitative data collection on the selection of KM technology is carried out at the KM technology selection analysis stage.

Table 8. The knowledge mechanism with KM technology alternatives.

Knowledge Mechanism	KM Technology
Training	Integrated training document management system (training materials, training records, and lessons learned from participants).
Document storage	Integrated document and File Management System (FMS)
Storage of programs and IS	Integrated document and FMS
Data Exploration	Web access to an integrated database

(4) Conceptual Model

From the results of the KM technology selection, this study concluded that necessary KM technology to support the existing knowledge mechanism were an integrated document and FMS (Microsoft OneDrive), web access to the database of the results of previous statistical activities, web access to scientific publications related to statistical activities from both external and internal agency, collaborative document creation technology (Microsoft SharePoint), GitHub usage for collaborative IS development, RStudio Server Enterprise usage with optimal collaboration features, and electronic discussion forums. These technologies can be described as a conceptual model of KSS as depicted on Figure 4.

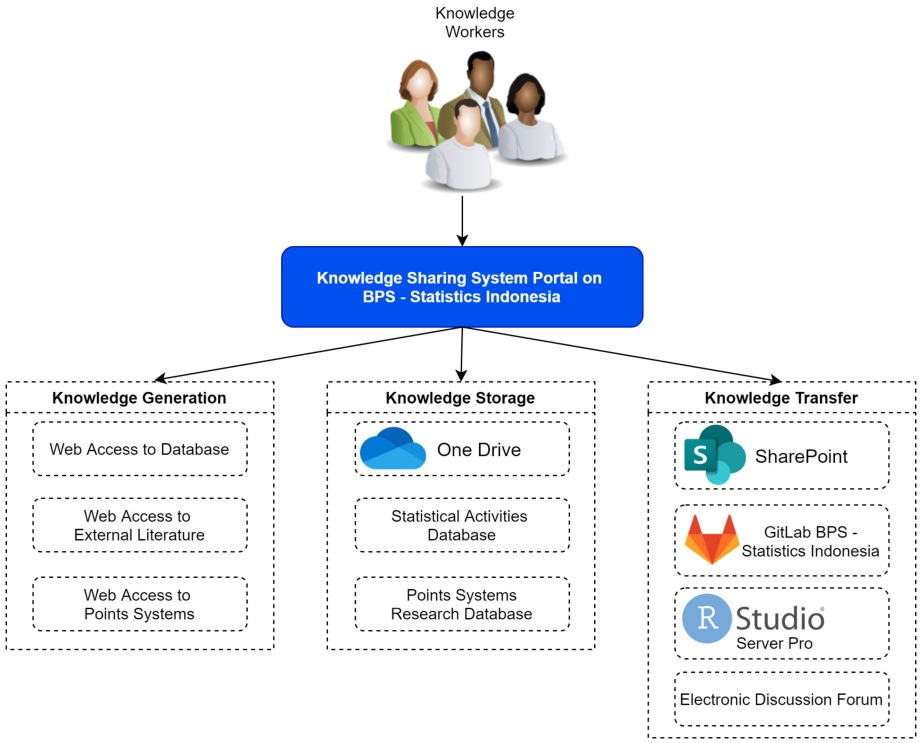

Figure 4. Conceptual model of KSS in statistical activities of statistical government agency.

(5) Prototype Implementation

In the prototype implementation, two processes should be carried out, namely the integration of KSS with technology that has been owned and the implementation of technology that has not yet been owned. Some technologies have been owned based on the conceptual model, but some have not (required technology).

Table 9 shows four technologies that should be built for this KSS: web access to statistical activity data, web access to employee performance report documents, web access to external literature, and electronic discussion forums. For technologies already owned,

the integration will be made with the KSS. These technologies are Microsoft OneDrive, statistical activity database, Employee performance report database, Microsoft SharePoint, GitLab, and RStudio Server Enterprise.

Table 9. Status of ownership of KSS technology.

Owned Technology	Required Technology
Microsoft OneDrive Database of statistical activities Employee performance report database Microsoft SharePoint GitLab RStudio Server Enterprise	Web access to statistical activity data Web access to Employee performance report documents Web access to external literature Electronic discussion forum

A web portal is needed to integrate all the supporting technologies in the KSP. When the user first accesses it, the user must log in to the KSS by entering the internal account username and password. The username and password entry data are filled in with data from the internal agency or single sign on (SSO) community account.

After the user logs in, the system will display a home page that contains the system introduction and access to technologies supporting the process of knowledge sharing in statistical activities. Figure 5 illustrates an example from the KSS prototype pages. This prototype is used to evaluate if the design is fitted with organization criteria.

Figure 5. KSS portal page (technology selection).

4.4. Evaluation

This phase hosted KSS testing that involved the assessor to examine the proposed KSS design. After presenting the prototype, the assessor will give score following the evaluation criteria, whether the system prototype has met the requirements from the KI analysis. The evaluators were representatives form BPS in the statistical activities: Head of the Data Processing, Head of Statistical Methodology, and Head of Information Technology. Table 10 portrays the evaluation criteria.

Table 10. Evaluation result.

Criteria	Disagree	Agree
User login uses community login (Single Sign-On),	0	3
The knowledge that can be accessed easily should be following the role of the user's login organizational unit,	1	2
Knowledge can be added, edited, and deleted according to the user's role,	0	3
Prioritizing collaboration as accelerating coordination both within the work unit or among work units,	1	2
Can be accessed anywhere and anytime	1	2
One portal access and login to each knowledge process module.	0	3

From Table 10, the chance of agreeing to observation (Pr(a)) is 0.83, while the chance of agreeing with the agreement (Pr(e)) is 0.72. While if calculated based on the kappa statistical formula, the kappa value in this measurement is 0.40. Kappa value indicates a value of more than 0.00; this study underlined "the evaluators agree that the prototype had been built following the organizational criteria." Specifically, the kappa value of 0.40 indicates that the agreement among the evaluators is quite agreeable.

5. Discussion

This study found specific roles and norms in the statistical activity process from the Problem Awareness stage using steps 1 and 2 of the SSM. The roles directly involved in statistical activities are the SM in statistics related to statistical activities, the statistical methodology section, and the data processing section. Each role has norms that should be implemented in statistical activities. In addition to identifying roles and norms in the Problem Awareness process, a rich picture of knowledge sharing problems in the agency's statistical activities was composed based on SSM intervention and social analysis.

This study composed root definition and CATWOE analysis to improve current KSS as obtained from the Suggestion stage. The root definition of the knowledge-sharing problem was formulated using the PQR formula. The root definition of knowledge sharing problems in statistical activities is "Doing the process of knowledge sharing in statistical activities by using an integrated KSS to help achieve statistical activities that are integrated, coordinated and socialized effectively and efficiently." This stage also conducted a CATWOE analysis to improve suggestions for improvement related to existing problems.

At the Development stage, an analysis is related to the system using the B-KIDE framework and technology selection survey, developing a conceptual model of the system analysis results, and implementing it through a prototype system. The conclusion obtained at this stage is by using a B-KIDE KSS framework built on statistical activities. From this framework, the knowledge mechanism is mapped when implementing statistical activities into the knowledge process model. This study found eight mechanisms of knowledge that have been mapped in each knowledge process. These stages generated the identification of technology supporting the knowledge mechanism. For an instrument with more than one alternative supporting technology, a survey to select the technology supporting the knowledge mechanism was conducted.

6. Conclusions

This study has implemented DSR and SSM to produce a KSS in BPS-Statistics Indonesia to overcome lack of business processes and knowledge circulation among employees. The proposed KSS leveraged the B-KIDE framework to compose necessary artifacts and business processes. This study defined four KM mechanisms to be accommodated in KSS: Training; Document storage; Storage of programs and IS; and Data Exploration. They covered 14 knowledge domains as identified by exploring BPS using SSM analysis. In

the validation phase, the proposed KSS perceive 0.40 in Fleiss Kappa formula involving representatives of BPS. It indicated organizational acceptance to adapt the KSS in practical implementation.

7. Recommendation

This study's scope excluded knowledge applications as part of the knowledge processes. Considering the subsequent studies, it suggests further research to extend on all KM processes in statistical activities. This study only focused on KSS oriented statistical activities as the core process. It indicated other supporting business processes as potential areas for further research, such as financial administration, staffing, administration, etc. The KSS design also should get commitment and support from the organization's leadership to support the KSS implementation in statistical activities. Moreover, further research can focus on change management when BPS starts the implementation of KM processes since Mat Nor et al. [22] reminded the importance of change management after performing SSM. Lack of change management affects the various individual assumption based on people's knowledge [23] that may occur in BPS.

This study does not include implementation strategies as the scope of research. However, this is still an important thing to note. As mentioned before, the proposed KSS design needs commitment and support from the organization's leadership to make it possible to implement within the organization. Some recommendations are including the development planning of KSS within BPS yearly program and make use of external pressure to increase awareness of the importance of KSS in BPS. One of the external pressures that might be used is the obligation of BPS to implement KM within the organization to fulfill the expectation of E-Government Evaluation criteria brought by Ministry of Administrative Bureaucratic reform. Development of KSS is also an obligation of BPS in the context of implementing bureaucratic reforms mandated by Ministry of Administrative Bureaucratic reform.

Author Contributions: Conceptualization, D.I.S., V.S.; Data curation, V.S.; Formal analysis, V.S.; Funding acquisition, D.I.S. and M.M.; Methodology, V.S., D.I.S., S.L., A.G., and M.M.; Project administration, A.G.; Supervision, D.I.S. and S.L.; Visualization, V.S., A.G. and D.E.; Validation, M.M; Writing—original draft, D.I.S. and V.S.; Writing—review and editing, A.G., M.M., and D.E. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Universitas Indonesia, PUTI Grant with contract number NKB-1482/UN2.RST/HKP.05.00/2020.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. BPS-Statistics Indonesia. *Deputy Performance Report 2014–2017*. Available online: https://www.bps.go.id/menu/36/laporan-kinerja.html (accessed on 5 May 2021).
2. Akram, T.; Lei, S.; Haider, M.J.; Hussain, S.T. The impact of organizational justice on employee innovative work behavior: Mediating role of knowledge sharing. *J. Innov. Knowl.* **2020**, *5*, 117–129. [CrossRef]
3. Ni, G.; Cui, Q.; Sang, L.; Wang, W.; Xia, D. Knowledge-sharing culture, project-team interaction, and knowledge-sharing performance among project members. *J. Manag. Eng.* **2018**, *34*, 04017065. [CrossRef]
4. BPS-Statistics Indonesia. *BPS Strategic Plan 2020–2024*. Available online: https://www.bps.go.id/menu/2/rencana-strategis-bps.html (accessed on 5 May 2021).
5. Molete, K.; Dehinbo, O.J.; Dehinbo, K. An innovative knowledge sharing system for collaboration in the public sector: The case of a south african government department. *Lect. Notes Eng. Comput. Sci.* **2015**, *2219*, 433–438.
6. Bercerra-Fernandez, I.; Sabherwal, R. *Knowledge Management. Systems and Processes*, 2nd ed.; Routledge Taylor & Francis: New York, NY, USA, 2014.
7. Huang, F.; Gardner, S.; Moayer, S. Towards a framework for strategic knowledge management practice: Integrating soft and hard systems for competitive advantage. *VINE J. Inf. Knowl. Manag. Syst.* **2016**, *46*, 492–507. [CrossRef]

8. Ali, A.A.; Selvam, D.D.D.P.; Paris, L.; Gunasekaran, A. Key factors influencing knowledge sharing practices and its relationship with organizational performance within the oil and gas industry. *J. Knowl. Manag.* **2018**, *23*, 1806–1837. [CrossRef]
9. Hevner, A.R.; March, S.T.; Park, J.; Ram, S. Design science in information system research. *MIS Q.* **2004**, *28*, 75–105. [CrossRef]
10. Nguyen, A.; Gardner, L.; Sheridan, D. Towards ontology-based design science research for knowledge accumulation and evolution. In Proceedings of the Hawaii International Conference on System Sciences, Honolulu, HI, USA, 8–11 January 2019.
11. Van Biljon, J.; Marais, M.; Platza, M. Digital platforms for research collaboration: Using design science in developing a South African open knowledge repository. *Inf. Technol. Dev.* **2017**, *23*, 463–485. [CrossRef]
12. Dresch, A.; Lacerda, D.P.; Junior, J.A.V.A. *Design Science Research: A Method for Science and Technology Advancement*; Springer International Publishing: Cham, Switzerland, 2015.
13. Craig, R.; Spyridopoulos, T.; Tryfonas, T.; May, J. Soft systems methodology in net-centric cyber defence system development. In Proceedings of the IEEE International Conference on Systems, Man and Cybernetics, San Diego, CA, USA, 5–8 October 2014; pp. 672–677. [CrossRef]
14. Nurani, T.W.; Wahyuningrum, P.I.; Wisudo, S.H.; Gigentika, S.; Arhatin, R.E. Model designs of Indonesian tuna fishery management in the Indian Ocean (FMA 573) using soft system methodology approach. *Egypt. J. Aquat. Res.* **2018**, *44*, 139–144. [CrossRef]
15. Checkland, P.; Poulter, J. *Learning for Action: A Short Definitive Account of Soft Systems Methodology, and Its Use Practitioners, Teachers and Students*; Wiley: Chichester, UK, 2006.
16. Strohmaier, M.; Tochtermann, K. B-KIDE: A framework and a tool for business process-oriented knowledge infrastructure development. *Knowl. Process Manag.* **2005**, *12*, 171–189. [CrossRef]
17. Febriantoro, W.; Surendro, K. Business process-oriented knowledge management system design (case study development Center of Metrological Human Resources, Ministry of Trade Republic of Indonesia). *Asian J. Technol. Manag.* **2015**, *8*, 83–95. [CrossRef]
18. Nurrohmah, I.; Sensuse, D.I.; Santoso, H.B. The expert-judgement validation and finalization of proposed interaction design process maturity instrument: Case study: E-commerce in Indonesia. In Proceedings of the Second International Conference on Informatics and Computing (ICIC), Jayapura, Indonesia, 1–3 November 2017; pp. 1–6. [CrossRef]
19. Viera, A.J.; Garrett, J.M. Understanding interobserver agreement: The kappa statistic. *Fam. Med.* **2005**, *37*, 360–363. [PubMed]
20. Brennan, R.L.; Prediger, D.J. Coefficient kappa: Some uses, misuses, and alternatives. *Educ. Psychol. Meas.* **1981**, *41*, 687–699. [CrossRef]
21. Landis, J.R.; Koch, G.G. An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. *Biometrics* **1977**, *33*, 363. [CrossRef] [PubMed]
22. Nor, N.M.; Khairi, S.M.M.; Rosnan, H.; Maskun, R.; Johar, E.R. Establishing a knowledge-based organisation: Lesson learnt and KM challenges in Malaysian organization. *Innov. Manag. Rev.* **2020**, *17*, 235–249. [CrossRef]
23. Stowell, F. Power in the 'Organisation': A soft systems perspective. *Syst. Pract. Action Res.* **2020**, 1–21. [CrossRef]