Database and Application Migration in the Financial Services Industry Sector in the Acquisition Environment and Environmental Science

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Abstract. Financial Services Industry (FSI) is a sector with day-to-day business transaction operations dealing with numbers of classified information owned by its customers. It can be managed by the private sector or other institutions pointed by the government, either it is a bank or an insurance company. Aiming to improve services, acquisitions between companies can occur. There will be a migration of applications and databases in the acquisition process. This process will present certain constraints and challenges and prone to data fraud. Improper handling will also have a negative impact on the environment, especially e-waste generation of IT components from financial sector due to company's acquisition case. So, study on database and application migration is important to be conducted. This research aims to identify constraints and challenge factors behind application and database migration in the FSI during a company acquisition. It uses a descriptive qualitative method with a case study approach that examines as much data as possible regarding the subject under study. The case studies use a single-case method, considering that the cases studied are unique and essential. The migration methodology used in this study combines application migration and databases from previous research journals and is added to the processes that occur in the field. Two factors become obstacles and challenges in the migration process, namely technology and non-technological factors. Database migration strategy uses a big-bang strategy based on joint decisions between the business and IT teams. The organizational challenge is the approval process for the transfer of membership management and data conditions that require validation and confirmation before migration. This research suggests using a mature migration strategy to anticipate technical and organizational constraints applying clear and scheduled policies and regulations.

1. Introduction
Data is a company's valuable assets in which the quality must be always maintained. To make the company's data can always be used as a basis for decision-making, data acquisition process maintenance, policy and data maintenance, data management organization, and supporting technology are required. These are all needed to ensure supply, accessibility, quality, consistency, audibility, and security data in a company [1]. On some special occasions, data migration is carried out by a company. It is a process of data transfer from the old system to the new one [2].

A company carries out data migration for some reason. Based on the research journal that has been done [3], it is conducted because of:
1. the need for the company towards merger or acquisition, or the need for data integration and an effort to consolidate the company's consolidation
2. carrying out a new model of business implementation with changes in functional and non-functional processes that are not supported in existing applications
3. technology advancement
4. new law and regulation which requires adjustment of the business process

Electronic waste (e-waste) is a term applied to all electrical and electronic equipment (EEE) that has reached the end of its useful life and is discarded or becomes obsolete, in the form of household electrical appliances, air conditioning units, television sets, computers, and all types of electronic devices [4]. The global e-waste management market is expected to grow to $49.4 billion by 2020; it is one of the fastest-growing waste streams with a reduced life span of electrical, electronic, and consumer electronic devices. Research shows that the generation of e-waste is the highest in the IT sector, followed by the Banking, Financial Services, and Insurance (BFSI) sector [5].

This research reviews the migration of applications and databases conducted by companies engaged in the Financial Services Industry (FSI). In general, FSI is one of the financial services that perform operations and handle many confidential data held by customers and data for daily business transactions. FSI is one of the main targets for data breaches [6] due to the high value of the data. Furthermore, this research's case study is the application and database migration in one division of a company engaged in the Dana Pensiunan Lembaga Keuangan (DPLK), which is acquired by another company.

DPLK can be handled by the private sector or other institutions pointed by the government; either it is a bank or insurance company. One of the Indonesian banks, which has a program of DPLK, is PT. Bank Mandiri (Persero) Tbk. or known as Mandiri DPLK. To increase the service of pension fund management, Mandiri DPLK was dissolved by transferring all DPLK program participants to PT Axa Mandiri Financial Services, which is known as DPLK Axa Mandiri afterward. With the transfer of membership, all rights, and responsibilities of Mandiri DPLK towards all participants, business partners, and other third parties have shifted to DPLK Axa Mandiri. One can dissolve a pension fund if the founder submits a request to dissolve the pension fund. One can dissolve a pension fund if the founder submits a request to dissolve the pension fund, it is stated in the Financial Services Authority Regulation No. 9/POJK.05/2014 concerning Dissolution and Liquidation of Pension Funds [7]. In that case, the management of membership data from the information technology side will also be transferred.

The application migration implementation and specific database on the FSI will face its challenges; this is stated in a research journal [8]. Some banks have mistakenly assumed regarding the data migration process, in which it was only thought that the data was only for Information Technology (IT). The user is as important in the migration process to ensure a smooth transition. These are ranging from transferring entries, balances, Profit & Loss (P&L) data/balance sheets, customer information, contracts, products, KYC details, and other forms of financial or non-financial data from the source to the target system.

In the article [9], conveyed in the data migration process, it is often underestimated for some reasons:

1. too few people involved with the implementation that knows the source and target system, including business requirements
2. the data model is a moving target because it is increased functionally to meet the business requirements
3. the new system that is less permissive and more demanding in data integrity regulations will need higher expertise in procurement or effort of data cleaning

The database migration process from Mandiri DLK to DLK Axa Mandiri is the most important, and it decides most of all the processes conducted. Data Quality Management (DQM) is a critical
supporting process in organizational change management. Changing business focus, company's business integration strategy, merger, acquisition, and partnership can mandate that IT functions integrate data source, create copies of gold data, collect the data retrospectively, or integrate the data. The capability objectives with a previous system or Business-to-business (B2B) require support from the DQM program [1].

Based on the explanations above, this research will analyze organizational and technological factors in implementing application and database migration on companies, which engaged in the FSI, particularly banking. In addition to that, the application and database migration is mainly due to the acquisition of business unit divisions by other companies. Furthermore, currently, there is not much research that discusses data migration in the FSI because of acquisition. This research aims to give further explanations concerning the implementation of application and database migration to minimize risk by combining findings from this research with some related literature.

Furthermore, the communication during the migration process is carried out face-to-face; this aims to reduce the potential risk of misunderstanding between the two parties. Data inspection and data transfer media use the application such as Microsoft Excel, Microsoft Outlook, and File Transfer Manager. The success of this research is expected to be a reference for the companies involved so that it can reduce the amount of electronic waste from company acquisition cases.

2. Literature Reviews

2.1 A Model of Data Migration Process

Database migration is transferring a database from one vendor to another or updating the current version. It is stated in the research journal [10]: in this modernization era, companies consider data as a valuable asset. When an unplanned and immature asset transfer is carried out in an unprofessional migration project, the company may face a higher risk. There are many reasons why many organizations intend to migrate their database. Those are related to the high cost of ownership and database platform maintenance, changing old servers, updating storage equipment, company merger, transferring data to cloud providers, and application migration [11]. Further explained in the journal [3], the migration project's primary purpose is to move data from the business application/source to the target permanently by implementing a specific process. The journal also explained four main stages in the migration process, namely:

1. Initialization (example: preparing the required infrastructure)
2. Development (example: developing a migration program with actual data)
3. Testing (example: conducting validation, stability, the timing of data migration, and program implementation migration)
4. Cut Over (the final stage of the migration process, moving to the target application by running the migration program)

In addition to the four main stages, it also contains fourteen process models for data migration, as illustrated in Figure 1.
Figure 1. A Model of The Data Migration Process [3]

Referring to data migration methodology in the journal [12]; there are five stages in carrying it out:

1. agility in migration
2. divide the migration process into two or more steps
3. planning
4. migration
5. validation

The crucial step in implementing data migration methodology is documentation and risk mitigation, which possibly occur. The migration process for every project has its risks; thus, there are no methodologies that could include risk estimation, which will be faced. To be more specific, the article [9] explains data conversion methodology to a specific sector of FSI by involving the functional process from the initial process of migration.

2.2 The Methodology of Application Migration
Application migration is resulted from doing it from one environment to another by doing a full re-script or due to the need for platform database migration to the new platform [13]. This application migration project between two companies will have different issues with those done in a similar company environment. A case study conducted in the journal [14] reveals that two problems will arise: technical problems and organizational problems:
1. building a MetaFrame system that is managed globally
2. building fault tolerance
3. there is an excessive number of available servers
4. implementing standard installation
5. developing a global support team
6. project duration

The research journal [15] reviews a case study of application migration, it describes application migration methodology. There are five steps to efficiently perform application migration at a high-level, aiming to minimize downtime, perfect the migration process during beta version (mock migration), test and fix the architectural design (load balancing, load capacity, and high availability). Those five steps are:

1. an initial migration assessment
2. mapping server and application inventory
3. creating an application group (it is ideally divided into business and technology group)
4. scheduling the migration and predicting the effort
5. the process to finish all five steps (Prerequisite Gathering, Mock Migration, Failover Testing, Migration/Go-Live, Decommission/Closeout)

![Figure 2. The Methodology of Application Migration [15]](image)

2.3. Server Performance/Load Testing
Server Performance Testing is the process of running an application by using a tool to conduct a simulation of application usage load, aiming to find a bottleneck in a system. Performance Testing is frequently regarded as load testing. The primary purpose is to test the scalability, availability, and performance of the hardware or software. The resource aspect, such as CPU usage, memory usage, cache coherence, data consistency (related to main memory, virtual memory, and disc), and energy consumption, bandwidth network usage is also observed and reported performance testing [16].

2.4 Microsoft SQL Server Performance Tuning and Indexing
Microsoft SQL Server Performance Tuning provides the problem-solving methodology to recognize procedures and bad quality saved search, isolate the causes of bad performance, and solve a fundamental problem. Performance tuning is a repetitive process to identify the primary constraint, aiming to complete, measure changes that occurred, and return to the first step until the performance can be accepted [17].
Index on SQL Server is a structure inside SQL Server, either in the disc or in the memory connected to table or view, which is used to fasten row identification or specific line group from table or view. The index comprises keys combined from columns in a table or view. Keys are saved in the B-tree structure that enables SQL Server to promptly and effectively find rows related to critical values. For index, which is located in a disc, keys are saved in the structured (B-Tree), making SQL Server extract rows or other rows related to critical values promptly and efficiently [18].

3. Research Methodology

The methodology used in this research was descriptive qualitative with a case study approach. In this research, the case study uses a single case as the case under study is unique and essential, meeting all requirements to test the existing theories. Furthermore, it can be generalized to other conditions [19]. These uses of study cases are aimed to review as much data regarding the subject that is being examined.

3.1 Instruments and Data Sources

According to Sugiyono [20], the thing that is being a research instrument or tool in qualitative research is the researcher itself. Thus, the writer must be validated and the instrument on how far they are ready to conduct research, which will be brought further into the field. The interview is becoming the research instrument in this research. The data is obtained through two sources: primary and secondary. The former is obtained from the direct interview with the informants or research objects. The latter is a written data used to support the primary data analysis. The data is mostly a script or document, pictures, and other related research sources.

3.2 Data Collection Technique

Data collection is done by using a triangulation technique approach. Triangulation means a data collection technique that is naturally a combination of other techniques and existing data sources [20]. Moreover, it also means that the researcher uses different collecting data techniques to obtain data from a similar source.

3.2.1 Observation. Participant observation is conducted in this research, considering the researcher was doing what has been done by the data source [20]. The observation was done for three months, started from February to April 2020.

3.2.2 Interview. The interview was conducted with the Head of DPLK Mandiri Division, Head of DPLK Axa Mandiri Division, the migration project team from Axa and Mandiri. Those are project managers, business users, and the infrastructure IT team. IT consultant vendors have also interviewed as DPLK application holders; three technical and two functional persons.

3.2.3 Documentation. By doing it to Functional Specification Document (FSD), document study consists of DPLK system functional specification and Technical Specification Document (TSD). Document study was also done by utilizing theories related to application and database migration used as a comparison and can be combined with this research result, which may lead to this research result.

3.3 Data Analytical Technique

This research analyzes organizational and technological factors in applying and database migration to the company due to other companies’ acquisitions. Objectives of this research are similar to other research that has been conducted in the journal [14], which discuss technological and organizational issues in managing system migration project in a company due to acquisition. The journal has challenges with complexity caused by a technological and organizational problem or business in an uncertain climate.
The Head of the DPLK Division conveys the problem above on both organizations in the interview session conducted separately. The division head conveyed that from the business side, it requires permission from OJK regarding the operations of the new division and related to technology audits that will be carried out by OJK as one of the business operational requirements. Moreover, cited from an interview with the Head of the Division, migration preparation still must be done in an uncertain condition and cannot be canceled. Another thing that the Head of DPLK Axa Mandiri Division said was Axa DPLK business users' readiness to run the DPLK business process under the new division and users that will operate the DPLK application.

The interview result with the user business team, the customer data that will be handed over to DPLK Axa Mandiri, should already be gone through legal and business team verifications related to company asset submission, including some of the customer data due to acquisition. Participants who disagree with the transfer of membership to DPLK Axa Mandiri will complete the account closure, and their data will not be migrated to DPLK Axa Mandiri. The participant's data will still be stored in the database and remains a data asset of PT Bank Mandiri (Persero) Tbk. Another thing, namely, for participant data that will be migrated to the DPLK Axa Mandiri, the final balance must be calculated until the data is migrated. Constraints faced in the DPLK database. Many customer data have been inactive for a long time, has no transaction history, customer balance mismatches, and data duplication.

Furthermore, the interview result with the IT, vendor, and user business team regarding the DPLK application used by Mandiri needs to be validated for the application's whole function before it is given to Axa. In the IT Mandiri team's interview, there will be a necessity to perform another UAT (User Acceptance Test) regarding the application's end-to-end process. Not all modules on the application are used during the user business usage, and the unused modules can have application bugs. From the interview, another thing that becomes an issue on the application is the probability of transaction process differences between them. However, both are engaged in DPLK services.

In conditions full of uncertainty from the business side, it is a challenge for the IT Team to carry out a mature strategy on this migration project; it was conveyed by the Mandiri IT Team and Axa Mandiri in an interview session on the topic of the migration strategy undertaken. Delivered by the IT Team, from the discussions with the management level and the experience of the database migration process that had previously been carried out and the current conditions, a big-bang strategy will be carried out. However, the implementation of this big-bang strategy must agree with top-level management. In this case, the company's head from both divisions, when the migration is complete, and the application is operated in the DPLK Axa Mandiri environment. Applications that are in the Mandiri DPLK environment will no longer be used.

The new infrastructure supply process of DPLK application implementation needs some time. Some procedures must be done based on the interview result about the readiness of the infrastructure issues. Excellent communication should be done with the IT Mandiri team regarding the required hardware's necessity and specifications. Axa Mandiri IT Team conveyed, to the readiness from the infrastructure side, it only needs the DPLK application implementation itself, for the data that could have been masked, related to the legality of the data due to the migration process had not officially started yet.

4. Results and Discussions

The main challenge of migrating applications and databases is to be done simultaneously. In a short time, this migration is expected to be done on time and succeed well, it was stated in the interview session by all parties involved in this migration project. In this study, the literature used, the application migration methodology [13] and the data migration methodology [15] and the data migration methodology [3], has several standard processes, although having different naming or terms. In this study, a combination of the two methodologies was carried out, and added the process that occurred in the field.
As an initial step, this research uses a model in the data migration journal [3] and application migration journal [15] as references. The migration approach is carried out in both journals with a case study with a gradual migration process. In the gradual migration process, the risk of failure can be known initially, and mitigation can be done immediately. Before the migration is done, the initial stage is to do a grouping of migration teams, namely the business and the technology team. In the application migration journal [15], the team must consider the input, process, and whatever that affects the migration process to develop an optimal migration schedule when grouping the migration team. From the interviews with each head of the division, the problems that arise are grouped into two factors, according to the team's division, namely business and technology factors.

**Business Factor**
From the interviews conducted with each division head, it was conveyed that this migration had to be carried out according to schedule, with the announcement of the transfer of participation in the DPLK program from Mandiri DPLK to DPLK Axa Mandiri to the public. Therefore, this migration's implementation has a significant burden and responsibility to maintain the two companies' credibility. The Mandiri DPLK business team's readiness is to verify and validate the membership data transferred to the DPLK Axa Mandiri. From interviews with the Axa Mandiri DPLK business team, for inactive customer data, no transaction history and balances that are inappropriate, data duplication, and participant data that do not agree to be transferred to Axa Mandiri DPLK, will be closed. Data accounts will not be migrated to DPLK Axa Mandiri; it is decided to do data cleansing on the DPLK.
database. Data cleansing activity is a stage carried out in the FSI. In line with the research journal [8], the data migration project's primary purpose is to migrate clean data into the core banking system. Cleansing of data is required, which can be not very easy, depending on the method chosen and, therefore, must be planned carefully.

Data migration in the FSI is generally having the main issue in the data migration process. Conveyed in a research journal [8], the main issues of data migration in the banking sector are the lack of data knowledge, the quality of data source, the higher volume of data, alignment of business and accounting standard, data mapping, duplicate data, the short duration of the conversion period, data reconciliation, the lack of flexibility, the regular business operation. For the IT team itself, smooth data migration is an essential part of the successful IT transformation, but its complexity cannot be underestimated.

The necessity of data verification and validation from the business team is formulated into a business requirements document, further implemented by the IT team into one of the migration phases. DMBOK defines data management as both business data stewards and data management professionals in IT organizations [1]. Cooperation from each business data steward must minimize potential risks during the migration process. The business data steward is responsible for the quality and management of data elements. Also, it requires the collaboration of data management professionals in Information Technology (IT) organizations responsible for data management's technical functions.

**Technology Factor**

Initial planning of technology factors helps identify issues or risk potencies, resulting in migration projects. One of the crucial aspects that must be planned earlier is migration strategy. In a research journal [8], basic data migration strategies should be considered: Big-Bang, Phased, Parallel run. From the result of an interview with the head of the division and IT team from both organizations, it was decided to use a big-bang migration strategy, in line with the research journal [8] due to some factors:

1. all the data should be migrated all at once
2. suitable for the FSI, which has a low data volume
3. short migration duration

However, the big-bang migration strategy has some demerits; these are high risk; small details might be ignored; a failure in a specific part might happens continuously. Furthermore, the IT team conveyed that the rollback strategy should be planned to regain the original condition of a system where migration is inadequate.

The migration schedule is arranged according to the team's agreement involved in the project. Based on the interview carried out, the head of the DPLK division from two companies conveyed that every step and migration schedule must be informed periodically to perform risk mitigation from business perspectives. It was also stated by the manager from both companies that the detailed work and estimation in the completion are outlined in the migration schedule.

**Proposed Approach for Database and Application Migration with A Big-Bang Strategy**

A merger is performed between application and database migration methodology from some journal research with the migration process condition. Figure 3 in this research summarizes each process done from either application or database side.

**Strategy and Pre-analysis**

DPLK application is owned and developed by an IT consultant vendor. To perform a database and application migration, vendor involvement must implement. The strategy and process of migration are discussed here. In this research, it has been stated that a big-bang strategy should be done in the migration process. The database migration strategy uses big-bang migration by doing a transfer to all databases. In this big-bang process, data is released from the system source, proceeded, then upload to
the system target, followed by the transfer of the process to the new environment. Offline migration will also be conducted, which means a source will be turned off during the migration [21].

**Database Cleansing Data**

One of the conditions that must be fulfilled during data migration on an IT company engaged in the FSI is migrating clean data to a target system. The business user team has submitted the IT team's business requirements document from the database side. The process is repeated, and the user's business team reconciles the data until the data is appropriate.

**Application User Acceptance Test (UAT)**

Before the DPLK application is submitted to DPLK Axa Mandiri, the UAT should be carried out by DPLK Axa Mandiri to ensure no application issues. There are 551 test scenarios and 41 functions in the DPLK application and have passed the Mandiri DPLK business users’ testing.

**Platform Application and Database Setup**

An agreement of testing has been made using the backup database production of Mandiri DPLK on a specific date to support the test from DPLK Axa Mandiri's IT infrastructure. Since the database is used for server testing, the Mandiri DPLK Mandiri database's data went through data masking for customers. A backup database is conducted in a .bak file. The backup database file and the application are then submitted to the PT Axa Mandiri Financial Services IT team to implement the DPLK Axa Mandiri server.

**Source Data and Application Unloading**

DPLK application and database implementation are performed on the application and database server. To ensure that both servers are used according to expectations, performance testing is done. In general, performance testing is a qualitative and quantitative assessment of a system in realistic conditions to ensure whether the performance requirements are met or not. In the testing flow, performance testing is carried out at the end of the assessment plan, after functional testing, including adjustment, other application integrations, and interactions are performed [22]. The testing is carried out using local computers connected to the DPLK LAN server to run all the testing scenarios. The tool used is to do test Internet Explorer ver. 11.0 by using a compatibility view setting. System Integration Testing (SIT) is also carried out by the Axa Mandiri IT team using some testing scenarios to ensure that system integration runs smoothly.

The testing is also done on web performance testing. The objective of simulating the actual load is to identify the performance obstacle, optimize system performance, and ensure that the program's practical operation can provide excellent and reliable performance [23]. For the load testing, the testing scenario simulation used is only during EOD (End of Day) generate. EOD generates a process to calculate the balance of all customers’ data on an active day. This process is the most severe one used in the DPLK application. Thus, carrying out the testing to application load testing can be used as a benchmark.

**Migration Run Test and Final Rehearsal**

To ensure the data is well-implemented, one of the methods is by comparing report EOD data from the DPLK Mandiri system with the DPLK Axa Mandiri’s. This step is conducted several times until the resulted data is appropriate and receiving clarifications from user businesses. On the rehearsal step, the process is illustrated in figure 4 below. In Figure 4, EOD generates a DPLK Mandiri report and the Axa Mandiri environment. The ninth step is the step that decides the success of the rehearsal. After all the reports of EOD transactions have been successfully issued in Excel file, manual reconciliation between EOD report on Mandiri DPLK database and DPLK Axa Mandiri is carried out by the users to ensure that the data is appropriate, along with the result.
There is an obstacle at the first migration rehearsal; although indexing SQL server has been done, withdrawal of an EOD transaction report still takes time. The solution is doing an SQL Server Performance Tuning from the query side. Like the first one, the final rehearsal data migration phase is carried out similarly. No obstacles were found in the second migration rehearsal process, and after a manual reconciliation for all EOD reports, it was declared user-friendly.

**Productive Migration and Finalizing**

An agreement for a closing date is decided; thus, big-bang migration is carried out on the database at that date, and impossible to perform a migration cancellation. In addition to the finalizing data migration stage, the activities carried out are the same as those performed during the final rehearsal. As shown in Figure 4, the difference is in the date of the database used. The implementation of big-bang migration is carried out by the date decided and is not found any obstacles during the implementation. Furthermore, the last phase is the reconciliation manually between the EOD report's result on the DPLK Mandiri database and DPLK Axa Mandiri by users. The result has already been appropriate.

**Maintenance**

This phase is closing from all application migration projects and the DPLK database from DPLK Mandiri to DPLK Axa Mandiri. The final phase of this migration is the DPLK application's usage by
DPLK Axa Mandiri later. The next essential step is monitoring the continuation of DPLK application maintenance on new business and IT infrastructure environment and the need for cooperation between the business team from those two organizations related to application operational.

5. Conclusion and Suggestion
This research shows factors that become obstacles and challenges behind application and database migration in the FSI during company acquisitions. The migration strategy of this research is by using a big-bang migration strategy. For mapping the technical issues, the writer uses application and data migration methodology, these two are combined, and some improvised processes at the research field are also added. This study's organizational challenges are related to business team decision for membership data to be migrated. There are some data conditions which need business team decision during data cleansing. This is important because it is not only detrimental to the company, but also indirectly has a negative impact on the environment from the generation of electronic waste from IT components. Electronic waste is a growing concern in today's global society, and a large amount of this e-waste is added to the global waste inventory every year.

This research is limited to the study case of application and database migration from DPLK Mandiri to DPLK Axa Mandiri. Hence to ease further migration projects, it is better to provide system documentation intact. The necessary thing in implementing data migration methodology is risk documentation, which may occur or risk mitigation. The migration process for each project has different risks. Hence no methodology can cover the estimated risks that will be faced. It is also necessary to find other alternatives in providing migration tools that suit the needs (cost, time, quality, and other benefits).

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