RESEARCH MS ACCESS SOFTWARE FOR APPLICATION IN SMART GARMENT FACTORY MACHINE MANAGEMENT

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DOI: 10.17973/MMSJ.2023_06_2023042

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This study was conducted to support the process of Vietnamese garment companies in building smart factories with production activities that can be controlled automatically. It is a model for managing the system of machines in the factory using MS Access, which allows for updating machines information, searching for machines, reporting, and statistics. It allows for managing the information changes in the system, including machine information, warranty time, maintenance schedule, repair history, disposed of machines, and purchasing new machines. The system replaced a batch of manual operations and paperwork procedures with queries, macros, and reports. The results are labor cost savings, reduced costs, and increased machine utilization efficiency.

KEYWORDS

MS Access, digital transformation, smart factory

1 INTRODUCTION

"Digital transformation" and "smart factory" are terms that have existed for quite some time [Klaus 2016] [Andreja 2017] and advanced manufacturers can put them into practice [Kyu 2019]. In an advanced smart factory, all production resources are monitored in real time via the Internet, and production activities can be controlled automatically [Kate 2021]. A smart factory was developed to remotely diagnose the conditions of the production site and predict future conditions while participating in the entire factory operation—from design and production products to logistics and handling. In fact, digital transformation refers to how machine data is transferred from devices to standard business applications such as Enterprise Resource Planning (ERP), Manufacturing Execution System (MES), and Customer Relationship Management (CRM) systems; analyses the data, shows conclusions, and applies back to the production process to make it better [Kyu 2019] [Woo 2020]. Currently, there are many software supporting business managements such as CRM, ERP, MES, Document Management System (DMS), Business Intelligence System (BI), the warehouse management system is applied in businesses operating in different industries [Diego 2016] [Woo 2020]. And they want to be a fully automated smart factory which means that accurate up-to-date production information is available at all times in these systems – for analysis, timely alerts, maintenance announcements, etc. [Areti 2018]. The digital transformation in the apparel industry, especially in the manufacturing sector, is relatively slower than in other industries due to the product's characteristics diversity and rapid fluctuations [Debraj 2022]. It can be said that it is more difficult than other industries the management of the production process for each individual order, but it also have in common that it is necessary to manage machines and people. Therefore, the garment industry can apply techniques integrated with IoT (Internet of Things), artificial intelligence, and digital software to improve production efficiency [Minyoung 2020]. Digital transformation allows efficient exploitation of machines as well as the fastest way to deploy a division of labor on sewing lines. The digitization of machine records will solve the following tasks: Overall management of the quality and quantity of existing machines; Monitoring warranty period, maintenance, and repair; Calculating the coordination of people and production machines to improve productivity and quality; Managing the productivity of the whole sewing line [Paola 2018] Digital management allows seeing the structure of the machine system, and the degree of automation of the whole system in each stag [Areti 2018].

Vietnamese garment companies have been managing machines by storing documents in the form of books or Excel files, leading to fragmented manual management [Truong 2019]. It is difficult for leaders to grasp the reality of how their company is operating. Through the survey of companies, the research team of Hanoi University of science and technology found that some problems need to be solved for the design of smart garment factories in Vietnam, which is the need to digitize the existing information of the company into fields then apply data analysis algorithms to come up with optimal solutions in production deployment to increase labor productivity, reduce costs, waste, etc. We plan to implement machine management as shown in Fig. 1. With the existing facilities of companies and their initial desire to calculate and design a total data management system that can be exploited internally for information security, we recommended : "Research MS Access software for application in smart garment factory machine management".

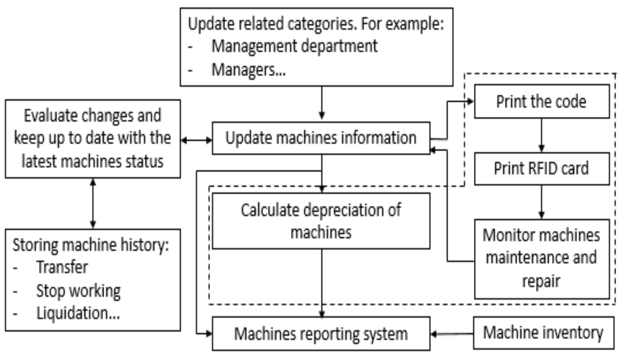


Figure 1. The process of updating machine management data information

This research is deployed with the following contents : part 2 is researching the functions of Access for designing data management systems, part 3 is the study to build information fields for machine management of garment companies, and the last part is the conclusion to evaluate the effectiveness of this system application [Microsoft 2016].

2 STUDY THE FUNCTIONS IN ACCESS SOFTWARE

Microsoft Access is a component of the Microsoft Office suite developed by Microsoft. Access is a Database Management System (DBMS) that provides high performance and ease of use due to its interface similar to other software in the MS Office suite such as MS Word and MS Excel. In addition, Access offers a powerful toolset system that simplifies the process of building small and medium-sized software projects for managing data [The University of Nottingham 2017].

Access includes 6 main objects: Tables, queries, forms, reports, macros, and modules. Tables are the basic element in an Access database. This is the most important object, used to store data. Each table stores information about a managed object [Phuong 2013]. There are three types of relationships between tables one-to-one, one-to-many, and many-to-many. The one-to-one relationship is when each record in a table is related to only one record in another table. This relationship is formed by the relationship between the two primary keys of the two tables. The one-to-many relationship is when one record in a table is related to many others in another table. This is the most common form of relationship and usually exists where one table is used to look up key values. Finally, the many-to-many relationship is that many records in one table can be related to many records in another table – this is formed by each relationship between two foreign keys. [The University of Nottingham 2017]. For example, an employee works with many machines and each machine is also managed and used by many employees, for this type of relationship, an intermediate table will usually be needed to establish a relationship.

Next is queries, which are a tool used to extract data under defined conditions, the extracted dataset is also tabular. The query includes 5 types: select query, total query, crosstab query, top query, and action query. In particular, the query is the source data for the design of the form. In MS Access, the form can be designed for various purposes such as entering data, displaying and editing data, etc. The source data can be obtained from tables or queries. If the source data is fields on a table, then take that table as the source data, if the source data is fields on multiple tables, then create a query as the source data for the form [Phuong 2013]. To create more functionality that connects the user and the interface, we can add controls to the form such as tab control, button, text box, etc. After that, we can extract that information by creating reports and setting the display, properties for the form such as display settings, data settings, and event settings through Macros.

Reports are generated from tables or from queries depending on the designer's intent [Phuong 2013]. These reports can be attached to the appropriate forms via buttons and set the corresponding macros to output and print reports.

Macros are one or more actions (operations) that Access performs once at runtime. The designer will set up the macros for the object to match the design goals through actions [Phuong 2013]

Finally, the module is an access tool that uses the Visual Basic language to create programs that work around the limitations of macros [Phuong 2013].

In addition, Access is one of the software in Microsoft's Office suite, it easily integrates with other software in the same system and is convenient in the process of sharing databases. Therefore, the software has been researched with the topic " Access applications in human resource management and accounting salaries " [Huynh 2010], applied in the field of human resources and accounting with the following functions such as: managing employee records, managing salary, calculating salary, making books, accounting documents, etc. and the research paper "Building management software for general chemistry labs for teaching in University of Fire Fighting and Prevention " [Bui 2021] has exploited MS Access software in managing activities of the practice room of General Chemistry to manage laboratory equipment and activities of teaching, learning and practicing activities in class. However, in the process of researching and using Access software, it will still be found that some of its limitations are that the software is limited in storage capacity, the number of locomotives operating simultaneously on the data system is not enough more than 40 computers, everyone processes data on the same file, so when the query outputs the data between the forms, it is delayed [Junaid 2022]. Moreover, the software is limited to internal applications only and cannot yet be applied to the cloud. After analysing the advantages and disadvantages of MS Access, combined with practical research conditions in small and medium-sized garment enterprises, we have chosen this software as an object to apply in our research to build a database system on equipment management that allows users to log in, view, search, edit, delete and share information in the system.

In this study, in order to be able to build a software application to manage the operation of the machine, we have designed 14 original data tables and 13 relationships, 3 queries, 30 forms, and 6 reports. In the following, we delve into the design of a data system for machine management.

3 RESEARCH MS ACCESS SOFTWARE FOR APPLICATION

In the future, in order to design a smart garment factory, it is necessary to complete all the contents as shown in Fig. 1. However, given the current conditions in Vietnam, the research group initially addresses the digital transformation of the machine management database in the garment industry. The machines management system designed by MS Access [Microsoft 2016] includes three main functions: updating information, searching information, and report - statistics. These functions are shown in detail as shown in Fig. 2.

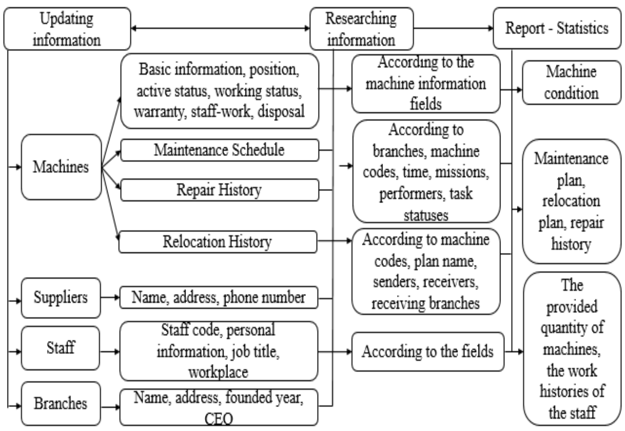


Figure 2. Diagram illustrating the main functions of the machine management system

Updating information for machines, branches, production lines, employees, machine statuses, and machine operation history and machine location. Calculating the state conversion of machines at each point in time to determine the total number of machines according to each management content. For example, in the case where one sewing machine is broken, the system will be updated to increase one broken machine and decrease one working machine.

Search for machines based on information such as code, type, location, status, the warranty period of machines, maintenance time, and for machines that need to be disposed of.

Reporting the status of machines by production line, branch, number of operating, broken, and needing maintenance machines, etc.

First of all, the machine management system is designed with a basic database consisting of a summary table of machine information, a list of branches, a list of employees, a list of machine suppliers, repair, relocation, disposal, and purchasing of new machines to optimize asset management and utilization. Fig. 3 presents a relational data model with its entities and attributes to serve the updating of information for machine management.

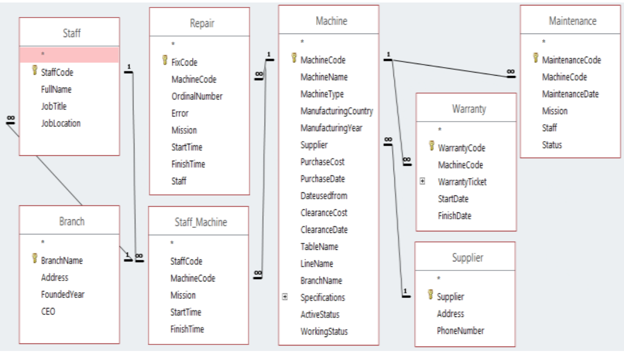


Figure 3. Model for updating machine information

The central entity of the data model is the "Machine". Therefore, the information fields of the machine will interact with each other when there is updated information. The "Machine Management" form contains the "Machine List" form along with calculation text boxes, search text boxes, a "print" button, and an "exit" button designed as shown in Fig. 4 to manage the enterprise's system of machines.

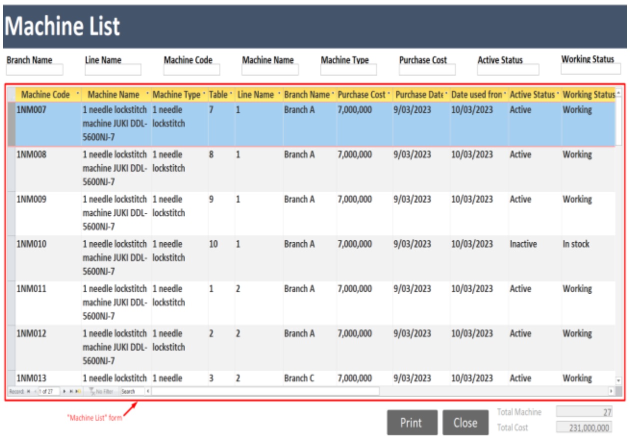


Figure 4. Interface of "Machine Management" form

The data that needs to be regularly managed and updated for each machine in the "Machine List" form are working status and active status. The active status is set to two states: active and inactive. The working status is set to the following states: working, pausing, fixing, maintaining, and disposed. The "count" and "sum" functions (Fig. 5) are used to count the number of machines being displayed and calculate the total amount spent on those machines through calculation text boxes placed in the footer of the "Machine List" form.

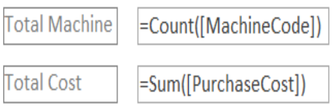


Figure 5. The calculation text boxes of the "Machine List" form

Eight text boxes are designed to search for corresponding information fields: branch name, line name, machine code, machine name, machine type, purchase cost, active status, and working status, which are set up using the "like" functions as Fig. 6.

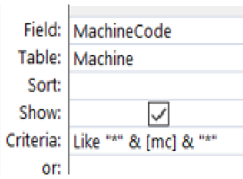


Figure 6. "Like" function of the "MachineCode" field

The "On Click" macro is set up with a suitable where condition to design the "Print" button to print the report according to the previous search. The machine profile such as machine information, warranty, maintenance, repair, staff - work, and relocation history. Each of these pieces of information is stored in a separate form, which is then synthesized into a form named "Machine Profile" (Fig. 8) and linked to the "Machine List" form by the "MachineCode" field (Fig. 7).

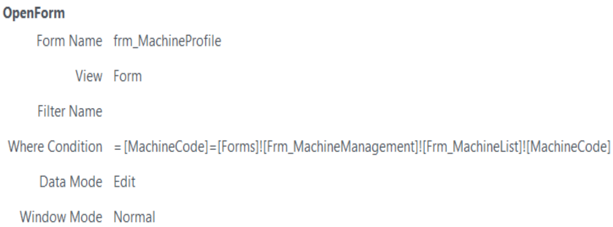


Figure 7. Designing "Dbl Click" in the "Machine Management" form

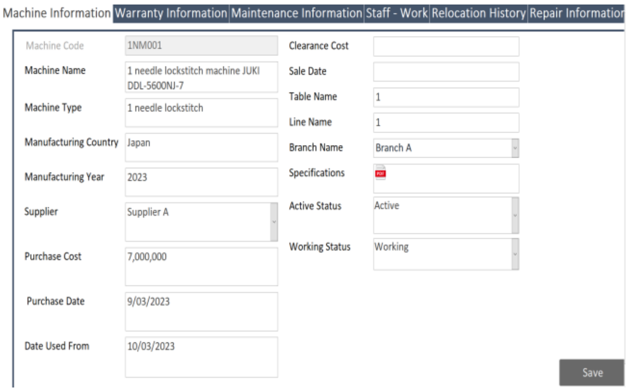


Figure 8. Interface of the "Machine Profile" form

To ensure machine productivity and quality, it is crucial to monitor the warranty and maintenance schedule to maintain the performance, reliability, and safety of the machines. In Vietnam, machine maintenance is still not given sufficient attention [Tuan 2017]. Moreover, the textile industry has various types of machines, each with different maintenance so monitoring the schedule for these jobs is also set for the management system. Therefore, the "Warranty Information" tab – Fig. 9 and "Maintenance Information" – Fig. 10 are designed to update and search for warranty and maintenance information on machines.

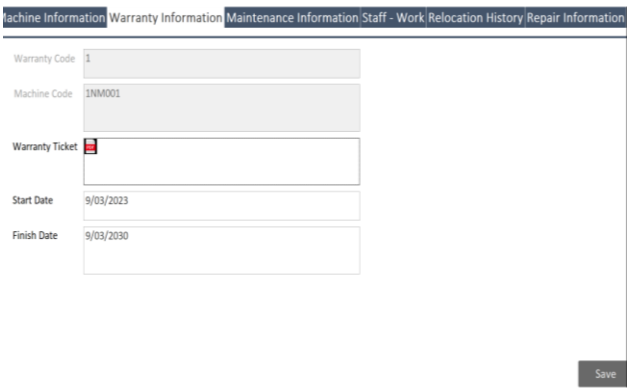


Figure 9. Interface of the "Warranty Information" tab

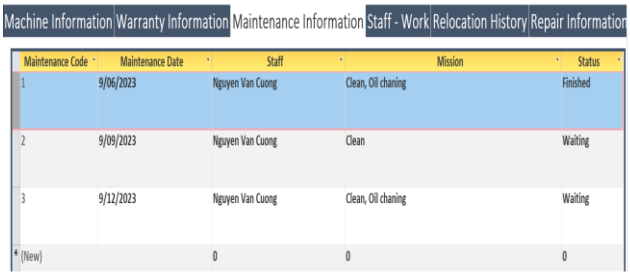


Figure 10. Interface of the “Maintenance Information” tab

The "Maintenance Schedule" form is designed to search for a list of machines that need maintenance and assign tasks to workers. It includes the "Maintenance Machine List" form, search text boxes, machines count text boxes, and a "Print" button for printing a monthly maintenance machine list as shown in Fig. 11.

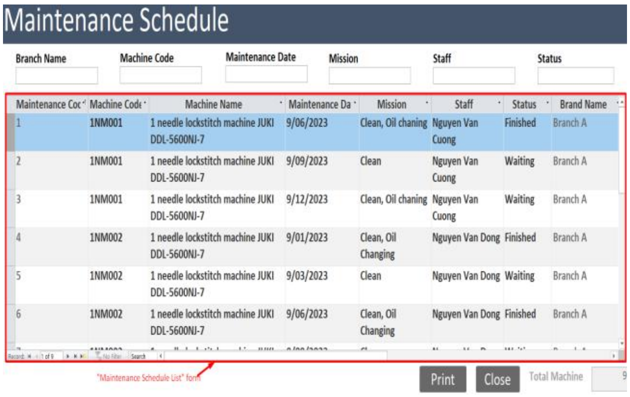
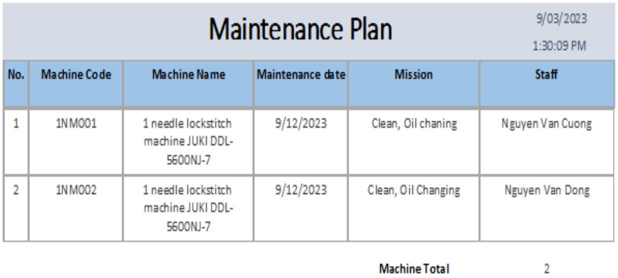


Figure 11. Interface of the “Maintenance Schedule” form

On the interface of the "Maintenance Schedule" form, it is possible to search by branch name, machine code, maintenance date, mission, staff, and status and print the maintenance plan report according to the month of the previous search as shown in Fig. 12.



Maintenance Plan 9/03/2023 1:30:09 PM

No.	Machine Code	Machine Name	Maintenance date	Mission	Staff
1	1NM001	1 needle lockstitch machine JUKI DDL-5600NJ-7	9/12/2023	Clean, Oil chaning	Nguyen Van Cuong
2	1NM002	1 needle lockstitch machine JUKI DDL-5600NJ-7	9/12/2023	Clean, Oil Changing	Nguyen Van Dong

Machine Total 2

Figure 12. Report of maintenance plan for machines per month

The repair of a machine during its use is inevitable. Repair tasks often occur unexpectedly. The repair missions are recorded in one of two ways: updating the task through the "Repair Information" tab of the "Machine Profile" form (Fig. 13) when selecting a device, or updating it through the "Repair History" form as shown in Fig. 14.

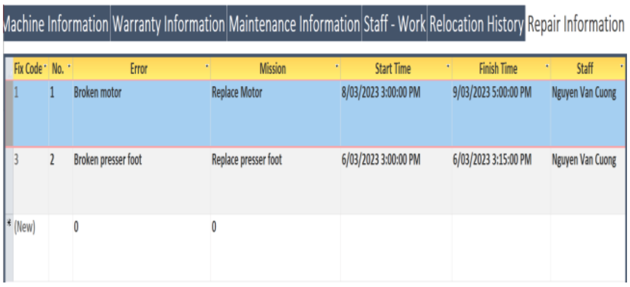


Figure 13. Interface of the “Repair Information” tab

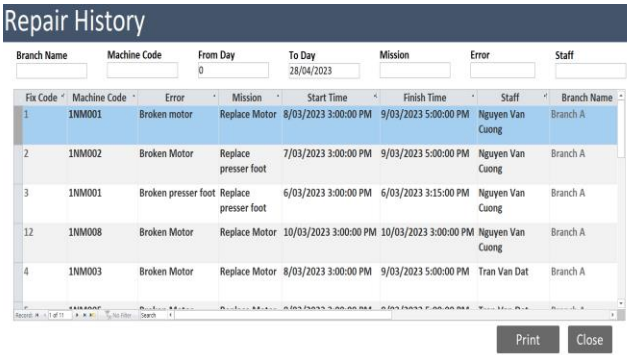


Figure 14. Interface of the “Repair History” form

To get an overview of the operations of the machine during a certain period of time, it is possible to query through the "Repair History" form to print out the report designed as shown in Fig. 15.

Repair History From Day 30/12/1899 To Day 13/03/2023

No.	Machine Code	Machine Name	Mission	Staff	Start Time	Finish Time
1	1NM001	1 needle lockstitch machine JUKI DDL-5600NJ-7	Replace Motor	Nguyen Van Cuong	8/03/2023 3:00:00 PM	9/03/2023 5:00:00 PM
2	1NM002	1 needle lockstitch machine JUKI DDL-5600NJ-7	Replace presser foot	Nguyen Van Cuong	7/03/2023 3:00:00 PM	9/03/2023 5:00:00 PM
3	1NM001	1 needle lockstitch machine JUKI DDL-5600NJ-7	Replace presser foot	Nguyen Van Cuong	6/03/2023 3:00:00 PM	6/03/2023 3:15:00 PM
4	1NM003	1 needle lockstitch machine JUKI DDL-5600NJ-7	Replace Motor	Tran Van Dat	8/03/2023 3:00:00 PM	9/03/2023 5:00:00 PM
5	1NM005	1 needle lockstitch machine JUKI DDL-5600NJ-7	Replace Motor	Tran Van Dat	8/03/2023 3:00:00 PM	9/03/2023 5:00:00 PM
6	1NM013	1 needle lockstitch machine JUKI DDL-5600NJ-7	Replace presser foot	Tran Van Dong	6/03/2023 3:00:00 PM	6/03/2023 3:15:00 PM
7	2NM010	2 needle lockstitch machine JUKI LH 3528A-7	Replace Motor	Tran Van Dong	8/03/2023 3:00:00 PM	9/03/2023 5:00:00 PM
8	2NM011	2 needle lockstitch machine JUKI LH 3528A-7	Replace Motor	Tran Van Dong	8/03/2023 3:00:00 PM	9/03/2023 5:00:00 PM
9	2NM004	2 needle lockstitch machine JUKI LH 3528A-7	Replace presser foot	Tran Van Duc	6/03/2023 3:00:00 PM	6/03/2023 3:15:00 PM

Figure 15. Report on repair history by time range

In addition to maintaining and repairing machines, to effectively exploit machines throughout the company, idle machines in this branch can be mobilized to other branches. To implement this function, it is necessary to establish a relationship between the machine table, the relocation plan table, and the relocated machine table, as constructed in Fig. 16.

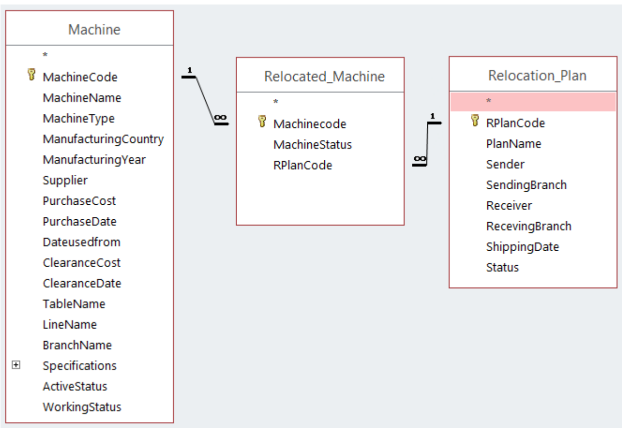


Figure 16. Model for managing machine relocation

After establishing the relationship, proceed to set up the "Machine Relocation" form containing the "Relocation Plan" form with fields, along with text boxes for searching based on plan name, sender, receiver, receiving branch and an "Update Machine List" button as shown in Fig. 17.

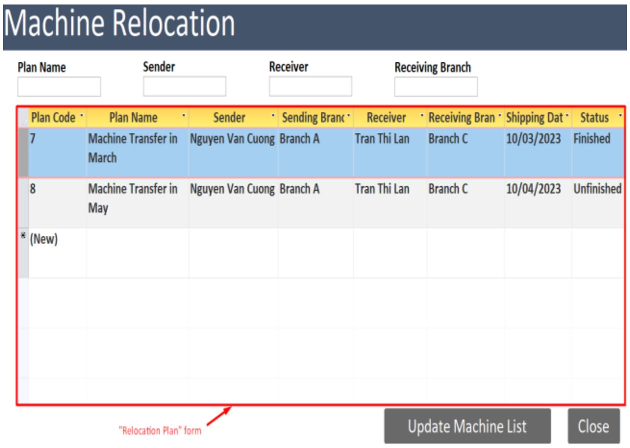


Figure 17. Interface of the “Machine Relocation” form

Set up a "Dbl Click" macro for the "RPlanCode" field with a suitable where condition to open the "List of Machine Relocation" form (Fig. 18) with the corresponding plan code. Then relocation history will be recorded in the machine profile.

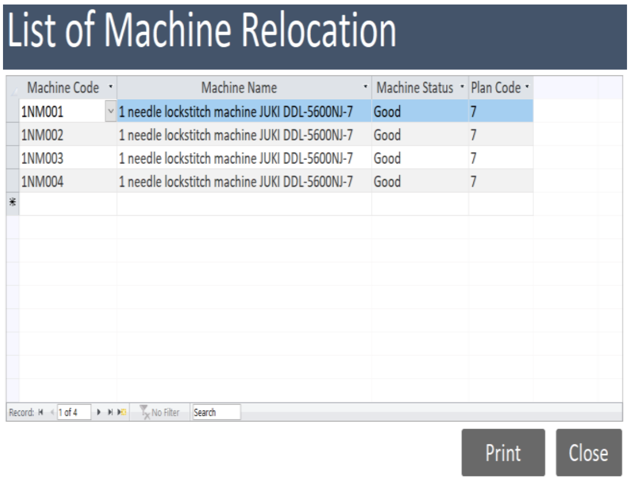


Figure 18. Interface of the “List of Machine Relocation” form

When transferring the machine, the machine's location and status in the profile changed. Therefore, to manage this change, the "Update Machine List" button has been set up. When the user changes the plan status to "finished", the new location of the machine will be updated in the "Machine List" form. This task is performed using the "Update Query" and the functions in "Update to" (Fig. 19).

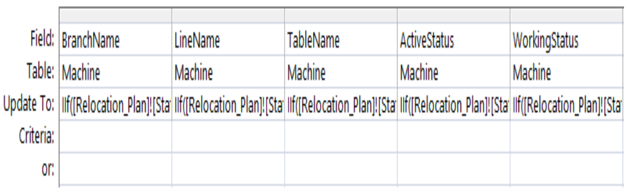


Figure 19. “Update Query” to reupdate the location after completing the relocation plan

The relational data model as shown in Fig. 20, the designed forms and “Update Query” aim to establish a list of machines that is no longer suitable for their intended purpose or is damaged and unusable.

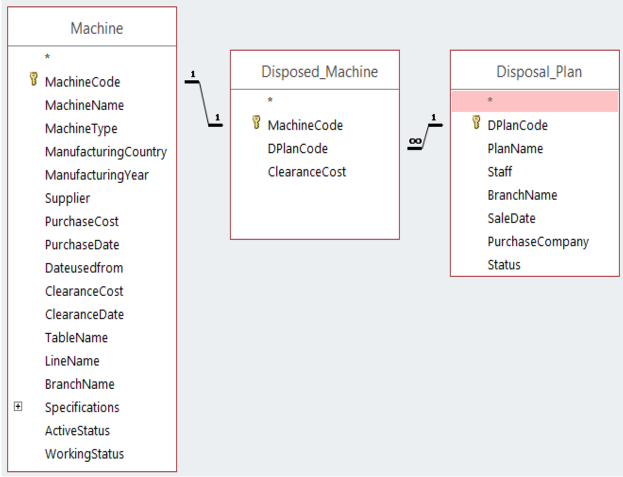


Figure 20. Establishing a relational data model for managing machine disposal

Similar to the relocation of machines process, the "Machine Disposal" form contains the "Disposal Plan" form and an "Update Machine List" button designed for creating, editing, viewing, or exporting disposal reports. Similarly, a "Dbl Click" macro is set up for the "DPlanCode" field to open the form for creating the disposal machine list. The disposal report is generated from the "Machine Disposal" form after completing the declaration information (Fig. 21) and reupdating the fields of the "Machine List" such as "ClearanceCost", "ClearanceDate", "ActiveStatus", "WorkingStatus", "TableName", "LineName" using an “Update Query” as shown in Fig. 22.

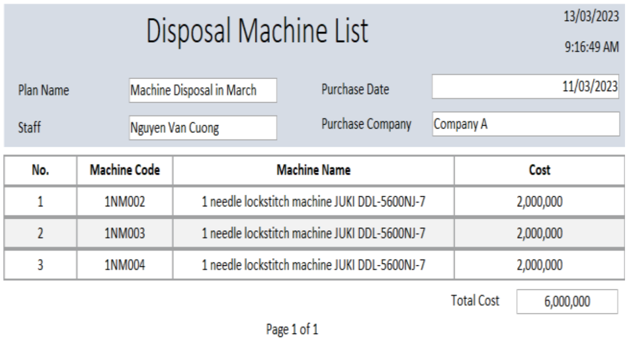


Figure 21. Report of the disposal machine list

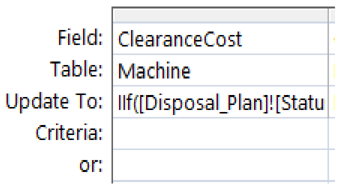


Figure 22. “Update Query” to reupdate clearance cost information

The machine management system also includes the task of purchasing new machines. In this case, it is necessary to plan the purchase, select suppliers, and determine the type and quantity of machine to be purchased. Similar to the disposal task, a "Machine Purchase" form contains a "Purchase Plan" form and an "Update Machine List" button. We set up a "Ddl Click" macro for the "PPlanCode" field to open the "List of purchased machines" form. After completing the purchase plan, the plan status is changed to "finished" and by selecting the "Update Machine List" button, all information about the machine in the purchase plan such as "MachineCode", "Machinename", "MachineType", "PurchaseCost", "ManufacturingCountry", ManufacturingYear", "Supplier", "LineName", "BranchName" "PurchaseDate" will be added to the machine list. To do this, we used “Append Query” as shown in Fig. 23.

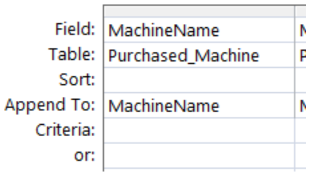


Figure 23. “Append Query” of “MachineName” field to add this information to the machine list

In summary, a digital technology application management system encompasses all activities related to machines designed through an overall relational data model presented in Fig. 24. The homepage interface of the management system has also been researched and designed as shown in Fig. 25. This system allows for the replacement of many manual operations along with many paperwork procedures with query command systems and printing corresponding reports. In the journey towards designing a smart garment factory, this system is considered an initial experiment in the process of digitizing machine management data through application software. It is still internal but has significantly reduced operating costs while increasing production efficiency. The specific figures will be determined in the future when this system is widely deployed in Vietnamese garment companies.

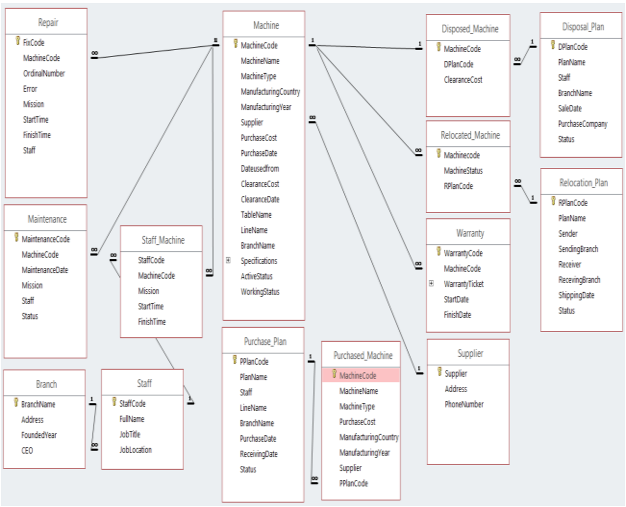


Figure 24. Relational data model manages the entire machine system

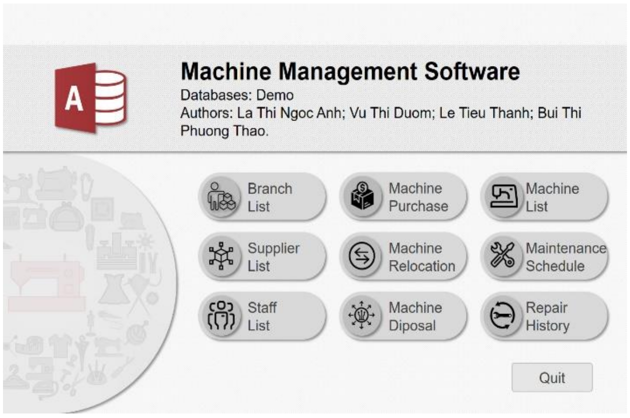


Figure 25. The interface of the homepage form for the equipment management system

4 CONCLUSIONS

We have designed a model for managing the system of machines in a garment factory using MS Access, which allows for updating machine information, searching for machines, and reporting and statistics. The machine profile includes information such as machine specifications, warranty, employees and jobs related to the machine, repairs, maintenance, and the location of the machine are digitized and put into the system. Additionally, the system supports monitoring activities, planning operations, and replacing a batch of manual management operations, and paperwork procedures with queries, macros, and corresponding reports. Our approach has provided a potential solution for small and medium-sized enterprises to save labor costs, reduced costs, and increased machine utilization efficiency. In terms of research as well as the financial capacity of small and medium enterprises, this system still has limitations such as not being integrated with IoT, artificial intelligence, or data analysis software and cannot having a Big Data connection. Therefore, our next research direction is the application of artificial intelligence and cybernetics to the automatic management of maintenance and repair of sewing machines without being limited in space and time.

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