Repair Service Process Improvement for TCYC

1. Background, Motivation and Purpose

At the beginning of the school year, more than 50% of students in the dormitory will experience a lengthy repair service, which may last up to 1 month or have secondary repairs. Besides, the repair website is complicated with the mixed-content form, and it limits the number of problem description words but without pictures or video upload functions to help clarify the problem. Therefore, it results in some difficulties for students to report repair problems. The current repair service is also opaque.

The low-quality repair quality not only brings inconvenience but also causes lots of dissatisfaction with students. This study hopes to analyze existing repair service problems and propose improvement measures through BPR philosophy and re-engineering technology (IDEF), establish a new repair service process and repair system to shorten repair time and service cycle time, improve service response speed and accuracy of repair-problem identification, thus providing students with high-quality repair services.

2. Improvement Methods

2.1 BPR

BPR is a business management strategy that focuses on the analysis and design of workflows and business processes within an organization. It aims to help organizations “fundamentally” rethink how they do their work to improve customer service, cut operational costs, and become world-class competitors.

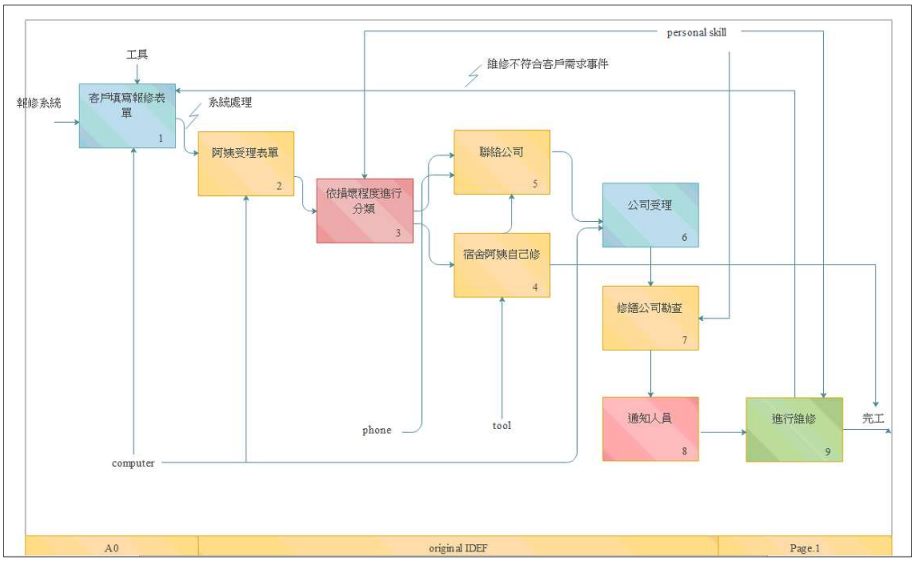
2.2 IDEF

IDEF is a group of modeling methods that can be used to clearly describe the operations of an organization or a system. It should assist in organizing system analysis and promote effective communication between the analyst and the customer through simplified graphical devices. Thus, IDEF models are often created as one of the first tasks of a system development effort. Moreover, IDEF can apply to BPR, information system development, and automated system, etc.

3. Analyze and Improvement

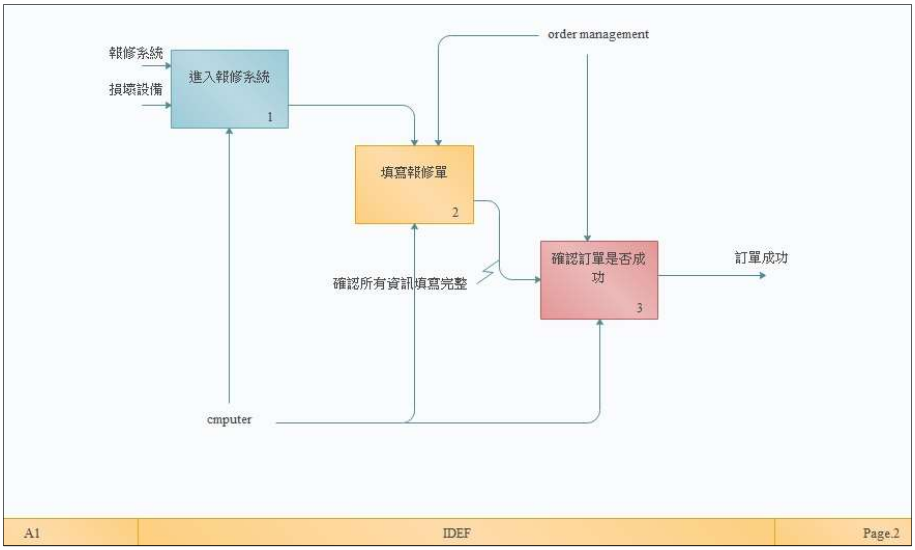
3.1. Process Description with IDEF Method

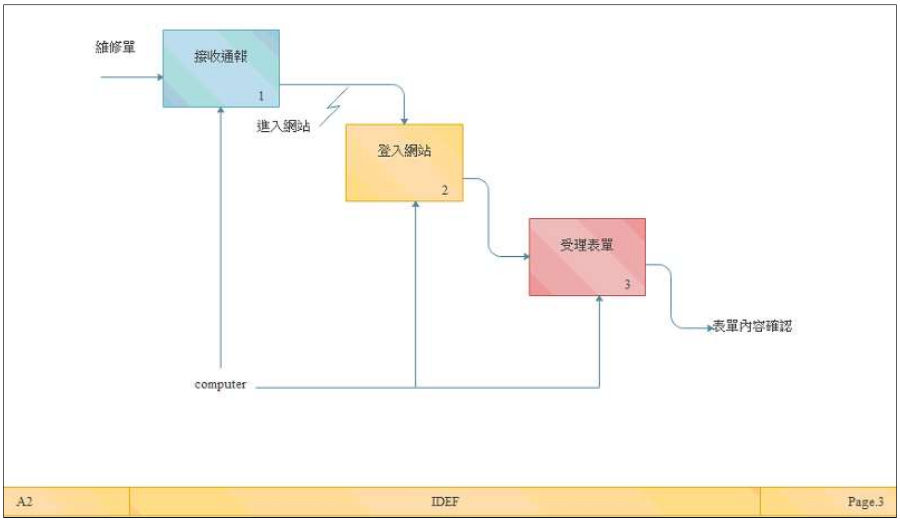
3.1.1 Original Process

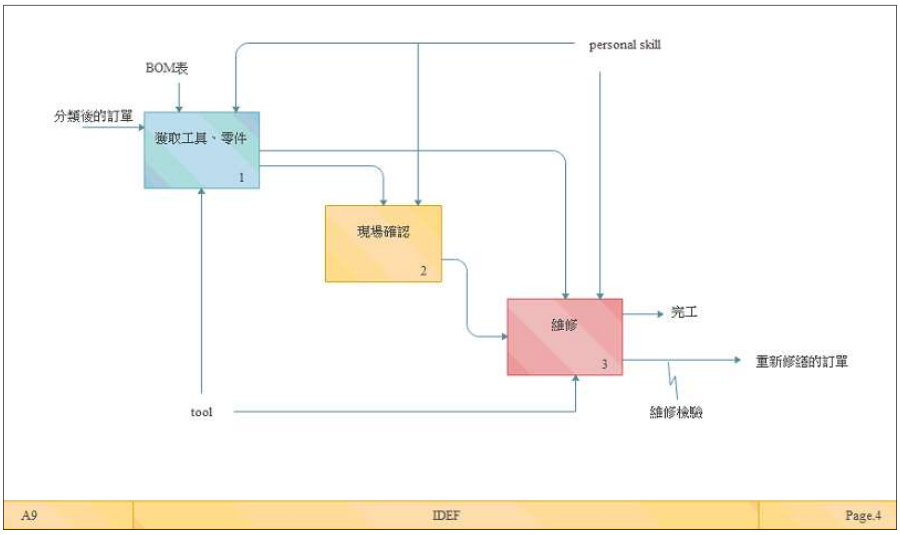


In A0, if the user wants to use the repair system, he needs to fill out the form. After receiving the orders, the supervisor will judge the level of damage. If the supervisors think it can be repaired by themselves, they will repair it and call the repair company if it damaged severely or they can't do it.

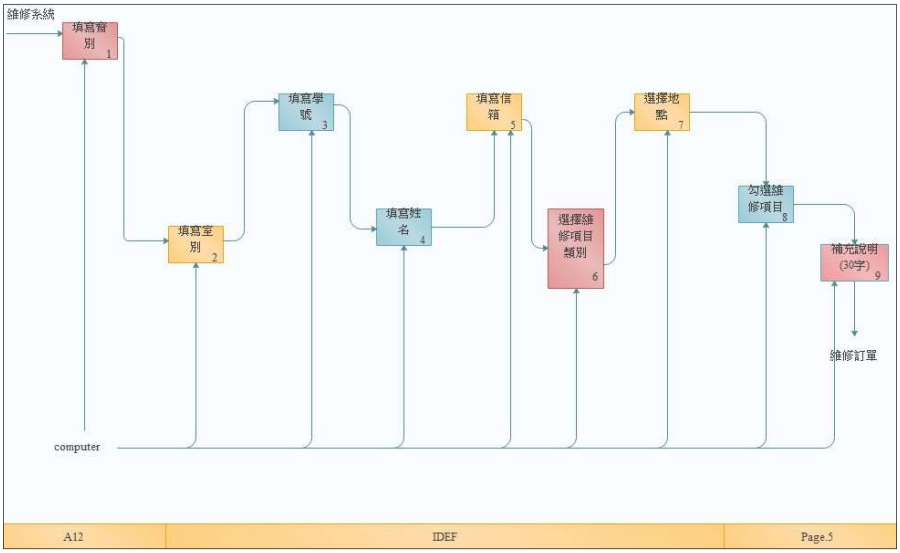
After receiving the notice, the company will key in the orders into the system. Sometimes the company goes to the dormitory in person because the supervisors can't express the problems exactly. Customers need to fill out the orders again if the consequence is not as expected.





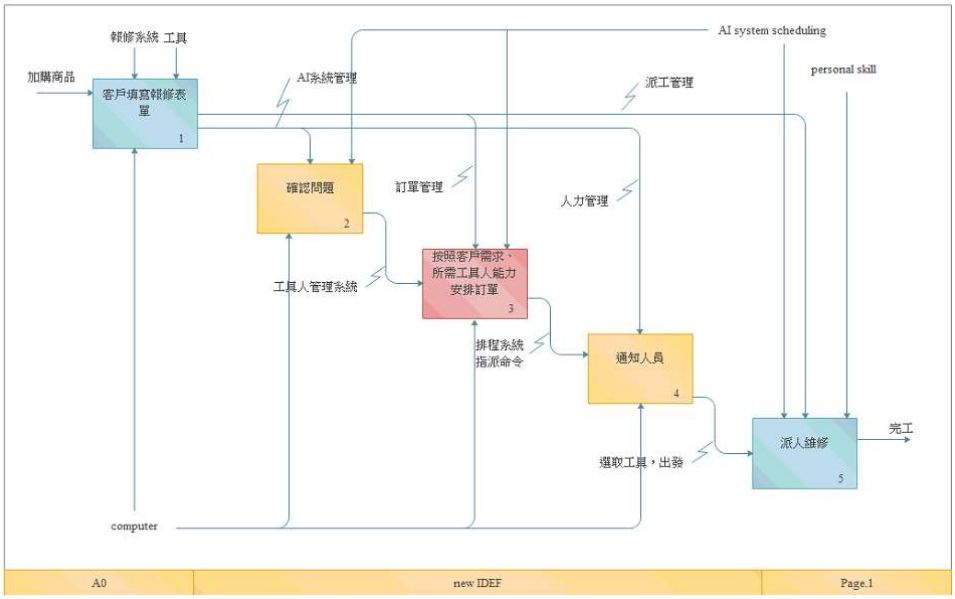


The above three figures represent the second layer. In A1, we divide ordering into logging, filling out the form, and confirming. In A2, we divide order handling into receiving, supervisors logging, and processing. In A9, repairing is subdivided into choosing tools, confirming problems, and fixing.

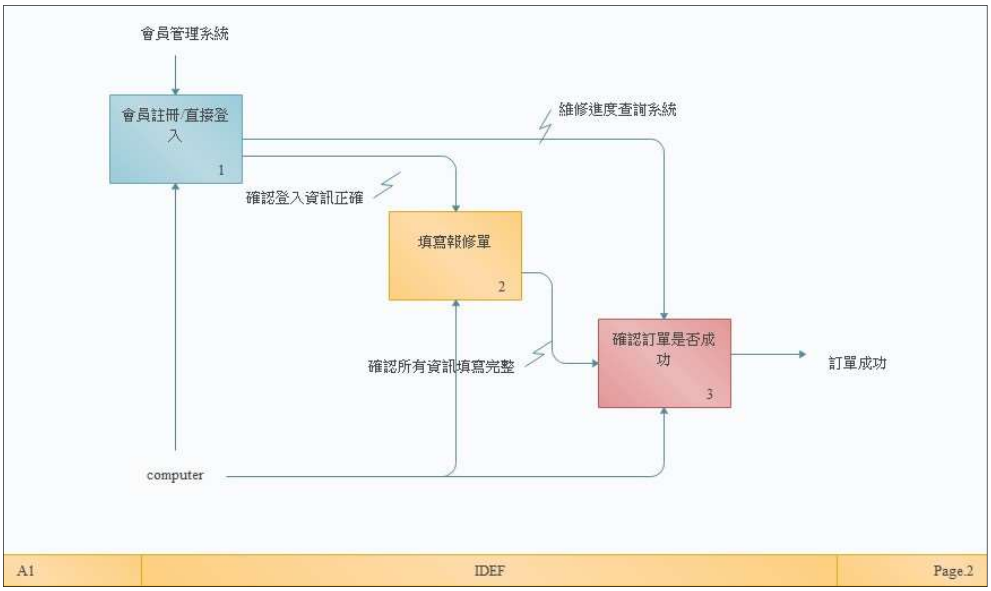


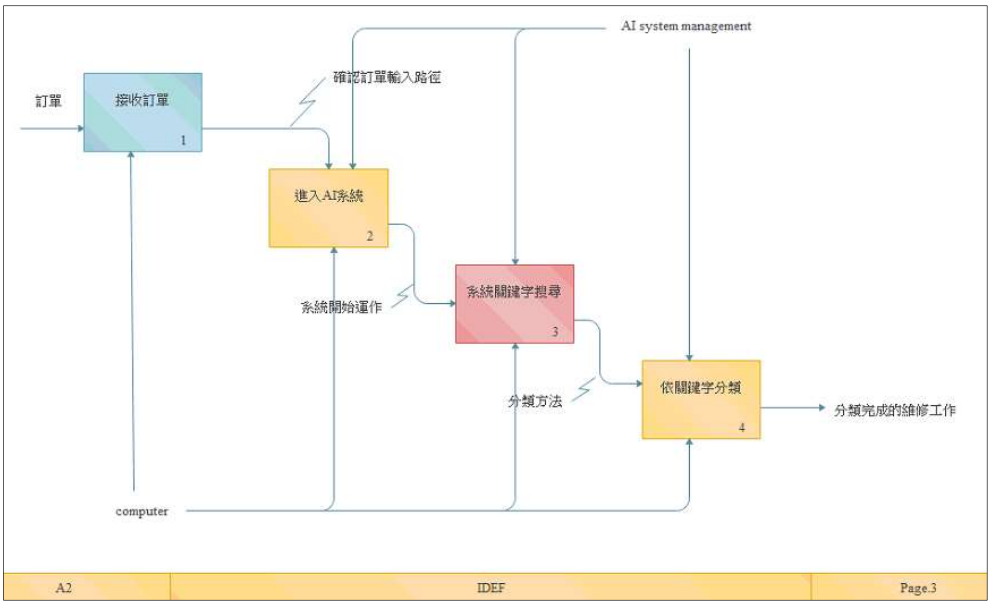
We also separate the A12 from A1. Filling out the form can be subdivided into detailed steps. The user needs to fill in the dormitory, room number, student ID, name, e-mail, check the maintenance categories, the repair location, the maintenance items, and describe the scenarios in thirty words.

3.1.2 New Process

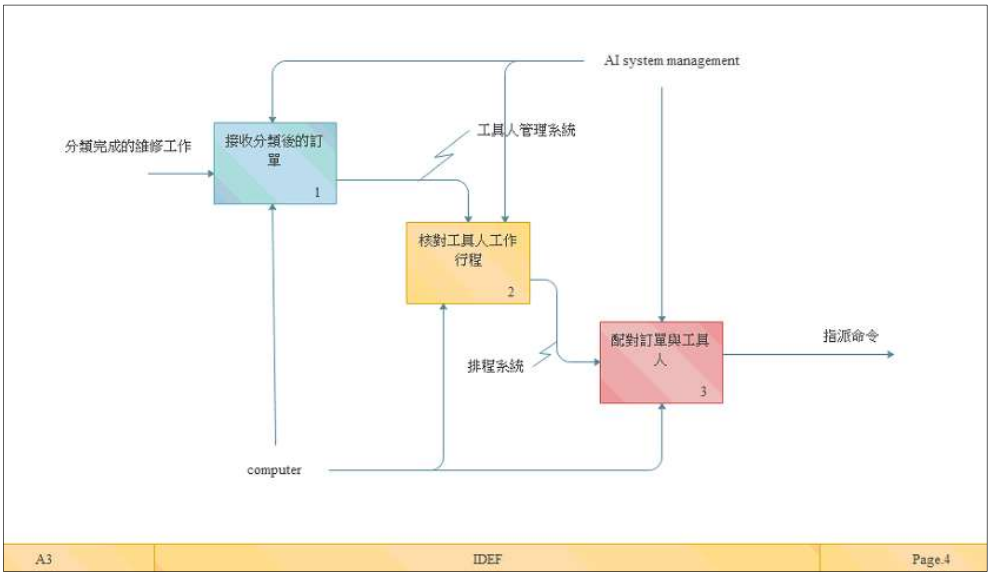


In A0, we can see that if the user wants a repair service, he needs to enter the system. The order goes to the company's system directly. Problems will be classified by the AI system, then be matched with the corresponding tool man. An assigned tool man will receive an e-mail, choose the tools and do the jobs.

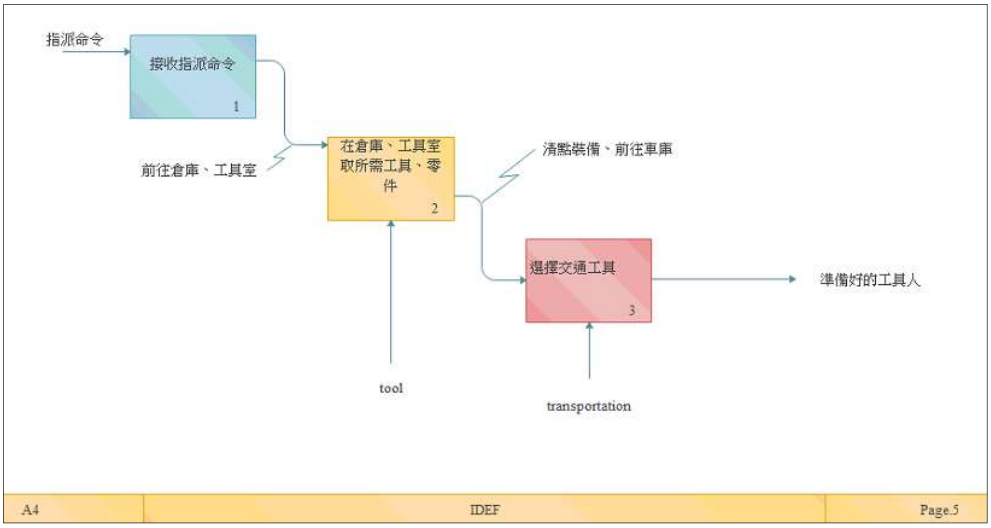




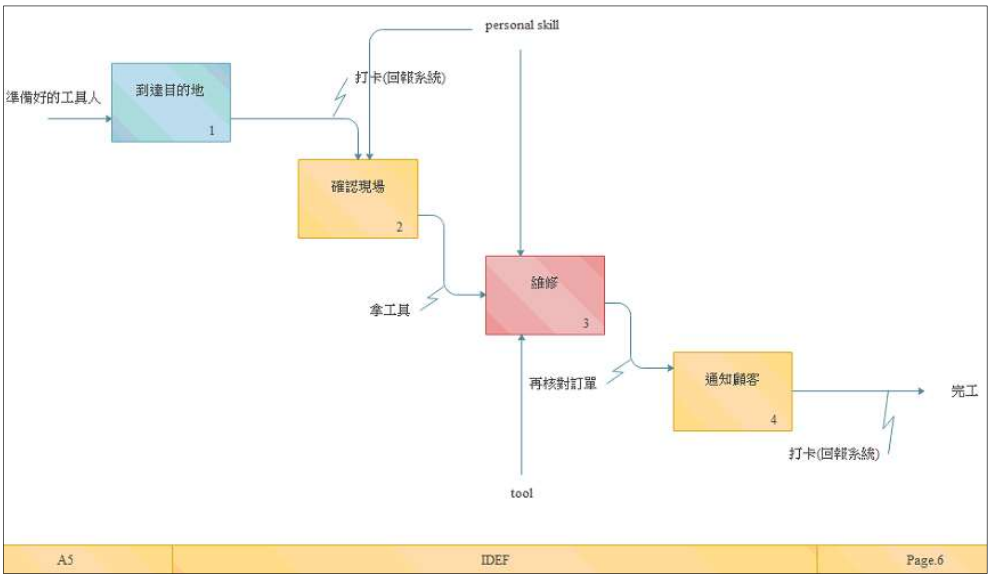
A2 | IDEF | Page.3



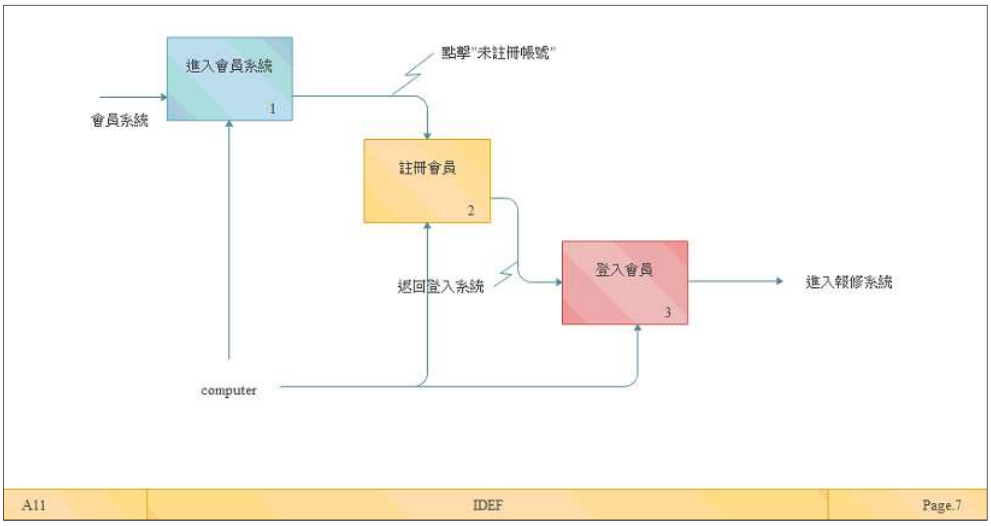
A3 | IDEF | Page.4



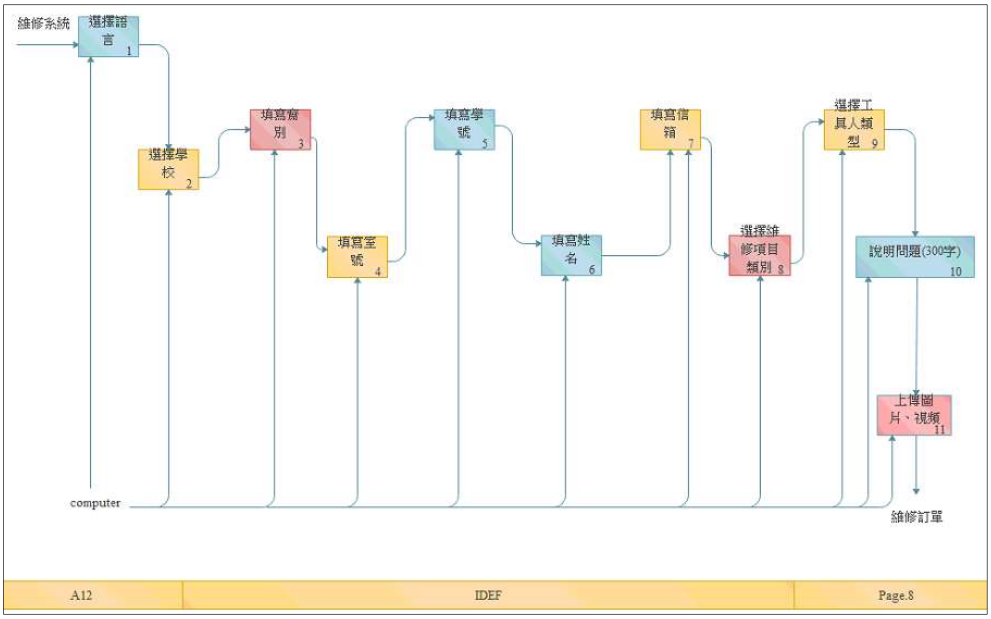
A4 | IDEF | Page.5



In A1, the users must register before login the system. In A2, the company system accepts the order directly. Then it will be sent to the AI system, sorted by keyword searching. In A3, the order will be passed to the next system to match a suitable tool man. The tool man will choose the required items in A4. In A5, the tool man needs to punch when they reach the destination. He will check the problems again and fix it. After that, he will notice the customers and punch out.



A1 layer can further separate into A11 and A12. New users need to register before the service. In A12, 90 percent is similar, but we add a space to upload the videos or photos.



3.1.3 Comparison

We can find out that the original process is much more complicated. There are two main reasons. First, users need to wait for order handling because the supervisors aren't on duty 24 hours, and the level of damage is not easy to judge precisely. Second, owing to the maintenance capability or the uncertainty, sometimes the supervisors think they can repair by themselves but forgive during fixing.

Also, we change the form design. Some check fields are too vague to understand, so we add a brief description. The limit of supplementary explanation is up to 300 words. Upload space can help to judge the problems efficiently.

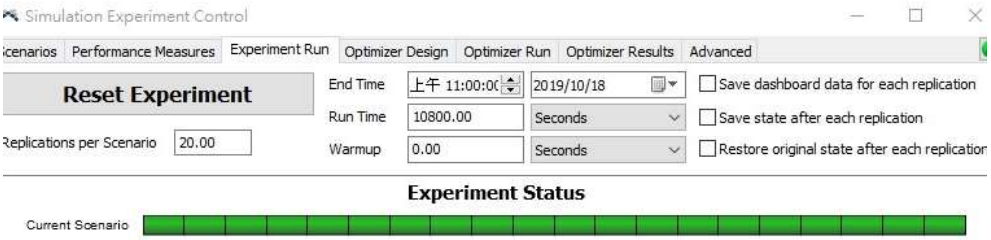


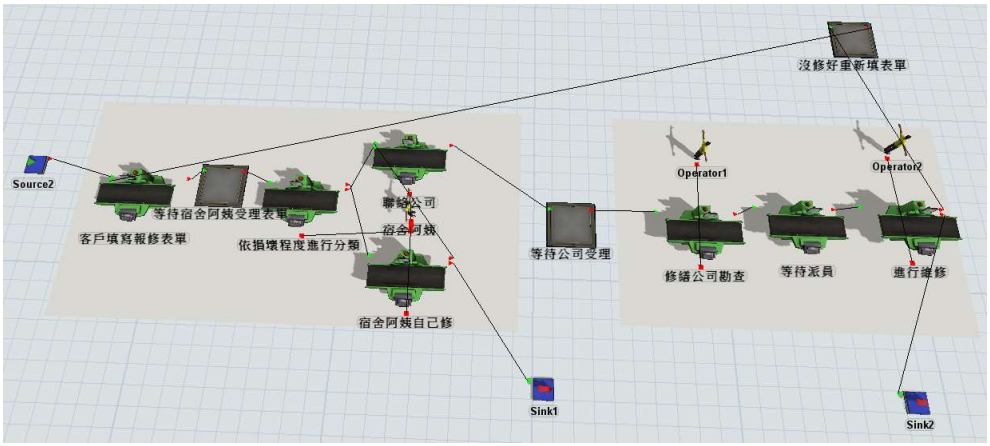
Figure. 4.1.1

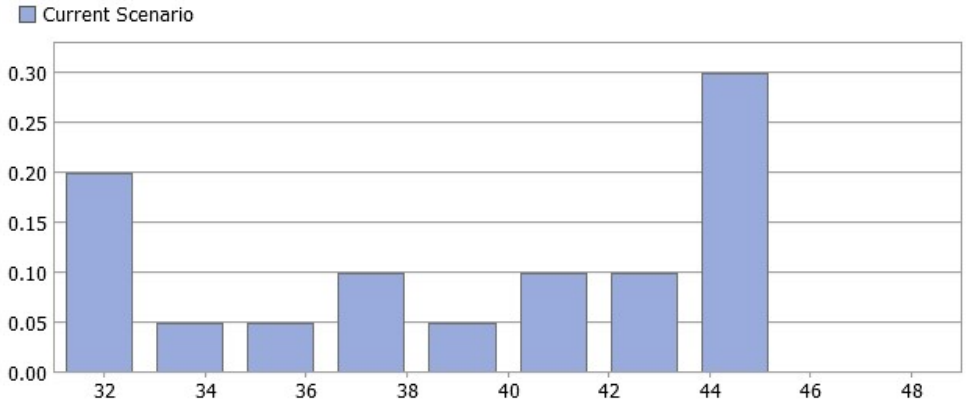
4. Improvement Results

4.1 FlexSim Simulation Comparison

We use FlexSim to simulate to understand the processes. Some basic hypotheses are needed, the number of simulations is 20, and the length is 10800 minutes, the distribution of the source is normal (100,10) (see Fig. 4.1.1). The comparisons we made are the number of outputs and the average cycle time.

4.1.1 Original Repair Process





	Mean (90% Confidence)				Sample Std Dev	Min	Max
Current Scenario	37.3	<	39.5	<	41.7	5.6	31.0	49.0

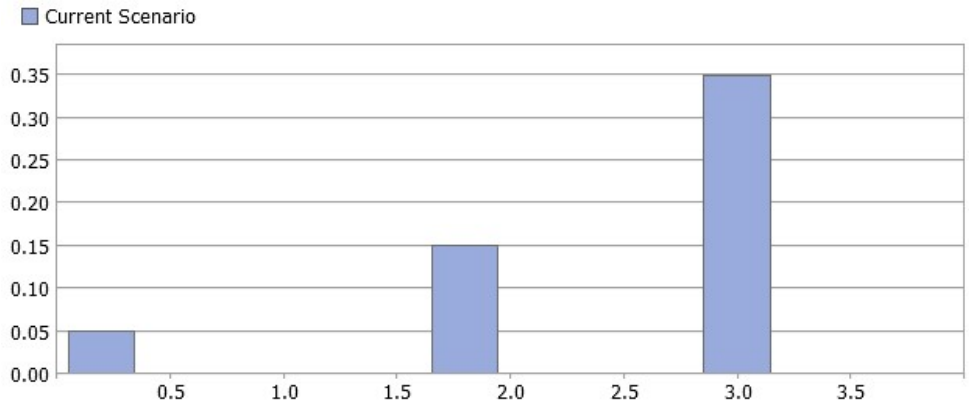
Rep1	Rep2	Rep3	Rep4	Rep5	Rep6	Rep7	Rep8	Rep9	Rep10
28	44	31	43	40	45	42	38	35	49
Rep11	Rep12	Rep13	Rep14	Rep15	Rep16	Rep17	Rep18	Rep19	Rep20
32	44	31	40	31	45	44	39	45	34

Sink1 - On Entry

```
1 /**Custom Code*/
2 Object current = ownerobject(c);
3 Object item = param(1);
4 int port = param(2);
5 double cycletime;
6 cycletime=time()-getlabel(item,"start");
7 settablenum("GlobalTable2",1,1,cycletime);
```

	Col 1
Row 1	94.77

In the original process, sink1 is the order completion quantity from supervisors. In the above figures, we can see that the total average number is 39.5 in twenty simulations. The average cycle time is 94.77 minutes.



	Mean (90% Confidence)	Sample Std Dev	Min	Max
Current Scenario	2.75 < 3.15 < 3.55	1.04	0.00	4.00

Rep1	Rep2	Rep3	Rep4	Rep5	Rep6	Rep7	Rep8	Rep9	Rep10
4	3	2	4	4	4	2	0	3	4
Rep11	Rep12	Rep13	Rep14	Rep15	Rep16	Rep17	Rep18	Rep19	Rep20
3	4	4	2	4	3	3	4	3	3

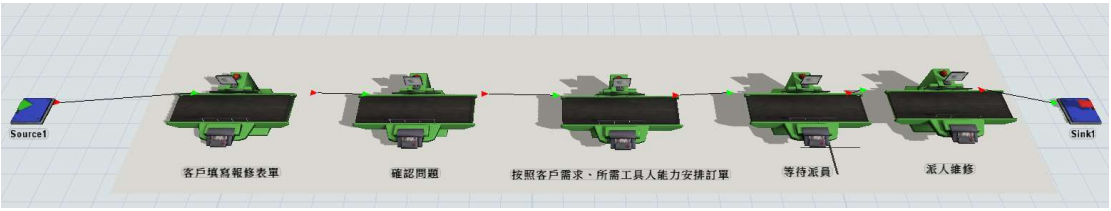
Sink2 - On Entry

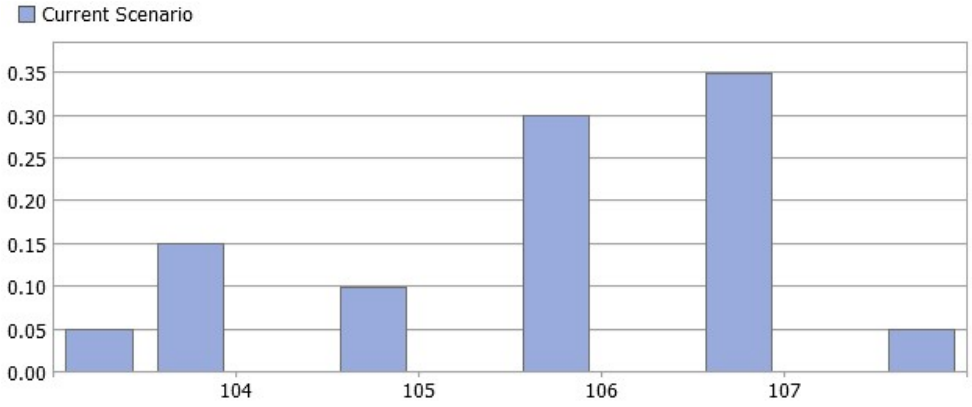
```
1 /**Custom Code*/
2 Object current = ownerobject(c);
3 Object item = param(1);
4 int port = param(2);
5 double cycletime;
6 cycletime=time()-getlabel(item,"start");
7 settablenum("GlobalTable1",1,1,cycletime);
```

	Col 1
Row 1	8437.88

Sink2 is finished by the company, and we also calculate the average events (order completion) and cycle time. It's obvious that the completion number is less than sink1 and cycle time is even more than 8400 minutes.

4.1.2 New Repair Process





	Mean (90% Confidence)	Sample Std Dev	Min	Max
Current Scenario	105.38 < 105.90 < 106.42	1.33	103.00	108.00

Rep1	Rep2	Rep3	Rep4	Rep5	Rep6	Rep7	Rep8	Rep9	Rep10
107	108	106	106	105	104	104	107	104	106
Rep11	Rep12	Rep13	Rep14	Rep15	Rep16	Rep17	Rep18	Rep19	Rep20
107	107	107	106	105	106	103	107	107	106

```
1 /**Custom Code*/
2 Object current = ownerobject(c);
3 Object item = param(1);
4 int port = param(2);
5 double cycletime;
6 cycletime=time()-getlabel(item,"start");
7 settablenum("GlobalTable1",1,1,cycletime);
```

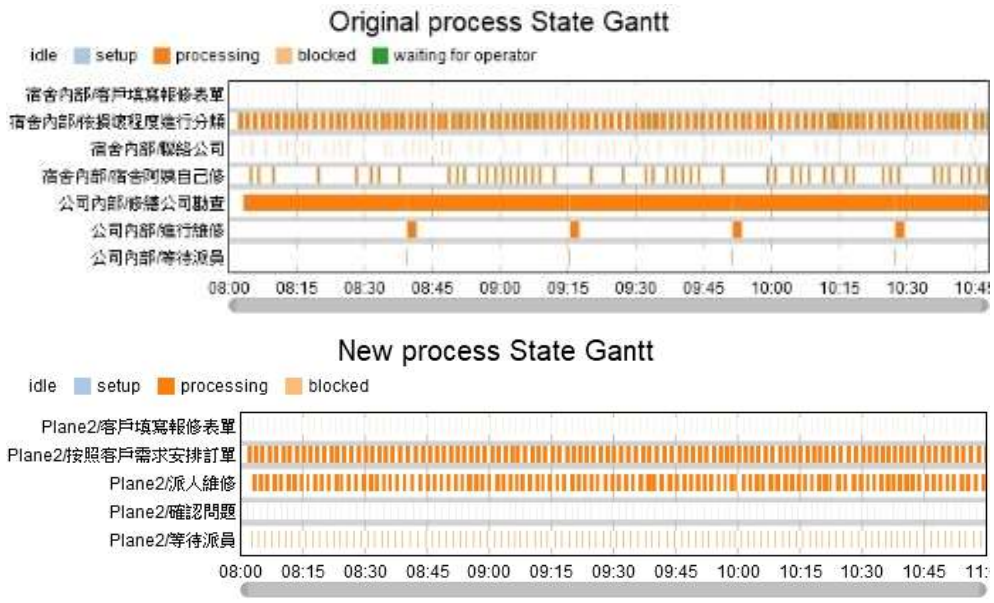
	Col 1
Row 1	129.93

4.1.3 Comparison of Two Repair Processes

If we redesign the process, it's dramatically different and can improve both the company's benefits and customers' satisfactory (see Table 4.1.1). The discrepancy is visualized in two State Gantt graphs.

Table 4.1.1 The Comparison of Original and New Processes

	original	new
Output	42.65	106
Cycle time(minute)	8400/94.77	130
Differences	Dormitory supervisors handle the problems first	Do all jobs by AI system and management system directly



4.2 Web Design and App Transformation

After IDEF and simulation analysis, a website is developed and transformed into the App to demonstrate the improved repair process.

4.2.1 Member Function and Manager Function

To safeguard users' rights and interests, we need to confirm users' identities as students; therefore, users can only apply for repair after logging in the member system. Fig. 4.2.1-4.2.3 and 4.2.7 show detailed steps. (See appendix for database content)

Figure 4.2.1. Log in page

Figure 4.2.2. Registration success page

Figure 4.2.3. Registration page

Haven’t logged in for a while, users are apt to forget their password. As a consequence, click “Forget Password” in the Sign-in page and Checking Coverage status page and enter username and e-mail, then the user’s password will be shown. See Fig. 4.2.4-4.2.5.

Figure 4.2.4. Search password page

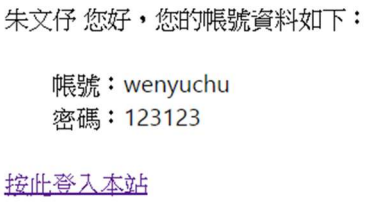
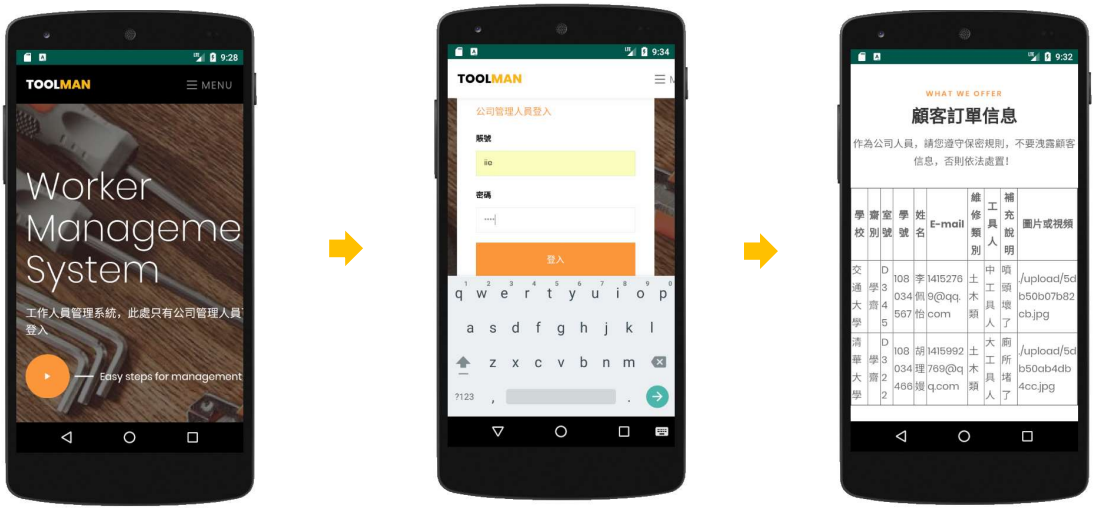


Figure 4.2.5. Search password results

Managers can log in from the homepage of the web page and check the customer order information that he has received so far. Managers can get all customer information. The steps are as follows:



4.2.2 Repair Form

In general, users can't describe their problem clearly in just 30 words. Consequently, we relax problem description to 300 words and allow users to upload the picture or video of the situation. What's more, we delete time-wasting item selection in our new form. There are also classification directions added on the repair page to eliminate confusion.

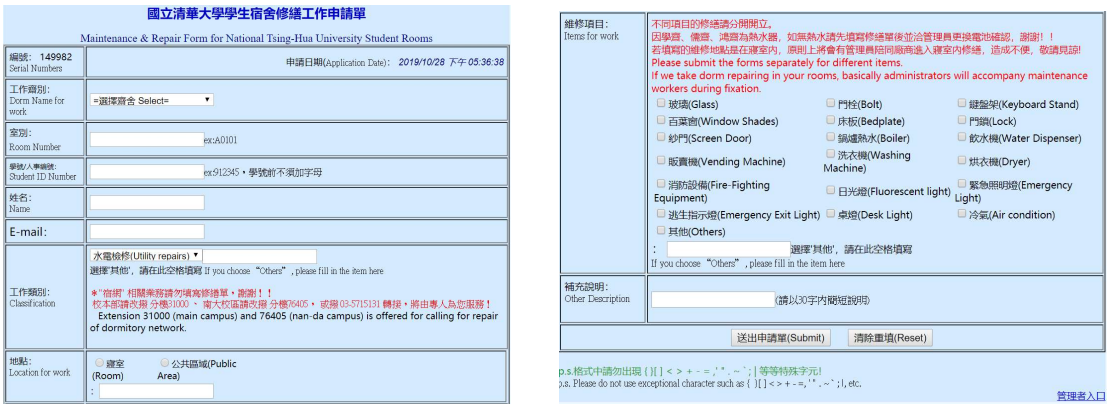


Figure 4.2.6. Repair form NTHU currently use

Figure 4.2.7. Repair form of Tool Man

Figure 4.2.8. Classification directions

4.2.3 Checking Coverage Status

In the original repair system, there's no "real-time checking coverage status" service. Students are always annoyed by whether their problem be fixed or not. As a result, we add a checking coverage status system on our home page. See Fig.4.2.9.

Figure 4.2.9. Checking Coverage status

Figure 4.2.10 Customers' Satisfaction Survey

4.2.4 Customer's Satisfaction Survey

For continuous improvement, users can log into the member system and fill out the customers' satisfaction survey after the repair is done. (See Fig. 4.2.10)

4.2.5 FAQ-Chatbot

Users can question by using the How It Works, Service Robot, and FAQ function at the bottom of the page, where there is a chat robot prompt replying. (See Fig.4.2.11)

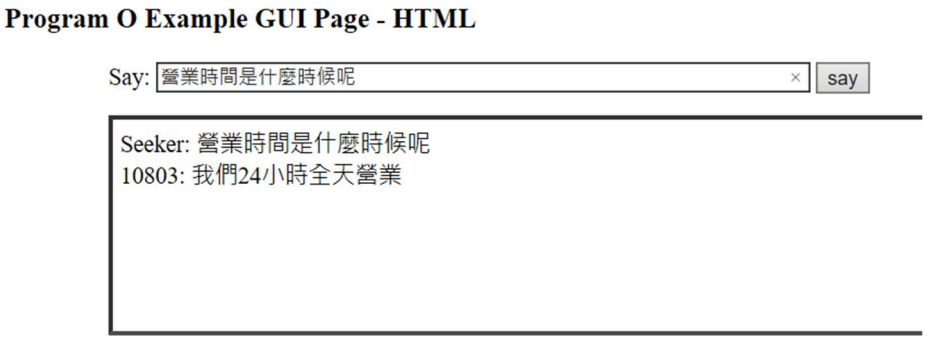


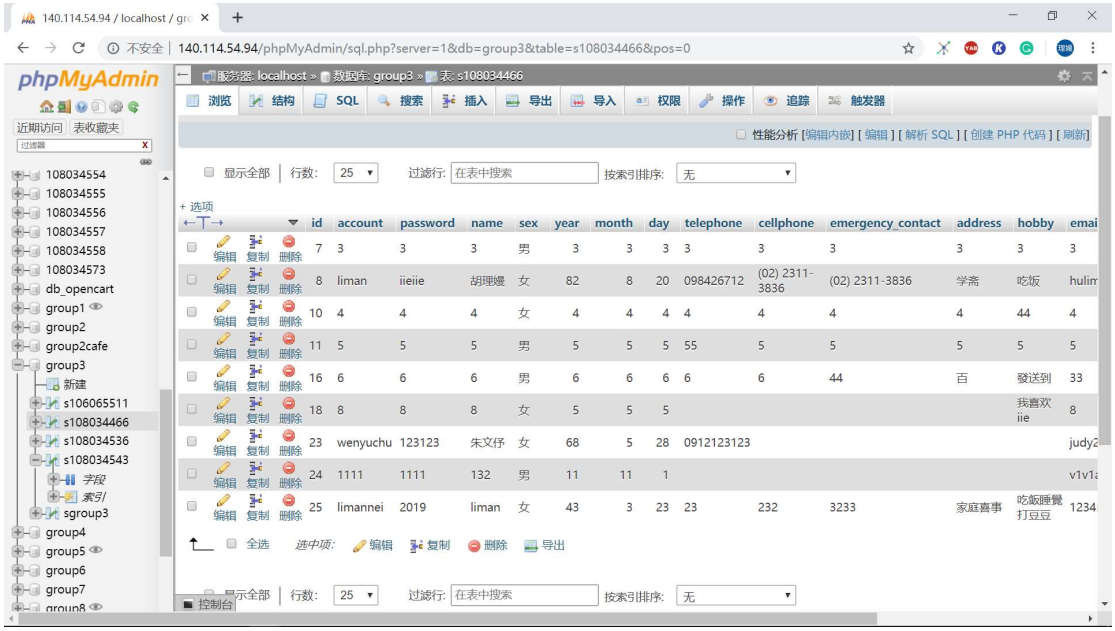
Figure 4.2.11 Chat Robot

5. Summary

Through the BPR analysis as well as IDEF techniques, we find out the root causes of inefficiency in the current process: long cycle-time repairs, unreasonable design of repair system, complicated and unbalanced operation process, and unprofessional dormitory supervisors. To deal with this, a new simplified process is proposed to accelerate the order completion and enhance the accuracy of problem identification. Furthermore, a user-friendly website and an app are developed to rapidly report repair, obtain the customized service, and manage customer information. Finally, simulation experiments are executed in FlexSim and demonstrate that the ideal new repair process takes only 1.5% time of the original, which greatly improves the repair efficiency and customer satisfaction.

Appendix

1.Database Table for Member System



2. Database Table for Repair and Manager System