CHAPTER 4: RESEARCH RESULTS

4.1 Data Summary

4.1.1 Sample Distribution (departmental based)

Total of 66 respondents had returned the distributed questionnaires. The distribution of the respondent based on department is as follow :-

Department	No. of respondents	Percentage of respondents	Total users (Executive)	% of respondent vs. total uesrs
Engineering	30	45.5%	51	59%
QCD	14	21.2%	15	93%
Production	11	16.7%	16	69%
Planning	11	16.7%	14	79%
Total	66	100%	96	69%

45.5% of the respondents are from Engineering department, 21.2% from Quality Control Department, 16.7% from Production and Planning Department respectively.

The table also shows that the size of respondents represents more than 50% of the total staffs who are the users of the system in each department. The response was obtained from 59% of Engineering Department's users; 93% of Quality Control Department's users, 69% of Production departments' users and 79% of Planning department's users.

4.1.2 Sample Distribution (frequency of accessing the system)

All the respondents who had returned the questionnaires have experience of accessing and using the system. 45.5% of the respondents are active users who access the system to obtain information in daily basis; 48.5% of the respondents access the system in weekly basis and 6.1% of the them are users who access the system in monthly basis.

Access Frequency	No. of respondents	%
Active (daily)	30	45.5%
Quite active (weekly)	32	48.5%
Not active (monthly)	4	6.1%

4.1.3 Overall Mean

Parameters	N	Minimum	Maximum	Mean	Std Deviation
Preciseness	66	1	4	2.17	0.597
Accuracy	66	1	4	2.58	0.609
Reliability	66	1	4	2.42	0.556
Relevancy	66	1	4	2.08	0.535
Free from data correction	66	1	4	3.08	0.883
Sufficiency	66	2	4	2.68	0.768
Timeliness	66	1	4	2.02	0.447
Up-to-date	66	1	2	1.71	0.456
Format	66	1	4	2.92	0.810
Content	66	1	4	2.44	0.844
User friendly	66	1	4	2.70	0.877
Ease of use	66	1	4	2.27	0.542
Flexibility	66	1	4	3.52	0.707
System free from b/down	66	2	5	3.53	0.728
Improved job efficiency	66	1	3	2.05	0.325
Top management support	66	1	4	2.17	0.571
Project management	66	2	4	3.32	0.586
User participation	66	1	5	3.30	1.336
User training	66	2	5	3.18	0.943
IS members understanding	66	1	4	2.48	0.638
IS members support	66	1	4	2.59	0.607
Availability of infrastructure	66	1	4	2.50	0.770

Note : The Likert scale design: Strongly agree (1), Agree(2), Neither agree nor disagree (3), Disagree (4) and strongly disagree (5)

The results show that the parameters that gain the best evaluation are the system information is up-to-date, timeliness and improved users' job efficiency. These are mainly attributed to the system feature of online data capturing and summarization for users' prompt decision making.

On the other hand, the system users are not satisfied with the unsatisfactory of system down frequency, low flexibility of the system, the output data need correction and the system's output format. The results also reflect that users' participation in this project is low and users judged that there was insufficient training provided to them and the project management is not satisfactory.

4.1.4 Mean Comparison (Among Departments and Between Project and Non-project Members)

Item	Mean						
	Total	Eng.	QCD	Prod.	Plan.	Project member	Non-member
No. of sample	66	30	14	11	11	10	56
Preciseness	2.17	1.97	2.36	2.36	2.27	2.3	2.14
Accuracy	2.58	2.97	2.29	2.55	1.91	2.7	2.55
Reliability	2.42	2.63	2.29	2.45	2	2.6	2.39
Relevancy	2.08	2.13	2.21	2.09	1.73	2.2	2.05
Not require data correction	3.08	3.63	3.07	2.73	1.91	3.3	3.04
Sufficiency	2.68	2.53	3	3.18	2.18	2.8	2.66
Timeliness	2.02	2.07	2	2.09	1.82	2.2	1.98
Up-to-date	1.71	1.87	1.79	1.36	1.55	1.5	1.75
Format	2.92	3.33	2.79	2.91	2	3.1	2.89
Content	2.44	2.57	2.79	2.27	1.82	3	2.34
User friendly	2.7	3.2	2.43	3.36	2	2.9	2.66
Ease of use	2.27	2.43	2.21	2.18	2	2.3	2.27
Flexibility	3.52	3.93	3.28	3.09	3.09	3.4	3.54
Free from system b/down	3.53	3.63	3.21	3.45	3.73	3.2	3.59
Improved job efficiency	2.05	2.03	2	2.18	2	2.1	2.04
Top management support	2.17	2.23	2.36	2	1.91	2.1	2.18
Project management	3.12	3.27	3.29	3.64	3.18	3.5	3.29
User participation	3.3	3.7	2.79	3.36	2.82	1.7	3.59
User training	3.18	3.5	3.07	2.73	2.91	2.2	3.58
IS members' understanding	2.48	2.77	2.5	2.27	1.91	2.2	2.54
IS members' support	2.59	2.9	2.78	2.27	1.82	2.5	2.61
Availability of infrastructure	2.5	2.73	2.5	2.82	1.55	2.6	2.48

The comparison of means among departments and between project member and non-project members are summarized in the above table. Further justification with One-Way ANOVA shows that there is significant difference

between Planning and other departments in terms of rating of various parameters.

ANOVA (Comparison Among Departments)

Parameter	F	Sig.
Preciseness	2.232	0.093
Accuracy	16.369	0.000
Reliability	4.458	0.007
Relevancy	2.085	0.111
Free from data correction	21.203	0.000
Sufficiency	5.095	0.003
Timeliness	0.954	0.420
Up-to-date	4.533	0.006
Format	10.867	0.000
Content	3.510	0.020
User friendly	9.013	0.000
Ease of use	2.060	0.115
Flexibility	9.116	0.000
System free from d/down	1.415	0.247
Improved job efficiency	0.816	0.490
Top management support	1.778	0.161
Project management	1.396	0.252
User participation	2.188	0.098
User training	2.527	0.066
IS members understanding	6.759	0.001
IS support	17.784	0.000
Availability of infrastructure	10.257	0.000

The mean difference is significant at the .05 level ($p<0.05$)

Respondents of Planning Department generally rate the system's output accuracy, reliability, sufficiency and system features: format, ease of use and flexibility better that other departments. They also rated the IS members' understanding on their job functions and requirements and IS members support higher than other departments.

The One-way ANOVA for comparison of project and non-project member is shown below:

ANOVA (Comparison Between Project and Non Project Member)

Parameter	F	Sig.
Preciseness	0.583	0.448
Accuracy	0.486	0.488
Reliability	1.179	0.282
Relevancy	0.631	0.430
Free from data correction	0.758	0.387
Sufficiency	0.276	0.601
Timeliness	2.048	0.157
Up-to-date	2.611	0.111
Format	0.551	0.460
Content	5.571	0.021
User friendly	0.629	0.431
Ease of use	0.029	0.864
Flexibility	0.309	0.580
System free from d/down	2.482	0.120
Improved job efficiency	0.329	0.568
Top management support	0.159	0.692
Project management	1.137	0.290
User participation	22.629	0.000
User training	15.651	0.000
IS members understanding	2.397	0.126
IS support	0.261	0.611
Availability of infrastructure	0.197	0.659

The mean difference is significant at the .05 level ($p<0.05$)

As shown in the above table, there is no significant difference between rating given by project team members and non-project team members except for the higher participation of project team members in the project and more training was given as compared to non-project team members.

4.2 Data Analysis

The respondents are satisfied with the system's up-to-date and timeliness information. They also agree that the new system has improved their job efficiency. This success is mainly attributed to the advance features of the new system as compared to the old information system. Online data collection and summarization provides immediate and fresh data such as production yield performance, machine status whether in-operation, idling or breakdown, work in process (WIP) status for smooth production lots moving and inventory control and etc. whenever users make inquiry through the system. Besides that the new system has enhanced simplification and automation of certain operation jobs. All these features have improved users job efficiency in making prompt decision for better WIP control, machine allocation, productivity and quality improvement and etc.

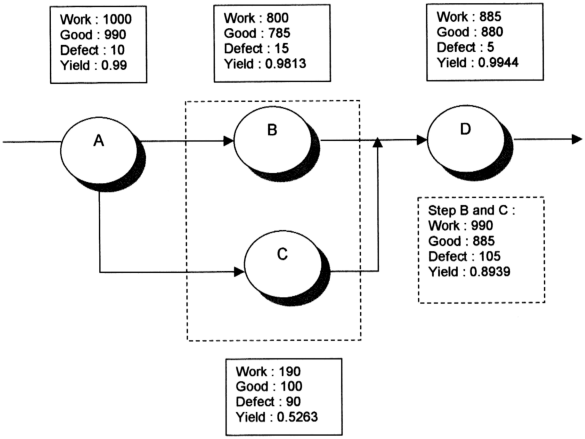
On the other hand, the respondents are unsatisfied with the new system's flexibility. It is surprising that the respondents judge the new system is not flexible enough. Study on the system features reveals it is a high degree of flexibility system with wide data integration. Users are free to specify the combination fields of data required for example specific machine, material, time period and many other items by themselves. All the data can then be exported for users' own manipulation and reporting format. Unfortunately, users do not realize that they are utilizing a very flexible system. This mainly due to insufficient training provided to the users. Lack of training and without a clear user instruction manual cause users unaware of many features and actual usage of the new system. Eventually the features of the system are under utilized. Users misunderstand that the system's usage is limited and not flexible.

The low satisfaction regarding the system output format is mainly due to the poor users' participation when developing the output format. The users were not asked to give their opinion regarding the format required by them. The low users' participation has resulted in poor users acceptance on the output format.

Every individual has his or hers own preferable format. Anyway, the format may gain higher acceptance if users have participated in discussion and given consensus to the finalized format.

The results reflect another weakness of the new system is the output data need for correction. Basically the data source shall be reliable since the data input system has the feature of auto prompt if there is input error before capturing the input data. The problem is due to some error in the calculation format developed in the software that generates misleading results. This problem arises from unclear user requirement specification. A quoted example is the results of total process yield calculation. The user requirement specification states that the total yield is defined as cross multiply of all junctions' yield. But in actual, there are cases of lot splitting into two different processes and then re-combined at the following junction. For such a case, calculation error will occur if formula is set according to the brief definition in the user requirement specification. The example is illustrated as follow:-

Lot flow (split to process B and C then combined in junction D) and yield performance:



Total yield based on user requirement spec. = 0.99 X 0.9813 X 0.5263 X 0.9944 = 0.5084 (50.84%)

Actual yield calculation in case of there is lot splitting = 0.99 X 0.8939 X 0.9944 = 0.8800 (88.00%)

There is error of 32.16% variance of total yield and users' own correction is required.

Comparison of respondent's satisfaction in departmental basis shows there is significant difference between Planning Department users as compared to other department users. Generally the higher rating of respondents of Planning Department than other departments is related to the structure of the organization. The main coordinator of the project is IS members. The IS group is a section of Planning Department and under control of Planning Department Head. Therefore IS members generally give high attention to the Planning users' request. They also have better understanding regarding the Planning Department's system user job requirements in terms of the Production Planning and Control. In this project, IS member act as a medium between users and software developer. They play a role of elaborating systems features to users and interpreting user requirement to software developer and feedback software developer difficulties and doubt about the user requirement to users. As a medium, IS member is the party who negotiate and compromise between users and software developer. The users are knowledgeable about production operation and technical jobs but they are unfamiliar with programmers' language, advantages and limitations of the system to be developed. Sometimes the users may not include certain requirements that they think not feasible but in actual the system able to perform and sometime the users may specify some requirements that are not feasible to be developed in the systems. For this project, a Japan software developer has been appointed by the company's headquarter to develop the required software. The Japan software developer does not familiar with production operation. They also have difficulty in understanding English and causes difficulty for them to interpret the user requirement specification precisely. In such circumstance, IS members play a very important role in explaining the users requirement precisely to the software developer. In this context, IS members' understanding on users job function and requirements are very important for them to express the requirements precisely to the software developer and also to advice the users to fully utilize the systems capability when developing the requirement specification. This explains why better understanding of IS members regarding the Planning

Department's Production Planner and Controller's job function and requirements has resulted in a satisfactory information system that suits the Planning Department users requirements.

The comparison of results between project and non-project team member shows that project team members do not rate the system outcome better than the non-project team members. This result is different from the previous research that project team members normally give higher rating to the project handled by them. Such a bias is not shown by the project team members of this project. In fact, there are various of parameters were rated slightly poorer than non-project team members. This may be related to their better understanding on the details of the project's expenses, resources and capital invested. This project has incurred millions of RM and dragged for 2 years since the initial planning until implementation stage. Better system performance is expected against the huge amount of invested resources.

Both the project and non-project team members give a poor rating to the project management. There are two major weak points that related to the poor rating. First of all is such a huge project that involves an entire change in company's information system is run by a team in part time basis. The team members are assigned to handle this project without reducing their current job load. Hence they have difficulty in paying full attention and concentration on this project. This has resulted in lacking of in-depth feasibility study and consideration during system requirements design stage and lack of thorough system test, monitoring and data verification during parallel. Such an arrangement reveals that the job load of the project has been under-estimated. The project leader (from Engineering Department) who has no experience in handling IT project has failed to foresee the consequences of a poorly developed system. Unlike an Engineering project where a poor designed machine can be easily modified; but a poor designed system may be difficult to be fully modified. Sometimes it requires to be developed all over again and it is costly to do so. Another major weak point is the poor project scheduling. There are 2 stages of the information

system project i.e. Data Input System development and Information Output System development. In this project, the requirement specification of the output information has been scheduled after the data input screens and requirements have been decided and developed. This causes some of the required output information are not feasible since the designed input screens do not have the field to capture the required data. Such a problem is resulted from an unorganized project. It can be avoided by considering the output requirements first before designing the requirement of data input screen. Review shows that one of the factors of the poor planning and scheduling is project team members lack of experience in running an IT project. This is the first time the company involves in a company wide new information system development and implementation. All the members (includes top management) are lack of experience in IT project. Team members job load has been under estimated and the project planning and scheduling is unsatisfactory.

4.3 Results Summary

The respondents are satisfied with the system's up-to-date and timeliness information. They also agree that the new system has improved their job efficiency. On the other hand, the system users are not satisfied with the unsatisfactory of system down frequency, low flexibility of the system, the output data need correction and the system's output format. The results also reflect that users' participation in this project is low and users judged that there was insufficient training provided to them and the project management is not satisfactory. There is significant difference in satisfaction about the system output among departments. Generally, respondents of Planning Department rate the system higher than other departments. It can be attributed to the better IS members understanding about Planning Officers job requirement. On the other hand, results show there is no significant difference between rating given by project team members and non-project team members.

4.3.1 Success Factors

Based on the results collected from the respondents and the review of overall project, the following success factors are derived:

4.3.1.1 System Fits User Task Needs

The great success of the new system is high user's satisfaction for its timeliness and up-to-date information output via online data capturing and summarization. Such a feature has improved user's job efficiency as reflected through the data collected from the questionnaires. The success is attributed to its ability to fulfill user task needs in obtaining immediate data for prompt actions and decision making. A successful information system project relies on its usefulness and importance to the users. Hence a system with features that fit user's task needs is a vital success factors of IT project.

4.3.1.2 User Participation

There was a lot of complaints from the system users during the initial implementation stage. They like to compare the new system with the old one. Although there are many useful functions of the new system, but users tend to focus and magnify the minor lacking points of the new system as compared to the old system. The user resistance is caused by the low user participation during system development process. If users' participation is sought and not taken for granted, the system is likely to be accepted by users. This is mainly attributed to the sense of ownership of the final outcome if users themselves have involved in discussion and decision making. Previous studies of impact of user involvement in the implementation of IT project also found that if user participation is taken for granted, then the potential of conflicts, disagreement and perhaps outright resistance may arise in the course of the project's development which may eventually contribute to project failure.

4.3.1.3 User Training

The success of an IT system is linked with how useful of the system to its user. For the users to realize its usefulness, sufficient training and guidelines on the usage of the system shall be provided. Without clear understanding on the system usefulness and how to use the system, users will not interested in accessing the system. A good system may remain as a waste if user utilization rate is low. Similarly, this study has found that insufficient user training has resulted in system under-utilized where many useful functions are not realized by users.

4.3.1.4 Project Management

Managing an IT project involves time scheduling, resource allocation and cost management in completing a project in time, within budget and according to functions requirements. For a successful project, the resources must be well managed by proper allocation and control. For example in this case study, the mistake in scheduling the Data Input System earlier then the Data Output System has resulted in difficulty to obtain some required output. Under-estimation of job load and requirements in the implementation of IT project with a non-full time project team members who are tightened up with other jobs has resulted in mistakes due to lack of focus during the system designing stage. This has resulted in additional budget in the later stage due to some requirements are not met and system modification is required.

4.3.1.5 Clear and Accurate Requirement Specification

The project involves customized software that developed based on the requirements defined by users. Hence the success of the system is very much depends on how well and accurate the requirement specifications have been written and expressed to the system developer. A poor written requirement that is established without detailed feasibility study before hand over to system developer will results in unmet user requirement. On the other hand, a not clearly written requirement specification after detailed feasibility study will also yield the same results since the software developer interpret the meanings differently if the requirements are not precisely and clearly documented.

4.3.1.6 IS Member's Understanding of User's Business Needs

In the project of the case study, IS members of the company acts as the medium between users and software developer. Hence the success of the project is very much depends on IS member's understanding of user's job requirements.

Users and software developer are from different disciplinary backgrounds. Communication is often hindered because the two parties speak different language. Users speak in technical terms whereas software developer speaks in software term and thinks in software logic. In this case, the IS members of the company who is familiar with software language play a vital role in interpreting users' requirement to software developer and advice user when developing requirement specification. In fact, their understanding of user's requirement is also essential in system modification and maintenance after the establishment of the system.

4.3.1.7 Top Management Support

The role of senior management and their commitment to the project is vital. Lack of management commitment and low perceptions of the value of the project to the organization may lead to the project's loss of support and funds. In the initial stage of the new system deployment in the case study, there were certain functions that cannot be met and voice to revert back to the old system can be heard. With the strong support of top management to insist on continuing the project and take initiative to negotiate with software developer for certain software modification without additional charge, then the system can be continued and abandonment is avoided. Besides the moral support, top management commitment in allocation sufficient fund for installation of all necessary facilities (hard and software) also a success factor of IT project.

4.3.1.8 Thorough System Test and Verification

One essential step to ensure a successful IT project is the system test and verification. Real environment test and verification of system's feasibility and effectiveness is crucial before accepting the system. Sufficient time and focus shall be allocated for the system test and data verification. For effective test and verification, sufficient real data for a period of time shall be captured. Hence parallel run of old and new system shall be long enough to build up sufficient data for verification and comparison. There is no other short way in testing a newly developed system effectiveness. Test and verification solely on dummy data is not enough. IT project effectiveness check is different from a conventional project. In a conventional project, it is easy to visualize the final results in terms of product dimension, machine index and so on. There are established way and confirmation items before machine buyoff. But we cannot estimate accurately the results of an information system with few data in a short period. Its effect can only be visible after the system has been actually used in real environment.

As mentioned earlier, the survey of user satisfaction reflects users are not satisfied with the frequent system down. This incident occurs when users are inquiring too much information from screens that involve high linkage of database. The high looping time especially when network traffic is congested will cause PC hang-up. The problem was not encountered during system test since the test was carried out by IS member's stand alone PC which directly captured data from data base and therefore network traffic jam was not experienced. This lesson tells us that system test with actual user environment is essential.

4.3.2 Weaknesses of the Project Implementation

There are few weaknesses have been identified in this case:

4.3.2.1 Improper Project Management

In this project, the information output requirement specs were designed after finalizing the data input requirement screens. Hence when discussing the system output requirement specs, many required data were found not captured by the data input screens. By then the input screens have been developed and need to be modified. This has shown that the project is not well planned. The input screens were decided without proper consideration of the output information required.

The leader of this project is from Engineering who is full of experience in handling engineering project but without experience of managing information system project. As mention earlier, there are differences in handling a conventional engineering project and IT project. A Cross functional team in part time basis works for conventional engineering project such as new machines set-up but not works for an IT project that requires detailed studies, testing, monitoring and verification. The new machine's index and quality can be easily obtained with test run of certain quantity of dummy product. But in developing an IT project, full concentration and careful study and verification are required right from planning, feasibility study, requirement specifications design, test run, parallel run until live run. Close monitoring is required especially during test run, parallel run and live run stages in order to solve all the problems and errors promptly especially in the manufacturing environment involves high production volume and fast moving of goods. The project team members are working for this project in part time basis. Moreover their existing job load was not reduced at all. Such an arrangement caused the members having difficulty in paying full attention to this project. Errors and mistake due to rushing job arise

4.3.2.2 Insufficient users' training

There is not enough training provided to the users on how to access and utilize the new system. The users are not well explained on what are the features and usage of the system. Therefore most of them know the basic data inquiry only and unaware of many useful functions. Many advance usage of the new system was not made known to most of the users. This has resulted in under utilization of the system.

4.3.2.3 Insufficient Users Participation

Insufficient users' participation in developing the system has resulted in poor user satisfaction and low acceptance on the certain parameters such as output format. If they participate in the discussion on what shall be the best output format and give consensus on the final decision, the finalized format shall be the one suits majority of users and it is likely to gain users' acceptance since the users themselves involve in the decision making.

4.3.2.4 Unclear Requirement Specs.

The requirement specifications are too brief and general. They are not detailed enough to express all the circumstances of process flow. Lack of thorough feasibility study on actual operations when designing the requirement specifications caused many circumstances had been overlooked and lead to necessity of output data correction. In a manufacturing based project, requirement specification involves process operations shall not be briefly discussed in meeting room. Actual study on the lot movement in the production lines is crucial to avoid errors.

4.3.2.5 Software Developer's Limitation

The software developer of the project in the case study was assigned by the company's headquarter in Japan. All the programmers are Japanese who have limitation in understanding English. The communication problem generates risk of mis-interpretation of users' requirements. Moreover, they are programmers who are lack of manufacturing knowledge. This causes the difficulties for them to understand the users' explanations and requirements. In many instances, it is difficult to express perfectly to the programmer without face to face discussion. Unfortunately, face-to-face discussion was unable to be held frequently since the programmers are based in Japan. In such circumstance, a lot of misunderstanding and misinterpretation arises.

4.3.2.6 Improper Facility Testing and Simulation

The survey results reflect that the system down are quite frequently faced by users when accessing the system to inquire data. This happened in the circumstance where too much information was inquired from screens that involve high database linkage. This resulted in high looping time especially when traffic congested i.e. many users are accessing the system at the same time. If the looping time is longer than the pre-set time, time-out error will occur and PC will hang. The problem was not discovered during facility testing stage since the trial run was carried out by IS group with their stand alone PC which is directly capture data from database. Hence, there is no traffic jammed and problem did not surface during the simulation test.

4.3.2.7 Improper and Insufficient Data Verification

The output data accuracy was tested with dummy data but not the actual data captured from the actual production. Hence problem like data need correction arises during the actual implementation stage. Such problem takes time to be justified since there are thousand lots running in production floor. It is really suffering to identify which part of the system went wrong. As mentioned earlier, quality of a conventional project in manufacturing line can be verified by running dummy product. But quality on an IT project shall be tested with actual operation environment and data captured from the actual production operations. Testing and verification by using dummy data are not effective for information system. Dummy data is the data generated with ideal conditions of main operations. Many circumstances and sub-operation procedures may be overlooked. Problem may be invisible during dummy data test but surfaces during actual running stage. Hence longer period shall be planned for parallel run stage to ensure sufficient data can be captured and sufficient time for user to revise requirement specification and also for programmer to modify the software accordingly.