# CHAPTER VI

# CONCLUSION AND RECOMMENDATION

## 6.1 Conclusion

**Overall Problems** - The current facility layout of the company is of a function layout type which is not suitable for its product range. The functional layout is causing three main problems for the company – high machine setup time, machine allocation problem and ineffective material flow path, which all lead to manufacturing inefficiency. The aim of the project is to improve the shop floor and reduce the non-value added activities which will ultimately make the company more competitive in the market.

**Machine Setup Problem** – The time taken to setup the machine is a major cause of concern. The machines need to be setup and calibrated every time the machine has a new order. Machine setup takes approximately 1 hour to complete. On average, the batch sizes are kept below 100 in order to control the quality and traceability. With 2006 production volume, this equates to about 1300 hours used for machine setup. Therefore, if the setup frequency can be reduces, then the machine utilisation rate can be improve.

**Machine Allocation Problem** – With the functional layout, the department managers need to manually decide which machine to use for which orders as there are many machines available in a department; each varying in sizes and technical capabilities The problem with this machine allocation system is that once an order has finished its operation in department A, it has to wait for the appropriate machine in the

department B to become available because it is very difficult to synchronise the production plan between the different departments. This is causing the factory to have a high level of WIP.

**Flow Path Problem** – The manufacturing flow paths are long and ineffective. The functional layout is causing the parts to travel farther than necessary across the factory to different departments.

**Initial Analysis** - From initial analysis, the products can be separated into three main groups according to its shape and process requirements; screws, plates and instruments. From knowing the existence of these families, the concept of group technology was investigated in the effort to improve the company's manufacturing efficiency and effectiveness. Under the group technology idea, attention was drawn into the theory of cell manufacturing because the criteria for successful cell manufacturing implementation fit wells with the company's profile; particularly the job shop type factory and the existence of product families. But before the cell formation technique can be implemented and for the cells to be formed correctly, various tools and technique such as process flowchart, production flow analysis (PFA), string diagram and traveling chart were used to provide the cell formation process with foundation information.

**Design Process** - After the initial analysis was completed, three cells were formed; one each for the three product families. With the three cells as the underpinning idea, two layout designs were created. The first design is a simple machine rearrangement to form the cells. This is done to create a base plan to develop

from. The second design is an evolution from the first. It combines the cell-manufacturing concept with the product layout concept to create a more organised flow path. The second design also relocates the office and the raw material storage area to provide a more effective entry and exit point for the factory. However, the benefits from the relocations must be weighed against its cost.

**Design Evaluation** - With the design completed, the next step was to evaluate the designs to see how it will benefit the company. The list below is the benefits that can be achieved through the new design.

1. Setup time reduction
2. Production capacity maximization
3. Extra profit gain from the extra capacity created
4. Product quality improvement through product ownership
5. Elimination of complicated machine allocation and scheduling
6. Movement of the office closer to the shop floor for better control
7. Manufacturing flow path simplification
8. Reduced product traveling time and distance
9. Implementation cost

Through the cell manufacturing concept, the setup downtime can be significantly reduced. With the machine being dedicated to specific products, unlike the original functional layout where machines are used for multiple products, the machines will not needed to be setup as often as before. The reduction of the machine setup time will increase machine utilisation, which will create additional capacity and

ultimately - extra profit. Table 6.1 and 6.2 on the next page summarises the amount of machine setup time that can be reduce and the resulting extra capacity and potential profit. The extra capacity created for some product will not directly translate to profit because there is insufficient demand.

Table 6.1 – Machine setup time saved through cell formation [min]

| | Screws | | | | | Plates | | Instruments | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | poly screw | pedicle screw | compression screw | cortical screw | set screw | Curved plates | Flat plates | Pliers type | Small type | Screw driver type |
| MC1 | | | | | | | 6448 | | | |
| MC5 | | | | | | 7642 | | | | |
| H3 | | | | | | | | | | |
| MC6 | 6088 | 4883 | | | | | | | | |
| LC2 | | | | 13281 | | | | | | |
| LC4 | | | 11398 | | | | | | | |
| LC5 | 5892 | 4725 | | | | | | | | |
| LC6 | | | | | 10389 | | | | | |
| LC7 | 5892 | | | | | | | | | |
| H1 | | | | | | | | | | |
| H2 | | | | | | | | | | |
| Manual Milling | 2455 | 1969 | | | | | | 414 | 411 | 7156 |
| Manual Lathe | | | | | | | | 2070 | 411 | 2684 |

Table 6.2 – Table showing the potential extra profit from the extra capacity generated

| | extra units | Profit margin [Baht] | Total profit [Baht] |
|---|---|---|---|
| Screw | | | |
| Poly | 409 | 740 | 302660 |
| Pedicle | 215 | 590 | 126850 |
| Compression | 1628 | 35 | 56980 |
| Cortical | 2214 | 25 | 55350 |
| Set screw | 1732 | 4 | 6928 |
| Plates | | | |
| Curved | 450 | 380 | 171000 |
| Flat | 716 | 25 | No demand |
| Instruments | | | |
| Pliers | 0 | 980 | N/A |
| Small parts | 0 | 765 | N/A |
| Screw drivers | 0 | 1220 | N/A |
| **Total** | | | **719768** |

Another improvement that can be achieved through the new layout design is the simplification and shortening of the products flow path on the shop floor. Figure 6.1 below briefly shows an example of flow path simplification and shortening realised by the new design. Example shown is for the cortical screw product. The left diagram is for the original design and the right diagram is for design #2.

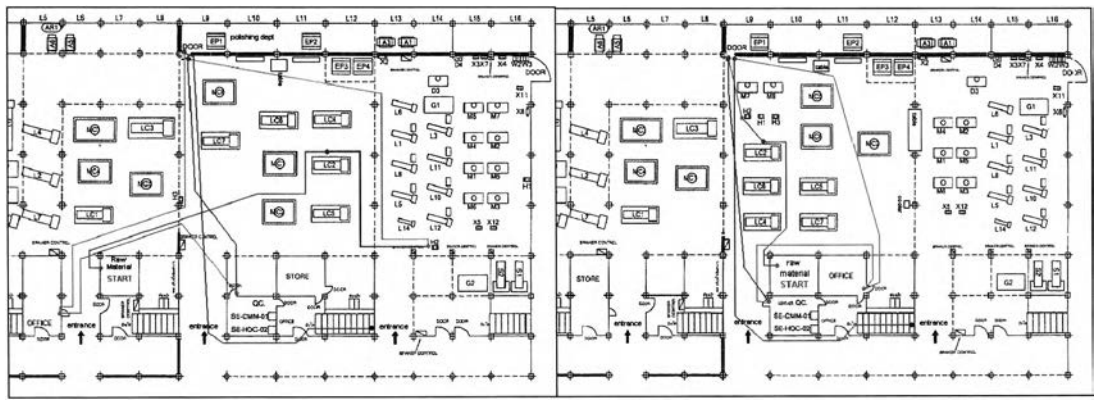


Figure 6.1 –On the left is the original design's flow path and on the right is design #2's, note the shortening and simpler flow path in design #2.

In conclusion, the inefficient manufacturing problem of high setup time, complicated machine allocation and unorganised manufacturing flow path that was caused by inappropriate shop floor layout was addressed using the cell-manufacturing concept to redesign the layout. The cell-manufacturing concept was selected because its criteria for successful implementation match well with the company profile. Product families were established according to their process requirements; resulting in three families namely screws, plates and operation tools. A manufacturing cell was designed for each product family because the three families can be produce more efficiently with cell manufacturing than current job shop layout. However, pure cell manufacturing concept needs some modification to improve overall flows in the plant, resulting in a hybrid cell manufacturing in the final design. The design can reduce the setup time by 85% and create as much as 720,000 bath extra profit for the company in the first year through better utilisation. The design will only cost 84,000 baht to implement and will be paid off in only one and a half month. The quality of the product will also be improved through better morale from the product ownership concept. The material flow path will also be simplified and shortened to create a more organised working atmosphere.

## 6.2 Recommendation

With this project, cells have been successfully formed, setup time has been reduced and the material flow path on the shop floor has been improved. However, there are always room for improvement. From the author's involvement with the project, the author feels that further study can be made in the subject of Cell Manufacturing and its effect on future factory expansion and, material handling.

This project has built a basis for the study of how the Cell Manufacturing concept will effect the future expansion of the company. An in depth project can be carried out to see whether it will be easier to expand the factory with the machines already placed in cells or would it be more effective to simply just keep buying the machines and put them in the existing functional department.

For the material handling study, with the established cells, the cells can be positioned to form a common aisle to further simplify the flow paths. A feasibility study should be carried out to investigate whether a conveyor system can be integrated with the common aisle concept to provide a more efficient material handling system.