

CHAPTER VI

RESULTS, CONCLUSION AND DISCUSSION

6.1 Implementation Results

This chapter would investigate into the implementation result of the post-ERP implementation. This was done by comparing various before and after implementation results along with performance indicators being the direct benefit inventory accuracy and satisfying more lost order and indirect benefits being one standardizing and improving the efficiency of the business processes by measuring the sale order lead time (order to deliver cycle), two improve the company's understanding of the ERP system for future implementation modules, and lastly reducing non-selling or slow moving inventory.

6.2 Comparison of Results

The comparisons could be done through observing the before-after system implementation results on various indicators following this section. This section could be divided into four sub-section presented as followed.

6.2.1 Comparison on Inventory Database

Prior running the new system and the BPs, the author had gathered the sale figures, production and inventory information of the control item namely N300-02 for a period of ten operating days using the old BPs and system. The results could be shown in the table 6-1.

The table 6-1 began with showing the inventory balanced forwarded from the previous transaction. At the end of each day the physical inventory count was done. The result was to be compared between the information on the previous database (resulted from the old work processes) and the actual physical inventory count.

In order to maintain data integrity it should be noted that the old system did not allow the inventory to be of negative value. Therefore the unsatisfied order would occur when there were actual sale orders coming in on each particular day but the system does not allow the transaction to be done i.e. negative inventory figure within the system although there might be finish good available physically. The unsatisfied order was then multiplied with the sale price of the product resulting in the value of sale order lost due to data inaccuracy.

Date	Transaction	Volumes (Gallons)			Database	Physical Count	Differences	Unsatisfied	Value of Lost Sale
		Balance Forwarded from Database + Production	Sales	On Hand					
	As of			9,800					
31072004	1	11,800	3,300	8,500					
	2	8,500	2,950	5,550					
	3	5,550	3,550	2,000		2,000	-800	0	0
2082004	4	9,200	3,000	6,200					
	5	6,200	900	5,300					
	6	5,300	620	4,680					
	7	4,680	1,200	3,480					
	8	3,480	2,300	1,180		1,980	-1,140	0	0
3082004	9	7,940	3,100	4,840	There were purchase order coming in for 1420 Gallons during the last 2 orders and since the database would not allow negative inventory. There were only 720 Gallons to satisfy the order leaving 700 Gallons unsatisfied. However cumulated difference and actual physical count shows there were actually 1140 Gallons left therefore if the database was not corrupted all order would have been satisfied. The value at the end day of the database was moved				
	10	4,840	700	4,140					
	11	4,140	2,020	2,120					
	12	2,120	350	1,770					
	13	1,770	1,050	720					

	14	720	720	0	on as Balance forward.									
	15	Unable to meet the demand of 700			0	1,140	-1,140	700	420,000.00					
4082004	16	8,000	950	7,050	There were purchase orders coming in for total 2420 Gallons during the last 3 orders and since the database would not allow negative inventory there were only 980 Gallons to satisfy the order leaving 1440 Gallons unsatisfied. In reality the cumulated difference and actual physical count shows there were actually 1140 Gallons therefore if the database was to be corrected there would be 300 Gallons of unsatisfied order. It should be noted that although the database shows 670 Gallons (which may results in data corruption) there was in fact nothing left in the warehouse, the order cannot be printed out for picking and were considered not to be satisfied.									
	17	7,050	600	6,450										
	18	6,450	1,200	5,250										
	19	5,250	800	4,450										
	20	4,450	300	4,150										
	21	4,150	700	3,450										
	22	3,450	970	2,480										
	23	2,480	1,500	980										
	24	980	980	0										
	25	Unable to meet demand of 800												
	26	Unable to meet demand of 640									1,140	-470	1,660	996,000.00
5082004	27	9,670	1,050	8,620	It should be noted that 670 Gallons carried forward are not available. It was just an incorrect figure due to errors, the real physical count is 1180 Gallons deducted by 670 Gallons.									
	28	8,620	800	7,820										
	29	7,820	1,090	6,730										
	30	6,730	200	6,530										
	31	6,530	350	6,180										

	32	6,180	600	5,580					
	33	5,580	650	4,930					
	34	4,930	300	4,630					
	35	4,630	250	4,380					
	36	4,380	1,200	3,180					
	37	3,180	800	2,380					
	38	2,380	300	2,080					
	39	2,080	900	1,180		1,650	-1,650	0	0
6082004	40	9,000	800	8,200					
	41	8,200	350	7,850					
	42	7,850	1,050	6,800	There were actually 510 Gallons left in the warehouse but was not carried forward to be in the database, therefore the actual physical count is 3960 Gallons.				
	43	6,800	800	6,000					
	44	6,000	1,050	4,950					
	45	4,950	600	4,350					
	46	4,350	900	3,450		5,100	-2640	0	0
7082004	47	4,460	1,200	3,260	There were total demands of 1740 Gallons in the last order. There were errors in the database again, the uncounted 1500 Gallons				

	48	3,260	3,020	240	could make the purchase order complete.					
	49	240	240	0						
	49	Unable to meet demand of 1500				2,640	-1,970	1,500	900,000.00	
9082004	50	9,670	750	8,920	It should be noted that 670 Gallons carried forward are not available. It was just an incorrect figure due to errors.					
	51	8,920	3,000	5,920						
	52	5,920	1,100	4,820						
	53	4,820	200	4,620						
	54	4,620	100	4,520						
	55	4,520	100	4,420						
	56	4,420	100	4,320		6,290	-6290	0	0	
10082004	57	5,700	770	4,930	There were purchase orders coming in for total 3650 Gallons during the last 3 orders and since the database would not allow negative inventory there were only 1150 Gallons to satisfied the order leaving 2500 Gallons unsatisfied. In reality the cumulated difference and actual physical count shows there were actually 6290 Gallons therefore if the database was to be corrected there would be no unsatisfied order. It should be noted that although the database shows 790 Gallons (which may results in data corruption) there was infact nothing left in the warehouse, the order cannot be					
	58	4,930	560	4,370						
	59	4,370	220	4,150						
	60	4,150	600	3,550						

		3,550	2,300	1,250	printed out for picking and were considered not to be satisfied.			
	62	1,250	100	1,150				
	63	1,150	1,150	0				
	64	Unable to meet 660						
	65	Unable to meet 1100						
	66	Unable to meet 200						
	67	Unable to meet 840				6,290	-5,500	2,500 1,500,000.00
1108.2004	68	9,790	1,000	8,790				
	69	8,790	1,120	7,670				
	70	7,670	200	7,470				
	71	7,470	650	6,820				
	72	6,820	200	6,620				
	73	6,620	800	5,820				
	74	5,820	350	5,470				
	75	5,470	150	5,320				

		5,320	800	4,520					
77	4,520		1,090	3,430					
78	3,430		1,200	2,230					
79	2,230		700	1,530					
80	1,530		430	1,100					
81	1,100		310	790		6,290	-5025	0	
Cumulated							-26625	6,360	3,816,000

Table 6-1: Inventory differences using the current information system and business processes

For comparison of the inventory accuracy purpose, the same set of data were entered in using the modified business processes mentioned in Chapter 4 and renewed information system discussed. The results were shown in the table 6-2.

From the table it could be observed that using the new BPs which allowed more automation, less data input and faster real-time flow of information resulted in zero differences between the actual physical count and those shown in the database at the end of each operating days. This was with the exceptional case of 4, 5, 9 and 10th operating day which showed the negative inventory value. The negative values represented the amount of finish good needs to be produce in order to cover the back order of the previous transaction.

During the test negative value of inventory was not allowed, this was done in order to preserve the data integrity as well as reasons from the general ledger perspective, It should be noted that the highlighted cells compiled of the back order plus the incoming gallons of paint from the production department.

Unit Price 600
 Item No. N300-02

Date	Transaction	Volumes (Gallons)			Database	Physical Count	Differences	Unsatisfied	Lost Sale
		Balance Forwarded	Sales	On Hand					
	As of			9800					
31072004	1	11800	3300	8500					
	2	8500	2950	5550					
	3	5550	3550	2000	2000	2000	0	0	0
2082004	4	10000	3000	7000					
	5	7000	900	6100					
	6	6100	620	5480					
	7	5480	1200	4280					
	8	4280	2300	1980	1980	1980	0	0	0
3082004	9	9080	3100	5980					
	10	5980	700	5280					
	11	5280	2020	3260					
	12	3260	350	2910					
	13	2910	1050	1860					
	14	1860	900	960	960	960	0	0	0
4082004	15	8960	950	8010	Does not allow negative inventory				
	16	8010	600	7410					
	17	7410	1200	6210					
	18	6210	800	5410					

	19	5410	300	5110					
	20	5110	700	4410					
	21	4410	970	3440					
	22	3440	1500	1940					
	23	1940	1200	740					
	24	740	800	-60					
	25	-60	640	-700	-700	0	-700	0	0
5082004	26	8300	1050	7250					
	27	7250	800	6450					
	28	6450	1090	5360					
	29	5360	200	5160					
	30	5160	350	4810					
	31	4810	600	4210					
	32	4210	650	3560					
	33	3560	300	3260					
	34	3260	250	3010					
	35	3010	1200	1810					
	36	1810	800	1010					
	37	1010	300	710					
	38	710	1,390	-680	-680	0	-680	0	0
6082004	39	8,320	800	7,520					
	40	7,520	350	7,170					

	41	7,170	1,050	6,120					
	42	6,120	800	5,320					
	43	5,320	1,050	4,270					
	44	4,270	600	3,670					
	45	3,670	900	2,770	2,770	2,770	0	0	0
7082004	46	4,770	1,200	3,570					
	47	3,570	3,020	550					
	48	550	1,740	0	0	0	0	0	0
9082004	49	9,000	750	8,250					
	50	8,250	3,000	5,250					
	51	5,250	1,100	4,150					
	52	4,150	200	3,950					
	53	3,950	100	3,850					
	54	3,850	100	3,750					

	55	3,750	1,050	2,700	2,700	2,700	0	0	0						
10082004	56	8,400	770	7,630	Does not allow negative inventory										
	57	7,630	560	7,070											
	58	7,070	220	6,850											
	59	6,850	600	6,250											
	60	6,250	2,300	3,950											
	61	3,950	100	3,850											
	62	3,850	2,000	1,850											
	63	1,850	660	1,190											
	64	1,190	1,100	90											
	65		90	200						-110					
	66		-110	840						-950	-950	0	-950	0	0
	11082004	67	8,050	1,000						7,050					
68		7,050	1,120	5,930											
69		5,930	200	5,730											

70	5,730	650	5,080					
71	5,080	200	4,880					
72	4,880	800	4,080					
73	4,080	350	3,730					
74	3,730	150	3,580					
75	3,580	800	2,780					
76	2,780	1,090	1,690					
77	1,690	1,200	490					
78	490	700	-210					
79		-210	430					
80		-640	310	-950	0	-950	0	0
						-3280	0	0

Table 6-2: Inventory differences using the new information system and business processes

As analyzed, the slow flow and the multiple entry of the information had resulted in inventory accuracy and slow sale order response time. During the ten days monitored period and just only 80 transactions the company had lost a staggering total of nearly 4 million baht of order which should be turn in to company's sale figure.

The total cost of the whole project as calculated in chapter 4 of this research was about 50 millions baht, therefore at the rate of this lost of sale, approximately the company would be able to recoup their investment within 130 operating days.

6.2.2 Comparison on Sale Order Lead-Time

The business processes had been reengineered improved and shortens to suit the new information system as shown in Chapter 4. The comparison of results of before-after the system implementation on the sale order lead-time was done by measuring the time taken for an order to be process from the time where the sale agent received call from a customer through the point where the shipment of the paint was made. The times measurement taken here did not include the delivery time that the goods spend on the delivery truck making its way to the customer depot.

The business processes and work flows which were associated with the order to deliver cycle (measuring time taken) could be found from figure 4-3 (the order being made) until the work flow 3-2 in figure 4-8 presented in Chapter 4. The time measurements were done monitoring and comparing the order to deliver lead time of 35 customer's calls. The following table showed the results of time usage before and after the system implementation.

	Sale Order Lead-time (minutes)	
	Before implementation	After implementation
Average	184.23	61.03
Median	182	61
Mode	162	57

Table 6-3: Comparison of Order to Deliver cycle lead time

6.2.3 Comparison on Comprehension of the ERP system

As indicated in section 1.7 of Chapter 1, the implementation of the ERP system on selected distribution modules of the ERP system would improve the company's overall employee comprehension on the benefits of the ERP system, work and effort needed for the system to be efficient. The research had a random selected group of 45 of the company's employee to take the ERP system comprehension test on various aspects such as benefits, functionality, and total cost of the ERP system. The comparison of the test results and score of before and after the piloted implementation could be found in the Table 6-4.

	Test Score	
	Before implementation	After implementation
Average	45.35	64.60
Median	45.00	64.60
Mode	60.00	71.00

Table 6-4: Test score comparison on ERP system comprehension

From the results it could be observed that the overall understanding of the selected population on the ERP system had improved by nearly 20%. This could be vital for the next phases and modules of the ERP system project implementation during the next phase

6.2.4 Comparison on Inventory Turnover Ratio

According to the company's Pareto/ABC analysis the inventory can be divided into A, B, C and D classes. They were grouped and arranged according to how fast each of the items was to be sold since the day of the production, with A being the fastest, C the slowest and D was classified as "dead-stock" or non-moving product.

According to Schreibfeder inventory turnover ratio is the way to measure how hard an inventory or capital investment had been working for the company over a specified period of time or in another word the performance of particular type of inventory. The inventory turnover ratio was

used as another performance indicator of the implemented ERP system presented in this research. The inventory turnover of the group D of the products which was the slowest moving product was done. Similarly the before-after of system implementation measuring such group of inventory turnover was done over 4 months period of time on 2 selected grouped D products being N 212, and N 325. The inventory turnover ratio was calculated using the following formula.

$$\text{Inventory Turn over} = \frac{\text{Cost of Goods Sold from Inventory Sales over a period of time}}{\text{Average Inventory Investment during over a period of time}}$$

The average inventory investment were taken from the past accounting book, it were calculated by taking the total value of the selected product in the inventory (quantity on-hand multiply but the cost) during the stock cycle count (on average the same day of the month for four months period of time). As mentioned the inventory of the selected product has very little fluctuation (grouped D in Pareto analysis).

It should be noted that inventory turnover is based on the cost of the selected items and not sales dollars. Base on the sales and production history figures the product N 212 managed only 3% of sales and N325 at approximately 4%. The production average inventory was 8,000 units for N212 and 6,000 units for N325. The cost of good sold using actual cost was 400 baths per unit. The following table shows the result of the inventory turnover for both products before and after ERP system implementation.

Product	Inventory Turnover ratio	
	Before implementation	After implementation
N212	0.03	0.42
N325	0.04	0.74

Table 6-5: Comparison on inventory turnover ratio before and after system implementation

From the table it could be observed that following new database, information system and work process the inventory turnover ratio of the

selected product had rose 14 times and 18.5 times for product N212 and N325 respectively. From the inventory turnover ratio perspective this result could be interpreted either that the product had made more value for the investment during the selected time frame of four months.

From the results the following points were observed as the cause of the improvement of the inventory turnover ratio.

- The faster and improved work processed had accelerated sale on overall products of the company which had also benefited group D of product.
- As a result of more updated and accurate inventory database, the ERP system would be able to alarm and show exact date of the product shelf life and holding cost exactly in each inventory report when cycle counting would be done. The sale manager agent could now plan ahead on which product or shade of color plan ahead of which product to emphasize his/her sale people. Whereas in the past this type of information was not made available.

Another benefit of the system implementation would be if the inventory turnover ratio of the product deem to be constant in the future, meaning being the same when a period of 12 months is applied as the average inventory investment value, it could mean that the production manager could then plan to produce the mentioned product at its most efficiency (not to overproduced) so that the company could enjoy better return on investment for the same amount of capital invested.

6.3 Conclusion

The success of the ERP system was hard earned. An organization must be ready in all aspect e.g. financial capability, information system infrastructure, capable human resource, the right organizational structure and culture.

The system was like a child, it need time devotion for it to grow into a system which capable of transferring, processing accurate transactions for the users and the management within the company to be able to use for the planning and work coordination. The managements would benefits from the reports retrieved from the system. The results comparing post and before ERP system implementation proved that the information when provided at the correct value and correct point in time would allows the management to plan ahead and react to any situation immediately.

As today's business world change rapidly, it also call for the change in an IS to be able to support the new BPs in order for the company to stay healthy and competitive. With the reintroduction of the figure 3-2 presented, the final phase of the SDLC show a cycle looping back to the first step of "system request". This would be done for the information system personnel to maintain and enhance or even optimizing the system's capability technically. Again according to Shelly et al (2003:25) the step in order to maintain changes, correct errors or making the system meet the requirement.

Therefore this step could be done as work in progress which should be a continuous improvement to achieve higher benchmark. The SDLC should ends with system replacement of where there would be ultimately change in the operation environment, information technology and BPs.

6.4 Discussion and Further Studies

As proved the ERP system was not just complex software but was one mega project which could affect everybody within the organization. This study had shown methods in implementing the system through good preparation and change

management. Huge costs would often associate with upgraded technology. Apart from the financial and technology aspects, modern project manager and project committee must not overlook the importance of the human factor and the business process which proved in this study was the core ingredient to any project implementation success.

The total cost of ownership or the TCO of the ERP system was widely debated by many technology gurus and expert. The success of the ERP system implementation in this study was a more accurate inventory database which would help the company save millions of baht. However the benefits measured in this study were only of those tangible ones. The intangible benefits of the ERP should be put into further studies. This should be study to assist organization with a dollar-measurement

Another interesting related topic may evolve around the integration of the supply chain into the ERP system. Many world-class organizations had succeeded and edge over their competitors via good supply chain management. Therefore it would be no doubt that good supply chain management would prove vital to the production efficiency and the ability to meets the customer requirement. An ERP system implementation which involves the backward integration of the supplier as another module would therefore be a very interesting topic for scholars to investigate.

Last but not least a study about the costing of the product using ERP system by the method of Activity Based Costing (ABC) or made to order (where parts are not standardized and cost standardization cannot be applied) related to engineering to help company increase its efficiency and save money would also be interesting field of study. Any further studies in the mentioned fields and topic could lead to a very beneficial outcome for organizations implementing ERP system.