CHAPTER 2

LITERATURE REVIEW

2.1 Overview of traditional costing system

(Dor R. Hansen and Maryanne M. Mowen, 1997: 301-314)

Traditional costing systems assume that all cost can be classified as fixed or variable with respect to changes in the units or volume of product produced. Thus, units of product or other drivers highly correlated with units produced, such as direct labor hours and machine hours, are the only drivers assumed to be of importance. The unit- or volume-based are used to assign production costs to be product. A cost **accounting system that uses only unit-based activity drivers to assign costs to cost objects is called a traditional costing system.** Since unit-based activity drivers usually are not the only drivers that explain causal relationships, much of the product cost assignment activity must be classified as allocation (recall that allocation is cost assignment based on assumed linkages or convenience). We can say, therefore, the traditional cost accounting systems tend to be allocation-intensive.

2.2 Overview of Contemporary cost management systems

(Dor R. Hansen and Maryanne M. Mowen, 1997: 301-314)

A contemporary costing system emphasizes tracing over allocation. The role of driver tracing is significantly expanded by identifying drivers unrelated to the volume of product produced (called non unit-based activity drivers). The use of both unit and non unit-based activity drivers increases the accuracy of cost assignments and the overall quality and relevance of cost information.

A costing system that uses both unit and non-unit-based activity drivers to assign costs to cost objects is called an Activity-Based Cost system. For example, consider the activity "moving raw materials and partially finished goods from one point to another within a factory". The number of moves required for a product is a

much better measure of the product's demand for the material handling activity than the number of units produced. In fact, the number of unit produced may have nothing to do whatsoever with measuring products' demands for material handling. (A batch of 10 units of one product could require as much materials handling activity as a batch of 100 units of another product.) Thus, we can say that a contemporary cost accounting system tends to be tracing-intensive.

Product costing in a contemporary system tends to be flexible. The contemporary cost management system is capable of producing cost information for variety of managerial objectives, including the financial reporting objective. More comprehensive product costing definitions are emphasized for better planning, control, and decision making. Thus, the maxim of "different costs for different purposes" takes on real meaning.

This new approach focuses on accountability for activities rather than costs and emphasizes the maximization of system-wide performance instead of individual performance. Activities cut across functional and departmental lines, are system-wide in focus, and require a global approach to control. Essentially, this form of control admits that maximizing the efficiency of individual subunits does not necessarily lead to maximum efficiency for the system as whole. **Another significant difference also should be mentioned. In the contemporary operational control information system, both financial and non-financial measures of performance are important.** Figures 1, 2, 3 compare the characteristics of traditional and contemporary cost management systems (Activity-Based Costing).

Figure 1: Comparison of traditional and contemporary cost management systems

Traditional	Contemporary
1. Unit-based drivers	1. Unit and non unit-based drivers
2. Allocation-intensive	2. Tracing-intensive
3. Narrow and rigid product costing	3. Broad, flexible product costing
4. Focus on managing costs	4. Focus on managing activities
5. Sparse activity information	5. Detailed activity information
6. Maximization of individual unit performance	6. System-wide performance maximization
7. Uses financial measures of performances	7. Uses both financial and non financial measures of performance

Figure 2: demonstrate traditional financial report compared with ABC report (Steve Player et al. 1998)

Traditional Cost Report for Obstetrics Department		Activity-based Cost Report for Obstetrics Department	
Salaries	$ 1,770,000	Admit Patients	$ 106,000
Fringe Benefits	$ 354,000	Assess Patients	$ 263,000
Medical Supplies	$ 250,000	Prepare Documentation	$ 213,000
Depreciation	$ 31,000	Monitor Patients	$ 447,000
Other Costs	$ 25,000	Administer Medication	$ 213,000
Total	**$ 2,430,000**	Deliver Babies	$ 542,000
		Prepare for C-Sections	$ 157,000
		Manage Patients	$ 383,000
		Discharge Patients	$ 106,000
		Total	**$ 2,430,000**

Figure 3: Comparison of of traditional costing system and activity-based costing (Michael H. Granof, David E. Platt and Igor Vaysman, 2000: 9)

Difference Between ABC and Traditional Costing

	ABC Costing	Traditional Costing
Cost Pools	ABC systems accumulate costs into *activity* cost pools. These are designed to correspond to the major activities or business processes. By design, the costs in each cost pool are largely caused by a single factor—the *cost driver.*	Traditional costing systems accumulate costs into facility-wide or departmental cost pools. The costs in each cost pool are heterogeneous—they are costs of many major processes and generally are not caused by a single factor.
Allocation Bases	ABC systems allocate costs to products, services, and other cost objects from the activity cost pools using allocation bases corresponding to cost drivers of activity costs.	Traditional systems allocate costs to products using volume-based allocation bases: units, direct labor input, machine hours, revenue dollars.
Hierarchy of Costs	Allows for non-linearity of costs within the organization by explicitly recognizing that some costs are not caused by the number of units produced.	Generally estimates all of the costs of an organization as being driven by the volume of product or service delivered.
Cost Objects	Focuses on estimating the costs of many cost objects of interest: units, batches, product lines, business processes, customers, and suppliers.	Focuses on estimating the cost of a single cost object – unit of product or service.
Decision Support	Because of the ability to align allocation bases with cost drivers, provides more accurate information to support managerial decisions.	Because of the inability to align allocation bases with cost drivers, leads to *overcosting* and *undercosting* problems.
Cost Control	By providing summary costs of organizational activities, ABC allows for prioritization of cost-management efforts.	Cost control is viewed as a departmental exercise rather than a cross-functional effort.
Cost	Relatively expensive to implement and maintain.	Inexpensive to implement and maintain.

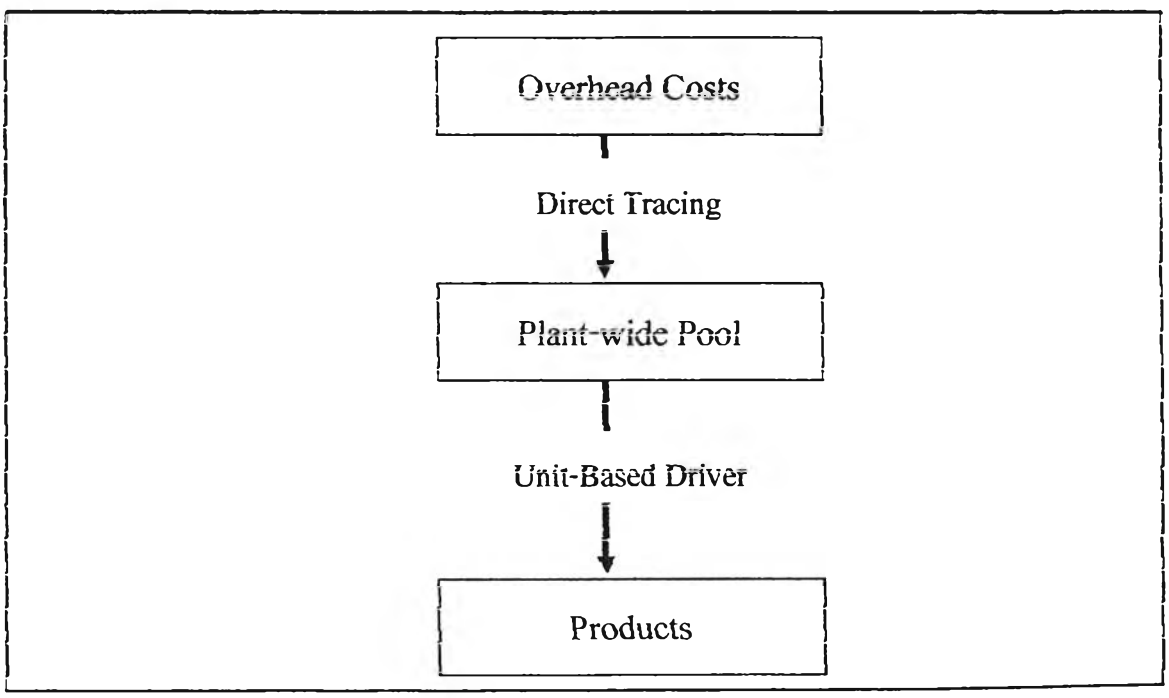
2.3 Limitation of Traditional Costing System

Traditional costing system assigns only manufacturing costs to products. Assigning the cost of direct materials and direct labor to products poses no particular challenge. These costs can be assigned to products using direct tracing or very accurate driver tracing, and most traditional cost systems are designed to ensure that this tracing takes places. **Overhead costs**, on the other hand, **pose a different problem**. The physically observable input-output relationship that exists between direct labor, direct materials, and products is simply not available for overhead. Thus, assignment of overhead must rely on driver tracing (and perhaps allocation). In a traditional cost system, only unit based activity driver are used to assign costs to products. Unit-based activity drivers are factors that cause changes in costs as the unit produced change.

The use of only unit-based driver to assign overhead costs to products assumes that the overhead consumed by products is highly correlated with number of unit produced, measured in term of such factor as direct labor hours, machine hours, or material costs. These unit-based activity drivers assign overhead to products through the use of either plant-wide or departmental rates.

Figure 4: Traditional Overhead Assignment

A. Plant-wide rates



B. Departmental rates

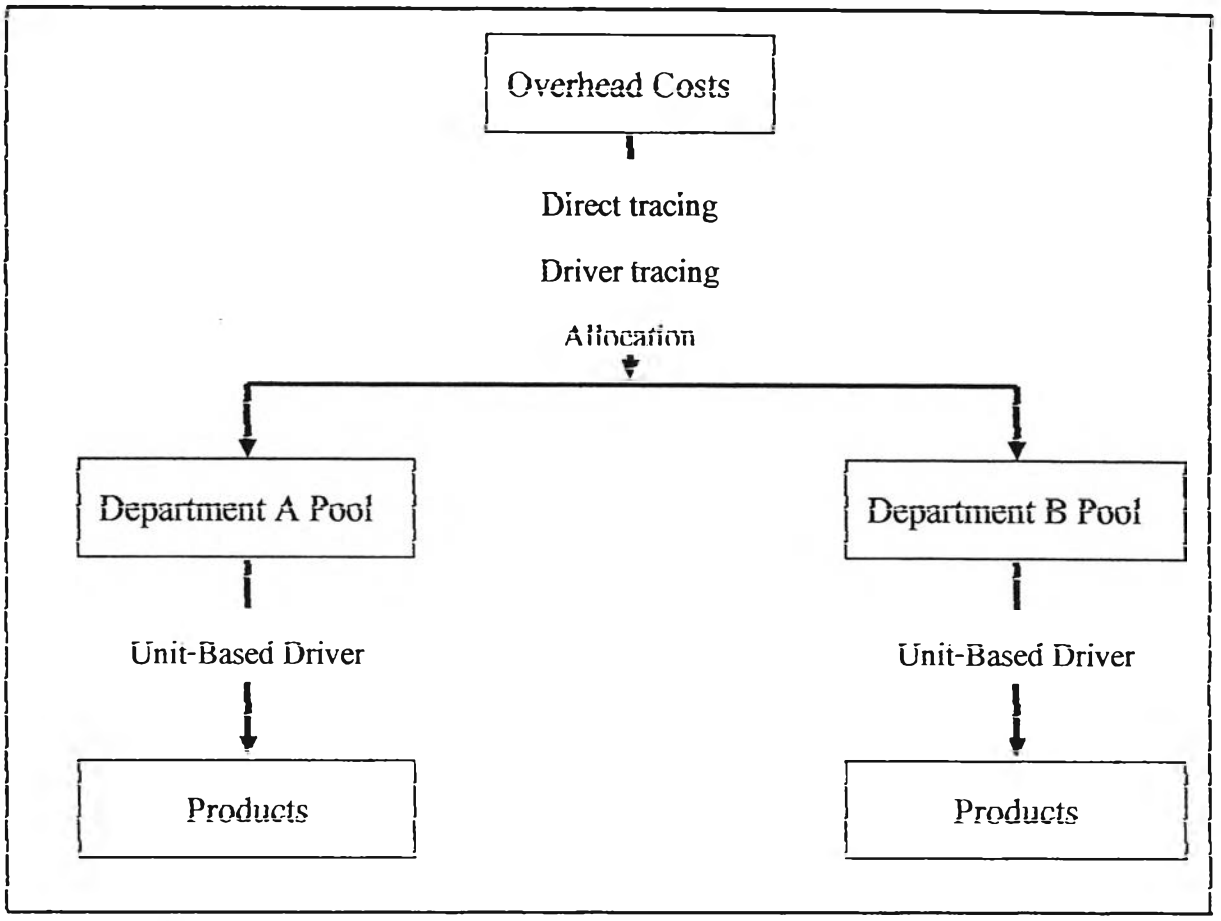


Figure 4 reviews the approach of traditional overhead assignment. Panel A illustrates plant-wide rates, and Panel B illustrates departmental rates, using two departments. **For plant-wide rates, overhead costs are first accumulated in one large plant-wide pool (first-stage cost assignment).** Overhead costs are assigned to the pool simply adding all the overhead costs identified in general ledger. Since all overhead costs belong to the plant, assignment to the pool is done with complete accuracy. In this first stage, the cost object is the plant and direct tracing can be used to assign costs to the plant-wide pool. In a sense, we could argue that the costs are assigned to a very broad macro activity: production. Once costs are accumulated in this pool, we then compute plant-wide rate using a single driver, which is usually direct labor hours.

Products are assumed to consume overhead resource in proportion to the direct labor hours used. Thus, in the second stage, overhead costs are assigned to products multiplying the rate by the actual total direct labor hours used by each product.

For departmental rates, overhead costs are assigned to individual production departments, creating departmental overhead costs pool. **In first stage, department are cost objects and overhead costs are assigned using direct tracing, driver tracing, and allocation.** Although an effort is made to assign these external costs using causal factors (driver tracing), some overhead costs are assigned using assumed linkage (allocation). Once costs are assigned to individual production department, then unit-based driver such as direct labor hours (for labor-intensive departments) and machine hours (for machine-intensive departments) are used to compute departmental rates. **Products passing through the departments are assumed to consume overhead resources in proportion to departments' unit-based driver (machine hours or direct labor hours used). Thus, in the second stage, overhead is assigned to products by multiplying the departmental rates by the amount of drivers used in the respective department.** The total overhead assigned to product is simply the sum of the amount received in each department.

2.3.1 The Inadequacy of Plant-wide and Departmental Rates

Plant-wide and departmental rates have been used for decades and continue to be used successfully by many organizations. **In some settings, however, they do not work well and may actually cause severe product cost distortion.** For companies operating in what is called the advanced manufacturing environment is characterized by firms engaged in intense competition (usually on a worldwide level), continuous improvement, total quality management, total customer satisfaction, and sophisticated technology. As firm operating in this advanced environment adopt new strategies to achieve competitive excellence, their cost accounting system often must change to keep pace. Specifically, the need for more accurate product costs has forced many

companies to take a serious look at their costing procedures. Cost systems that worked reasonably well in the past may no longer be acceptable.

Organizations, such as John Deere Component Works, have found that their plant-wide or departmental rates are simply no longer capable of accurately assigning overhead costs to individual products. **There are at least two major factors that impair the ability of the unit-based plant-wide and departmental rates to assign overhead costs accurately: (1) the proportion of non-unit-related overhead costs to total overhead costs is large, and (2) the degree of product diversity is great.**

1) Non unit-related overhead costs

The use of either plant-wide rates or departmental rates assumes that a product's consumption of overhead resources is related strictly to units produced. But what if there are overhead activities that are unrelated to the number of units produced? Setup costs, for example, are incurred each time a batch of products is produced. A batch may consist of 1,000 or 10,000 units and the cost of setup is the same. Yet as more setups are done, setup costs increase. The number of setups, not the number of units produced, is the cause of setup costs. Furthermore, product engineering costs may depend on the number of different engineering work order rather than the units produced of any given product. Both these examples illustrate the existence of non unit-based drivers. Non unit-based activity driver are factor, other than the number of units produced, that measure that cost objects place on activities. **Thus, unit-based activity drivers cannot assign these costs accurately to products.**

Using only unit-based activity drivers to assign non unit-related overhead costs can create distorted product costs. The severity of this distortion depends on what proportion of total overhead costs these non unit-based costs represent. For many companies, this percentage can be significant. Schrader Bellows and John Deere Component Works, for example, experienced non unit-based overhead cost ratios of about 50% and 40%, respectively. **This suggests that some care should be exercised in assigning non unit-based overhead costs. If non unit-based overhead costs are**

only small percentage of total overhead costs, the distortion of product costs would be quite small. In such a case, using only unit-based activity drivers to assign overhead costs might be acceptable.

2) Product Diversity

Product diversity simply means that products consume overhead activities in different proportions. For example, differences in product size, product complexity, setup time, and sizes of batches all can causes products to consume overhead at different rates. Regardless of nature of the product diversity, product cost will be distorted whenever the quantity of unit-based overhead that a product consumes does not vary in direct proportion to the quantity consumed by a product is defined as the consumption ratio. **How non unit overhead costs and product diversity can produce distorted product costs is best illustrated with an example.**

3) An Example illustrating the failure of unit-based overhead rates.

To illustrate how traditional unit-based overhead rates can distort product costs, assume that Goodmark Company has a plant that produces two products: scented and regular birthday cards. Scented cards emit a pleasant fragrance when opened. There are two producing departments: Cutting and Printing. Cutting is responsible for shaping the cards, and Printing is responsible for design and wording (including the insertion of the fragrance for scented cards). Expected product costing data are given in Figure 5. The units are boxes of one dozen cards. Because the quantity of regular cards produced is ten times greater than that of scented cards, we can label the regular cards a high-volume product and scented cards a low-volume product. The cards are produced in batches.

For simplicity, only four types of overhead activities, performed by four distinct support departments, are assumed: setting up the equipment for batch, moving a batch, supplying electricity, and inspection. Each box of 12 cards is inspected after each department's operations. After cutting, the cards are inspected individually to ensure correct shape. After printing, the boxes of cards are also inspected individually

to ensure correct wording, absence of smudges, insertion of fragrance, etc. Overhead costs are assigned to the two production department using direct method. Assume that the four services centers do not interact. **Setup costs are assigned based on the number of production runs handled by each department**. Since the number is identical, each department receives 50 percent of total setup costs. Materials-handling costs are assigned by the number of moves used by each department (which are assumed to be the same). Power costs are assigned in proportion to the machine hours used by each department. Finally, inspection costs are assigned in proportion to the direct hour used (experience indicates almost a perfect correlation of inspection hours with direct labor hours)

3.1) Plan-wide overhead rate

The total overhead for the plant is $360,000, the sum of the overhead for each department ($108,000 + $252,000). Assume that direct labor hours are used as the unit-based activity driver. Dividing the total overhead by direct labor hours yields the following overhead rate:

Plant-wide rate = $360,000/100,000

= $3.6 per direct labor hour

Using this rate and other information from figure 5, the unit costs for each product are calculated and shown in figure 6.

Figure 5: Product costing data

	Scented Cards	Regular Cards	Total
Unit produced per year	10,000	100,000	
Prime costs	$78,000	$738,000	$816,000
Direct labor hours	10,000	90,000	100,000
Machine hours	5,000	45,000	50,000
Production runs	20	10	30
Number of moves	60	30	90
	Departmental Data		
	Cutting Dept.	**Printing Dept.**	**Total**
Direct labor hours:			
Scented cards	3,000	7,000	10,000
Regular cards	77,000	13,000	90,000
Total	80,000	20,000	100,000
Machine hours:			
Scented cards	1,000	4,000	5,000
Regular cards	9,000	36,000	45,000
Total	10,000	40,000	50,000
Overhead costs:			
Setup	$60,000	$60,000	$120,000
Materials handling	$30,000	$30,000	$60,000
Power	$10,000	$90,000	$1000,000
Inspection	$8,000	$72,000	$80,000
Total	$108,000	$252,000	$360,000

Figure 6: Unit cost computation: Plant-wide rate

	Scented	**Regular**
Prime costs	$78,000	$738,000
Overhead costs $3.60 x 10,000 $3.60 x 90,000	36,000	324,000
Total manufacturing costs	**$114,000**	**$1,062,000**
Units of production	10,000	100,000
Unit cost (Total costs/Units)	**$11.40**	**$10.62**

3.2) Departmental rates

Based on the distribution of labor hours and machine hours in Figure 5, the Cutting Department is labor-intensive and the Printing Department is machine-intensive. Moreover, the overhead costs of the Cutting Department are 40% of those of the Printing department. Based on these observations, it could be argued that departmental overhead rates would reflect the consumption of overhead better than would a plant-wide rate. If true, product costs would be more accurate. This approach would yield the following departmental rates, using direct labor hours for the Cutting Department and machine hours for Printing Department.

Cutting Department rate = $108,000/80,000 direct labor hours

= $1.35/direct labor hours

Printing Department rate = $252,000/40,000 machine hours

= $6.30/machine hours

Using these rates and the data from figure 5, the computation of the unit costs for each product is shown in figure 7.

Figure 7: Unit cost computation: Departmental rates

	Scented	**Regular**
Prime costs	$78,000	$738,000
Overhead costs ($1.35 x 3,000) +($6.30 x 4,000) ($1.35 x 77,000) +($6.30 x 36,000)	29,250	330,750
Total manufacturing costs	**$107,250**	**$1,068,750**
Units of production	10,000	100,000
Unit cost (Total costs/Units)	**$10.73**	**$10.69**

3.3) Problems with Costing Accuracy

The accuracy of the overhead cost assignment can be challenged regardless of whether the plant-wide or departmental rates are used. **The main problem with either procedure is the assumption that machine hours or direct labor hours drive or cause of overhead costs.**

From figure 5, we know that regular cards, the high-volume product, use nine times the direct labor costs used by the scented cards, the low-volume product (90,000 hours versus 10,000 hours). Thus, if a plant-wide rate is used, the regular cards will receive nine times more overhead cost than will the scented card. But is this reasonable? Do unit-based activity driver explain the consumption of all overhead activities? In particular, can we reasonably assume that each product's consumption of overhead activities increase in direct proportion to direct labor hours used? Let's look at the four overhead activities and see if unit-based drivers accurately reflect the demand of regular and scented cards.

Examination of data in Figure 5, 6, 7 **suggest that a significant portion of overhead costs is not driven or caused by the units produced (as measured by direct labor hours).** For example, each product's demand for setup and material-handling activities are more logically related to number of production run and number of moves, respectively. These non unit activities represent 50% ($180,000/$360,000)

of the total overhead costs-a significant percentage. Notice that the low-volume product, scented card, uses twice as many runs as do regular cards (20/10) and twice as many moves (60/30). However, use of direct labor hours, a unit-based activity driver, and plant-wide rate assigns nine times more setup and material-handling costs to the regular cards than to the scented. **Thus, we have product diversity and we should expect product cost distortion because the quantity of unit-based overhead that each product consumes does not vary in direct proportion to quantity consumed of non unit-based overhead.** *The consumption ratios suggest that a plant-wide rate based on direct labor hours will over cost the regular cards* and *under cost the scented cards.*

The problem is only aggravated when departmental rates are used. In the Cutting Department, regular cards consume 25.67 times as many direct labor hours as do the scented cards (77,000/3,000). In Printing Department, regular cards consume nine times as many machine hors as the scented cards (36,000/4,000). Thus, the regular cards receive about 25.67 times more overhead than do the scented card in Cutting Department, and in the Printing Department, they receive nine times more overhead. As figure 7 shows, with departmental rates, the unit costs of scented card decrease to $10.73, and the unit cost of the regular cards increase to $10.69. This change is in the wrong direction, which emphasizes the failure of unit-based activity drivers to reflect accurately each product's demands for setup and materials-handling costs.

Figure 8: Product Diversity: Consumption Ratios

Overhead activity	Scented Cards	Regular Cards	Activity Drivers
Setups	0.67 [a]	0.33 [a]	
Materials handling	0.67 [b]	0.33 [b]	
Power	0.10 [c]	0.90 [c]	
Inspection	0. 10 [d]	0.90 [d]	

[a] 20/30(scented) and 10/30(regular)

[b] 60/90(scented) and 30/90(regular)

[c] 5,000/50,000 (scented) and 45,000/50,000 (regular)

[d] 10,000/100,000 (scented) 90,000/100,000 (regular)

Note: Because direct labor hours are highly correlated with inspection hours, direct labor hours are used as the activity driver for the inspection activity (necessitated by the fact that collection of inspection hours by product stopped when the correlation was documented)

3.4) Additional example about problem of traditional costing system

L. Leslie Gardner, Mary E. Grant and Laurie J. Rolston (1994) said that **failings of traditional costing practices were product or job cost distortion due to misallocation of overhead, and failure to estimate changes in overhead that were consequences of a product mix decision.**

Proponents of activity-based costing claim that cost distortion can be avoided by analyzing activities and choosing appropriate cost drivers for allocation of activity costs. They also claim that activity-based costing is effective for predicting changes in overhead resulting from a product mix decision.

Steve Player (1998) said that **traditional cost-accounting method evaluated the profitability of service lines or elements of patient care by allocating organizational or departmental costs into single or multiple cost pools**, such as labor and medical supplies. **The chief problem with this approach was that it does not account for the diversity of activity that underlies each cost pool.** Single-step allocations failed to reflect the activities being performed or specific resources being used. Activity-Based Costing, on the other hand, provided a means of accounting for the costs associated with specific activities and resources.

Mark Shinder and David McDowell (1999) said that activity-based costing addressed deficiencies in the traditional costing systems. **These traditional costing systems were based on a few cost drivers, usually direct labor or direct machine**

hours, and did not accommodate the recent changes in business environment. As an organization's product and customer mix becomes more diverse, **the assignment of overhead expenses became grossly misleading, distorting the costs of individual products/services.** As a result, many manufacturing organizations had cost systems which could support financial reporting, but provided distorted information about the individual products. This sent the wrong signal to decision makers. Mark Shinder and David McDowell also said that Activity-Based Costing was a cost measurement system that provides a cost for each product, service or customer by analyzing each activity needed to produce a product or service a customer. When indirect costs were allocated to products based on the wrong cost driver, products would appear less or more expensive than they actually were. Activity-Based Costing was used to identify all activities, direct and indirect, and allocate the costs associated with these activities more precisely.

Activity-Based Costing could be used in any type of organization. It was most useful though, when an organization had complex transfer pricing issues, high indirect costs and shared processing stations. Activity-Based Costing provided useful insights, but information without action did not add value. The results should be used to generate improvement.

Then, Activity-based costing provides more accurate product and service cost than traditional costing systems due to the nature and the number of cost drivers used:

- Activity-Based Costing emphasizes cost tracing while traditional cost systems are allocation intensive. Cost tracing exploits cause and effect relationships between a cost and a cost object. Allocation is arbitrary, and largely ignores cause and effect relationships. Moreover, allocation can result in severe cost distortions on a per unit or per service level.

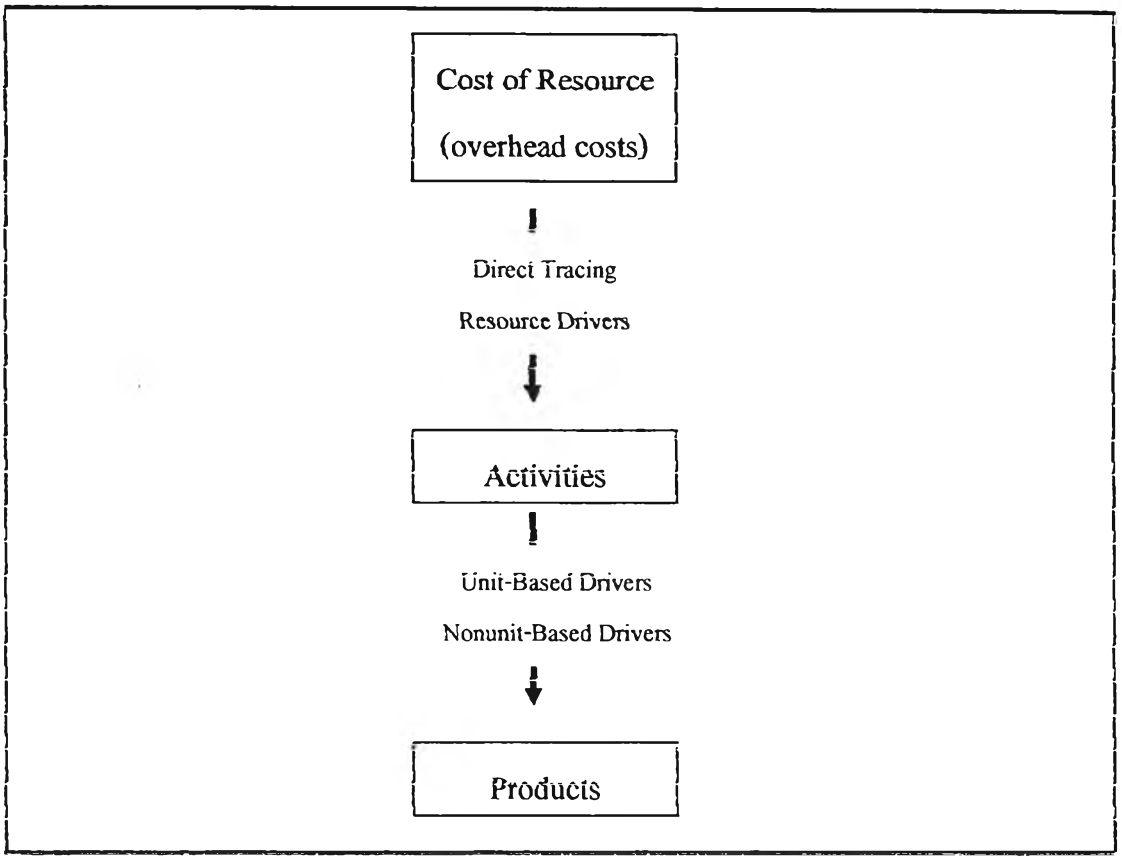
- Activity-Based Costing better reflects reality by using many cost drivers while traditional cost systems use fewer cost drivers. In many traditional systems only one cost driver is used.

- Activity-Based Costing better reflects reality by using unit-based and non unit-based activity drivers while traditional systems tend to use unit-based drivers only.

2.4 Principle of Activity-Based Costing system

(Dor R. Hansen and Maryanne M. Mowen, 1997: 301-314)

Figure 9: Activity-Based Costing: Two stage cost assignment



2.4.1General Description

In figure 4, we saw that traditional overhead assignment involved two stages: first, overhead costs were assigned to an organizational unit (plant or departmental), and second, overhead costs were then assigned to products. As figure 9: illustrates, an Activity-Based Cost (ABC) system is one that first traces costs to activities and then to products. **Thus, activities-based costing is also a two-stage process, but in the first stage, it traces overhead costs to activities rather than to an organizational unit such as the plant or departments.** In both traditional and activity-based costing, the

second stage consists of assigning costs to the product. **An Activity-Based Cost system, however, emphasizes direct tracing and driver tracing (exploiting cause-and-effect relationship), while a traditional cost system tends to be allocation-intensive (largely ignoring cause-and-effect relationship).** Thus, the principal computational different between the two methods concern the nature and the number of activity drivers used. **Activity-Based Costing uses both unit-based and the non unit-based activity driver. These drivers must reflect a cause-and-effect relationship**. In practical terms, drivers must explain a large percentage of activity cost variability. This criterion can be tested by preparing cost formulas for each activity and using the activity drivers that have high R^2s. Generally, the number of drivers is greater than the number of unit-based drivers commonly used in a traditional system. As a result, the Activity-Based Costing method produces increased product-costing accuracy.

From a managerial perspective, however, an Activity-Based Costing system offers more than just more accurate product cost information. It also provides information about the cost and performance of activities and resources, and it can trace cost accurately to cost objects other than products, such as customers and channels of distribution. For example, knowing the cost of activities, their importance to the organization, and how efficiently they are performed allows managers to focus on those activities that might offer opportunities for cost saving-provided they are simplified, perform more efficiently, eliminated, and so on.

2.4.2 First-Stage Procedure

In the first stage of activity-based costing, activities are identified, costs are associated with individual activity, and activities and their associated costs are divided into homogeneous sets. Recall that an activity is work performed within an organization. Thus, activity identification requires a listing of all the different kinds of work, such as materials handling, inspections, process engineering, and product enhancement. A firm may have hundreds of different activities. Once an activity is

defined, the cost of performing the activity is determined. At this point, the firm could determine the activity driver associated with each activity and calculate individual activity overhead rates. For the average setting, this could literally produce hundreds of overhead rates, a cumbersome method of assigning overhead to products.

To reduce the number of overhead rates required and to streamline the process, activities are grouped together in homogeneous sets based on similar characteristics: (1) they are logically related, and (2) they have the same consumption ratios for all products. Costs are associated with each of these homogeneous sets by summing the costs of the individual activities belonging to the set. The collection of overhead costs associated with each set of activities is called a homogeneous cost pool. Since the activities within homogeneous cost pool have the same consumption ratio, the cost variations for this pool can be explained by a single activity driver. Once a cost pool is defined, the cost per unit of the activity driver is computed by dividing the pool costs by activity driver's practical capacity. This is called the pool rate. Computation of pool rate completes the first stage. Thus, the first stage produces five outcomes:(1) activities are identified, (2) costs are assigned to activities, (3) related activities are grouped together to form homogeneous sets, (4) the costs of grouped activities are summed to define homogeneous cost pools, and (5) pool(overhead) rates are computed.

2.4.3 Second-Stage Procedure

In the second stage, the costs of each overhead pool are traced to product. This is done using the pool rates computed in the first stage and measuring of the amount of resources consumed by each product. This measure is simply the quantity of the activity driver used by each product. In above example, that would be the number of production runs and machine hours used by each type of card. Thus, the overhead assigned from each cost pool to each product is computed as follows:

Applied overhead (to a product) = Pool rate x Activity usage

2.4.4 Step for develop Activity-Based Costing

Step 1: Identify and classify the activities related to company's product

Activities in all areas of value chain (product design, production, marketing, distribution, etc.) must be included. People identify the activities that a company performs to produce a product and prepare a list called an activity dictionary of these activities. The activity dictionary can be obtained in number of different way, including interviews with the employees who perform the activities. As activities are identified, they are classified as unit level, product level, customer level, or facility level.

Step 2: Estimate the cost of activities identified in step1.

Estimate the cost of specific activities that cause costs. These costs are for both human resources, such as employee labor for production and machine maintenance, and physical resources, such as the cost of machinery and building occupancy. Information must include employee data from personnel interviews and financial data from accounting department. Then calculate the total cost of each activity.

Step 3: Calculate a cost-driver rate for each activity

The activity cost data from step 2 is used to calculate a cost-driver rate that the company can use for assigning activity costs to goods and services. This rate should use a base that has some causal link to the cost. For example, costs of running a production machine are likely caused by the number of hours it is run. Thus, choosing a rate for this activity based on machine hour is wise.

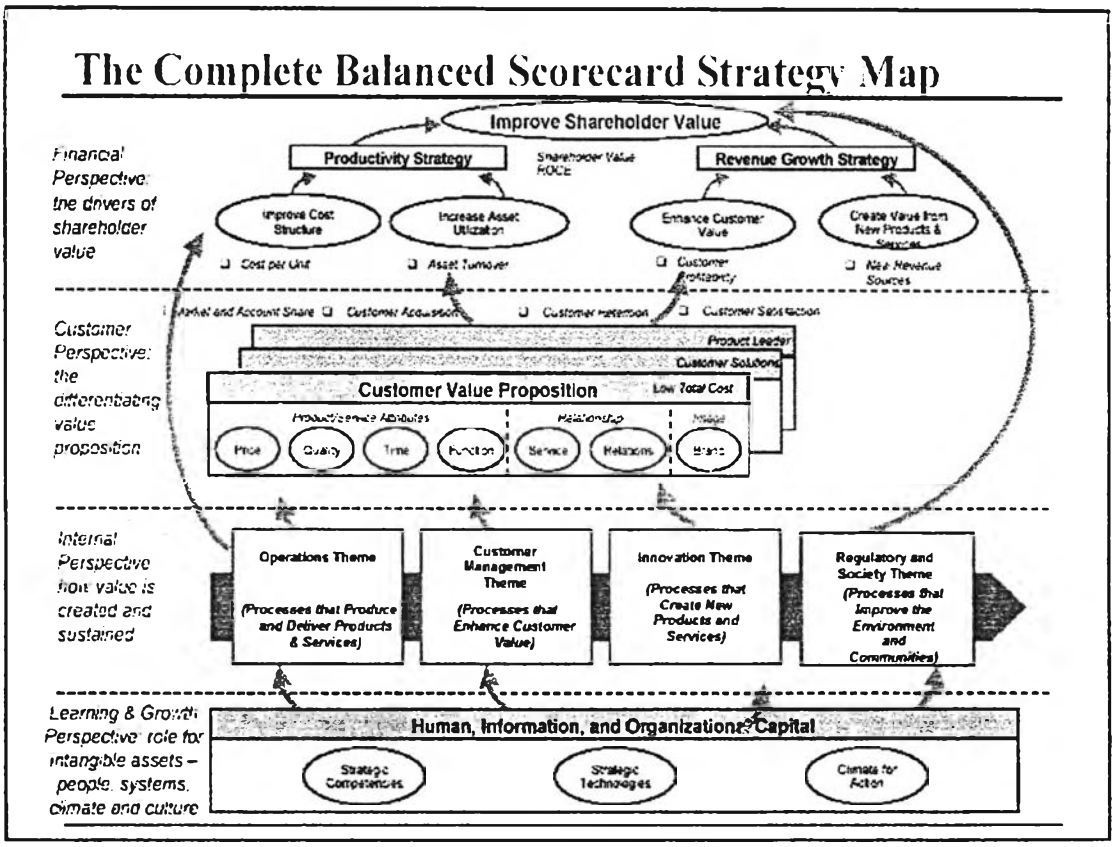
Step 4: Assign activity costs to product

The cost-driver rates prepared in step 3 are used to assign activity costs to goods and services. For example, if a particular product uses 1.5 machine hours in production and the rate from step3 is $50 per hour, the product is assigned $75 based on its machine usage.

2.5 Activity-Based Costing system and The Balanced scorecard

The Balanced scorecard concept, which is an integrated set of performance measure derived from company's strategy, has several models, with that of Kaplan and Norton's as the most popular. The four perspectives in this model are interrelated in the following manner: learning is necessary to improve internal business processes; improving business processes is necessary to improve customer satisfaction; and improving customer satisfaction is necessary to improve financial results (Teresita T. Nadurata, 2002)

Figure 10: Balanced Scorecard concept



From Internal business processes perspective, among all the attention to process time and process quality measurements, one loose sight of the cost dimension process. Traditional costing system measures the expenses and efficiencies of individual tasks, operations, or departments. But these systems fail to measure costs at the process level. Typically, processes like order fulfillment, purchasing, or production planning and control use resources and activities from several responsibility centers.

Not until the advent of activity-based cost systems could managers obtain cost measurement of their business process.

In general, Activity-Based Costing analysis will enable organization to obtain process cost measurement that, along with quality and cycle time measurement, will provide three important parameters to characterize important internal business processes. As companies use either continuous improvement (such as TQM) or discontinuous improvement (such as reengineering or business process redesign) of important internal business processes, the three sets of measurements-on cost, quality, and time-will provide data on whether the goals of these improvement programs are being achieved. (Robert S. Kaplan and David P. Norton, 1996)

Mark Shinder and David McDowell (1999) said that while the cost aspect is vital, managers need to understand the impact on revenues, volumes, customer satisfaction, market position, employee morale and a host of other factors. Therefore, cost information alone, regardless of how accurate it is, is insufficient to maximize value. Managers need to understand how costs interact with other performance indicators before they can improve the performance of their business. This concept ties to the Balanced Scorecard.

In fact, these tools were quite complementary. Activity-Based Costing could help managers understand the cost and capital impact of their decisions. The Balanced Scorecard broadens the view of performance to include financial and non-financial indicators of both a leading and lagging nature.

In final, they concluded that activity-based costing and Balanced Scorecard were useful tools that can help a company achieve greater success in the current dynamic and competitive business environment.

2.6 Related literature

2.6.1 Related literature in Thailand

Pipat Intang (2002) using Activity-Based Costing (ABC) technique calculate unit cost of nursing services activities in primary care unit. Major finding were as follows: 1) Total cost of medical and nursing care service was 283,700.39 baht. The average cost of medical and nursing care services was 23.11 baht / activity. The highest unit cost by activity was 125.60 baht / activity of treatment, diagnosis and counseling. The lowest unit cost by activity was 33.84 baht / activity of interview history illness. 2) Total cost of family practice was 196,287.38 baht. The average cost of family practice service was 1,102.74 baht / activity. The highest unit cost by activity was 490.71 baht / activity of home visit. The lowest cost by activity was 223.88 baht / activity of after home visit. 3) Total cost of maternal and child care service was 152,783.05 baht. The average cost of maternal and child care service was 724.10 baht / activity. The highest unit cost by activity was 557.61 baht / activity of interview pregnancy history. The lowest cost by activity was 69.82 baht / activity of service number card, register and information. 4) Total cost of immunization service was 104,066.58 baht. The average cost of immunization service was 193.80 baht / activity. The highest unit cost by activity was 49.52 baht / activity of immunization service and interview immunization history. The lowest cost by activity was 21.19 baht / activity of service number card, register and information. 5) Total cost of family planning service was 77,245.56 baht. The average cost of family planning service was 305.32 baht / activity. The highest unit cost by activity was 948.40 baht / activity of service number card, register (new case) and information. The lowest cost by activity was 47.22 baht / activity of service number card, register (old case) and information.

Boonruen Chaichana (2002) using Activity-Based Costing (ABC) technique calculate costs of nursing activities at the four in-patient units of the Yuwaprasatwaitayopratum hospital. Major finding were as follows: all cost of nursing service was 3,679,554.64 baht. The cost divided into direct labor cost 2,045,058.14

baht (55.58%) and overhead cost (include medicine) 1,634,496.50 baht (44.42%). The ratio of labor cost among professional nurses: technical nurses: nurse aides were 1.28: 1: 1.26. Social development and rehabilitation consumed highest labor cost 515,720.28 baht with overhead cost consumed mostly in general caring 397,389.72 baht. Total cost of Social development and rehabilitation was the highest 877,344.55 baht and general caring was secondary level 792,860.70 baht. Cost per patient day was highest in caring to the family of 1,274.32 baht and discharge was secondary level 1,037.44 baht. Cost per batch was highest in self-care training 3,054.58 baht and social development and rehabilitation was secondary level 1,642.97 baht. Highest total cost in patient level 1 and level 4 was general caring and in patient level 2 and level 3 was social development and rehabilitation 16,258.95 baht, 68,834.28 baht, 575,378.55 baht and 226,289.04 respectively. Highest cost per patient day in patient level 1 and level 2 was admission and in patient level 3 and level 4 was self-care training 723.13 baht, 672.65 baht, 302.54 baht and 201.35 baht respectively.

Summary of unit cost analysis study of public hospital (Kasame Tungkasamesamran,, 2001) **unit: baht**

Year	Researcher	Hospital	Allocation method	Unit cost/visit	Unit cost
1987-1989	Jitchinakul	Loedsin	Stepdown method	OPD = 90	IPD = 26-391/day
1980	Karnchanakul et al	12 provincial	Double distribution	OPD = 37-86	IPD = 193-248/day
1986	Pongprasert et al	Lampang	Double distribution	OPD = 160	IPD = 529/day
1986	Rungtanapirom et al	Suppasittiprasong	Double distribution	OPD = 39-180	IPD = 212-1,602/day
1987	Tungcharoensatien et al	Trakarnpeutpol Srisaket	Double distribution & Simultaneous eq.	OPD = 72 OPD = 85	IPD = 550-1,216/case IPD = 1,255/case
1990	Wannawek	Chulalongkorn	Simultaneous eq.	OPD = 242	-
1990	Chalaipirom	Somdetchaopraya	Simultaneous eq. Operating cost only	OPD phychi = 199 OPD neuro = 567	IPD phychi = 123/day IPD neuro = 653/day
1991	Butsayapanpong	Chonburi	Double distribution	OPD = 110 ER = 173	-
1995	Ngarmsiriudom et al	Chiangmai maternal And children	Simultaneous eq.	OPD-PED = 148 Adult = 244 OB-GYN = 127	IPD-PED = 1,992 IPD OB-GYN = 5,170

Year	Researcher	Hospital	Allocation method	Unit cost/visit	Unit cost
1996	Patcharanarumol	Khonkaen	Simultaneous eq.	OPD = 236 Dental = 553	IPD = 1,242/day
1996	Pannarunothai	9 provincial	Simultaneous eq.	OPD = 380	IPD = 987/day IPD = 5,443/case
1996	Pittayarungsarit et al.	Numpong Pol Ubonrat Puvieng	Simultaneous eq.	OPD = 164 OPD = 137 OPD = 242 OPD = 158 Average OPD = 162	
1996	Seelapat	Payamengrai	Direct allocation	Traditional medicine OPD = 91	-
1997	Kongsawat	16 community in 15 provinces	Simultaneous eq. only operating cost	OPD = 119	IPD = 696/day
1997	Kongsawat	7 provincial in 5 provinces	Simultaneous eq. only operating cost	OPD = 236 Dental = 324	IPD = 6,372/case

Year	Researcher	Hospital	Allocation method	Unit cost/visit	Unit cost
1997	Kongsawat	7 provincial in 5 provinces	Simultaneous eq. only operating cost	OPD = 236 Dental = 324	IPD = 6,372/case
1998	Kitteerawuttipong et al.	Maeai	Stepdown method	OPD = 117 Dental = 500	IPD = 286/day
1998	Sridang	Thoen	Simultaneous eq	OPD = 201 Dental = 380	IPD = 945/day
1999	Thantaristri	Bangpli	Simultaneous eq	OPD = 147	IPD = 1,173
1999	Kongsawat	Regional Provincial District Primary care in 5 Province in UC	Double distribution & Simultaneous eq.	Regional = 270 Provincial = 247 District = 119 Primary care = 66	- - - -
2001	Trityaticom et al.	Trang	Simultaneous eq.	OPD = 205.68	IPD = 1,125.18 /day
2002	Kanokwongnuwat	Prapokklao Community	Quick method	OPD = 547.38 OPD = 226.15	IPD = 9,852.83/case IPD = 3,166.05/case

2.6.2 Related literature in foreign countries

Hugh Waters et al (2003) using Activity-Based Costing (ABC) technique calculate unit cost of MaxSalud Institute for High Quality Health Care, a non governmental, nonprofit healthcare provider in Chiclayo, Peru. At that time, MaxSalud consisted of a management support unit (MSU) and one clinic in each of the communities of Balta and Urrunaga. **Results of this study demonstrates that it is feasible to apply the ABC model in a developing country, yielding unit cost estimates that include reasonable allocations of overhead and other indirect costs to specific services.** However, conclusions about the ultimate impact of the ABC method are not made here because the study was not repeated, and changes in utilization patterns and the addition of new clinics affected applicability of the results.

Crott R et al (2002) use activity-based costing technique to calculate cost of an upper gastroduodenal endoscopy was investigated in ambulatory adults in a large academic hospital in the province of Quebec, from the perspective of the hospital. An activity-based costing methodology was used to break down the procedure into a number of priory tasks, to which resources used at the department level (labour, equipment, materials) were allocated. The direct cost of performing an endoscopy ranged from $62 for an unsedated, unbiopsied patient to $89 for a sedated, biopsied patient. Not included in this amount were separate reimbursement fees of $15 for biopsy analysis and the $50 professional fee for the performing physician, which are charged directly to the Ministry of Health. Incorporating overall, general hospital fixed overhead costs raises the cost of the procedure substantially, by $41, as does the use of non reusable biopsy forceps, which adds about $63 to the total cost of the procedure. Given the high proportion of overall, hospital-wide, overhead costs in the total cost of the procedure, allocation methods of these overhead costs in current hospital accounting systems should be improved to obtain a more precise estimate of the full cost of upper gastroduodenal endoscopy.

Silvia A. et al (2002) analyzed the costs of outpatient care on tracer ischemic cardiovascular diseases events in public healthcare institutions using Activity-Based Costing for cost calculation. The study was carried out from April to October 1998, on a sample of 2000 (290 tracer diseases and 1,710 non-tracer diseases) first-time outpatient visits at the San Roque de Connet General Hospital, Buenos Aires, Argentina. They founded that Outpatient care activity improvements would result in significant savings in indirect costs of 7.11% on average for products defined as high blood pressure, dyslipemia and diabetes. Total savings in unit cost per product from elimination of activities would be 11.78% for high blood pressure, 13.96% for dyslipemia, 19.05% for diabetes, and 11.45% for non-tracer diseases. A total of 66.26% of the total indirect costs corresponding to dyslipemia and 61.80% of the total indirect costs corresponding to diabetes were inefficiently allocated or misspent. The total unit cost of medical care assessed by the traditional method is $22.98, a figure that in some cases is quite below the cost obtained by the ABC method used in this study. The conclusions was necessary to work on re-designing the patient healthcare process, to evaluate the activities which do not add any value, and that turn out to be a nuisance and delay for the patient. These activities make the system inefficient since resources are allocated to activities that hinder the process and that are therefore charged to the cost of medical visits.

Laurila J et al (2000) use Activity-based costing technique to calculate unit cost of pediatric radiological unit, they found that, **The allocation of overhead costs was greatly reduced by the introduction of Activity-Based Costing compared to conventional costing.** The overhead cost as a percentage of total costs dropped to one-fourth of total costs, from 57% to 16%. The change of unit costs of radiological procedures varied from -42% to +82%. **Costing is much more detailed and precise, and the percentage of unspecified allocated overhead costs diminishes drastically when Activity-Based Costing is used.** The new information enhances effective departmental management, as the whole process of radiological procedures is

identifiable by single activities, amenable to corrective actions and process improvement.

Mervyn D. Cohen et al (2000) developed a methodology for an activity-based cost (ABC) analysis in an academic radiology department, to test the hypothesis that the business of academic radiology could be separated into three distinct businesses—clinical activity, teaching, and research—and to determine the effect of the current teaching paradigm on clinical productivity. They found that the methodology provided a successful understanding of the relative costs of each of the businesses of teaching, research, and clinical activity. It also provided the departmental costs of performing the separate activities typical of each business. **Key findings included the following: Faculty spends 72% of time in clinical activities, research is the most expensive service per direct activity hour, and clinical reads (23%) are the single largest departmental cost element.**

Gary Siegel (1999) measures practice expense per unit of output in pulmonary practices using Activity-Based Costing. Practice expense includes all the costs of running a medical practice except physician compensation and malpractice insurance. Output refers to the medical services delivered by pulmonary practices.

Using the model he developed, he entered the financial and non-financial information provided by participating practices into an ABC software program that computes the cost of processes and the cost of cost objects. The model first assigns resource costs (practice expense) to processes using the cost drivers and the cost of each process is assigned to the cost objects using the cost drivers

Conclusion was the practice expense component for all pulmonary procedures is, on average, about the same. Procedures differ in complexity and in the amount of physicians' time required to perform the procedure. But time and complexity do not affect the practice expense component of the procedure.

Roybal H, Baxendale SJ and Gupta M (1999) use activity-based costing and theory of constraints to guide continuous improvement in managed care. They found that Activity-based costing and the theory of constraints have been applied successfully in many manufacturing organizations. Recently, those concepts have been applied in service organizations. This article describes the application of activity-based costing and the theory of constraints in a managed care mental health and substance abuse organization. One of the unique aspects of this particular application was the integration of activity-based costing and the theory of constraints to guide process improvement efforts. This article describes the activity-based costing model and the application of the theory of constraint's focusing steps with an emphasis on unused capacities of activities in the organization.

Brian Aird (1996) said that by providing improved information for strategic planning purposes, activity-based cost management (ABM) systems can help hospitals and other health care providers improve the quality and efficiency of the care they provide, control costs and manage their resources better. The National Health Service is starting to evaluate the ABM approach. Describes a research project in one specialist hospital in Sheffield, UK, which found that conventional approaches to costing can be inaccurate by as much as 100 per cent; conventional approaches will consistently under cost complex, specialist, infrequent episodes of care and over cost straightforward, frequent episodes; and the resulting information from ABM about costs and processes significantly improves the decision-making capabilities of managers, particularly in relation to "what if" situations.