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NATURAL FLOW COSTINGTM, A SIMPLE AND NATURAL MANAGERIAL COST ACCOUNTING METHODOLOGY THAT IMPROVES COST PRECISION AND EASE OF IMPLEMENTATION FOR MEDIUM AND LARGE ENTERPRISES

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Abstract

Traditional managerial cost accounting methodologies such as ABC and TD-ABC, make it difficult to allocate the costs of resources, processes or activities that are not closely related to cost objects. Methods like TOC solve some problems but it is considered incomplete by many and it is only applicable in certain environments. The big challenge is that they all struggle recognizing how costs naturally flow in the enterprise.

Natural Flow Costing (NFC) is a breakthrough that solves this challenge: it is simple and *naturally* replicates the actual flow of costs in medium and large enterprises with more precision and yet faster and easier implementation. NFC models can accommodate in a single model various methodologies. Based on experience with over 200 cost modeling projects in manufacturing, financial services, healthcare and the utilities industries, the most difficult cost modeling component, allocation drivers, are 3 times more in existing methodologies models than NFC models.

Keywords

Costing models, costing methodologies, ABC, Activity based costing, TD-ABC, time driven activity based costing, cost precision, cost systems, full absorption costing, micro costing, lean accounting, theory of constraints, TOC, managerial cost accounting.

Managerial Cost Accounting Background

Introduced by R. Kaplan, and W. Burns Activity Based Costing (ABC) made costing more precise than direct cost accounting methodologies [1] [2]. While Activity Based Costing delivered on the promise of precision, it required many difficult months to implement in actual enterprises; its conditions make it expensive to implement and maintain[3]; and offered beneficial results only under specific conditions[4]. In Kaplan's own words[5]:

> *"The traditional ABC model has been difficult for many organizations to implement because of the high costs incurred to interview and survey people for the initial ABC model, the use of subjective and costly-to-validate time allocations, and the difficulty of maintaining and updating the model…"*

Many researchers and users have stated the difficulties to implement and sustain an ABC model[6]. An NFC model methodology focuses on three drawbacks:

1. An ABC model represents enterprises in a simplified three level structure: (1) resources that execute (2) activities that are consumed by (3) cost objects that as described below seldom reflect an enterprise's real flow of costs.
2. ABC model drivers for secondary (support) activities are very difficult to determine because of the contrived relation between the support activity and the cost object.
3. ABC model forces activities to allocate from resources to cost objects sometimes increasing the frequency of errors in product cost measurement[7]. For example, certain areas for which activities are not relevant, like customers and products or branches and products.

Due to the above ABC model drawbacks it was quickly recognized that a cost/benefit analysis was needed. The Professional Accountants in Business Committee of the International Federation of Accountants addresses this ABC model issue as the maturity approach[8]:

> *"The maturity approach usefully recognized that there will be a maturity level in the Framework for any organization beyond which additional analysis will fail to improve decision making enough to justify the incremental effort and associated cost to improve cost management… An apparent gain in system sophistication can easily be negated by a later inability to maintain, update and operate the system effectively."*

Some like Stapleton et al.[9] go as far as declaring ABC analysis is not worth the trouble: "*With ABC the costs of finding true costs overshadowed the benefits of finding true costs*".

Time Driven ABC (TD-ABC) incrementally improves one of the biggest ABC drawbacks: drivers that are too hard to define and maintain. This improved version of ABC required that users estimate only two parameters for each driver: the cost of each resource used in the particular process, and the quantity of time the driver is allocating for each resource.

But as discussed below many drawbacks remained, making TD-ABC also a luxury that only very disciplined companies with enough resources can afford. Even in such cases the outcome hasn't really fulfilled the object of more cost precision without a herculean implementation effort. TD-ABC solves the problem of specifying drivers for missional activities, (verses support activities) but it did not solve the three other above described drawbacks.

Although ABC was popular in the 1990's and was a very promising decision making tool supported by academic and management consultants, it didn't go main-stream[10], and in most cases did not even go beyond a short pilot[111]. In practice, many firms today use traditional managerial cost accounting in spite of its limitations instead of ABC[12] [13] . Nevertheless, ABC is still the most precise managerial cost accounting methodology[14]. Currently ABC is supported by leading enterprise resource planning software (ERP) vendors like SAP, Oracle, and analytic vendors such as SAS.

Natural Flow Costing (NFC) conceptually supports ABCs principles, but through more flexible models and sophisticated software can very efficiently capture and maintain more precise cost models in medium and large enterprises where the model size and data can cause current ABC approaches to collapse.

ABC, TD-ABC and NFC Comparison

For the following description, a simplified healthcare example is used. However, the techniques have been implemented in financial services, manufacturing, agribusiness, retail and the utilities industries.

[1] Stratton, Desroches, Lawson and Hatch stated "Many companies abandoned activity-based costing because it did not capture the complexity of their operations, took too long to implement, and was too expensive to build and maintain"

Prior to ABC, cost models were based on direct full absorption allocations. As shown in Figure 1, if you want to calculate the impact of "Nurses A" on the different procedures, you might allocate using an appropriate driver metric like "length of stay".

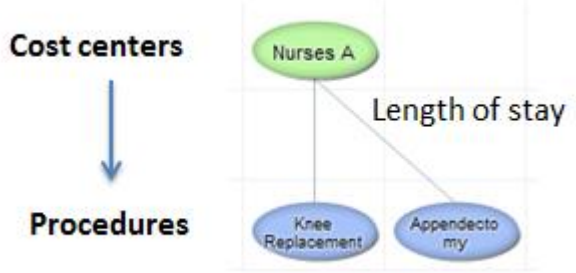

Figure 1: Simple two level cost allocation based on a patient's length of stay.

If "Nurses A" total cost is $80,000 a month, and "Knee Replacement" had a total for all patients Length of Stay of 8,000 patient-days and "Appendectomy" had a total Length of Stay of 3,000 patient-days, then based on the above model, the Knee Replacement monthly cost are $80,000 * 3,000 / (8,000 + 3,000) = **$21,818**, and similarly an Appendectomy monthly total is **$58,181**.

This direct allocation is simple to implement but as expected too imprecise to gain any insights about realistic costs. The ABC methodology introduced the concept that resources performed activities that are consumed by cost objects[2] [15]. In our simplified hospital example, as shown in Figure 2, the Nurses divide their time (and cost) on two activities and each of them allocates their cost to the two procedures:

[2] As defined in the CAM-I ABCM Model (CAM-I Cross©), the Close Loop Planning and Budgeting framework developed by CAM-I, and the cost assignment flow defined in the Operational Data and Cost Measurement Data Flow developed by CAM-I.

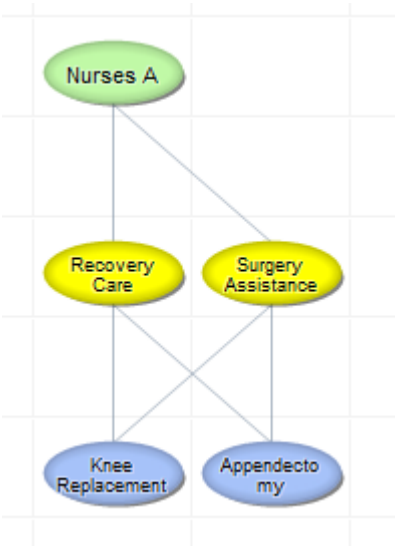

Figure 2: An ABC model with resources, activities and cost objects.

ABC looks deeper into how resources are consumed producing more precise cost results. Unfortunately larger enterprises generate ABC model complexities which make specifying drivers a lot more effort to create and maintain. TD-ABC is a good alternative for defining driver metrics, but is still limited by adherence to the ABC methodology.

Thus, the major problem that comes during implementations is that it is not easy to define allocation drivers. Figure 3 introduces the Human Resource department to the previous ABC Model.

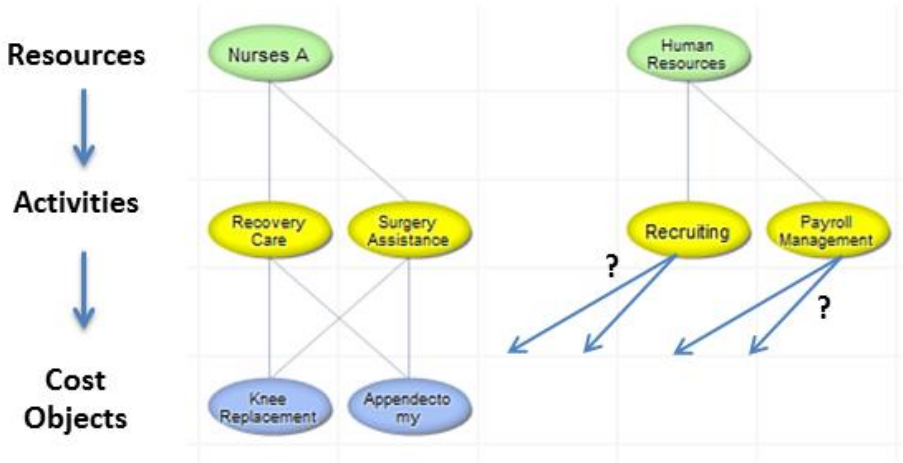

Figure 3 Introduction of Indirect Human Resources Department Costs

Like the Nurses, Human Resource's cost can be easily allocated to the activities it performs. But activities like "Recruiting" and "Payroll Management" cannot be easily allocated to the

two procedures. Determining a driver that clearly and accurately connects "Recruiting" to the different procedures is a challenge.

As a consequence of this challenge and the limited sophistication of software applications in the 1990s, costing professionals and cost accounting organizations formulated "best practices" to manage allocation drivers that are not straightforward. These compromises fall into two broad categories:

1. Allocate from *activities* to *activities*. In the above example, "Recruiting" and "Payroll Management" (support activities) will directly allocate its costs to "Knee Replacement" and "Appendectomy" (missional activities).
2. Create combined drivers by somehow calculating each individual driver's portion contribution from the support activity to the cost object, even when there is not a real operational relation between them (there is no good and precise driver to allocate from "Recruiting" to "Knee Replacement").

In either case, these best practice drivers do not reflect the actual flow of cost in the hospital (so we refer to them as "unnatural drivers"). Unnatural ABC drivers occur when there is no close connection from a resource or activity to another resource, activity or cost object. Unnatural drivers are one of the biggest problems in ABC and TD-ABC, not only are they difficult to define, but they introduce error and create models that are difficult to understand, build and maintain, which results in a lack of model credibility

Natural Flow Costing

Natural Flow Costing reflects the flow of actual costs in an enterprise without the need to introduce unnatural drivers: For our example, "Recruiting" and "Payroll Management" allocate directly to "Nurses A", and "Lab. Personnel". In an ABC methodology, "Nurses A" is a resource, but also is a cost object for "Recruiting", which is a close or natural driver as shown in Figure 4.

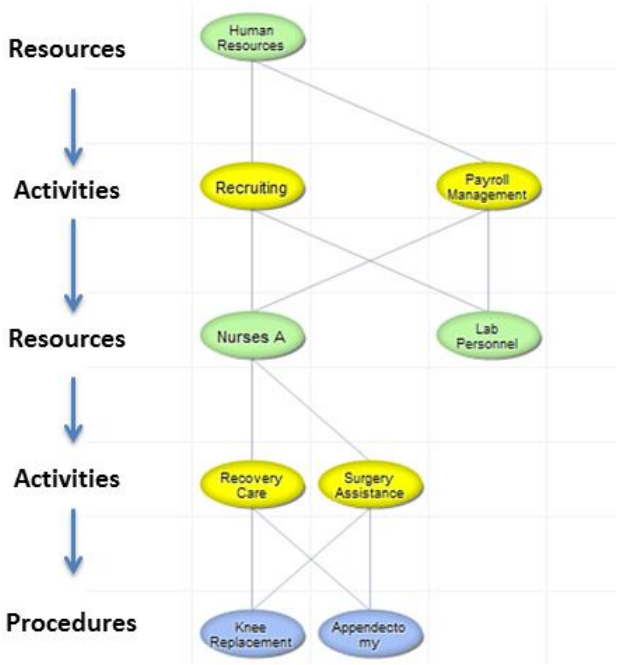

Figure 4 NFC model showing how natural the drivers are in reflecting the flow of costs

Besides the direct cost of "Nurses A", as shown in Figure 4, there can now be easily added other enterprise resource and service costs such as recruitment and training. The total cost of "Nurses A" can now be calculated before it is passed to the next levels of the cost model.

The value of "Natural" in cost modeling**:** our simple example highlights the differences between ABC and NFC cost model creation:

- In NFC, to allocate from "Recruiting" to "Nurses A" and to "Lab personnel" a straightforward driver allocation is the number of new employees: for example hiring 30 nurses and 5 lab people. If the effort (time) to hire each type of employee is different, an easy factor can be included.
- In ABC: what driver would allocate from "Recruiting" to "Recovery Care" and "Surgery Assistance"? Number of nurses? Time? It is very difficult to find a straightforward driver; you either have to select a driver with a very loose connection or build a complex one looking for a connection that is very indirect (best practices).
- ABC requires unnatural drivers; there is no way around this problem because nurses is a resource and cannot get costs from activities.

Besides making the models complicated and hard to implement, one of the problems with unnatural drivers is that they are difficult to understand for most managers and decision

makers with a substantial loss of credibility. Being able to understand the model and the flow of costs, and more importantly being able to identify a direct relation between the cost model and the enterprise, builds confidence in the numbers to make profitable decisions possible.

Cost Model Precision: Unnatural drivers create cost imprecision because they don't provide a close and direct relationship between the cost origin or source to the destination or cost object. When there is no relationship between two activities or from an activity and object, it is extremely difficult to find a driver metric that represents proportionality.

"Payroll Management" directly relates to the employees of the company. When the cost of this activity is assigned to the employees this assignment is made because this is what is actually happening in the enterprise: the hospital's actual cost flow.

Standard or semi-standard costing supported by NFC: The flexibility of NFC models can support all past managerial cost accounting methodologies. An example used primarily by manufacturing and healthcare enterprises is to have the NFC model analyze standard costing or semi-standard costing (standard costing that includes indirect costs) in addition to full NFC allocations for each period to determine the monthly variance between these cost methodologies.

The large number of ABC drivers and their complexity

Unnatural drives create several major implementation and usability issues: difficult to define, difficult to understand, introduction of errors, and by far the biggest problem, the large number of "extra" drivers[16]. Figure 5 shows a typical NFC vs ABC model comparison.

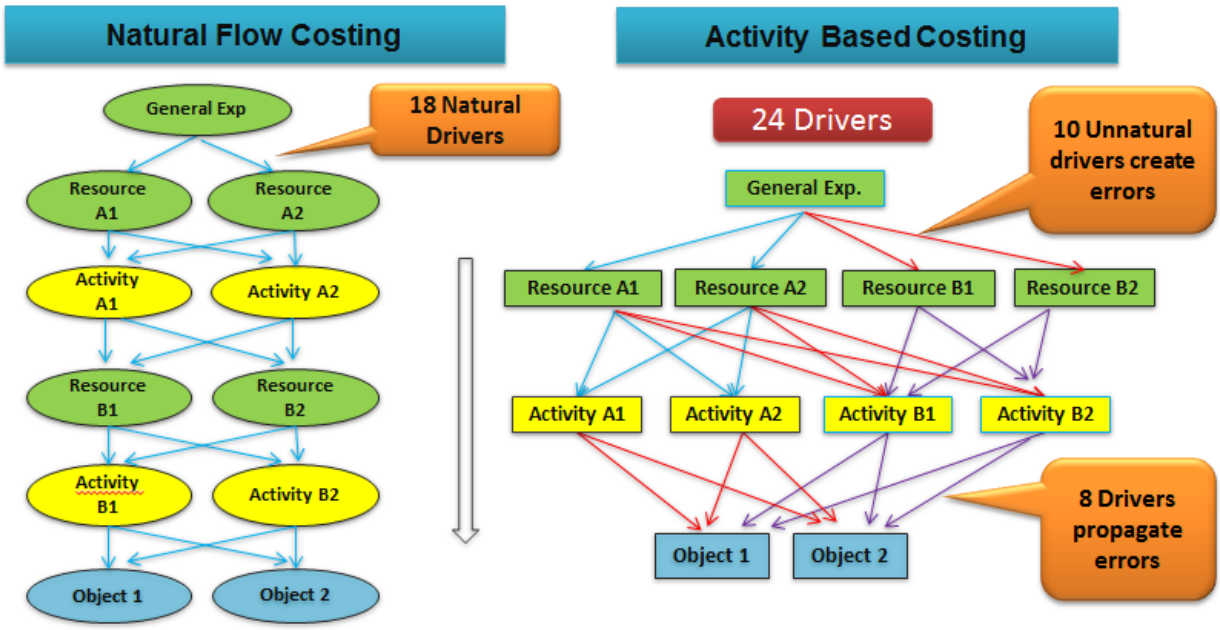

Figure 5 Simple example contrasting NFC and ABC drivers.

Figure 5, shows a very common enterprise cost flow with 4 resources, 4 activities and 2 cost objects and "maximum connected" drivers. Notice the Activity A1 and A2 naturally drives Resource B1 and B2 similar to our above Nurse example in Figure 4. Using an NFC methodology, without the restrictions of a 3 level ABC model, there are a maximum of 18 drivers. In contrast, the ABC model requires 10 more drivers (red lines such as Resource A1 to Activity B1 and B2 which are not needed in the NFC model) and 8 drivers (purple lines) that can propagate errors: a maximum total of 24 drivers. From our experience, as the number of objects increases, for example hundreds of activities and thousands of objects, the number of ABC drivers increases dramatically (up to 300%) above an NFC model.

As shown in Figure 5, an NFC model does not use the traditional three ABC allocation levels of Resources to Activities to Cost Objects. An NFC model has multiple levels with no restrictions, allowing an enterprise's natural flow of costs to be modelled directly without employing the contortions of ABC's best practices. *NFC has fewer and more natural drivers.* For example, in Figure 6 is a typical NFC model section of a hospital with 6 levels. Most large hospitals require 10-12 levels, which makes using ABC's 3 levels an impossible challenge.

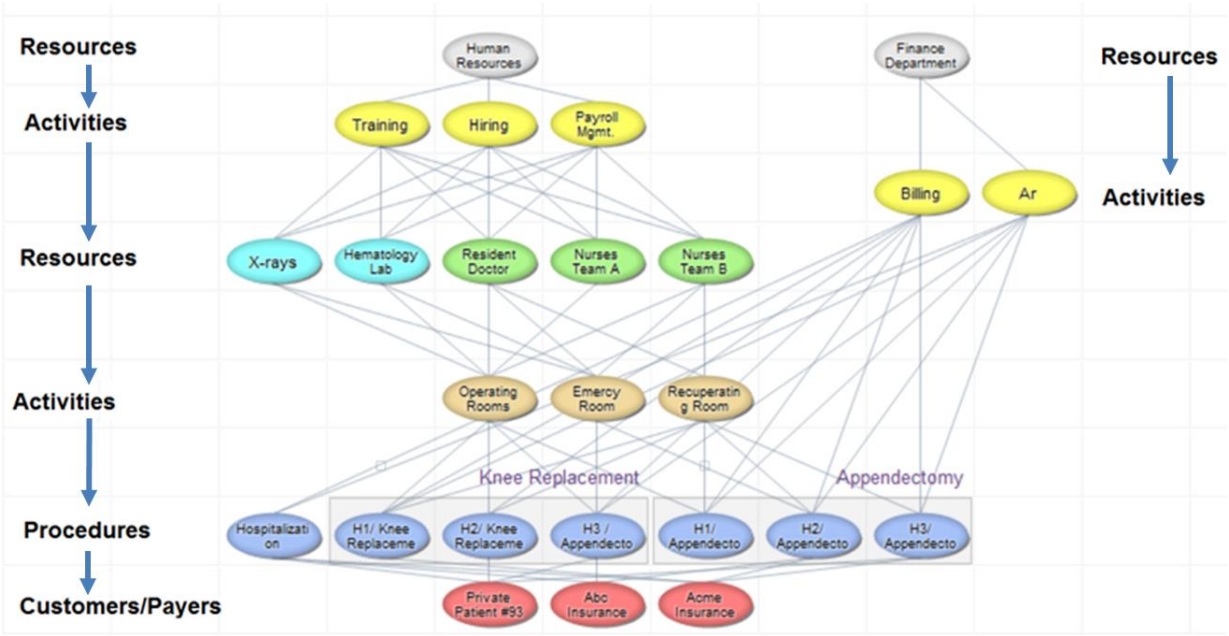

Figure 6 A typical NFC model section for a hospital with natural levels and drivers

NFC naturally supports marginal costing, Theory of Constraints, TOC

Since the nineteenth century there has been an ongoing debate between advocates of full absorption cost methodologies (like Activity Based Costing ABC and Time Driven ABC) and marginal decision methodologies, such as Theory of Constraints, TOC[17] for strategic planning.

The advocates of TOC concede that in practice enterprises prefer absorption costing. However, NFC addresses many of TOC's main criticism over ABC[18] for strategic planning.

- Because NFC handles costing with separate accounts and doesn't mix operational resources with other resources like ABC, TOC's most important metric, *throughput*, can be accurately calculated. Using the same model and with no additional effort, an enterprise can calculate throughput for each product for short term planning and EBITDA for strategic planning.
- NFC can accurately and easily calculate TOC's bottlenecks. An NFC model can represent resources that include capacity constraints, because NFC drivers have a direct and close relationship between the origin resource and the destination object and therefore the NFC driver can calculate the idle capacity and its cost.
- Unlike ABC, NFC can perform accurate *what-if* calculations. ABC struggles with accurate simulations, even with Activity Based Management (ABC/M) and Activity

Based Budgeting (ABM/B) methodologies. The main problem are ABC's unnatural drivers cannot represent realistic proportions back to the resources.

By calculating TOC throughput and by correctly managing bottlenecks and capacity, NFC is a method to integrate TOC strategic planning into an enterprise's GAAP financial system.

NFC Model Overview

An NFC model has just three components and a supporting allocation algorithm to take actual enterprise data and execute the NFC model:

1. **Accumulators** represent anything that receives stores or allocates revenue or cost. The can be organized in classes than can be freely named to adjust to the company's own terminology, for example: resources, processes, products, customers, cost centers, patients, plants, and geographic regions. Accumulators are represented by colored ovals as shown in Figure 6 such as Nurses Team A and Knee Replacement. Although it is not mandatory, the graphical representation is important, to easily allow other non-financial employees understand the cost model. Accumulators of certain classes may specify "capacity"; for example People or Machines have limited capacity. This is important for performance, overcapacity, under-capacity and TOC analysis and simulation.
2. **Accounts** are represented as arrows entering the accumulators as shown in Figure 7 and load the specific accumulators with the appropriate general ledger data.

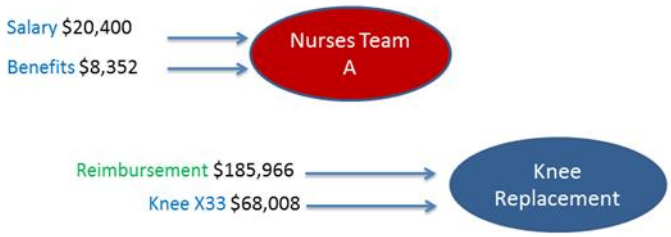

Figure 7, Accounts are shown as blue arrows entering accumulators

Special Accounts can be created such as formulated accounts, EBIDTA, and net profit margin, and throughput that track the individual account as it is propagated through the model.

3. **Drivers** as shown in Figure 6 are represented by arrows that connect an origin accumulator to a destination accumulator. All drivers leaving from an accumulator usually have the same driver metric, for example hours, number of employees or square feet, and each accumulator can have its own drivers. In real life some drivers are created explicitly, but many drivers can be inferred or calculated using different methods that make maintenance very easy.

   There are two general types of drivers:

   1. Full cost absorption drivers: These can be classified in the following:
      i. Direct proportional drivers: Are the most common drivers is where money is allocated from a certain origin to destinations accumulators based on a value, for example, allocate "Recruitment" to other cost centers based on the number of new employees for each one.
      ii. Time driven drivers (TDD) are the same as TD-ABC, except that they are automatically calculated and can be triggered through several levels (up the model).
      iii. Feature inferred drivers are similar to TDD is based on numerical features or rules of the destinations.
   2. Consumption drivers define certain accumulators as "inventory accumulators" which carry consumable costs through different time periods. The driver specifies the number of units consumed at current unit cost. This is useful for processes that have long lead times and in general in companies with inventariables.

The NFC cost allocation algorithm executes the above model elements with a set of given data inputs by analyzing the "flow" of costs through the driver "network" to each cost object. There are two very critical allocation processes to insure a user's experience is not compromised by the process' execution:

- The cost resolution, how the algorithm tracks and maintains the allocated costs through the model's network for each driver to the lowest level of cost objects.
- The speed of the allocation process, how much time does the process take in doing the allocation and can it reach a successful conclusion (too many model elements or difficult converging to a solution).

The algorithm needs to not only track individual costs through the network (sometimes referred to as account permanence) but also can do full tracing for effective root cause analysis. Figure 8, a simple example, illustrates the basic process requirements. The cost of the Payroll is distributed proportionally by using the number of employees as the driver, the accumulator on the right receives $500 * (6 / (4+6)) = $300 and on the left $200.

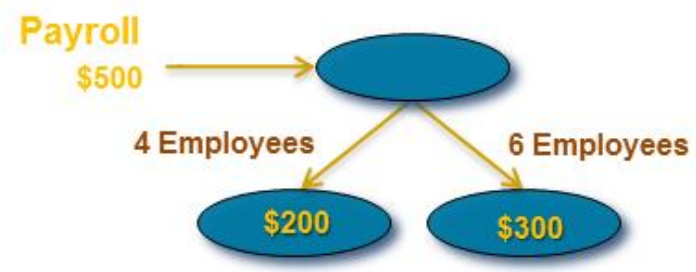

Figure 8 Simple allocation example

In Figure 9 the yellow highlighted accumulator now has a $500 lease cost. The algorithm allocates the payroll costs separate from the lease costs, as these details will be important for analysis and helps in finding cost savings and gaining insights. So at the next level the amounts for payroll ($100 and $200) and for lease cost ($167 and $333) are maintained separately throughout the flow.

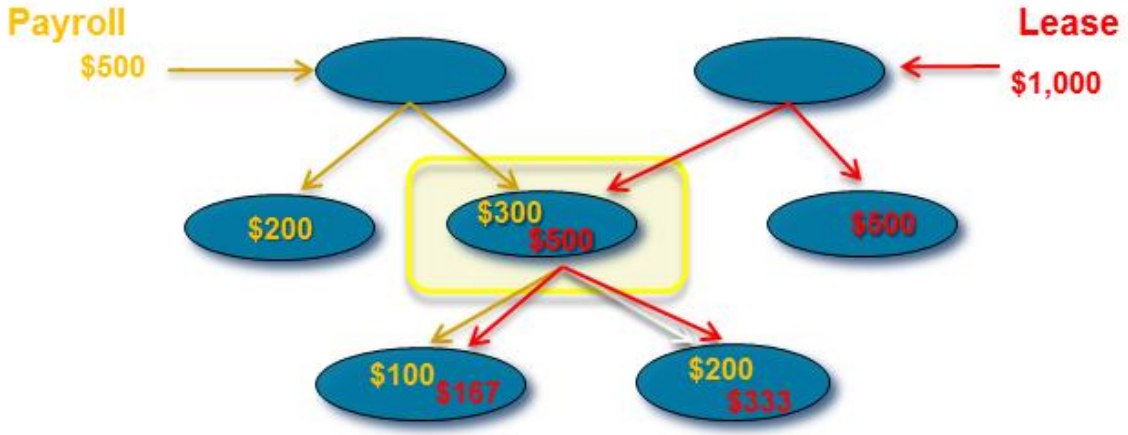

Figure 9 The allocation must maintain the individual costs for each accumulator

Upon completion of the allocation process as shown in Figure 10 all the costs are accounted for each accumulator and a full profit and loss statement for each cost object such as a procedure, payer, or patient. This makes it possible to tell how much of the cost of each unit came from direct labor, indirect labor, insurance, power, equipment, etc.

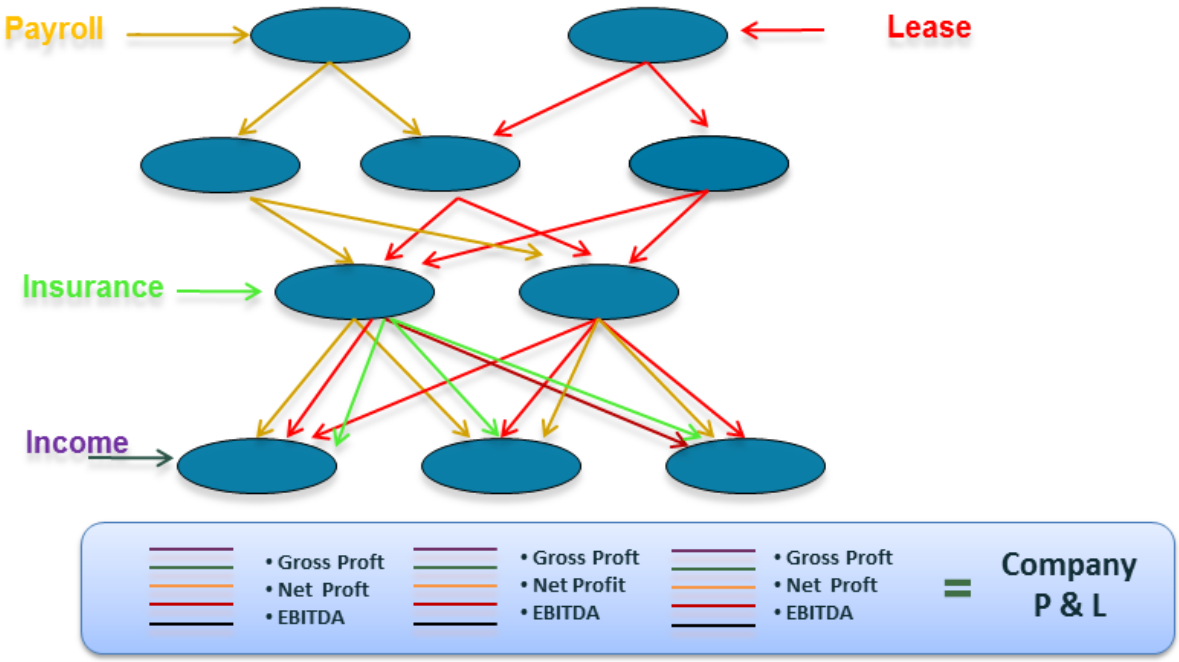

Figure 10: P&L creation for each cost element with tracing of costs as they flow through the model.

Doing an allocation for a large enterprise consumes a large amount of memory and compute resources that in the past greatly hindered the use of ABC. Utilizing the performance advantage of today's computer systems a 10,000 object NFC model takes about 5 minutes to complete an allocation, and it is now possible to process a 2 million object NFC model in one hour.

Conclusion

For over two decades, Activity Based Costing (ABC) and TD-ABC have improved cost precision but have had relatively little use because of ABC model complexity and long implementation times for medium and large enterprises. For strategic planning TOC has also struggled to become practical.

Natural Flow Costing solves the drawbacks of more precise costing by being able to easily model the actual flow of costs in a medium or large enterprise through a flexible number of model levels and a sophisticated allocation algorithm that linearly scales with an enterprise's size. The most difficult cost modeling task is determining a cost model's allocation drivers. NFC has 3 times fewer drivers than ABC and these natural drivers are easily specified.

Based on experience with over 200 cost modeling projects in manufacturing, financial services, healthcare, and the utilities industries among others, more cost precision can be achieved with reasonable effort allowing medium and large enterprises for the first time to effectively manage their bottom line.

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