Is the Opportunity Cost of Idle Capacity Zero? Coase (1938) Versus Managerial Accounting Circa 2000

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Abstract

Many accounting textbooks state that the opportunity cost of idle fixed assets is zero. A few exceptions refer to repair, overhaul, employee vacation and congestion giving rise to positive opportunity cost. We show that in important and frequently encountered situations, idled assets have positive opportunity cost arising from extension of their useful life. We also present a simple framework to help managers identify such situations and correctly assess opportunity cost.

JEL Codes: L2, M21, M41

Keywords Opportunity cost, Resource management, Time-based costing, Resource granularity, decision-making.

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I. INTRODUCTION

In a series of articles published in the *Accountant* during 1931-1938, Ronald Coase, following Friedrich Von Wieser and others, argued for opportunity cost as the relevant concept for decision-making and suggested methods to estimate the opportunity cost of various resources.[1] He labeled 'depreciation through use' what Keynes (1936) had called 'user cost,' and suggested that it is equal to the change in the present value of future cash flows resulting from use. In a summary of these ten articles published in 1973, Coase pointed out (p. 115):

> If a machine is used in the present instead of leaving it idle, it may well be that its life is shortened. This means that profits that would have been earned at the end of its life will no longer be received. This loss of profits in the future through the use of a machine in the present is a cost of using the machine that must be taken into account.

Coase's arguments imply that the opportunity cost of idle capacity can be positive. Yet, many current managerial accounting textbooks tell readers that the opportunity cost of idle capacity is zero. In Table 1, we present the results of an informal sampling from the current editions of texts on our bookshelves.[2]

(Place table 1 Here)

In this paper, we revisit Coase's arguments and use a simple example to show that idle capacity can have positive opportunity costs in important and oft-encountered situations. Whether the opportunity cost of a capacity resource should be zero or positive depends on how its value depreciates with time and use, a characteristic of the resource. We therefore present a simple framework to classify capacity resources by their intrinsic characteristics (see Balakrishnan, Sivaramakrishnan and Sunder, 2001 for additional detail).

Capacity resources are lumpy, requiring upfront investment. It is not economical to adjust continually their levels to demand so they are neither idle nor in short supply. Investments in capacity are undertaken based on expectations about demand, balancing the costs of excess and insufficient capacity. Once acquired, idleness cannot be avoided unless the capacity installed is enough only to meet minimum demand. Nor can shortfall be avoided unless capacity acquired can accommodate maximum possible demand. Many textbooks suggest that in periods of lean demand, the opportunity cost of idle capacity is zero; therefore, any alternative use of these resources that promises a positive contribution margin is desirable as a short run decision. This assertion is true only if the benefits of unused idle capacity are lost forever. The assumption holds for some resources but is violated for many others.

For resources such as salaried staff and warehouses, remaining benefits expire with the passage of time, used or not. A time-based measure of opportunity cost is appropriate for such capacity resources when they are busy; the opportunity cost of idle capacity is zero. For other resources such as fuel and machine parts (both bought ahead of use), remaining benefits diminish only when the resource is used. A use-based method to measure opportunity cost is appropriate, and replacement cost is the opportunity cost. Traditional approaches implicitly recognize this feature when they do *not* classify such resources as capacity resources, even though the resource is bought based on *expected* use. For a majority of resources, however, remaining benefits diminish with both use *and* time. A sparingly used machine lasts longer than one put to heavy-duty use. Machine capacity idled today could prolong its life and result in additional usable capacity later. Coase's primary argument is that this partial "storability" of capacity influences its opportunity cost,[3] and implies a positive opportunity cost for idle capacity.

In the next section, we use a simple numerical example to illustrate our basic point. In section 3, we identify the objective properties of economic resources that may help estimate opportunity costs. We call these characteristics *granularity of benefit expiration* and *of benefit consumption* and provide examples of how these concepts can help make better decisions. Section 4 concludes.

2. AN EXAMPLE

Parameters in table 2 have been chosen to represent a multi-product manufacturing setting. Panel A of table 2 lists resources and their costs, grouped into variable and capacity resources (variable and committed costs).

(Place table 2 here)

As assumed in panel B of table 2, the firm has 2,000 inspection hours and 2,000 order assistant hours available in a year. Machinery is available for 24,000 hours per year for five years under normal usage. Lower usage prolongs the machine's life, though even a machine left idle will become obsolete in eight years.

The facility has two support activities (order processing and setup) and a production activity. Table 2, panel C reports that order processing requires five hours of a salaried order assistant's time and $25 per order toward other out-of-pocket costs such as the mailing of purchase orders. Each setup requires fifteen hours of machine time and five hours of inspection time.

Panel D reports consumption data on two of the products in the firm's portfolio. Annual volume is 1,000 units for A and 100 units for B. Each product uses 1 pound of materials per unit. Production requires two hours of machine time per unit of product A, and three hours per unit of product B. Over the year, each product will require four orders and four setups.

Table 3 presents the consumption and expiration rates for the resources. Consumption rate is the rate of decrease in remaining benefits as the resource is put to use**.** Expiration rate is the rate of decrease in remaining benefits due to sheer passage of time, even if the resource is idle. As argued by Coase, opportunity cost is the depletion of value through time and use. If a resource is being fully used, its unit opportunity cost is the consumption rate. If the resource is idle, its unit opportunity cost (for a proposed use) is the consumption rate less the expiration rate. Only the incremental depletion is considered because depletion in value due to the passage of time is unavoidable.

Because materials are acquired when needed, and are assumed not to be perishable, their expiration rate is zero. Their consumption rate therefore equals their acquisition cost of $4 per material unit. Similar arguments apply to the out-of-pocket order costs of $25 per order. For these resources, unit opportunity costs equal their consumption rates.

(Place table 3 here)

The inspector and the order assistant require upfront employment commitments. Assume that these individuals are on long-term contracts with specified work schedules,[4] making the time supplied by these individuals capacity resources. When fully utilized, their unit opportunity costs are approximated well by their consumption rates. However, any unused time is lost forever. The resources' expiration rate equals their consumption rate. Therefore, the opportunity cost of the inspector's and the order assistant's time when idle is zero.

The remaining benefits of machinery diminish with both time *and* use. If the machine is fully utilized, $5 per hour (=$600,000/ (5 years X 24,000 hours per year)) is the rate of diminution of future benefits. The consumption rate of $5 per hour is the machinery's opportunity cost when fully used. When it is idle, the machine's unused benefits are not all lost. Idling a machine today extends its life up to a maximum of eight years. The uniform rate at which the remaining benefits of machinery diminish based on time *alone* (the expiration rate) can be calculated by reference to this maximum extendable life span. We calculate the expiration rate as $3.125 per hour (=$600,000/(8 years x 24,000 hours per year)).[5] It follows that machinery's opportunity cost when otherwise idle is $1.875 = $5.000 - $3.125 per hour.

Panel A of table 4 uses the data from tables 2 and 3 to calculate activity costs. Order processing for parts involves a variable cost of $25 per order and 5 hours of the order assistant's time. If the order assistant is fully utilized, the opportunity cost (the consumption rate) for each order processed is $100 per hour (= $25 per order + 5 x $15 / hour). If idle, the opportunity cost of the order assistant's idle time is zero because the benefits of the unutilized time are lost forever.[6] Therefore, the expiration rate for order processing is $75 per order (=0 per order + 5 hours x $15 per hour), and the opportunity cost of any unused capacity is $25 per order. Similar comments apply for the setup activity – its consumption rate is $200 per setup (=15 machine hours x $5 per hour + 5 hours of inspection x $25 /hour), its expiration rate is $171.875 (=15 machine hours x $3.125 per hour + 5 inspection hours x $25 per hour), and its opportunity cost when idle is $28.125 per setup.

(Place table 4 here)

Panel B of table 4 shows the unit costs for the two products as per traditional computations and panel C shows suggested computations. Each panel considers normal and insufficient capacity utilization scenarios. The cost computation for the second scenario is useful for decisions such as pricing special orders for the two products that would allow gainful use of idle capacity.

Under normal capacity utilization, the two systems yield identical product costs. Absent idle capacity, accounting costs estimate the opportunity costs well.

With idle capacity, our analysis is the same as textbook analysis for some resources and activities but differs for others. For materials, our analysis coincides with the traditional analysis. The zero expiration rate for materials implies that opportunity cost is determined by use alone. The analysis is also the same for order processing. For the resources used by this activity, the expiration rate is either zero (out of pocket ordering costs) or is the consumption rate (order assistant time). At either extreme, our analysis again coincides with traditional analysis.

Our analysis differs for the setup activity and for machine time. Focusing on machine time, recall that remaining benefits from machinery diminish with both use and time. Each hour of machine time that is idled now results in the machine's life being extended by some amount. As shown in table 3, the incremental diminution in machine value from using an hour of machine time that would otherwise be wasted is $1.875 per hour (consumption rate of $5 per hour – expiration rate of $3.125 per hour). This amount is appropriately charged to the product being made. Traditional analysis implicitly ignores the extension of machine life (i.e., implicitly sets expiration rate equal to consumption rate). Turning to the setup activity, differences in the cost estimates occur because the activity utilizes machine time. The other resource used by this activity (inspection time) lies at an extreme in terms of its expiration rate and, thus, does not trigger a difference between the traditional and the proposed analyses.

To recap, a comparison between the existing and the proposed costing procedures shows that they are identical in the absence of idle capacity. With idle capacity, the assumption that the opportunity cost of idle capacity is zero can understate opportunity costs. In our example, the cost of product A is understated by $3.86 and product B is understated by $6.76; these understatements could lead to sub-optimal decisions relating to gainful use of the idle capacity.

We now proceed to cast this example in a more general framework to help our understanding of how consumption and expiration rates of capacity resources are determined by intrinsic resource characteristics.

3. FRAMEWORK

Efficient management of resources calls for organization of resource entitlements and obligations over time in a Pareto-efficient manner (Sunder 1997). The measurement and management of opportunity costs, a key to good resource management, is linked to the lumpiness or granularity of the resource. Time flows continuously, smoothly and uniformly, and therefore has zero granularity. Resource flows exhibit varying degrees of lumpiness or granularity because resource flows are rarely continuous, smooth or uniform. Two dimensions of granularity, the natural time-based expiration of resource usefulness (*expiration granularity*), and the user's flexibility in timing the consumption of benefits (*consumption granularity*), are important to understanding the depreciation of resources with time and use, and hence their opportunity cost.

Expiration granularity is a measure of the storability of the remaining benefits of a resource. The more storable the benefits of a resource, the more granular it is. Remaining benefits of a resource may expire over time due to weathering, obsolescence, and relevance.[7] When the diminution of remaining benefits of an asset is unrelated to its use and is determined solely by the passage of time, the resource has zero expiration granularity. The remaining benefits of a salaried employee, highway sign, factory roof or a grain silo diminish almost continuously through time. Barring renovation to replenish the remaining benefits, a silo slowly deteriorates and falls apart, largely independent of whether it is used for storage. Diamonds and land perhaps lie near the other extreme of the scale of expiration granularity. A diamond retains its benefits indefinitely ("Diamonds are forever," we are told). These benefits are perfectly storable, unaffected by the passage of time. A bag of grocery lies somewhere between the silo and diamond; groceries become useless if not utilized within a few days or weeks. Each economic resource can be positioned on this dimension by its expiration granularity.

Consumption granularity is a measure of the extent of the owner's control over the timing and rate of extraction of benefits of a resource. For some resources, the rate at which the remaining benefits of the resource expire may be fixed with the owner exercising little control over the rate. For other resources, the owner may fully determine when and by how much the remaining benefits diminish. The benefits of a stone sculpture or a factory building, both standing in open weather, expire with time, and the rate at which the benefits expire is not manipulable. The owner has considerable discretion in extracting the benefits from an automobile, however. Consequently, the life of an automobile may be defined, at least partly, in terms of the number of miles driven and the life of a die in terms of the number of blanks it produces than any time-based measure.

Expiration and consumption granularity are intrinsic resource characteristics that capture how a resource's stock of benefits decline with time and use. In figure 1, we present a two-way classification of some resources along the expiration and consumption granularity dimensions. We then discuss implication for computing the opportunity cost.

(Place figure 1 here)

As shown in figure 1, salaried employees, a sports stadium and batteries are all resources that have low expiration granularity. A salaried employee's time, if unused, is lost forever. A sports stadium has low expiration granularity because it yields benefits continuously over time until it deteriorates and needs to be demolished or rebuilt. A battery cell has a finite life even if unused, and its usefulness declines with time. However, these resources differ in the decision maker's control over the rate with which their remaining benefits can be extracted. Human resources have low consumption granularity because it is not possible to extract two hours of work in one hour. A stadium has medium consumption granularity because rough usage and lack of proper maintenance affect its remaining useful life. Batteries have high consumption granularity because the decision-maker has considerable control over the extraction of benefits from the battery.

A software program has medium expiration granularity because it is likely to become obsolete with the advance of software and computer technology. Until such time it retains its full benefits. Its consumption granularity is low because using it once does not diminish its value for the next use. A car has medium expiration granularity under assumptions of normal use because its life extends somewhat if less than expected mileage is put on it in a given year. A two-year old car with 15,000 miles on it can be expected to be in a better condition than another car of the same vintage but with 45,000 miles on it. Fresh fruit has medium expiration granularity because its freshness can be preserved over a part of its useful life. Within this period, it retains its full benefits. It has high consumption granularity because the benefits can be extracted within a short period by eating the fruit.

Diamonds, oil fields and industrial gold are resources that have high expiration granularity because their benefits are storable for long periods. A diamond has low consumption granularity because wearing it does not diminish its value for subsequent use. An oil field has medium consumption granularity because there are physical limits to the rate at which oil can be extracted without seriously reducing the total amount of oil that can be extracted from the oil field over its lifetime. Industrial gold has high consumption granularity because they yield their full benefits when used for the intended purpose (e.g., melted to coat the terminals of a computer chip).

While the classification of specific resources may be open to debate, we hope the above discussion makes the distinction between the consumption and expiration granularity concepts clear in the context of normal and ordinary use of each resource.[8] We next discuss how these concepts may help us in determining opportunity cost and thus in decision-making.

Resource Granularities and The Opportunity Cost of Idle Capacity

Table 5 presents an overview of our analysis.

(Place table 5 here)

Resources with Low Expiration and Consumption Granularities

Consider the extreme case of a resource with zero expiration and consumption granularity. Such a resource yields benefits at an unchanging rate through time whether or not anyone uses these benefits. It is also not possible accelerate or diminish the rate at which the remaining benefits diminish. These resources best represent a *pure capacity resource*.

Formally, let $C_0(0)$ be the initial acquisition cost of a resource with zero expiration granularity. Let the resource expire in T time units, and let $C_0(T)$ be its estimated salvage value. Assuming linearity, the time rate of expiration of benefits of this resource is given by $\dot{C}_0 = \frac{C_0(0) - C_0(T)}{T}$. This rate is an estimate of the opportunity cost (OC) per unit of time that must be charged to a decision that requires the use of this resource, if it is not otherwise idle. If idle, the opportunity cost of this resource is zero.

Referring to our numerical example in section 2, inspection time and the order assistant's time are pure capacity resources. When fully utilized, time-based rates are used for these resources ($25 per hour for inspection, and $15 per hour for the order assistant). With idle capacity, the opportunity costs of these resources are zero.

Resources with high expiration and consumption granularities

At the other extreme, consider a resource with infinite expiration and consumption granularity. It does not decay with time when not consumed. Its cost can therefore be assigned to a decision only through a metric of use. The value of an electronic toll pass diminishes with each use and not over time. Formally, let $C_\infty(0)$ be the acquisition cost of an infinite expiration granularity resource and let *X* be a "count" measure of its life. Let $C_\infty(X)$ be its salvage value at the end of its economic value of count *X*. A decision requiring use of this resource will be charged at the rate of $C'_\infty = \frac{C_\infty(0) - C_\infty(X)}{X}$. In our example, raw materials represent resources with high expiration and consumption granularity.

Resources with low expiration and high consumption granularity

If a resource has low expiration granularity but high consumption granularity, its opportunity cost is best estimated by comparing how much of it is required for the decision (consumption) with the attrition in benefits during the time period spanned by the decision (time attrition or expiration). For every resource in this category, the value diminution due to use (consumption rate) exceeds that due to time (expiration rate). Thus, if the resource is being fully utilized, the consumption determines the opportunity cost. If idle, some *but not all* of the resource's benefits is lost. The remaining benefits are not lost because of the extension in the resource's useful life. In this case, opportunity cost is the excess of the consumption over the time attrition.

In our example, under full capacity utilization, the opportunity cost of machine time is its consumption rate of $5 per hour (which is greater than its time attrition rate of $3.125 per hour). When there is idle capacity, machinery's opportunity cost is $1.875 per hour, the excess of consumption over time attrition.

Resources with high expiration and low consumption granularity

Cost basis is not suitable for estimating the opportunity cost of a resource that has high expiration granularity but low consumption granularity. The benefits from such a resource does not expire with time; neither does the owner have any measure of control over the rate at which the benefits are extracted. The benefits of real estate (contrasted to an oil field or mine) cannot be accelerated nor does its benefit diminish over time. The opportunity cost for a diamond is the value attached by the decision-maker to the "road not taken." This value often has little to with the acquisition cost for the resource.

4. DISCUSSION AND CONCLUSION

We develop a simple framework to capture the economics of resource acquisition and use. This framework recognizes two characteristics of the benefits from capacity resources. The first, expiration granularity, represents the extent of the storability of the benefits associated with the resource. The second characteristic, consumption granularity, captures the user's ability to vary the rate at which benefits are extracted. Analysis of the opportunity cost of idle capacity within this framework shows hidden assumptions in textbook discussions.

The remaining benefits of most resources decay with both time and use. For pure capacity resources, decay with time exceeds that with use. For these pure capacity resources, the opportunity cost of idle capacity is zero. At the other extreme, opportunity cost is acquisition cost for resources with perfect storability of benefits. We argue that many resources that are traditionally classified as "fixed" capacity resources fall between the two extremes. For such resources, the distinction between time-based and use-based diminution in resource value is relevant when computing opportunity cost.

We note that the distinction may be relevant even for resources normally classified as inventoriable. For such resources, decay with use typically exceeds that with time. In the normal course of events, the resource is consumed before appreciable time-driven decay in value, making acquisition cost a good estimate of opportunity cost. However, even inventoriable resources do not retain their value indefinitely through time. Inventoried parts could either become obsolete, or deteriorate in quality with the passage of time. Thus, if obsolescence and time expiration of remaining benefits are significant issues for some inventory items, then the calculations similar to what is presented in this paper apply to these items as well. Assertions of zero opportunity cost for idle resources are true only if the resource's time-based decay in value (expiration granularity) equals the value lost through use (consumption granularity).

Whether the benefits from using the granularity framework are worth the costs remains to be determined. An avenue for future research would be to develop an implementable rule for partitioning an organization's resource set into a manageable number of granularity classes. Characterizing the granularity of each individual resource in an organization may be no more practical than using a separate cost pool for each resource in a traditional ABC system. Classifying resources into a small number of granularity classes will give rise to intra-group heterogeneity, and errors of measurement. These errors must be weighed against the costs and other consequences of using a larger number of resource pools (see Lim and Sunder 1990,1991; Datar and Gupta 1994).

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End Notes

[1] Wieser's Law can be found in his *Natural Value* (1888, pp. xlii): "… the idea of 'costs' as sacrifice of wealth capable of other uses than that to which it is actually put."

[2] It is important to distinguish idle capacity that exists at any given point in time and *expected* idle capacity at the time of planning. Banker, Datar, and Kekre (1989) show that the opportunity cost of expected idle capacity is positive because of the associated option value. Excess capacity allowed at the time of planning brings down costs of congestion during times of peak demand. See also Zimmerman (1997). In this paper, our focus is on what the opportunity cost of realized idle capacity should be in deciding how to use it gainfully.

[3] The same is true of the time-based diminution of the benefits of resources normally treated as inventoriable. Even parts inventory is reduced to scrap given passage of enough time. We return to this topic in the concluding section.

[4] When labor contracts incorporate managerial flexibility to call up and use labor for a specified number of hours over, say a month, it too can be treated as an inventoriable resource until it perishes. The standard Monday-Friday 9-5 labor contracts make labor a capacity resource. The term of labor contract determining this crucial economic characteristic is a frequent cause of labor disputes.

[5] We have assumed a smooth function for ease of exposition. It is likely that time-based decay in value is non-linear and may be a step-function. For example, the benefit from a microprocessor declines dramatically after the next generation of processors is introduced. In such cases, the non-linear function could be approximated by a piece-wise linear function, and create a horizon-dependent expiration rate.

[6] Of course, it is possible that, as with machinery, the benefits of an idle order assistant and inspector are not lost forever either. Then following the argument we use here for the machine, the opportunity cost of idle time of these staff will also be positive. In this illustrative example, we consider the future benefits of idle machine but not of idle people. Also see footnote 4 above.

[7] Weathering refers to the progressive diminution of remaining benefits with the passage of time due to physical deterioration in its environment. Cars rust and milk sours. Obsolescence and timeliness have more to do with the economics of a fixed resource in a changing environment. Changing technology may reduce or eliminate the demand for a resource. Personal computers with an 8088 processor and Visicalc (the first personal computer worksheet) became obsolete within a decade of their introduction. Finally, the services of a resource may have value only if they are available at a specific time. A printing press that breaks down until 2 AM and fails to print the morning edition of the paper causes permanent economic loss.

[8] When resources are used for purposes other than what we call normal and ordinary, their granularities may change. The resultant estimates of opportunity costs may change too. After all, opportunity costs depend on the context in which resources are used.

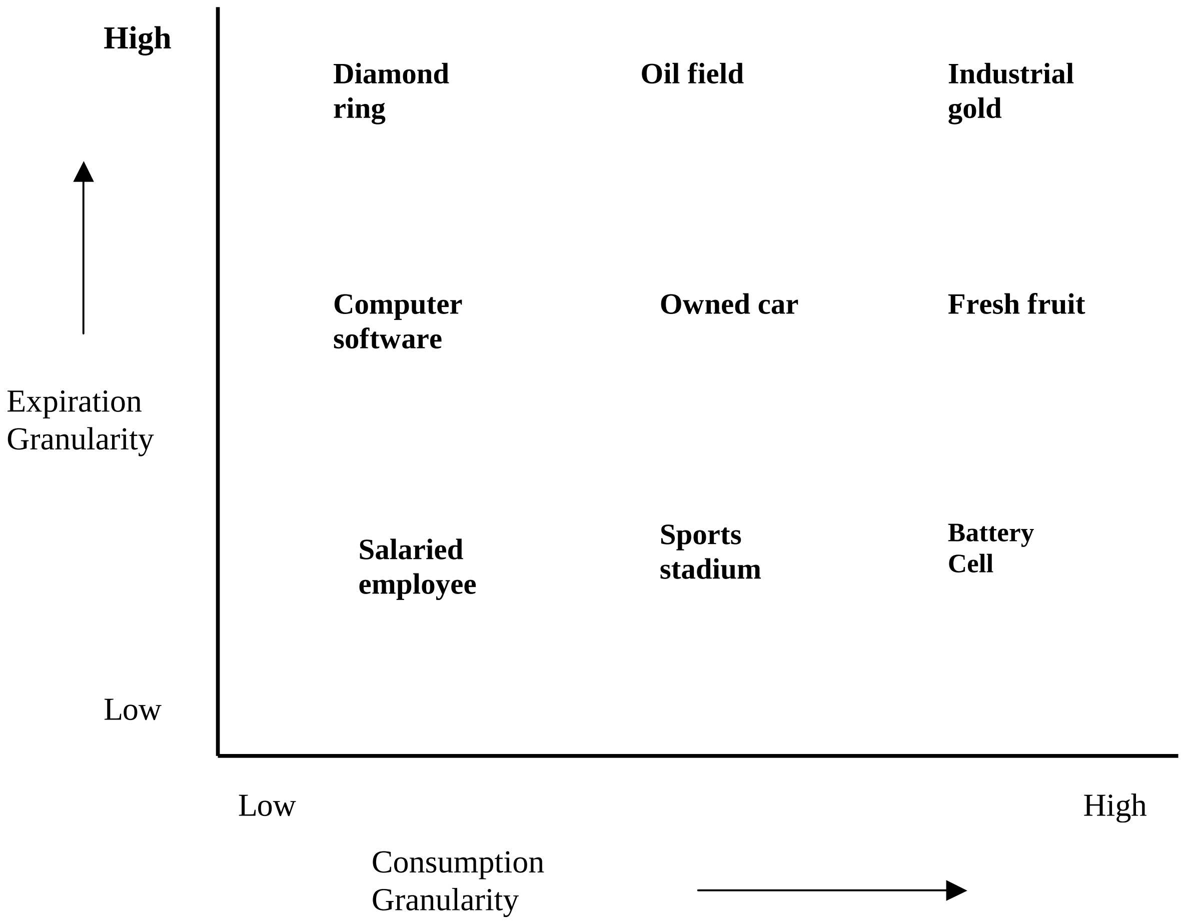

Figure 1: Expiration versus Consumption granularity

Table 1
Excerpts from Text Books Regarding the Opportunity Cost of Idle Capacity

Reference	Context	Statement
Horngren, C., G. Foster and S. M. Datar. *Cost Accounting: A Managerial Emphasis*. Annotated Instructor's version (10th edition). (1996)	Special order	"If facilities would otherwise be idle, the opportunity cost of insourcing is zero, because there's nothing better to do with the plant." (p. 389. Margin note to instructor)
	Transfer Pricing	If the Transportation Division has excess capacity, its opportunity cost of transferring the oil internally is zero because the division does not forego any external sales and hence does not forego any contribution margin from internal transfers. (p. 804)
Morse, D., J. R. Davis and A. Hartgraves. *Management Accounting: A Strategic Emphasis*. (1999)	Special order	"Because Mind Trek has excess productive capacity, no opportunity cost is associated with accepting the Brazilian distributor's one-time order." (p. 122)
	Transfer Pricing	"From the viewpoint of the corporation, the relevant costs in make or buy decisions are *the external price, the outlay costs to manufacture and the opportunity cost to manufacture*. The opportunity cost is zero if there is excess capacity." (p. 474)
Jimbalvo, J. *Managerial Accounting* (2001)		"[I]n the calculation of the net benefit of accepting the special order, none of the fixed cost of production are considered to be incremental costs. This is because these costs will be incurred whether or not the special order is accepted."
	Transfer pricing	"When no external market exists, the opportunity cost of producing and selling an item internally is simply the variable costs of producing that item." A footnote clarifies that "This assumes that the selling division has excess capacity." (p. 380)
Barfield, J.T., C.A. Raiborn and M. r. Kinney. *Cost Accounting: Traditions and Innovations . (*2000)	Special order	"Also, the company has no immediate opportunity to apply its current unused capacity in another way, so there is no opportunity cost." (p. 516)
Hilton, R. W., M.W. Maher and F. H. Selto. *Cost Management: Strategies for Business Decisions.* (2001)	Special order	"Notice that if there were no alternative uses of the space, the opportunity cost would be zero." (p. 558)
	Transfer pricing	… suppose that the Koala Camp Gear Division's Melbourne plant has excess production capacity. … . The *outlay cost* in the Koala Camp Gear Division's Melbourne plant is still $40, since it does not depend on whether there is idle capacity or not. The *opportunity cost*, however, is now zero. (p. 873)

Table 2
Parameters of the Example

Panel A: Available Resources

Resource	*Traditional Classification*	*Cost basis*	*Cost*
Materials	Variable	Per pound	$ 4
Order costs	Variable	Per order	$25
Inspection	Committed	Per year	$50,000
Order assistant	Committed	Per year	$30,000
Machinery	Committed	Per year	$600,000

Panel B: Characteristics of Committed Resources

Item	*Inspector*	*Order Assistant*	*Machinery*
Normal Annual Usage (hours)	2,000	2,000	24,000
Life with normal usage (years)	N/a	N/a	5
Life if left idle (years)	N/a	N/a	8

Panel C. Resource Consumption by Activity

Activity	*Resources Used*	*Consumption basis*	*Units Consumed*
Order Processing	Order assistant time	Hours	5
	Out-of-pocket costs	Per order	1
Setup	Machinery	Hours	15
	Inspector time	Hours	5

Panel D. Product Characteristics (2 representative products only)

Product	*Budgeted quantity*	*Materials (lbs per unit)*	*Machine hours per unit*	*Number of orders*	*Number of setups*
A	1,000	1	2	4	4
B	100	1	3	4	4

Table 3
Granularity Characteristics and Rate Computations

Resource	*Unit for driver*	*Consumption rate*	*Expiration rate*	*Opportunity Cost*	
				Fully used	*Idle*
Materials[1]	Lbs.	$ 4.00	-	$ 4.00	$4.00
Out of pocket order costs	Order	$25.00	-	$25.00	$25.00
Inspector time[2]	Hour	$25.00	$25.00	$25.00	0
Order assistant time	Hour	$15.00	$15.00	$15.00	0
Machinery[3]	Hour	$ 5.00	$ 3.125	$ 5.00	$1.875

<u>Notes</u>

1. Consumption rate is acquisition cost. Expiration rate does not apply because benefits are storable until needed. Similar comments apply to order cost.
2. Consumption rate for inspector's time is $25 / hour = $50,000/2,000 hours. Expiration rate is same because benefits expire with passage of time, used or not. Similar comments apply to the order assistant's time.
3. The consumption rate for the machine is $5 per hour = $600,000/(5 years * 24,000 hours /year.). Expiration rate of $3.125 / hour = $600,000 / (8 years * 24,000 hours / year).

Table 4
Product Cost Computations

Panel A: Costing Activity Units

Activity	*Consumption Rate* [1]	*Expiration Rate*	*Opportunity cost*	
			Fully used	Idle
Order Processing	$100	$75.000		$25.00
Setup [2]	$200	$171.875	$200.00	$28.125

Panel B: Product Cost Computations (Traditional)

	Full Utilization of Capacity		*Unused Capacity will be idle*	
Item	*Product A*	*Product B*	*Product A*	*Product B*
Material	4.00	4.00	4.00	4.00
Machinery	10.00	15.00	0	0
Order Processing	0.40	4.00	0.10	1.00
Setup	0.80	8.00	0	0
Total cost / unit	15.20[3]	31.00	4.10[4]	5.00

Panel C: Suggested Product Cost Computation

	Full Utilization of Capacity		*Unused Capacity will be idle*	
Item	*Product A*	*Product B*	*Product A*	*Product B*
Material	4.00	4.00	4.00	4.00
Machinery	10.00	15.00	3.75	5.63
Order Processing	0.40	4.00	0.10	1.00
Setup	0.80	8.00	0.1125	1.125
Total cost / unit	$15.20	$31.00	$7.9625 [5]	$11.755

Notes

1. Consumption rate is the rate of decrease in remaining benefits as the resource is put to use**.** Expiration rate is the rate of decrease in remaining benefits due to sheer passage of time, even if the resource is idle.
2. Consumption rate of $200 / hour = 5 hours * $25 per hour for inspection + 15 hours *$5 / hour for machine time. Expiration rate is computed using expiration rates for table 2. Similar computations apply for the other activity, Order Processing.
3. Materials cost is 1 unit at 1 Lb. at $4/Lb., cost of machine time is 2 hours at $5/hour, setup cost is $0.80/unit = 4 setups * $200 per set up / 1000 units, order processing costs are 4 orders * $100 per order / 1000 units.
4. Opportunity cost (OC) of machine time is zero because the machine has idle capacity. Setup cost is also zero because it only uses capacity resources that would otherwise be idle. With respect to order processing, the opportunity cost of the order assistant's time is zero and the OC for ordering costs is $25. Thus, the opportunity cost per unit of product A is $25 * 4 orders /1000 units = $0.10. Similar calculations apply for product B.
5. OC is consumption rate less expiration rate. Refer to table 3 for details. OC of order processing per unit of product A = $25.00 * 4 Orders / 1,000 units = $0.10 /unit. Similar comments apply to the set up activity.

Table 5
Computing Opportunity Cost

		Consumption Granularity	
		Low	High
Expiration Granularity	Low	OC = Expiration rate. Use of duration or time based driver appropriate.	OC is consumption rate if fully used. OC is the difference between the consumption and expiration rates, if idle.
	High	Cost is not a good basis for determining opportunity cost.	OC = Consumption rate. Use of count or consumption based driver appropriate.