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Dollars, Sense, and Sunk Costs: A Life Cycle Model of Resource Allocation Decisions[1]

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Decisions as to whether to cut off a losing enterprise (clouded by what already has been invested in the venture) may be facilitated by a new model proposed here—the life cycle model. The model, borrowing an accounting measure (the time adjusted rate of return) to describe the effect of "sunk costs" on the expected rate of return for future costs in a project, is used to examine the relevance of negative feedback to the decision to commit further resources to completion of a project.

The year 1982 began on a record tear in business and economic circles: in the first quarter, more U.S. based companies filed for bankruptcy than in any first quarter since the Great Depression of the 1930s. For the owners or CEOs of firms in the throes of such economic woes, deciding whether to "throw in the towel" could be the most difficult and painful choice of a lifetime. However, this type of decision is not an extraordinary circumstance. Even for the most profitable companies, not all projects and new ventures meet with success. Cost overruns, revenue shortfalls, and bad news of other sorts are, unfortunately, all too common. Often the decision that needs to be made is when to cut off a losing proposition before it can take the rest of a corporate entity down with it.

But is this an easy decision to make? This paper explores how one might assess whether this decision is clouded by what has already been invested (or "sunk") in a venture—both personally and monetarily. Consider the following examples:

—An investor has all her money in a long term savings account at 20 percent interest. Interest rates change, so that new certificates become available at 21 percent. After some deliberation, the investor decides to keep her money in the 20 percent account.

—A construction company is building a new subdivision when interest rates go sky high and the bottom falls out of the housing market. Despite facing certain losses in doing so, the company decides to finish building the subdivision.

—A secretary is calling an airline to make plane reservations for his boss. He knows he can expect to wait at least 4 or 5 minutes and often 10, before getting through. But today he has already waited 15 minutes. He decides to keep waiting.

—The city council of a major metropolitan area decides to go ahead with a slum renewal project. The project will provide new low cost housing for low income residents of the area, while lowering crime rates and generally improving the quality of life in a substantial portion of the city's old downtown area. Halfway through the project, it becomes clear that costs for the project have been underestimated by almost 40 percent. The city council decides to finish the project, as planned, anyway.

These examples all share one central theme. An initial decision to invest time or money in some venture has met with negative feedback—the expected "best-possible" outcome has not been realized. Nevertheless, the decision maker has opted to continue in the course of the initial decision. In common parlance, this smacks of "throwing good money after bad." Worse yet, this scenario does not appear to be at all uncommon (Staw, 1981). Why should such

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seemingly irrational behavior occur? This paper will present a framework, the life cycle model of investment decisions, which begins to answer this question.

These examples are all instances of "sunk cost" situations—a decision has been made and resources irretrievably expended following from that decision. From a traditional accounting or financial analyst perspective, decision makers throw good money after bad in sunk cost situations because of confusion. The decision maker fails to understand that money already spent should not have any bearing on decisions to commit further resources to a project in the future. If the decision maker is interested in maximizing returns on investment, the path to the best return lies in allocating resources to whatever available investment alternative promises the best ratio of future revenues to future costs, even if it means abandoning a project that is a success in comparison to prior expectations. The best return on future allocation of resources is what counts, and the past therefore cannot possibly be relevant (Horngren, 1982).

The psychologist brings a different perspective to bear in understanding why a decision maker might throw good money after bad. The psychologist claims to be less interested in how investment decisions should be made, and more interested in how they are made. The psychologist says that a decision maker faced with negative feedback about a project's financial progress may feel the need to reaffirm the wisdom of time and money already sunk into the project. Further commitment of resources in the face of negative feedback somehow "justifies" the initial decision (Staw, 1976) or at least provides further opportunities for it to be proven correct. The decision maker also may treat the negative feedback as simply a learning experience—a cue to redirect efforts within a project rather than abandon it (Connolly, 1976). Or perhaps the decision maker will rationalize away the negative feedback as a whim of the environment—a storm to be weathered, rather than a message to be heeded. In any case, the psychologist's conclusion is the same: whether it should or not, a project's financial past plays a role in future decisions. Quite simply, sinking resources into a project fosters a kind of psychological momentum or inertia that negative feedback may be powerless to halt.

For the practicing manager, throwing good money after bad is the aftermath of a particularly puzzling dilemma: when to get out of a losing situation one has already sunk time and money into, versus when to persevere to overcome adversity. In fact, the manager often is caught between acknowledging the wisdom of the accountant's prescription and living out the psychologist's inertia. As the accountant suggests, the manager wants to get the best possible return on allocation of his resources. But as the psychologist suspects, the manager feels committed or entrapped. He feels that money already sunk into a venture somehow "counts" in making decisions.

What Are Sunk Costs?

Sunk costs arise not in a single choice and outcome situation, but in projects in which over time there are streams of anticipated costs and revenues. In a project, funds are expended incrementally and precede revenues. A plan or budget for a project details the disbursement of costs for the project over time and also the projected revenues. Often there will be a period in the budget when costs exceed revenues, in anticipation of subsequent periods in the budget when revenues will exceed costs. Sunk costs are the negative cash flows experienced in anticipation of future compensating positive cash flows. Without flows of revenues and costs, one cannot have sunk costs. If costs and revenues occur in a single decision or time period, there can be no sunk costs. Sunk costs are of interest after a project has started and the point in the budget reached at which costs spent exceed revenues realized. Now the manager needs to decide whether to continue and finish the project. What might be considered at this juncture?

—Are the experienced revenue and cost streams following the plan? If there are large costs early in the project, the return on investment (ROI) for costs taken to this point in the project may be less than what is expected for the project as a whole. But is it less than planned? Without a budget, this would be impossible to know and meaningless to ask.

—What is the projected ROI for the remaining costs of the project? How does it compare with the ROI rates offered by other current investment alternatives?

—If news is received that a departure from the budget (a cost overrun or revenue shortfall) is imminent, how much of either is acceptable? Does it matter when this departure from the budget occurs? And, finally, which is preferable: cost overruns or revenue shortfalls?

Without the necessity of further resource commitments, there seems little for the manager to decide. Why exit a project when it promises only future revenues at no additional costs? In that event, decreased future revenues are annoying but do not present any decision for the manager. The problem occurs when there are sunk costs and required future costs and a departure from the budget is anticipated. In that event, the manager needs to understand the relationship between past and future costs and future revenues.

In the traditional sunk costs situation, recovery through use seems to be an appealing notion. When a piece of machinery is purchased for a project, the machinery is expected to "produce" revenue during its productive life—for instance, by turning raw materials into marketable finished goods. Faced with negative feedback (i.e., certain loss through cost overrun or revenue shortfall), the manager may wish to continue a project to its natural (albeit costly) conclusion, whereby recovery through use would be maximized and loss through sunk costs minimized. Intuitively, this strategy is rather attractive and may underlie the manager's feeling that the accountant is not capturing the whole picture in the prescriptions to ignore sunk costs in making investment decisions. For the accountant, the decision to continue is simply a matter of the ratio of future revenues to future costs; "recovery through use" muddies the waters of the decision.

Psychologists have tended to leave "negative feedback" ill-defined in their experimental examinations of sunk cost situations. The information provided is rarely sufficient to complete future-revenues-to-future-costs calculations (such as net present value or time adjusted rate of return). This reflects the psychologist's claim that the "correctness" of further resource allocation is not an issue. The psychologist is interested only in whether the existence of sunk costs influences psychological commitment (as revealed by further resource commitment) in the face of negative financial feedback.

Yet, this rendering of the psychologist's position seems misleading. What makes further allocation of resources to a project in the face of negative feedback indicative of psychological commitment to the psychologist clearly must be the apparent irrationality of the resource allocation decision. In cases in which it is economically advisable to allocate further resources despite negative feedback, any psychological causal mechanism volunteered by the psychologist is superfluous—a simple economic explanation would be equally predictive and more parsimonious. This is not to suggest that a manager cannot feel psychologically committed to a project when the project is successful. Rather, the notion of commitment under such circumstances may add little or nothing to the understanding of behavior. Therefore, any hope that the psychologist holds of shedding light on sunk costs decision making must come from examining situations in which the accountant would maintain that "good money is being thrown after bad."

Unfortunately, previous sunk cost research by psychologists has not examined decision making situations in which commitment of further resources is explicitly economically inadvisable. Instead, psychological researchers have examined decisions in which sunk costs and negative financial feedback are explicit but the revenue picture is not (Staw & Ross, 1978). The economic rationality of further resource commitment is left indeterminable for the decision maker. In some cases (Brockner, Shaw, & Rubin, 1979), the expected rate of return for further financial commitment even can be shown with a few assumptions to be increasing and (after a certain amount of investment) financially advisable, despite the claim that further resource commitment under the circumstances is psychologically rather than economically motivated.

Altogether, it is not clear that psychologists have examined investment decision in which further commitment of resources amounts to throwing good money after bad. Yet, only through examining decisions in situations in which further resource commitment is demonstrably irrational can the psychologist hope to add to the explanatory power of economic accounts of resource allocation decision making.

TARR: A Tool for Assessing Investment Rationality

ROI decisions have three dimensions: expenses, revenue, and time. Time enters the picture in terms of the opportunity costs of committing capital. For instance, one would expect $5,000 "sunk" into a project for two years to yield a greater return than the same amount committed for one year. The second year of being "sunk" represents foregoing other investment opportunities that would yield additional earnings.

Accountants and economists often have assumed that managers are interested in the time dimension only insofar as it influences cost and revenue calculations, because profit is the goal of resource allocation decisions and profit is a function of revenue-to-cost ratios. Consequently, accountants have developed such discounting procedures as the time adjusted rate of return to incorporate time in the evaluation of costs and revenues for investment opportunities. The time adjusted rate of return (TARR) is derived by adjusting the actual costs and revenues written into a budget to reflect the time value of money, and then calculating a rate of ROI for all costs and revenues discounted to the present. The resulting rate of return is the effective yield of a project, or the interest rate for borrowing money at which the project would exactly break even. (This measure also is known as the internal rate of return.) For a more detailed explanation of this calculation, the reader is urged to consult an accounting text, such as Horngren (1982).

It would be foolish to dispute the usefulness of procedures such as TARR for objectively assessing the advisability of an investment opportunity. As a comment on how decisions should be made, the TARR represents an important point of departure for assessing how they are made. This paper develops a richer framework of investment decisions—the life cycle model—in which the accountant's prescription for handling suck cost situations can be explored.

The life cycle model has two dimensions: types of decisions and stages within decisions. The model follows the lead of the time adjusted rate of return in incorporating time as a consideration. It uses TARR to examine successive resource commitment decisions over the life of a project. Previous researchers—for example, Terborgh (1958)—of course have examined and discussed the interplay and influence of different facets of resource allocation decisions. Hackney (1965), for instance, modelled changes in overall return rates for a project over the life of the project, as influenced by such factors as cost overruns and underruns. However, the life cycle model provides two important benefits over previous work in this area. First, it allows a clear specification of when a financial setback is likely to constitute a rational reason to terminate or abandon a project. For future psychological research, this will provide a true baseline from which to explore more precisely than previously when and why people really do throw good money after bad. More to the point, the life cycle model clearly reveals the psychologist's fallacy: continuing a project in the face of a financial setback is not always irrational (it depends on the stage in the project and the magnitude of the financial setback). Second, the life cycle model provides an insight into the manager's preoccupation with a project's financial past. It demonstrates how a project's financial past can be used heuristically to understand the project's future.

Project Life Cycles

Four types of project life cycles, corresponding to the four examples with which this paper began, are derived from examining the changes in TARR for the allocation of further resources to the projects throughout the courses of the projects. (To be accurate, rate of return figures should incorporate dollar value estimates for corporate image cultivation, influence on reputation, and other "intangible" costs and revenues, as well as some adjustment for appreciation or increased liquidation value of a project.) The projected TARR for a project is of interest precisely because this is one measure recommended by accountants by which to judge whether resources should be committed to a project. For instance, if competing investment opportunities offer a TARR of 20 percent, a TARR of 21 percent for commitment of further resources to a partially completed project would be worth putting money into; a TARR of 19 percent would not. Any time the TARR for a project is less than what is available from competing investment alternatives, commitment of resources would be financially inadvisable.

Typically, the time adjusted rate of return might be used to choose among competing investment opportunities before investment has been made in any of the opportunities. In practice, TARR would be one of several measures used; any one measure alone has limitations. For instance, TARR compares return rates rather than total dollars returned. TARR therefore may be misleading if comparing two investment opportunities with cost streams that are quite different in magnitude. The following discussion draws on TARR because of its intuitive appeal—similar measures (such as net present value) would lead to the same conclusions.

TARR calculations also can be used to decide whether to continue a project that has incurred a financial setback. Negative financial feedback (either cost overrun or revenue shortfall) will diminish a project's overall projected rate of return. This is irrelevant financially, though it could well make a difference to a manager. What matters financially, as the accountant will be quick to note, is the rate of return (as measured by TARR, for instance) for

Table 1
Four Sample Project Budgets

Time	Project A Costs	Project A Revenues	Project B Costs	Project B Revenues	Project C Costs	Project C Revenues	Project D Costs	Project D Revenues
Year 1	$833	$1000	$1164	$1000	$2306	$1000	$1540	$ 0
Year 2	833	1000	800	1000	300	1000	200	0
Year 3	833	1000	720	1000	270	1000	180	0
Year 4	833	1000	650	1000	245	1000	150	0
Year 5	833	1000	590	1000	220	1000	120	5000
Time-adjusted rate of return (for remaining expenditures)								
At year 1	20%		20%		20%		20%	
At year 5	20%		70%		355%		4067%	

remaining resource commitments required by a project. TARR calculations can be used to assess whether this rate of return for remaining costs is better than competing investment alternatives (either new or partially completed).

Table 1 presents four different types of sample project budgets. Each sample budget is represented by a 5 year cost stream and a 5 year revenue stream. The format for presenting cost and revenue streams is taken from Horngren (1982). To simplify the examples, costs are assumed to be taken at the beginning of each year and revenues realized at the end of each year. For each of the sample project budgets presented, the time adjusted rate of return for remaining expenditures in the project is shown both for the beginning of the project and for the beginning of Year 5. This highlights the changes in TARR values over the course a project budget, as influenced by different cost and revenue streams, and it leads to four types of rate of return life cycles:

Type I

Project A in Table 1 shows a project budget in which TARR is constant (at 20 percent return) throughout the entire life cycle of the project. The investor mentioned at the beginning of the paper, with her money in a long term savings account, provides an example of a type 1 rate of return life cycle. Notice that there are no sunk costs in such an investment opportunity. At no point would halting the project occasion a financial loss for the investor. Also notice that the TARR for such a project is the same at all points in the project's life cycle.

Type II

Projects B and C (continuous variable TARR) in Table 1 show project budgets in which the TARR for remaining expenditures varies over the life cycle of the project. Specifically, there are costs at the beginning of the projects (these may be start-up costs or equipment expenditures) that are not expected to generate immediate revenue. These are sunk costs in the traditional sense. The construction company building a subdivision provides an example of this: materials and machines must be purchased, designs drawn up, and workers trained before any income is realized. Because revenues are not accruing when these costs are realized (or, perhaps, revenues are not being generated at the rate of expenditures), the TARR must be greater after these costs than before in order that total revenues exceed total costs for the entire project. Only if the TARR increases after costs that do not generate immediate revenue have been realized can the rate of return for the entire project reach the rate projected at the project's inception.

Project C in Table 1 illustrates this point. A substantial proportion ($2,306) of the project's total costs are taken early in the project, but revenues are evenly distributed throughout. Consequently, though the rate of return for the entire project is only 20 percent, by the beginning of year 4 the rate of return for remaining expenditures ($245 in year 4 and $220 in year 5) is 355 percent.

Type III

Project D in Table 1 shows a special case of the discontinuous variable TARR life cycle; virtually no revenue accrues until the very end of the project life cycle, at which point all benefits accrue. Examples of this would include the building of a bridge or waiting "on hold" on the telephone to make airplane reservations.

One can imagine a family of curves of Type II, ranging from type I to type III, depending on: (1) the proportion of costs (compared to the total budget for the project) realized before revenues begin accruing faster than costs, and (2) the ratio of revenues to costs when revenues are accruing faster than costs. It bears mentioning that TARR values might meander up and down through the life cycle of a project. For instance, in building missiles, some assembled components might command a healthy profit for the maker. However, once fitted and installed in the missile, they become effectively valueless until the entire missile is completed, at which point an even healthier profit is realized. Rate of return thus reaches a potential local maximum once, when components are completed but not yet physically "committed" to final assembly, and then reaches yet a higher maximum again when the missile is completely assembled. In terms of TARR analysis, this means that it might make sense to commit some amount of resources to partial completion of a project in order to get the project to a local maximum in the project's life cycle, without committing enough resources to complete the project. (This should become apparent later, when the impact of negative financial feedback on TARR calculations for remaining expenditures is discussed in further detail.)

Type IV

The life cycle for TARR-inappropriate projects may look like any member of the type II family, except that for this type of project TARR calculations are inappropriate. There might be two reasons for this. First, some projects are undertaken not because they are cost effective, but because they are effective. For example, TARR calculations may be unnecessary to understanding the funding of a war, or research on some acute disease crisis, or the slum renewal project noted earlier. Statements such as "Hang the expense" or "Whatever it costs, it's worth it" are traditionally associated with such projects, whether accurately or not. Another way of saying this is to note that decisions concerning such projects appear to be dominated by outcomes. It may be worth just about anything to avoid losing a war if it means being sold into slavery. There are limits to this perspective, of course. It is not thought to be worth selling oneself into slavery to one group to gain its protection from another. But, within limits, the apparent extreme value of anticipated revenues makes formal TARR calculations unnecessary.

A second possibility for the inappropriateness of TARR calculations arises when the benefits of a project are not easily specifiable or quantifiable. This would render the calculations of TARR difficult and might lead to the appearance or illusion that the outcome picture renders TARR calculations unnecessary, as noted above. Behaviorally, a manager may even prefer to keep the outcome picture ambiguous so that his or her performance cannot be monitored or evaluated so easily.

This examination of TARR values over the course of different projects immediately presents two possibilities for which commitment of further financial resources would be rational even in the case of negative feedback (such as cost overruns or revenue shortfalls). First, type IV life cycles (projects are dominated by outcomes) constitute situations in which financial negative feedback may have no bearing on whether a project should be continued or not. When an entire nation is dying from the plague, learning that research to find the cure is going to be more costly than originally projected does not render continuation of the research economically inadvisable. On the other hand, managers interested in protecting their turf may find this reasoning a convenient smokescreen behind which to hide their failures. Second, if the environment changes during the course of a project, the relevant comparison value for TARR may change. If so, even if a financial setback decreases TARR, TARR for the remainder of the project nevertheless may exceed the rate of return offered by competing investment opportunities, so that further commitment of resources to the project would be economically advisable. Note that either of these points could hold even if the financial setback were encountered at the beginning of a project, before any money had been spent.

Stages of a Project

The existence of variable TARRs through the life cycle of projects raises the specter of stages of a project during which TARR for the remainder of the project is increasing, decreasing, constant, and greater or less than the return rate projected for the entire project before the project was begun. There are four stages in the life cycle of a project:

First

In stage 1 no significant sunk costs have yet accrued. Time has been spent perhaps on "blue sky" types of research, which may be usefully applied to other projects. Personnel have been gathered or hired or even trained in project-nonspecific ways and can be diverted to other projects if this one is terminated. Materials may have been purchased or ordered, but have not yet been utilized in a way that prevents their return to the supplier or diversion to some other project.

Second

Costs are being realized faster than revenues are accruing in stage 2. Workers are spending time on this particular project or are being trained for aspects of this particular project and they cannot readily transfer to something else. Materials have been channeled into this project. But revenues are not accruing as fast as costs are being realized. At any point during this stage of the project, TARR for the remainder of the project is increasing and is greater than the return rate projected for the entire project before it began.

Third

In the third stage revenues are being realized faster than further costs. In the manufacturing realm, this might be when production is going full swing. The only costs now are the variable costs per unit produced (such as labor and raw materials). In the traditional view, this is the period of the project life cycle when sunk costs are being recovered. Unlike stage 2, TARR for the remainder of the project may be constant during this period if there are no economies of scale to be realized during the later stages of production. If there are such economies, TARR may continue to increase (as it does for projects B and C in Table 1) through this stage. In either case, TARR for the remainder of the project will be greater throughout this stage than the return rate originally projected for the entire project, just as it was in stage 2.

Fourth

Revenues for the entire project exceed total costs in the fourth stage. At this point, a project may be deemed completed and halted, such as in the case of a construction project when a building is finished and sold. Or TARR may become constant or continue to increase, depending on whether there are additional economies to be realized. In the manufacturing realm, this would correspond to that time in a project when all start-up costs have been recovered and the production item has become one of the firm's "cash cows."

Impact of Negative Feedback

Negative financial feedback to a project can be of two kinds; cost overruns or revenue shortfalls. Cost overruns and revenue shortfalls occur as discrepancies between experienced costs and revenues and the costs and revenues planned in the budget for a project. Negative feedback can occur for any of the four types of projects. However, the variable TARR projects (type II and III) have different stages, and negative feedback will have a range of different implications for decision making, depending on the stage in the project during which the feedback is received. The limits of this range of implications are found in type I and type IV projects.

In the case of type I (constant TARR) projects, negative feedback has the same effects throughout the life cycle of the project. Negative feedback lowers the calculated TARRs. If TARR falls below the acceptable criterion value (which represents what is available elsewhere), it would be irrational to stay in the project and unlikely that a manager would stay unless the manager was inattentive or the cost of changing was great (as with savings certificates that require "substantial penalties for early withdrawal"). In the other most extreme case, type IV projects, TARR analysis is inappropriate because one would finish the project regardless of feedback. Negative financial feedback could have an impact on decision making for a type IV project if the feedback caused the manager to reconceive the project as a type II or III project.

The type II (variable TARR) project begins (stage 1) as if it is a type I project. In subsequent stages, costs flow out faster than revenues flow in. (If revenues are all deferred to the end of the project, the project is a type III project.) To determine the magnitude of negative feedback that can be absorbed in a variable TARR project, an analysis crossed four levels of how early in a project costs are spent against four levels of how late the revenues are realized. The four cost levels were: (1) all costs at the beginning of the project; (2) most costs early; (3) costs almost evenly distributed over time; and (4) costs evenly distributed over time. The four levels of revenues were: (1) revenues evenly distributed over time; (2) revenues distributed almost evenly but with slightly more

Table 2
TARR Factors for Projects with Various Costs and Revenues Streams[a]

	Revenues			
	Constant	*Slowly Increasing*	*Quickly Increasing*	*All at the Project's End (Type III)*
	$1000	*$ 720*	*$ 440*	
	1000	*865*	*660*	
	1000	*1035*	*990*	
	1000	*1245*	*1490*	
Costs	*1000*	*1475*	*2175*	*$7442*
All up front				
$2988 (1)[b]				
1 (2)	833[c]	924	1014	1155
1 (3)	833	1021	1234	1704
1 (4)	833	1125	1501	2819
1 (5)	833	1229	1812	6201
Mostly up front				
$2306 (1)				
300 (2)	3.15	3.49	3.83	4.36
270 (3)	3.36	4.11	4.97	6.87
245 (4)	3.57	4.81	6.42	12.06
220 (5)	3.79	5.59	8.24	28.19
Somewhat up front				
$1164 (1)				
800 (2)	1.18	1.31	1.44	1.64
720 (3)	1.26	1.54	1.87	2.58
650 (4)	1.34	1.81	2.41	4.53
590 (5)	1.41	2.08	3.07	10.51
Constant				
$833 (1)				
833 (2)	1.00	1.11	1.22	1.39
833 (3)	1.00 (Type I)	1.22	1.48	2.04
833 (4)	1.00	1.35	1.80	3.38
833 (5)	1.00	1.48	2.18	7.44

[a]All costs, revenues, and TARR factors are shown for a 5-year project life cycle, as in Table 1.
[b]Years shown in parentheses.
[c]TARR factors are the numbers by which remaining costs could be multiplied or remaining revenues divided, while maintaining a TARR of 20 percent for the remainder of the project.

at the end of the project; (3) revenues skewed strongly toward the end of the project; and (4) all the revenues realized at the end of the project.

Table 2 reports the results of the analysis, showing the magnitude of negative feedback that can be absorbed by a project if the project is to yield a 20 percent time adjusted rate of return for the remaining costs in the project. In Table 2, the magnitude of negative feedback that could be absorbed is expressed as a factor—the maximum number by which subsequent costs could be multiplied, or subsequent revenues divided, and the 20 percent TARR maintained for the remainder of the project. (For example, in cell 2 of row 2 of Table 2, if at the beginning of year 3 all subsequent costs were multiplied by 4.11, or all subsequent revenues divided by 4.11, the project would still have a 20 percent TARR for remaining costs taken in the project.) This factor is shown for all combinations of the four types of cost streams and four types of revenue streams, at the beginning of each year of the project budget.

This analysis shows that if there is a period in a project's budget (stage 2) in which costs are to be taken faster than revenues are to be realized, it will be possible during subsequent periods for the project to absorb negative feedback and still obtain its initial intended ROI for the remaining costs taken in the project. The allowable discrepancy between intended and realized costs and revenues post-stage 2 in a project might be called the region of rationality for the project. This region of rationality bounds the magnitude of negative feedback that rationally can be absorbed if a project is to continue. The contents of Table 2 demonstrate that the later in a project revenues are realized, or the earlier in a project costs are taken, the larger will be this region of rationality in the later stages of the project. The region of rationality is nonexistent with a type I project, increasing in size from type II through type III projects (as anticipated revenues are realized later in a project), and largest in type IV projects (for which virtually any negative feedback can be rationally absorbed).

This analysis shows the conditions under which it is quite rational to throw good money after bad: the more a manager has invested in a project early on, or the larger and later the payoffs, the wiser it is to stay in a project. Thus, the life cycle model suggests that it should not be surprising that in many cases managers persist in a course of action even in the face of negative feedback. What may need explanation is why a manager might not persist when his or her project is well within the region of rationality. The answer may lie in the manager's framing of a project as a whole—a series of investments that began in the past, rather than a series of remaining investments that begin now. It may be rational to finish a project even in the face of substantial negative feedback. However, in evaluating a manager, it also may be reasonable for the organization to hold the manager accountable for the total project that returns a loss. Finishing the project efficiently may not offset the project's overall subpar performance and may imply that the manager is ignoring or unaware of the project's shortcomings.

This trade-off can lead to an interesting dilemma for the manager. Even if a project is destined to lose money overall, there may be a point in the project's life cycle after which the TARR for further funding will be greater than what is offered by competing investment opportunities. Therefore, if the manager can get the project to that point in its life cycle, his or her performance will look extremely good for the remainder of the project. Thus the manager may commit further resources in order to get a project to the point at which he or she is bound to look good for the balance of the project. What is irrational for the organization may be rational for the manager. This would happen if the organization rewards turning a loss into a success, rather than holds the manager accountable for the total project.

This trade-off of success over the remainder of a project against failure over the total project raises new opportunities for research on project selection. If two projects have the same expected TARR, which is preferred: one with a smaller or larger proportion of costs early in the project? A smaller proportion of the costs up front means that it will be more likely for a project to be abandoned if negative financial feedback is encountered, because the region of rationality will be smaller. On the other hand, a larger proportion of costs early in the project helps insure completion of a project, even in the face of a financial setback, because the region of rationality will be large. Options and strategies of this sort may be salient to politicians and managers, but they have not yet been the subject of systematic investigation.

The life cycle model also suggests that further research on cognitive biases of decision makers may add to understanding of resource commitment decisions. Specifically, managers may have preferences for revenue shortfalls over cost overruns within the region of rationality; revenue shortfalls may be seen as gains foregone, but cost overruns felt as losses out of pocket. Kahneman and Tversky (1979) have proposed that utilities for gains are treated differently than for losses; managers are risk-averse toward gains, but risk-prone toward losses. Further, as noted earlier, managers may have a bias to construe their failures as type IV projects, whereby they can contend that the success or failure of the project is beyond any numerical assessment.

The life cycle model suggests two major directions for research on resource allocation decisions. These two directions correspond to the two types of departure from the model one might expect to see in a resource allocation decision. First, the behavior of decision makers may depart from the model because of involuntary cognitive biases. Decision makers simply may not be able to see the world the way the model suggests that the world should be seen. Second, the behavior of decision makers may depart from the model because of deliberate indifference to the model's prescriptions. This may occur, for instance, when psychological commitment overrides any sense of financial rationality, or when repeated receipt of alterations to a project budget causes the decision maker to lose faith in the budget as a reliable input to the decision making process. Both of these directions for research certainly invite the psychologists to expand and clarify their contributions to the understanding of why a project manager might commit further resources to a project in the face of negative feedback.

Conclusions

The life cycle model of resource allocation decisions provides a richer framework in which to view the accountant's prescription that resource commitment decisions should be made only by comparing future revenues to future costs. The model does not dispute the accountant's claim. Rather, it notes the heuristic value of: (1) different *types* of cost and revenue life cycles and (2) different *stages* in cost and revenue life cycles in arriving at the decision of whether to commit further resources to a partially completed project.

The model is not at all in conflict with the accountant's prescription. What it does provide is an understanding of what the accountant's "future revenues to future costs" measures (such as TARR) are likely to be at any point in a business venture and, perhaps more importantly, where (higher or lower) those measures are likely to be going. The model uses the accountant's prescription to capture the systematic predictability of costs-to-revenues measures during the course of a business venture.

The region of rationality established by the model serves as a baseline from which to pursue new research. Exploration should begin on the possibility of behaviors genuinely outside the bounds of rationality. There might be personal, organizational, or other nonfinancial reasons for such behaviors, as suggested by previous psychological research on commitment. Research also needs to focus on managerial decision making processes and propensities within the region of rationality. Within the region of rationality, managers' perceptions of changes in revenues-to-costs measures over time, and in reaction to cost overruns and revenue shortfalls, need to be examined. Further, the behavior of these measures reveals (perhaps) a dilemma for the manager in managing a project. Accolades may accrue for turning losses into gains, but punishments may await projects that lose money overall. Similarly, although managers may prefer revenue shortfalls after a project is under way, budgets with large up-front costs may be preferred before a project is underway if the manager is committed to seeing the project finished.

Thus the life cycle model—with its types and stages—lays the groundwork for some important insights into the managerial investment decision process. It does not redefine the accountant's prescription for investment rationality but, instead, extends that rationality to a point of predictive utility. It provides a framework into which the psychologists can cast their contributions and in which practicing managers can better understand the meaning of their intuitions. In the end, it is a model that should help all three (the accountant, the psychologist, and the practicing manager) do better in their attempts to make dollars and sense out of sunk costs.

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