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INFORMATION AND INCENTIVES ISSUES IN MANAGEMENT CONTROL

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The problem of managerial control arises whenever the top management or owner of the firm delegates the task of decision-making to a subordinate or manager whose actions, in turn, are guided only by his own self-interest. Delegation is deemed unavoidable as it is often not feasible for the owner to undertake the decisions himself. Further, the owner might like to take advantage of the manager's specialized information about the situation. However, self-interested behavior on the part of the manager can potentially cause divergence between the manager's and the owner's respective choices, i.e., a lack of "goal congruence".

In this paper, I address certain aspects of the goal congruence problem in delegation. Specifically, I model the control issue as a conflict situation between an owner and his manager operating in an uncertain environment. My objectives are as follows:

1) To represent the essential theoretical structure of this managerial control problem; and

2) To obtain some insights on how accounting reports affect decisions and how accounting-based incentive mechanisms can be employed to alleviate this control problem.

To fix ideas beyond the descriptive model, a familiar managerial accounting setting is developed, against which the concepts are applied.

The Decision Environment

Consider the following general decision situation. The owner of the firm has delegated the operating decisions to a manager. Although the owner is not physically present when the manager makes his decision, he knows the results of decisions from accounting reports.

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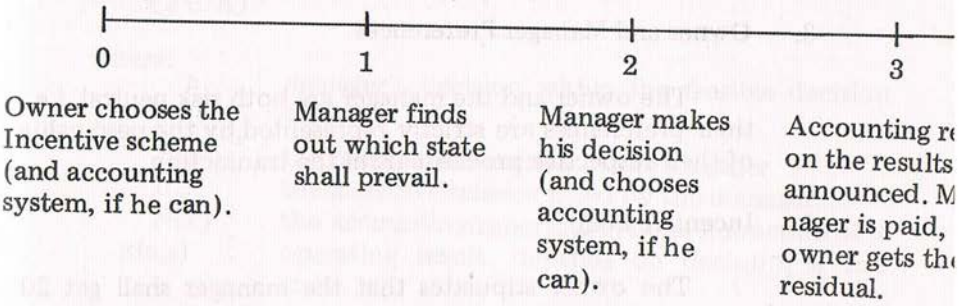
The operating results depend not only on managerial decisions but also on an uncertain variable ("state of nature") which is beyond the control of the manager. With these, the *reported* result to the owner depends on three things: the manager's decision, the realized state of nature, and the accounting reporting system used. While the owner may be able to determine the decision of the manager after the fact (*ex post*), he could not directly observe the state of nature at any time. However, the owner could conduct, at some cost, an *ex post* audit or investigation which is imperfect i.e., he still could not determine what state happened with perfect certainty; otherwise, he has no idea as to what state of nature prevailed.

The manager has better information about the situation compared to the owner. At the extreme, he could observe the state of nature prior to making his decision. Note that the owner could simply ask the manager about what state prevailed, but the latter has no incentive to report the truth. The absentee landowner, for example, could ask the farmer to explain the reason for a small harvest but if he does, he might as well expect the farmer to report "insufficient rainfall" all the time (instead of "insufficient efforts devoted to tending the crops"). In short, the manager can be expected to take the decision which best serves his self-interest and then claim "bad state" should an unfavorable outcome prevail.

Specific examples of the preceding scenario are easy to find. In job type production, the machine shop owner could find out what jobs were accepted by his manager but not necessarily the quality of materials used (state of nature). In health services, the hospital administrator knows what operation (decision) was undertaken by the physician (decision-maker) but only the latter knows the severity of the illness (state of nature). Under these situations the preferred decisions of the owner and the manager may diverge.

The question now is whether there are instruments available to the owner to enforce goal congruence. Here, the owner is constrained to work within his policy prerogatives. First, he could make adjustments in the compensation or incentive policy. Second, he could choose the accounting or scorekeeping system which is used to evaluate the results of managerial decisions. In turn, the manager chooses his action conditioned on the incentive scheme and on the accounting system. In certain cases, the accounting system specification requires information which is available only to the manager. Consequently, even the scorekeeping system may be chosen by the manager instead of the owner.

The preceding sequence of decisions and events are summarized in the following time line.



A Specific Setting: The Special Order Decision Problem

The concepts which are to be developed can be illustrated in a specific case problem. A familiar problem in managerial accounting is that of whether to accept or reject a special order and which cost reporting technique is relevant for decision-making. While the essential structure of the problem is simple, additional considerations of owner-manager preferences, of uncertainty in actual costs and of the incentive system used are usually suppressed in "traditional" (e.g., Horngren) discussions of the problem. These factors are explicitly incorporated in the following simple problem, as follows:

1. Special Order Decision Problem:

   There is a "one time" special order from a customer for 500 units of widgets at ₱6 each. The manager must accept or reject the order.

2. Uncertainty in Cost:

   The cost of the order is uncertain at the time of the order. It is not known whether the workers will learn fast in this order or not. In the latter case, there shall be substantial quality problems and rework costs. At the time the order was received, these are two equally probable events:

   a) The order may turn out to be difficult and costly to process: variable (labor) costs estimated at ₱5 each with fixed costs (machine) of P1,000. The machine is useful only for this order.

   b) The order may not be difficult to process, with

short learning period for workers: variable costs of ₱2 each, also with fixed costs of ₱1,000.

3. Owner and Manager Preferences

The owner and the manager are both risk neutral, i.e., their preferences are strictly represented by the peso value of their respective proceeds from the transaction.

4. Incentive Plan

The owner stipulates that the manager shall get 20 per cent of the measured/reported profit or loss from the order. The owner gets the residual or 80 per cent.

5. Relative Beliefs on the Uncertain Cost

The owner does not know whether the order will be costly to process or not, i.e., he assigns a 50-50 probability to each event. The manager knows better because he could observe the process. For ease in calculations, assume that the manager's knowledge is perfect — by asking a worker to test-process one widget, he resolves the uncertainty in cost before he decides whether to accept the order or not.

6. Accounting/Reporting System

The reporting system is specified by either the owner or the manager. While there is no question about the accounting treatment for labor cost, the fixed cost can either be entirely charged to the order or allocated to other output of the firm. For example, the manager can claim that the machine constituting the fixed cost is useable for processing other products. If this is the case, assume that the per unit fixed cost charge is ₱.50 and otherwise, ₱2 (₱1,000 ÷ 500 units).

Choice-Theoretic Model: The Owner Specifies the Reporting System

Assume that the owner could completely specify the reporting system. The solution to the delegation problem results from the parties' maximization of their respective expected rewards over their decision prerogatives. More formally, the manager solves the problem:

(1) MAXIMIZE $\sum_{s} U_m \{I[N(x),s]\} P_m(s)$
$\{a \in A\}$

where:

a	:	manager's decision within the feasible decision set A
U_m	:	the preference function of the manager
I(.)	:	the incentive scheme faced by the manager
N(x)	:	the accounting/reporting system, a function of x
x(a,s)	:	operating result, depends on decision, a and state, s
s	:	the state of nature
$P_m(s)$	:	the probability assigned by the manager to state s.

In words, a manager with preference U_m makes a final decision, a*, conditional on the announced incentive scheme, I, on the reporting system, N(x), and on his beliefs, $P_m(s)$. Alternatively stated, a change in the incentive scheme, or the reporting system or his beliefs might result in a change in his decision.

In turn, the owner chooses the incentive system, I(.), and reporting system, N(x) which solves:

(2) MAXIMIZE $\sum_{s} U_o \{x(a,s) - I[N(x),s]\} P_o(s)$
$\{I(.),N(x)\}$

where:

U_o	:	the preference function of the owner
$P_o(s)$	:	the probability belief of the owner for state s.

In this given scenario, there will be "goal congruence", i.e., the manager will always choose the decision which the owner prefers because the manager can use his superior knowledge only for evaluating his action choices and the owner chooses the incentive system and the reporting system *optimally*.

In the "special order" problem, the owner can specify the reporting system as one where all direct costs are charged to the order i.e., a "contribution margin approach". Given the incentive scheme, the manager's decentralized choice depends on his payoff under each state (he observes). The relative payoffs for the example are summarized in the following table with the first payoff representing that of the owner and the second, of the manager.

Table 1 – Payoff Table: Owner Specifies N(x)

State	Decision	a_1 = Accept	a_2 = Reject
s_1	= High Labor	(–400, –100)	(0, 0)
s_2	= Low Labor	(800, 200)	(0, 0)

Clearly, the manager solves (1) by choosing reject (a_2) if he knows that the order is difficult to process (s_1) and accept otherwise. With this, the (*ex ante*) expected payoff to the two parties are as follows:

Expected Payoff (Manager) = 1/2 (0) + 1/2 (200) = ₱100
Expected Payoff (Owner) = 1/2 (0) + 1/2 (800) = ₱400

In this case, the owner prefers to delegate the decision to the manager because if he were to decide himself, the absence of better information regarding s will force him to instruct the manager to *accept* the order *all the time.* To see this, observe the owner's expected payoff under each decision alternative:

Expected Payoff (Accept) = 1/2 (–400) + 1/2 (800) = ₱200
Expected Payoff (Reject) = 1/2 (0) + 1/2 (0) = ₱0

Since the owner's expected payoff under the delegation alternative is better than if he gives a direct instruction to the manager, he would prefer to leave the manager alone. In this case, the owner's choice of incentive scheme and reporting system already ensures goal congruence.

Choice-Theoretic Model: The Manager Chooses the Reporting System

The previous scenario presents a satisfactory state of affairs for top management/owner because of the separation between the manager's decision-making and how his results are measured. Unfortunately the same informational differences which induce delegation of operating decisions to the better-informed manager may apply to the choices of measurement systems. This issue is often ignored in managerial accounting textbooks. For instance, the "contribution margin" approach is advocated as a "correct" method of measuring divisional performance. Little consideration is given to the fact that top management, in imposing this measurement method, must first find

out which costs are relevant or attributable to the division. Such information, by its very nature may be available only to the manager.

Under this alternative setting, the manager in effect selects the particular reporting or measurement system (within general guidelines, say, "contribution margin approach", imposed by the owner). Intuitively, the owner can expect some losses in his own payoff because not only can the manager choose his decision — he can also choose how his results will be reported. However, all is not lost for the owner. What he can do is choose among a potentially richer set of accounting-based incentive systems, i.e., either:

1. As before, base the manager's remuneration only on the latter's reported profits, i.e., $I[N_j(x)]$ with N_j, $j = 1,...$ representing the manager's reporting scheme choice j or

2. Base the manager's remuneration on both his self-reported result, $N_j(x)$, and on an audit investigation report, y, conducted for the purpose of finding out which state of nature prevailed when the manager made his decision, i.e., the incentive scheme becomes the function $I[N_j(x), y]$.

The investigation result, y, could be seen as the report of an "operational audit" conducted for top management purposes. In effect, y is a signal about s and is probabilistic in nature. If each possible signal y is associated with one and only one s, then the "audit technology" is said to be "perfect" — the owner could find out, after the fact, under precisely what conditions the manager acted (and presumably, provide a "just" reward/penalty). Otherwise, the signal only gives an indication of what could have happened. In symbols, the probability of a particular signal, y, given what actually happened s, or $p(y/s)$, summarizes the audit technology employed by the owner.

With the preceding discussions, I can now formally state the respective choice problems as follows:

The manager selects his decision, a, and the reporting system, N(x), to solve the problem:

$$(3)\quad \underset{\{a \in A;\, N(x)\}}{\text{MAXIMIZE:}} \sum_y \sum_s U_m[N(x),y]\, p_m(s/y)\, p(y)$$

where:

p(s/y) is the conditional probability of s given y, defined as

$$\frac{p(s)}{\sum_{s} p(y/s)}$$

The owner selects the generalized incentive system, I[N(x), y], to solve the problem:

$$(4)\ \underset{\{I[N(x),y]\}}{\text{MAXIMIZE}} \quad \sum_{y}\sum_{s} U_o\{x - I[N(x),y]\}\, p_o(s/y)\ p(y)$$

Note that the expectations are taken over both the possible states of nature and the possible signals from any investigation. Also note some special cases. If the owner chooses not to investigate, then the expectation over y disappears. If the audit technology is perfect, then p(s/y) = 1 and p(y) = p(s) for every pair (s,y). If the manager and the owner are risk neutral, then each decides to maximize his respective expected cash proceeds. The numerical examples shall take advantage of these various simplifications.

The first question is whether the manager's capability to choose the reporting system can cause problems to the owner.

For the "special order" problem, the manager can choose to charge the entire fixed cost against the order, N_1 (x), or alternatively, to claim that the fixed cost benefits future jobs, N_2 (x),. His reported profit under each decision alternative reporting system and state are as follows:

	a_1 = accept		a_2 = reject
	s_1	s_2	s_1 or s_2
Revenues: 500,₱6@	₱3,000	₱3,000	₱0
Labor Cost	(2,500)	(1,000)	0
	500	2,000	0

Fixed Cost Component:			
if: charge ₱1,000 or ₱2@	(1,000)	(1,000)	0
$N_1(x)$	₱ (500)	₱1,000	0
if: charge less than ₱1,000, or ₱.50@	(250)	(250)	0
$N_2(x)$	₱ 250	₱1,750	0

Under the given incentive scheme, the following payoff table summarizes the reporting system $N_2(x)$ effects (Table 1 represents $N_1(x)$):

Table 2 — The Manager Chooses $N_2(x)$

State	Decision	a_1 = accept	a_2 = reject
s_1		(—550, 50)	(0, 0)
s_2		(650, 350)	(0, 0)

Expected Payoff (Owner) = (—550) 1/2 + (650) 1/2 = 50

Expected Payoff (Manager) = (50) 1/2 + (350) 1/2 = 200

Clearly, the manager could increase his expected remuneration by accepting the order *all the time* (regardless of whether it is difficult or not) and then claim that the machine is useful for some future jobs. Unlike the previous scenario, the owner cannot force the manager to reject the order when s_1 prevails. Alternatively stated, the owner is no better than if he were to instruct the manager to accept the order all the time regardless of the state.

In general, this potential conflict shall prevail whenever the manager could improve his rewards by changing his decision rule and then choosing the reporting system. In symbols, the manager deviates from the owner-preferred decision/reporting choices whenever:

$$E[U_m|a_{ij}, I(.), p_m(s), Nj] > [U_m|a_{io}, I(.), p_m(s), N_o]$$

if he only has a probabilistic knowledge of the states; or

$$\{U_m \mid a_{ij}, I(.), s, N_j\} > \{U_m \mid a_{io}, I(.), s, N_o\}$$

for some s if he can observe the state before making his decision.

Here, a_{io} and N_o represent the owner's preferred decision and reporting system, with the manager's utility for rewards, U_m, conditioned on a_1, I(.), p(s) and N(x).

The second question is whether the owner, recognizing the manager's self-interested behavior, can exercise his incentive policy prerogatives in order to restore goal congruence in decentralized decision-making. In doing so, he must always work within his own informational limits and the prevailing accounting/reporting system.

Restoring Goal Congruence: Incentive Policy Alternatives

As stated previously, some approaches which the owner can employ include that of working within the present incentive scheme and that of threatening to investigate (audit) the manager. Specifically, the following policies could be imposed by the owner:

1) Guarantee the manager a fixed, predetermined amount conditional on his decision without any further investigation;
2) Conduct an investigation or audit and distribute additional reward or penalty depending on the findings of the audit; or
3) Conduct an investigation and impose additional large penalties for "unfavorable" audit findings and little or no rewards for "favorable" findings.

Each of these alternative schemes are evaluated in the "special order" example.

The first option of the owner is to use the present profit sharing scheme and just give the manager a fixed amount, say ₱60, if he rejects the order *regardless* of the state. Of course the ₱60 will have to come from the owner's pockets if the manager decides to reject the order. The following payoff table can be readily derived:

Table 3 — The Side Payment Alternative

State	Decision	a_1 = accept	a_2 = reject
	s_1	(—550,50)	(—60, 60)
	s_2	(650, 350)	(—60,60)

Expected Payoff (Owner) = (-60) 1/2 + (650) 1/2 = ₱295

Expected Payoff (Manager) = (60) 1/2 + (350) 1/2 = ₱205

Note that goal congruence is restored — the manager rejects the order (a_2) if it is "high cost" (s_1). Moreover, this policy is preferred by both parties because their respective expected payoffs (Table 3) are strictly better than with no side payment (Table 2).[1] Alternatively stated, this owner-initiated policy change shall be acceptable to the manager (e.g., he will not go on strike).

In short, analysis showed that the manager, by choosing how his profit is measured, creates a threat to hurt the owner a lot (a loss of ₱550) and make himself only slightly better off (₱50). Thus the owner can eliminate this threat by guaranteeing the manager an amount more than he would get by manipulation of the reporting system.

The second policy alternative is to conduct an audit of the manager to find out what state prevailed when the manager made his decision. To avoid computational clutter, let the owner's audit procedure, e.g., a study of labor time tickets generate a signal, y, which *precisely* indicates whether the labor cost is "high" (y_1) or "low" (y_2). Then the owner can set up a reward-penalty system partly-based on the audit result, of the following form:

$$I[N(x),y] = \begin{cases} .2x + w & \text{if } (a_1, y_2) \text{ or } (a_2, y_1) \\ .2x - w & \text{if } (a_1, y_1) \text{ or } (a_2, y_2) \end{cases}$$

This means that the manager gets an additional reward, w, for "correct" decisions -- accept (a_1) "low cost" jobs (y_2) or reject (a_2) "high cost" jobs (y_1). Conversely, he gets penalized for "wrong" decisions (a_1, y_1 and a_2, y_2).

[1] More concisely, this policy is *Pareto-superior* to the old regime, i.e., it makes the owner better off while the manager is *at least* as well off as before.

Setting the reward/penalty amount $w = ₱60$, the following payoff table can be derived:

Table 4 — The Audit with Symmetric Rewards Alternative

Signal/State Decision	a_1 = accept	a_2 = reject
$y_1 = s_1$	(—490, —10)	(—60, 60)
$y_2 = s_2$	(590, 410)	(60, —60)

Expected Payoff (Owner) = (—60) 1/2 + 590 (1/2) = 265

Expected Payoff (Manager) = (60) 1/2 + 410 (1/2) = 235

Again, the manager is induced to make the decisions preferred by the owner. However, whether the audit alternative is preferred by both parties shall depend on the cost of doing the audit. If the audit is costless, then comparison of the expected payoffs in Table 4 with those in Table 2 indicates that the audit shall be Pareto-preferred. If the audit is costly (i.e., more than ₱265 — ₱200 = ₱65), then it does not pay for the owner to conduct the investigation.

In summary, the audit alternative can restore goal congruence but since this activity is a costly process, it may or may not be undertaken by the owner. Stated another way, the reward/penalty aspect of an audit-based scheme is *effective* at inducing "correct" managerial decisions but the policy need not be *efficient* because of additional costs involved, an audit being a "deadweight loss".

A third alternative is for the owner to conduct the same audit but use a "heavy-handed approach" — impose a large penalty for "wrong" decisions, say ₱100, and no reward for "correct" decisions, as follows:

$$I[N(x), y] = \begin{cases} .2x + 0 & \text{if } (a_1, y_2) \text{ or } (a_2, y_1) \\ .2x - ₱100 & \text{if } (a_1, y_1) \text{ or } (a_2, y_2) \end{cases}$$

The following payoff table summarizes the effects of this scheme:

Table 5 — Audit with Large Penalty Alternative

Signal/State	Decision	a_1 = accept	a_2 = reject
$y_1 = s_1$		(—450, —50)	(0, 0)
$y_2 = s_2$		(650, 350)	(100, —100)

Expected Payoff (Owner) = (0) 1/2 + (650) 1/2 = 325

Expected Payoff (Manager) = (0) 1/2 + (350) 1/2 = 175

Again, goal congruence is restored since the manager chooses a_2 if he observes s_1 and a_1 otherwise. In addition, the owner clearly prefers to impose a large penalty compared to the other alternatives (to see this, compare his payoffs in Table 5 against Tables 2, 3 and 4). However, this is not Pareto-preferred *even if the audit is costless* because the manager will *not* agree to an effective reduction in his expected payoff (from ₱200 in Table 2 to ₱175). Thus while a large penalty audit scheme may be effective and efficient (in theory), the owner can expect to encounter problems in enforcing it on the manager.

Concluding Remarks

The theoretical issues involved in managerial control under decentralized settings are quite complex because explicit considerations must be given to such factors as:

a) any difference in the preferences of the decision-makers;

b) the nature of the decision problem, including the uncertainties involved and the environment;

c) what the decision-makers know and do not know; and

d) the policies and instruments available to the decision-makers.

An analysis of the goal congruence issue was made in this paper, yielding the following conclusions:

1) While the owner and the manager's preferences may be congruent (both are risk neutral), control problems may

arise whenever the manager chooses both the decision and the scorekeeping system in an environment of uncertainty.

2) Informational asymmetries can preclude the owner/top management from imposing its preferred reporting system. In this case, there may be a need to resort to more complex managerial remuneration schemes, including those based on internal audit results, to improve the owner's welfare.

3) Regarding controls through incentive scheme design, several observations can be made based on the preceding analysis:

   a) The owner's welfare is reduced due to his relatively inferior information endowment. The goal of control system design for the owner is to find schemes towards obtaining his welfare level under a perfect information setting (Table 1 scenario).[2]

   b) Compensations based on the type of managerial decisions made can restore goal congruence. However this is premised on the requirement that the owner must be able to observe, *ex post*, the manager's decisions.

   c) Audit investigation results can be used as basis for rewarding managers. If the cost of the audit is sufficiently small, then the owner can use this mechanism for achieving goal congruence *and* improving his returns. Two interesting notes are appropriate here. First, audit is a costly process with no benefit *per se* i.e., a "deadweight loss," which is motivated only by the uncertainty of the environment and the incongruence in goals of the parties involved. Second, if the penalties are sufficiently small, the manager will agree to be investigated. While large penalties favor the owner, this benefit is derived at the expense of the manager. Consequently, enforcement of large penalties shall be a problem.

[2]Economists would recognize the situation described in this paper as a case of market imperfection due to informational asymmetry. In the scenario of Table 1, this asymmetry does not exist (in effect) and this situation is often called the "first best" solution. Information asymmetries tend to favor the manager, and even with the schemes in Tables 3-5, solutions are just "second best" in nature.