EXPANDING THE CONTEXT OF UTILITY: THE STRATEGIC IMPACT OF PERSONNEL SELECTION

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Others have demonstrated that traditional applications of the Brogden-Cronbach-Gleser (BCG) selection utility formula are deficient in responding to the financial context of managerial decisions (Boudreau, 1983a, 1983b; Cronshaw & Alexander, 1985, 1991). We demonstrate that traditional estimates of selection utility also fail to reflect the strategic context faced by managerial decision makers. We modify the traditional BCG model to yield an estimate of total utility derived from human resources (U_{total}) that can be directly compared to firms' strategic need at a particular point in time (U_{target}). Further, we demonstrate that, while strategic need is rarely constant over time, the capacity of a selection system to meet that need is also likely to change as \( r_{xy} \) and \( SD_p \) change over time. Re-examination of what is important to strategic human resource decision makers (selection utility vs. total utility and strategic need) and changing selection system contributions over time yields a more realistic view of how firms benefit from personnel selection.

Personnel researchers have been interested in assessing the financial impact of selection methods since the 1920s. Most activity from 1920–1965 focused on developing models of utility (e.g., Brogden, 1946; Cronbach & Gleser, 1965). These models typically portrayed a relationship between two sets of constructs—psychological “predictor” constructs and economic “criterion” constructs reflecting costs and benefits. Unfortunately, much as “criterion problems” have plagued the larger

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domain of personnel selection (Smith, 1976), problems in identifying, operationalizing, and incorporating aspects of the economic criterion construct domain have plagued efforts at estimating selection utility. For example, Boudreau (1991) and Cronshaw and Alexander (1985) argued that current personnel selection utility models are deficient when they ignore the decision context in which utility estimates are used. Boudreau (1983a) and Cronshaw and Alexander (1985) specifically introduced capital budgeting techniques from the field of financial planning to correct part of this deficiency. Boudreau (1983b) made modifications to incorporate the likelihood of changes in labor flow over time, while Cronshaw, Alexander, Wiesner, and Barrick (1987) and Rich and Boudreau (1987) demonstrated alternate means of assessing risk or variability in the point estimates of selection utility.

In summarizing this research Boudreau (1991) noted that when utility models “focus on the consequences of improving the…labor force, a fundamental consideration is how the organization uses quality improvements” and that “all existing payoff scales reflect a concern with productivity-based outcomes, virtually ignoring other factors that might be affected by selection decisions, such as community relations, work force attitudes, and adherence to a code of ethics. Thus, every payoff function is deficient in some way” (p. 648). We would add that no current models of selection utility account for the strategic needs of the firm. Specifically, while certain generic economic objectives are common to all private sector organizations (e.g., profit maximization, cost minimization), strategic opportunities are not common across firms and do not occur within firms in a uniform, predictable way (Ansoff, 1988). As opportunities are forecasted to occur, strategic decision makers must carefully align resources (personnel, capital, and raw materials) to meet strategic objectives. As strategic objectives vary within and between firms, different “alignments” of resources are dictated.

For example, modifying an illustration from Ansoff (1988), an entrepreneur starting a mail-order computer firm may see a strategic opportunity to develop a distribution network, gaining enough market share to meet the strategic objective of selling out to a major computer manufacturer within a 3-year period while reaping a substantial capital gain. It would be expected that the way this entrepreneur “aligns” resources, including the recruiting and selection of critical personnel, would be very different from the way resources would be “aligned” if the strategic objective was to grow large enough to pose a long-term challenge to major computer manufacturers. The entrepreneur concerned with capital gains would need a narrow applicant pool (i.e., one with a fairly high minimum skill level) and a selection system that procured skilled personnel to meet needed performance levels relatively quickly.
(at least within a 3-year period). Another entrepreneur concerned with long-term growth could focus on a broader applicant pool with an emphasis on hiring less skilled applicants that are trained and developed over a longer period. Traditional applications of utility models to the selection of computer sales personnel will be deficient because they fail to account for differences in the entrepreneurs' strategic objectives.

The human resource literature has recently begun to address the strategic implications of human resource systems (Devanna, Frombrun, & Tichy, 1981; Schuler & Jackson, 1987; Snow & Snell, 1993; Tsui & Gomez-Mejia, 1988). However, integrations of strategic considerations and methods of estimating selection utility have not been considered. It is very likely that estimates of utility will be identical for a given selection system in the two strategic scenarios outlined above (given identical predictors and criteria), especially if estimates of criterion validity have been meta-analytically derived and corrected for range restriction caused by the "narrow" versus "broad" applicant pools found in the two strategic circumstances. Very simply, a selection system that did not result in performance levels needed to attract buy-out offers would be worthless to our entrepreneurs concerned with capital gains, while potentially very valuable to entrepreneurs concerned with long-term growth potential.

Ansoff (1988) elegantly described how changes in size, technology, and third party ownership of firms have made profit maximization only one of many strategic objectives. Ansoff (1988, pp. 31–32) provided a taxonomy of organizational objectives that might result. Different strategic intent (Hamel & Prahalad, 1989), such as the near-term buy out versus long-term growth objectives of our computer entrepreneurs, will embrace different weighted combinations of these goals and objectives.

The primary purpose of the current effort is to demonstrate how a firm's strategic considerations change the focus of personnel selection utility discussions. Derivations resulting from this change provide strategic decision makers with additional information needed to determine a selection system's contribution to strategic goals and objectives. First, we introduce the notion of organizations' strategic goals, how strategic goals might vary over time, and how strategic goals impact the application of selection utility models. This change in focus captures the fact that temporal changes in strategic goals must be considered in determining whether a selection system contributes to the "alignment" of resources needed to meet that need.

Second, we demonstrate how existing utility models might be applied in ways that reflect the context of strategic intent. Specifically, we show how a given selection system may vary in its ability to meet changing
strategic needs over time. This highlights an assumption made by current utility models that is rarely questioned: That predictor-criterion relationships \( r_{xy} \) and applicant pool performance variation \( SD_y \) can be counted on to remain the same over time (see Henry & Hulin, 1987, for an exception). Since the timing of resource "alignment" is critical if strategic needs are to be met, differences in criterion validity \( r_{xy} \) and applicant pool performance variance \( SD_y \) over time must be considered. We briefly explore the literature suggesting that changes in validity \( r_{xy} \) and performance variation \( SD_y \) might be expected over time, before illustrating the impact of such changes on utility estimates. The relaxation of this assumption in the dominant Brogden-Cronbach-Gleser utility model, combined with a focus on the strategic impact of selection utility, yields more realistic portrayals of a selection system's impact on organizational goals and objectives.

In this way, we demonstrate how joint changes in strategic need, and selection systems' capacity to meet that need over time, must be considered by human resource and strategic decision makers. Current metrics of selection utility, pegged to a lone performance measure taken at a single point in time, fail to provide decision makers with this strategic information. Before introducing these proposed changes, we briefly review the dominant Brogden-Cronbach-Gleser model of selection utility.

The Brogden-Cronbach-Gleser Model in a Strategic Context

Brogden (1946, 1949) developed a basic formula for deriving the economic return realized from a selection system:

\[
Y_s = r_{xy} SD_y Z_{xs} + \mu_y
\]  

(1)

where \( Y_s \) is the average job performance measured in dollar terms for the individuals actually selected, \( r_{xy} \) is the Pearson product moment correlation between the predictor \( X \) and criterion \( Y \), \( SD_y \) is the standard deviation of the dollar performance criterion \( Y \) that would be expected if the entire applicant cohort had been hired and placed on the job, \( Z_{xs} \) is the average predictor score performance in standard score form of those selected, and \( \mu_y \) is the expected level of job performance in dollars for a group of randomly selected applicants. Note that the average individual's job performance is neatly partitioned into the portion that would have been expected if random selection had been used (\( \mu_y \)) and the portion by which this "base line" performance is expected to increase due to use of the selection system \( r_{xy} SD_y Z_{xs} \). To obtain "net performance" or utility gain due to use of the selection system for a given time period:

\[
Y_s - \mu_y = r_{xy} SD_y Z_{xs}.
\]
or, more commonly,

\[ \Delta U_{\text{per selectee}} = r_{xy} SD_y \frac{\lambda}{\phi} \]  

where,

\( \Delta U_{\text{per selectee}} = \) expected economic return relative to random selection
\( \lambda = \) height of normal curve at cut score
\( \phi = \) the selection ratio
\( Z_{z_s} = \) average predictor score performance in standard score form

To determine the total marginal utility resulting from use of the selection device, Brogden (1949) multiplied Equation 2 by the number of employees selected \( (N_s) \) and subtracted testing costs as follows:

\[ \Delta U_{\text{selection}} = N_s SD_y r_{xy} \frac{\lambda}{\phi} - N_{\text{app}} C_s \]  

where \( C_s \) is the cost of testing an applicant, \( N_{\text{app}} \) is the number of applicants, and \( \Delta U_{\text{selection}} \) is the difference between the “total” performance level of all those selected \( (N_s \bar{Y}_s) \) minus the value of the base-line performance level that would have been expected if the selection system had not been used (i.e., \( N_s \bar{Y}_p \), the total performance level expected from random selection). Cronbach and Gleser (1965) extended Brogden’s (1946) model to other types of selection situations (e.g., multi-stage selection and placement decisions), deriving a formula identical to Equation 3. This equation has become known as the Brogden-Cronbach-Gleser (BCG) utility model, which constitutes the foundation for most utility analyses performed today (see Cascio, 1991, for the BCG model chronology).

It is interesting to note that Equation 1 can be modified in a similar manner to obtain the total utility of labor to the firm for a particular job:

\[ U_{\text{total}} = [N_s r_{xy} SD_y Z_{z_s} - N_{\text{app}} C_s] + \bar{Y}_s \]  

where \( N_{\text{employed}} \) is the total number of individuals employed in the job and \( C_{\text{labor}} \) is the average employee cost of labor excluding the cost of the selection system (salaries, benefits, recruiting, human resource department overhead, etc.). Where \( \bar{Y}_s \) in Equation 1 represents the total average performance expected from those selected, \( U_{\text{total}} \) in Equation 4 represents the net total performance after adjusting for the costs
of that performance (i.e., $C_x$ is the cost of the performance gain expected from use of the selection system while $C_{labor}$ is the cost of performance levels expected from random selection). Hence, this equation is partitioned to illustrate the net value added by the selection system

\[ (N_{expected}SD_yZ_x + N_{app}C) \]

and the base-line utility expected from labor selected at random $\left(N_{employed}\mu_y - C_{labor}\right)$. A new cohort of employees screened by the selection system and hired into a job is expected to add $(r_{xy}SD_yZ_x + C) + (\mu_y - C_{labor})$ per employee to the firm, while all initial employees who had not been screened would each contribute only $(\mu_y - C_{labor})$. This model is similar to one developed by Boudreau and Rynes (1985) and Boudreau and Berger (1985) to estimate the utility of recruiting policies (see Boudreau & Rynes, 1985, Equation 2, p. 358), though for clarity we have deleted modifications for net present value, taxes, and changes in employee flow. Regardless, an interesting implication is that $\Delta U_{selection}$ can be large while $U_{total}$ might be very small or even negative, a circumstance that becomes important when we introduce firms’ strategic needs below.

Investigators have made various adjustments to the BCG model (Equation 3) to make it less deficient and more representative of organizational decision contexts (Boudreau, 1991). For example, Schmidt, Hunter, McKenzie, and Muldrow (1979) were the first to expand the scope of the BCG model over time by multiplying utility gains by the average tenure of employees hired under a new selection system. A key assumption (which we will come back to) of Schmidt et al. (1979) was that both criterion validity ($r_{xy}$ and $SD_y$) remain constant over time, and hence, utility (Equation 3) realized in each work period by those selected remains constant over the planning period for which the utility estimate is derived. Murphy (1986) adjusted the BCG model to incorporate job offer rejections. Boudreau (1983a) and Cronshaw and Alexander (1985, 1991) argued that the BCG model should be modified to reflect capital budgeting variables, in effect enhancing the construct validity of all the BCG model’s economic parameters. Boudreau (1983a) introduced the notions of variable costs (increased productivity may mean higher wages due to merit pay, lower raw material costs due to decreased waste, etc.) and taxes, while Boudreau (1983b) and Cronshaw and Alexander (1985, 1991) suggested that forecasts of future utility gained from selection of current employees be discounted. These extensions emphasize ratios and metrics commonly used by financial planners (Boudreau, 1991). This paper extends this line of inquiry by showing that inattention to the strategic context of selection decisions is an additional deficiency of the BCG model.
Change in Focus: Strategic Need and Temporal Change in Strategic Need

A common deficiency in estimating the impact of selection systems occurs when estimates derived from the BCG model (Equation 3) are appraised without considering the expected total value added by human resources to be realized by the firm (Equation 4). As noted above, situations can occur at different points in time where the relative BCG utility estimate is positive while the absolute economic return is negative. The three examples below demonstrate this in circumstances where three different strategic objectives are dominant: economic survival, maintenance of the status quo, and rapid growth of market share through the sale of franchises.

The Ultimate Strategic Need: Economic Survival

Russell and Domm (1990) reported a criterion-related validity coefficient of .32 between an assessment center rating and profit generated by a sample of retail store managers. Let us assume that all fixed and variable costs of producing sales volume are the same across stores (Russell & Domm controlled for store size in deriving their validity coefficient). Then it can be assumed that profit generated by the store is a reasonable measure of value added by the manager. Russell and Domm reported that the validity coefficient of .32 translated into an expected quarterly increase (\(\Delta U_{selecte} \)) of $3,000 in store profits. Interestingly, average quarterly profit generated by the sample was negative $3,662.61 and the gain expected from use of the assessment center was not enough to offset the loss each store was already incurring. It is important to realize that these figures yield a large positive BCG utility estimate from Equation 3, though total value added by human resources to the firm (Equation 4) remains negative. Hence, relying only on the incremental utility obtained from selection might cause one to recommend investing in a costly assessment center for stores that will continue to lose money.

Most corporate strategic goals and objectives involve something beyond mere economic survival (e.g., the near-term and long-term goals of our mail-order computer entrepreneurs described above). Based on careful forecasts of environmental changes and resource availability, most firms' objectives will consist of a longitudinal pattern of desired economic outcomes, growth, product mix, and so forth. We will label this desired mix of performance levels the firm's strategic need over some relevant time horizon. This suggests the possibility that temporal changes
in strategic need might dictate differential weighting (across time periods) of expected future economic returns from a selection system. Specific examples are described below of how differential weights applied to BCG forecasts of economic return yield very different conclusions. Each example assumes that the appropriate values of \( r_{xy} \) and \( SD_y \) have been used in each time period to derive forecasts of \( \Delta U_{\text{selection}} \) (Equation 3) and \( U_{\text{total}} \) (Equation 4).

Turnover and Maintenance of Status Quo

In this scenario, over the next 2 years an organization faces high turnover due to the retirement of a disproportionately large number of its retail store managers. We will consider this firm to be focused on a narrow product market, existing in a highly homogeneous external environment, with few adjustments needed in technology, methods, or structure. Primary attention is paid to maximizing the efficiency of existing operations (i.e., maintaining the status quo). Because of this strategic posture, all future economic returns from a selection system will be of equal strategic value—the critical, or minimally acceptable level of strategically needed \( U_{\text{total}} \), hereafter labeled \( U_{\text{target}} \), is constant over time. These conditions are presented graphically in Figure 1.

A number of characteristics of Figure 1 are of interest. First, the forecasted utility using BCG Equation 3 is positive (\( \Delta U_{\text{selection}} = Y - \mu_Y \)) at every point in time, while expected economic return (\( U_{\text{total}} \)) is negative for the first 2 years and below the level of strategic need (\( U_{\text{target}} \)) throughout the period A to C. Expected economic return (\( U_{\text{total}} \)) changes over time in accordance with the common finding that newly hired individuals do not immediately yield high steady-state performance levels (cf. Deadrick & Madigan, 1990).

Second, the firm will net a positive economic return from the selection system if the area labeled “AHG” is less than the area labeled “GDE” (we assume that all the appropriate discounting, taxes, etc. have been applied to all future economic returns). Third, and most importantly, the firm will have met its strategic goal if the area labeled “CDE” is greater than the area labeled “ABC.” This example provides a straightforward extension of Schmidt et al.’s (1979) and Cronshaw and Alexander’s (1985, 1991) applications of the BCG model using a comparison of areas above and below \( U_{\text{total}} \) (and not \( \Delta U_{\text{selection}} \)) as the basis of a decision to implement the selection system. Specifically, decision makers following the Schmidt et al. and Cronshaw and Alexander procedures would have combined future values of \( \Delta U_{\text{selection}} \) (Equation 3) to arrive at an estimate of “return” which, while extremely (and accurately) large, is not a realistic or valid estimate of how well strategic need is met (i.e.,
$U_{\text{total}}$ relative to $U_{\text{target}}$ in each future time period). The next example considers a situation where $U_{\text{target}}$ is not constant over time.

An Undercapitalized Entrepreneur

Let us change the strategic scenario by making our firm an exploiter of new product and market opportunities. This firm also generates revenue through retail sales, though primarily through the “innovative” means of leveraging growth in market share using franchisee capital (a developing trend in the 1990's U.S. economy, Martin, 1988). We will assume that the franchisees own and operate independent restaurants. The labor market (applicants for franchises) faced by this firm consists of individuals both in and out of the restaurant industry who want to own and operate their own business. Our hypothetical firm intends to use a cognitive ability test to select franchisees. However, this industry faces a labor market characterized by applicants with a lot of desire and little capital, causing the failure of many new franchisees as initial cash flow and profits are inadequate to meet the personal needs of the franchisee during the start-up period (Evans & Jovanovic, 1989; Martin, 1988). If we assume that the average franchisee has capitalization to last one year before showing a profit, the selection instrument that predicts $U_{\text{total}}$ to be negative until year 2 is of no value to our restaurant franchiser (see Figure 1). Since the average franchisee is predicted to go bankrupt at the end of year 1, fixed costs incurred for franchisee training and start-up costs yield a negative expected total utility to the franchiser.

Decision Implications of a Strategic Focus

Stated simply, in the economic survival (Russell & Domm, 1990) and “status quo” examples, the firm needs to ask: (a) Given all other factors besides the selection system (e.g., capitalization, availability of raw materials, etc.), what is the expected level of performance generated by a manager? (b) How much of a performance increment could be expected if a new selection system is used? and (c) Are the levels of performance expected with or without the selection system adequate to meet the firm’s strategic need? After addressing these questions, an additional question found at the heart of traditional applications of BCG utility estimates must be asked: Is the incremental performance increase expected from selection instrument “A” greater than that expected from instrument “B”? The examples differ from traditional BCG applications only in that the focus has shifted from $\Delta U_{\text{selection}}$ to include the comparison of $U_{\text{total}}$ to $U_{\text{target}}$. 

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$U_{\text{target}}$ = the level of utility (value) dictated by the firm’s strategic goals
G = "break even" point, where cost of labor = total utility derived
C = point at which total utility derived from labor = strategic target
If Area AHG < Area GDF, then positive economic return
If Area CDE > Area ABC, then strategic goal is met

Figure 1: Utility derived from selection ($\Delta U_{\text{selection}}$) and total utility derived from human resources ($U_{\text{total}}$) over time: $\Delta U_{\text{selection}} = U_{\text{total}} - U_{\text{y}}$

The restaurant example introduces an additional source of variation in that strategic need is now a moving target. If strategic objectives are to be met in the face of limited access to capital, the required “alignment” of resources (capital and human) must be altered. More human resources in the form of higher skill levels must be brought into the production process at an earlier point in time. Hence, the answer to the question regarding whether the expected performance levels are adequate to meet the firm’s needs becomes complicated. Instruments with positive selection utility may not meet the strategic needs of the firm in any of the examples, though the timing of the restauranteur’s strategic needs may add an additional reason for the rejection of an instrument, namely, that it does not deliver the essential levels of performance at the right time. In sum, depending on the strategic needs of the firm (e.g.,
survival, maintenance of status quo, or market penetration and growth), differences between the traditional use of $\Delta U_{\text{selection}}$ and our weighted combinations of $U_{\text{total}}$ matter.

Note that our restaurateur requires performance for the first year to be at some specified level for the continued fiscal health of the franchisee. The strategic decision maker at our restaurant franchiser would be using a conjunctive decision model (Einhorn, 1970) to decide whether the selection system will generate adequate economic return during the critical initial planning period. It is a conjunctive decision process under conditions where $U_{\text{total}}$ must be positive in a "single hurdle" decision model, that is, where $U_{\text{total}}$ must be positive after one year. Assuming fixed costs for labor and the selection system, either a better test will need to be acquired (i.e., increase $r_{xy}$), the labor pool will need to be enhanced (increase $\mu_y$, as per Boudreau & Rynes, 1985), or both. Regardless, while derivations of the basic BCG formulae are used to arrive at estimates of utility in each interval of the planning period, the firm's strategic target will dictate how these estimates should be combined in deciding whether the selection system contributions are adequate. Our "status quo" firm simply adds them up, while our restaurant franchiser must consider a nonlinear, conjunctive configuration.

**Implications for Estimating How Well Strategic Need Is Met:**

*Changing Values of $r_{xy}$ and $SD_y$ Over Time*

Hunter, Schmidt, and Coggin (1988) recently criticized capital budgeting methods for utility estimates that appear extreme compared to competing investment decisions. Such extreme values make utility estimates of personnel interventions appear so preposterous that they are dismissed as ridiculously inaccurate by managerial decision makers (cf. Ashe, 1990). Ashe suggested that estimates of utility which dwarf the national debt (e.g., Hunter & Schmidt, 1982) preclude their credible use in management decisions and in arguments of legal defensibility. Unfortunately, even in applications of the BCG model that have been adjusted with capital budgeting procedures, utility estimates tend to be unrealistically large.

One reason current return on investment (ROI) estimates derived from selection utility (Cronshaw & Alexander, 1991) may seem inflated relative to estimates of ROI made for competing investments (e.g., retooling, acquisition of new retail outlets) is the assumption that "things stay the same." Boudreau (1983a) speculated whether effects of human resource interventions (e.g., $r_{xy}$) remain constant for each relevant performance measure over some planning period and whether estimates of $SD_y$ in the applicant pool would vary as the labor market changed over
time throughout the planning period. Hence, as with our demonstration of how $U_{target}$ can change over time, $U_{total}$ and $\Delta U_{selection}$ may vary over time as estimates of $r_{xy}$ and $SD_y$ change. Instead of single values of $r_{xy}$ and $SD_y$ derived from predictors measured at $T_1$ and a criterion measured at $T_2$, the BCG model must be modified to account for multiple criterion measures taken at $T_2$, $T_3$, $T_4$, ... $T_n$. Hunter et al. (1988) and Cronshaw and Alexander (1985, 1991) did consider utility gained at multiple points in the future; however, they assumed $r_{xy}$ and $SD_y$ remain constant such that expected returns in each future period are the same. Regardless, almost all derivations of selection utility over time can be modified to accommodate changes in $r_{xy}$ and $SD_y$ (e.g., Boudreau, 1983a, Equation 11, or any of Cronshaw & Alexander’s, 1985, capital budgeting derivations).

A large literature suggests that $r_{xy}$ is not constant over time (cf. Fleishman & Quaintance, 1984), while only one study has reported empirical evidence of instability in $SD_y$ over time (Deadrick & Madigan, 1990). We present a brief review of the evidence suggesting longitudinal instability in $r_{xy}$ and $SD_y$, and summarize how estimates of selection utility ($\Delta U_{selection}$) and total utility ($U_{total}$) might change.

*Stability of $r_{xy}$ and $SD_y$*

*Stability of $r_{xy}$. Fleishman and his colleagues have spent almost 40 years examining longitudinal relationships between predictor and criterion construct domains (Fleishman & Quaintance, 1984). Fleishman and Hempel (1954, 1955), Fleishman (1960), and Fleishman and Rich (1963) have demonstrated that: (a) Cognitive ability tends to be highly correlated with initial task performance and decreases in correlations with subsequent performance trials until zero or nonsignificant criterion-related validities result, and (b) motor response time and perceptual motor skill tests tend to be uncorrelated with initial performance levels and increase in correlation with later task performance. Though most of these findings were obtained in laboratory settings using relatively simple tasks, they underscore the need to examine criterion performance measures taken at more than one point in time.*

*Hulin, Henry, and Noon (1990) examined the temporal trends in predictive validity across 41 studies and 77 independent validity sequences. Predictors spanned a broad range of cognitive and psychomotor tests (e.g., from Law School Admissions Test and undergraduate GPA to rotary pursuit tasks and two-handed coordination tests). Hulin et al. found substantial evidence of decreasing trends in validity over time across all tasks and/or jobs. Their summary evidence strongly suggests that (a)*
The combinations of abilities required for job performance change over time, and/or (b) incumbents' skills and abilities change with practice.

Conclusions from these findings are far from universally accepted (see Austin, Humphreys, & Hulin, 1989; Barrett & Alexander, 1989; Barrett, Alexander, & Doverspike, 1992; Barrett, Caldwell, & Alexander, 1985; Deadrick & Madigan, 1990; Henry & Hulin, 1989; Hoffman, Jacobs, & Gerras, 1992, for contrasting views). Ackerman (1986, 1987, 1989) proposed that observed changes in relationships between cognitive and psychomotor skill tests and task performance over time can be explained by a moderator variable—the cognitive processing requirements of the task. Ackerman used the distinction between automatic and controlled cognitive processing (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977) to explain why relationships between (a) cognitive and psychomotor predictors and (b) task performance criterion measures increase, decrease, or are sustained over time. He hypothesized that measures of cognitive skills should exhibit little or no decay in predictive validity when tasks are inconsistent in their "rules for information processing... components of processing, or... sequences of information processing components" (Ackerman, 1987, p. 4). Performance of such tasks is hypothesized to be dependent on the limitations of an individual's cognitive resources. Hence, measures of those cognitive resources should exhibit sustained predictive validity with task performance over time. This explanation is consistent with Hunter's (1986) observation that measures of general cognitive ability (g) tend to yield higher criterion-related validities in complex jobs (Hunter's term "job complexity" implies a continuum of jobs that vary in quantity of consistent vs. inconsistent tasks). Hunter (1986) speculated that this was due to complex jobs requiring incumbents to innovate (a complex cognitive task) when faced with "situations that will be only approximately like the situation described when the rules were given" (p. 348). It is also interesting to note that the School and College Ability Test used in the Management Progress Study at AT&T demonstrated an increase in criterion-related validity between the 8- and 20-year time lag (Bray, Campbell, & Grant, 1974; Howard & Bray, 1988), a finding that was not included in the Hulin et al. (1990) review.

In contrast, automatic processes are thought to develop over time on tasks that are easily broken into units and procedures, limiting the amount of controlled monitoring and information processing that is needed. These tasks may require extensive controlled processing initially. However, the quantity of cognitive resources required decreases over time. Consequently, measures of g will demonstrate criterion-related validity with early trials of task performance that slowly shrink over task repetition as automatic processes reduce the need for
controlled cognitive resources. Perceptual or psychomotor measures of more specialized skills would be expected to demonstrate sustained or increasing criterion validities with performance on more consistent tasks.

Hence, there is reason to believe that, at least in the task-job combinations examined by Fleishman and Ackerman, estimates of $r_{xy}$ are not constant over time for two common classes of predictors: tests of general intellectual ability and psychomotor skill. Evidence of substantial changes in $r_{xy}$ is prominent with other commonly used selection systems (cf. Bray et al., 1974; Howard & Bray, 1988). The implications derived for forecasts of selection utility and total utility are straightforward but substantial. It would be predicted that criterion-related validity for cognitive ability and perceptual/psychomotor tests will be moderated by the automatic versus controlled cognitive requirements found in the criterion construct space. Other things being equal, criterion-related validities with long-term performance (and hence, utility) should be augmented most by perceptual/psychomotor predictor tests in jobs that permit automatic functioning for the majority of the applicant pool after some initial on-the-job learning period. In contrast, general cognitive ability predictor tests should yield consistently high validities with long-term performance in jobs that require controlled cognitive functioning.

Variations in $SD_y$ over time. It is instructive to revisit the definition of $SD_y$ before exploring the possibilities for true change in $SD_y$ over time. $SD_y$ is the standard deviation of performance measured in dollar terms that one would observe if the entire applicant pool were hired. Further, any estimate of $SD_y$ will be specific to the time at which the criterion measure $Y$ is obtained. Consequently, if an entire applicant cohort is hired and 20 criterion measures are obtained over the first 20 months of employment, 20 different estimates of $r_{xy}$ and $SD_y$ can be obtained.

While Landy, Farr, and Jacobs (1982) and others have called for research on differences in $SD_y$ across jobs, job families, and industry, we are unaware of any studies of $SD_y$ in which an entire applicant cohort is hired with absolutely no screening procedure of any kind. To our knowledge, only one study has reported actual change in $SD_y$ over time in a sample that was not prescreened using the selection instrument of interest. Deadrick and Madigan (1990) reported increases of 7%, 18%, and 17% in $SD_y$ estimates over a 24-week period among three samples of sewing machine operators. These differences translate into 7%, 18%, and 17% changes in $U_{selection}$ (percentage changes in $U_{total}$ will also depend on the base-line level of performance, $N_{employed}[\mu_y - C_{labor}]$). Interestingly, Deadrick and Madigan (1990) found average hourly production rose from approximately $2.00 to $4.50 per hour over a 24-week period, consistent with our example in Figure 1.
Though changes in $SD_y$ are not typically studied, the pattern of decreasing correlations between performance measures as time lags between measures increase (commonly called the simplex pattern) has been repeatedly observed over the last 35 years (Ackerman, 1987; Henry & Hulin, 1987). One straightforward interpretation of the simplex pattern is that variance as reflected in subjects' rank order in early job-performance measures tends not to be related to variance in later job-performance measures. While the simplex pattern of correlations suggests that individuals' relative performance levels change over time, it may be that total variation around mean performance stays the same. Hence, $SD_y$ at time $T_1$ may be the same as $SD_y$ at time $T_2$. However, this seems unlikely, especially in jobs where new hires have no prior experience and must learn on the job. New hires' average performance level ($\bar{Y}_{selectee}$) would be expected to be low initially, as would their $SD_y$ (i.e., a tight distribution of performance measures at the low end of the scale). It would also be expected that, over time, average performance level would increase. $SD_y$ might also increase as individual differences emerge. These individual differences may be in $g$, or in levels of motivation and/or opportunity. Alternatively, in jobs that are machine-paced, $SD_y$ might be initially large, then shrink over time as members of the cohort group reach some machine-dictated asymptotic performance level. Regardless of whether the focus is on new hires with no prior experience or trained professionals expected to step in and perform immediately, it seems unlikely that variation in contributions to the firm will remain constant over the employment tenure of a cohort of newly selected employees, though the exact nature of such variations remains to be understood.

**Summary and Example**

Importantly, selection utility *and* total utility derived from the selection tests as calculated when $r_{xy}$ and $SD_y$ vary over time will be substantially different from traditional applications of the BCG model. The impact of the two utility parameters $r_{xy}$ and $SD_y$ on selection utility and total utility can only be derived if longitudinal changes in $r_{xy}$ and $SD_y$ are known. If these changes were known, they could be used to evaluate the "risk" associated with each selection battery/job combination—those combinations with greater temporal variation in $r_{xy}$ and $SD_y$ are a "riskier" investment for the firm (financial theory dictates that riskier investments be paired with higher discount rates as described in Boudreau's, 1983a, and Cronshaw & Alexander's, 1985, 1991, capital budgeting adjustments to BCG models).
Estimates of selection and total utility become further complicated
when batteries of tests are used, where all predictors are correlated
with one another and exhibit different rates of change in r_xy
as the predictor-criterion time lag increases (sample derivations are available from
the first author). As an example, suppose X_1 is the U.S. Office of Personnel
Managements’ General Aptitude Test Battery (GATB) that predicts
initial on-the-job performance (Y_1) with a typical validity coefficient of .40
(i.e., r_{1,3} = .40). Also assume that X_1 predicts later on-the-job performance
(Y_4) with validity .30 (r_{1,4} = .30). Now, suppose that a psychomotor
test (X_3) is correlated with initial performance at r_{2,3} = .20. How-
ever, Ackerman’s findings suggest that this validity may increase substi-
tually over time for “automatic” jobs. So, for example, we let r_{2,4} = .60.
Finally, we let the correlation between the two predictors be .30 (r_{1,2} =
.30). Assuming SD_3 = SD_4 and all other aspects of the utility model are
fixed (e.g., selection ratio, costs of selection, etc.), the utility of GATB
and psychomotor tests on initial performance is driven by the product
r_{xy} \cdot SD_y. The value of r_{xy} \cdot SD_3 is:

\[
\frac{(r_{1,3} + r_{2,3})SD_3}{\sqrt{2 + 2r_{1,2}}} = \frac{(0.4 + 0.2)SD_3}{\sqrt{2.6}} = 0.37SD_3,
\]

while the product generated for later performance (Y_4) is:

\[
\frac{(r_{1,4} + r_{2,4})SD_4}{\sqrt{2 + 2r_{1,2}}} = \frac{(0.3 + 0.6)SD_4}{\sqrt{2.6}} = 0.56SD_4,
\]

(Derivations of these formulae are available from the first author). Be-
cause SD_3 = SD_4, the utility obtained (before considering costs or de-
preciation) from later on-the-job performance is (0.56 ÷ 0.37)100 = 150%
greater than the utility obtained from early on-the-job performance.
Clearly, differences in criterion-related validities over time within a
multiple-test selection battery combined with changes in SD_y can mean-
ingfully impact forecasted selection utility.

Discussion

Throughout this paper we have adopted the perspective of someone
who is required to gather relevant information before embarking
on some course of action (i.e., strategic decision makers and human
resource managers). A criterion measure is needed to help the stra-
getic decision maker determine whether alternate selection systems
contribute more or less to the firm’s strategic objectives. We argued that the
BCG model of selection utility as it is commonly used is deficient for this
purpose. First, a metric of utility relative to random selection, pegged to
a single point in time at which a lone performance measure was taken, does not tell strategic managers what they need to know. Specifically, strategic decision makers need to know whether the expected total utility forecast by a given “alignment” of resources, in this case the alignment of human resources generated by a selection instrument(s), will meet the firm’s strategic needs. We have shown that a strategic perspective dictates consideration of sound estimates of $U_{total}$.

Second, recent findings regarding the stability of $r_{xy}$ (Hulin et al., 1990) and $SD_y$ (Deadrick & Madigan, 1990) strongly indicate that changes in $r_{xy}$ and $SD_y$ are likely to occur over time. It is clear how temporal changes in $r_{xy}$ and $SD_y$ impact the validity of $U_{selection}$ and $U_{total}$ estimates. Strategic decision makers require realistic, valid forecasts of total expected utility that account for known changes in relevant parameters. While previous investigators have permitted consideration of changes in tax rates, discount rate, and testing costs, the impact of true temporal changes in two fundamental parameters ($r_{xy}$ and $SD_y$) has not been explored. Variations in $r_{xy}$ and $SD_y$ will also be important to the human resource decision makers who use estimates of $\Delta U_{selection}$ to decide among alternate expenditures from limited personnel budgets. Interestingly, by augmenting the decision context to include strategic issues, we arrive at a somewhat different emphasis than Boudreau (1991). He argued that $SD_y$ estimation research “can advance measurement theory” and that the “value of $SD_y$ research rests not on its ability to better describe, predict, explain, or enhance decisions” (emphasis added, p. 660). Rather, we show that valid point estimates of $SD_y$, $r_{xy}$, and their changes over time become critical when strategic issues are considered. Any representation of selection utility that does not accommodate changes in firms’ strategic needs and changes in the capacity of a selection system to meet those needs (i.e., changes in $r_{xy}$ and $SD_y$ that impact $U_{total}$ and $U_{selection}$) will be deficient.

Many directions for future research are implied by our analysis. Examinations of the dynamic nature of $r_{xy}$ initiated by Ackerman (1987); Alexander, Barrett, and Doverspike (1991); and Deadrick and Madigan (1990) need to be extended. Unfortunately, similar efforts exploring the nature of changes in $SD_y$ across time seem to be critical, yet almost nonexistent. Further, estimates of $SD_y$ derived from nonmarket sources (e.g., subject matter expert judgments) are prone to distortion (Bobko, Karren, & Kerkar, 1987). Shetzer and Bobko (1987) and Bobko, Shetzer, and Russell (1991) demonstrated that the stake-holder group used to generate $SD_y$ estimates (i.e., customers vs. supervisors) will greatly impact both the estimates and the types of error in those estimates. It is routinely assumed by strategic decision makers that stake-holders from
the investor community, management, incumbents, customers, and others attach different value to job performance and hence yield different estimates of $SD_y$. Currently, the most consistent $SD_y$ estimates seem to be derived from labor market wage and salary surveys. Unfortunately, this stability may be deceiving. Specifically, estimates of $SD_y$ derived from labor market wage and salary surveys can be prone to nonrandom contamination (see England & McLaughlin, 1979, and England, 1982, for a description of how barriers to entry distort market forces, specifically labor supply, behind “equilibrium” wages). Exploration of alternate, nondollar means of calibrating $SD_y$ have taken place in public sector and military settings (Eaton, Wing, & Lau, 1985; Eaton, Wing, & Mitchell, 1985). It remains to be seen whether these methods are less prone to systematic and random measurement error.

Interestingly, we are aware of no research examining the various influences on $\mu_y$ other than Boudreau and Rynes’ (1985) examination of differences in initial values of $\mu_y$ achieved through alternate recruiting procedures for sampling applicants from the labor pool. As noted above, this estimate has a major impact on the critical difference between notions of selection utility and total utility, yet no literature examines the relative merits of (a) implementing a selection system for an existing job and its applicant pool versus (b) redesigning the job to obtain higher expected economic returns from the combination of a different selection system and different applicant pool. On a broader scale, estimates of $\mu_y$ for regional or national labor markets should factor into decisions concerning where facilities should be located, under the assumption that in a global economy all aspects of production (capital, technology, raw materials, etc.) are mobile except labor (in the short term). Finally, as is implicit in Figure 1 and documented by Deadrick and Madigan (1990), $\mu_y$ will change for a cohort group over time through maturation and learning acquired on-the-job. Knowledge of the initial values of $\mu_y$, $r_{xy}$, and $SD_y$ that characterize each labor market and how they change over time will be critical in determining the expected economic return from each location.

In sum, decisions based on the financial impact of selection systems, indeed, all human resource management systems, take place in a richer decision context than heretofore described. We have tried to refocus attention on the underlying economic criterion construct domain by partitioning the utility construct into notions of selection utility and total utility. The impact of total human resource utility on accomplishment of strategic needs was delineated. We further questioned the viability of implicitly assuming that key parameters ($r_{xy}$ and $SD_y$) remain constant over time. Hence, for selection research to have its proper impact on managers’ decisions, we must (a) expand the focus of our efforts to
include estimates of absolute economic return that can be used by strategic managers, and (b) reassess our assumptions concerning the temporal stability of parameter estimates.

REFERENCES


Alexander RA, Barrett GV, Doverspike D. (1991, April). Appropriate (and inappropriate) data and analyses relevant to the dynamic criterion question. In Hanges PJ (Chair), Dynamic criteria: Are we shooting at a moving target? Symposium conducted at the Sixth Annual Conference of the Society for Industrial and Organizational Psychology, St. Louis, MO.


Ashe RL Jr. (1990, April). The legal defensibility of assessment centers and in-basket exercises. Presented at the Fifth Annual Conference of the Society for Industrial and Organizational Psychology, Miami Beach, FL.


