Utility Analysis of Assessment Centers using objective profit data

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Abstract

In this study we analyze the utility of an assessment center for selecting sales representatives of an German insurance company. Unlike most other utility studies an objective indicator of job performance yearly sales figures is used. The sales figures allow a simple and valid computation of the standard deviation of performance, the Achilles' heel of utility analysis. Our results which are mainly based upon the Brodgen-Cronbach-Gleser model show that the assessment center leads to a very high utility measured in German marks. Thus, this study confirms the results of many previous studies using mostly subjective indicators of job performance: Well designed human resource programs produce considerable benefits.

Introduction

Utility analysis has become an established quantitative method of evaluating human resource programs. It can make a valuable contributions to judgments and decisions about investment in human resource management. Subsequently to the classical contributions to utility analysis (Brogden, 1949; Brogden & Taylor, 1950; Cronbach & Gleser, 1965), two main directions in research can be identified.

The first was stimulated by the work of Schmidt, Hunter, McKenzie and Muldrow (1979) and concentrates on the problems which occur when estimating model parameters. In particular, the estimation of the parameter SD_y, the standard deviation of job performance in dollars, was adjudged by Cronbach and Gleser(1965) to present difficulties. Schmidt et al (1979) developed the first easy-to-use method for estimating SD_y. Even today this area of research has not lost its relevance. A series of alternative methods for estimating SD_y and empirical research in this field have been published since 1979 (e.g. Bobko, Karren & Parkington,1983; Cascio & Ramos,1986; Judiesch, Schmidt & Hunter, 1993; Raju, Burke & Normand, 1990).

The second main emphasis in research has been the attempt to further develop utility models. This has particularly concerned concepts of economy (Boudreau, 1983a; Cronshaw & Alexander, 1985) and a realistic representation of personnel recruitment and turnover (Boudreau, 1983b; Murphy, 1986). At first the development of utility models has taken place almost exclusively in the context of personnel selection. Later efforts have also been made to adapt them for other human resource programs (e.g. Boudreau & Berger, 1985; Murphy & Cleveland, 1991).

The classical model of utility analysis, called the BCG-utility model after its originators Brogden,Cronbach and Gleser (cf. Boudreau,1991) is tailored for personnel selection and can be written:

$$\Delta U = N\ T\ SD_y\ r_{xy}\ \lambda(Q)/Q - C \quad (1)$$

The value of the selection program is measured in dollars and is represented by the symbol ΔU. N is the number of accepted applicants who remain with the organization for a time period T. SD_y represents the standard deviation of job performance (in Dollars) in the applicant population and r_{xy} is the validity of the selection procedure. The selection rate is Q and $\lambda(Q)$ is the ordinate of the normal distribution at the point where the area under the function is Q%. The term $\lambda(Q)/Q$ is an estimate of the average standardized predictor $\bar{z}_x^*$ assuming that the candidates have been selected in a top-down strategy and assuming that the predictor is normally distributed. Thus

$$\bar{z}_x^* = \lambda(Q)/Q \quad (2)$$

The part of the utility function to the left of the of the subtraction sign estimates the return produced by the intervention. From this sum the costs of the measures (C) are subtracted.

Cronshaw and Alexander (1985) suggest that human resource management programs should be considered as a type of investment decision. With the support of capital budgeting theory, they separate the fixed costs of an intervention program from its variable costs.

The impact of personnel selection programs is usually of long duration. This means that suitable staff are selected by the organization, employed and remain with it. Thus the impact's duration is determined by the length of time the employee remains with the organization and ends when he or she takes up other employment elsewhere outside the company. In order to represent this process within the utility model, Boudreau (1983b) suggested dividing the duration of the intervention program into a number of intervals. These are time periods in which productivity increase occurs (k). This enables the inclusion of the effect of discounting in the model (Boudreau, 1983a). Furthermore, the model parameters can have different values in each of the time periods. This is an essential feature in cases where, for example, a predictor has a variable predictive validity according to whether short-term or long-term job performance is being considered. A further adaptation in line with economic concepts is achieved by taking tax into account (Boudreau,1983a).

In utility analysis, the concept of job performance (y) is the most critical component. In the relevant literature a variety of definitions have been given for this concept, for example "(...) the yearly value to your agency (...) consider what the cost would be of having an outside firm provide these products or services." (Schmidt et al., 1979, p.621), "(..) dollar value as sold." (Hunter, Schmidt & Coggin,1988, p.526) and "the total amount (in dollars and cents) contributed toward the coverage of fixed costs, and then profit (...)" (Greer & Cascio, 1987, p.590). This lack of conceptual clarity has also had an effect on the operationalization of the variables y and SD_y. Through the inclusion of the parameter V (the proportion of the variable costs of performance; Bordreau,1983a) the concept y(1-V) can be used to determine the contribution margin (Greer & Cascio, 1987). Here y is understood as the sales value of the product or service of an employee. The standard deviation of the contribution margin of job performance SD_{cmy} can be calculated as follows:

$$SD_{cmy} = SD_y\,(1-V) \qquad (3)$$

This dollar-scaled measure is, in our opinion, the figure to be estimated in utility analysis.

When we include the suggestions of Boudreau (1983a, 1983b) and Cronshaw and Alexander (1985) we can specify our utility model in the following way:

$$\Delta U = \sum_{k=1}^{F} [N_k\, r_{xyk}\, \bar{z}^*_{xk}\, SD_{yk}\, (1-V_k)\, (1/(1+i_k)^k)\, (1-TAX_k)]$$

$$- \sum_{k=1}^{F} [(N_{ak}/Q_k)\, C_{1k}\, (1/(1+i_k)^{k-1})\, (1-TAX_k)]$$

$$- \sum_{k=1}^{F} [C_{0k}\, (1/(1+i_k)^{k-1})\, (1-TAX_k)] \quad (4)$$

with (2) $\bar{z}^*_{xk} = \lambda(Q_k)/Q_k$

and $N_k = \sum_{t=1}^{k} (N_{at} - N_{st})$ (5)

This utility model illustrates the incremental value of a personnel selection program in relation to an alternative program. In the first line of (4) we estimate the returns from the personnel program. In the second line the variable costs, and in the third the fixed costs, of the program are given. The parameters can be defined:

ΔU	Incremental utility of the personnel selection program in the time period 1..k. This is the incremental utility produced when the utility of a personnel selection program is compared to an alternative program.
k	Time period. This could be a duration of up to a complete year, and indicates the particular k-th year after the commencement of the program.
F	Impact duration of the program. The duration lasts as long as $N_k > 0$, that means that there are employees with the organization who are treated by the program.
N_k	The number of employees in the organization in time period k who have been selected through the program. N_k is calculated according to the equation (5) above.
N_{at}	The number of employees selected in time period t.

N_{st}	The number of employees who left the organization in time period t.
r_{xyk}	Incremental validity of the selection instrument in time period k. This is the product-moment correlation of the predictor x and the sales value of the job performance y (see below). r_{xy} relates to applicant's population and indicates the difference of the validity when compared to an alternative selection program.
$\bar{z}^{*}_{xk}$	Average standardized predictor value of the selected applicants. Assuming a normal distribution of x and a top-down selection strategy this can be calculated using (3) above.
Q_k	Selection rate in time period k.
SD_{yk}	Standard variation of the sales value of the job performance in the applicant population in the time period k.
V_k	The proportion of the variable costs of the job performance for the organization in the time period k. The factor (1-V) gives the ratio between SD_{cmy} and SD_y.
i_k	Interest rate in the time period k.
TAX_k	Tax rate in time period k.
C_{1k}	Incremental variable costs of the personnel selection program per applicant in the time period k.
C_{0k}	Incremental fixed costs of the program including those incurred for the development, implementation and evaluation of the program in the time period k.

This study deals with the fundamental question whether a relatively cost-intensive selection program using assessment centers (AC) yields a positive utility in comparison to fictitious simpler procedures (such as straightforward "job interviews".) In order to evaluate these selection programs using utility analysis we have integrated a number of the proposals made to adapt the utility model to economic values (equation 4).

The human resource program in question is used by an insurance company to select their sales representatives. One of the special features of this study is that the sales figures of insurance salesmen are relatively easy to determine. Thus, the estimation of the parameters SD_y and r_{xy} is far simpler than is the case with other professions.

The empirical study

The Assessment Center

The selection program under study was designed to assist a German insurance company with very broad interests across the whole range of the insurance field to select sales representatives (SR). The core of the program is an AC developed and led under the direction of a firm of consultants.

The ACs last one day. Six AC exercises are held (self-presentation, leaderless group discussion, oral presentation; exploratory interview; an exercise testing ability to handle objections; planning task). The fourth day is reserved for an assessor conference and for a feedback session with the AC participants. On average 5.3 applicants participate in each AC (s=1.57). The assessor/ applicant ratio is approximately 1:2 or better.

The performance of the participants in each exercise is recorded by the assessors, each using a selection from ten performance dimensions which emerged as the result of job analysis (persistence; resistance to stress; initiative; sociability; achievement orientation; learning and adaptation; personal appearance; independence; self-confidence; negotiating skills). The ratings are scored on a four-level scale (1= seldom/ hardly observable; 2= occasionally/ sporadically observable; 3= regularly observable; 4= prominently/ strongly observable). Using these scores assessors decide at their conference whether to accept or reject candidates. These decisions are taken on the basis of group discussion using implicit decision rules. The selection rate of these ACs is about 50%. Due to data protection regulations no data is available about unsuccessful candidates.

Sales figures as an objective indicator of job performance

The sales value of job performance (y) is taken to be the yearly sales figures of the SR. An internal coding system allows a calculation to be made of the sales and commission of each individual SR, taking into account the type and range of policies sold and also those canceled. The sales figure for each SR during the first year of his /her employment with the company is taken as the sales figure to be used. The performance of SRs can be compared because of a years basis seasonal influences are effectively be canceled out and cannot unfairly distort any individual SR's figures. So this figure gives an objective and criterion of job performance with considerable construct validity. From the individual sales performances it becomes possible to calculate the standard deviation of the job performance SD_y across the SR.

Prospective evaluation of a personnel selection programs using empirical data

This study aims to assist in the summative and formative evaluation of the described personnel selection program. On the basis of this study proposals are made which are designed to integrate AC predictors into a general decision-support tool. In this way only predictors are proposed which are valid to predict job performance criteria. Furthermore, algebraic rules of information integrating are to be developed to provide a better judgment concerning the acceptance or rejection of job applicants.

Up to now a clinical decision about the selection or rejection of candidates was made on the basis of data from Acs. Because no explicit decision-making rules existed and the AC result and the performance of rejected applicants could not be measured, any estimate of the predictive validity of the original selection instrument has been very difficult.

For this reason we conduct a utility analysis of a future modified selection program. However, in order to estimate the utility model parameters we have used empirical data arising from an existing selection program which has not included the proposed modifications. Therefore, this utility analysis does not give a retrospective evaluation of the personnel program but is really a decision support system which helps in evaluating a potential future human resource program.

Estimated values of the model's parameters

Average standardized predictor value of accepted applicants ($\bar{z}^*_{xk}$)

As a result of data protection regulations no AC results are available for unsuccessful candidates and therefore ($\bar{z}^*_{xk}$) has to be estimated for this group using equation (2). The selection rate of ACs is about 50% on the average. There are no reasons to suppose that the assumptions necessary for the estimation are seriously undermined.

(2) $$\bar{z}^*_{xk} = \lambda(Q)/Q = 0.399/\ 0.5 = 0.8$$

Number of SR in the time periods (N_k) *and impact duration of the program (F)*

The data resulting from this long-term study were collected between 1990 and 1993. We set the length of the time period k at one year in line with the usual convention. The number of SRs selected and leaving the company during the first three time periods could thus be empirically measured. In the following we assume that the same selection procedure was used without any significant changes for a period of five years. The number of SRs employed and leaving the company after the three year study period has been estimated by means of extrapolation. Table 1 shows the (partly estimated) number of SRs in each time period. Moreover it can be seen from table 1 that the selection program remains effective for a period of F=6 years. Due to the high turnover of staff in this field it is comparatively low, which at the same time points to a serious reduction in the usefulness of the program.

Table 1: The number of the SR treated by the personnel selection program (N_k) in the time periods k. The values which are marked with "*" are estimated.

time period (k)	accepted SRs (N_{ak})	left SRs (N_{sk})	number of treated Srs in k (N_k)
1	89	0	89
2	126	0	215
3	100	98	217
4	105*	132	190*
5	105*	132*	163*
6	0*	132*	31*
7	0*	132*	0*

Predictive validity of the predictor (r_{xyk})

We assume that candidate selection from time period k=1 onwards is based on the optimal statistical judgment. We also assume that the selection judgments used before the optimization of the AC was as valid as a normal simple selection procedure (such as job interviews). Because this is a very weak assumption (multi-modal AC with several assessors and a duration of a number of days against the conventional interview) we consider the empirical, and in terms of range restriction uncorrected validity coefficients of the optimal information integration rule, to be a conservative estimate of the incremental validity of the ACs over against the simple selection procedures such as job interviews. The incremental predictive validity of ACs for two predictors has been calculated at 0.31 (uncorrected multiple correlation, of the three trait-oriented predictors "achievement orientation", "self-confidence", and "persistence") and 0.40 (uncorrected correlation of the planning-task) respectively (Holling & Reiners, 1994). We assume an incremental validity of r_{xyk}=0.3 for the optimized AC selection program over against the simple program for all time periods k.

Tax rate (TAX_k) and rate of interest (i_k)

In the current utility analysis we assume that interest is paid on capital at an average rate of interest of i_k=0.12 or 12%. The tax rate of costs and profits is set at a rate of TAX_k=0.4 in all time periods k.

Standard deviation of the contribution margin of job performance ($SD_{cmyk} = SD_{yk}\ (1-V_k)$)

In order to ascertain the standard deviation of the contribution margin SD_{cmy} in the time periods two problems must be overcome. On the one hand, the standard deviation of the revenue (turnover) generated by the SRs for each time period must be determined. On the other hand the calculation of SD_{cmy} out of SD_y requires an estimate of the proportion of the variable costs of this turnover (V). Both parameters are difficult to estimate.

As stated above the level of revenue generated by each SR in his first year with the company is known. These sales figures are the basis for the calculation of the SR's commission. However, the duration of each of the policies sold is not known. Because the length of the policy is dependent on the type of insurance being sold (e.g. life assurance, motor insurance etc.) and no data is available about the proportion of the policies belonging to each of these insurance categories sold by each SR, we have estimated that all policies have an average duration of four years for all SRs. According to expert opinion this is a conservative estimate. Moreover, not taking into account the average difference in duration between the policies (which could be due to differences in the customer service provided by the SRs) leads to an even greater underestimate of the standard deviation of the job performance SD_y.

The average revenue generated by the SRs in the first year of employment was DM 40859.[1] Given an average policy length of four years and an interest rate on later revenue of i=12% this results in y = DM 138,995. The standard deviation of the sales value of job performance provided in a single working year is SD_y = DM 89,673 (which means a standard deviation of sales in the first year of DM 26,360).

The second problem concerning the determination of SD_{cmy} lies in the estimation of the proportion of the revenue’s variable costs (V). The contribution margin of the job performance y can be calculated in that one subtracts the value of the variable costs from the sales value of the job performance.

The ratio of variable costs to revenue generated is very high in this sector. They consist of, for example the commission payable to Srs as well as to managers, and the variable administration costs. The variable administration costs result from the variety of policies which are sold, but especially the actual payments that may have to be made as a result of claims, which exist in a relationship of probability to the number and cost of the policies sold. This relationship is the basis for calculating the level of premiums.

The contribution margin of job performance is therefore only a small part of the sales value of the job performance. (1-V) can also be interpreted as a proportion of the ratio of the fixed costs to revenue. These fixed costs consist of fixed salaries, costs of buildings, general administrative costs, personnel programs etc. In addition to these fixed costs the profit of the company is also included in (1-V).

A direct calculation of V using the internal cost calculations is very involved and very inaccurate. Barthel (1989) used in his (albeit not explicit) estimate of V the fact that the value (1-V) includes the profitability. We estimate (1-V) = 0.2 assuming a profitability of 5% and 15% of revenue for the coverage of the fixed costs. The remaining 80% of revenue is required to meet variable costs. The parameter SD_{cmyk} is thus calculated using

(3) $$SD_{cmyk} = SD_{yk}\,(1-V_k) = \text{DM } 89673\,(1-0.8) = \text{DM } 17935$$

Simplifying, we assume that this value is constant for all time periods k.

The estimation values of the model parameters which determine the returns of the personnel selection program are summarized in table 2.

[1]All money values are given in German marks. Conversion into US dollars can be roughly calculated with the factor 0.7)

Table 2: Estimation values of the model parameters which determine the returns of the personnel selection program. The values are assumed to be constant over all time periods k.

parameter	symbol	estimated value	unit
average standardized predictor value of the selected applicants	$\bar{z}_x^*$	0.8	
incremental validity of the selection instrument	r_{xy}	0.2	
standard deviation of the sales value of the job performance	SD_y	89673	DM
the proportion of the variable costs of the job performance	V	0.8	
standard variation of the contribution margin of the job performance	SD_{cmy}	17935	DM
interest rate	i	0.12	
tax rate	TAX	0.4	

The cost of the personnel selection program (C_{0k} and C_{1k})

In the case of both costs and returns parameters only the increments over that of a simple selection procedure is considered. Here the advantage of handling the issue in this way over the calculation of the absolute cost of both systems becomes very clear. It is very difficult to estimate for example, the proportion of over head costs which are generated by the activities of the personnel department in the planning and conception of a selection program. In our scheme this problem can simply be ignored. Instead it is assumed that over head costs are the same for both the program actually analyzed and any alternative selection program. Only the incremental costs of the program being researched are considered. In the case of the current AC program these are, for example, the costs of using the potential SR's immediate superior as an observer and decision-maker in an AC. This same staff member would, of course, also participate in any alternative interview system. We consider then in our model only the additional costs of the program in question over against alternative programs, such as observer training or the additional hotel costs.

The fixed incremental costs of the AC programs are mainly incurred at the beginning of the program. These include incremental development and implementation costs claimed by the consultancy firm. We estimate these to be about DM 80000. Furthermore, the cost of training the observers and moderators is DM 86000. Thus, in the first time period fixed incremental costs are C_{01} = DM 166,000. We further assume that in the third time period incremental evaluation costs for fine-tuning the program of C_{03} = DM 10,000 are incurred.

In addition to these fixed costs it is also necessary to calculate the variable costs (e.g. per selected applicant) of the selection program. We assume that no incremental personnel costs are generated by using AC observers since they would be involved to conduct job interview in alternative programs.

However, incremental personnel costs are incurred for daily costs of food, accommodation and material for candidates, assessors and moderators. We assume a lump sum of DM 300 per candidate.

Utility analysis results

The estimated value of the parameters will be used in our utility model (equation 4). Table 3 shows the results of the utility analysis. The selection program under scrutiny reveals, under the conditions given above, a higher positive utility than a simpler program. The development and implementation costs are covered within a year and returns is greater than variable costs in every time period.

Table 3: Utility analysis of the personal selection Program. In the last line we indicate the total amount of incremental utility of the program compared to an alternative simple selection program. All figures are without units or in German marks.

		returns parameters						returns	cost parameters				costs	utility
k	N_k	r_{xyk}	z_x^*	SD_{yk}	$(1-V_k)$	$(1-Tax_k)$	$1/(1+i_k)^k$	total	C_{0k}	$(N_{ak}/Q_k)C_{1k}$	$(1-Tax_k)$	$1/(1+i_k)^{k-1}$	total	ΔU_k
				DM			i=0.12	DM	DM	DM		i=0.12	DM	DM
1	89	0.3	0.8	89673	0.2	0.6	0.89	205223	166000	186700	0.6	1.00	211620	-6397
2	215	0.3	0.8	89673	0.2	0.6	0.80	442646	0	263800	0.6	0.89	141321	301325
3	217	0.3	0.8	89673	0.2	0.6	0.71	398896	10000	209200	0.6	0.80	104847	294049
4	190	0.3	0.8	89673	0.2	0.6	0.64	311843	0	219900	0.6	0.71	93912	217930
5	163	0.3	0.8	89673	0.2	0.6	0.57	238865	0	219900	0.6	0.64	83850	155014
6	31	0.3	0.8	89673	0.2	0.6	0.51	40561	0	0	0.6	0.57	0	40561
7	0	0.3	0.8	89673	0.2	0.6	0.45	0	0	0	0.6	0.51	0	0
total								1638034					635551	1002483

Thus this utility analysis endorses the conclusions of those other studies which have impressively confirmed the economic utility of psychological human resource programs (e.g. Boudreau, 1991). The special feature of our study lies in the fact that we have taken actual sales data to estimate the standard deviation of the job performance. This data is highly reliable. In general it can be said that that our estimated parameter values are comparable to those of other studies using utility analysis but achieved with different methods.

As a result of the adaptation of the utility model in our study to fit in with economic standards, the results of utility analysis should be more easily communicable to those concerned with decisions regarding human resource programs and be more easily be critically examined by them.

A number of methods have been established to examine the stability of utility analyses. We have used two of these: the calculation of break-even points and sensitivity analysis.

Break-even points

The break-even point is the value of a parameter which if crossed would change the positive utility of a human resource program into a negative utility. In order to determine this point each parameter is varied until a utility of zero is reached while holding all other parameters constant. In this way information as to the extent of the risk involved in decisions can be won. For example, if those parameters which are difficult to estimate, of their nature involve risk, or are over time unstable, lie at a level well-beyond their break-even point, it can be safely assumed that the program will have a positive utility value even if estimates are inaccurate or unfavorable conditions should unexpectedly occur. In table 4 the break-even points of the parameters are given. Due to simplicity the costs C_{03} to C_{01} have been added together. The break-even points of the parameters are considerably lower than the estimates. Thus, our results seem to be very sound.

Table 4: The break-even-points of the parameter values.

Parameter	break-even-point	remark
r_{xy}	0.048	
$\bar{z}_x^*$	0.19	This value corresponds to a selection rate of Q ≈ 10%.
V	0.95	
SD_y	21.600 DM	This corresponds to SD_{cmy} = 6940 DM.
C_O	930.000 DM	
C_1	1.930 DM	This corresponds to variable incremental costs of 16027 DM per AC.

Sensitivity analyses

Our utility model uses a non-linear combination of the parameters. If the value of one of the parameters is increased by a particular proportion there follows a proportionate change in the utility value. The relationship of the change to the utility value to the change in the parameter value is called the sensitivity of the parameters (e.g. Cascio & Silbey, 1979). This is dependent on the nature of the mathematical operation with which the parameter is linked to the utility model and its estimated value. Table 5 shows the sensitivity of the parameters in our model.

If the parameters V, SD_y, r_{xy} and $\bar{z}_x^*$ change there is an over-proportional change in the utility. It is interesting to note that the sensitivity of the parameters approximately reflects the frequency with which the parameters are discussed in the literature. In particular, the standard deviation of the job performance and its parameters SD_y and V have a high value. It is just these parameters which are most often discussed in the literature about utility analysis. However, the validity r_{xy} and the parameter associated with rate of selection $\bar{z}_x^*$ have also been the subject of discussion for some time (Taylor & Russell, 1939).

The suggestion that the parameters TAX and i should be incorporated in the utility model came, on the other hand, relatively late (Boudreau, 1983a). Furthermore not all authors include these two parameters in their models. This decision may be justified considering their sensitivity values. The cost parameter of the model also reaches an outstandingly low value. In particular, the fixed costs of human resource programs, which include, for example, costs incurred during the development, implementation and evaluation of the programs, have very little influence on utility of the program. Decision-makers should consider this result carefully when planning the development of a new human resource program. It is a false economy to opt for the least expensive to develop and implement program when this is at the expense of other parameters. This result is consistent with the conclusion of the study made by Cascio and Silbey (1979), who used a similar approach to the utility analysis of an Assessment Center-based selection program.

Tabelle 5: Sensitivity of the parameters of the utility model.

Parameter	Sensitivity (proportional change of the utility value to the change in the parameter value)
V	- 5,27
r_{xy}	2,32
$\bar{z}_x^*$	2,32
SD_y	2,32
TAX	- 0,18
C_1	- 0,18
I	- 0,31
C_0	- 0,13

Discussion

This study shows that despite of many difficulties in estimating the parameters the utility of human resource programs can be determined. For the particular program under consideration a high utility was obtained. If investment in this type of program is compared to investments is clear that our program gives a very favorable return on investment. We have chosen very conservative estimates for several parameters. Therefore, we can assume that the utility we have given represents a lower limit of the actual utility of the investment. The difference between the break-even points and the estimated parameter values indicates that the program gives at the very least a positive utility.

Because of the considerable difficulties in estimating the parameters the absolute utility value of the program should not be interpreted. Utility analysis cannot achieve the goal of absolute utility estimation. Rather more it provides a useful tool for helping to decide between alternative programs (cf. Murphy & Cleveland,1991). Since some parameter estimates are common to both program alternatives the risk of a mistaken decision is reduced. In our example it was possible to see that a personnel selection program, incorporating an AC, was to be preferred to simpler program (for example using interviews) in this concrete situation. Furthermore, the program is shown to be preferable to a random selection (i.e. minimum cost chance selection).

The quality of each particular cost-benefit analysis stands and falls, assuming it is a realistic model, on the quality of its parameter estimates. How realistic are our parameter estimates? In particular, how realistic is our estimate of the "Achilles-heel" parameter SD_y (Cronbach & Gleser, 1965)?

One point of reference in this matter is a comparison with similar studies of other professions. Barthel (1989) has examined the utility of measures designed to identify the suitability of insurance salesmen for their profession. He used a procedure very similar to ours in his study to determine the standard deviation of performance, i.e. the sales of the salesmen. He estimated the standard deviation of turnover to be DM 57,000 per annum, a value far higher than our, admittedly very conservative, first year estimate of SD_y = DM 26,360. We take this to mean that our value is in no way over-estimated.

Hunter and Schmidt (1982) suggest that the standard deviation of job performance can be determined heuristically using proportional rules. Using a revision of empirical findings they reach the conclusion that the standard deviation of performance is usually between 40% and 70% of earnings. In our case-study the average annual earnings of SRs was about ca. 32,850 and the estimate of SD_{cmyk} about 55% of this figure. Thus our estimate lies within the boundaries mentioned by Hunter and Schmidt. Despite holding some reservations about the 40-70% rule, we see this as a further indicator for the validity of our own estimate.

Are the results of this study transferable to other professions? An answer to this difficult question can only be given through empirical studies. However, it cannot be overlooked when one compares the results of earlier utility analyses in the most diverse of professions (Boudreau, 1991) the main results are mainly very similar. This is particularly astonishing recalling the great variety of utility models used and the great range of ways in which SD_y and other parameters are estimated. Our particular model is transferable to other professions to only a very limited extent. However, the central result of this and other studies, that under particular conditions expensive human resource programs are financially worthwhile can be confirmed for them, too. Here again we should emphasize that our results are based on some very conservative estimates of parameter values. When determining the standard deviation of the job performance SD_y no correction for attenuation was made for range restriction. Secondly, it should be remembered that the utility of this cost intensive program was reduced by an unusually high turnover of staff. If the turnover of staff was comparable to other professions the AC would bring a manifold increase in returns.

One should not forget that BCG-utility models don't cover all components of utility of personnel intervention programs. For example, selection of employees with higher performance usually causes less expenses for education and training especially at the begin of the new work. Furthermore, such employees claim less attention and time of their superiors and colleagues. Since resources of persons with higher performance are often limited selection of the best ones forces other companies to employ persons with lower performance.

Beyond this direct benefit of personnel selection programs, which are not covered by the BCG-model (benefit II & III), human resource programs can produce side-benefits (benefit IV). These side-benefits have only an indirect relationship to the main aim of the programs and are also not included in the BCG-model. Personnel selection by means of ACs can also make a contribution to the development of management qualities in those acting as assessors (observational skills, communication skills, the ability to handle sensitive areas following customer queries etc. ...). The fair and open selection of new members of staff also has a positive effect on the company's culture and helps the company project a very confident and modern image to the public. Not least, a usual side-effect of the AC system is the fact that superiors take part in selecting their juniors and so share responsibility for their selection. In this way there is more likelihood of new staff being accepted within the firm, if not having their performance artificially enhanced through the self-fulfilling prophecy effect.

Taken together it is clear that not all utility relevant elements are included in the BCG-model. The actual value of human resource programs could be remarkably higher than the values estimated by the utility function. Nevertheless, considering only the ordinal information provided by comparable estimates of the utility of alternative programs BCG-utility models are still very valuable decision-making tools.

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