Universal Leadership Education And Development for Managers and Engineers (U LEAD ME)

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Four years of undergraduate engineering education is not a panacea of success for engineers. Evidence suggests that most engineers need to learn the art of management when they have become successful as engineers but poor as managers of people, and must move on as more successful managers of technology and people. [Drucker (1991)]

But, such characteristics must be *developed* by programming and intervention and by tapping into the hidden (latent) potential of engineers as they work on the job. These management development programs must be effective from four desirable aspects -- (i) reaction to the intervention, (ii) knowledge gained for immediate analysis and use, (iii) demonstrated change of behavior in making decisions, and finally (iv) the impact in the job, on subordinates, and the employing organization [Kirkpatrick (1979)].

The criteria employed in the evaluation of management development program must be measurable yet defensible [Guba & Lincoln (1982)]. This is a quantitative research demonstrating the fulfillment of the professional needs of engineers with regard to their management development. The instruments used for this research have been widely accepted for professional development for effectiveness and for highlighting the correlates of importance of managerial skills, competence of managerial skills, managerial background variables, learning style inventory, and leadership style inventory. Such correlates are important for projecting engineering executives' success.

The Importance of the Study

The importance of the research lies in determining the usefulness of a professional education program for practicing managers [Grotelueschen (1986)]. The managers need development programs due to continued obsolescence of their knowledge, skills and abilities. Managers' growth is needed if they are to stay competitive in a rapidly changing technological environment [Schon (1987)]. Personal and professional development due to executive education programs must be objectively measured to uncover to what degree or level the stated objectives of the program met the needs of such managers.

It is all the more important for the international managers and engineers on global assignments because their professional competence and effectiveness depends on the use of immediately updated knowledge and skill. The international managers face obsolescence more quickly and more rapidly as the international strategy for global competitiveness changes very swiftly. Executive Development Associates study has shown that the multinational companies believe that their most important prioritiy of the millenium is the human resource development.

The instruments have been designed to gather evidence regarding how well participants

were served by the program and to serve the following needs for the managers' development:

- Need for management development and strategy for effectiveness
- Need for corporate education for global competitiveness
- Need for executive development, promotion and succession
- Need for lifelong learning of managers
- Need for program evaluation and review for effectiveness
- Need for bridging theory and practice by bringing university and industry [Knowles (1980)]

Program Evaluation and Review Technique

Effective Management Development Program Evaluation and Review Technique (EMDPERT) was a structured process of data collection, analysis, discussion and defensible conclusion. Data from the population of ninety-eight engineering managers, technology managers, and corporate specialists from different organizations who attended the tenth annual Purdue University Engineering/Management program from April 24-April 30, 1995 was collected. Data collected from all questionnaires were analyzed comprehensively to develop correlates of managerial learning and behavioral effectiveness which determines the effectiveness of the program by a critical process method.

A pretest questionnaire was administered to these ninety-eight managers at their arrival. These questionnires were attached to the reading assignments of Monday, April 24. Participants were requested by the program administrators to complete the pretest and return it promptly at 8:30 a.m. before the beginning of the program. Seventy-eight participants returned the questionnaires. A similar posttest questionnaire was administered by the administrators at the conclusion of the program, but before the luncheon plenary and exit ceremony on Saturday, April 30. Sixty-two participants returned the posttest. All the Participants had been requested to nominate their friends with similar backgrounds who did not attend the program as a comparison group for the study. Fifty- four comparison group managers returned the same questionnaire. All the participants were requested at the exit to return the three-month posttest questionnaires from their job site. Thirty-two participants returned such questionnaires.

The sixteen member faculty were also requested to return the same questionnaire for comparing learning styles, collective profiles, and leadership behavior profiles. Eleven faculty returned the completed questionnaire. Originally interviews were planned with the participants and faculty members. However, it was suggested by the program administrators that, due to the busy schedule of participants and faculty members, actual interviews not be conducted because interviews will interfere with the participants' out of class assignments.

Assumptions

(1) Managers were either nominated by their corporations, or by their immediate bosses or by themselves who had a high opinion of the program -- they are being compared with those who weren't nominated. Evidently the cross section was not truly international.

(2) Companies represented by their managers were very diverse in terms of place, people, product and processes. These managers used diverse capabilities of machinery, manpower, material, and money. The program assumed that they had same or similar needs of management development.
(3) Responses from the program participants were analyzed for program effects assuming that they were well-reasoned perceptions of the experts.
(4) The managers of the population attending the program gave information that was up-to-date in their own belief and capacity in their area of expertise.
(5) It was assumed that program was geared to meet or excell the needs of managers attending the program and that the needs assessment process was accurate.
(6) It was assumed that all program faculty had knowledge of and applied the latest techniques of effective management development and developed course contents to satisfy the needs of program participants.
(7) It was assumed that because instruments had previous popularity in research they were defensible. The use of instruments were based on published opinions.

Limitations

(1) The population of the study was a small ninety-eight managers who participated in the program -- an obvious limitation of the scope of the program dictated by the relatively small population of captive audience in the program which was not truly international.
(2) Findings were limited to the responses obtained from participants attending the program. The study used limited numbers of (independent) background variables and limited numbers of (dependent) skills variables that had limited generalizability.
(3) Limitations were imposed on the research design. The design selected was such that conformance to it was possible within the constraints of time, cost, place and researcher ability.
(4) The quality of participants' responses could perhaps have been influenced by participants' motivation and commitment to self development.
(5) The size of the population was limited by the capacity of the university to handle the management training.
(7) Participants attending the program had previous knowledge of the reputation of the program, the school, and the program faculty.
(8) Some corporations represented had internal management development programs and some did not. Besides, some programs were linked to corporate strategy and some were not. This may have produced a bias.

Research Hypotheses of Management Development

Effective Management Development Program Evaluation and Review Technique (EMDPERT) was a structured process of data collection, analysis, discussion and defensible conclusion. This critical process method of evaluation was completed with the following research hypotheses:

I. Twelve Null Hypotheses of Managerial Importance

1. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill across Type of company's business (manufacturing vs. non-manufacturing).
2. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill across a broad range of titles (corporate, senior, middle, technical,other managers).
3. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill by size of company (1-100, 101-500, 501-1000, 1001-2000, Over 2000).
4. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill by the number and type of subordinates a manger has (Professional, Support).
5. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill by the race of the manager (American Native, Asian American, Black American, Caucasian American, Spanish Surnamed American, Other).
6. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill by the number of years in current position (0-3, 4-5, 6-7, 8-10, more than 10).
7. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill by the number of years of employment with the current employer (0-3, 4-5, 6-7, 8-10, more than 10).
8. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill by the number of years in the industry (0-3, 4-5, 6-7, 8-10, more than 10).
9. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill by the type of degree held by the manager (Baccalaureate, Masters, MBA, ED.D/PH.D, Other).
10. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill by gender (Female, Male).
11. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill by age of manager (25-32, 33-40, 41-48, 49-55, >55).
12. There will be no significant difference in the responses of participants regarding the ***importance*** of each leadership skill by training linked to corporate strategy (Linked, Not Linked).

II. Twelve Null Hypotheses of Managerial Competence

1. There will be no significant difference in the responses of participants regarding the ***competence*** of each leadership skill across Type of company's business (manufacturing vs. non-manufacturing).
2. There will be no significant difference in the responses of participants regarding the ***competence*** of each leadership skill across a brad range of titles (corporate, senior,

middle, technical, other managers).
3. There will be no significant difference in the responses of participants regarding the ***competence*** of each leadership skill by size of company (1-100, 101-500, 501-1000, 1001-2000, Over 2000).
4. There will be no significant difference in the responses of participants regarding the ***competence*** of each leadership skill by the number and type of subordinates a manger has (Professional, Support).
5. There will be no significant difference in the responses of participants regarding the ***competence*** of each leadership skill by the race of the manager (American Native, Asian American, Black American, Caucasian American, Spanish Surnamed American, Other).
6. There will be no significant difference in the responses of participants regarding the ***competence*** of each leadership skill by the number of years in current position (0-3, 4-5, 6-7, 8-10, more than 10).
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9. There will be no significant difference in the responses of participants regarding the ***competence*** of each leadership skill by the type of degree held by the manager (Baccalaureate, Masters, MBA, ED.D/PH.D, Other).
10. There will be no significant difference in the responses of participants regarding the ***competence*** of each leadership skill by gender (Female, Male).
11. There will be no significant difference in the responses of participants regarding the ***competence*** of each leadership skill by age of manager (25-32, 33-40, 41-48, 49-55,> 55).
12. There will be no significant difference in the responses of participants regarding the ***competence*** of each leadership skill by training linked to corporate strategy (Linked, Not Linked).

Analysis and Summary of Presentations

Using SPSS, the data were analyzed with respect to variables associated with participants' (1) key background information, (2) perceptions of managerial skills with regard to importance and competence [Knudson(1989)], (3) leadership adaptability behavior to managerial decision making situations [Hersey (1994)] and (4) preferred learning styles [Kolb (1981)]. Twenty-two background variables were summarized and their effects analyzed. Sixteen themes of programs consisting of sixteen courses were collapsed to four major themes of strategy, productivity, leadership and global competition. The managerial skills survey of importance and competence with forty-two items were combined to produce the above four major themes. Hersey and Blanchard's Leadership behaviors of the participants were scored and plotted in the relevant quadrants of Telling-Selling-Participating-and Delegating. The distribution of the leadership profiles of participants fell primarily in the style quadrant of Selling and secondarily in the style quadrant of Participating. Kolb Learning Styles were also scored and their distributions were recorded in the four quadrants consisting of Diverging-Accommodating-Converging-

Assimilating. The primary learning style was found to be Converger and the secondary style to be Accommodator (Kolb, 1976, 1981). The chi-square table of learning style profiles of participants agrees with the charts of engineers and managers.

There were forty-two **Importance** related questions as well as forty-two **Competence** related questions in the Management Skills questionnaire. For the sake of meaningful discussion and results and for correct statistical procedures, these forty-two variables were collapsed to seven major criteria on which results were tabulated and reported. Statistical text book on Analysis of Variances (ANOVA) suggest (Stevens, 1990) that there is more reliability in having small number (in this case seven) of collapsed sub-scale items of skills than large number of individual outcome level elemental items (forty-two). With this treatment, to give reliable results, and for ease of reporting results, the forty-two items were collapsed to seven sub-scales of major skills as reported in table 1. The Purdue Management Development Program had sixteen courses designed and delivered in seven major skill areas. The skills analyzed were the seven sub-scales of the questionnaire. From a statistical standpoint, this method increases the likelihood of finding reliable results. From the theoretical standpoint, this method increases the likelihood of finding meaningful results.

Skills Group (Sub-scale)	**Skill Items (#Questions)**	**Purdue Courses**
Organizational Leadership	1-12 (Twelve Questions)	Three courses
Human Resource Management	13-19 (Seven Questions)	Two courses
Financial Management	20-22 (Three Questions)	One course
Decision Making	23-28 (Six Questions)	Three courses
Strategic Planning	29-33 (Five Questions)	Four courses
Negotiation and Conflict Resolution	34-40 (Seven Questions)	Two courses
Managerial Communication	41-42 (Two Questions)	One course

Table 1. Classification of Subscales of skills for analysis and number of courses offered

The Executive Development Associates (EDA) study has shown earlier that management development programs normally have four main areas of thrust, namely, *Strategy*, *Productivity*, *Leadership and Global Competition*. These following sixteen courses fall into four major areas.

- *Strategy*: Negotiation and Dispute Resolution, Competitive Advantage, Change Management, Human Resource Management (Skills Sub-scales: Negotiation and Conflict Resolution, and Human Resource Management)
- *Productivity*: Design for manufacturability, Human Factors and Ergonomics, Career Management, Decision Analysis (Skills Sub-scale: Strategic Planning)
- *Leadership*: Managerial Communication, Designing Organizations for Teams, The Creative Process, Presentational Speaking (Skills Sub-scales: Organizational Leadership, and Managerial Communication)
- *Global Competition*: Global Technology Management, Managing Investment Decisions, Marketing for Technical Managers, Accounting and Finance (Skills Sub-scales: Decision Making, and Financial Management)

Statistical analyses combined the important findings from the four important modules of the questionnaire--background, important skills needed to develop/ competence displayed or possessed, management style predominantly present, learning style employed to manage.

Results and Summary

This study entitled, "Effective Management Development Program Evaluation and Review Technique," examined Purdue University Engineering/Management Program for 1995. The purpose of the program was to offer management training to a population of ninety-eight engineering managers. From a quality assurance perspective the study attempted to measure those changes that occurred in the knowledge, skills and behaviors of the participants, from before to after the program, in four levels of program effect e.g., reaction, learning, behavior and results.

Responses were gathered using qualitative interviews. Evidence was gathered using Learning Skills Inventory. Behavior was gathered using Leadership Effectiveness and Adaptability Description Questionnaire. Results were gathered using Managerial Skills of Importance and Competence over pretest, posttest and a three-month posttest on the job.

Forty-two management skills criteria were collapsed to identify seven main leadership skills for reliable evidence on the hypotheses tested: **Leadership/ Organization, Human Resource Management, Financial Management, Decision Making, Strategic Planning, Negotiation and Conflict Resolution, and Managerial Communication.** The important results of the study are summarized below.

No significant differences were found in the Importance of each leadership skills:
(a) by the type of company's business, (b) by the number of years of employment with the current employer, (c) by the number of years in the industry, and (d) by the type of degrees held.

Significant Differences were found in the Importance of each leadership skills:
(a) by a broad range of titles, (b) by the size of company, and (c) by the number of years in current position.

No significant differences were found in the Competence of each leadership skills:
(a) by the type of company's business, (b) by the size of company, (c) by the number of years in current position, (d) by the type of degrees held by the manager (BS, MS, MBA), and (e) by the number of years in the industry.

Significant Differences were found in the Competence of each leadership skills:
(a) by a broad range of titles and (b) by the number of years of employment with the current employer.

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