

A DELPHI STUDY OF MOTIVATIONAL PROFILE OF SCIENTISTS IN RESEARCH AND DEVELOPMENT ORGANISATIONS¹

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Summary.—A delphi study was conducted to analyse the motivational profile of scientists working in research and development organisations using need hierarchy theory. The hierarchy of need and the concepts of basic motivation proposed by Maslow have received wide acceptance for the understanding they provide for organisational research. In this study an attempt was made to find out whether the scientists are motivated primarily by higher needs or not. 82 scientists representing four different research and development organisations in India took part. The results of two rounds show that the potential for self-accomplishment is neutralised by hurdles due to nonfulfilment or partial fulfilment of lower-order needs.

Motivation is the key element to improved utilisation of manpower when there is difficulty using available “highly skilled manpower” efficiently. A large number of nations are investing huge financial resources in research and development activities and establishing national laboratories with the hope of fostering development. Unfortunately the importance of human resources in research and development activities seems to be partly overlooked by these organisations. An unpublished study by Sengupta in 1987 showed that the total productivity index of an economy was directly related to the number of qualified scientists and engineers in the labour force and that the growth rate depends on their quality and competence.

As a developing country, India possesses the third largest repository of scientific and technical manpower quantitatively and perhaps about the seventh or eighth qualitatively. There is a pressing need to reevaluate objectively the principles of manpower use to improve scientific productivity. This study was undertaken to draw a motivational profile of scientists to find out whether scientists are satisfied with their working conditions. Specifically objectives were to assess the achievement motivation of scientists in research and development institutions and to match achievement motivators with job requirements.

With regard to the theory of basic motivation and the theory of management in the USA, Goble (1970) showed that three of the top four behav-

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ioral scientists who influenced the field of management were McGregor (1960), Likert (1961), and Argyris (1964) whose ideas could be traced directly to Maslow's theory (1954). This suggests a widespread intuitive acceptance of Maslow's conception of motivation and its associated notion of self-actualization, despite the fact that Maslow's hierarchy of needs has been difficult to establish empirically (Grieg, 1982).

Delphi is a popular, long-range, qualitative forecasting technique that has been extensively applied to a wide variety of problem domains (Gupta & Clarke, 1996). Achievement motivation (Maslow's Self-actualization) in the context of research and development can be expressed as a concern for excellence, a desire on the part of the person to perform in terms of standards of excellence or to be successful in competitive situations. The other components of this motive are the desire to develop personal capabilities, and to do something new. Persons dominated by such motive are generally active, work hard, set high goals, take on challenging tasks, derive pleasure from doing difficult things, and constantly look for quality.

There are several frequently observed characteristics of successful research scientists. Successful research scientists are repeatedly described as enjoying a creative, innovative environment where they can "do things differently" (Holland, 1973; Keller & Holland, 1981). Many prefer an unstructured approach and dislike highly structured situations (Holland, 1973). This is also reflected in personality traits; scientists are described as tolerating ambiguous situations and having a low need for clarity (Keller & Holland, 1981). A self-reliant and independent approach was noted in a number of studies (Holland, 1973; Pelz & Andrews, 1976). This has been reflected in the finding that scientists tend to have internal locus of control, i.e., they believe that they can control both themselves and their own destiny (Keller & Holland, 1981). Interestingly, some of them have been seen as less interested in dealing with people (Campbell & Hansen, 1981), less sociable, and more task-and-theory oriented. This is reflected in the typical Myers-Briggs profile of the scientist, i.e., introverted, intuitive, more interested in theory than practice, indecisive, and thoughtful). Primary motivators for scientists appear to involve interest in, praise of, and recognition of their technical skills (Latham & Mitchell, 1976). McKelvey and Sekaran (1977) reported that for some research scientists, the primary concern in making their career choices is the technical or functional content of the work. Research scientists have a high interest in theory and abstraction. In the light of the above findings, one may conclude that scientists have a high potential for achievement motivation and a tendency to actualise their full potential.

Sahni (1979) studied the motivational orientation, professional commitment, and personality characteristics of administrators, engineers, and scientists in research and development organisations and reported that scientists

who were highly committed to their profession tended, when compared to the not-so-committed, to be more interested in job content, perceived their organisational climate as favourable, were high in achievement motivation, and experienced less conflict with their supervisors. Dhawan and Roy (1993), who studied Indian scientists' satisfaction with their jobs, found "challenge" and "relating with co-workers" were most important satisfaction factors but the remaining factors like comfort, resources, and pay were average. Also, scientists who in their original workplaces were less satisfied with their jobs than those who had moved from other organisations.

METHOD

Sample

The sample consisted of 82 scientists from five different research and development organisations in the city of Trivandrum, India who participated in two rounds of the delphi study.

Materials

A questionnaire on work motivation developed by Fred Luthans (1989) was modified to suit the organisational conditions of the Indian research and development organisations. A pilot study was conducted by collecting data from 40 scientists and split-half reliability was estimated for the questionnaire as .82. The questionnaire contains four items for each need category of Maslow's hierarchy, 20 items altogether. Each item had to be answered using a 7-point rating scale, anchored by 3 (I Strongly Agree) and -3 (I Strongly Disagree). The scores for each need categories were the sum of the four item scores, with a maximum score of 12. A high score on any one of the need categories indicated that the individual had high drive on that need which was felt and was not completely satisfied. From a low score usually one infers that the need is substantially satisfied. The scoring and the validity of the scale are reported by Luthans (1989). The reliability was supported here by data from two rounds of the delphi exercise.

A delphi exercise was designed and monitored by the investigator to assess the achievement motivation of research and development staff. Delphi is one of the techniques for technology forecasting which handles qualitative data. This method is an iterative process of extracting opinions from a panel of experts to build a consensus on an issue. This is a program of sequential individual interrogations using questions interspersed with information and controlled feedback on opinions. The advantage of this method over group discussion is that the panel members do not confront one another but at the same time receive the opinions of other members.

Statistical Analysis

Mean scores obtained for each need category in the hierarchy for the

two rounds were compared and analysed using a special computer software package "RATS", Regression Analysis of Time Series—a computer software for Econometrics, Forecasting and Statistics (cf. Griffiths, Hill, & Judge, 1993; Pindyck & Rubinfeld, 1993).

RESULTS AND DISCUSSION

Round I

The average score for each need category in the Maslow hierarchy (Self-actualization, Esteem Needs, Belongingness Needs, Security Needs, and Basic Needs) is given in Table 1.

TABLE 1
ROUND I OF THE DELPHI PROCEDURE: MEANS, RANKS, AND STANDARD DEVIATIONS FOR FIVE
NEED CATEGORIES OF LUTHANS' SCALE AND RANKS EXPECTED FROM MASLOW (1954)

Need Categories	Luthans' Scale			Maslow's Theory		
	M	Rank	SD	Score	Actual Rank Scored	Expected Rank
Self-actualization	7.46	4	3.36	7.46	4	1
Esteem	7.62	3	3.09	7.62	3	2
Belongingness	8.12	1	2.76	8.12	1	3
Security	5.31	5	4.15	5.31	5	4
Basic	7.98	2	3.34	7.98	2	5

Note.—5 is the highest (most basic need).

Since the range of scores for each need category can vary from -12 to +12, the obtained scores can be ranked. These results show that the research and development staff may be driven by Belongingness Needs (Rank 1), Basic Needs (Rank 2), Esteem Needs (Rank 3), Self-actualization Needs (Rank 4), and finally by Security Needs (Rank 5).

Even though Table 1 shows that the scientists differ in their scores from the expected ranking, this research and development staff with high scores on all need categories exhibit high need for basic conditions. According to Maslow's theory, scientists are expected to be motivated primarily by higher order needs. The desirable trend would be low ranking (drive) for lower order needs and as one ascends the hierarchy, higher ranking (drive) for higher order needs. It is seen in the table that scientists not only have unsatisfied lower order needs but also have strong drive for higher level needs. The actual scores were undesirable for lower level needs. The high rankings given for Belongingness Needs and Basic Needs can be explained by superimposing the Herzberg two-factor theory of motivation (1966), in which there are two distinct sets of factors, namely, Motivating factors and Hygiene factors. Job dissatisfaction then would stem from the absence of motivating factors in the work setting. Such motivating factors are Work,

Growth Opportunity, Higher Responsibility, Challenging Job, Recognition of work, and Advancement Hygiene factors are Working Conditions, Interpersonal Relations, Technical Supervision, Salary, Financial Benefits, and Job Security. In other words, hygiene factors are hypothesized not to lead to better motivation, although the lower order needs must be met for scientists to be motivated primarily by higher order needs. The management must therefore provide infrastructure, working materials, equipment, and ample funds as well as freedom and opportunity for growth. Greater responsibility, recognition, and advancement are important to motivate the scientists.

Round II

The mean scores obtained for different levels in the second round, shown in Table 2, depict a pattern of response similar to that in Round I. It

TABLE 2
ROUND II OF THE DELPHI PROCEDURE: MEANS, RANKS, AND STANDARD DEVIATIONS FOR FIVE NEED CATEGORIES OF LUTHANS' SCALE AND COMPARISON FOR ROUNDS I AND II

Need Categories	Luthans' Scale			Comparison				Desirable Rank	Average of 1+3
	M	Rank	SD	Round I		Round II			
				Score	Rank	Score	Rank		
Self-actualization	7.08	4	3.28	7.46	4	7.08	4	1	7
Esteem	7.41	3	3.45	7.62	3	7.41	3	2	7.5
Belongingness	8.04	1	2.74	8.12	1	8.01	1	3	8
Security	5.32	5	4.56	5.31	5	5.32	5	4	5
Basic	7.51	2	3.37	7.98	2	7.51	2	5	7.5

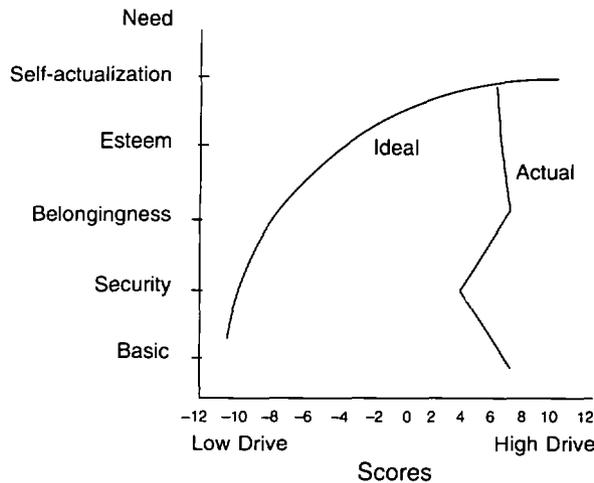


FIG. 1. Ideal condition in which lower-order needs are satisfied compared with actual scores obtained by Indian scientists

also shows that research and development staff apparently face situations in which they work to satisfy lower order needs although they have higher order needs which create drive to be involved in achievement-oriented creative work. In fact, the drives for higher potentials are not pursued given the non-fulfilment of basic needs and security needs.

In the second round of the delphi procedure the same pattern of ranks for need category was obtained, which supports the stability of the questionnaire. Since scientists are involved in creative and developmental research, it is natural to expect them to be motivated by higher order needs (esteem need and self-actualisation need). Instead, they seem to have unfulfilled lower order needs. The high means scores indicate that the scientists have high drive to act in achievement-oriented ways if the lower order needs are met.

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