MOTIVATION PARAMETERS FOR ENGINEERING MANAGERS USING MASLOW’S THEORY

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ABSTRACT: This paper emphasizes total self-development of the individual for improved motivation and organization management. It builds on Maslow’s hierarchy of needs theory to examine motivational levels for four levels of engineering staff at a public construction agency. The researchers studied these engineering groups qualitatively through interviews and quantitatively using a questionnaire. Using a holistic approach, this study focused on 15 parameters from Maslow’s five essential needs—the physical, safety, social, esteem, and self-actualization levels. Considerable emphasis was placed on the development of Maslow’s principle of “self-actualization.” This difficult-to-grasp concept, as Maslow reported, is a prerequisite for enlightened management. The researchers analyzed engineers’ perceptions regarding the fulfillment of need parameters and measured their perception of the importance of those parameters. Among specific findings were that junior project engineers had higher scores on self-actualization than senior engineers. Findings showed that changes are desirable for satisfying meaningfulness of tasks, increasing self-sufficiency in doing the job, and improving individuality and sense of mission of employees. The application of the findings based on Maslow’s model directly benefits the agency studied and other organizations in development programs. It also helps in increasing morale.

BACKGROUND

General

Early psychologists, belonging to Freud’s school, studied mentally ill people to learn about human nature and its deficiencies. Psychological principles were primarily developed by subjective interpretation of diseases and neuroses. Their theories also relied on methods such as interpretation of dreams to expand knowledge of the human inner self. The theories placed major motivational emphasis on deep urges and inner drives.

Second-generation psychologists belonged to the Behaviorism school led by John Watson (Globe 1970). This group used strictly “scientific” principles. Their theory established an approach based on external, environmental influences. Behaviorists put great stress on the associative or stimulus-response learning as the major explanation for human behavior, made through assumptions such as that man is flexible, malleable, and a passive victim of his environment.

Third Force, Maslow’s Theory

Initially, Dr. Maslow studied the Northern Blackfoot Indian Tribe in Alberta, Canada. Later he concentrated on people who were the highest achievers in their fields, calling them “superior human beings,” or “self-actualizing people” (Globe 1970; Cleary 1996). He somehow integrated the positive and applicable aspects of both earlier theories into what became known as “the third force” in search of the “whole truth” of human development. He focused his work on the achievers, advising that we must aim to become the “well-developed” human. In contrast to his predecessors, he rejected the animal analogy in analyzing man, since it neglects capacities that are uniquely human, such as martyrdom, self-sacrifice, shame, love, honor, humor, art, beauty, conscience, guilt, patriotism, idealism, poetry, philosophy, music, and science. In these characteristics, not supposedly shared by other primates, man was considered unique in latent learning.

Maslow’s main contribution is in his consideration of peoples’ feelings, desires, hopes, and aspirations in an attempt to understand human behavior. He introduced the holistic approach is studying man as an entity or as a system, holding that the whole is more than the sum of its parts. Maslow expressed the importance of elements such as job and play interaction, the discipline of hard work, creativity, and freedom of one’s opinion. He also confirmed Plato’s and Socrates’ contention that virtue is rewarding. He found that self-actualizing people...
enjoy life more (including its pains, sorrows, and troubles) and get more out of it. Maslow drew the characteristics of a self-actualized person as observed from the superior people he carefully studied. Some of these characteristics interpreted and enhanced by the researchers, are:

- Creativeness
- Harmony with universe
- Integration with civilization
- Meaningfulness
- Professional creativeness
- Independence/strength
- Individuality
- Self-sufficiency
- Self-understanding
- Goodness
- Sense of mission
- Effortlessness

These further relate to (Cleary 1996):

- Playfulness
- Justice
- Aliveness
- Richness
- Completion
- Beauty
- Simplicity
- Necessity
- Truth
- Order
- Perfection

Acceptance of Maslow’s Theory

Maslow’s theory and model have been extensively accepted in management science (Roberts 1982). He was highly respected in his own time. Literally hundreds of research projects have been based on Maslow’s model. His theory is taught in management, medical, and psychology curricula around the world. Perhaps the primary reason for the acceptance of his theory is the essential appeal it has to people of all denominations (Diligensky 1981). His concepts of love, safety, self-esteem, and spiritual development are fundamentally acceptable to individuals, psychologists, and management scientists alike. There is no doubt that Maslow had a fundamental message to impart to mankind.

Maslow’s ideas have been shown to have basis in Aristotle’s metaphysics (Ivie 1985), which has been the basis of Western philosophy for two millennia. Nevertheless, Maslow has been criticized for use of empirical methods in his research (Daniels 1982). However, the applications of Maslow’s theories were accurately reflected in real studies measuring motivation in Venezuela (Socorro and Ramirez 1986) and the United States (Hankins and Clark 1989). Personality-factor tendencies in a study in Israel were discovered to be highly consistent with Maslow’s self-actualization characteristics (Megen 1985). Very importantly, a study in Lesotho found evidence to believe that people are motivated to satisfy the hierarchy of needs described by Maslow (Russell 1984). The level of satisfaction of the five need levels were proven to be related, as predicted by Maslow, to scores on measures of neuroticism and belief in an internal locus of control, thereby proving that Maslow’s theories have scientific merit (Lester et al. 1983).

Maslow’s supporters have defended against critics by claiming that the linear thinking espoused by them are not applicable to the human self and psychology. Maslow’s transcendence and spiritualism of self-actualization—both nonlinear factors—are at the essence of his theories (Ginsburg 1984). Moreover, Maslow’s model better explains adaptation than do stimulus-response models, thereby suggesting that hierarchical standards can be used to enhance worker motivation (Melewski 1980). This finding is of particular significance to productivity enhancement in construction and industrial engineering.

ORGANIZATION AND MOTIVATION

Among the three broad classes of motivational need, cognition, and reinforcement, Maslow’s comprehensive and holistic model offers much simplicity of a recognized set of need elements. Argyris (1964) equated being “civilized” with being “organized” yet he said that too much organization, or the wrong kind, can injure the individuals, organization, and civilization. When principles of enlightened management were introduced, the question was raised as to how much each member of the organization should possess of both technical and administrative skills to perform well the duties his position warranted (Maslow 1964). Maslow stated that the dogma of human relations comes first; the objective requirements of the situation are secondary. The delicate balance between formality and humanity is what organizational design must pay attention to for maximizing peak performance levels.

HIERARCHY OF NEEDS PARAMETERS

According to Maslow, the desire to pursue the traits of self-actualization by the “superior man” is built on a hierarchy of other needs that emphasize the essential elements to be satisfied. In the order of their priority, these needs are (Maslow 1943):

1. Physical needs—air, water, food, sex, etc., which are basic and most powerful.
2. Safety needs—assurance of survival and continuing satisfaction of basic needs.
3. Affection or belongingness needs—relation to emotional and social grouping, loving, being loved, and fellowship with others.
4. Esteem needs—by self and others, an individual having adequate self-esteem being more capable, confident, and productive.
5. Self-actualization or self-development needs—this set includes the characteristics and conditions for advancing self and humanity through elevating
culture, science, and other areas of growth, including spiritual, that propel a drive for oneness, interconnectedness, justice, perfection, and ultimately the truth in all dealings, perceptions, and beliefs.

SELF DEVELOPMENT POTENTIAL

Total self-development (TSD) is a concept that drives one to expand awareness, beyond common materialistic knowledge, into higher consciousness levels of existence (Singh 1996). Complementing what we have learned and applied in total quality management (TQM), TSD integrates earlier applications of TQM in organization with the self-development concept to extend human potential for a more effective, more operationally successful human individual. The deep link to spiritual mysticism in the concept of self-actualization was something that Maslow (1964) said should be explored further.

The pursuit toward self-actualization is also a drive to exploit the human potential for expanding the mind’s capabilities. Usually, human achievements are made and felt in those great moments that Maslow called “peak experiences,” where one feels joy, happiness, bliss, wholeness, beauty, aliveness, perfection, completeness, justice, order, simplicity, richness, effortlessness, playfulness, and self-sufficiency (Cleary 1996). Beyond peak experiences, and in organizational settings, immediate advantages are gained by widening one’s own horizon outside the necessary knowledge listed on one’s organizational job description. Organizations can reap great benefits by encouraging employees and by capitalizing on these unutilized frontiers. Maslow’s motivation principles are based on acquiring higher knowledge to seek the ultimate potential in awareness.

This research utilizes the existing theories while developing a customized model to enhance the decision-making process and improve productivity at a construction organization by the identification of suitable motivation measures.

RESEARCH PLAN AND METHODOLOGY

Scope and Objective

The objective of the present study is to use the traditional Maslow’s needs theory in developing measurement parameters to evaluate motivation levels of the technical staff of this organization. The purpose of this research is to determine what parameters are in need of development to enhance the operational effectiveness and eventually maximize employees’ productivity.

The study plan is to first determine need parameters pertaining to the customized model. These parameters will then be evaluated using a questionnaire survey. Next, responses will be compared across classifications of staff. Lastly, guidelines will be provided for the organization to implement organizational changes.

Research Target Group and Response Received

The target groups are the construction engineers (project engineers, resident engineers, and area engineers) and inspectors working at the area site offices. Collectively, these groups have an impact on the daily organizational functions and the overall technical operations. The basic data for this research was obtained through direct survey and interviews conducted with the target groups.

The survey, by way of a research questionnaire, was sent to all 42 engineers of the organization. The number of questionnaire replies mailed back by respondents was 39. Replies received were 19 by project engineers, five by resident engineers, three by area engineers, seven by inspectors, and five were unclassified replies. There were also seven qualitative field surveys. Each survey was conducted in various group and individual formats. These interviews were conducted in the period between December 1996 and March 1997.

Sufficiency of Sample Size

The response rate from the population surveyed was 93% (39 out of 42 engineers responding). The 42 engineers are 100% of the entire organization—a relatively large engineering management organization responsible for construction works in the largest county (by land area) of the United States, Honolulu. The surveys were stratified, in that all engineer ranks were surveyed. All stratifications were surveyed randomly, since responses were voluntary. Thus, the data obtained are probability samples in contrast to judgmental samples (Freund and Williams 1972). The random response rate was extraordinarily high (93%), lending additional justification to the completeness and sufficiency of the sample size.

Holistic Approach

As an organizational unit, the surveyed unit’s performance is a function of the studied parameters. So this research places an emphasis on the holistic approach that an organization performs well only when all of its components are performing together in concert. This is acknowledged in the design of the research model and during formulation of interrelationships between factors and effects. The holistic approach is one of the major elements in Maslow’s approach in the analysis of self-actualization.

MOTIVATION MODEL AND ANALYSIS

Questionnaire

The questions help to develop a quantitative assessment of motivational parameters being met by current organizational settings. The questionnaire, shown in Fig. 1 includes 31 questions covering the studied areas of needs. In addition, a parallel set of questions was presented to respondents about the personal value placed on the importance of each of the need parameters.

For responding to the questions, a Likert scale is used with seven degrees of intensity of feeling with which the respondents associate their response to the questions. The questions are combined to represent the various need parameters. Table 1 shows the distribution of questions over the study parameters.
TABLE 1. Distribution of Questions among Studied Parameters

<table>
<thead>
<tr>
<th>Hierarchy of needs studied parameters</th>
<th>Survey questions used in parameter</th>
<th>Total Q's used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1: physical</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Level 2: safety</td>
<td>2, 3, 4, 5, 6, 7</td>
<td>6</td>
</tr>
<tr>
<td>Level 3: social</td>
<td>8, 9, 10, 11, 12, 13</td>
<td>6</td>
</tr>
<tr>
<td>Level 4: esteem</td>
<td>14, 15, 16, 17</td>
<td>4</td>
</tr>
<tr>
<td>Level 5: self actualization</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Meaningfulness</td>
<td>19</td>
<td>—</td>
</tr>
<tr>
<td>Self sufficiency</td>
<td>20, 21</td>
<td>—</td>
</tr>
<tr>
<td>Effortlessness</td>
<td>22, 23</td>
<td>—</td>
</tr>
<tr>
<td>Creativeness</td>
<td>24</td>
<td>—</td>
</tr>
<tr>
<td>Professional creativeness</td>
<td>25</td>
<td>—</td>
</tr>
<tr>
<td>Self understanding</td>
<td>26</td>
<td>—</td>
</tr>
<tr>
<td>Independence/weakness</td>
<td>27</td>
<td>—</td>
</tr>
<tr>
<td>Harmony w/universe</td>
<td>28</td>
<td>—</td>
</tr>
<tr>
<td>Individuality and sense of mission</td>
<td>29</td>
<td>—</td>
</tr>
<tr>
<td>Goodness</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td>Integrated with civilization</td>
<td>31</td>
<td>—</td>
</tr>
</tbody>
</table>

**Evaluation of Quality Index (QI)**

A quality index is a value for a need parameter developed by averaging scores given by one respondent to the questions relevant to that particular need parameter. The formulation is made as follows:

\[
QI = \frac{1}{n} \sum_{Q=1}^{n} S_Q
\]  

where \( QI \) = instant satisfaction index value from one respondent; \( n \) = number of questions involved in the evaluation process; and \( S_Q \) = score given by a respondent to a question \( Q \).

Index values range from a low of 1 to a high of 7. A group quality index (\( QI_g \)) is then obtained by averaging QIs of all respondents of this particular group. It is important to note that a quality index reflects a measure of the respondent’s instant perception of an issue—it gauges the instant gratification or lack thereof.

**Evaluation of Relevance Factors (RF)**

Next, a relevance factor (RF) is obtained from the responses to importance questions in a similar way to QIs (by combining responses to questions). The original set
of data from questionnaire responses was obtained on a Likert scale (1–7). The relevance factor (RF) reflects the importance of an issue as viewed by a respondent.

In analyzing variances (ANOVA) for the obtained RFs, there was no significance in the differences between rates of RF of surveyed groups. Hence, the presented plot shows only results of the combined groups.

Evaluation of Scaled Quality Indexes (SQI)

Finally, the quality indexes are scaled over their respective relevance factors (QI, divided by RF) producing a new set of parameters for a group’s assessment of the studied needs. This provides a realistic view of the status of need parameters, since now the importance of a need and its actual fulfillment are both measured. To obtain values of SQI, need category quality indexes for groups are divided by the corresponding category relevance factors (the original RFs on the Likert scale). Hence, SQI is a relative ranking system. To normalize SQI scores between 0 and 100, all SQI scores were divided by an arbitrary “convenience factor” of 0.7 for easy comparison and comprehension of the performance of measured parameters (Table 2).

\[
SQI = \frac{QI}{RF} \cdot k
\]

where SQI = need category scaled quality index for a group (presented in a percent format); QI = need category quality index for the group; RF = need category relevance factor on the Likert scale; and \( k \) = convenience factor (constant equal to 0.7).

As a numerical example from project engineers’ data for the category of “effortlessness,” we have \( QI = 5.8; RF = 5.25 \) (shown as 1.25 on the RF shifted scale, Fig. 4); \( k = 0.70 \). Then, \( (QI/RF) \cdot k = 0.7733 \) (~77%).

The scaled quality index (SQI) computes the true performance of a motivation category since it combines the perception of the quality and the relevance of it.

Central Tendency

Analyzing the questionnaire results proved that the responses follow the central tendency theorem. In each group of answers, most answers clustered around their mean. In such cases, observations were made of all fluctuations because the fluctuations become very important, and therefore, must be analyzed. Initially, standard deviations were computed for fluctuation of data among responses to direct questions by individuals, group responses to direct questions, group QI results, group RF results, and group SQI results.

These deviations within groups fluctuate in somehow narrow ranges, and most responses cluster around their means, two facts necessary for central tendency. This places greater emphasis on analyzing even slight fluctuations. For instance, deviations (\( \sigma \)) obtained within each need category for QIs were \( 0.05 \leq \sigma \leq 0.21 \). For SQIs, \( 0.25 \leq \sigma \leq 1.14 \).

**FINDINGS FOR QI, RF, AND SQI**

The results of surveying the technical staff are presented later in chart format. Below, various comparisons are made in the performance of the indexes between the surveyed groups and between the motivation categories. Henceforth in this paper, the terms QI, RF, and SQI represent group values.

**Quality Index Results**

The results of QI are presented in Fig. 2, which shows a general comparison between levels of needs for the target groups. Additionally, Figs. 3(a and b) show a sample of the distribution of answers across the response scale for the group of project engineers (PEs).

**Relevance Factor Results**

Fig. 4 shows the results of the survey. The data set from all job titles was combined, since there was low variability in how the relevance factors were viewed by various groups.

**TABLE 2. Hierarchy of Needs’ Model Performance for this Organization’s Motivation**

<table>
<thead>
<tr>
<th>Hierarchy of needs’ categories</th>
<th>QI</th>
<th>RF</th>
<th>SQI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Level 5, self-actualization</td>
<td>4.7</td>
<td>0.50</td>
<td>73</td>
</tr>
<tr>
<td>Level 4, esteem</td>
<td>4.9</td>
<td>0.87</td>
<td>70</td>
</tr>
<tr>
<td>Level 3, social</td>
<td>4.6</td>
<td>1.01</td>
<td>64</td>
</tr>
<tr>
<td>Level 2, safety</td>
<td>4.1</td>
<td>1.35</td>
<td>54</td>
</tr>
<tr>
<td>Level 1, physical</td>
<td>4.6</td>
<td>1.16</td>
<td>62</td>
</tr>
<tr>
<td>[Mean]</td>
<td>4.56</td>
<td>0.98</td>
<td>65</td>
</tr>
<tr>
<td>[Standard deviation]</td>
<td>0.26</td>
<td>0.32</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Note: Correlation between QI and RF = −0.68; correlation between RF and SQI = −0.95; correlation between QI and SQI = +0.88.
FIG. 3. Project Engineers’ Response Distribution: (a) Categories of Need (Levels 1–4); (b) Subsets of Self-Actualization Needs

Scaled Quality Index Results

This set is a measure that provides a comprehensive view of the actual status of perceived parameters, as valued to be important collectively by an operating group in a particular organization. If a need parameter is perceived important (high RF) by the groups, SQI performance would then appear relatively low (since we divide QI by its RF), emphasizing the need to develop and im-

FIG. 4. Relevance Factors, RFs, for Basic and Self-Actualization Needs of Combined Groups

For a more meaningful presentation, this data is plotted on a scale of -3 to +3 by shifting the center of the scale leftward by 4. Such presentation emphasizes positive (important) and negative (unimportant) aspects in respondents’ perceptions.

FIG. 5. Performance of Scaled Quality Indexes (SQI = QI/RF) for Basic Needs and for Self-Development Parameters
BASIC NEEDS FINDINGS

According to the needs hierarchy theory (Maslow 1954), there is an individual emphasis on fulfilling first the most primary needs of psychological survival. Other needs are fulfilled in an ascending order. Nevertheless, small amounts of fulfillment across all categories and hierarchies exist with all individuals. Additional needs, placed higher in the hierarchy, emerge more or less sequentially, the satisfaction of which will eventually drive an individual toward the level of self-actualization. The value placed by individuals on the fulfillment of different needs varies between individuals.

The following findings are obtained for the target groups of inspectors (Insp), project engineers (PEs), resident engineers (REs), and area engineers (AEs). Table 3 presents the data for basic needs. The overall mean for QI is 4.6, the overall mean for SQI is 69% for all evaluations, and the overall RF mean is +0.71.

Performance of Physical Needs

As the foundation of man’s livelihood, physical needs are central to man’s physical existence and physiological being; they are so powerful that a deprivation causes serious effects on human functions. In reviewing the data (Table 3), it is quickly realized that engineers exhibited relatively low QIs and SQIs, and that these values decrease significantly as engineers move up the management ladder at this organization. The PE group is the most fulfilled with their basic needs, in contrast to the higher ranks of engineers who lack satisfaction with the basic elements of life and physical well-being.

It must be noted that the groups of REs and AEs need to examine their personal life and how they are meeting their physical necessities. Improvements are necessary in the way they conduct their life to ensure that these necessities are met. The inspectors group also shows low values for both indexes. The groups identified satisfaction with physical needs as relatively important, indicated by a score of +1.16, as compared to an overall mean for all categories of +0.71 (Fig. 4). The conclusion is that engineers consider their physical needs very important, but find little fulfillment.

Performance of Safety Needs

The satisfaction with one’s own safety and security is essential. This includes both physical and mental safety needs. Safety is important for stability of one’s life at home, at work, in society at large, for sanity, and for any other productive generation and application of the thought process. The lack of this basic need creates instability, incoherence, and fragmented thought and personality. The data in Table 3 shows low values across all groups for fulfillment of the safety needs; in fact, all scores are below the overall means of QI and SQI. Satisfaction is lacking with this need category, though the groups identified this category as second most important among all categories (RF = +1.35). In other words, the groups exhibited an unfulfilled need, while expressing its high importance. Therefore, safety deserves attention among engineers in this organization. At every level, individual and managerial, an emphasis must be placed on job stability in one’s work, security within society, and at home in one’s community.

Performance of Social, Love, and Belonging Needs

This set of needs encompasses all social grouping in human life. It relates to professional grouping at work (such as at office, with coworkers, professional, and trade associations) as well as personal relationships (such as family, friends, spouses, and neighbors). According to Maslow, a fulfillment of this set of needs provides man with an integral part of his human attributes. The lack of satisfaction in this area would trigger characteristics as exhibited by antisocials. “Belonging” is essential in a profession; in engineering and construction, belonging is crucial since work is often done in teams. Through “belonging” engineers can have a common professional vision, common company vision, or common organizational culture.

The data in Table 3 show declining values for this level, in QI and SQI, as one moves up the management ladder at this organization. With an above-average level of RF, the groups realize the necessity of social/professional grouping but feel a lack of satisfaction with it. This may be due to little time available to bond with coworkers and organize joint activities. In the case of engineers at this organization, it may be related to dissatisfaction with priorities and policies prevalent in the organization.

Performance of Esteem Need

This need encompasses feelings derived by respect from and to others. This need also relates to a respect that a leader commands, that a parent needs, and which engineering groups require to fulfill their job requirements. The esteem need is as much an earned position as an exerted power of one’s expertise, skills, and mastery over others who respect those qualities. In organi-
zational settings, if a position is regarded with prestige, prominence, or special authority, it adds to the personal esteem of the person occupying the position.

Fulfillment of this need provides man with a uniqueness and charisma that builds into the individual personality and sense of worth, which are, on their own strength, important human attributes. The lack of satisfaction in this area would cause humiliation and low self-worth. At the professional level, this translates into low command power, ineffective leadership, and little respect by others for one’s opinion and expertise advice. It also affects the motivation to offer such advice and opinion if little value is set on it. Supervisors must offer encouragement, opportunity, consideration, and value the contribution through experience and expertise by members of the team. The data (Table 3) shows declining values, in QI and SQI, as engineers move up the management ladder. With an average level of perception of importance (RF = 0.87), the groups place a reasonable importance on esteem, but feel a lack of satisfaction with it, especially at the higher ranks. A lack of fulfillment by REs and AE is may cause problems in “commanding the troops” at this organization. Respect of one’s opinion is essential for operation as much as leadership is also required to execute decisions at any level. The noted decreasing scores from PEs to REs and AE are in opposition to the esteem required at the higher command levels. (Note: The project engineers group of this survey emerged having a higher perception of satisfaction with most basic needs, an indicator of a full, more stable human personality.)

FINDINGS ON SELF-ACTUALIZATION PARAMETERS

Prior to Maslow’s writings on the “enlightened management” style, leaders in this field of study, such as McGregor, felt that once basic needs are satisfied, further incentives to boost workers’ productivity were not necessary. Maslow, however, assumed that higher “self development” needs exist, and that workers strive to satisfy them once lower needs are satisfactorily fulfilled. Later, he even incorporated the additional ideas of metamotivational factors and metapay (compensation geared toward higher needs like creativity and autonomy) into his original need theory to include transcendent states of consciousness (Cleary 1996). This revision reflected a healthier, more fully human, self-actualizing transcender.

In the present study of motivation and needs, there are 11 topics of focus (or categories) related to self-actualization; these topics are divided into five subsets. In the following sections, the subsets are discussed in a holistic context where all self-actualization parameters are together considered one need element—consisting of components complementing each other—and are together reflective of a composed state of harmony. The application of Maslow’s self-actualization parameters open a myriad of additional dimensions to examining human potentials (Singh 1996). Data for this section is presented in Table 4.

**Performance of Meaningfulness, Self-Sufficiency, and Effortlessness**

The tasks performed daily in construction and engineering management consist mostly of activities that are logically or practically connected in scientific, sequential, or organizational steps. To perform these tasks, engineers and inspectors often go through a learning process and an experience building that takes years to accumulate to a comfortable level of performance. However, once this level is achieved, the next challenge is manifested in the quality of work produced by an individual with less effort and more self-sufficiency. It is also manifested in levels of expertise, fluency, competence, and facility. Results are also manifested in improved understanding of the universal task at hand exhibited in this organization by concepts such as public safety, engineering service, system stability, progress, and development in transportation construction. An understanding

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Insp</th>
<th>PE</th>
<th>RE</th>
<th>AE</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Meaningfulness (RF = 1.09)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI</td>
<td>4.0</td>
<td>4.8</td>
<td>4.5</td>
<td>5.3</td>
</tr>
<tr>
<td>SQI</td>
<td>55%</td>
<td>66%</td>
<td>62%</td>
<td>73%</td>
</tr>
<tr>
<td>(b) Self-sufficiency (RF = 1.61)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI</td>
<td>5.7</td>
<td>5.4</td>
<td>4.6</td>
<td>5.0</td>
</tr>
<tr>
<td>SQI</td>
<td>71%</td>
<td>67%</td>
<td>58%</td>
<td>62%</td>
</tr>
<tr>
<td>(c) Effortlessness (RF = 1.25)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI</td>
<td>5.9</td>
<td>5.8</td>
<td>4.6</td>
<td>4.8</td>
</tr>
<tr>
<td>SQI</td>
<td>78%</td>
<td>77%</td>
<td>62%</td>
<td>64%</td>
</tr>
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<td>(d) Creativeness (RF = 0.29)</td>
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</tr>
<tr>
<td>QI</td>
<td>4.3</td>
<td>4.6</td>
<td>3.3</td>
<td>4.0</td>
</tr>
<tr>
<td>SQI</td>
<td>70%</td>
<td>74%</td>
<td>53%</td>
<td>65%</td>
</tr>
<tr>
<td>(e) Professional creativity (RF = 0.14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI</td>
<td>3.1</td>
<td>4.4</td>
<td>2.8</td>
<td>4.3</td>
</tr>
<tr>
<td>SQI</td>
<td>53%</td>
<td>75%</td>
<td>46%</td>
<td>73%</td>
</tr>
<tr>
<td>(f) Self understanding (RF = 0.22)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI</td>
<td>5.0</td>
<td>5.1</td>
<td>4.5</td>
<td>4.3</td>
</tr>
<tr>
<td>SQI</td>
<td>83%</td>
<td>84%</td>
<td>75%</td>
<td>72%</td>
</tr>
<tr>
<td>(g) Independence/strength (RF = 0.50)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI</td>
<td>4.6</td>
<td>4.9</td>
<td>4.3</td>
<td>3.3</td>
</tr>
<tr>
<td>SQI</td>
<td>71%</td>
<td>76%</td>
<td>66%</td>
<td>52%</td>
</tr>
<tr>
<td>(h) Individuality and sense of mission (RF = 0.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI</td>
<td>3.3</td>
<td>4.7</td>
<td>3.5</td>
<td>2.7</td>
</tr>
<tr>
<td>SQI</td>
<td>57%</td>
<td>81%</td>
<td>60%</td>
<td>46%</td>
</tr>
<tr>
<td>(i) Harmony with universe (RF = −0.36)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI</td>
<td>3.1</td>
<td>3.8</td>
<td>3.5</td>
<td>3.7</td>
</tr>
<tr>
<td>SQI</td>
<td>60%</td>
<td>74%</td>
<td>67%</td>
<td>71%</td>
</tr>
<tr>
<td>(j) Integration with civilization (RF = 0.14)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI</td>
<td>4.7</td>
<td>4.8</td>
<td>5.0</td>
<td>4.3</td>
</tr>
<tr>
<td>SQI</td>
<td>80%</td>
<td>82%</td>
<td>85%</td>
<td>73%</td>
</tr>
<tr>
<td>(k) Goodness (RF = 0.61)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QI</td>
<td>5.4</td>
<td>4.9</td>
<td>5.0</td>
<td>4.7</td>
</tr>
<tr>
<td>SQI</td>
<td>82%</td>
<td>74%</td>
<td>76%</td>
<td>71%</td>
</tr>
</tbody>
</table>
of these concepts, by the target groups, adds to further meaningfulness for the engineers in the way in which they perform their tasks.

The recorded QI values (Table 4) are good indicators in favor of both engineers and inspectors. Among all groups, resident engineers show slightly lower values than other groups. The project engineers group shows a higher cumulative value for all three categories. The target groups placed these categories high on the importance scale indicating they are viewed as essential to the tasks of technical staff and elements of the job. These categories were the only ones from the subsets of self-actualization that scored RF above +1.0, indicating they are held in high importance.

Performance of Creativeness and Professional Creativeness

Creativeness relates to the way one performs, using resourcefulness and imagination. Professional creativeness, however, relates to technical aspects, ingenuity, originality, and adeptness when doing work; it is a common fact that engineering work contains much creativity in the way business is conducted. The nature of work of engineering and construction management, though often described as rough and stressful, can also be described as innovative and inventive, real and practical, and flexible and dynamic. The existence of associated qualities can satisfy creativeness and professional creativeness in performing the job, which may otherwise be missing among the groups. Elements of job enrichment and encouragement for creativity are sometimes neglected in the management operations, which is driven toward hard performance for meeting deadlines.

Quality index values were generally low across the board for all groups, with REs showing significantly low values in both categories (toward the negative side of the scale). It seems that creativeness elements are not sufficiently stimulated in this organizational environment. Two groups, REs and inspectors, in recording their lowest scores in all categories, showed a perception of least professional creativeness. (Note: RF scores were low indicating that the surveyed groups assign little importance to the aspect of creativeness and professional creativeness, believing that these are not important for their job. This is ironic. A possible reason behind this may be in that the job has been structured to the point that they have become repetitive. Technical assistants can be hired to perform repetitive tasks at a subengineering level. However, encouraging creativity must become an organizational pursuit for any entity that wants to rise above the norm.)

Performance of Self-Understanding, Independence/Strength, and Individuality and Sense of Mission

These are three categories that reflect the individual’s self worth, wholeness, completeness, and uniqueness. These qualities translate into faith in and reliance on professional capabilities that lead to firm decision making. They also mirror one’s own character, elevated self respect and regard, and a distinguished valuation of one’s self and goals in the journey of life.

Engineering groups exhibited relatively high to reasonable values of SQI for self-understanding (Table 4). They also exhibited a decreasing perception of self-understanding, independence, and individuality as they went up the ranks from project to resident to area engineers. For the inspectors group, QI values were relatively high in self-understanding and independence but significantly low in individuality and sense of mission. The decline in QI values, as engineers rise in the organization toward management levels, is an alarming indicator that must be taken seriously by this organization’s executives.

This particular subset of self-actualization is made up of categories essential in shaping the individual’s personality, leadership style, charisma, and other qualities necessary for moving up in managerial positions and in leading others. The perception of lack of these qualities at the higher ranks among engineers may be troublesome to a large, dynamic, and thriving organization going through change. The RF results show the groups have lower appreciation of these elements as important to the way the job is performed.

Performance of “Harmony with Universe” and “Integration with Civilization”

These difficult-to-imagine categories offer an alternative perspective to one’s understanding of the self’s role in a larger arrangement of total unity with the outer world. Satisfaction with this subset’s needs relate one to all, fitting parts to whole, and defines a harmony between simplicity of part and integrity of completeness. Fulfillment of these needs connects simple order to chaos, providing richness to both; it enlightens the view separating one’s self from outer limits realizing the importance of the integration of both.

Regarding whether their job has any harmony with the universe, these target groups show a negative attitude in very low QI scores, and in the only negative RF in all studied categories (Table 4). In contrast, their responses were clearly positive on how their jobs integrate with civilization, a more practical and less utopian reaction, but still, the level of importance assigned by them was low (RF = +0.14). This reading could be expected in the context that these technical personnel (engineers and inspectors) have less of a romantic notion in viewing the world and are more of the practitioner and “hands-on” type. (Note: Little interest is generated by this group in these two categories. Apparently, enthusiasm for life can often be related to romanticism of the universe. But, this group does not realize the aspect of unity of one’s job in relation to other humans and the civilization at large; further, they do not view the essence of one’s uniqueness as tied to the universe as relevant to their work or themselves.)

Performance of Goodness

This category reflects one’s perception of life and righteousness. It relates an individual to beauty and
aliveness, to richness and usefulness, to completeness and truth. Understanding goodness elevates one’s thinking through unlocking the best in human self-consciousness—in morality, purity, and complete virtuosity. In general, the result of these quality index values can be considered positive.

**OVERALL PERFORMANCE OF THIS ORGANIZATION**

Interestingly, no need parameter was considered exceptional by the respondents, since no RF or QI value is exceptionally high; it is possible that this reflects the medium intensity with which the technical groups live their lives. It could be they do not take life too seriously, or it could be they care less. Neither possibility is, at this stage, a verification of universal truthfulness. In terms of the Maslow’s hierarchy and the five sets of need levels for the combined groups, Table 2 shows the model’s performance. The respondent groups apparently place a low relevance on level 5 (self-actualization RF = 0.50), which Maslow would surely find to be unfortunate. Further, the correlation between RF and SQI is very high but negative (corr = −0.95). This means that for what is considered important, the SQI’s performance is low, and the particular level’s need parameters are in a higher need of development. This is very important, in that it means that engineers are unfulfilled on items they think are highly important, and fulfilled only on things they find unimportant. The correlation between QI and SQI is high and positive (corr = 0.88); this is expected since SQIs are highly affected by QI’s performance.

**AREAS TO BE DEVELOPED BASED ON SQI**

It is considered that categories with SQI values below 69% (overall SQI mean) require intervention; these are categories at the lowest half of SQI category performance. Further, the ones below 65% (lowest third) are adjudged to be in critical need of improvement (Fig. 5). (Note: It is to be noted, perhaps with despair or anguish, that even some basic need values were found to be substantially below the overall mean.)

Based on the scaled quality indexes in self-actualization categories, specific areas of improvements are listed below for each respondent category. [Note: It is significant that project engineers, the relatively younger or unlicensed group of engineers, have no critical needs (no SQI below 65%).]

- Inspectors group: categories with critical need are (in order of necessity) professional creativeness, meaningfulness, individuality and sense of mission, and harmony with universe.
- Project engineers group: two somewhat less critical categories are meaningfulness and self-sufficiency.
- Resident engineers group: categories with critical need are (in order of necessity) professional creativeness, creativeness, self-sufficiency, individuality and sense of mission, meaningfulness, and effortlessness. Somewhat less critical are independence and harmony with universe.
- Area engineers group: categories with critical need are (in order of necessity) individuality and sense of mission, independence, self-sufficiency, and effortlessness. Somewhat less critical is creativeness.

**RECOMMENDATIONS FOR INTERVENTION**

The recommended areas for development are selected based on their high direct relevance (RF results) and their low specific quality (SQI results). Developing the following primary parameters would translate into benefits for personal development and professional performance:

- Meaningfulness of tasks, performance, and organization and how all of them integrate together. Lower rank groups (other than area engineers) perceived a little amount of meaningfulness derived out of performing their tasks. For a system to perform well, it is necessary to develop a synergized understanding of tasks at any organizational level. This organization’s goals must be reidentified, and clearly shared and understood by all participants from a macro view at executive level to a micro view at workforce levels. Full understanding of one’s role derives meaningfulness in participation.
- Self-sufficiency in doing the job. Development of this parameter can be achieved through continuous training. Engineering groups exhibited a low specific quality, SQI, in self-sufficiency.
- Individuality and sense of mission for employees and organization. As explained earlier, having a unified and clear mission provides for the individual’s understanding and worthiness in accomplishing own role and how his tasks integrate with everyone else’s.

There are other parameters, secondary to the above, that are in need of development, which can be discerned from the figures and tables, but are not mentioned here. It is suggested that upper management endorse and generally foster an environment of self- and professional development. This process of development would be a slow one with particular difficulty to pursue in a public agency. The negative aspects of these constraints create a special challenge that make it difficult for public agencies to sponsor the motivational efforts needed for self-development. However, motivational programs would result in galvanizing the work interest of individuals and stimulating harmony within the organization.

**CONCLUSIONS**

In studying elements of motivation, as attempted here using the hierarchy of needs theory, one uncovers the vast scope of human potential related to a worker’s performance. The basic needs examined here were initially
thought to be fully met for targeted groups; however, some of these needs were not fully satisfied (Fig. 5). From Maslow’s research, it is learned that these needs are basic, elementary, and powerful, and must be met. The target groups must examine their personal life and professional life at work to ensure that these minimums for basic needs are sufficiently met.

This research uncovered many areas of human development that are lacking the minimum required to produce self-actualizing people. In this organization, where progressive engineering applications and other advancements in construction and transportation are expected, the technical staff and its management have a duty to provide a well-developed team in technical quality as well as in self-development levels. In some regards, these levels were not achieved (Table 4).

Nevertheless, it is only somewhat discouraging to lack these qualities since this development process is a slow ongoing refinement of human aspects that takes years to complete, if ever. The process has no definable upper limits. The process of self-development is by itself an achievement when going through it and while experiencing the transformation taking place.

This research presented three different parameters in its results. The first is the perceived quality of motivation parameter, QI; the second is the relative importance placed by the groups, RF; and the third is the personalized relative quality valuation or a specific quality, SQI.

As management continuously attempts to motivate workers toward high performance, job enrichment efforts often become secondary to meeting deadlines and the short-term goals of the organization. It was apparent from this and other research questionnaires, that management has continuously made available to this staff a few seminars in technical and managerial fields. Additional self-improvement topics may need to be included among the offered ones, or to encourage individuals to seek their own development. Self-development, for individuals or groups in this organization or others, is a long process of initiation and of nurturing of potentials. It is a process of triggering inner elements to start other processes.

In this research, low scores are important to point the deficiencies, and equally important are some periodic measured improvements. This exercise sets the current baseline for other future measurements, a focus serving as a means to determine the status of motivation levels.

ACKNOWLEDGMENTS

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APPENDIX I. REFERENCES


APPENDIX II. NOTATION

The following symbols are used in this paper:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE</td>
<td>area engineers group (engineers by trade), who supervise engineers;</td>
</tr>
<tr>
<td>Insp</td>
<td>inspectors group, who perform daily monitoring and quality control of field work;</td>
</tr>
</tbody>
</table>
\[ k_t = \text{transformation constant, 0.70;} \]
\[ \text{PE} = \text{project engineers group (most are engineers by trade), field level of engineers, who are first contact with construction work and contractors;} \]
\[ QI, QI_{gi} = \text{quality index and subgroup quality index;} \]
\[ \text{RE} = \text{resident engineers group (engineers by trade), who supervise project engineers and inspectors;} \]
\[ \text{RF, RF}_g, \text{RF}_i = \text{category relevance factor, subgroup factor, and combined groups factor;} \]
\[ S_O = \text{score given by respondent to question } Q; \text{ and } \]
\[ SQ, SQ_{gi} = \text{scaled quality index and subgroup scaled quality index.} \]