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ESTIMATION OF MOTIVATION USING ENTROPY

Sachin Kumar Srivastava[1], Dhruve Narain Kakkar[2]

[1]Dr. M. C. Saxena College of Eng. and Tech., Lucknow, India
E-mail: sachi_luv@rediffmail.com
[2]Sahara Arts & Management College, Lucknow, India

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Abstract. Motivation has been in practices since the life of mankind. It is such an effort, which requires to be quantified for better management technique. The present paper deals with estimation of motivation efforts using entropy and ability of manpower involved in certain organization.

Keywords: motivation, motivation unit, working ability, estimation.

1. Introduction

In any development or production unit it is observed that either labor is used more and machines are employed less or labor is employed less, and the machines carry out more work.

In both cases, participation of manpower is necessary. One requires more capital to purchase machines; the other depends upon the availability of skilled labor. As in either method skilled manpower is involved, it requires being approximately motivated to work at full capacity and dedication. The motivation therefore is an incentive and there is no unit to measure it presently. The present paper is an effort to define the measuring way for motivation. The layout for a production where manpower is also involved and motivation is provided is shown in Fig. 1.

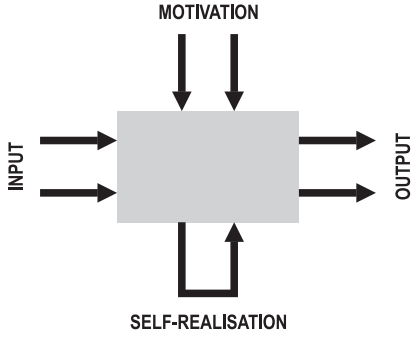


Fig. 1. Working process and motivation

2. Motivation

Fig. 1 describes the production organization where raw materials, machines and manpower are involved. To achieve the desired quantum of good in quantity motivation is required of people involved in the production activities to do the work with dedication, with the available machines and raw materials (Kovach 1987).

Through persuasion and motivation such situations can be developed in which they can think their work or job is respectful and honorable. Their needs should be appreciated and should be met if possible. The organization should review and should reinforce where it is

necessary. Motivation has been categorized as given below:

- need base motivation;
- process base motivation;
- reinforcement base motivation.

There are a few other situations in working scenario that generate automatically the enthusiasm to work-hard (Heller 1998). This can be called as self-generated motivation. There is one other process of motivation and that is of recognition of the expertise of the product. The demand for the products is another motivating factor. The mutual competition of organization becomes at the time a great deal of motive force. During wartime it has been experienced that workers worked overtime, without charging extra wages for producing the product required for the war (Higgins 1994). It has been found that 'Willi jeep industry' produced jeep vehicle one at every two minutes to meet the requirement of 'Friends Army' without charging extra salary. The workers in that industry were honored worldwide for their dedication and work for the cause of humanity. So the motivation study has been limited to descriptions and is evaluated abstractly such that they are poorly motivated or deeply motivated.

While carrying out the study of communication, similar situation was experienced for the evaluation of information.

Sennon, who resolved and described by using entropy for the measurement of information (1947) faced a similar situation to evaluate the complexity of programs (Sennon 1947). He also used the term 'entropy' through probability of occurrence of fault in the program, and interaction of 'Do loop'. The author of this paper has met similar situation in metering and estimation of motivation.

3. Analytical representation of motivation

Three factors are to be prominent in motivation and each one is complex in providing enhanced activities of production (Physiological, safety or security, social, esteem, self-actualization,) (Maslow 1943) the other motivation is based on process and depends up on the transfer function of the system, Reinforcement motivation provided additional need for specific variables (Guest 1987; Heller 1998) it is being reinforced.

3.1. Lemma

Whenever the products of variable are equal to the sum of the values, then, the operating function will be logarithmic.

Proof:- Assuming that variables are:

$\{X, X_2 \ldots X_n\}$ and are expressed by operating function H, then it can be expressed as:

$H(X_1, X_2, \ldots\ldots\ldots\ldots\ldots\ldots, X_n)$.

If the operating function is written:

$H(X_1, X_2, \ldots\ldots X_n) = H_1(X_1) + H_2(X_2) + \ldots\ldots\ldots$

then the operating function H will be a logarithmic function, such as:

$\text{Log}(X_1, X_2, X_3\ldots) = \log(X_1) + \log(X_2) + \ldots\ldots\ldots$

This proves the preposition.

3.2. Lemma in motivation

The motivation processes have two situations.

1) when elements of motivation are quantitatively equal:

$$H_1(N_b) = H_2(P_b) = H_3(R_b), \quad (1)$$

where, N_b – Need base motivation; P_b – Process base motivation; R_b – Reinforcement base motivation.

Then the motivation is expressed as:

$$\text{Mot} = \sum_1^2 (H_i P_i), \quad (2)$$

where, Mot = Motivation effort. Then

$$\text{Mot} = 3\ H\ (K) = 3 \log K, \quad (3)$$

where, k = Constant.

As equation (3) resembles entropy, then to satisfy entropy constraints $K < 1$ and say is equal to be 'P' and is called motivation factor. Then

$$\text{Mot} = 3 \log \text{P}. \quad (4)$$

If so, the value of 'Mot' will be less than zero. This will satisfy the second law of thermodynamics too.

2) If the motivation efforts are different, for different motivation, then, the 'Mot' should be taken out of Right Hand Side of the Lemma. This will minimize error in calculating of logarithmic value, as it is computed once:

$$\text{Mot} = H\ (N_b, P_b, R_b) = \log\ (N_b, P_b, R_b), \quad (5)$$

where, $B(i) = \text{i}^{\text{th}}$ motivation; B(1) = representation of need base motivation (N_b); B(2) = representation of need base motivation (P_b); B(3) = representation of need base motivation (R_b).

The equation (4) represents motivation efforts in the form of entropy.

$$\text{Mot} = \text{Log}\left\{\sum_1^2 B_i\right\}. \quad (6)$$

4. Numerical method for estimation of motivation

Motivation is a complex phenomenon and if represented by numerical values, then it is random (Heller 1998) ever to make a start, one can represent need base motivation in percentage as given below (Boxall, Purcell 2007):

Case 1

1) Physiological need fulfillment = 90 % = 0.90.
2) Safety and security need fulfillment = 80 % = 0.80.
3) Social recognition need fulfillment = 70 % = .70.
4) Esteem need fulfillment = 50 % = .50.
5) Self-actualization = 50 % = .50.

Then the need base motivation factor is given as N_b = [[[[[physiological]security]social]esteem] self-actualization]

N_b = [[[[[0.9].8].7].5].5],
N_b = 0.126.

Case 2

1) Physiological need fulfillment = 80 % = .80.
2) Safety and security need fulfillment = 75 % = .75.
3) Social recognition need fulfillment = 70 % = .70.
4) Esteem need fulfillment = 50 % = .50.
5) Self-actualization = 50 % = .50.

N_b = [[[[[0.8].75].7].5].5].
N_b = 0.105.

Process base Motivation process: The other motivation factor is process base motivation:

P_b = depending on input and output.

Output in any organization will be function of input and the man – machine relations, this is expressed as given below:

P_b = [raw input] * [man-machine],
P_b = $\{r_i(t)\}$ * {man-machine function in percentage},

where,
Man-machine relation = 0.75
and $r_i(t)$ = [good, fair, bad] = [80 %, 50 %, 20 %] = [0.8,0.5,0.2].

Then, P_b = [0.8, 0.5, 0.2] * 0.75,
P_b = [0.6, 0.37, 0.15].

The man-machine relation is assumed to be 75 %. Provided he remains with machine for a long time.

Reinforcement motivation process:

It is a system where some processes / input are reinforced in its follow-up working of the organization. One can make a policy on reinforcing percentage for the total output. In the present case it is assumed to be 20 % of total. Three cases are studied for the sake of explanation.

Case 1

R_b = 20 % = 0.20.

Case 2

R_b = 30 % = 0.30.

Case 3

R_b = 35 % = 0.35.

Tabular representation of the motivation estimation

Need Base Motivation	Process Base Motivation	Reinforcement Base Motivation	Total (N_b*P_b*R_b)	Total Motivation
0.126	0.6	0.2	0.015	1.823
0.126	0.37	0.2	0.0093	2.031
0.126	0.15	0.2	0.0037	2.43

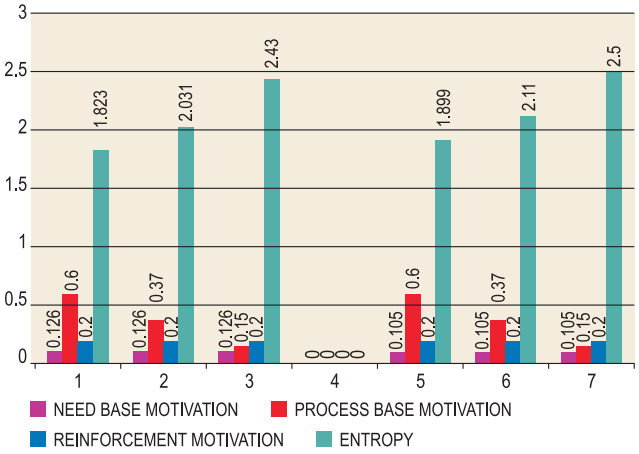
Need Base Motivation	Process Base Motivation	Reinforcement Base Motivation	Total (N_b*P_b*R_b)	Total Motivation
0.105	0.6	0.2	0.0126	1.899
0.105	0.37	0.2	0.0077	2.11
0.105	0.15	0.2	0.0031	2.5

Need Base Motivation	Process Base Motivation	Reinforcement Base Motivation	Total (N_b*P_b*R_b)	Total Motivation
0.105	0.6	0.03	0.18	1.744
0.105	0.37	0.03	0.011	1.9558
0.105	0.15	0.03	0.0047	2.327

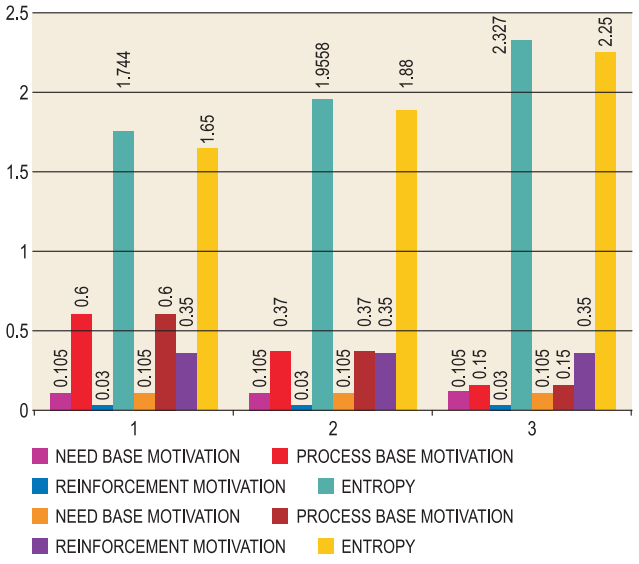
Need Base Motivation	Process Base Motivation	Reinforcement Base Motivation	Total (N_b*P_b*R_b)	Total Motivation
0.105	0.6	0.35	0.022	1.65
0.105	0.37	0.35	0.13	1.88
0.105	0.15	0.35	0.0055	2.25

Graphical representation of the performance of motivation

Case 1



Case 2



5. Impact of motivation and ability of people (Bach, Sisson 2000)

The study carried out envisages the evaluation of motivation on persons carrying out the job. There can be many situations in the working scenario. The people engaged on the job may be fully motivated but due to constraints and limitations on him the output may be partial. We can introduce a factor ABILITY evaluation in totality of the motivation with ability, the term ability 'A' can assume values between 0 to 1, resembling to the value of probability which measures the chance for devotion of man involved in work depending upon the mental and physical condition.

Chance is a typical situation representation of human behavior and can be expressed using operator 'Logarithmic'. If chance is represented using Lemma by ($g < 1$) then working ability will be:

$$W_a = \log \frac{1}{g}. \quad (7)$$

After substituting the value of W_a equation () in the equation of motivation equation (), we get the impact of the motivation [EM] as given below:

$$EM = Mot * W_a.$$

Substituting the values here,

$$EM = \sum_1^3 H_i P_i \log \frac{1}{g}. \quad (8)$$

6. Conclusion

Motivation is an important term commonly used to encourage people to carry out the assigned work with sincerity, dedication, and enthusiasm. Motivation is the tonic to provide additional energy to overcome the fatigue, disinterest and feelings to drop the job. The paper describes mathematical representation for the evaluation of motivation in two terms Entropy and Working ability having used to measure the Entropy with logarithmic operator.

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