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Abstract: Here we investigate the theories and principles of motivation and survey their application in today's engineering organizations. Throughout the report the impact of a well planned and carefully implemented motivation system is emphasized. It concludes with a list of major factors which should be practiced by managers in order to elevate individual goals and objectives to the organizational level.

MOTIVATION OF ENGINEERS AND TECHNICAL STAFF

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I.1 ABSTRACT

Motivation of engineers and technical staff is an important component to improve the productivity of an organization. The need to focus on these qualitative aspects is as important as the quantitative dimension of productivity. Nevertheless, it seems that managers are not systematically trained to successfully handle the motivation of their subordinates.

The purpose of this paper is to investigate the theories and principles of motivation and to survey how it is applied in today's engineering organizations. The impact of a well planned and carefully implemented motivation system is strongly observed in our findings. Successful companies identify themselves as organizations which do consider a variety of alternatives to motivate their employees. The paper concludes with a list of major factors which managers should practice in order to escalate individual goals and objectives to the organizational level.

I.2 EXECUTIVE SUMMARY

Motivation is concerned with the "why" of human behavior and with what it is that makes people do things. It is related to the question of how to bring individual goals and objectives as close as possible to the goals and objectives of the organization, and how to make individuals feel more productive in their daily work. An understanding of motivation is a necessity for all managers, as motivation and individuals' behavior are important components of productivity.

There are variety of factors that affect motivational qualities in people, in this respect the major theories were reviewed:

1. What energizes human behavior? (static-content theories)
2. What channels and directs behavior? (process theories)
3. How can behavior be sustained and maintained over time? (environmentally-based theories)

In order to make some assessment of the motivational perspectives and approaches which are practiced in real world, four literature cases were researched, we interviewed three local engineering firms and reviewed our own experiences. A questionnaire was prepared for this purpose and utilized for the interviews.

The discussion-conclusion part of the paper highlights the main areas which seemed to have major effect on motivation: rewards, recognition, communication, working environment, job content, job security, responsibility and decision making. The paper concludes that managers should realize that they also need to deal with the fact that employees are people whose needs and behavior have to be taken into consideration to ensure the success of a project. There is no single universal approach to motivate engineers and technical staff that can be applied to all cases. Managers should apply these theories and perspectives as a part of an ongoing diagnosis of organizational activity rather than assuming we know the answer to what motivates people.

II. INTRODUCTION

Motivation is concerned with the "why" of human behavior, with what it is that makes people do things. An understanding of motivation is a necessity for all managers. One of the biggest problems for a manager is how to motivate his/her subordinates. "How can I motivate my people" is the frequent question that every manager asks himself. Contingency Theory says "there are no universal principles of management (in this case motivation theory) that can be applied uncritically in all situations".

Douglas McGregor identified two contrasting views which he labeled Theory X and Theory Y. He believed that each of these orientations represents basic underlying beliefs about the nature of human behavior which influence a manager to adopt one particular motivational approach. Theory X beliefs tend to lead managers to think in terms of close direction and control of subordinates since people in general are viewed as inherently lazy, lacking in ambition and desire to assume responsibility, self-centered and likely to act contrary to organizational needs, and resistant to change. In contrast, Theory Y assumes that people are more growth and development oriented, and not necessarily irresponsible and naturally resistant to organizational objectives.

Given this orientation, management should try to arrange organizational conditions to create opportunities for people, provide guidance, remove barriers and encourage their growth. From a managerial standpoint, therefore, it seems that using the theories and perspectives is as part of an ongoing diagnosis of

organizational activity rather than assuming we know the answers about what motivates people. It appears to be the most realistic to understand motivation approach.

III. THEORY OF MOTIVATION

Motivation has been defined as "all those inner striving conditions described as wishes, desires, drives, etc. ... It is an inner state that activates or moves. " More specifically, the term motivation has often been called an intervening variable. Intervening variables are internal psychological processes which are not directly observable and which account for behavior.

Motivation cannot be seen, heard, or felt. We can judge how motivated a person is by observing his or her behavior; managers cannot measure motivation directly.

Three key areas of concern are recognized by delving into the three broad classifications of motivational theories: 1) static content theories which look at what energizes human behavior; 2) process theories which look at factors that channel or direct behavior; 3) environmentally-based theories which generally focus on sustaining or maintaining behavior over time.[1] Not all theories will be discussed in this paper, only several main theories which are most adapted by many companies will be observed and this paper is trying to relate the theories to real world.

III.A. STATIC CONTENT THEORIES OF MOTIVATION

Static content theories of motivation can be broken up into several well-known theories such as; Maslow's Hierarchy of Needs, McClelland's Socially Acquired Needs Theory, Alderfer's ERG Theory,

Herzberg's Motivator-Hygiene Theory and many other theories. These theories do not necessarily predict motivation or behavior but they can provide basic understanding as to what energizes (motivates) individuals.

Maslow's need hierarchy theory stresses two fundamental premises:

1. Each person is a wanting animal whose needs depend on what he or she already has. Only needs not yet satisfied can influence behavior. A satisfied need is not a motivator.
2. Needs are arranged in a hierarchy of importance. Once one need is satisfied, another emerges and demands satisfaction.

Maslow argued that the needs underlying all human motivation could be organized in a hierarchy on five basic levels. These levels are: 1) physiological, 2) safety, 3) social, 4) esteem, and 5) self-actualization. The main strength of this approach is the recognition and identification of individual needs for the purpose of motivating behavior.

McClelland and Atkinson developed a theory of motivation which is known as "Achievement Theory". In later works McClelland investigated the continuity of achievement theory which is influenced on economical growth. He proposed three basic needs that people develop, a need for achievement, power and affiliation. According to his theory, each person will be influenced by a need for achievement, power or affiliation. Two interesting points that

we can recognize from this theory are: 1) the theory suggests that motivation is changeable even in adulthood, and 2) rather than treating motivation as an independent variable, motivation becomes a dependent variable as researchers focus on antecedent conditions which develop a particular need.

Alderfer found three levels of needs. These levels are proposed in his ERG theory. Those levels are: basic existence or survival needs, relatedness needs dealing with social interaction and the external facets of esteem (recognition and status from others), and growth needs focusing on a person's desire to achieve and develop one's potential and the internal facets of ego fulfillment (success and autonomy).

Herzberg suggested that motivation is composed of two, largely unrelated dimensions. The approaches of the theory are: 1) those aspects and activities of the job which can prevent dissatisfaction but do not influence employees to grow and develop (hygiene factors), and 2) those job-related aspects and activities that actually encourage such growth (motivators). The main implication of this theory is that a focus on hygiene factors could only prevent job dissatisfaction.

III.B. PROCESS THEORIES OF MOTIVATION

While static content theories look at what energizes human behavior, process theories look at factors that channel or direct human behavior. Research has indicated that people vary quite considerably in the way in which they respond to similar aspects of their jobs. Many different needs may be operating

simultaneously and unfulfilled needs are influential in motivation. Three theories that are mostly used or recognized in this process theory of motivation are: 1) Expectancy theory, 2) path-goal theory of motivation and 3) goal-setting theory.

Expectancy theory is a function of three components: 1) an effort-performance expectation that: increased effort will lead to good performance, 2) a performance-outcome perception that good performance will lead to certain outcomes or rewards and 3) the value or attractiveness of a given reward or outcome to an individual. Thus for an individual to be motivated the outcome or reward must be valued by the person, she or he must believe that additional effort will lead to higher performance and that the higher performance will subsequently result in greater rewards or outcomes. The main implications which can be drawn from this VIE (Valence, Instrumentality, Expectancy) theory are:

1) Rewards or other outcomes to motivate people must be desired by those individuals.
2) If employees are to be motivated, they must perceive that differences in actual performance will result in differences in rewards or outcomes.
3) Employees must also perceive that their effort (behavior) will result in good performance.

A problem with expectancy theory, however, is that it assumes that people will act in a rational manner and weigh all the alternatives open to them.

Second process theory of motivation is path-goal model. This

model is often referred to in terms of leadership effectiveness. Its basic focus is the examination of motivation and the way in which such diagnosis can influence the management of performance. Individuals will be motivated to produce when they perceive that their efforts will lead to successful performance and the attainment of desired rewards. Thus management should focus on clarifying a subordinate's path to a desired goal or objective.

The basic premise of goal-setting theory is that a person's conscious intentions (goals) are the primary determinants of task-related motivation since goals direct our thoughts and actions. Not every goal necessarily leads to performance since a particular goal may conflict with other goals a person may have or may not be appropriate in a particular situation. In terms of goal-setting theory, managers should set clear and specific goals for employees, make goals sufficiently difficult to be perceived as challenging but not so difficult as to be viewed as impossible and involve employees in goal setting when appropriate.

III.C ENVIRONMENTALLY-BASED THEORY OF MOTIVATION

Environmentally-based theories of motivation generally focus on sustaining or maintaining behavior over time. These different models have largely dealt with motivation as an independent variable, that is, a particular need or goal is the cause of a particular desire which results in certain behavior.

Skinner's theory of operant conditioning assumes that human behavior is determined and maintained by the person's environment. Although behavior may be random at first, as an individual explores

the environment and reacts to it, certain behavior will be reinforced and subsequently repeated. Thus operant conditioning and reinforcement theory assumes that an individual's behavior or motivation is a function of the consequences of that behavior. The theory so far has focused on positive reinforcement (reward) to encourage the repetition of certain behaviors and using negative reinforcement (punishment) as an alternative way that can be used to shape behavior.

Social comparison theory focuses on the variables which surround the individual who is to be motivated. It looks at how people view reality based on their own experience. This theory suggests that attitudes about a particular job are likely to be constructed from both the present job situation as well as past behavior which is linked to the present job. Tendency to justify or rationalize certain behaviors help us to understand particular attitudes and behaviors.

Similar to social-comparison theory, equity theory looks at the comparison of the ratio of inputs (efforts) and outcomes (rewards) from each individual. This theory was developed by J. Stacy Adams in 1960. For the purpose of explaining aspects of motivation in organization, a number of different theories have been developed in the social science. This theory is the most relevant for that purpose since it is spelled out in detail and focuses directly on organizational behavior and performance. This theory noted in the traditional employee-employer exchange whereby the employee gives something (inputs) and gets something (outputs).

In detail, this theory says, the balance in employee-employer exchange can be calculated by dividing a person's outcomes by his/her inputs. If the outcomes are greater than the inputs, the person is being over-rewarded, but if the inputs are greater, he is under-rewarded. The equity feeling is not contributed by his/her own balances, but the equity feeling results when he/she feels being treated in the same ways as one's chosen reference group. The key is whether an individual perceives equity or inequity in this relationship:

$$\frac{\text{outcomes}}{\text{person's own inputs}} = \frac{\text{outcomes}}{\text{comparable other's input}}$$

The feeling of inequity is the result of an imbalance of the two sides. This feeling will lead to inequity motivation, which develops when those two ratios depart from each other in either direction. Adam's formula for calculating equity & inequity can be supplemented with the following proportion, which Adam incorporated into his theory:

1. Individuals will try to maximize their overall outcomes (rewards minus punishments).
2. Group & organizations can maximize their collective rewards by developing systems for equitably apportioning resources among members and then encouraging members to accept and adhere to those systems.
3. In general, groups and organizations will reward members who treat others equitably and punish members who treat others inequitably.

4. Individuals who believe that they are in inequitable job relationships, will become distressed and will attempt to eliminate their distress by restoring equity. The greater the inequity, the greater the distress, and the more intense the effort to restore equity.

The research on this theory showed that many over-rewards in equity are soon corrected through distortion and do not have long-term effects on performance, but under-reward in equity causes both absenteeism and turn-over.

Exchange theory basically attempts to explain group behavior in terms of reward exchanged and costs incurred in different interactions. Four basic concepts of this theory are:

1. Rewards or payoffs which emerge from a particular interaction.
2. Costs which are broadly conceived and encompass such factors as fatigue, anxiety, punishment, and loss of status as well as the value of other rewards an individual misses by not participating in other exchanges.
3. Outcomes which are defined as rewards minus costs.
4. Comparison levels or the processes through which an individual evaluates the outcome of a particular interaction against the potential outcome of a foregone interaction.

The process underlying exchange theory is that behavior is caused by inducements (rewards) of various kinds only when the outcomes

(rewards minus costs) exceed some minimal level of expectation that the individual could not achieve elsewhere (comparison level).

IV. CASES

Case 1: Sybron Corporation (D3)

Diversified manufacturing company
(See Appendix A for article)

Sybron Corporation is a diversified company in the areas which use high technology. They are producing chemicals, instruments, process equipments, dental products, scientific products, etc. Recently they are facing a problem, namely "The Executive Attic Problem". This situation or problem generates some questions to be answered such as: How long should an executive remain in his position? How should we confront the reality of the executive attic? What are the effects of this phenomenon on the individual and the corporation?

According to Mr. Sherran, Vice President of Corporate Development, to answer those questions some factors must be considered. These factors are: the necessity of providing opportunity for upward mobility to managers below the vice president level, the necessity of providing each successive president with the maximum flexibility in selecting his own top management team, and the mental, physical, and emotional health of executives involved.

The problem facing Sybron involves two of its top managers. Both men are very valuable. They are good managers, they have devoted great time and effort to the development of their subordinates, but Sybron has also many young aggressive executives who would make excellent successor. If Sybron keeps these two managers, it will block the advancement of the young subordinates

and also will cost a lot of money.

Four solutions or alternatives are offered to solve this problem: Promotion, lateral movement, demotion and early retirement. Using promotion, the individual can be bumped up while maintaining his status and position, where he can continue his contribution to corporate goals. Lateral movement can be accomplished by moving the executive to staff or as a special assistant with no change in the communication level. Using demotion, executive would be demoted to a lower communication level by creating a shelf-job or by returning to a former job in which he was successful. Mr. Sherran is mostly in agreement with the early retirement alternative. Three phases must be considered in order to apply this fourth alternative:

1. To systematically prepare people throughout their working careers for the realities which inevitably will come their way.
2. To provide shock absorbers in the form of counseling services to help people cope with psychological injury.
3. To provide an attractive and equitable pre-retirement or semi-retirement program to maintain financial and psychological wholeness. This program would not be provided for executives who exhibit poor performance or lack the trust and confidence of the superior.

Another solution to the executive attic problem was reorganization. Either by creating new position to be filled by the candidates or creating new position to be filled by the present

group vice president and then placing the candidates in the vacated group vice president positions.

Case 2: Sybron Corporation

Diversified manufacturing company

(See Appendix B for article)

Sybron Corporation is facing a problem about compensation system, particularly the bonus system. Old bonus system was designed for the top executives in order to provide incentive to improve earnings and accelerate the company's growth. The principal concept for this incentive plan was improvement of the company's earnings as measured by the return on assets employed (RAE). Thus company has to maintain a certain level of RAE to generate yearly bonus fund.

The bonus fund was distributed to the various major segments, then to the operating segments (division), and finally to the individual participants. Each group or division was evaluated on the basis of several factors which are; qualitative in nature, quantitative measures and ratings. And then each executive received his share of the bonus fund for his organizational segment based on the operating segment's share and qualitative rating of the segment.

Criticisms of this bonus plan by group and division management ranged over a number of issues. One group objected to the basic fickleness of the system. It may be imbalance bonus from one group to another. Another group made a number of complaints based on the fact the amount of an individual's bonus
depended largely upon factors over which he had little or no control. Another complaint is that the bonus system sometimes complicates the hiring process and too complex to be effective.

Not all groups criticize the existing bonus system, one division president felt that the bonus was a useful tool to review subordinates' performance.

Arise from those criticisms, Mr. Cliff Sherran, Vice President of Corporate Development has to re-examine the existing bonus plan. By the help of his subordinates and the consulting firm, McKinsey & Company, he came up with several alternatives to the compensation plans. One solution is reward the division executives based on their division's performance, for which quantitative measurement could be developed.

By the end of Mr. Sherran re-examination, he has to choose one of the following solutions:

1. Make no change in the bonus system.
2. Discontinue executive bonuses.
3. Tie individual bonuses to quantitative performance measures only, thereby eliminating all qualitative aspects of evaluation.

Mr. Sherran felt that the third solution is preferable, because assessing qualitative aspects of performance in annual evaluations of groups and divisions had been largely unsuccessful. He also felt that it would increase general acceptance of the bonus system without introducing serious dysfunctions in the corporation. The divisions would continue to be rewarded for superior performance.

Case 3: Lincoln Electric Company
Arc-welding equipment and electronic motors
(See Appendix C for article)

The Lincoln Electric Company of Cleveland, Ohio manufactures arc-welding equipment and electronic motors. It has been experimenting with various types of incentives and pay plans throughout most of its ninety years of existence (since 1895).

Rather than paying an hourly rate, this company uses a piece work basis. For each acceptable piece they produce, employees receive so many dollars. This system is applied for as many jobs as possible, usually based on individual output, and occasionally on group output.

In addition, each employee receives a yearly merit rating based on his or her dependability, ideas, quality and output, which serves as the basis for a year-end bonus. Every employee is evaluated by his/her supervisor twice a year. A person who is rated low within a unit loses out to those rated higher. It is not at all unusual for employees to double their yearly compensation as a result of bonus earnings.

After working one year in the company, each employee is guaranteed that he will not be discharged except for misconduct and he is guaranteed at least thirty hours of work each week. There has been no layoff at Lincoln since 1949.

Lincoln also provides training and education, even though it is just a short period of on-the-job training. Employee participation in this company is applied by giving more responsibility to employees.

James F. Lincoln says, "Financing for company growth should come from within the company, it comes from initial cash investment by founders, from retention of earnings and from stock purchases by those who work in the business" (the employees). One of the advantages of this approach is that it provides individual incentive because employees feel that they will benefit from company's profitability.

The result from those policies are that, the turnover is practically nonexistent, except for retirements and departures by new employees. And even though the compensation costs are high enough, the company is still able to remain competitive in its industry, because their productivity is sufficiently high.

From the interviews of some workers, most of them said that monetary incentives are the most important. Although there are several other things that are also important, such as good relationship between executives and workers and job environment, however most of them thought that financial incentives are the most important reason for working in Lincoln Company.

Case 4: Semco Company of Brazil
Manufacturing Company
(See Appendix D for article)

Semco is one of the fastest growing companies in Brazil. They produce a range of sophisticated products such as marine pumps, digital scanners, truck files, commercial dishwashers and mixing equipment for everything from bubble gum to rocket fuel. Their customers include Alcoa, Saab and General Motors.

Ricardo Semler, 30 who became Semco's president in 1980 made drastic changes in their concepts of management. Their New concept has three fundamental values on which they base some 30 management programs. These values are, democracy, profit-sharing and information. Those values work in a complicated circle, each dependent on the other two.

Democracy (employee involvement or participation) gives employees control of their works. Because it is clear that workers who control their working conditions are going to be happier than workers who do not. For examples, the employees can choose their own schedules, even on the factory floor. Twice a year can also evaluate managers and fill out a questionnaire about company credibility and top management competence. The company also insists on making important decisions collegially, and certain decisions are made by a company wide vote. Because the executives believe that in the long run, letting people participate in the decisions that affect their lives will have a positive effect on employee motivation and morale. This was proved when the company wanted to build a new plant. The employees chose the location and

designed the lay out. That plant really belongs to its employees. It has a clear result, the division's productivity in dollars per year per employee has jumped from $ 14,200 in 1984 (the year they moved) to $ 37,500 in 1988. And the market share went from 54% to 62%.

The executives believe that profit sharing will not motivate employees if they see it as just another management gimmick and if the company makes it difficult for them to see how their own work is related to profits and to understand how those profits are divided. In Semco, each division has a separate profit-sharing program. Twice a year the company calculates 23% of after-tax profit on each division. The division will decide what they want to do with that money. In most cases, they just distributed equally to all division members.

The company has experience that profit-sharing has an excellent chance of working when it crowns a broad program of employee participation, when the profit-sharing criteria are so clear and simple that the least gifted employee can understand them, and perhaps most important, when employees have monthly access to the company's vital statistic-costs, overhead, sales, payroll, taxes and profits.

For that reason, information is important. Semco provides classes that can be attended by all members to learn about numbers on balance sheet, profit-and-loss analysis and cash flow statement. Every month employees get the statements for their own division. By giving this information, it will tell the employees how well

they know their units, and tell them if there is going to be a profit.

So, the company just let the employees do whatever they want. It's up to them to see the connection between productivity and profit and to act on it. And by implementing this concept, management associations, labor unions, and the press have repeatedly named them the best company in Brazil to work for.

V. COMPANY INTERVIEWS:

The following is the questionnaire that our group developed to assist us in our interviews of engineering firms.

Motivating Engineers and Technical Staff

1. What kinds of rewards are used for the engineering and technical staff?
   a. Pay raises: annual, a given percentage, equally to all? Do they motivate one more than the other?
   b. Promotions: How do you promote a design engineer or technical person? Do you treat them differently.
   c. Benefits: Pension, insurance,...
   d. Special awards: Please explain if any.
   e. Training, educational, academic opportunities.

   Which one of these rewards motivate engineers more effectively? Which one of these rewards motivate technical staff more effectively?
2. How do you measure the productivity and performance of your staff.
   a. What factors do you look at?
   b. What subjective rating measures are used?
   c. Do you have a systematic procedure to evaluate the engineers?
3. What type of working hours and schedule do you use? Do you feel that flexibility or rigidity of working schedule motivate your staff?
4. How do you provide recognition to your staff? Does it

motivate them?

5. Do you provide job security to your engineers and technical staff? Does it motivate them? Do you hire on a long-term or a short-term basis? How does it affect their performance?
6. Do you believe that the working environment can affect motivation of your staff? How do you change the working environment to affect motivation?
7. How do you work on individual staff members deficiencies?
8. How do you encourage positive competition between your engineers?
9. How does assignment of responsibility and decision making motivate your staff?
10. Do you think that company sponsored social and family activities enhances motivation?

Summary:

What do you think are the main motivators for the engineer?

What do you think are the main motivators for the technical staff?

Is the company motivation system working?

What are the important parts of your system?

INTERVIEW NUMBER 1

Company: Kramer Gehlen Associates, Inc.
400 Columbia st., Suite 240
Vancouver, WA 98660

Product: Structural engineering services.

Number of Employees: 19

Interviewed: Mike Hayford, Vice President

1. What kinds of rewards are used for the engineering and technical staff?

   a. Pay raises: They are given annually, based on the performance of each person, is he making profit on the work he is doing, and how he is doing on the work he is given. It is not always possible to make a profit on each job. Does he keep the client happy? Is he motivated for the office? After an employee has worked for a firm for a long period of time, it is more difficult to give them raises because you can not bill him out at any higher rate and still remain competitive.

   b. Promotions: Are based on how a person handles himself with a client and if he can handle the pressure and the problems.

   c. Benefits: Pay the full medical and dental plan for the employees and their family.

   d. Special awards: Bonuses are given at the end of each year, and are based on performance similar to pay raises.

   e. Training, educational, academic opportunities: We pay for any classes related to work.

Which one of these rewards motivates more effectively? We don't feel that any of the above items are effective long term motivators, but if we didn't provide any of them, they would become dissatisfiers. Technicians and engineers in this office are treated the same. We have not found the that engineers react differently than technicians to any of the motivators listed above.

2. How do you measure the productivity and performance of your staff? What factors do you look at?: Productivity, profitability, their ability to solve problems, and their ability to keep the clients happy.

3. What type of working hours and schedule do you use? Do you feel that flexibility or rigidity of working schedule motivate your staff?: We use a semi-flexible system. We like all employees to be at the office between the hours of 8:30 to 5:00. If a person needs to leave early or come to work late they are free to do so, but they must make up the time later in the week. We have found that too much freedom in the time schedule reduces the productivity of the company.

4. How do you provide recognition to your staff? Does it motivate them? We tell the employee when we get a complement from a client. When an employee is putting in a lot of overtime, we tell them that we appreciate it. A good comment to an employee is more motivating is the long run than a $150.00 bonus at the end of a good job.

5. Do you provide job security to your engineers and technical

staff? Does it motivate them? Do you hire on a long-term or a short-term basis? How does it effect their performance? We hire on a long term basis. When an employee is hired on a long term basis he is more productive and has more interest in doing a good job. When a person is hired on a short term basis they are only interested in putting in their eight hours and collecting their pay check. He doesn't care about the quality of work he is doing.

7. How do you work on individual staff members deficiencies? We tell the employee about their deficiencies. If it is related to engineering, we give him books to study on his own time and tell him he is free to ask questions of the senior engineers. We try to encourage them as much as possible.

8. How do you encourage positive competition between your engineers? NO! In a small firm competition between individual engineers, even positive competition, can have a very negative effect on the company. Engineering firms rely on team work to put out the highest quality work possible.

9. How does assignment of responsibility and decision making motivate your staff? Depends on the employee, if you let a person who is responsible and capable of making decision, do that, it can be very motivational. But if they are not capable of that type of work it can destroy them.

10. Do you think that company sponsored social and family activities enhances motivation? No. There are some employees that enjoy socializing and tend to take advantage of the

activities and other that don't. This can cause bad feeling between employees. I feel this does more harm than good.

Summary:

What do you think are the main motivators for the engineer? For good engineers and designers the motivators are: Good office attitude, being well treated in the office, good communication between their boss and themselves, good pay, and recognition of good work when it is done well.

What do you think are the main motivators for the technical staff? Technical staff react the same as the engineers.

Is the company motivation system working? It works well. We need to think about motivation more often.

INTERVIEW NUMBER 2

Company: Moffatt, Nichol & Bonney, Inc.
1845 N.E. Couch St.
Portland, Oregon 97232

Product: Civil, Structural, and Architectural services.

Number of employees: 36

Interviewed: Robert M. Bonney, Partner
James R. McGrew, Senior engineer

1. What kinds of rewards are used for the engineering and technical staff?

   a. Pay raises: They are given annually and are based on the performance of the individual. We feel that this is more motivating.

   b. Promotions: They are based on the performance of the individual and when the managers feel that the person can take on the added responsibility. A lot of our technicians are promoted to engineering positions. They are very motivated and are hard working people. Same with our CAD operators.

   c. Benefits: We provide the usual health insurance.

   d. Special awards: We do not make any special awards, but do give out bonuses at the end of the year.

   e. Training, educational, academic opportunities? We do pay for work related classes, but we don't know how many employees are aware of this program.

   Which one of these rewards motivate more effectively? None of the above items are real strong motivators, but if we did not have them the employees would not be satisfied with their

jobs.

2. How do you measure the productivity and performance of your staff? We do not have a set program or procedure. When the owners and the managers feel that a person can handle the added responsibility they give him a small job with the added responsibility and watch how he handles it. If he does a good job then he is given larger jobs.

3. What type of working hours and schedule do you use? Do you feel that flexibility or rigidity of working schedule motivate your staff? We have a semi-flexible work schedule. If a person needs to take some time off during the day or come in late some days it is OK as long as they make the time up that week or on the weekend. Each employee is expected to work a minimum of 40 hours a week.

4. How do you provide recognition to your staff? Does it motivate them? By complementing them on their work. We feel that we do not complement our employees as much as we should. Specially the young engineers like to be told if they are doing better.

5. Do you provide job security to your engineers and technical staff? Does it motivate them? Do you hire on a long-term or a short-term basis? How does it affect their performance? Everyone is hired on a provisional bases until they see how they fit in with the rest of the employees and what kind of work they do. We hire on a long term bases because we find it more productive. Our base group of employees have been

with the firm for an average of 15 years. We have hired several new employees in the last couple of years as the work load increased and we expect them to be long term employees. We do not like to lay off employees when there is a slow down in work load. We will either cut back on hours that all employees work or try to find work in another firm for the employee until the work load increases.

6. Do you believe that the working environment can affect motivation of your staff? How do you change the working environment effect motivation? We try to keep a good positive atmosphere to work in by hiring good people, and complementing them on their good work. There is always support and someone to give you assistance with your work.

7. How do you work on individual staff members deficiencies? We work with them to improve on their deficiencies by giving them work in that area and helping them by answering their questions and directing them to books that will help them improve.

8. How do you encourage positive competition between your engineers? NO! We feel that competition within a engineering firm can cause that firm to fail. Engineers must work together as a team to be effective. Competition does not allow this.

9. How does assignment of responsibility and decision making motivate your staff? Yes, both engineers and technicians are motivated when they are given responsibility which they are

prepared to handle. But if you give someone too much responsibility too early, it can discourage them and reduce their productivity. It is very hard for managers to determine the amount of responsibility an employee can handle.

10. Do you think that company sponsored social and family activities enhances motivation? Yes. It is good for the families to meet the other people that work at the office.

Summary:

What do you think are the main motivators? Good communication between the managers and the employees is the most important motivator. Complimenting the employee is very important and providing them with a good working environment. We try to give our employees a variety of work to keep them motivated. People are not motivated if they have to work on the same thing all the time.

Is the company motivation system working? We don't have a motivation system, but after going through these questions we feel that we need to think about motivation a lot more.

INTERVIEW NUMBER 3

Company: Intel Corporation
5200 NE Elam Young Pkwy
Hillsboro, OR. 97124

Product: Software, and Hardware

Number of Employees: 20,000(world wide), 3-4000(Oregon)

Interviewed: Robert C. Brown, Manager of a Software Engineering Group

I am not an Intel's spokesman, that is not my job, you cannot quote me as this being Intel's policy. I can give you one engineering manager's opinion integrated over a number of different companies, but you cannot construed this as Intel policy.

1. What kinds of rewards are used for the engineering and technical staff?

   a. Motivation is one thing and things like pay raises, promotions and benefits are more of gut-level. To get someone do a job, those are compensation areas rather than motivation. We certainly use pay raise as a reward primarily on an annual basis, not as a given percentage and not equally, I believe pay motivates some people more than others, everybody likes to make more money, but some are motivated more by Dollars. People that I work with are specially motivated by seeing their product in the industry, they want to see their product written about, they want to see their product talked about, that's what motivates these people, they feel they are doing something that matters, that is important in the industry, that is a much more motivating factor than a

pay raise. The people we work with are exempt professional people, and other technical staff are outnumbered by the engineers and are basically motivated the same way as the engineers are.

b. There are two career tracks, an engineering career track and a technical career track, they both have roughly the same process, but they are run separately, people are compared with different peer groups and are compared with their peers,the criterion is different for each, but in each case there is a criterion. It is relatively a uniform format throughout the company promotions are scrutinized by a group of managers on an annual basis, so people are put up by their manager for annual promotion, and that is reviewed by their peer managers, who hopefully have some visibility in their abilities, it is not a single person making the decision it is a group decision.

c. Intel provides health and dental insurance, pension plan, a 401-k plan, a lot of different benefits and in the several forms. I think these are less important to the junior employees and more important to the senior employees, for a new college graduate the benefits are not so important, he doesn't have any dependents.

d. Yes we use all kinds of special awards, an individual achievement award, a company wide award that every body is recognized, then there are divisional and departmental

awards, they come in different flavors, a $50 cash award for a small accomplishment to a $1000 award if you do a major thing, like if you get a patent or get a paper published there is a $1000 incentive, in that bulk part. I don't think people do things to get these bonuses, what it does is a way to recognize the person after he/she has done something, a way to recognize their contribution after they have done something, and people appreciate that. Typically if we do a product release, the release team will get a little walnut plaque, with their names and what they did, people hang it them in their offices as a reminder of what they did, and that they did a good job.

e. Intel has an in house education group, provides training, certainly it is there to motivate people, to make it easier to continue their education, but I don't think it is used as a perk, the training is a prerequisite not a perquisite. You got to have the training to keep your employee competitive, it is not used as a reward, you don't get to go to a class for doing a good job, you get to go to a class in order to get the training you need to do your job. Perhaps going to a convention or something like that is seen as a reward, but training and education is seen as a part of doing business not as a reward. Intel also has a master's degree plan which is not seen as a reward, only given to one or two people a

year, a full pay program, but awarded based on people who apply. That is the only area where education is tied into award. Intel sponsors it, it is a real gut-buster master's degree it is not like you get time off, you got to be dedicated if you want to sign up for it.

f. I think it depends on the rank of person the junior engineers might be motivated by the pay raise, the more senior engineers are motivated by the promotions and most senior engineers are probably motivated by the benefits, and everybody likes the special recognition awards just because somebody has noticed what you have been doing. It is difficult to say what are the most effective motivators, maybe the little plaques that go to your office are the most effective ones, because you see them all the time. You get a hundred dollar bonus, you get it and spend it the next week, but the twenty dollar plaque, the dinner that somebody gave you, the pat on the back that was publicly given to you probably means more. Each reward has it's own place, otherwise we wouldn't have all these different ways of rewarding people, I don't think there is a best one, there is got to be a spectrum, some rewards recognize a year of work and some say two weekends that you worked on a special project.

2. How do you measure the productivity and performance of your staff?

Intel has a methodology called management by objectives. Every quarter a department sets their objectives and operations sets their objectives. They review those every month as a group and grade themselves, so it is two problems: one you spend some time agonizing over what your objectives are going to be for the quarter as a group and once a month you review how you are doing.And each engineer spends time writing the status report once a month where he lists his personal objectives and key results and how you did against them. So they set their own objectives and key results as a group and then as individuals and they grade themselves as how they did against them. That is not used as how management grades individuals, but how engineers and groups grade themselves. This is to let you know were you are, but it is not used for pay raises or promotions, these are parts of status reports and copies of it goes to the management. Its an internal check and balance, it is not how you would set rewards.

For rating productivity and performance, managers from the group of peers sit down together and through a process of ranking and rating, rank the engineers in the group, best performer to the least best and then they rate them on a four point scale and compare it with the norm for their grade level. We give a written review to each engineer once a year. The review says what you are good in, what you are weak in, what you need to work on. This is on a yearly basis and is

coupled with the pay raise and promotion cycle. We like to call it areas for improvement rather than deficiencies or even weaknesses. Manager will work on the employee and encourage him to take training if that is what he needs, present him with different situations if he needs to challenge himself in a different way. So we have a yearly cycle to evaluate the engineers with a check point at mid-year. One is a formal one and the other informal.

3. What type of working hours and schedule do you use? Do you feel that flexibility or rigidity of working schedule motivate your staff?

   We encourage a 8 to 5 work slot, we don't have a company wide flexitime although we can accommodate individual basis as special occasions come up. Because Intel is a world wide company and since we have a lot of intra-organizational meetings it is difficult to deal with people flexing their time all over the place. Up until a year ago Intel had a late-list that needed to be signed in if you were late and it was very rigid it is less rigid now.

4. How do you provide recognition to your staff? Does it motivate them?

   One is just personal recognition, just acknowledging what they did to them in your presence and that you understand what they did. We are not specifically taught as how to recognize somebody. On occasion take somebody to lunch if they have

reached a mile-stone, if they have released a product then we will have a dinner.

5. Do you provide job security to your engineers and technical staff? Does it motivate them? Do you hire on a long-term or a short-term basis? How does it effect their performance?

   Difficult question, Intel hires temporary people for specific job, hires contract people for specific job and hires people for what is called whole time permanent. Permanent positions are not likely given and are not likely filled. In the high-tech. business environment nothing is forever. People come with that understanding and I think that it works.

6. Do you believe that the working environment can affect motivation of your staff? How do you change the working environment effect motivation?

   Intel has a campaign, a corporate objective to make Intel a good place to work. They asked the employees what is that is bothering you and they requested the late-list to be abolished. Also they asked for showers and lockers and we put it in. We do try to take steps that make the working environment more pleasant. This was a corporate objective, then each division took it and said what do we need to do at this local to satisfy the objective. They also quick banned smoking from the building except in certain areas. Like for the case of smokers it was a constant source of annoyance to a majority and time was spent on people complaining and so on. So it has made everybody more productive.

7. How do you work on individual staff members deficiencies?

   Yearly review as previously explained, with quarterly follow ups. If someone is grossly deficient, there is a written procedure and informs the employee that he is less than the requirements to meet the job and that a plan is put together to help the employee to rectify that.

8. How do you encourage positive competition between your engineers?

   I don't think we have ever done that. Competition with another company yes, but competition between engineers just doesn't fit.

9. How does assignment of responsibility and decision making motivate your staff?

   Giving people more responsibilities definitely gives them more incentives, they feel that they are acting on their own initiatives and they will carry a lot more weight. The trick is to figure out when a person is ready for more responsibility. Sometimes that is hard to do, so you have to give him a test case. But in most cases the engineers rise to the occasion.

10. Do you think that company sponsored social and family activities enhances motivation?

    Yes it gives the family a better feel for where the employee is, what his work is, and who he is working with. Intel has an annual picnic in the summer and a social event in the winter time.

11. Summary:

a. What do you think are the main motivators for the engineer? For me the most important thing is that the engineer is seeing that what he is doing has an impact on the industry; if they don't think that they are working on something important it is tough to motivate them. As far as assigning people on projects it is sometimes hard. There are glamorous ones and there are ones that have more visibility than others. But as long as people take a long view and recognize that today they are on a high-profile project but tomorrow they won't be, then that is ok.

b. What do you think are the main motivators for the technical staff? I think the same motivators are for the technical staff, because they are pretty much outnumbered by the engineering staff, and they tend to have the same values set.

c. Is the company motivation system working? I don't know how to measure that except by success of the company. Intel overall is a successful company. Intel overall is about 20,000 which is a worldwide figure; in Oregon it is somewhere between 3-4000.

d. What are the important parts of your system? Good question, I think you have to view the whole thing as a continuum. If there was only one method that worked best we would be using only that one, the fact that there is

a bunch, says that different situations demand different kinds of rewards, people with different positions in their career need different kind of reward. One reward is just working for a company that is doing well. The company wide presidents have no walled offices, so there is that kind of openness, there is no segregation in the cafeterias, parking lots, rest room facilities for the managers as opposed to the other employees. I would say this comes with most of the successful high-tech companies.

VI. DISCUSSION-CONCLUSION:

From our review of the literature, interviews, and our own personal experience, we found there are several ways of motivating engineers and technical staffs in engineering office environment. They can include rewards, recognition, communication, working environment, job content, job security, responsibility and decision making, etc. which should be applied by the management at the proper time and conditions.

We have found that rewards like pay raises, promotions, and benefits are generally considered as compensation rather than motivators. It is not to provide means for long term employee motivation, they are expected by the employees, although their non-existence would work as a dissatisfier. This closely correlates with Herzberg's theory "Hygiene Factors". A "healthy" company is deemed to have such policies.

Bonuses seem to have more effect than the above mentioned rewards on the motivation of the employees. Bonuses should be given frequently because they seem to have short term effects on motivation.

"Rewards should be given as soon as possible after the desired performance occurs. The employee will be more likely to associate the reward with the performance. Rewards should be contingent on performance. If you give rewards that are not deserved then they will lose their values." [12] This application of the Equity Theory was reinforced in our interviews.

Training and educational opportunities are looked as

prerequisites not perquisites. They are provided by the companies because it is required for maintaining the employee's skill level required for his position or future promotion. However the fact that the training program exist in the company and that the employees can always rely on it as a technical support, serves as a motivator.

Positive reinforcement (rewards) is generally preferred to encourage repetition of certain behavior leading to improved performance as opposed to negative reinforcement (punishment) as pointed out in Skinner's Theory.

Response to rewards vary with the age of the engineers and technical staffs. Single engineers respond more to monetary rewards and engineers with family respond to benefits such as insurance. We found that engineers and technical staff in engineering offices respond similarly to rewards. Technicians are typically outnumbered by the engineers in these companies, and they also work as a team with the engineers, this results in common response toward the reward systems.

Recognition is an important factor in motivating the engineers and technical staff. Recognition should not be confused with monetary reward. It is a way of telling them that they count in the organization and that the management understands and appreciates their contribution. It can be as simple as a "thank you" or some kind of direct personal attention, it can be given to an individual or a group of employees at the same time, a group gathering such as a dinner, a plaque given to a project team with

their names and what they accomplished, or giving a public announcement for someone's achievement. Another method of providing recognition is to increase the employee's responsibility as he improves his skills. The recognition should also consider the technical, social, cultural and background of the employees. What may work as a motivator for one employee may not be perceived as such by other employees.

Managers should try to **provide support** to the needs of their employees and **communicate** with them properly.

-- do not only hear, but listen.

-- do not only see, but assimilate.

-- do not only promise, but act upon it.

Both cases and interviews suggest that we need to consider the **work environment and job content**. Set clear and specific goals, sufficiently difficult to be perceived as challenging. Involve them in goal setting when appropriate. It is important to equitably distribute the projects with high visibility and other less glamorous projects between the employees. The employee should be given projects which are closely related to his specialty but should also be involved in projects which challenge him to exceed his current level of knowledge. It is also important to provide **job rotation** for more creative work environment. Some kind of **flexibility in working hours** should be provided to employees, too rigid time schedules can be demotivating. **Competition** between companies is desirable, however competition between engineers within a company should be discouraged. We have found in our

interviews that engineering companies encourage team work and competition is a deterrent to team work.

Job security is another factor in motivating engineers and technical staff. Hiring employees on a long term bases can be more motivating. The companies that we interviewed have found that people hired on a short term bases or temporary bases tend to be less productive and less motivated. On the other hand, job security should be tied to the performance of the employees.

Another general factor affecting motivation of the employees is the **company's size**. As a company gets larger they must change the way they motivate their employees. In larger companies the management is more distant from their employees and must have a more structured motivation system, such as a reward plan, plaques, bonuses etc. In small companies the employees are in contact with the management and motivation can be accomplished in a more informal basis such as a verbal compliment from the management.

This paper investigated motivational factors for engineers and technical staff under limited time and information sources. Various motivational techniques and theories were reviewed and we can conclude that there is no universal single principle of motivation that can be equally applied to all cases. From a managerial stand point, therefore, it seems that using the theories and perspectives is as part of an ongoing diagnosis of organizational activity rather than assuming we know the answer about what motivates people.

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VIII. APPENDICES