Title: The Retention of Engineers and Scientists in High Technology Companies

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Abstract: Many factors contribute to the competitiveness of high technology companies. An essential factor is the staffing level of engineers and scientists to meet the technological challenge. This report compares the factors that affect the retention of graduate engineers and scientists in high technology companies

THE RETENTION OF ENGINEERS AND SCIENTISTS IN HIGH TECHNOLOGY COMPANIES

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EMP - P8811

TABLE OF CONTENTS

Problem Statement :

Many factors contribute to the competitiveness of companies involved in the high technology marketplace. An essential factor to a company's competitiveness and profitability is their staffing levels of engineers and scientists at any particular time to meet a technological challenge. This term project studies and compares the factors that can affect the retention of graduate engineers and scientists in high technology companies. Our goal is to enable companies to better retain their engineers and scientists through the comparative analysis of their management policies and strategies with those factors that affect retention.

I. INTRODUCTION

Why Engineers and Scientists?

In today's economy, the United States work force is shifting more toward information-based industries and technologies. Also, it is accurate to say that the world economic triad of the United States, Japan, and western Europe are all shifting toward an increasingly dependent role on information processing technology and industries. In the U.S., 67 percent of the work force is projected to be engaged in information processing work by 1990 [7]. The "fuel" that will continue to power the economies of the economic triad in the information age is the respective country's supply of trained and motivated engineers and scientists. It is this class of workers, more than any other, that will continue to push the boundaries of knowledges for those companies involved in developing and marketing high technologies.

However, in the face of record demands for engineers and scientists, engineering enrollment in colleges and universities is down nationwide [1]. This translates to a future shortage of qualified technical personnel. Retention of engineers and scientists already employed in high-technology companies is a critical factor in determining responsiveness to a technological challenge [10]. The existing engineers or scientists employed in a company represent a significant investment to that company. Not only to fulfill the present company needs, but also as future protection against the predicted shortages in engineers and scientists.

There are both direct and indirect costs to companies in the recruiting, hiring, developing, and maintaining their employees [1]. Generally, less turnover in focal employees (engineers and scientists), the better the financial picture for the company. Also, it has been established through previous research that the factors effecting retention of the highly innovative and creative engineers and scientist are different than those of non-technical workers. For these reasons this study focuses specifically on the retention of engineers and scientists.

Studies have established the reasons why desirable and competent technical personnel leave or stay in high technology companies (see appendix). Our study compares the management policies of local high technology companies to research factors which affect the retention of technical personnel. This study also will evaluate the effectiveness of management strategies in improving retention rates. Originally, the Project Team was going to do a comparative analysis on the management policies and strategies of local high technology companies regarding the retention of engineers and scientists with the management policies and strategies of high technology companies in Japan and France (see appendix). We had intended to compare local company policies through a literature search of foreign companies.

We were not able to find any literature dealing with the management policies and strategies regarding the retention of focal employees in foreign high technology companies. However, we did find some articles that talked in a general sense about

A. Existing Reasech Information Regarding Turnover Propensities

To address the study on retention, the project team first investigated reasons, as established by existing research information, why engineers and other technical personnel leave their positions in high technology companies. The Literature Search team collected important research information on turnover propensities among technical personnel from existing research reports in the IEEE journal, Personnel Management publications, the Journal of Management, and other behavioral science journals. It was necessary in this report to develop the factors effecting turnover among focal employees based on existing research for the following reasons:

1) Summarizes the literature search of existing data regarding the factors in the work environment and turnover propensities among focal employees.

2) Provide a standard of comparison for the effectiveness of the personnel policies of high technology industries.

3) Provide guidance in the development of the survey questions used by the Company Survey group to collect information germane to the retention of technical personnel.

B. Survey of Local High Technology Companies (see appendix)

Concurrent with the literature search phases of the study was the company survey phase. This phase involved making contact

and interviewing with key management personnel of local high technology companies to gather information regarding the retention of their focal employees. These companies were chosen for their significant research and development activities. The companies selected for study were Intel, Tektronix, Hewlett-Packard, and Wacker Siltronic Corp.

The Project Team, with the insights gained from the literature search, devised a questionnaire to use for the personal interviews of the key management personnel from the selected companies. The questionnaire included questions regarding:

1) Turnover rates, normal attrition rates, average tenure, number of focal employees, and salary structure.
2) The management policy, written or unwritten, for the recruiting, developing, and maintaining of their engineers and scientists.

C. Comparative Analysis of the Selected Companies

After the collection of all the data from both the literature search and the interviews, we performed a comparative analysis of the issues regarding the retention of focal employees. We compared, as closely as we could, literature search data factors regarding the turnover to the actual management practice of selected local companies. This required processing of raw data into forms where a valid comparison could be made.

FACTORS	Sherman(2)	Bluedorn(3)	Bartol(4)
1-Promotional Opportunity	1	2	1
2-Job Content	2	3	2
3-Autonomy	4	5	**
4-Immediate Supervisor	7	6	5
5-Fellow Employees	8	9	3
6-Self Esteem	6	1	**
7-Resources & Environment	9	8	*
8-Goal Congruence	5	7	*
9-Equity of Reward	3	4	4

* not studied ** noted as important and discussed

Other factors such as age, tenure, extent of education, state of the economy, etc. all were associated with turnover, but those highlighted in the matrix have behavioral implications either in their entirety or in part. The group manager is able to control these factors of the group environment.

Description of factors

1. Promotional Opportunity - The perceived ability of an individual to occupy roles or positions in the organization that offer higher rewards.

Studies have found that technical professionals who have had the opportunities to rise in a company have the tendency to remain in that company. The rate of turnover is small compared to those who have no promotional opportunities. On the other hand, companies make it one of their criteria to advance employees who have shown likelihood of staying in the company. However,

individuals tend to have advantageous conditions toward career development. More of this promotional opportunities could be witnessed on the Japanese work force where many of them are switching firms looking for promotional opportunities. (Wall Street Journal, Vol. CXIX No.71, Oct 11, 1988)

2. Job Content/Satisfaction - The degree to which the content of the work itself is satisfying, meaningful to the individual, or non repetitive.

It is proven that engineers who love their job description or job content stay longer at work than those who don't. They have longer hours during their normal working-day ie., they do not quit in time. A study done by Kraut and Porter indicated that satisfaction with work assignments has been found to significantly affect turnover rate. However, job content and work assignment may depend heavily on the manager's ability to identify individual's special talent and specialty. Failure to recognize these special talents may result to misallocation of human resources and which will in turn cause a turnover.

3. Autonomy Level - The perceived right the individual has in setting his own goals and work direction.

Due to the nature of their jobs, most engineers and scientists tend to enjoy autonomy especially in project organizations. Technical professionals are drawn towards autonomous work environment than non-technical employees. As one expert puts it, Engineers are substantially disabled in communication due to the nature of their work, and especially

when an engineer is a designer. In addition, the level of autonomy that the individual possesses has been found to be negatively correlated with turnover and positively correlated with innovation [2]. However, the level of autonomy depends on the organizational setting and supervisory style.

4. Immediate Supervisor - A function of the human relations skills possessed by the supervisor with regard to resolving conflict rapidly and equitably.

This factor is widely speculated among expert that turnover rate in an organization depends heavily on the managers. Strict supervision may become a burden to technical staffs and professionals. The relationship between an employee and his immediate supervisor has very strong impact on the retention of the employee. A study of engineers at General Electric where higher turnover rate were found among engineers who indicated that they received less personal assistance from their superiors. proved that managers who pay little attention to human relations are additional factors of inflated turnover rates. However, turnover may be instrumented from the top where the managers use strict supervision weapons for turnover. According to William W. Holloway's workshop on coping with employee turnover in the age of high technology, indicated that strict supervision may bring about high turnover rate.

5. Fellow Employees - Individual perception of acceptance by the group and a feeling of teamwork among its members.

Teamwork is one of the main factors affecting the decision to leave or stay in a job. An employee who does not get along

with his coworkers might readily leave at the first opportunity. A study done by Hellriegal and White found a negative relationship between the quality of teamwork and turnover. Individual personality can enhance a team effort or group participation. The studies also recommended that workers of like personalities should work together.

6.Self Esteem - The degree to which an employee is able to achieve and obtain recognition for successful achievements. Related to ego satisfaction.

It is very important to technical professional to feel that they are recognize for what they do by their peers. In the R & D industries or units, employees are known for what kind of work and what kind of studies or research they are doing. Individual pride builds up by simple realization that their peers respect them, and that they have high esteem.

Both Hellriegel and White and Marsh and Mannari found that perception of prestige or status with the company or the community resulted in lower turnover. Similarly, Farrish found that status and opportunities for self-actualization influenced turnover among engineers.

7.Resource or Environmental Adequacy - The adequacy of the physical plant which is provided the employee.

This subject influenced turnover rate in a less dramatic manner than the one mentioned above. Sherman mentioned that here is statistical significant impact on turnover where individuals

who consistently lacked the necessary resources to conduct their work effectively coped with the frustration through seeking alternative employment.

8. Organization and Individual Goal Congruence - The expectation of the job before hiring as it relates to actual assignments after hiring.

Many technical professionals become obsolete when the organization is redefining its goals. This is also the same as individual Engineer or employee begins to define new goal for him self. It is always clear that it takes two to make a pair.

Dunnette, Arvey and Banas found that an important non financial antecedent to turnover is the degree of incongruence between expectations prior to employment and the subsequent realization of those expectations.

9. Equity of Reward - The perception by the employee that he is being treated equally with respect to the inputs / outputs ratio.

No doubt, every employee wants to be paid either in cash or in kind. Salary may not be the main issue but an employee must expect to gain a reward equitable to his proffessional annual salary adjustments play a major roll in the retention of engineers and scientists. Failure to adhere to equitable compensation has contributed to a high turn over rate.
Armknecht and Early found in their study that most important factor determining industry variations in voluntary separations was level of earning and in ability to compensate employees according to their work.

IV. LOCAL HIGH-TECH SURVEY AND RESULTS

The employer questionaire (see appendix) was an attempt to associate the factors effecting retention to the policies and practices of the local high-tech companies surveyed. The four companies responded to a varying degree, and all wished to have the results remain confidential. To facilitate this, only companies A, B, C, and D will be mentioned. Also, the number of focal employees will not be given (The company identification is given in the special appendix).

QUESTIONAIRE - RETENTION FACTOR STUDY

5 - High Factor Score 1 - Low Factor Score

Factor	Question #	Comp.A	Comp.B	Comp.C	Comp.D
* Promotional	6	3	3	5	2
opportunity	7	4	5	4	5
* Job content	14	4	N.A	4	4
* Autonomy	4	5	4	4	5
* Supervisor human relations	10	3	3	4	5
* Employee self esteem	11	4	3	4	3
* Goal Congruence	12	4	N.A	4	4
* Fellow employees	13	4	N.A	4	5
* Resources	15	4	4	4	5
* Pay equity or salary (1 - 4)	5	3	4	4	4
Total points (49 poss.)		37	26	41	42
N.A (response not given)					
avg. per response		3.70	3.71	4.10	4.20
Organization deems retention important					
	1	4	5	5	5
	16	4	5	4	5

The factor being studied appears along with the questionaire question number dealing with the factor. Company responses from 1 to 5 (except question 5) are associated with the answer. The higher scores indicate company recognition of factor importance and a company program which deals with provision of the employee needs. The total points and the average points per response are not statistically significant, but they offer a couple of interesting associations and possible fuel for further study.

V. COMPARISON OF FINDINGS

Company A deemed employee retention slightly less critical from the answers to questions 1 and 16. This corresponds to an average factor score of 3.70. The other companies all rated retention as more critical, and had higher factor averages. This indicates that employers are generally aware of factors effecting retention, and provide valued factors to a greater extent, when retention is viewed as critical to the organization.

Another view of the responses reveals that average tenure at the companies was similar. Since A is providing less need factors / tenure ratio, factors outside the realm of the study probably have a presence. This may include factors such as long term company stability or reputation, employee seniority, employee qualifications or level of expertise, or the level of stress.

The scatter of the factor responses suggests that a "more balanced attack" of retention could be suggested. The responses of companies B and D indicate possible deficiencies in certain areas. Since particular individuals associate with various

factors, the companies interested in general retention should analyze their practices with respect to all of the factors.

VI. MANAGEMENT STRATEGY FOR REDUCTION OF TURNOVER

An appropriate selection process is most beneficial to the employer / employee relationship. Thorough content analysis and an exact job description are prerequisites to a successful interview process. But the management effort does not stop after the "right" employee has been chosen. Managers must develop a proactive plan which regularly assesses the highly ranked factors developed through the research articles.

* Promotional Opportunity

This can be performed through career pathing. It requires developing a potential career plan for those who desires to improve their position. Included is the fostering of skills development and a clearly communicated set of goals and expectations of the individual with respect to future employee that management is involved with his efforts. The probability of successful attainment is not the key factor, but the fact that a path exists to the employee and this path gives him the a means of self-actualization (the highest form of personal challenge).

* Job Content

High tech companies employ many technically degreed specialists. This specialization leads to involvement with smaller areas of work. One detrimental result is the employee loses site of where their efforts fit relative to the overall product. Job rotation offers three advantages. First, it enables

a person to experience new challenges. Second, it exposes him to the total picture. Third, it allows the manager to develop multiple expertise which decreases the dependence on any particular individual.

* Equity of Reward

The organization should clearly relate pay to performance. This is not to say that other factors do not enter into salary issues, but among professionals, the outputs to inputs ratio is a visible measure of the higher order need attainment. Management should factor performance into raises, and focus levels of performance on acceptable bench marks.

* Autonomy

Management should attempt to expand the individual's horizon and broaden his freedom. This job enlargement requires managerial development of standards so that everyone works toward common goals under low levels of supervision. Managers must exercise discretion in autonomy issuance because many valuable employees desire continual concrete direction.

* Achievement / Recognition Programs

Setting challenging, but achievable, goals and subsequent recognition of high performance is a satisfier of individual's self-esteem and a method of assuring goal congruency. Drawbacks to these programs involve divisiveness through competition. Overall group effectiveness may suffer, and therefore, implementation of these programs must be carefully monitored.

VII. EXECUTIVE SUMMARY
(Employee Retention)

The many research articles and reference materials written on turnover show a list of common factors which effect an employees decision to remain with a company. Some factors such as geography, age, and salary are not directly controllable by the manager. The nine factors studied enable the manager to make the largest impact with the available resources.

Promotional opportunity

Job Content

Autonomy

Immediate supervisor human relations skills

Fellow Employees / Teamwork

Self Esteem

Resources and Environment

Goal Congruency

Equity of Reward

Although turnover does not negatively impact the organization in every instance, the research shows costs, impacts, and disruptions exceed overall benefits. Every manager must assess the retention issues, as they relate to the individual organization, and enact a "proactive" plan which sets a company plan of dealing with the issue.

Positive programs are exemplified through:

Career pathing to provide promotional opportunity

Job rotation and job customizing to prevent routinization

Broadened work scopes with increased freedom

Performance and pay relationships

Achievement and Recognition programs

After a program is initiated, the manager must continually obtain meaningful feedback which confirms the program effectiveness. The successful retention program will not only allow keep the expertise at home, but will also motivate the stayers to perform at higher levels.

Where are the journals mentioned on p.5?

VIII. REFERENCES

[1] . Bluedorn,Allen C. Research in Sociology of Organizations "The Theories of Turnover " Causes, Effects, and Meaning. Vol 1.

[2] . Sherman,J Daniel. IEEE Transactions on Engineering Management. " The relationship between Factors in the Work Environment and Turnover Propensities among Engineering and Technical Support Personnel ." Vol 33. May 1986.

[3] . Bluedorn,Allen C. Human Relation. " A Unified Model of Turnover from Organizations." vol 35, Number 2 1982.

[4] . Bartol,Katheryn M. Journal of Vocational Behavior . "Individual versus Organization Predictors of Job Satisfaction and turnover among Provessionals." Vol 15, (p.55-67) 1979.

[5] . Mobley,William H. Employee Turnover : Causes, Consequences, and Control.

[6] . Gardner,James E. Stabilizing The Workforce : A compete Guide to Control Turnover.

[7] . Holloway,William. Personnel administrator : Coping with employee turnover in the age of high technology. may 1985.

[8] . Price,James L. The study of turnover.

[9] . Barocci and Cournoyer, 1982.

[10]. Shannon,Robert E. Engineering Management.

References are cited here but not fully given.

IX. APPENDIXES

Comp. A - Wacker Siltronic Corp., Portland

Comp. B - Intel Corp., Hillsboro

Comp. C - Tektronix Corp., Beaverton

Comp. D - Hewlett-Packard Co., Corvallis

Introduce project team
Introduce project title

Engineering Excellence,
Senior engineers (Drucker)
Put proprietary info. in appendix.

3 Chapters regarding comparison of retention rates of Japanese, European, and US companies

ENS 541
October 17, 1988

Project Team:

Literature Search Team:	Company Survey Team:
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Term Project Title: The retention of graduate engineers and scientists in ~~company workforces in regard to~~ high technology ~~industries~~ companies

Strategy:

We will be performing a comparative analysis of this subject along two main fronts:.

1. The Literature Search team will gather existing data regarding retention rates of graduate engineers and scientist of high technology companies in Japan and France. The companies targeted for the literature search will be Sony, Mitachi, Fujitsu, Aerospatial etc. They will also collect management data regarding the policies or strategies of those companies towards the recruitment, development, role, and retention of their graduate engineers and scientists. Other factors such as social and corporate culture will also be studied. We realize that it is difficult to draw a direct correlation between the success of a company and retention rates of graduate engineers and scientists but we will gather data regarding the company's profitability anyway. We will narrow the time period for our literature search to 1978 - 1988.

2. The Company Survey team will gather data by performing a mix of literature research and survey questionnaires of local high technology companies. The companies targeted for this phase are Hewlett-Packard, Techtronix, Intel, ~~Data General~~, SEH America ~~Corporation~~. We will be seeking similar data such as retention rates, management policies or strategies, and company profitability. We will provide survey and a backup interview with contacts in the local high technology companies to present the results of our comparative analysis to them. Regardless of the results of the comparative analysis we will solicit their reactions. We will compile these responses with the other data make a subjective evaluation of the importance of the retention of a company's graduate engineers and scientists to the future of local as well as state high technology companies.

EAS 541 - FALL 1988
TERM PROJECT
EMPLOYER QUESTIONAIRE

SUBJECT: RETENTION OF GRADUATE ENGINEERS AND SCIENTISTS IN HIGH TECHNOLOGY BUSINESS.

DEFINITIONS:

Retention - Organizational success in keeping Focal Employees from finalizing a move to another company.

Focal Employee - A graduate engineer or scientist who has performed to a professional standard, and is considered worthy of future employment by the organization.

Please respond to the statements as you actually observe, have known to be true, or in a way which you feel the opinion represents organizational goals and objectives. The perspective viewpoint is that of the manager representing the organization.

1. Our organization agressively attempts to retain focal employees.
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

2. How many Focal Employees does your organization currently employ?

3. What is the average tenure of your Focal Employees?
A. 0 - 5 yrs How Many ?_____
B. 5 - 15 yrs
C. over 15 yrs

4. Does your organization pay salaries commensurate with:
A. market line studies
B. experience and salary history
C. value to the organization
D. other explain_____

5. Of the employees which have obtained employment elsewhere, salary was the main issue :
A. 0 - 25 % of the time
B. 25 - 50 % of the time
C. 50 - 75 % of the time
D. 75 - 100 % of the time

6. Our organization has clearly defined promotional paths for Focal Employees.
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

7. Our organization promotes from within whenever possible, and our Focal Employees are aware of this organizational value
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

8. Rank the reasons Focal Employees seek employment elsewhere: 1 is most often sited, thru 9 which is rarely sited
_____ Work assignment dissatisfaction
_____ Conflict with supervisors personality
_____ Lack of perceived teamwork ethic
_____ Other personal reasons
_____ Dissatisfaction with promotional path or progress
_____ Dissatisfaction with salary
_____ Resources or work environment not adequate
_____ Environment deficient in autonomy
_____ Individuals goals not compatible with organizational goals

9. Our Focal Employees are offered a high level of autonomy at work.
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

10. Supervisors of Focal Employees are trained and consciously evaluated on human relations skills.
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

11. Supervisors regularly focus on and attempt to improve Focal Employee self esteem.
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

12. Supervisors and Focal Employees develop goals thru a process which assures goal congruence.
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

13. Supervisors cultivate work group morale.
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

14. Supervisors attempt to make work interesting for individual Focal Employees even if this requires custom designing of the responsibilities to a degree.
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

15. Resources required by the Focal Employee are readily provided if required in the performance of duties.
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

16. A relationship exists betweeen retention of Focal Employees and organization success.
A. strongly agree
B. agree
C. niether agree nor disagree
D. disagree
E. strongly disagree

17. This material will not be associated with your particular organization without your approval. If you wish to further specify the degree of confidentiality, please do so here.

Thank you