# *Technical Competence and Job Satisfaction Among Engineering Profession*

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# Technical Competence and Job Satisfaction Among Engineering Professional

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*Abstract* - Developing the technical competence and job satisfaction of engineers in a manufacturing firm is clearly a critical component of the firm's competitive edge. This study looks at these aspects of an engineer's work life and career along with the issue of development of technical competence. This study of 20 manufacturing engineers and 20 design engineers from a full range of low to high technology companies endeavors to link job satisfaction with technical competence. A number of related issues are investigated and in the end much of the statistically significant results came from these peripheral areas.

## I. Introduction

With the rapid growth of technology-related industry, the need for highly skilled engineering personnel also increases at a high rate. Although it is well known that engineering knowledge in fast-growing fields can become obsolete in 3 to 5 years, technically competent engineers have increasing opportunities to change to new, challenging jobs [38]. This causes the high turnover rate in the industry, which is a concern to engineering managers and company executives. One source states that the main sources of uncertainty in an organization are related to technology and the nature of the organization itself [42]. Clearly, the technologists in the organization are a key to getting on top of this changing situation, hopefully somewhat stabilizing it. So, retaining technologist is very important to the functioning and competitive edge of a firm, but financial incentives alone cannot retain these engineers [39]. To retain these personnel, the companies must strive to make their employees satisfied [47]. There are a number of important factors relating to job satisfaction for engineers that have been identified by prior research models [4], [6], [18], [12], [29], [45], [48], [54]. This includes the many factors found in the motivational theories, industrial programs such as job enrichment and a whole variety of integrated organizational-development structural changes with most of the important factors confirmed through studies.

However, as students in an engineering management program, we have attempted to focus on two factors that may directly or indirectly affect job satisfaction, and ultimately retention.

The first factor is the engineer's technical competence since all engineering jobs require some level of technical skills and few engineering jobs remain static. Specifically, technical competence fits into the above back drop of exhaustive motivational research through the similitude of self actualization theories and an engineers relation to technical competence [15]. Our approach clearly limits sources of variation, but technical competence also is complicated by issues such as interaction of various aspects of competence and the organization model for measuring and harnessing competence [11], [36].

The second factor we are interested in is the relationship between technical development and technical competence because we believe that they are related. We have divided technical development in two parts: *formal technical training*, in which an engineer has training away from work, and on-the-job training, or *job content*, in which engineers develop technical skills as a result of work experiences.

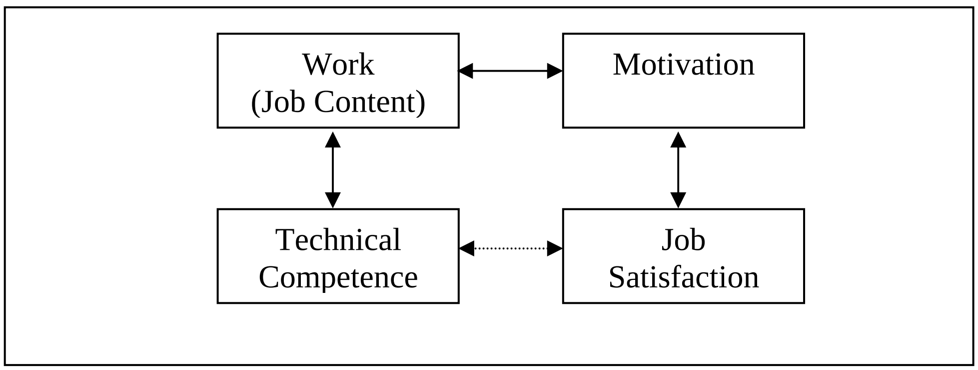
As we did a literature search on job satisfaction and technical competence, we found that there was no clearly established relationship between them despite other research relating competence to job content and other studies showing relationships between job content, motivation and satisfaction. Thus, this may be a good opportunity for research to fill the gap.

## II. Building a model

A huge wealth of research exists, from a variety of disciplines (behavioral science to organizational theory), concerning all aspects of work dynamics, performance, content and motivation. And yet many opportunities for integration of research models has not been capitalized on. For instance the following model, see figure 1, is not found in this paper's bibliography, but the relationships of each adjoining box is found in various literature, except for the relationship of Technical Competence and Job Satisfaction [13], [15], [24], [49].

Briefly, a definition of competence is the act of doing the job, the work itself. For an engineer, work in and of itself is a main motivational factor. Motivation is found to be a measure of Job satisfaction. But finally, only a relatively peripheral finding of one study found a relationship between Technical Competence and Job Satisfaction [51 ].

**Figure 1:** Relationships found in literature.

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Technical Competence and Job Satisfaction shared a tenuous correlation in a study of Herzberg's motivation theories while implementing quality improvement [51]. The use of motivators carried a positive relationship with project success and job satisfaction. Some relationship was inferred between feelings of competence and completion of the task and is clearly identified in behavioral science [10].

## III. HYPOTHESIZING RELATIONSHIPS

Clearly, it is hard to measure the objective level of technical competence of a person in a self survey without any biases because getting at the truth would require the person's peer group [33]. Therefore, we will measure the level of *feeling* of technical competence of the engineer, which should be a more attainable measure. Since our main point of concern is satisfaction, clearly subjective, the use of a subjective measure on the opposing variable seems appropriate, if not required. This brings us to our first hypothesis:

**Hypothesis 1: The feeling of technical competence has a positive relationship with the feeling of job satisfaction.**

Moreover, as mentioned above, technical development may have a significant impact on the feeling of technical competence. We tend to believe that people that have some technical training should have a higher level of feeling of technical competence than people who do not have technical training. Hence, our second hypothesis is:

**Hypothesis 2: Technical development has a positive relationship with the feeling of technical competence.**

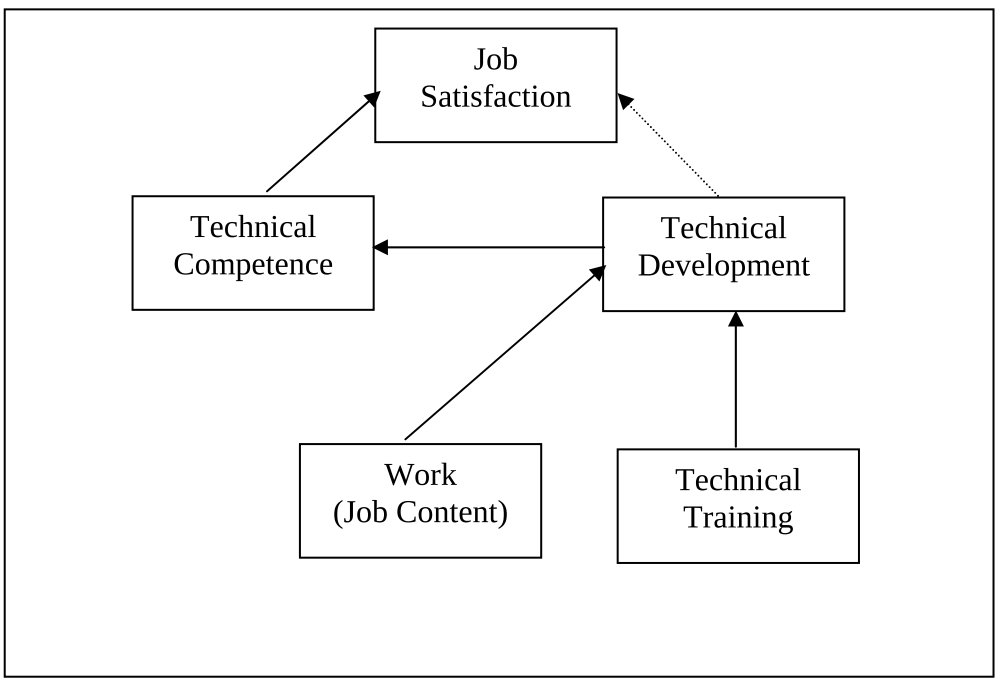
Moreover, as we divide technical development in two parts, we have sub hypotheses:

**Hypothesis 2a: Technical training has a positive relationship with the feeling of technical competence.**

**Hypothesis 2b: Job content has a positive relationship with the feeling of technical competence.**

The relationship between technical development and the feeling of technical competence may manifest itself in the relationship between the technical development and the feeling of job satisfaction as well. If we can find a relationship between technical development and the feeling of technical competence and the relationship between the feeling of technical competence and the feeling of job satisfaction, we may find a relationship between the technical development and the feeling of job satisfaction. Figure 2 illustrates the relationships we are hypothesizing.

**Figure 2:** Model of the research



# IV.  METHOD

### Testing the model

A research instrument was developed that would measure our chosen variables along with a number of factors based on their ability to provide insight into this research area.

### Sample population

The research participants were technical worker whose jobs related to either **research and development** (including product design and development) or **manufacturing** (including manufacturing engineering and support function).  The participants were screened before they were given the questionnaire; only engineers still performing a relatively high level of technical work were chosen (no supervisors, managers or project managers were chosen.) In addition, no one with less than 6 months experience in a technical specialty was given a survey.

## Independent Variables

### Demographic (clustering) Variables

The research will survey engineers in both manufacturing and research and development environments.  Due to the increasing pace of technology, engineers in both environments should concern themselves with "when and how" they will acquire the new skills and information to be confident and competitive in the field.  One of the factors which might affect an engineer's feeling of technical competency is the length of time in their technical field.  The engineer's feeling of technical competency in turn may affect their job satisfaction.  Increased time in the technical field may not increase the engineer's feeling of technical competency beyond a certain point if the technical field is now obsolete or the engineer is not keeping abreast of technological changes.

Other criteria that might affect to their feeling of technical competence are the size of department and number of peers in their field within their company, since an engineer who is isolated from peers might feel some he or she is isolated from new developments. In addition, a large functional organization usually has more breadth and depth of work being done in the engineer's technical field than a small organization or project team. Hence the engineer in the large functional organization might feel that he is the midst of more technical competency than an engineer who is the sole technical specialist in a small project team. However, engineers in large organizations sometimes are "pigeonholed" into positions with limited scope, whereas an engineer in a small company might have to learn a wide range of skills.

**Technical Development Variables**

In prior literature, researchers drew attention to accelerating technology change and greater technological sophistication; for example, Bansignore [5] said that when he studied in engineering, a slide rule was used to do routine calculations. At that time, computers were vacuum tube-powered, tape-driven and room-filling. In the past 25 years, the rapid development of new technologies such as integrated circuits, computer software and hardware, and communication networks have demanded rapidly developing skills in engineers. In order to understand new technologies and to improve one's new technical knowledge and skill, technical development or training has been a key element of fostering technology development [5][52][54][31]. Technologies in both manufacturing and research & development (R&D) areas have seen very fast development requiring significant training in order to remain competitive. [9]

Since technical development is viewed as essential to the individual's and company's continued competitiveness, it follows that there are many forms of training that might be beneficial. There are four sources of technical development: classroom training, formal company training, training that is inherent in the work itself (job content training) and other types of training, such as self-study, informal "on-the-job" training and mentoring [9]. For the research, we focused both on formal training and job content training. It is well known that employees learn through their work experience.

Engineers can acquire new technologies from the demands of their position, job content training is used to measure human capital acquisition [37]. It would be interesting to understand the relationship between training and the feeling of technical competence. However, not much prior research has studied this specific topic.

A study sights that "human capital theory predicts that workers will be more likely to invest in job training the longer they expect to remain working" and notes that the probability of the job turnover is significantly related to receiving training [44]. According to the relationship between job satisfaction and the probability of turnover, there should be a relationship between training and job satisfaction [47]. Consequently, if we can measure the relationship of technical development, training, and the feeling of technical competency, we might understand more about the relationship of the feeling of the technical competency and job satisfaction.

## Dependent Variables

### Feeling of Technical Competence Variable

There are relatively few studies concerning technical competence of engineers compared with the number of studies related to job satisfaction or career development. Mainly, motivational sciences discuss professional self actualization issues and the importance, or assumption, of competence is implied [15]. As in most areas of psychological and sociological significance, competence is not an uncomplicated issue for measurement and evaluation. For instance, Hamilton [22] stated "technical competence includes not only mastering procedures but also understanding the fundamental principles and concepts underlying the procedures, gaining capacity for analytical judgment, and becoming computer literate." Therefore, the measurement of technical competence is very difficult to do because we cannot easily measure all of the elements that comprise technical competence. However, the feeling of technical competence in which there is a measurement of the level of confidence and self-perception of a person can probably be measured more accurately.

As [32] and [33] provided some guidelines to measure the level of competency, we developed survey questions to ascertain a trustable and accurate level of feeling of technical competence. The result of this measurement indicates the feeling of technical competence of the participants, not their real competence. For instance, a new graduate engineer may feel that everything they have learned from school makes them extremely competent, whereas they may have very limited knowledge of their technical field. On the other hand, an engineer with a Ph.D. with many years of experience may think that he needs to learn a lot more, even though he is already an expert in his field.

There are some complexities to view the feeling of technical competence as a variable in this research. Technical competence is an independent variable when we examine its relationship to job satisfaction in hypothesis 1; on the other hand, technical competence could be view as dependent variable when we examine its relationship to technical development in hypothesis 2.

### Job Satisfaction Variable

This area of study has interested many scholars since World War II [6]. For instance, Wong [54] established relationships between job perception and job satisfaction, and other studies have related employee’s performance and job satisfaction. Furthermore, we find a lot of support in the literature for a positive relationship between job motivation and job satisfaction [6]. Cordero [12] found job satisfaction and likelihood of turnover had a negative relationship. Birdi [4] concluded that prior participation in required training courses and work-based development activities were significantly correlated with overall job satisfaction and organizational commitment. Geyer [18] found that job satisfaction levels were negatively associated with relocation consequences.

This research will be additional research in the field of job satisfaction. However, the research will focus on aspects specific to engineers. As described above, the data that will be used to analyze the relationship between the feeling of job satisfaction and the feeling of technical competence will be collected from two groups of participants only (R&D and Manufacturing disciplines). Engineers with a significant management role will not be asked to participate as the issues of motivation, i.e. satisfaction, are considered to be considerably different than technically focused engineers [11]. As we already mentioned above, we could not find any study that clearly establishes that the relationship between technical competence and job satisfaction exist. This research will attempt to separate out technical competence from the many factors that affect job satisfaction based on the hypothesis that competence is more important to engineers based on the nature of their work.

## Interview Methodology

### Sample Profile - Respondents

We decided that for any engineer to qualify to be a respondent in this project, s/he must be on his/her current job for a duration of at least 6 months. We did not put any limit for the upper end. Based on this screening process, our respondents had a wide range of experiences ranged from 1 year “fresh out of school” new engineer to 39 year experienced “old timer.”

### Sample Profile - Organizations

Forty surveys were completed in eleven different companies Company names are kept confidential. The size of the department/ site that the respondents work ranged from 3 to 4,000 employees. Respondents are selected from the two main functional groups:

Research and Development

Manufacturing

We tried to keep the balance between the number of respondents from each group and incidentally, the categorization yielded in equal number (20) of responses from each.

All of the respondent organizations are product manufacturing in nature, but are from a wide variety with respect to product and technology.

According to R.Daft, product organizations have common characteristics differentiated from other types of organization, such as service organizations which happen to have the polar opposite characteristics [14]:

CONFIGURATION

Many boundary roles,

Little geographical distribution,

STRUCTURE

Low employee skill level, on average
(with respect to our respondent organizations, we questioned this item's validity),

Skill emphasis is technical as opposed to interpersonal,

High degree of centralized decision making and

Highly formalized.

**Survey application**

Survey purpose was first explained to the respondents by the surveyor.  Then, the respondent was given approximately one to four days to complete the survey.  Once the surveys were completed, the cover page was detached from the main survey in order to keep the confidentiality of responses.

After all the surveys were completed, the responses were entered into the excel spreadsheet by each surveyor. (See Appendix (2):  Survey Results - Raw Data).

**Survey questions**

The questionnaire is divided into five sections.  The majority of the 26 questions were on a 6 point scale, with the end of the scale being polar extremes.  The remaining questions were categorical or fill in questions.  The survey was intended for prescreened engineers to fill out in 15 minutes.   Appendix (1) contains the actual survey.

1. **Basic Information  (Q1-Q5)**

The survey asked about the participant's work, their size of their site, the number of technical peers, the type of their department organization and the length of time in their technical field.

2. **Technical Expertise (Q6-Q12)**

To measure technical expertise, the questions asked were both direct and indirect. The direct question asked the engineer to rate his/her feeling of competency.  In addition, indirect questions were asked to validate the engineer's self-appraisal.  For instance, the engineer was asked to indicate the level of influence in critical technical decision [12];  to rate whether they seek or provide technical advise [25]; to rate their confidence in their competence if they were given a promotion; to rate their mix of job responsibilities (technical versus other responsibilities) [25], and to rate how technical expertise is viewed by their organization.[35].

3. **Technical Development: Formal Training (Q13-Q19)**

Participants were asked to rate the amount of technical focused training received in the past 12 months [4] and the amount of technical focused training their wish to receive in the future.  They were also asked to rate the relevance to their job of their recent technical focused training and to rate the benefit to their job and career of their recent technically focused training.   Finally, in  categorical questions, participants were asked to  identify the most helpful of their technical training programs in their both current job and future career.

#### 4. Technical Development: On-the-job training (Q20-Q22)

To measure on the job training, questions about job content were asked, including the degree to which participants' recent work experience promoted development of their technical skills. Participants were asked to indicate the technical difficulty of their work, and to indicate the level of technology of their work environment.

#### 5. Job satisfaction (Q23-Q26)

To measure job satisfaction, participants were asked to rate their feeling of job satisfaction in their current position [12] and to compare current work to their most ideal job. They were also asked to rate their status compared with management co-workers and to indicate the probability of seeking a job change in the next year.

# V RESULTS AND DISCUSSION

## ANALYSIS OF RESULTS

Two hypotheses were analyzed by this project.

**Hypothesis 1:** The feeling of technical competence has a positive relationship with the feeling of job satisfaction.

**Hypothesis 2:** Technical development has a positive relationship with the feeling of technical competence.

Hypothesis 2 is further divided into 2 sub-hypotheses:

**Hypothesis 2a:** Technical training has a positive relationship with the feeling of technical competence.

**Hypothesis 2b:** Job content has a positive relationship with the feeling of technical competence.

The data is analyzed in several levels and presented in two main sections containing main finding and additional findings.

## MAIN FINDINGS - Detailed Look at the Responses

The data is analyzed using the t-test and linear regression methodologies.

**T-Test:**

**Manufacturing vs. Research and Development**

We analyzed the difference amongst engineers who work at the Manufacturing and Research & Development. Differences between the two functional groups were considered significant when p was less than 0.15. The findings are summarized in Table 1.

| Variable Tested: | Q8 | | Q11 | | Q25 | |
|---|---|---|---|---|---|---|
| | *Variable 1* | *Variable 2* | *Variable 1* | *Variable 2* | *Variable 1* | *Variable 2* |
| Mean | 4.6 | 4.157894737 | 4.95 | 4.3 | 4.263157895 | 3.75 |
| Variance | 0.463157895 | 1.140350877 | 0.681578947 | 1.589473684 | 0.538011696 | 0.934210526 |
| Observations | 20 | 19 | 20 | 20 | 19 | 20 |
| Hypothesized Mean Difference | 0 | | 0 | | 0 | |
| df | 30 | | 33 | | 35 | |
| t Stat | 1.532942005 | | 1.928922393 | | 1.873451363 | |
| P(T<=t) one-tail | 0.067884635 | | 0.031189089 | | 0.034687926 | |
| t Critical one-tail | 1.697260359 | | 1.692360456 | | 1.689572855 | |
| P(T<=t) two-tail | 0.135769271 | | 0.062378179 | | 0.069375852 | |
| t Critical two-tail | 2.042270353 | | 2.03451691 | | 2.030110409 | |

Variable 1: Respondents who work in Research and Development
Variable 2: Respondents who work in Manufacturing

***Table 1:*** T-test results between Manufacturing and Research and Development groups.

***Question 8:*** On this question, we tried to understand what the individual's rating of his/her own technical competency. Respondents were asked to rank 1 from 6 where 1 represents "not at all confident" and 6 represents "extremely confident". The T-test results showed at better than 85% confidence that engineers who work in Research and Development field feel more technically competent than those engineers who work in the Manufacturing field (average of 4.60 vs. 4.16).

***Question 11:*** This question states: "For the most satisfying achievement of your career, would you say that the technical challenge was: Insignificant (rank 1) through Substantial (rank 6)." Again, the T-test results revealed that engineers who work in

Research and Development field feel more technically challenged than those engineers who work in the Manufacturing field (an average of 4.95 vs. 4.30; the null hypothesis can be rejected at almost 95% confidence level).

***Question 25:*** For the question on how they would rate their status compared with management co-workers, engineers who work in Manufacturing field felt that their status is significantly lower in comparison to their co-workers in the management field (these engineers averaged 3.75). Research and Development engineers felt better about their status (they averaged 4.26). The null hypothesis can be rejected at the 90% confidence level.

**Linear Regression / Correlation**

To test the hypotheses, dependant, independent and clustering variables were measured in the survey instrument. When the survey was being developed, we decided to ask several questions for each dependent and independent variable to check for consistency. When doing the regression analysis, we found that most of these questions were well designed and were cross-correlated

For example, when defining technical competency, we asked 7 questions to the respondents, in order understand or quantify the respondent's feeling of his/her technical competency. In our regression analysis, we found that questions 6,7,8 and 9 can be averaged to be used a composite value for the respondent's technical competency. The correlation coefficients of these questions among themselves were significantly higher than with the other questions. Questions in the sections that were not included in the composite variables were evaluated individually. Further results on the composite values and how they are defined can be found in Appendix 2.

While defining the composite variables, we found that question 10 correlates better with the "Job Content" variable even though the question was designed to measure "Technical Competency." It was decided to include this question in the "Job Content" variable. The "Job Content" variable was redefined to include this question based on the good cross-correlation.

Another interesting variable is the "Training Gap" which is defined as the difference between the training desired and training received. As the first part (training desired) correlates with "Technical Competency", and the second part (training received) correlates with "Job Content", the composite variable correlates nicely with both variables.

We have defined 5 composite values. Subsequent analyses is performed using the composite values defined as:

JS: Job Satisfaction

TC: Technical Competency

JC: Job Content

ET: Effectiveness of Technical Training

TG: Training Gap

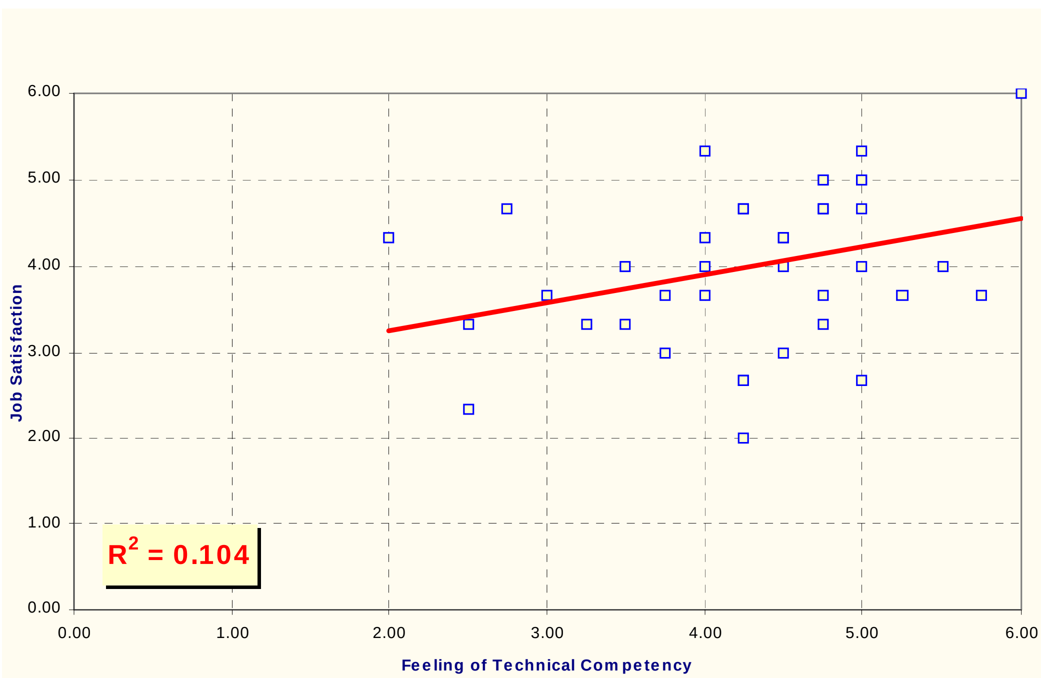
The analysis and its results will be discussed in detail in the next section.

## TESTING OF THE HYPOTHESES

### Hypothesis 1: The Effect of Technical Competency on Job Satisfaction

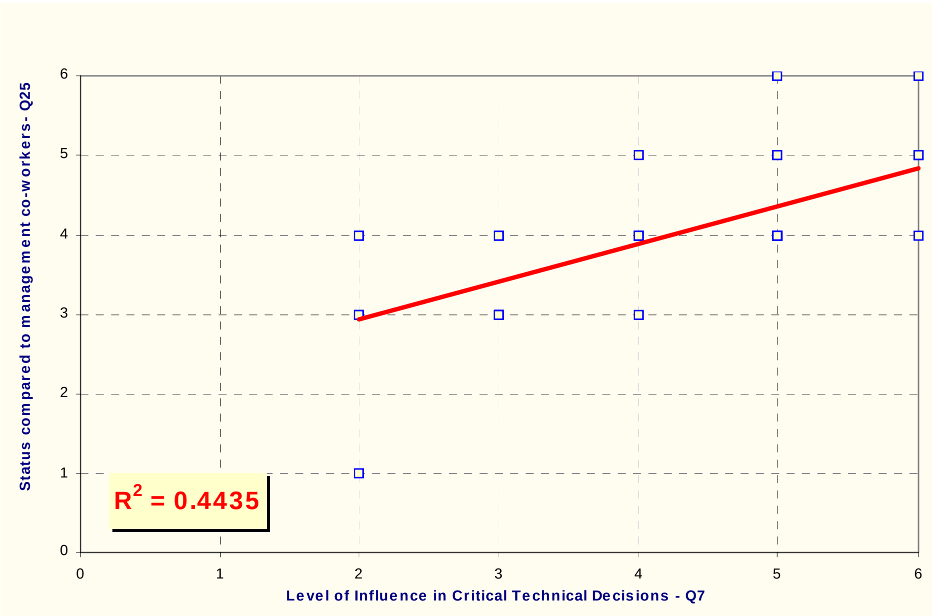
Although the correlation between these two composite variables was not as high as we expected, there was a significant positive correlation with an $r^2$ value of 0.104. For a survey of 40 respondents from diverse industries, different environments and with different background and experience levels, it would be quite difficult to get much higher correlation values between two very generalized variables like “Job Satisfaction” and “Technical Competency” without eliminating and/ or controlling all other factors that may have an impact on them. The acceptance of hypothesis 1 is supported by our research but does not show a strong relationship.

Figure 3: Hypothesis 1-Job Satisfaction Versus Feeling of Technical Competency.



The highest correlation found ($r^2$= 0.4435) between the individual questions of these variables was between Q7 and Q25 which are the respondents' feelings about the "influence on key technical decisions" and "status against management co-workers"

Figure 4: Feeling of "status compared to management coworkers" versus "influence on key technical decisions".




**Effect of Technical Development on Job Satisfaction**

Two aspects of Technical Development , "formal training" and "technical development by the job itself" were evaluated separately. This was the intention right at the beginning, while developing hypotheses and preparing the survey, but results verified the value of this approach as explained later.

**Effect of Formal Training on Job Satisfaction**

The questions that are contained in the composite variable “Technical Training” were related to the “effectiveness” or “usefulness” of the training rather than the amount of the technical training. In other words, responses to the questions about the “amount of training” did not correlate well with the others in the same group.

The effectiveness of the technical training seemed to have more effect on the job satisfaction than the amount of the training, or the “training gap” which is defined as the difference between the training desired to received and the training received. These are shown in Figures 5 and 6. Neither the “effectiveness of technical training” or “training gap” were considered to be related to job satisfaction at a high enough significance level.

Figure 5: Job Satisfaction Versus Technical Training Effectiveness.

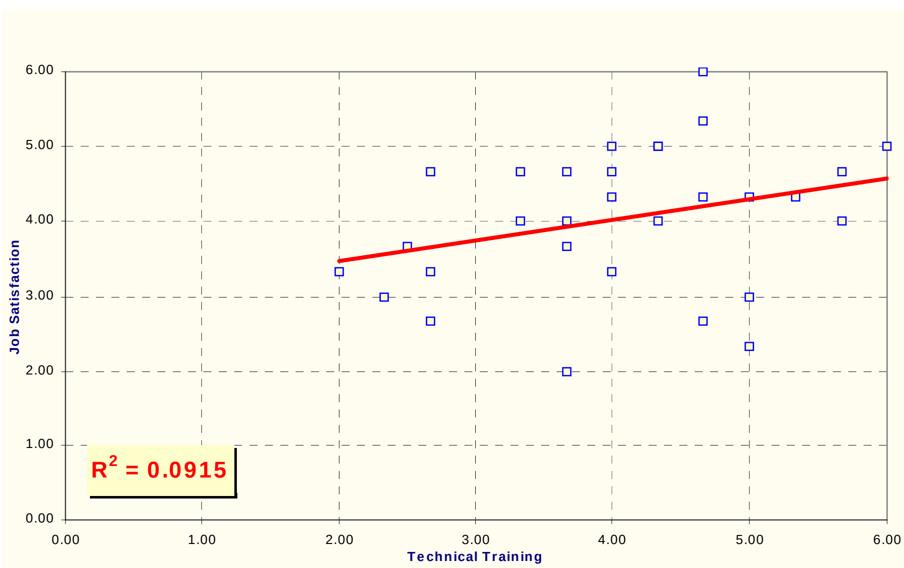
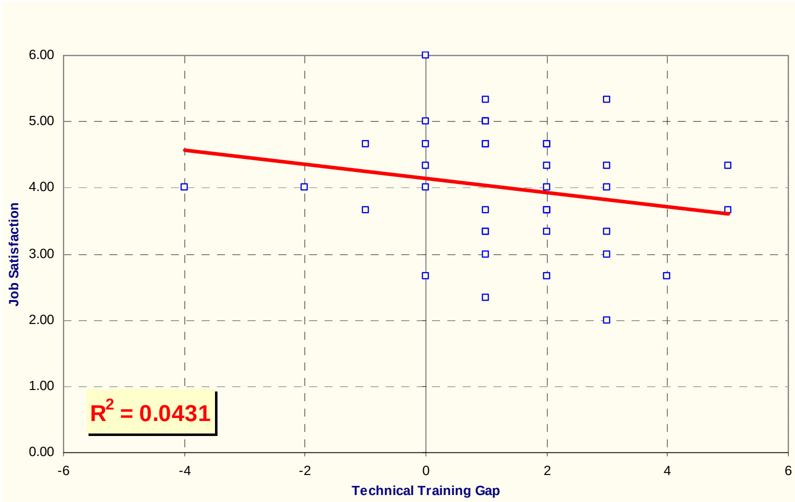


Figure 6: Job Satisfaction Versus Training Gap.




### Hypothesis 2a: Effect of Formal Training on Technical Competency

Analysis of the effect of formal training on the feeling of technical competency gave us completely different results. The "training gap" appears to have more impact than the effectiveness of the training on technical competency. We interpreted the result as the engineer's feeling of low technical competency is expressed as a need for more training. This is, of course, also a hypothesis that needs to be tested by further research. Figures 7 and 8 show this relationship. Only the "training gap" was considered to be significant due to the high correlation. To some degree, our hypothesis is supported by the finding of the relationship of "training gap" to technical competency, however, there is a possibility that "training gap" is another measurement of the feeling of technical competency.

Figure 7: Feeling of Technical Competency Versus Effectiveness of Technical Training.

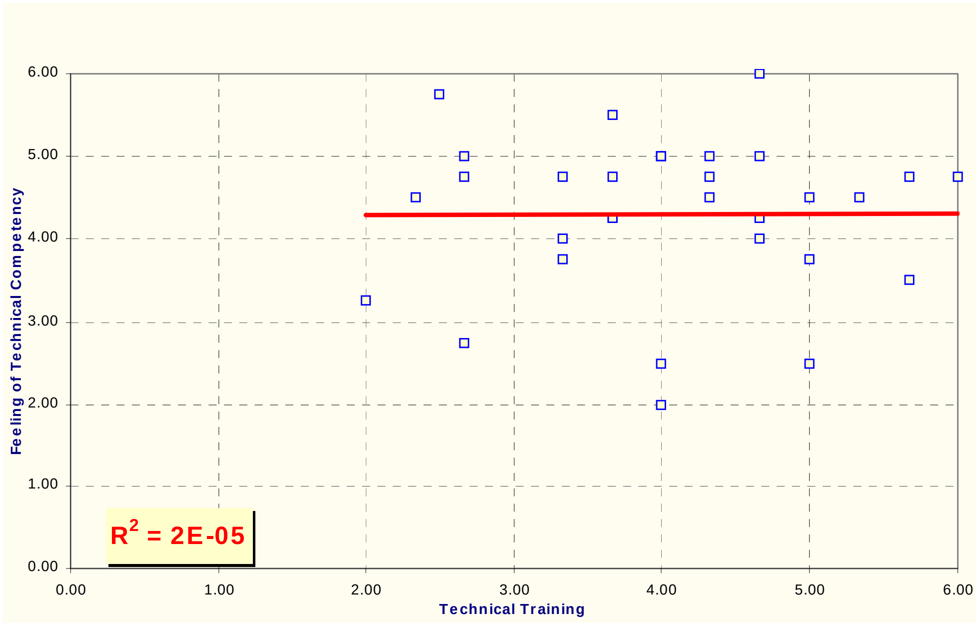



Figure 8: Feeling of Technical Competency Versus the Training Gap.

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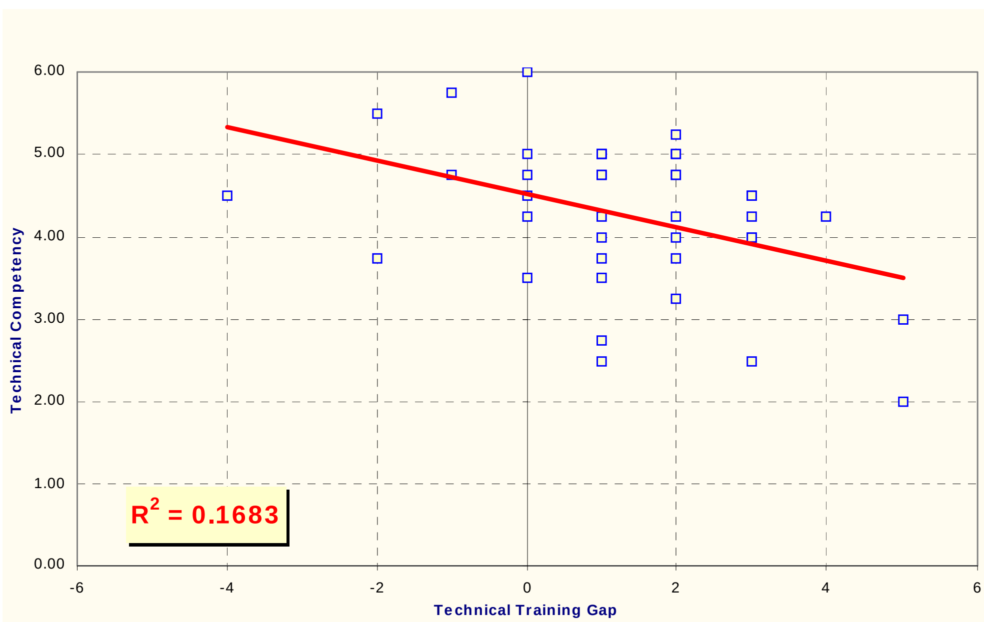
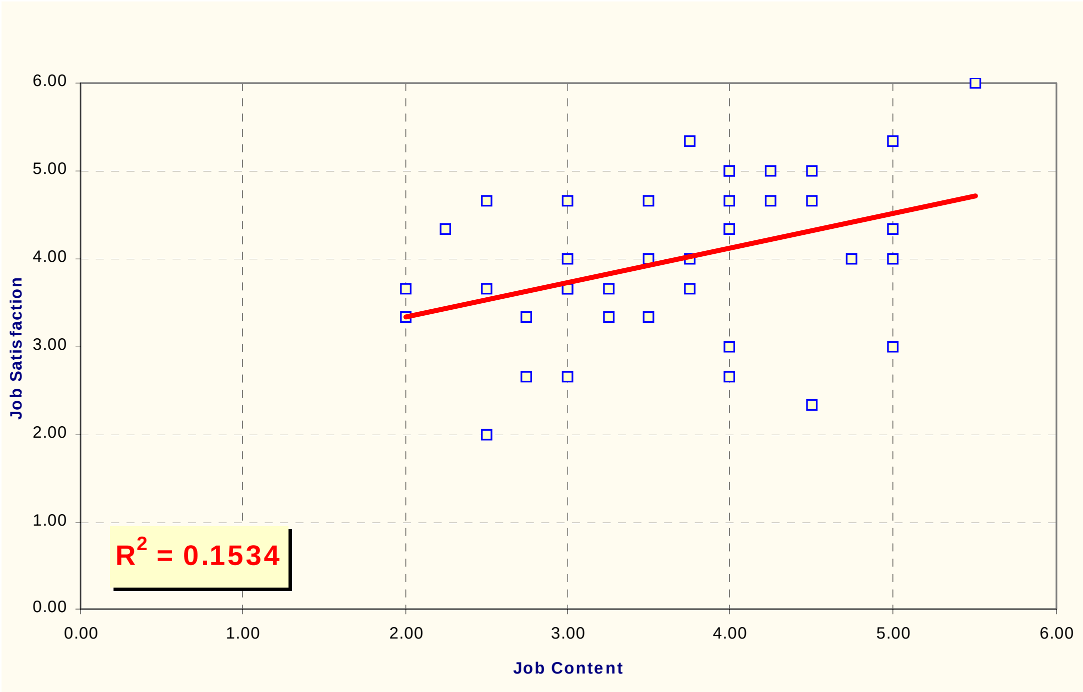


**Effect of Job Content (On-The-Job-Training) on Job Satisfaction**

As the main contributor to the technical development, the richness of the job itself strongly correlates with the job satisfaction. This has been validated by many researchers in more general and more specific scopes. Our results are in line with the literature. Figure 9 shows the relationship.

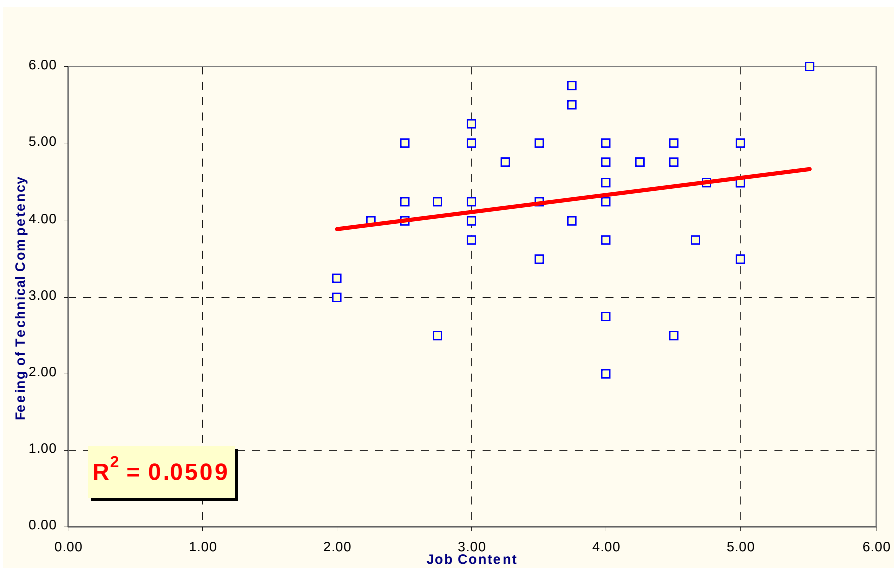
Figure 9: Job Satisfaction Versus Job Content.



**Hypothesis 2b: Effect of Job Content (On-The-Job-Training) on Technical Competency**

We do not see a strong relationship between job content and technical competency. This may be due to the fact that there is a time lag between exposure to challenging work and the feeling of competence or the fact that highly competent engineers are assigned to work rich in opportunities for further development. This hypothesis was not supported by this research. Figure 10 shows the relationship.

Figure 10: Feeling of Technical Competence Versus Job Content



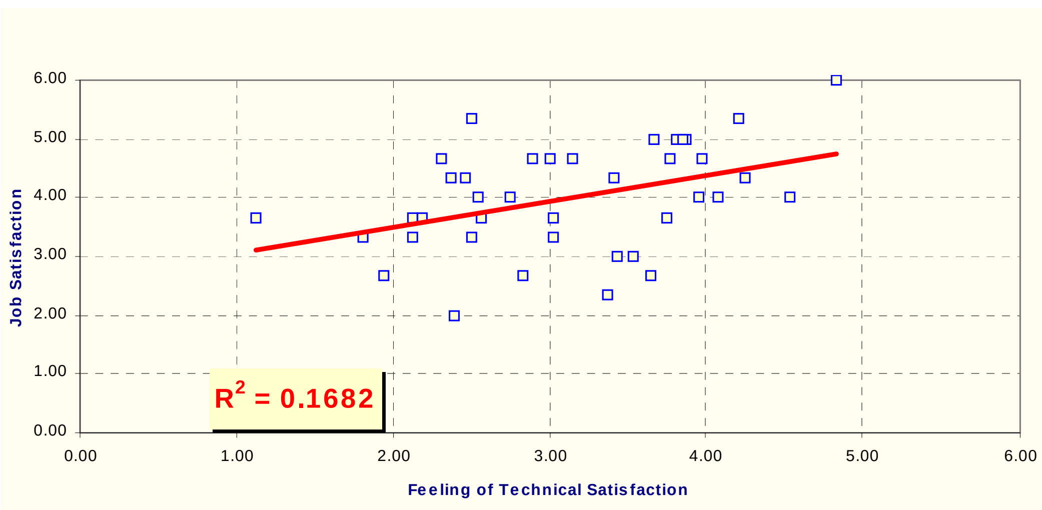
## ADDITIONAL FINDINGS

### Effect of Combined Variable on Technical Competency

Based on the initial hypothesis and the analysis results, we can intuitively expect that a new variable that would combine all aspects of technical competency and technical development could correlate with job satisfaction. We can show that such a composite variable can be created by a simple formula as a first step for modeling these relations. We tried weighing the composite variables according to their individual correlations with the "Job Satisfaction" and created the "Technical Satisfaction" variable as follows :

TS = ¼*(2*JC+TC + (TT-TG)/2)

Figure 11: Job Satisfaction Versus Combined Technical Satisfaction Variable.

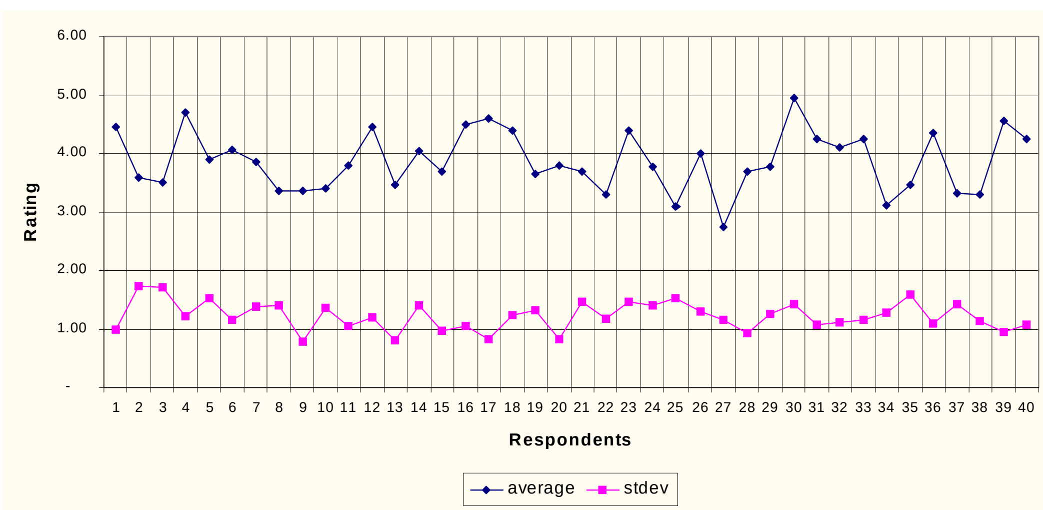



It is very difficult to support the weighing factors and the correctness of the method for measuring the "technical satisfaction". However, the result shows how all the independent variables can be combined into one variable which has a very high correlation to “Job Satisfaction”. This also shows that all the variables are interrelated rather than being random. This suggests that there needs to be a more complex model for both Job Satisfaction and Technical Competency.

**Respondent’s ratings**

We had an even distribution of responses in both Manufacturing and Research and Development categories (there were 20 responses for each category). Results seemed to be very well distributed across the scale and no pattern for bias or inconsistency in the ratings of different respondents were observed. The averages and the standard deviations for each respondent’s answers is shown below in Figure 12.

Figure 12: Distribution of respondent’s ratings.




Additional analysis of the data is as follows in the following areas:

### Formal Training

71% of the respondents said the amount of training they received within the last 12 months was not enough (Ranked ≤3).  Only 29% said it was satisfactory (Ranked ≥4). The vast majority of respondents (86%) wished to receive more training.

The area they need the most training was chosen to be “New technologies and advancements in your field” and “Advanced Computer Training (Systems/ Application Programming, CAE, Analysis Tools)” with a total of 82%.  Most engineers did not feel that they needed “General technical skills refreshment (math, science, engineering) “ and “Basic Computer Training (PC Software, Basic CAD)” type training.

Interestingly, the respondents felt that the technical training programs that would be the most helpful for their career development would also be the most helpful for their current job.  This finding implies that respondent are well aware of their technical/skill deficiencies.

### Job Content - On the job training

More than two thirds (69%) of respondents felt that their recent work experience significantly promoted development of their technical skills.  The technical content of the work they are assigned was almost evenly  distributed within the range of from being predictable and routine to unpredictable and unusual. Their work environment ranged form being almost obsolete to state-of-the-art.

### Technical Expertise

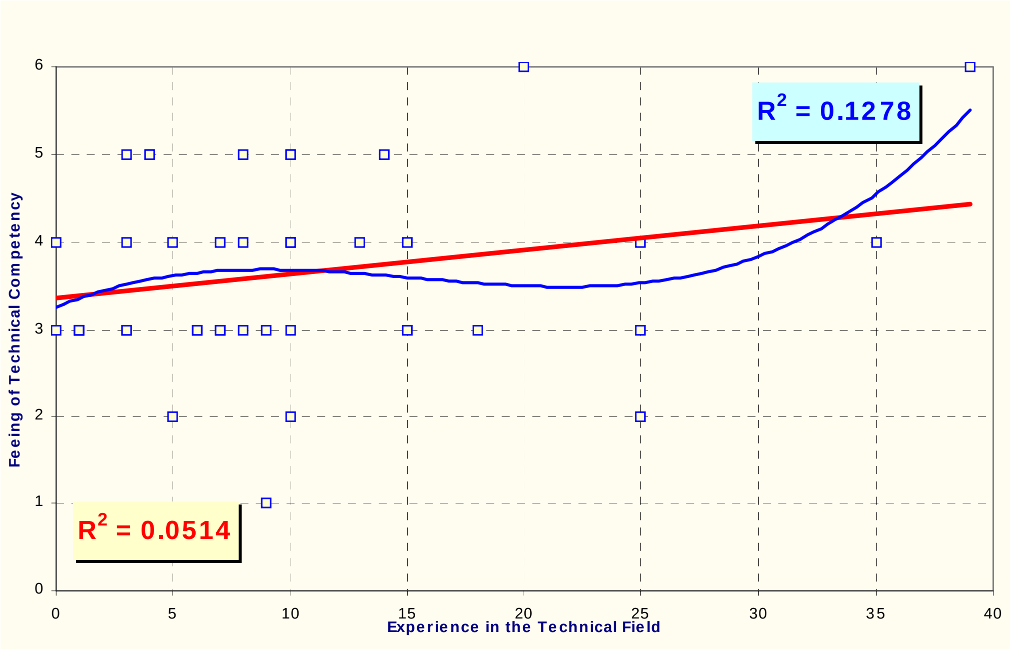
In technical matters, 79% of respondents characterized themselves as “providing technical assistance” and 69% of them said their level of influence in critical technical decisions is very significant. 89% of respondents ranked their current technical competency as confident (Ranked ≥4). The majority of respondent who have ranked their technical competency ≤3 had less than 6 years of experience.

When engineers were asked how confident would they feel in their technical competency if they were given a promotion (in their technical area), 72% felt “very confident.”

Almost 60% of respondent’s mix of job responsibilities (technical versus other responsibilities) fall into the middle (rank 3-4). 32% said that technical expertise is viewed by their organization as simply expected or assumed.

We could not find a linear relationship between the “number of years in technical field” and the feeling of technical competency. Although the interpretation would be trickier and would require more research to validate, there seems to be a polynomial relationship between these two, where the feeling of technical competency goes down between 10-20 years and goes up again after that.

Figure 13: Relationship between Technical Competence and Years of Experience in the Technical Field.



**Job Satisfaction**

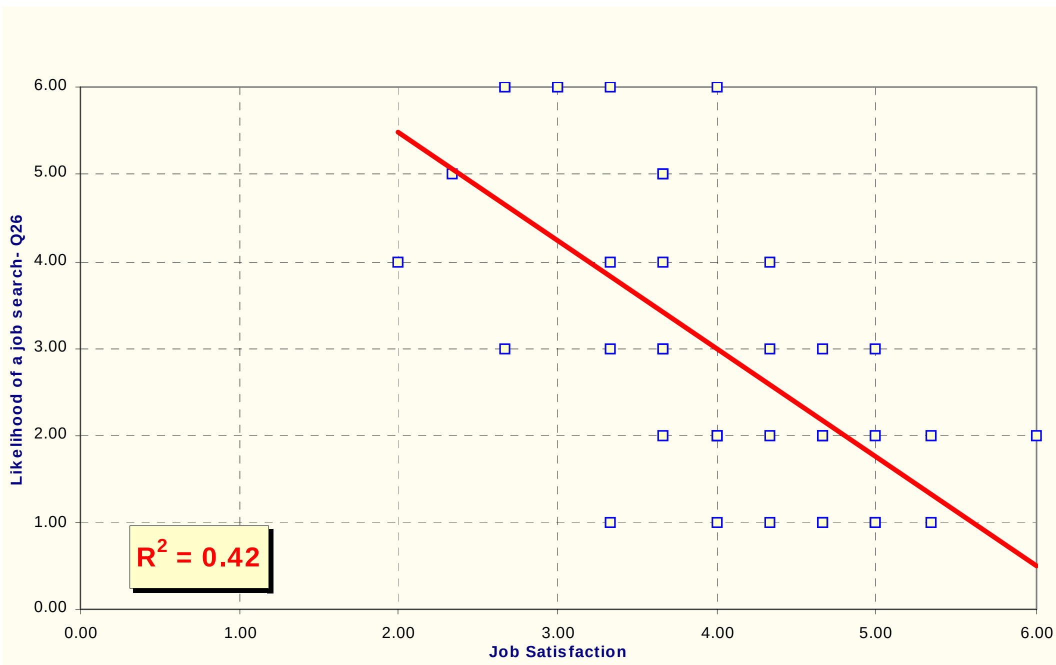
Only 13% of the respondents were “extremely” satisfied with their job. About 74% ranked their satisfaction at and above 4. 68% found their job encouraging maximum performance.

58% of respondents felt that technical expertise is viewed by their organization as above average (ranked 4).

65% of respondents said that the likelihood that they will actively seek a job change in the next year (Ranked ≤3).

We found an extremely strong correlation between the “likelihood of job searching” and the “job satisfaction”. It is not surprising, because the desire to look for a job is a direct expression of a sort of dissatisfaction with the job. But, this result has validated the appropriateness of our “job satisfaction” composite variable. Figure 14 shows this relationship.

Figure 14: Relationship between Probability of Job Searching and Job Satisfaction.



**Study of Herzberg’s Motivation-Hygiene Theory**

Question 12 was intended as a measure of the relative level of motivation to seek technical expertise. In addition, it sheds some light on the type of motivational factor technical expertise is, following Herzberg’s Motivation-Hygiene Theory [all of the OD, and Behavioral Science texts previously sighted include material on this]. The survey results were an average of 4.0, sd 1.5, for R&D and 4.3, sd 1.4, for manufacturing. Clearly, these engineers believe that their technical expertise, overall, is appreciated, but the relatively large standard deviation, and lack of revealing trends (particular companies low or high, etc.), shows the weakness of this measure. In terms of future application, this area would be one of the more interesting areas to follow up. It would be helpful to know that an engineer’s satisfaction is tied to technical expertise, but more so if the particulars of that satisfaction are understood. Interestingly, using the 0.10 $r^2$ significant Pearson’s correlations found in the appendix, this question had correlation with questions +5, -9, +16, +20 and +JC (positive/negative +/-). Briefly, our survey results seem to indicate:

Q5, a project oriented company shows more value for technical expertise.

Q9, how confident the person was in his technical competency in taking on a promotion (less confidant in a situation that highly regards technical expertise).

Q16, 20 and JC (Q20, 22), could be identified as a new composite variable of “Demonstrated excellence in technical development” for the organization, as viewed by the engineer (not including Q21 of JC which does not fit the above model, so this does not dilute the consistence of the results). They all indicate that when an engineer views a company as specifically appreciating technical expertise, that the company also follows through effectively in implementing avenues for the engineer to receive appropriate technical development.

### Additional discussion

Taken as a whole the study was successful in creating measures of the variables which indicated correlation. The strongest example of this is in the correlation of questions 7 and 25: Q7 influence on key decisions and Q25 status against management co-workers, at $r^2$ of .444. Question 25 was taken from a previous study [48] which also found favorable results in using this question to measure satisfaction among American engineers. Neither of the questions received follow up analysis to determine if there were conflicting issues, confounding the measurement of the intended variable. As they appear to be uncomplicated, appropriately focused and with such good results this would be an excellent area for confirming research. Other measures showed weak correlation's, but as a whole give reason to believe that there may in fact be a correlation between technical competence and job satisfaction (all correlation's were positive).

## VI. Implications of the Study (limitations, conclusion)

### Limitations

Areas not included in the survey: the type of technology applied (long-linked, mediating, intensive), and therefore tasks of an engineer, varies from organization to organization with these differences influence how work performance is measured and how effectiveness is defined. In particular, the interaction required between groups changes with technology changes [6]. The level of technocracy and the possible debilitating effects, "The Rational Model" questions the validity of a purely deterministic and easily quantified model. The pitfall of an overly narrow technical approach can be dubious success [39]. The issue of possible team structure of an engineers work group was considered and dropped for brevity of the survey. In a team environment the focus of technical competence has to with a members contribution to the team [36]. Certainly this could influence the relationship of our dependent variables, but this is a difficult area to provide equal measure among respondent (requires a controlled measure beyond the scope of the study). Our measure of other aspects of the work environment and recent experiences of the respondent were limited. There are many factors related to project success besides technical and certainly theses would affect job satisfaction and perhaps even feelings of competence. Also, an engineer may be judged to varying degrees by the ability to communicate than by his degree of technical knowledge [11]. Looking at the organizational development assumptions: Individuals desire personal growth and development **IF** the environment is supportive and challenging. Most people are willing to make a higher level of contribution to attaining organizational goals than is permitted by the environment, i.e. motivation and satisfaction [20]. That is a big "if" that our study was not able to evaluate.

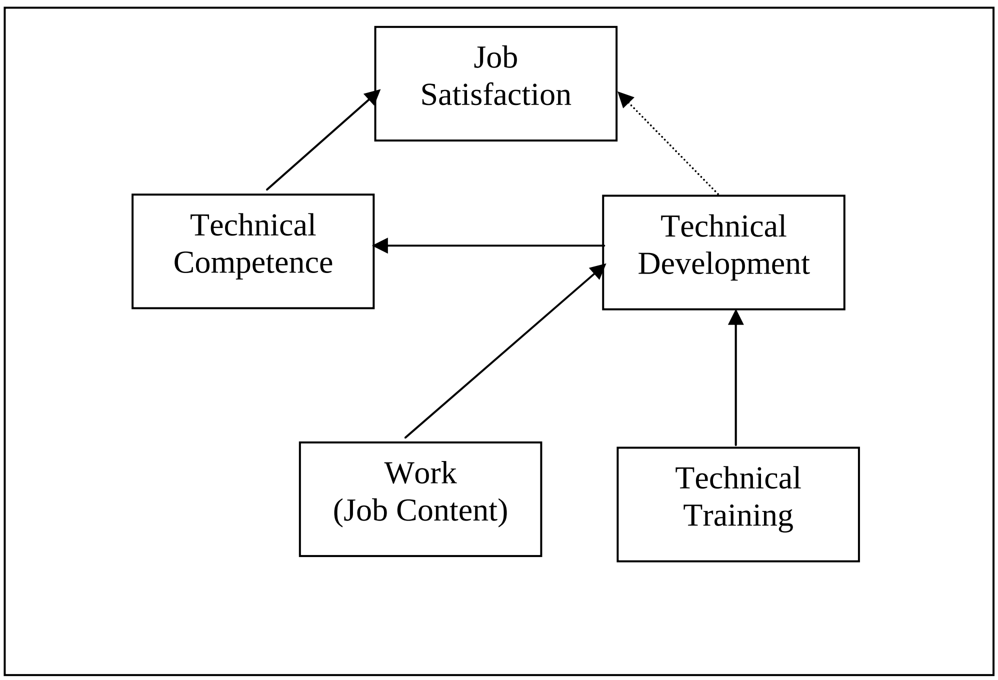
Most of the variable measures were directed at the engineer's current situation, but many theories indicate that history is an important factor. "Competence", as related to self actualization needs, is a mainspring to action in a human being. It implies the drive to control the environment. Expectancy theory says that our degree of past success will dictate our current competence outlook [24]. An examination of obsolescence [49] indicates that the high and low performers continue as such indicating that a historical measure of job satisfaction and technical competency could be a more effective measure than the ones used in this study. This is by no means an exhaustive list of limitations, but indicate some of the areas related to existing knowledge in the area of investigation.

**Conclusion**

This research found only marginally significant support of Hypothesis 1, in which we show a positive relationship between Technical Competence and Job Satisfaction. For Hypothesis 2, we found no strong support of the relationship hypothesized between technical competence and either formal technical training (defined as the effectiveness of that training) or job content. Interestingly, we found that there was a direct correlation between both areas of technical development and job satisfaction, indicating that engineers are (as supported by the literature) satisfied by work that challenges them to acquire new skills and information. The technical satisfaction variable created in the analysis supports this by showing a significant positive relationship to job satisfaction.

The development of an engineer’s feeling of technical competence is somehow independent of these variables. Perhaps there is a time lag between the current feeling of competence and prior technical development, or the feeling of competence is more strongly influenced by other personality traits (such as self-motivation) that were not measured by this research. Further research is needed to understand this unexpected finding. These results are shown in Figure 15.

Figure 15: Research Findings Model




The implication for engineering management is that engineers should be provided with opportunities for technical development to increase their job satisfaction. This will ultimately reduce employee turnover. In addition, engineering managers can measure their engineer’s competence by simply asking whether the engineer feels the need for significant additional training. Unfortunately, there is no guarantee that any technical development opportunities will improve the engineer’s competence.

## REFERENCES


[1] E. W. Aslaksen, "Managing engineering - ergonomics of the mind," *Portland International Conference on Management of Engineering and Technology*, pp. 303-306, 1997.

[2] C. B. Bardwell, "How to find the best engineering jobs," *The Black Collegian*, vol. 23, no. 3, pp. 51-55, Jan-Feb 1993.

[3] J. W. Beard and R.A. Giacalone, "Exit interviews of technical personnel: missed opportunities, lost knowledge," *Portland International Conference on Management of Engineering and Technology*, 1997.

[4] K. Birdi, C. Allan, and P. Warr, "Correlates and perceived outcomes of four types of employee development activity," *Journal of Applied Psychology*, vol. 82, No. 6, pp. 845-857, 1997.

[5] M. Bonisgnore, "Four forces of career change," *IEEE Engineering Management Review*, Spring 1997.

[6] J. L. Bowditch, and A. F. Buono, *A Primer on Organizational Behavior*, New York, NY: John Wiley & Sons, 1997.

[7] L. A. Burke, "Developing high-potential employees in the new business reality," *Business Horizons*, pp.18-24, Mar-Apr 1997.

[8] M. A. Campion, L. Cheraskin, M. J. Stevens, "Career-related antecedents and outcomes of job rotation," *Academy of Management Journal*, vol. 37, no. 6, pp. 1518-1542, 1994.

[9] A. P. Carnevale, and E. S. Carnevale, "Growth patterns in workplace training," *Training and Development*, vol. 48, no. 5, pp. s22-s28, May 1994.

[10] A. B. Carroll, *Business and Society, Managing Corporate Social Performance*, Boston, MA: Little, Brown and Co., 1981.

[11] D. I. Cleland and D. F. Kocaoglu, *Engineering Management*, New York, NY: McGraw-Hill.

[12] R. Cordero, N. DiTomaso, and G. F. Farris, "Career development opportunities and likelihood of turnover among R&D professionals," *IEEE Transactions on Engineering Management*, vol. 41, no.3, pp. 223-233. Aug 1994.

[13] P. B. Crosby, *Quality Without Tears*, New York, NY: New American Library, 1984.

[14] R. L. Daft, *Organizational Theory and Design*, St. Paul, MN: West Pub., 1989.

[15] G. Dessler, *Personnel Management*, Englewood Cliffs, NJ: Prentice Hall, 1988.

[16] S. Deutsch, "Successful worker training programs help ease impact of technology," *Monthly Labor Review*, vol.110, no. 11, pp. 14-21, Nov1987.

[17] G. A. Ferguson and Y. Takene, *Statistical Analysis in Psychology and Education*, New York, NY: McGraw-Hill, 1989.

[18] P. D. Geyer, and J. P. Daly, "Predicting job satisfaction for relocated workers: interaction on relocation consequences and employee age," *The Journal of Psychology*, vol. 132, no. 4, pp. 417-427, July 1998.

[19] J. Gingras, "The imperfect job," *Canadian Manager*, vol. 24, no. 1, pp. 15-16, Spring 1998.

[20] H. F. Gortner, J. Mahler and J. B. Nicholson, *Organization Theory, A Public Perspective*, Chicago, IL: Dorsey Press, 1987.

[21] M. E. Hacker, "Creating 'Win-win' industrial/academia relationships," *Portland International Conference on Management of Engineering and Technology*, 1997.

[22] M. A. Hamilton and S. F. Hamilton, "When is work a learning experience?," *Phi Delta Kappan*, pp. 682-689, May 1997.

[23] K. Hattori and K. Niwa, "Management of organizational shared-vision, style and skills for innovative r&d output," *Portland International Conference on Management of Engineering and Technology*, 1997

[24] P. Hersey and K. H. Blanchard, *Management of Organizational Behavior*, Englewood Cliffs, NJ: Prentice Hall, 1988.

[25] "How Engineers View Themselves," IEEE Spectrum, vol. 30, No. 4, pp. 24-28, April 1993.

[26] M. Installé, "Engineering and technology management for a more sustainable development," *Portland International Conference on Management of Engineering and Technology*, 1997.

[27] G. K. Kanji, *100 Statistical Tests*, Broughton Gifford, Melksham, Wiltshire: SAGE Publications, 1994.

[28] R. L. Knowdell, "The 10 New Rules for Strategizing Your Career," *The Futurist*, (Jun-Jul 1998), pp. 19-24.

[29] B. Mannheim, Y. Baruch, and J. Tal, "Alternative models for antecedents and outcomes of work centrality and job satisfaction of high-tech personnel," *Human Relations*, vol. 50, no. 12, pp. 1537-1562, 1997.

[30] W. Marx, "The new high-tech training," *American Management Association*, pp. 57-60, Feb 1995.

[31] R. H. McCuen, "Balancing corporate and personal values," *Journal of Management in Engineering*, vol. 13, no. 2, pp. 40-44, Mar-Apr 1998.

[32] D. Z. Milosevic, "Strategic project management: from ad-hocracy to standardization," *Portland International Conference on Management of Engineering and Technology*, pp. 369-374, 1997.

[33] R. J. Mirabile, "Everything you wanted to know about competency modeling," *Training & Development*, vol. 51, no. 8, pp. 73- 77, Aug 1997.

[34] G. Morgan, *Images of Organization*, London, England: Sage Pub. Ltd., 1986.

[35] R. A. Noe, A. Wiggins, and J. A. Bachhuber, "An investigation of the correlates of career motivation," *Journal of Vocational Behavior*, vol. 37, pp. 340-356, 1990.

[36] J. D. Orsburn, L. Moran, E. Musselwhite, Self Directed Work Teams: *The New American Challenge*, Homewood, IL: Business One Irwin, 1990.

[37] R. N. Oslsen, and E. A. Sexton, "Gender differences in the returns of the acquisition of on-the-job training," *Industrial Relations*, vol. 35, no.1, pp. 59-77, Jan 1996.

[38] A. Pacey, *The Culture of Technology*, Cambridge, MA: MIT Press, 1984.

[39] T. J. Peters, and R. H. Waterman, *In Search of Excellence*, New York, NY: Harper & Row, 1982.

[40] J. Pfeffer, "Six dangerous myths about pay," *Harvard Business Review*, pp.109-119, May-Jun 1998.

[41] M. E. Richerson, "Observations of an engineer who has managed both technical and nontechnical employees," *Portland International Conference on Management of Engineering and Technology*, 1997.

[42] D. L Rogers and D. A. Whetten, Interorganizational Coordination: *Theory, Research and Implementation*, Ames, Iowa: Iowa State University Press, 1982.

[43] J. A. Ross, "Human resources: does friendship improve job importance?," *Harvard Business Review*, pp. 8-9, Mar-Apr 1997.

[44] A. B. Royalty, "The effects of job turnover on the training of men and women," *Industrial and labor relations review*, Vol. 49, No. 3, pp. 506-521, Apr 1996.

[45] S. P. Schappe, "The Influence of Job Satisfaction, Organizational Commitment, and Fairness Perceptions on Organizational Citizenship Behavior," *The Journal of Psychology*, (1998), pp. 277-290.

[46] R. C. Seethamraju, R. K. Agrawal, and V. Jayaraman, " organizational support in managing transition of engineers into management roles-an empirical study in Australia," *Portland International Conference on Management of Engineering and Technology*, pp. 299-302, 1997.

[47] D. P. Schwab, "Contextual Variable in Employee Performance-Turnover Relationships," *Academy of Management Journal*, vol. 34, No.4, pp. 966-975, 1996.

[48] C. S. Shankar, W. Y. Yeoung, "Factors Influencing Job Satisfaction of Technical Personnel in the U.S., Singapore and India," Engineering Management Journal, vol. 9, No. 3, Sep 1997.

[49] R. E. Shannon, *Engineering Management*, New York, NY: John Wiley & Sons, 1980.

[50] J. H. Thamhain, *Engineering Management: Managing Effectively in Technology-Based Organizations*, New York, NY: John Wiley & Sons, 1992.

[51] D. R. Utley, J. Westbrook and S. Turner, “The relationship Between Herzberg’s Two’Factor Theory and Quality Improvement Implementation,”

[52] P. Warr and D. Bunce, "Trainee characteristics and the outcomes of open learning," *Personal Psychology*, vol. 48, pp.347-375, 1995.

[53] J. Whittaker, "Studying the engineer's day," *Portland International Conference on Management of Engineering and Technology*, pp. 291-294, 1997.

[54] C. Wong, C. Hui, and Kenneth S. Law, "A longitudinal study of the job perception-job satisfaction relationships: a test of the three alternative specifications," *Journal of Occupational and Organizational Psychology*, vol. 71, no. 2, pp. 127-147, June 1998.

**APPENDIX (1)**

# PSU Engineering Management
# Student Questionnaire

**Research Goal:** This survey is part of a student research project at PSU. This project will attempt to identify the relationship of an engineer's job satisfaction with the level of technical expertise and technical development.

**Notes to Survey Respondents:**

- For the purpose of this survey, **"Technical work"** is defined as: Strongly engineering related work, using tools, methods and analysis required to satisfy the technological aspect of a situation. (Note that Project and Business Management do NOT fit this definition)
- Technical development consists of formal training (classroom, seminars, self-study, etc.) and informal ("on-the-job") aspects.
- **All responses will be kept confidential.** Only aggregate data will be used.
- Please consider your current or most recent technical position at which you spent at least 6 months.
- Questions? Please ask your student contact!

---

**Your Name:** ____________________ **(Optional)**

**Your Position:** ____________________

**Your Company:** ____________________

[This page will be detached from your completed survey].

**I. Basic Information**

1. How would you describe your work?

   ___ Research and Development (including product design and development)
   ___ Manufacturing (including manufacturing engineering and support functions)

2. How long have you been in your current technical field?

   _____ years.

3. Number of employees in your work site?

   _____ people.

4. Number of technical peers in your site?

   _____ people.

5. Is your department organized with a:

| Strongly functional orientation | | | | | Strongly project orientation |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

**II. Technical Expertise**

6. In technical matters, do you primarily:

| Seek technical advice | | | | | Provide technical advice |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

7. What is your level of influence in critical technical decisions?

| Not significant | | | | | Very significant |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

8. How do you currently rate your technical competence?

| | | | | | |
|---|---|---|---|---|---|
| Not at all competent | | | | | Extremely competent |
| 1 | 2 | 3 | 4 | 5 | 6 |

9. If you were given a promotion (in your technical area), how confident would you feel in your technical competency?

| | | | | | |
|---|---|---|---|---|---|
| Not at all confident | | | | | Extremely confident |
| 1 | 2 | 3 | 4 | 5 | 6 |

10. How would you describe your mix of job responsibilities (technical versus other responsibilities)?

| | | | | | |
|---|---|---|---|---|---|
| Less technical | | | | | More technical |
| 1 | 2 | 3 | 4 | 5 | 6 |

11. For the most satisfying technical achievement of your career, would you say that the technical challenge was:

| | | | | | |
|---|---|---|---|---|---|
| Insignificant | | | | | Substantial |
| 1 | 2 | 3 | 4 | 5 | 6 |

12. Do you feel that technical expertise is viewed by your organization as:

| | | | | | |
|---|---|---|---|---|---|
| Simply expected or assumed | | | | | Critical to the organization's success |
| 1 | 2 | 3 | 4 | 5 | 6 |

**III. Technical Development: Formal Training**

13. Rate the amount of technical focused training you have had in the last 12 months:

| Not enough | | | | | Too much |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

14. Rate the amount of technical focused training you wish to receive:

| None | | | | | Substantial |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

15. Rate the relevance to your job of your recent technical focused training:
[Leave blank if no recent technically focused training]

| Totally irrelevant | | | | | Extremely relevant |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

16. Rate the benefit to your career of you recent technically focused training:
[Leave blank if no recent technically focused training]

| Totally irrelevant | | | | | Extremely relevant |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

17. Has recent formal training improved your job competence?
[Leave blank if no recent technically focused training]

| No improvement | | | | | Significant improvement |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

18. Which of the technical training programs would be the <u>most</u> helpful for <u>your career development</u>?

- ❑ General technical skills refreshment (math, science, engineering)
- ❑ New technologies and advancements in your field.
- ❑ Basic Computer Training (PC Software, Basic CAD)
- ❑ Advanced Computer Training (Systems/ Application Programming, CAE, Analysis Tools)
- ❑ An in-depth orientation about company systems and procedures
- ❑ Other (describe)

19. Which of the technical training programs would be the <u>most</u> helpful for <u>your current job</u>?

- ❑ General technical skills refreshment (math, science, engineering)
- ❑ New technologies and advancements in your field.
- ❑ Basic Computer Training (PC Software, Basic CAD)
- ❑ Advanced Computer Training (Systems/ Application Programming, CAE, Analysis Tools)
- ❑ An in-depth orientation about company systems and procedures
- ❑ Other (describe)

**IV. Technical Development: Job Content ("On-the-Job" training)**

20. How much does your recent work experience promote development of your technical skills?

| No opportunity | | | | | Numerous opportunities |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

21. Is the technical content of the work you are assigned:

| Routine and predictable | | | | | Unusual and unpredictable |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |

22. Within your work environment, is the technology employed:

| | | | | | |
|---|---|---|---|---|---|
| Obsolete | | | | | Cutting edge, state-of-the-art |
| 1 | 2 | 3 | 4 | 5 | 6 |

**V. Job Satisfaction**

23. How do you rate your job satisfaction in your current position?

| | | | | | |
|---|---|---|---|---|---|
| Extremely dissatisfied | | | | | Extremely satisfied |
| 1 | 2 | 3 | 4 | 5 | 6 |

24. Compared with your most ideal job, do find your current work:

| | | | | | |
|---|---|---|---|---|---|
| Encourages minimal performance | | | | | Encourages maximum performance |
| 1 | 2 | 3 | 4 | 5 | 6 |

25. How would you rate your status compared with management co-workers?

| | | | | | |
|---|---|---|---|---|---|
| Extremely low | | | | | Extremely high |
| 1 | 2 | 3 | 4 | 5 | 6 |

26. What is the likelihood that you will actively seek a job change in the next year?

| | | | | | |
|---|---|---|---|---|---|
| 0% probability | | | | | 100% certainty |
| 1 | 2 | 3 | 4 | 5 | 6 |

# Appendix 3

**Progress of Survey Questions**

A week after we had known what our project proposal and hypothesis were, we explored past literatures and journal articles in order to find the hypothesis' factor and information to support our hypothesis. Unfortunately, the information gathered for the literature and other sources did not directly related to our issues. With our curiosity and attempt to prove our hypothesis, we, having as an engineer's background, brainstormed the hypothesis' factors and then tie them with survey questions. In addition, we set our survey style, format, and a measure scale of our survey question, 5 point scales, which would be developed, later on in the next step. By the middle of the second week, the first draft of the survey question was constructed.

From the first effort, the outline of questionnaires looked good for us even though the matters were not complete. We looked over the first outline again, added some more questions which would produce answers to prove the hypothesis. In the meanwhile, we were still searching literatures and journal articles. Thus, the outline of questionnaires was more completed than the first draft. After further discussion, we decided to change the measure scale from 5 point scale to 6 point scale because we would like to avoid a middle point which participants might select. As, the middle point would not give us the information. After we added new questions and changed the scale measurement, the second draft was setup in the early of the third week.

With a lot of additional questions in the second draft, we decided to stay focus on what we were looking for and how to get there. This stage was very difficult for us due to each person had their own perspective to see things.  In order to move unrelated questions, we frequently asked ourselves if these questions would give us the answer that we were looking for. The second draft of the survey question was updated to the third draft.

For the third draft, we asked for some recommendation from Dr. Milosevic. The result was returned to us. We received a lot of comments, which were very serious issues. Those were “make sure you know how each question relates to your (sub) hypothesis, lay out questions to shorten length of the questionnaire, some questions appear similar and subheading not clear to me”. To us, the comments and plus some suggestion in class were very useful to redesign our questionnaires.
At the juncture, the original idea began more suspicious due to the fact that we could not see the overall picture. We tried to find a new approach of doing the survey questions. We began by rewriting our hypothesis and drew some charts that give us the overall picture. Then, we put them on the discuss table, in case, we forgot to focus on our hypothesis while we were working on our questions. In addition, we tried to keep the questions short and simple. When the question was too long or complex, the respondent might have difficulty following the intent of the item. Besides, the other concerns in the survey were the length of the survey and organized logically.

With the comment and the new approach, the fourth edition of the questionnaires was written down. Then, we brought the questionnaire over the psychology department in order to discuss and receive some comments. Dr Jansen, head of the psychology department, looked over the survey and help us with unclear sentences, select words and organized structure. We also discussed each individual question if we should keep the question or rewrote them in proper way. Finally, the fifth edition of the questionnaires was ready to distribute to our participants.

# APPENDIX 2

## Exhibit 1: Survey Results- Raw Data

| Function | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Q18 | Q19 | Q20 | Q21 | Q22 | Q23 | Q24 | Q25 | Q26 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Design | 1 | 3 | 425 | 40 | 5 | 4 | 6 | 5 | 5 | 5 | 6 | 4 | 3 | 4 | 3 | 5 | 4 | 6 | 8 | 5 | 4 | 4 | 5 | 5 | 5 | 2 |
| Design | 1 | 10 | 75 | 7 | 1 | 6 | 6 | 5 | 6 | 5 | 5 | 2 | 2 | 1 | 3 | 2 | . | 2 | 2 | 5 | 3 | 2 | 4 | 2 | 5 | 3 |
| Design | 1 | . | 1500 | 100 | 2 | 2 | 2 | 3 | 1 | 4 | 5 | 6 | 1 | 6 | 5 | 4 | 3 | 11 | . | 6 | 4 | 2 | 5 | 4 | 4 | 1 |
| Design | 1 | 39 | 1500 | 25 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 5 | 3 | 4 | 5 | 4 | 5 | 4 | 4 | 4 | 6 | 4 | 6 | 6 | 4 | 1 |
| Design | 1 | 3 | 1100 | 400 | 1 | 5 | 5 | 6 | 6 | 3 | 6 | . | 4 | 2 | 5 | 4 | 2 | . | . | 4 | 4 | 4 | 4 | 4 | 4 | 1 |
| Design | 1 | 8 | 400 | 100 | 2 | 4 | 3 | 5 | 3 | 5 | 5 | 5 | 6 | 4 | 4 | 4 | 2 | 4 | 2 | 5 | 4 | . | . | . | . | . |
| Design | 1 | 10 | 700 | 250 | 2 | 5 | 5 | 4 | 6 | 3 | 6 | 2 | 4 | 4 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 3 | 4 | 5 | 5 | 3 |
| Design | 1 | 10 | 2000 | 200 | 2 | 3 | 3 | 5 | 5 | 2 | 5 | 1 | 3 | 4 | . | . | . | 9 | 3 | 1 | 5 | 2 | 4 | 3 | 4 | 5 |
| Design | 1 | 25 | 100 | . | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 3 | 3 | 4 | . | . | . | 4 | 4 | 3 | 3 | 4 | 4 | 3 | 3 | 1 |
| Design | 1 | . | . | . | 1 | 5 | 5 | 5 | 5 | 3 | 4 | 3 | 2 | 4 | 3 | 2 | 3 | 4 | 4 | 4 | 2 | 3 | 2 | 2 | 4 | 6 |
| Design | 1 | 1 | 200 | 50 | 2 | 4 | 4 | 4 | 5 | 3 | 5 | 5 | 3 | 4 | 3 | 4 | 4 | 2 | 2 | 4 | 4 | 3 | 5 | 4 | 5 | 1 |
| Design | 1 | 7 | 240 | 40 | 6 | 4 | 5 | 4 | 5 | 3 | 5 | 6 | 2 | 5 | 5 | 6 | 5 | 6 | 4 | 5 | 5 | 3 | 5 | 4 | 4 | 2 |
| Design | 1 | 18 | 250 | 50 | 4 | 4 | 4 | 4 | 3 | 3 | 4 | 5 | 2 | 4 | . | . | . | 4 | 1 | 3 | 3 | 3 | 4 | 3 | 4 | 2 |
| Design | 1 | 13 | 6 | 3 | 5 | 4 | 5 | 5 | 4 | 4 | 4 | 5 | 2 | 5 | 2 | 3 | 2 | 2 | 2 | 5 | 6 | 5 | 1 | 4 | 4 | 6 |
| Design | 1 | 5 | 900 | 35 | 4 | 4 | 4 | 4 | 4 | 2 | 4 | 3 | 3 | 5 | 5 | 4 | 5 | 1 | 1 | 2 | 2 | 3 | 4 | 5 | 4 | 3 |
| Design | 1 | 14 | 1500 | 500 | 6 | 5 | 5 | 4 | 5 | 5 | 6 | 6 | 5 | 4 | 3 | 3 | 4 | 6 | 4 | 4 | 5 | 4 | 4 | 5 | 5 | 2 |
| Design | 1 | 5 | 200 | 30 | 5 | 5 | 5 | 5 | 5 | 4 | 6 | 5 | 4 | 5 | 5 | 4 | 4 | 4 | 5 | 5 | 4 | 3 | 5 | 4 | 6 | 3 |
| Design | 1 | 7 | 300 | . | 2 | 3 | 6 | 5 | 5 | 4 | 5 | 4 | 3 | 5 | 6 | 6 | 5 | 7 | 7 | 5 | 5 | 3 | 5 | 5 | 4 | 2 |
| Design | 1 | 15 | 3 | 3 | 5 | 5 | 3 | 5 | 4 | 4 | 4 | 3 | 2 | 4 | . | . | . | 4 | 4 | 3 | 3 | 2 | 6 | 5 | 3 | 1 |
| Design | 1 | 15 | 40 | 8 | 4 | 5 | 5 | 5 | 4 | 3 | 4 | 3 | 2 | 4 | 4 | 3 | 4 | 6 | 4 | 4 | 3 | 3 | 4 | 3 | 4 | 5 |
| Manufacturing | 2 | 1 | 450 | 20 | 1 | 3 | 2 | 3 | 2 | 3 | 6 | 5 | 3 | 4 | 5 | 5 | 5 | 2 | 5 | 5 | 5 | 5 | 2 | 2 | 3 | 5 |
| Manufacturing | 2 | 1 | 1500 | 100 | 2 | 4 | 3 | 4 | 5 | 3 | 5 | 2 | 1 | 4 | 4 | 3 | 3 | 11 | 5 | 2 | 5 | 2 | 4 | 4 | 4 | 2 |
| Manufacturing | 2 | 3 | 1500 | 15 | 2 | 5 | 6 | 5 | 3 | 3 | 6 | 4 | 3 | 4 | 6 | 6 | 6 | . | . | 5 | 5 | 3 | 5 | 5 | 5 | 1 |
| Manufacturing | 2 | 3 | 1500 | 4 | 4 | 5 | 4 | 4 | 3 | 4 | 4 | 2 | 1 | 4 | . | . | . | 2 | 2 | 5 | 4 | 2 | 6 | 6 | 4 | 2 |
| Manufacturing | 2 | 25 | 1500 | 4 | 1 | 5 | 2 | 5 | 5 | 3 | 5 | 1 | 2 | 5 | 4 | 2 | 5 | 5 | 2 | 2 | 3 | 2 | 3 | 2 | 1 | 4 |
| Manufacturing | 2 | 35 | 1500 | 100 | . | 5 | 5 | . | 5 | 4 | 5 | . | 1 | 3 | . | . | . | 11 | 11 | 4 | 4 | 2 | 4 | 4 | 4 | 6 |
| Manufacturing | 2 | 2.5 | 4000 | 100 | 4 | 1 | 4 | 2 | 6 | 2 | 2 | 3 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 4 | 3 |
| Manufacturing | 2 | 7 | 1000 | 60 | 5 | 4 | 5 | 5 | 5 | 3 | 3 | 5 | 3 | 4 | 3 | 3 | 2 | 4 | 2 | 3 | 3 | 4 | 3 | 3 | 4 | 4 |
| Manufacturing | 2 | 9 | . | 65 | 3 | 5 | 5 | 5 | 6 | 3 | 3 | 5 | 2 | 4 | . | . | . | 10 | 8 | 5 | 2 | 2 | 3 | 4 | 4 | 3 |
| Manufacturing | 2 | 20 | 1000 | 30 | 1 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 4 | 4 | 5 | 5 | 4 | 6 | 6 | 6 | 4 | 6 | 6 | 6 | 6 | 2 |
| Manufacturing | 2 | 4 | 400 | 40 | 4 | 4 | 4 | 4 | 3 | 5 | 5 | 6 | 4 | 5 | 5 | 5 | 5 | 2 | 4 | 5 | 2 | 4 | 3 | 3 | 3 | 6 |
| Manufacturing | 2 | 8 | 450 | 5 | 3 | 4 | 4 | 5 | 4 | 3 | 5 | 3 | 5 | 5 | 5 | 4 | 5 | 2 | 2 | 5 | 3 | 5 | 2 | 2 | 4 | 6 |
| Manufacturing | 2 | 4 | 350 | 150 | 3 | 4 | 2 | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 6 | 6 | 5 | 2 | 2 | 5 | 4 | 6 | 5 | 4 | 3 | 2 |
| Manufacturing | 2 | 6 | 250 | 15 | 1 | 5 | 5 | 4 | 3 | 3 | 3 | 4 | 1 | 5 | . | . | . | 2 | 5 | 2 | 3 | 3 | 2 | 2 | 4 | 3 |
| Manufacturing | 2 | 9 | 250 | 75 | 5 | 3 | 3 | 3 | 3 | 1 | 6 | 6 | 1 | 6 | . | . | . | 2 | . | 2 | 2 | 3 | 4 | 4 | 3 | 4 |
| Manufacturing | 2 | 10 | 30 | 15 | 4 | 4 | 5 | 5 | 4 | 4 | 5 | 6 | 6 | 2 | 4 | 5 | 4 | 6 | 6 | 6 | 4 | 5 | 4 | 4 | 4 | 2 |
| Manufacturing | 2 | 6 | 1500 | 750 | 4 | 3 | 3 | 2 | 2 | 3 | 2 | 5 | 2 | 5 | 2 | 6 | . | 4 | 1 | 3 | 2 | 3 | 2 | 5 | 3 | 6 |
| Manufacturing | 2 | 8 | 2000 | 100 | 2 | 2 | 2 | 4 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 3 | 2 | 4 | 2 | 4 | 3 | 5 | 5 | 5 | 4 | 1 |
| Manufacturing | 2 | 10 | 2000 | 500 | 1 | 5 | 5 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 5 | 5 | 5 | 4 | 5 | 4 | 4 |
| Manufacturing | 2 | 10 | 200 | 30 | 5 | 5 | 4 | 5 | 5 | 4 | 4 | 5 | 3 | 3 | 5 | 4 | 4 | 6 | 6 | 5 | 4 | 4 | 6 | 5 | 4 | 1 |

** Company and respondent names are requested to be kept confidential.*

**Exhibit 2: Pearson Matrix**

| | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Q18 | Q19 | Q20 | Q21 | Q22 | Q23 | Q24 | Q25 | Q26 | Job Satis | Tech Comp | Effective Tech Tra | Job Content | Experien | Training gap(14-13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q5 | -10.36% | 9.00% | -13.14% | -0.70% | 1.69% | -8.32% | 37.17% | -3.12% | 16.67% | -20.67% | 7.52% | 4.27% | -5.87% | 2.80% | 0.00% | 2.97% | 1.23% | 17.61% | 29.45% | 1.85% | -6.31% | 21.84% | -3.56% | -1.38% | 1.23% | 23.71% | 11.09% |
| Q6 | | 54.39% | 65.81% | 40.22% | 37.58% | 31.41% | -11.30% | 12.11% | -36.52% | 24.80% | -3.44% | 27.82% | -0.91% | 24.45% | 21.20% | 11.05% | 2.28% | 18.30% | 12.81% | 29.69% | -1.37% | 23.97% | 79.92% | 15.69% | 23.33% | 10.67% | -28.65% |
| Q7 | | | 49.33% | 52.84% | 24.00% | 20.56% | 9.13% | 13.80% | -30.00% | 2.66% | 10.15% | 9.53% | 3.11% | 41.25% | 29.22% | 15.54% | 4.11% | 7.83% | 20.34% | 66.60% | -1.21% | 34.38% | 82.23% | 6.68% | 23.48% | 8.31% | -26.39% |
| Q8 | | | | 49.10% | 34.94% | 33.25% | -16.30% | 33.19% | -40.98% | 27.61% | -8.89% | 4.62% | 20.17% | 37.91% | 29.94% | 27.99% | 19.43% | 24.12% | 6.71% | 29.59% | -13.76% | 24.03% | 79.61% | 7.18% | 37.29% | 9.15% | -45.72% |
| Q9 | | | | | 7.24% | 11.49% | -31.70% | 12.89% | -45.90% | -9.00% | -30.80% | -19.09% | 14.19% | 28.87% | -12.35% | 1.51% | -8.82% | 14.34% | 4.67% | 35.86% | -10.94% | 20.55% | 77.80% | -24.92% | -5.59% | 30.01% | -34.27% |
| Q10 | | | | | | 22.76% | 27.67% | 40.38% | -23.68% | 15.95% | 18.40% | 15.69% | 6.28% | 25.67% | 62.70% | 40.19% | 45.06% | 40.07% | 38.95% | 27.15% | -24.85% | 44.90% | 31.15% | 17.80% | 81.59% | 22.68% | -42.70% |
| Q11 | | | | | | | 10.25% | 33.12% | -6.56% | 53.45% | 25.06% | 38.76% | 10.08% | 27.86% | 24.31% | 47.35% | 12.25% | 30.04% | 14.33% | 26.57% | -14.86% | 29.18% | 29.14% | 43.29% | 35.30% | -5.00% | -28.09% |
| Q12 | | | | | | | | 27.24% | 21.99% | 11.68% | 48.31% | 11.00% | 2.04% | 25.55% | 52.66% | 18.41% | 46.50% | 5.57% | 23.53% | 14.51% | -11.07% | 17.68% | -15.34% | 30.60% | 48.78% | -12.60% | -9.12% |
| Q13 | | | | | | | | | -20.06% | 27.51% | 30.99% | 9.53% | -20.79% | -8.82% | 35.62% | 16.77% | 67.41% | 6.82% | 15.06% | 25.85% | -7.17% | 18.27% | 20.43% | 27.87% | 52.91% | -7.47% | -84.96% |
| Q14 | | | | | | | | | | 14.23% | 21.99% | 26.54% | -7.08% | -19.60% | -15.70% | -6.53% | -3.28% | -16.87% | 5.16% | -23.99% | 22.87% | -13.57% | -48.05% | 27.25% | -16.25% | -14.14% | 68.72% |
| Q15 | | | | | | | | | | | 57.84% | 61.42% | 13.13% | 32.79% | 32.58% | 26.33% | 19.18% | 47.56% | 21.23% | 1.18% | -30.28% | 31.20% | 12.24% | 84.80% | 30.79% | -11.64% | -11.76% |
| Q16 | | | | | | | | | | | | 53.13% | 2.94% | 30.96% | 40.64% | 25.39% | 35.95% | 30.40% | 48.64% | 7.49% | -16.43% | 36.98% | -10.12% | 84.33% | 39.49% | -28.61% | -9.86% |
| Q17 | | | | | | | | | | | | | -5.85% | 30.48% | 28.16% | 24.71% | 10.92% | 23.65% | 5.43% | -17.92% | 1.17% | 6.86% | 6.78% | 83.35% | 24.51% | 4.15% | 5.80% |
| Q18 | | | | | | | | | | | | | | 67.99% | 10.34% | 28.87% | -32.62% | 21.68% | 13.67% | 8.33% | -11.63% | 19.10% | 11.42% | 5.62% | 4.12% | 11.76% | 12.26% |
| Q19 | | | | | | | | | | | | | | | 34.11% | 23.35% | -3.34% | 19.11% | 15.15% | 19.86% | -3.29% | 22.19% | 43.24% | 37.42% | 25.41% | 18.01% | -3.15% |
| Q20 | | | | | | | | | | | | | | | | 36.08% | 45.15% | 24.32% | 22.88% | 32.98% | -13.42% | 32.31% | 19.82% | 38.66% | 82.53% | -20.67% | -34.87% |
| Q21 | | | | | | | | | | | | | | | | | 25.83% | 28.32% | 30.47% | 22.58% | -24.24% | 34.13% | 16.42% | 30.20% | 66.16% | 6.83% | -15.95% |
| Q22 | | | | | | | | | | | | | | | | | | -4.15% | 14.57% | 9.99% | 0.00% | 7.68% | 3.30% | 28.15% | 71.50% | -5.25% | -50.27% |
| Q23 | | | | | | | | | | | | | | | | | | | 67.03% | 32.21% | -74.88% | 87.22% | 19.23% | 39.13% | 28.97% | 11.27% | -14.40% |
| Q24 | | | | | | | | | | | | | | | | | | | | 34.82% | -48.06% | 86.91% | 14.23% | 32.70% | 34.93% | 7.63% | -7.91% |
| Q25 | | | | | | | | | | | | | | | | | | | | | -25.43% | 63.17% | 51.77% | -4.50% | 31.06% | -15.48% | -32.07% |
| Q26 | | | | | | | | | | | | | | | | | | | | | | -64.81% | -7.10% | -17.80% | -20.37% | 0.98% | 18.03% |
| Job Satisfaction | | | | | | | | | | | | | | | | | | | | | | | **32.25%** | **30.25%** | **39.16%** | **3.62%** | **-20.76%** |
| Tech Comp | | | | | | | | | | | | | | | | | | | | | | | | **0.40%** | **22.55%** | **19.81%** | **-41.02%** |
| Eff Tech Training | | | | | | | | | | | | | | | | | | | | | | | | | **37.09%** | **-14.72%** | **-4.63%** |
| Job Content | | | | | | | | | | | | | | | | | | | | | | | | | | **-0.48%** | **-47.98%** |
| Experience | | | | | | | | | | | | | | | | | | | | | | | | | | | **-2.07%** |
| Trng Gap(Q14 Q13) | | | | | | | | | | | | | | | | | | | | | | | | | | | |

## Exhibit 3: $r^2$-Correleation Coefficient Matrix

| | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Q18 | Q19 | Q20 | Q21 | Q22 | Q23 | Q24 | Q25 | Q26 | JS | TC | TT | JC | Q2 | TG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q5 | 1.07% | 0.81% | 1.73% | 0.00% | 0.03% | 0.69% | 13.81% | 0.10% | 2.78% | 4.27% | 0.57% | 0.18% | 0.34% | 0.08% | 0.00% | 0.09% | 0.02% | 3.10% | 8.67% | 0.03% | 0.40% | 4.77% | 0.13% | 0.02% | 0.02% | 5.62% | 1.23% |
| Q6 | | 29.58% | 43.31% | 16.18% | 14.12% | 9.86% | 1.28% | 1.47% | 13.34% | 6.15% | 0.12% | 7.74% | 0.01% | 5.98% | 4.49% | 1.22% | 0.05% | 3.35% | 1.64% | 8.82% | 0.02% | 5.75% | 63.87% | 2.46% | 5.44% | 1.14% | 8.21% |
| Q7 | | | 24.33% | 27.92% | 5.76% | 4.23% | 0.83% | 1.91% | 9.00% | 0.07% | 1.03% | 0.91% | 0.10% | 17.02% | 8.54% | 2.41% | 0.17% | 0.61% | 4.14% | 44.35% | 0.01% | 11.82% | 67.62% | 0.45% | 5.51% | 0.69% | 6.96% |
| Q8 | | | | 24.11% | 12.21% | 11.05% | 2.66% | 11.01% | 16.79% | 7.62% | 0.79% | 0.21% | 4.07% | 14.37% | 8.97% | 7.83% | 3.78% | 5.82% | 0.45% | 8.75% | 1.89% | 5.77% | 63.38% | 0.52% | 13.91% | 0.84% | 20.91% |
| Q9 | | | | | 0.52% | 1.32% | 10.05% | 1.66% | 21.07% | 0.81% | 9.49% | 3.64% | 2.01% | 8.33% | 1.52% | 0.02% | 0.78% | 2.06% | 0.22% | 12.86% | 1.20% | 4.22% | 60.54% | 6.21% | 0.31% | 9.01% | 11.75% |
| Q10 | | | | | | 5.18% | 7.66% | 16.31% | 5.61% | 2.54% | 3.39% | 2.46% | 0.39% | 6.59% | 39.31% | 16.15% | 20.31% | 16.05% | 15.17% | 7.37% | 6.18% | 20.16% | 9.70% | 3.17% | 66.57% | 5.14% | 18.23% |
| Q11 | | | | | | | 1.05% | 10.97% | 0.43% | 28.57% | 6.28% | 15.03% | 1.02% | 7.76% | 5.91% | 22.42% | 1.50% | 9.03% | 2.05% | 7.06% | 2.21% | 8.51% | 8.49% | 18.74% | 12.46% | 0.25% | 7.89% |
| Q12 | | | | | | | | 7.42% | 4.84% | 1.36% | 23.34% | 1.21% | 0.04% | 6.53% | 27.74% | 3.39% | 21.62% | 0.31% | 5.54% | 2.11% | 1.23% | 3.13% | 2.35% | 9.36% | 23.79% | 1.59% | 0.83% |
| Q13 | | | | | | | | | 4.02% | 7.57% | 9.60% | 0.91% | 4.32% | 0.78% | 12.69% | 2.81% | 45.44% | 0.47% | 2.27% | 6.68% | 0.51% | 3.34% | 4.18% | 7.77% | 28.00% | 0.56% | 72.18% |
| Q14 | | | | | | | | | | 2.02% | 4.84% | 7.05% | 0.50% | 3.84% | 2.46% | 0.43% | 0.11% | 2.85% | 0.27% | 5.75% | 5.23% | 1.84% | 23.08% | 7.43% | 2.64% | 2.00% | 47.22% |
| Q15 | | | | | | | | | | | 33.45% | 37.72% | 1.72% | 10.75% | 10.61% | 6.93% | 3.68% | 22.62% | 4.51% | 0.01% | 9.17% | 9.73% | 1.50% | 71.91% | 9.48% | 1.35% | 1.38% |
| Q16 | | | | | | | | | | | | 28.23% | 0.09% | 9.58% | 16.52% | 6.45% | 12.93% | 9.24% | 23.66% | 0.56% | 2.70% | 13.67% | 1.03% | 71.12% | 15.59% | 8.19% | 0.97% |
| Q17 | | | | | | | | | | | | | 0.34% | 9.29% | 7.93% | 6.11% | 1.19% | 5.59% | 0.30% | 3.21% | 0.01% | 0.47% | 0.46% | 69.47% | 6.01% | 0.17% | 0.34% |
| Q18 | | | | | | | | | | | | | | 46.23% | 1.07% | 8.33% | 10.64% | 4.70% | 1.87% | 0.69% | 1.35% | 3.65% | 1.30% | 0.32% | 0.17% | 1.38% | 1.50% |
| Q19 | | | | | | | | | | | | | | | 11.63% | 5.45% | 0.11% | 3.65% | 2.29% | 3.94% | 0.11% | 4.92% | 18.70% | 14.00% | 6.46% | 3.24% | 0.10% |
| Q20 | | | | | | | | | | | | | | | | 13.02% | 20.38% | 5.91% | 5.23% | 10.87% | 1.80% | 10.44% | 3.93% | 14.95% | 68.11% | 4.27% | 12.16% |
| Q21 | | | | | | | | | | | | | | | | | 6.67% | 8.02% | 9.29% | 5.10% | 5.87% | 11.65% | 2.70% | 9.12% | 43.77% | 0.47% | 2.54% |
| Q22 | | | | | | | | | | | | | | | | | | 0.17% | 2.12% | 1.00% | 0.00% | 0.59% | 0.11% | 7.93% | 51.12% | 0.28% | 25.27% |
| Q23 | | | | | | | | | | | | | | | | | | | 44.93% | 10.37% | 56.07% | 76.08% | 3.70% | 15.31% | 8.39% | 1.27% | 2.07% |
| Q24 | | | | | | | | | | | | | | | | | | | | 12.12% | 23.10% | 75.53% | 2.02% | 10.69% | 12.20% | 0.58% | 0.63% |
| Q25 | | | | | | | | | | | | | | | | | | | | | 6.47% | 39.91% | 26.80% | 0.20% | 9.65% | 2.40% | 10.29% |
| Q26 | | | | | | | | | | | | | | | | | | | | | | 42.00% | 0.50% | 3.17% | 4.15% | 0.01% | 3.25% |
| JS | | | | | | | | | | | | | | | | | | | | | | | 10.40% | 9.15% | 15.34% | 0.13% | 4.31% |
| TC | | | | | | | | | | | | | | | | | | | | | | | | 0.00% | 5.09% | 3.92% | 16.83% |
| TT | | | | | | | | | | | | | | | | | | | | | | | | | 13.76% | 2.17% | 0.21% |
| JC | | | | | | | | | | | | | | | | | | | | | | | | | | 0.00% | 23.02% |
| Q2 | | | | | | | | | | | | | | | | | | | | | | | | | | | 0.04% |

JS: Job Satisfaction Composite (Q23, Q24, Q25)
TC: Technical Competency Composite (Q6, Q7, Q8, Q9, Q10)
TT: Technical Training Composite (Q15, Q16, Q17)
JC: Job Content Composite (Q20, Q21, Q22 )
TG: Training Gap Composite (Q13, Q14)