Association for Information Systems
AIS Electronic Library (AISeL)

ICIS 1984 Proceedings

International Conference on Information Systems (ICIS)

1984

# The Effects of Maintenance Assignments On Goal Congruence For Programmers and Analysts

J. Daniel Couger
*University of Colorado at Colorado Springs*

Mel A. Colter
*University of Colorado at Colorado Springs*

# The Effects of Maintenance Assignments On Goal Congruence For Programmers and Analysts

**J. Daniel Couger**
**Distinguished Professor of Computer and Management Science**
**University of Colorado at Colorado Springs**

**Mel A. Colter**
**Associated Professor of Management Science and Information Systems**
**University of Colorado at Colorado Springs**

## ABSTRACT

The effect of varying amounts of maintenance work on perceptions of role conflict, role clarity, and reward clarity was analyzed in ten organizations representative of widely varying computing environments. The organizations had one characteristic in common—productivity of maintenance personnel was satisfactory, consistent with that of personnel assigned to new development work. The research revealed significant differences in perceptions of congruency between high maintenance and low maintenance employees. High maintenance employees appear to attain much higher levels of role clarity and reward clarity and much lower role conflict.

## Introduction

Maintenance of existing programs is consuming an increasingly larger proportion of the IS budget. The studies of Boehm (1981) indicate that the proportion of hardware/software cost allocated to system maintenance in the typical U.S. computer installation is not only more than half of the total software cost, it is approximately 50 percent of the *total* computing cost. Maintenance is also labor-intensive. Diebold (1979) projects that by 1985 the cost of hardware will be one-tenth of the 1979 rate and labor costs will be twice as high as the 1979 rate.

Compounding this problem is the perception of programmers and analysts that maintenance work is less interesting and challenging than new development work. Quantitative support for this view resulted from the studies of Couger and Zawacki (1980). Their database of more than 6,000 computer personnel indicates the job's motivating potential (MPS)[1] decreases precipitously as the percent of maintenance work increases. MPS for personnel whose work is over 50 percent maintenance is only 2/3's that of personnel assigned to new development work.

[1]MPS=Motivating Potential Score as computed from survey variables.

The potential for improvement led to the Couger-Colter (1983) in-depth research on the maintenance motivating environment. The results indicated that maintenance tasks could be redesigned to enhance motivation significantly.

The second part of that research, reported here for the first time, analyzed the effect of role conflict, role ambiguity, and clarity of reward linkages on maintenance personnel.

The objective was to extend the work of Bostrom (1981) who had examined role conflict and role ambiguity in 75 dyads (user-programmer/analyst) in maintaining an information system. Our objective was threefold:

1. To examine a broader sample of organizations and maintenance activities.
2. To examine the effect of the three congruence variables versus the percentage of maintenance performed.
3. To increase the profundity of research by use of both written questionnaires and in-depth interviews.

However, the major difference between this and preceding research was our conctration on firms where maintenance productivity was commensurate with that of

new development. It was hoped that study of these productive maintenance environments would enable a generalization of approaches to permit industry-wide application. Productive maintenance is crucial to cost containment in an era of rapidly increasing information system expenditures.

## Description of the Survey Process

The measures of role conflict and role ambiguity were derived from the work done originally by Kahn, Wolfe, Quinn, Snoek, and Rosenthal (1964). Role conflict is defined as "the degree of incongruity or in compatibility in the expectations and requirements communicated to a focal person." Role ambiguity is "the degree to which desired expectations are vague, ambiguous or unclear, thereby making it difficult for the person to fulfill the requirements" (Bostom, 1981, p. 92-93).

The measurement approach was based on the eight item scale developed by Rizzo, House, and Lirtzman (1970) and further validated by Schuler, Aldog, and Brief (1977). Goldstein and Rockart (1984) extended this work to a study of job satisfaction in programmer/analysts but did not analyze the effect of maintenance assignments. The measure of reward linkages was derived from the work of Carrell and Dittrich (1978). Reward clarity is "the degree to which employees can link performances to rewards."

The data collection process began with the administration of the Couger-Zawacki version of the Hackman-Oldham survey instrument (1975), to all analysts and programmers in the organizations included in the study (to be described in the next section). This instrument is primarily directed at clarification of the motivational environment for the data processing effort. In addition, the instrument was used to gather demographic data, and each respondent was asked to indicate his or her relative maintenance load as a percentage of total effort.

After the preliminary survey data was analyzed, each firm received a two day site visit by at least one of the two researchers. During that visit, top level IS management was apprised of the preliminary analysis results. Then, in a meeting with first line IS managers, the early results were again explained and a structured interview questionnaire was used to elicit information from that group about the maintenance process in general for the organization.

The remainder of the two day site visit was spent in a series of one to 1½ hour interviews with employees. These employees were selected by their management as being representative of individuals involved with maintenance within the IS organization. The first line supervisors were specifically asked to include a majority of high maintenance personnel. This selection process was not random, and it therefore lacks some statistical robustness. However, the sample sizes involved forced this type of interviewee selection to ensure inclusion of representative maintenance employees.

The types of data relating to perceptions of the maintenance activity fell into three broad classes. First, demograhic data was acquired from the initial survey instrument. The set of demographic variables is:

- –Sex
- –Age
- –Education
- –Marital Status
- –Years With Firm

The variable 'Number of Dependents' was also collected, as it has been found to hold more predictive power than marital status. However, the variable 'Marital Status' will be used in this paper to ensure consistency with other published results. In addition, the respondent's estimate of the amount of his or her time spent on software maintenance activities was collected as a percentage.

The second catagory of data came from the structured portion of the interview questions. It included:

- –% Time on Maintenance Activities
- –%Time on *Fixit* Activities
- –%Time on *Enhancement* Activities
- –Definition of Maintenance (Fixit vs. Enhancement)
- –Distribution of Maintenance Task Size in Lines of Code (LOC)
- –Relative Severity of Maintenance Problems:
  - –Poor Documentation
  - –Poor Existing Design
  - –Unrealistic Schedules
  - –Other Problems
- –Relative Importance of Individual Performance Evaluation on Maintenance Tasks:
  - –Lines of Code Produced
  - –Lines of Error-Free Code Produced
  - –Compliance with Schedules
  - –Minimizing Costs
  - –Other Areas

Note that the percent of time spent on maintenance was collected both on the initial survey instrument and during the early portion of the interview. In both of these cases, the question was asked with no guidance as to what the researchers believed maintenance to be. Each respondent was allowed to answer the questions using whatever perception of the term he or she held. Then, in

the interview process, the discussion of two components of maintenance was initiated.

The reason for this approach is that the definition of maintenance varies greatly throughout the literature and within the industry itself. By avoiding definitional problems, the instrument was able to elicit the amounts of maintenance which individuals *perceived* that they performed, irrespective of any specific definition of the term. This is no way reduced the significance of the resulting data. The approach was consistent with industry studies designed to determine the percent of budget spent on new development versus maintenance. Definitions are rarely provided to respondents of those surveys. By allowing individual definitions of maintenance, the instrument was able to relate perceived maintenance responsibilities to perceptions about the resulting job effects.

During the interviews, each individual was asked to provide a definition of the maintenance effort. Contrary to much of the published literature on the subject of the definition of maintenance, the responses to this question were uniformly simple and straightforward.

The literature definition of maintenance contains complex definitional structures for this type of effort. For example, one such structure (Reutter, 1981) defines maintenance through a set of sub-components as:

- -Emergency Repairs
- -Corrective Coding
- -Upgrades
- -Changes in Conditions
- -Growth
- -Enhancements
- -Support

Another definitional structure, with somewhat less complexity, is provided by Leintz and Swanson (1980) as:

- -Corrective Maintenance
- -Adaptive Maintenance
- -Perfective Maintenance

While definitions of this type may be of value in the formal classification of specific maintenance efforts, this research found that they are not consistent with the manner in which individuals perceive the maintenance task. In every case, the interviewed personnel, through their own definitions, supported a binary classification of maintenance.

### FIXIT WORK

First, all of the individuals perceived a class of maintenance effort which is required of existing systems because of failure. These efforts must be performed in order to make the system operate and they generally involve time pressures related to actual processing schedules. This class effort is referenced in this study as being *fixit* work. In other words, the system or problem must be fixed in order to support further operation.

### ENHANCEMENT WORK

The second class of activity discussed by these individuals involved all other changes to the system. While the literature discusses multiple sub-classifications for this type of effort, the individuals in the study clearly did not support that type of detailed breakdown. They perceived that maintenance work was either nessesary simply to make the system function (fixit effort), or that is was required due to some external stimulus. The details of the source of the latter requirement were considered to be relevant only in terms of performing the work and meeting the requirement. Otherwise, all of these efforts were combined into a single class of maintenance which we refer to as *enhancement*.

This classification of all maintenance effort into two types, fixit and enhancement, was common to all of the individuals involved in the interview process. While the more detailed classifications may be of value in certain types of research, this study found that the personnel involved in the maintenance effort simply do not perceive the effort at that level of detail.

The average percent of maintenance activities reported by all programmers, programmer/analysts, and analysts, across all of the firms in the study, was 32%. Averages for individual firms varied from a low of 23% to a high 45%. Within each of the firms, the range was zero to 100 percent. This indicates that these organizations did not equally distribute maintenance across all of their employees. Instead, the amount of maintenance effort varied greatly for individuals.

The final class of collected data involved employee perceptions of goal congruity. This data involved a set of questions which elicited responses about role clarity, role conflict, and reward clarity. The primary hypotheses of the study involved the relationship between these three variables and maintenance related variables.

## Description of the Survey Participants

The criteria for selection of firms to be included in the research project were as follows:

- —Representative of both public and private organizations.

**Table 1**

Correlation Between Demographics and Congruence Variables

| Variable | Percent Maintenance | Role Clarity | Reward Clarity | Role Conflict |
|---|---|---|---|---|
| Education | -All Subjects- | -.19 * | .15 | -.09 |
| | 0-49% | .43 | .01 | -.26 |
| | 50-100% | -.31 ** | .22 * | -.07 |
| Age | -All Subjects- | .21 * | .12 | -.12 |
| | 0-49% | .25 | .34 | .04 |
| | 50-100% | .21 * | .12 | -.13 |
| Years | -All Subjects- | .20 * | .11 | -.12 |
| | 0-49% | -.14 | .13 | .08 |
| | 50-100% | .25 * | .12 | -.14 |

Significance: p = .10 .. *
p = .05 .. **
p = .01 .. ***

— Representative of centralized and decentralized data processing organizations and equipment.
— Representative in the mix of maintenance/new development work.

Ten organizations, geographically dispersed, were included in the survey:

— A city government organization
— A state government organization
— A federal government organization
— A software development firm
— An energy supplier (primarily oil)
— Three consumer product suppliers/retailers
— A government contractor
— A regional center for one of the above

The organizations ranged in size as follows:

— Four small-sized organizations—25 to 50 analysts/programmers.
— Three medium-sized organizations—50 to 100 analysts/programmers.
— Three large-sized organizations—100 to 200 analysts/programmers.

A total of 555 usuable responses were obtained from the written questionnaire. Interviews were conducted with personnel whose assignments ranged from zero to 100 percent maintenance. The remainder of this paper presents statistical results where appropriate and utilizes graphical representations of the results in all other cases.

## Data Analysis Results

The primary goal of the research effort reported in this paper was to investigate the relationship between role clarity, reward clarity, and goal conflict and the set of maintenance variables. Here, careful note must be made about the nature of the maintenance data and the resulting nature of the statistical tests.

The primary hypotheses involve statements about the relationship between the *level* of the congruence variables and the *amount* of maintenance reported in various catagories. Therefore, the majority of this paper deals with discussions about correlation. For example, the correlation between perceived role clarity and the reported amount of fixit effort was of interest. It is of both practical and theoretical interest if this correlation is significant, indicating that more fixit effort is positively or negatively related to role clarity.

The concept of correlation is somewhat obscured in much of the analysis due to the multiple factors of interest. First, the respondents were separated into two groups with high maintenance individuals (50% or more of their effort on maintenance) and low maintenance individuals (less than 50% maintenance) compared throughout the analysis. Furthermore, the maintenance responses were often broken into several classes. For example, respondents were asked to indicate the per-

**Table 2**

Correlation Between Maintenance Workloads and Congruence Variables

| Variable | Percent Maintenance | Role Clarity | Reward Clarity | Role Conflict |
|---|---|---|---|---|
| %-Maintenance | -All Subjects- | .05 | -.20 * | -.21 ** |
| | 0-49% | -.51 ** | -.43 | .22 |
| | 50-100% | .24 ** | -.08 | -.32 *** |
| %-Enhancement | -All Subjects- | .13 | -.20 | -.12 |
| | 0-49% | -.64 * | .20 | .74 ** |
| | 50-100% | .16 | -.06 | -.20 |
| %-Fixit | -All Subjects- | -.02 | -.09 | .00 |
| | 0-49% | .21 | -.77 ** | .31 |
| | 50-100% | -.03 | -.01 | -.02 |

Significance: p = .10 .. *
p = .05 .. **
p = .01 .. ***

centage of their time spent on maintenance tasks of different sizes. This provided metric data for each task classification. As a result, we were able to study the correlation, for example, between role clarity and the reported amount of time spent on very small, small, medium, and large maintenance tasks. This supported the analysis of questions about the possible differences in the effects of different sizes of maintenance tasks on the congruence variables.

The results of the study of demographics are shown in Table 1. For all employees, role clarity was found to negatively correlated (p = .10) to education and positively correlated (p = .10) to years with the organization. It is most interesting, however, that these relationships were not found at a significant level for low maintenance employees and that they were more significant for high maintenance employees. In addition, high maintenance employees were found to exhibit a positive (p = .10) correlation between education and role clarity. No significant relationshps were found between the demographic variables and role conflict.

At this point, the nature of the presentation of the results should be clarified. A traditional presentation would concentrate heavily on findings of statistical significance. However, the complexity of the relationships under analysis, along with the practical and theoretical importance of these relationships, support the presentation of a larger body of results. The full coverage suggests important trends.

Table 2 shows the relationship between reported levels of maintenance efforts and the congruence variables. First, the amount of maintenance in various categories is uniformly negatively correlated to reward clarity and role conflict, though the correlation is significant only for overall measure of maintenance efforts. For low maintenance employees, the amount of enhancement effort is positively correlated to role conflict and the amount of fixit is negatively related to reward clarity.

Though role clarity is not significantly related to overall maintenance loads for all subjects, that variable is strongly correlated for high and low maintenance employees. However, the direction of the correlation is different for the two groups. Low maintenance individuals indicate a negative relationship between maintenance work loads and role clarity, while high maintenance professionals see a positive correlation. In addition, low maintenance personnel show a negative correlation between the amount of enhancement and role clarity.

The analysis of relationships between congruence variables and the methods of assigning personnel to maintenance is shown in Table 3. The results of specific interest are easily identified by the indications of significance. First, low maintenance personnel positively view

**Table 3**

Correlation Between Assignment Practices and Congruence Variables

| Variable | Percent Maintenance | Role Clarity | Reward Clarity | Role Conflict |
|---|---|---|---|---|
| Preference | -All Subjects- | .16 | .01 | -.01 |
| | 0-49% | .63 ** | -.22 | -.03 |
| | 50-100% | .02 | .03 | -.04 |
| Training | -All Subjects- | .16 | -.09 | .18 * |
| | 0-49% | .27 | .03 | .32 |
| | 50-100% | .11 | -.10 | .18 |
| Availability | -All Subjects- | .05 | .10 | .20 * |
| | 0-49% | -.38 | .19 | .29 |
| | 50-100% | .10 | .11 | -.22 |

Significance: p = .10 .. *
p = .05 .. **
p = .01 .. ***

the assignment of individuals to maintenance through indications of preference. Though not significant, they negatively view assignments to maintenance for training purposes on the basis of availability as increasing role conflict.

Table 4 provides the effect of different performance measurement approaches. For all employees, role clarity and reward clarity are significantly and positively related to increased emphasis on quantitative bases. This is particularly true for high maintenance individuals, with low maintenance personnel showing no significant relationship here. Low maintenance subjects indicate significantly that quantitative bases may increase role conflict.

Performance evaluation based on qualitative judgements by supervisors is negatively related to reward clarity for low maintenance subjects. However, supervisor judgement appears to reduce role conflict. Finally, when individuals other then direct supervisors are perceived as having subjective input into performance measurement, role conflict increases.

Table 5 shows the effects of different methods of quantitative performance evaluation. Evaluation based on measures of lines of code (LOC) are positively related to role clarity and reward clarity. These findings agree with the results shown in Table 4.

When evaluation is based on the amount of cost reduction achieved by the professional, reward clarity increases, though this result is most significant for high maintenance personnel. Unfortunately, evaluation based on cost reductions also increased role conflict, possibly due to another finding which indicated that schedule compliance is the most commonly use evaluative measure. It appears that cost reduction is perceived as being a clear and fair evaluation method, but that cost reduction may conflict with schedule compliance.

The remaining results are shown in Figures 1 through 10. These results are shown graphically to include as much information about the complex interactions between task size, maintenance loads, and congruence variables as possible. In Figure 1, the correlation between the amount of time spent on enhancement tasks and role clarity is shown. Note that each employee was asked to indicate the amount of time spent on *each type of task*. Thus, the relationship between role clarity and amount of effort can be determined for each class of maintenance effort.

For example, consider only the shaded portions of Figure 1, detailing results for low maintenace individuals. Here, increasing loads of small enhancements are positively related to role clarity. However, tasks in the 51 to 200 LOC range are negatively correlated to role clarity. This set of relationships is visible again in Figure

**Table 4**

Correlation Between Methods of Measuring Performance and Congruence Variables

| Variable | Percent Maintenance | Role Clarity | Reward Clarity | Role Conflict |
|---|---|---|---|---|
| Quant-Measures | -All Subjects- | .29 ** | .30 *** | -.07 |
| | 0-49% | .02 | -.06 | .42 * |
| | 50-100% | .34 *** | .34 *** | -.15 |
| Qual-Supervisor | -All Subjects- | -.07 | -.15 | -.21 ** |
| | 0-49% | .08 | -.49 * | -.72 *** |
| | 50-100% | .09 | -.10 | -.15 |
| Qual-Others | -All Subjects- | -.07 | .16 | .33 *** |
| | 0-49% | .30 | .17 | .38 |
| | 50-100% | -.13 | .17 | .33 *** |

Significance: p = .10 .. *
p = .05 .. **
p = .01 .. ***

**Table 5**

Correlation Between Evaluation Practices and Congruence Variables

| Variable | Percent Maintenance | Role Clarity | Reward Clarity | Role Conflict |
|---|---|---|---|---|
| Total LOC | -All Subjects- | .21 ** | .18 * | -.10 |
| | 0-49% | .29 | .61 ** | -.01 |
| | 50-100% | .19 * | .11 | -.12 |
| Error Free LOC | -All Subjects- | .27 ** | .13 | .05 * |
| | 0-49% | -.11 | .50 ** | .24 |
| | 50-100% | .22 *** | .09 | .03 |
| Cost Reduction | -All Subjects- | .09 | .23 ** | .16 * |
| | 0-49% | -.04 | .21 | .11 |
| | 50-100% | .11 | .23 ** | .17 |

Significance: p = .10 .. *
p = .05 .. **
p = .01 .. ***

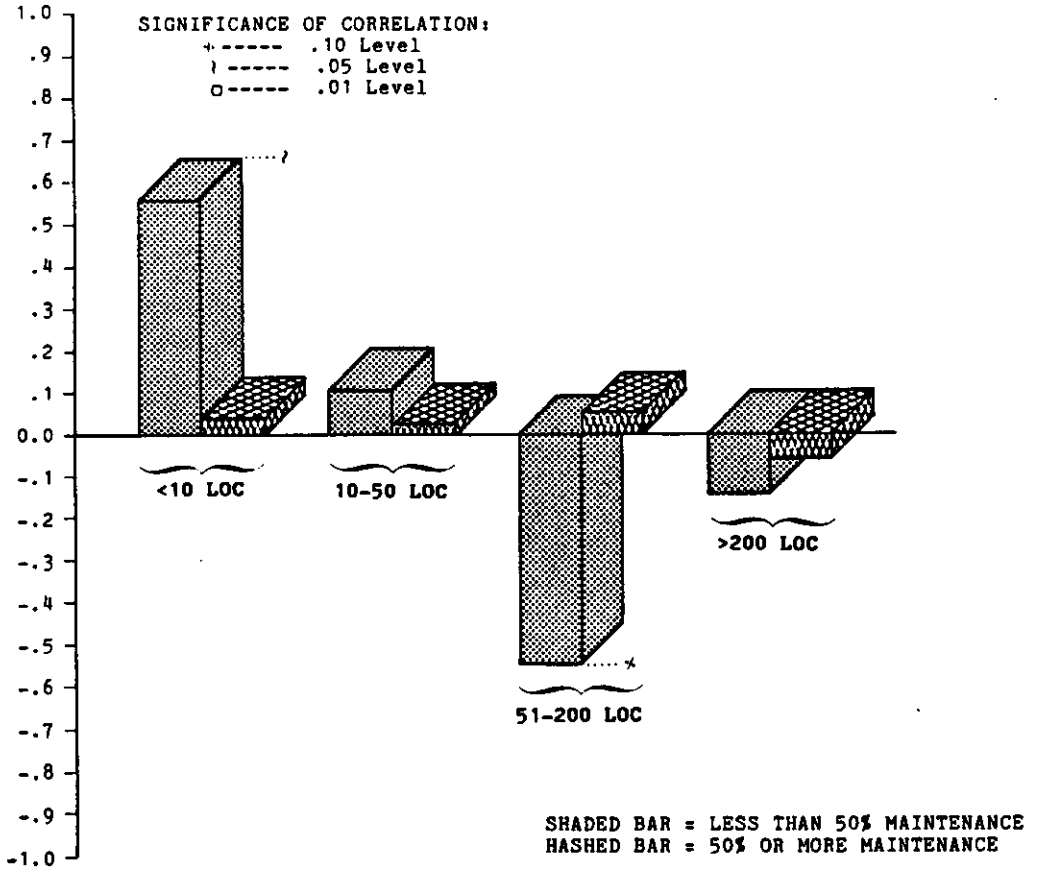


Figure 1 Correlation Between **Reported Amount of Workload** and **Role Clarity** for Enhancement Tasks of Different Sizes (LOC)

2, where the amount of small fixit efforts is positively related to role clarity, but the intermediate sized efforts are negatively correlated.

The important result from Figures 1 and 2 is that increasing assignments of tasks of different sizes appears to have mixed effects on role clarity. Too many assignments to intermediate sized tasks appear to have negative effects on low maintenance personnel. Conversely, high maintenance individuals perceived little relationship between role clarity and enhancement task size, though the amount of small fixit efforts was negatively related to role clarity.

Figures 1 and 2 exhibit a pattern which recurs in subsequent figures. That is, high and low maintenance individuals show correlations in different directions for the same research variables. Figure 2 contains a clear example of this. If only small fixit tasks are considered, high and low maintenance personnel show statistically significant correlations in opposite directions. More assignments to small fixit tasks appear to increase role clarity for low maintenance subjects, but decrease role clarity for high maintenance individuals. On the other hand, medium sized tasks reverse the relationships. More medium sized tasks increase role clarity for high maintenance persons, but decrease that variable for low maintenance staff.

These results clearly indicate that high and low maintenance personnel may respond differently to specific changes in their work assignments. Task assignments which result in increased role clarity for one group may produce the opposite result for the other group.

In Figures 3 and 4, the same relationships are analyzed, this time with task size measured in terms of time instead of lines of code. Again, small tasks seem to be positively correlated to role clarity for low maintenance personnel, while larger maintenance efforts reduce role clarity. Though few of the individual results indicated in Figures 3 and 4 are statistically significant, the trends indicated for increasing task time are intuitively appealing.

One clear result is that high maintenace employees respond differently to task time than to task size in LOC.

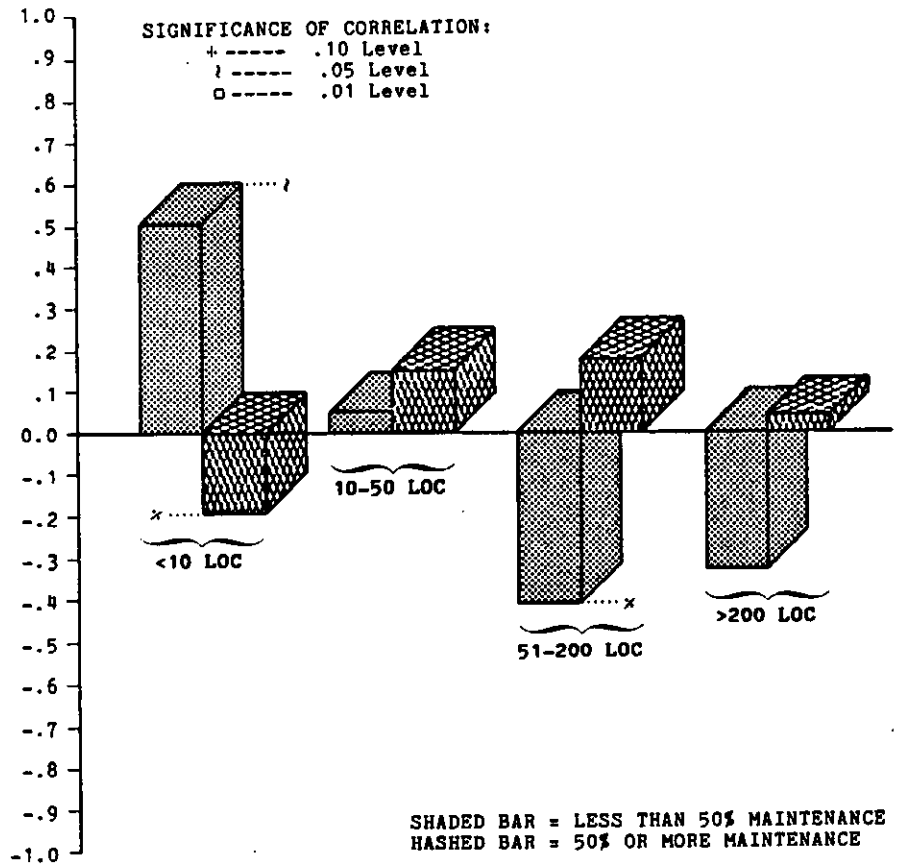


Figure 2 Correlation Between **Reported Amount of Workload** and **Role Clarity** for Fixit Tasks of Different Sizes (LOC)

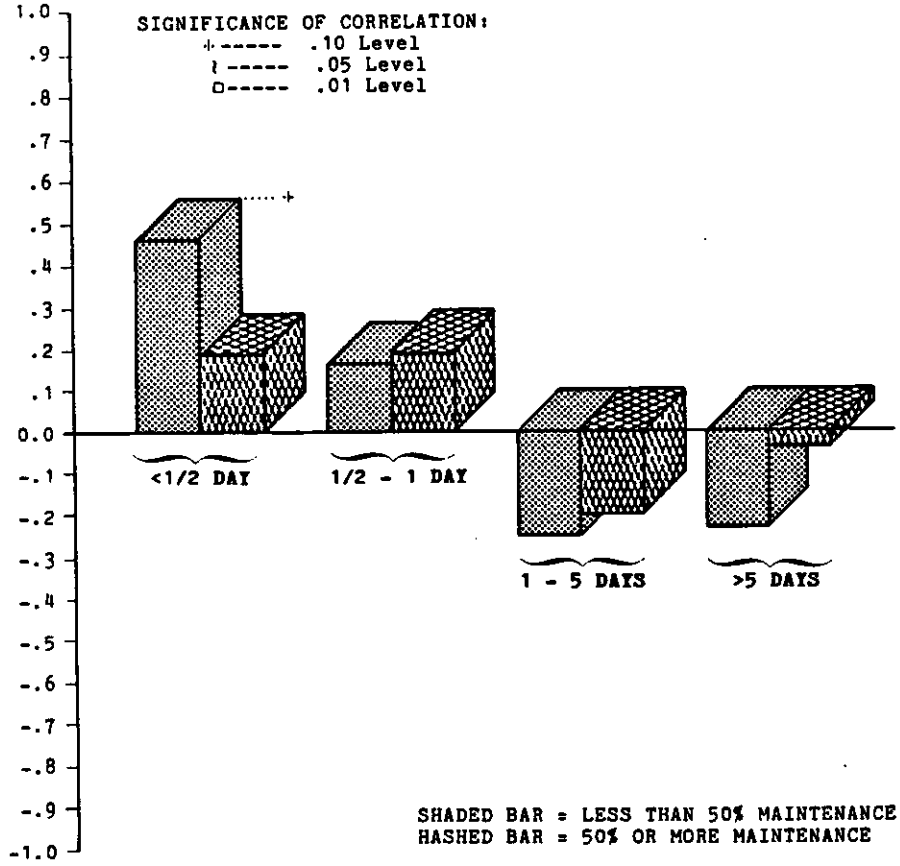


Figure 3 Correlation Between **Reported Amount of Workload** and **Role Clarity** for Enhancement Tasks of Different Sizes (Time)

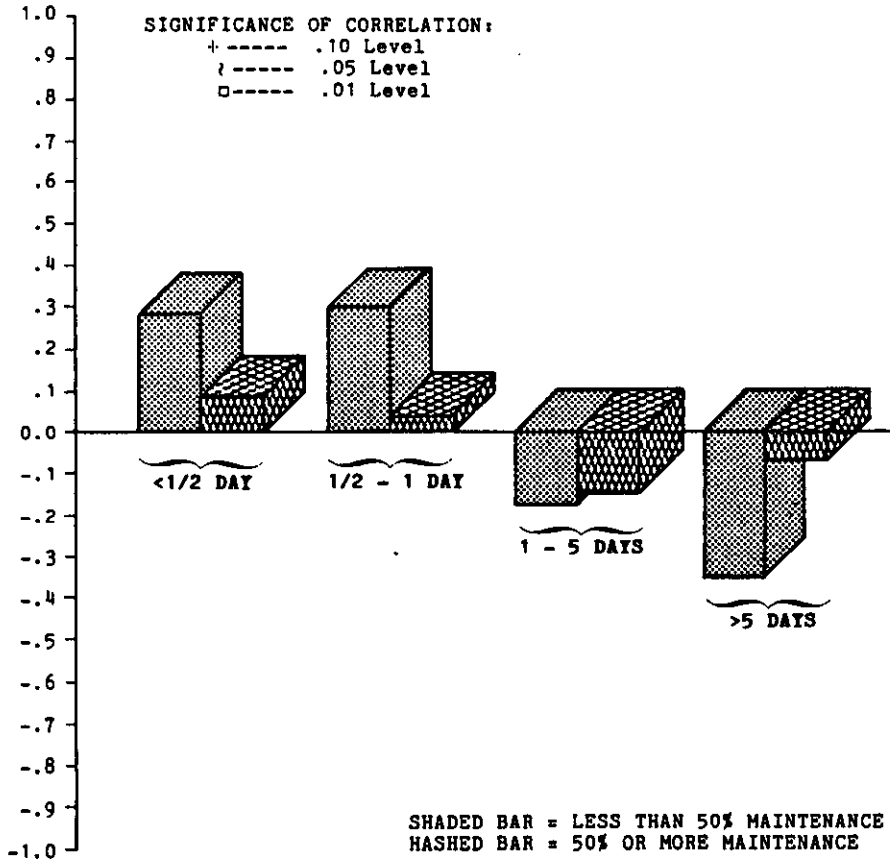


Figure 4 Correlation Between **Reported Amount of Workload** and **Role Clarity** for Fixit Tasks of Different Sizes (Time)

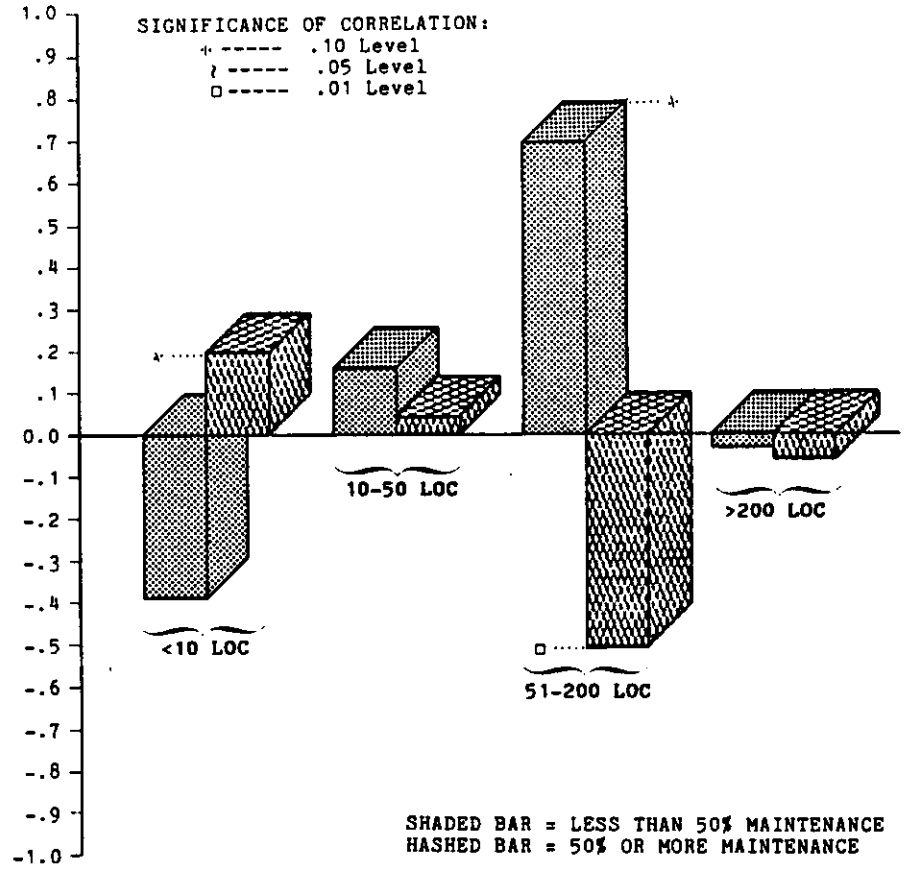


Figure 5 Correlation Between **Reported Amount of Workload** and **Role Conflict** for Fixit Tasks of Different Sizes (LOC)

When task size was measured in LOC, high maintenance personnel showed opposite effects than did low maintenance personnel. However, when time is the relevent measure, both groups show similar trends with increasing task size. This result illustrates the difference between LOC measures and time measures. LOC measures are inherently quantative and are directly linked to productive output. Time, however, is more linked to schedule compliance than to the actual effort necessary to complete a task. These results indicate that maintenance employees respond differently to tasks when asked to consider them from the two perspectives, time and LOC.

Figures 5 and 6 show the correlation between task size (LOC and time) and role conflict. For low maintenance subjects, the amount of small tasks is negatively correlated to role conflict, while medium sized efforts show the opposite relationship. Clearly, individuals who perform maintenance only part time appear to find medium sized maintenance tasks hard to handle. Figures 1 through 6 show that increased assignment to these tasks may result in low role clarity and high role conflict. Increased assignments to small tasks, coversely, increase role clarity and decrease role conflict.

High maintenance personnel, on the other hand, respond differently. Small tasks may reduce their role clarity and increase their role conflict, while medium sized efforts appear to have more positive relationships. Again, Figures 5 and 6 show high and low maintenance personnel with diametrically opposite correlations between task size and role conflict.

In Figures 7 and 8, the relationships between enhancement task assignments and reward clarity are shown. Now, the directions of the correlations are reversed for the high and low maintenance personnel. While low maintenance subjects show a positive relationship between assignments to small tasks and role clarity and role conflict, the correlation to reward clarity is in the opposite direction. Low maintenance personnel exhibit lower reward clarity as the amount of small enhancement tasks increases.

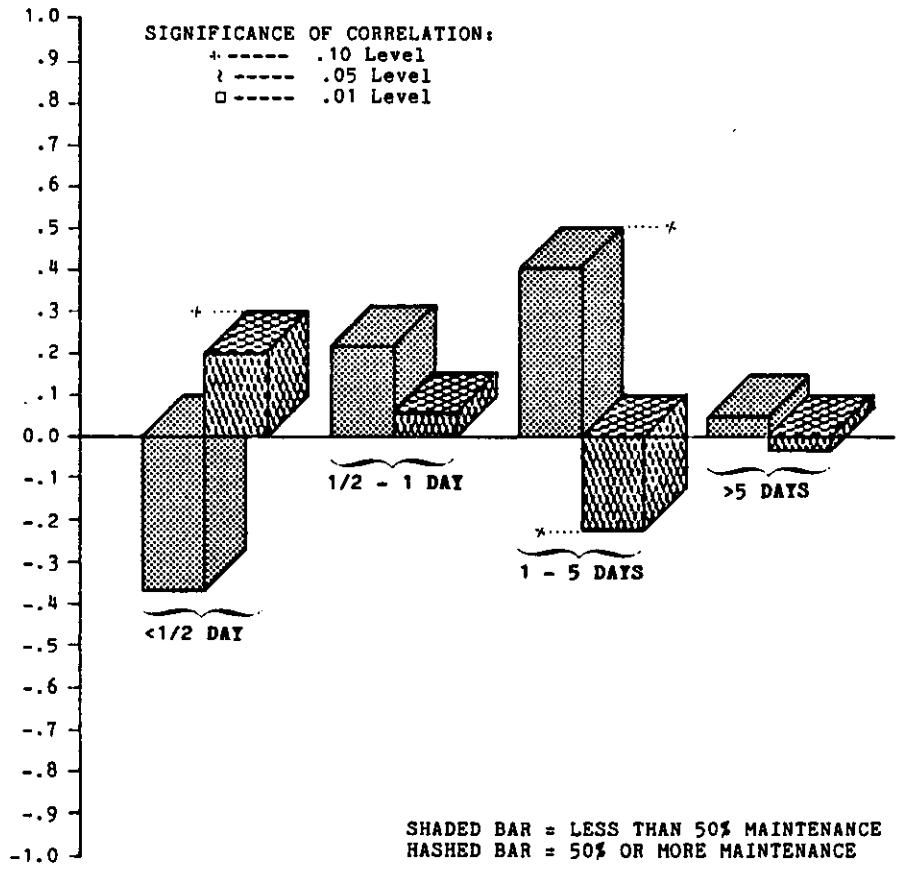


Figure 6 Correlation Between **Reported Amount of Workload** and **Role Conflict** for Fixit Tasks of Different Sizes (Time)

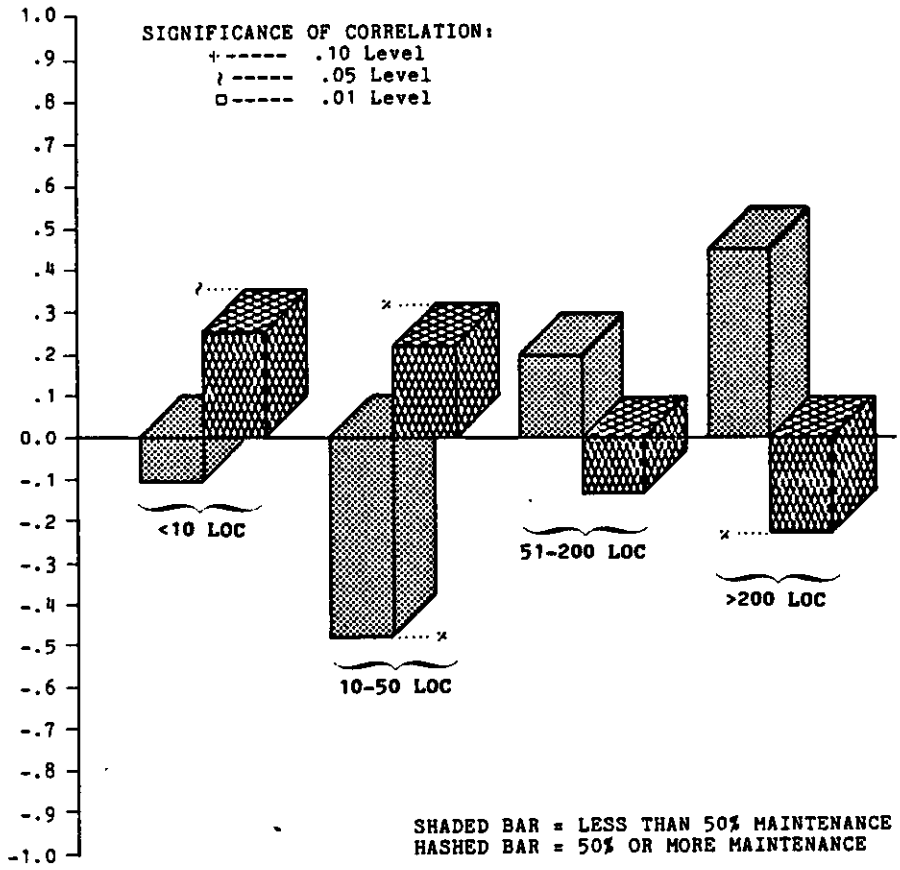


Figure 7 Correlation Between **Reported Amount of Workload** and **Reward Clarity** for Enhancement Tasks of Different Sizes (LOC)

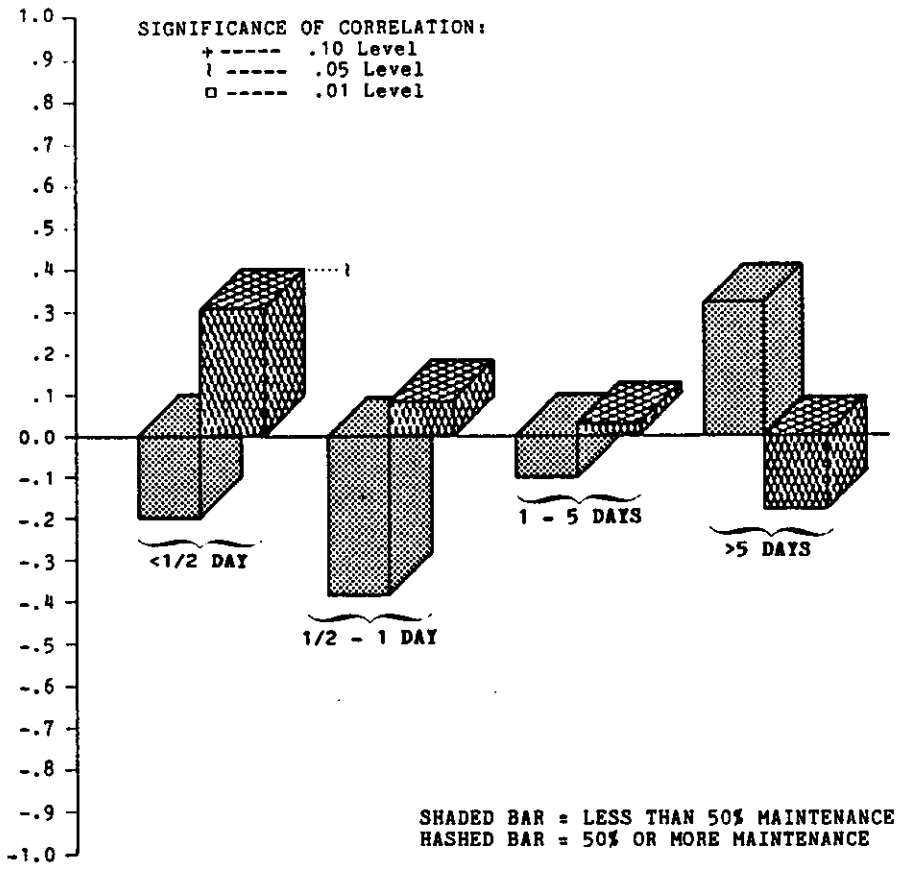


Figure 8 Correlation Between **Reported Amount of Workload** and **Reward Clarity** for Enhancement Tasks of Different Sizes (Time)

Conversely, high maintenance personnel show positive realtionships between the amount of small enhancements and reward clarity. For these individuals, reward clarity may be weakest if large assignments of medium sized projects exist.

Finally, Figures 9 and 10 show the correlations between the severity of specific problems and role conflict. For low maintenance respondents, the problem of maintaining poorly designed systems is significantly related to role conflict. As design problems impact the fixit and enhancement efforts, role conflict decreases. This relationship is more significant for enhancements. As schedules are increasingly unrealistic, however, role conflict also increases. While documentation problems are relatively unrelated to role conflict, poor code has opposite effects, depending on whether the task is classed as fixit or enhancement.

For high maintenance employees, poor documentation decreases role conflict, while poor design increases role conflict. The directions of the relationships are the same for fixit and enhancement efforts. Again, high and low maintenance individuals appear to respond differently to the set of study variables.

In summary, this section has presented a brief discussion of a set of complex research results. Not all of these results are statistically significant. However, those results which are significant lead to conclusions supported by the trends of the rest of the data. High and low maintenance personnel clearly seem to respond differently to task assignments and to aspects of evaluation, performance evaluation procedures, and problem factors. These data obviously suggest that management efforts which are positive for one group may have the opposite effect on the other. In fact, it may be fair to say that high and low maintenance professions appear to attract different types of individuals, requiring different management techniques, different task assignments, and different methods of evaluation. While these results are clearly preliminary, they are sufficiently strong to have serious implications for the industry.

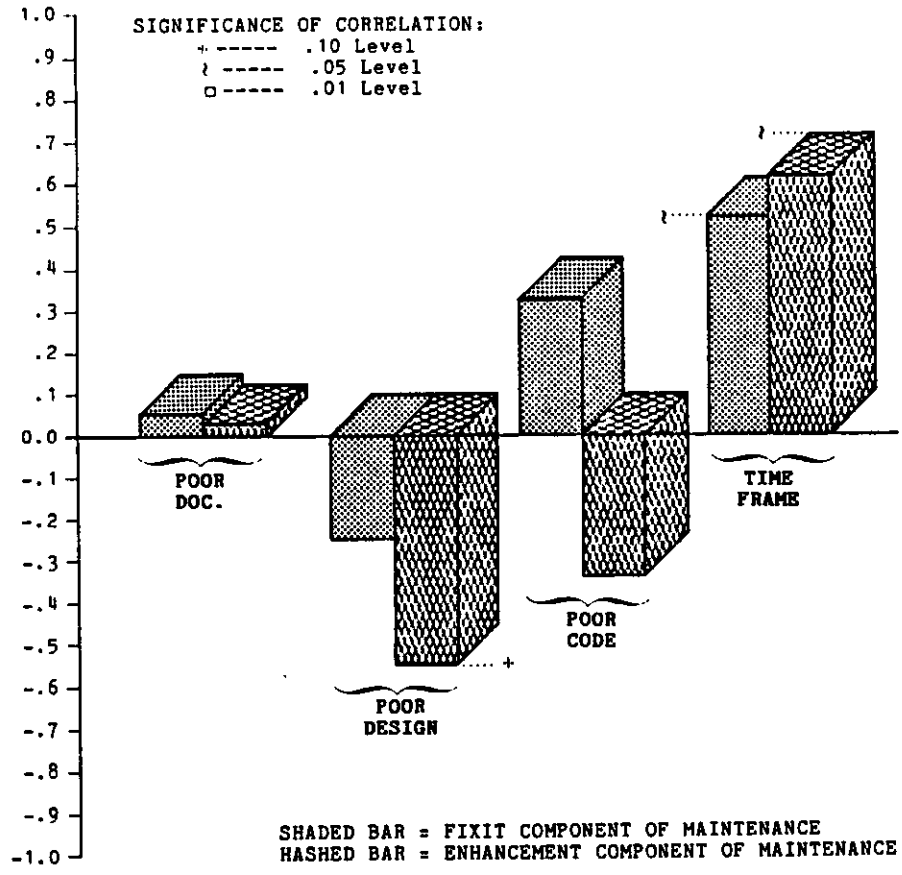


Figure 9 Correlation Between **Reported Problem Severity Ratings** and **Role Conflict** for Respondents With Less Than 50% Maintenance

## Discussion

The research revealed some interesting data that contradict commonly held views about maintenance work. The prevalent view is that maintenance work is not nearly as interesting and challenging as new development (Couger and Colter, 1983). This view was substantiated by data from the Couger-Zawacki national database which showed that the MPS (motiviated potential score) was negatively correlated with the percent of maintenance performed.

Different results were obtained in the ten organizations in the present research. They were not average firms. They were selected for study because maintenance productivity was good. People assigned to that work had growth need strength (need for achievement) equivalent to that of personnel assigned to new developmental work. Yet, they perceived their work to be interesting and challenging (high MPS) and their productivity was considered by their management to be equivalent to that of new development.

However, the high productivity was not due to a concerted effort to raise the prestige of maintenance activity through a "positive thinking" type of campaign. The companies had enhanced the maintenance work to raise the MPS to a level comparable to that of new development.

Viewed in this context, the results of the research portrayed in the tables and figures takes on a new perspective. The patterns and trends are hard to decipher until one has this added perspective. As a consequence, the following patterns emerge.

*Principal Finding No. 1.* Personnel whose primary assignmemt is new development and who spend less than half of their time on maintenance, experience many more problems in role clarity and role conflict than those

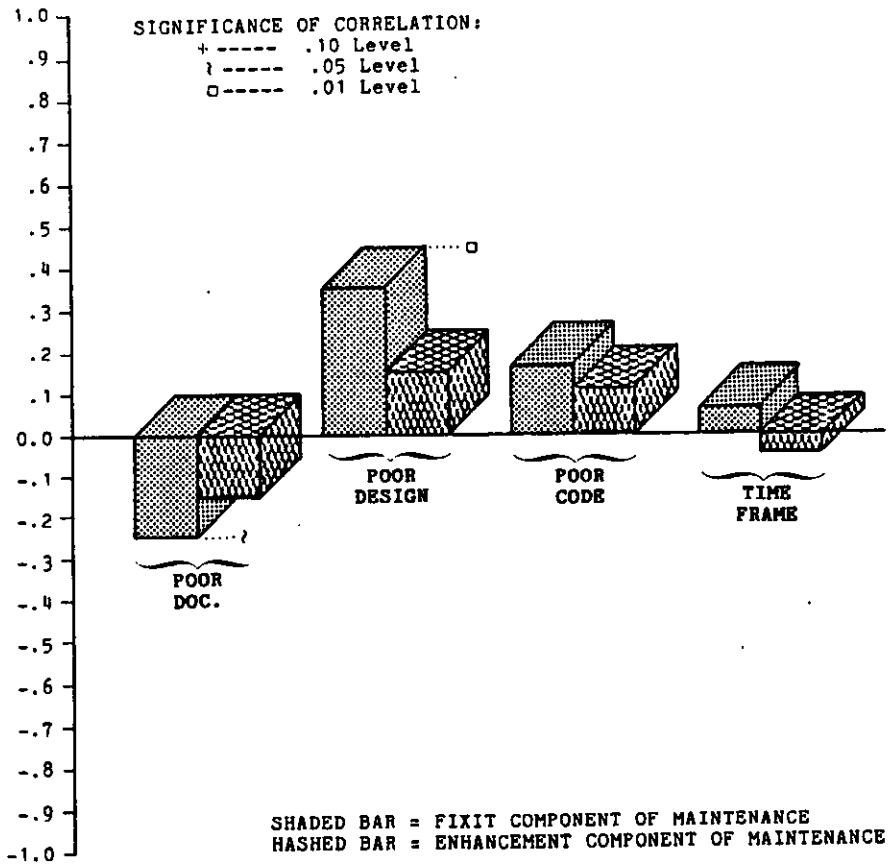


Figure 10 Correlation Between **Reported Problem Severity Ratings** and **Role Conflict** for Respondents With 50% or More Maintenance

whose primary assignment was maintenance. We will differentiate these two categories as part-timers and regulars (as related to the amount of time spent on maintenance activities).

1. Increasing the percent of maintenance for regulars produces a corresponding increase in role clarity but decreases role clarity for part-timers (Table 2). Conversely, an increase in percent of maintenance decreases role conflict for regulars but increases role conflict for part-timers.

2. Regular maintenance personnel experience higher role clarity when performance measures are quantitative (Table 4). Reward clarity is also positively correlated with use of quantitative measures. Consistently, role conflict is negatively correlated.

3. Regular maintenance personnel experience reduced role conflict when they spend more of their effort on work of longer duration (both time and lines of code) (Figures 5 and 6). They also experience reduced reward clarity in this situation (Figures 7 and 8). The opposite reaction occurs for part-timers.

4. Age and experience aid in role clarity for regulars. Surprisingly, education does not (Table 1).

*Principal Finding No. 2.* The point at which fixit maintenance work becomes similar to new development work—and therefore has null effect on role conflict—is where the work consists of more than 200 lines of code and five days of effort (Figure 5 and 6). Dramatic and opposite effect on role conflict occurs between regulars and part-timers when their work primarily consists of smaller assignments.

*Principal Finding No. 3.* Enhancement work poses more problems in role conflict and role clarity for part-timers than regulars.

1. Enhancement is negatively correlated with role clarity and positively with role conflict for part-timers. The reverse is true for regulars (Table 2).

2. For part-timers, role clarity diminishes as more effort is spent on longer enhancement projects (for both time and LOC) (Figure 1). There is no effect on regulars.

## Causal Factors

Some important trends have been identified by research. Additional statistical analysis is underway with the expectation that further underlying causal factors might be identified and that predictions might be derived. Nevertheless, some conclusions appear reasonably justified at this stage of the research.

For example, the difference in tolerance for change between part-time maintenance and regular maintenance personnel may be a result of the varying procedures and standards required of each type of work. Another reason may be the recognition of the necessity for fixit work. The importance of fixit work is clear. The same is not true for all enhancement work. Some consists of relatively unimportant report format changes and changes to meet the tastes of a particular client or user.

## Recommendations

Although the research is still in its preliminary stages, the findings suggest that managers can produce improvements in goal/reward clarity by the following activities:

1. Evaluate the extent to which role ambiguity and role conflict exist, using the Rizzo, House and Lirtzman instrument.

2. If the instrument identifies problems, reassess the approach to assignments of maintenance work versus new development work.

   a. As shown in Principal Findings #1 and #2, it is better to increase the maintenance percentage for people whose principal assignment is maintenance than to give additional maintenance work to persons whose principal assignment is new development.

   b. Whenever possible, accumulate and consolidate maintenance work requests until they reach the scope where there is null effect on role conflict. Principle Finding #2 indicates this to be about five days of effort or 200 lines of code.

### REFERENCES


Boehm, W. *Software Engineering Economics,* Prentice Hall, Inc., Englewood Cliffs, New Jersey, 1981.

Bostrom, R.P. "Role Conflict and Ambiguity: Critical Variables in the Designer Relationship," *Proceedings of the Seventeenth Annual Computer Personnel Research Conference,* 1981, pp. 88-112.

Carrell, M.R. and Dittrich, J.D. "Equity Theory: The Recent Literature, Methodological Considerations, and New Directions," *Academy of Management Review,* April 1978.

Couger, J.D. and Colter, M.A., *Motivation of the Maintenance Programmer,* CYSYS, Inc., Colorado Springs, Colorado, 1983.

Couger, J.D. and Zawacki, R. *Motivating and Managing Computer Personnel,* Wiley-Interscience, New York, New York, 1980.

Diebold, J. "Improving the Utilization of Personnel Resources," *The Diebold Computer Planning and Management Service,* August 1979, pp. 44-46.

Goldstein, D.K. and Rockart J.F. "An Examination of Work-Related Correlates of Job Satisfaction in Programmer/Analysts," *MIS Quarterly,* Volume 8, Number 2, June 1984, pp. 103-115.

Hackman, J.R. and Oldham, G.R. "Development of the Job Diagnostic Survey," *Journal of Applied Psychology,* Volume 60, Number 2, 1975, pp. 159-170.

Kahn, R.L., Wolfe, D., Quinn, R., Snoek, J.D., and Rosenthatl, R. *Organizational Stress: Studies in Role Conflict and Role Ambiguity,* John Wiley and Sons, New York, New York, 1964.

Leintz, B.P. and Swanson, E.B. *Software Maintenance Management,* Addison-Wesley, Reading, Massachusetts, 1980.

Reutter, J. "Maintenance is a Management Problem and a Programmer's Opportunity," *Proceedings of the National Computer Conference,* 1981 pp. 343-348.

Rizzo, J.R., House, R.J., and Lirtzman, S.J. "Role Conflict and Ambiguity in Complex Organizations," *Administrative Science Quarterly,* Volume 15, Number 2, June 1970, pp. 150-163.

Schuler, R.S., Aldag, R.J., and Brief, A.P. "Role Conflict and Ambiguity: A Scale Analysis," *Organizational Behavior and Human Performance,* Volume 20, Number 1, October 1977, pp. 111-128.