Using Pareto Analysis with Trend Analysis: Statistical Techniques to Investigate Incident Reports Within a Housing System

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INTRODUCTION

Although the concepts of Total Quality Management (TQM) have reached the halls of academe, they still have not gained wide acceptance among many higher education professionals. Many still are skeptical about the outcomes of a system which was primarily designed for use throughout the business community (Fisher, 1993). Through the works of Edward Demming (1986) and Juran and Gryna (1988), TQM is identified as a way of increasing quality while decreasing costs through a combination of teamwork and scientific measurement.

Within higher education, professionals have become interested in TQM's declaration of quality service, cost efficiency, and customer satisfaction (Astin, 1985; Barr, Upcraft, & Associates, 1990; Coate, 1991; Kuh, Schuh, Whitt, & Associates, 1991; Seymour, 1992; Sherr & Teeter, 1991; Upcraft, Gardner, & Associates, 1989). Because TQM is still rather new to higher education, some problems have existed which have raised questions regarding the effectiveness of TQM within the educational or service environments (Van Allen, 1994).

Although higher education and industry differ substantially in their ideologies and missions, the problems both groups may experience with TQM can be traced to a few common factors such as time limitations, a lack of definitive measurements, vague mission statements, and too much time spent on trivialities (Early & Godfrey, 1995).

Probably one of the greatest obstacles higher education professionals face with implementing TQM is a lack of consistent and definitive measurement techniques to synthesize and examine quality. Measurement is an essential function in the science of TQM in order to make significant change to any process (Luna, 1996; Teeter & Lozier, 1993). In TQM, statistical rules and empirical observations of a process are used to make inferences about the quality of that process (Mawhinney, 1992). Through this statistical process control, it is possible for TQM teams to scientifically measure the effects and changes of their new ideas to any given process.

This article addresses two simple measurement techniques, used in tandem, which any higher education professional can use to understand a particular process, make changes to it, and measure whether or not those changes are effective in increasing quality within that process. The focus of this study, therefore, is to show how the statistical techniques of TQM can be used to stimulate and focus discussion on improving process quality within any institution.

METHOD

The purpose of this study was to determine trends and difficulties concerning student incident reports within the residence halls as they relate to the incident reporting system from the Department of Housing and Residential Life at a Southeastern Doctoral I Granting Institution. Furthermore, this study was used by housing staff to identify areas of change to the current system which would increase the overall quality and integrity of the incident reporting process.

The incident reporting system is a process whereby housing staff kept track of any physical or social problems occurring within the housing community. Resident Assistants, Hall Directors, and Area Coordinators were responsible for initiating a report after an incident occurred. Each report was logged into a database for use in the department's future planning.

Incident classifications were separated into 12 categories: Alcohol, Assault (Physical), Fire Safety, Harassment (Verbal), Medical, Miscellaneous, Noise, Sanitation, Security, Theft, Vandalism, and Visitation. The classification of Miscellaneous included all incidents which could not be placed into any of the remaining 11 classifications.

This study used the frequency distributions of each classified incident by month for the 1993-94 and 1994-95 academic years (N = 773).

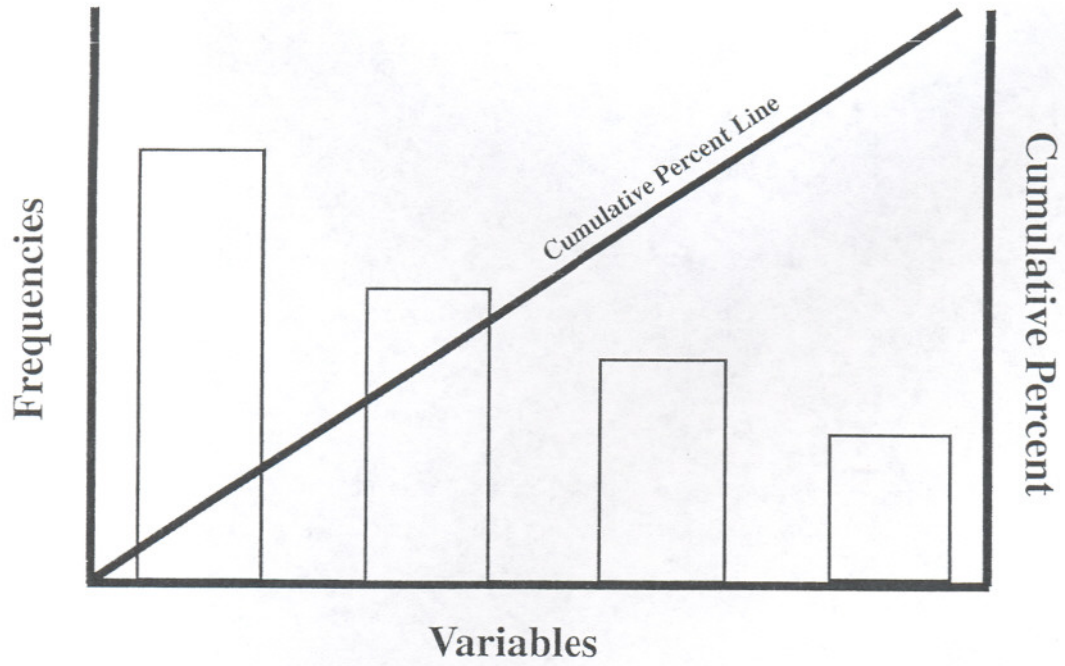


Figure 1. Sample of Pareto Analysis.

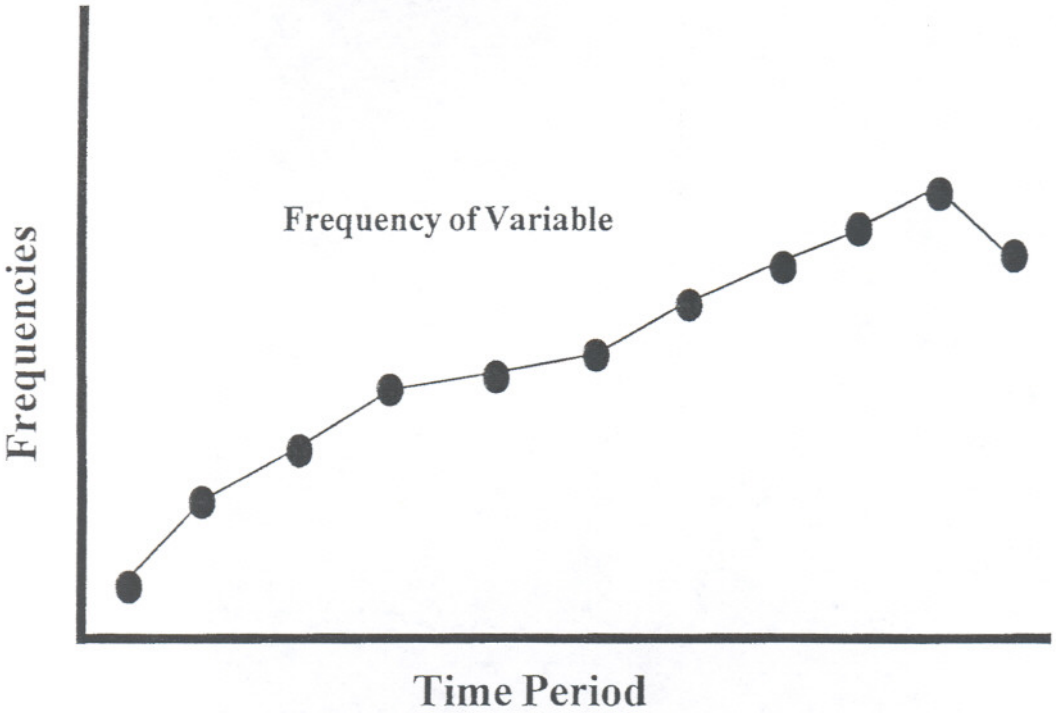


Figure 2. Sample of Time Series Analysis.

Because this study was interested in the trends as well as the problems within the system, both the Pareto Analysis and Trend Analysis were used with the data.

The Pareto Analysis is a bar graph which displays the frequency and importance of each classification (Tague, 1995). The principal behind the Pareto Analysis is to identify the few vital causes that often are attributed to most of an effect (Juran & Gryan, 1988). In this study, each classification of incident is plotted on the bottom of the chart and the number of occurrences are plotted on the left axis (see Figure 1). The cumulative percent of each classification is plotted along the right axis. A line graph is used to plot the cumulative percentage of occurrence. The classifications which made up 80% of the occurrences were considered vital problems. This cumulative ranking is referred to as the 80% margin of concern in the Pareto Analysis.

Although the Pareto Analysis is a useful tool for TQM, it has the following drawbacks: (a) its inability to effectively analyze small amounts of data, (b) its inability to measure variation over time, (c) its inability to measure trends (Duffy, 1995).

To limit these problems, the Trend Analysis or Run Chart was used. The Trend Analysis shows a measurement located on the vertical axis that is plotted against time on the horizontal axis (see Figure 2). As the measurement increases or decreases over time, the upward or downward direction (trend) can be visualized easily on the chart. The purpose of this analysis was to measure variation within each of the incident reporting categories and to analyze any trends or patterns that were present (Tague, 1995).

RESULTS

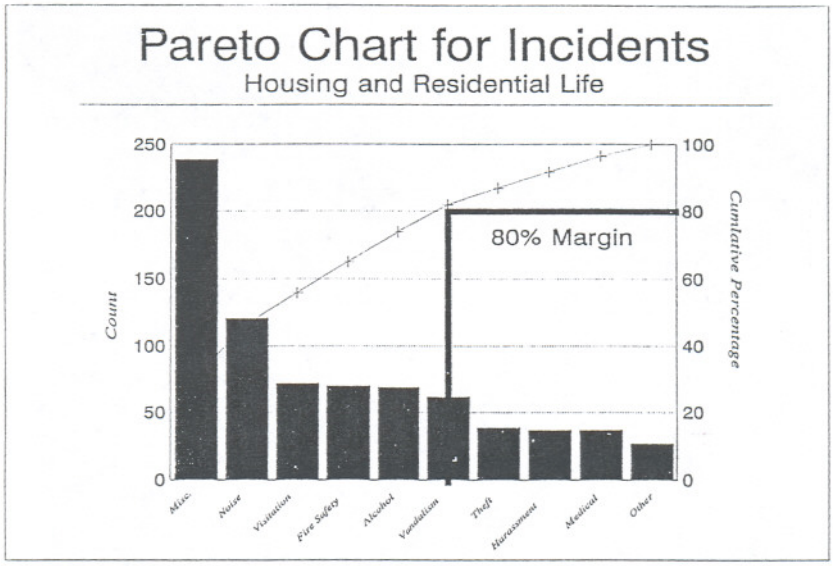
The results of the Pareto Analysis revealed that Miscellaneous, Noise, Visitation, Fire Safety, Alcohol, and Vandalism classifications were within the 80% margin of concern (see Figure 3). Because Security, Assault, and Sanitation incidents individually made up such a small percentage of the total number of incidents, they were combined into the bar labeled "Other." One would assume, after examination of the Pareto Analysis, that those classifications within the 80% margin of concern were the most important and, therefore, should be addressed immediately. By utilizing the trend analysis, however, the direction and pattern of each classification could be analyzed to determine if it indicated a downward or upward trend, or if the variation was due to a seasonal pattern. When the Pareto Analysis was compared with the Trend Analysis, and each classification was individually explored, the following findings were made:

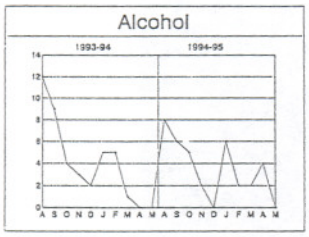
1. The Miscellaneous classification was too high. To begin, a miscellaneous classification should have included all incidents that were not part of the other 11 classifications. Ordinarily, the frequency within this classification should not exceed the frequency of the other individual classifications. In this case, the total number of Miscellaneous incidents amounted to 246, which was much greater than any of the other classifications. After analyzing the individual records, it was found that many incidents contained within this classification were mistakenly identified and should have been placed in one of the 11 other classifications. The individual records also revealed a substantial number of incidents relating to maintenance problems. Because the maintenance classification was not present in the reporting system, it was difficult to identify trends and patterns within this area.

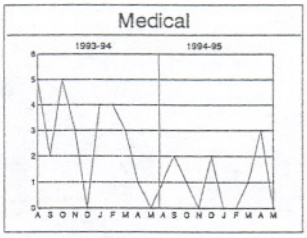
2. The trend for Noise and Vandalism indicated a significant decrease in frequency. Although Noise and Vandalism classifications were the second and sixth largest problems contained in the Pareto Analysis respectively, the Trend Analysis indicated a significant decrease in the frequency of incidents over the two-year period. The higher number of incidents at the beginning of the measurement period for each of the classifications affected the overall number of incidents within these classifications, causing them to show a higher cumulative percentage. This inflation within the cumulative percentage could not have been detected by the Pareto alone.

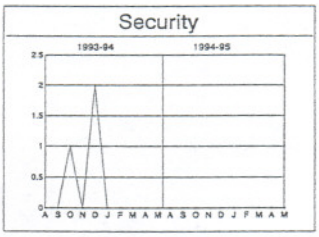
3. The variations in Alcohol and Fire Safety seemed to show seasonal patterns. Although classifications were shown in the Pareto Analysis as important, their importance may only be of concern during particular times of the year—especially during the beginning of the fall and spring semesters for Alcohol incidents and during February for Fire Safety incidents. Higher incident numbers during peak times for these classifications, again, caused an inflated cumulative percentage value within the Pareto Analysis.

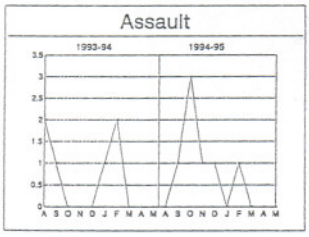
4. Visitation was a consistent problem. According to both the Pareto and Trend Analyses, visitation incidents seemed consistent and within

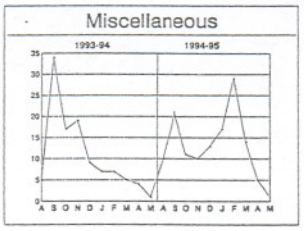

Pareto Chart for Incidents
Housing and Residential Life
Count
Cumulative Percentage
80% Margin
250
200
150
100
50
0
100
80
60
40
20
0
Misc
Noise
Visitation
Fire Safety
Alcohol
Vandalism
Theft
Harassment
Medical
Other

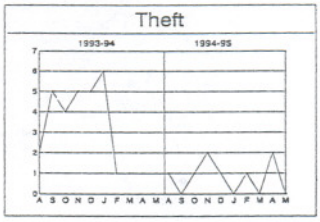

Alcohol
1993-94
1994-95


Medical
1993-94
1994-95

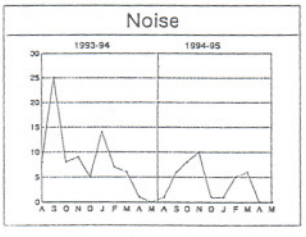

Security
1993-94
1994-95

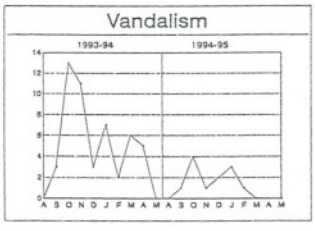

Assault
1993-94
1994-95

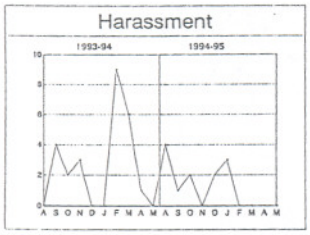

Miscellaneous
1993-94
1994-95

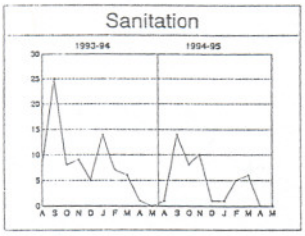

Theft
1993-94
1994-95

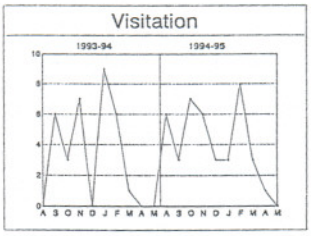

Fire Safety
1993-94
1994-95


Noise
1993-94
1994-95


Vandalism
1993-94
1994-95


Harassment
1993-94
1994-95


Sanitation
1993-94
1994-95


Visitation
1993-94
1994-95

the 80% margin of concern. A visitation incident occurred when a student of one gender was found in a residence hall housing the opposite gender during times not assigned for visitation. Although this classification indicated a decreasing trend toward the end of each academic year, both the Pareto and Trend Analyses indicated that the frequency and consistency of this type of incident should still be a concern for housing administrators in order to maintain the safety and comfort level of student residents.

In addition to these findings, the study also showed a significant drop-off in Security incidents after the fall 1993 semester. Although some of this drop-off can be attributed to misclassification, the frequencies of Security incidents also were inconsistent with other internal and external reporting methods. Furthermore, although the Medical problem classification was not within the 80% margin of concern, its trend indicated a possible area of future concern for housing administrators.

IMPLICATIONS AND RECOMMENDATIONS

This study demonstrated the combined use of the Pareto and Trend Analysis tools for detecting trends and problems within the residence hall incident reporting system at a Southeastern Doctoral I Granting Institution. By using these TQM tools in tandem, this study identified both trends of incidents and problems with the incident reporting process.

Although the Pareto Analysis indicated that six classifications were within the 80% margin of concern, the Trend Analysis indicated that Noise and Vandalism incidents were significantly decreasing in number and that Alcohol and Fire Safety incidents were seasonal. Both analyses indicated the Visitation classification was a major concern and both indicated problems existed with incidents classified as Miscellaneous.

Through this study, a better understanding of the incident reporting system was achieved and recommendations for the improvement of the system were made. The first recommendation concerned the Miscellaneous classification. Because hall staff tend to mis-classify incidents under this category, staff entering incident reports into the database should be better trained and a system for checking mistakes should be included within the overall process.

Many of the Miscellaneous classifications included maintenance problems within the personal and common space of the buildings. Because of the large frequency of incident reports involving maintenance, a separate maintenance classification should be included within the system.

Both the Pareto and Trend Analysis tools indicated a concern with the visitation incidents. After careful observation, visitation was seen as a consistent problem and in need of intervention by the hall staff.

Although Noise and Vandalism were considered important under the Pareto Analysis, they revealed a decreasing trend month to month, indicating some sort of intervention by hall staff or other variable. If this intervention came from the hall staff, it could have been in the form of education, enforcement, or communication. It is important, therefore, for the hall staff to identify the most effective areas of intervention and continue with their efforts to keep these numbers low.

Alcohol and Fire Safety also were considered important under the Pareto Analysis but indicated only seasonal activity under the Trend Analysis. This simply means that hall staff need to become more aware of the peak times these incidents occur and develop programming or other intervention activities beforehand to decrease incident numbers during these times.

Two additional recommendations resulted from this study. The staff should re-evaluate their efforts to identify security incidents so that these problems will be more easily detected and that the Security incident will be consistent with other internal and external reporting. Furthermore, the staff evaluate each medical incident and determine what measure, if any, housing personnel could have taken to decrease these types of incidents or, by intervening, prevent them from occurring in the future.

CONCLUSION

Although TQM has yet to win acceptance throughout the academic community, its concepts and tools can be effectively used to stimulate discussion on improving process quality within higher education. It is important, however, to understand that measurement techniques are critical to the successful implementation of TQM. As seen in this study, useful measurement tools are available to synthesize and evaluate quality within higher education. This study also found that the combination of the Pareto and Trend Analysis provides a powerful instrument for higher

education professionals by giving them more information than if these tools were used separately.

Not only do these tools identify the major problems within a system, they assess long-term and seasonal trends, and the effectiveness of intervention or corrective actions. When used as an ongoing measurement tool, problems may even be eliminated before they become problems. Furthermore, the design and use of these tools is fast and easy, allowing most higher education professionals to utilize them even if they have little time or TQM training.

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