academicJournals

Vol. 7(39), pp. 4037-4045, 21 October, 2013
DOI: 10.5897/AJBM10.821
ISSN 1993-8233 © 2013 Academic Journals
http://www.academicjournals.org/AJBM

African Journal of Business Management

Review

Applying 6-sigma methodology to reduce burglary on campus

C. S. Shyu[1], C. M. Shin[2*], K. M. Cheng[3] and C. H. Hsu[4]

[1]National Taichung Institute of Technology, Taiwan, R.O.C., 99-1, Jhonghua Rd., Linluo Township, Pingtung County 909, Taiwan.
[2]National Kaohsiung Normal University, Taiwan, R.O.C, No.116, Heping 1st Rd., Lingya District, Kaohsiung City 802, Taiwan.
[3]National Taiwan College of Physical Education, Taiwan, R.O.C, No. 16, Section 1, Shuang-Shin Road, Taichung, 404, Taiwan.
[4]National Chin-Yi University of Technology, Taiwan, R.O.C, No.35, Ln. 215, Sec. 1, Zhongshan Rd., Taiping City, Taichung County 411, Taiwan.

Accepted 6 October, 2013

This study aims to contribute to a better understanding of burglary on campus. A DMAIC model of six sigma was done to decrease burglary rate on campus. The model systematically defines five stages of definition, measurement, analysis, and control as the step of execution. And through measurement, we quantify stolen equipment. Improvement strategy is further proposed via the result acquired from tool analysis. The coordination with control model helps to solve and improve problems in time and also helps to monitor and keep efficiency result within required area. The result shows burglary rate is cut down through the use of DMAIC model of six sigma.

Key words: Six sigma, DMAIC model, burglary, cause and effect diagram.

INTRODUCTION

The campus is an open space dedicated to education. Not only does it serve as a learning environment for students, it is open to the general public and introduces community activities to the campus as well. Recently, campus community development has also become the priority in American education reform. From the perspective of organizational ecology, the campus has moved from its previously closed system to an open one. With the rapid changes in society, the campus environment is become increasingly complicated each day. Confronting various situations has put the school under pressure. The ability of school organizations to adapt is being tested by different campus safety issues, and the prevention of these problems is an important task of the school administration. Campus safety issues arise from outsiders or the involvement of external forces, and the most common natural calamities are typhoons and earthquakes. The five targets of campus safety include the safety of personnel, work, material, time and mind. Material safety involves safety installations of equipment, facilities and premises used for various activities, as well as care and maintenance of various equipment, facilities and properties within the campus. Various equipment, facilities, installations, and properties on campus are deemed resources of the country which are paid for by taxpayers. They are “from the people and for the people”, and hence must be well-maintained and cherished so that they are protected from burglary and vandalism; and operational safety is guaranteed (Technological and Vocational Education Department, 1995). According to the Campus Security and Safety Statistics of U. S. Department of Education, the number of campus burglary is 19679 in

*Corresponding author. E-mail: cmshih1001@gmail.com. Tel: 886-9-12315620.

2002, 9859 in 2003 and 6919 in 2004. In addition, according to statistics of The University of Arizona Police Department in 2007, the "major crime" problems on the campus continue to be theft and burglary. These are crimes of opportunity, which in many cases, can be prevented through simple crime prevention measures.

Recently, with campuses introducing Information Technology (IT) equipment to assist education, schools have become high risk areas for burglary. The stolen educational equipment includes projectors, computers, monitors, digital cameras and stereos (Taipei Teachers Association, 2005). On the other hand, in response to the use of IT in education, junior high and primary schools in Taipei city have been purchasing IT equipment for educational purposes since the year 2000. However, the high unit price and the convenient availability of this equipment have made them the best target for thieves. The number of burglary increased greatly each year. In 2005 alone, 44 schools have fallen victim to burglary with losses totaling as much as NT$21,464,844 (Wang, 2005). The huge amount in losses has grown four times compared to last year. It is a crucial goal of how school administrators build up the mode with a set of evaluation, analysis and improvement to promote the management of burglaries on campus. From the perspective of current methods of management, Six Sigma is the best method to improve the performance. As a result, the present study applied Six Sigma methodology to reduce the burglaries on campus.

In recent years, more companies are deploying Six Sigma to regain competitiveness. Motorola invented Six Sigma in the mid 1980s as a powerful business strategy to improve quality. Jack Welch, the former CEO of General Electric, was the great supporter of six sigma management. Chen et al. (2009) argued Six Sigma efforts at such companies as CITI Band, Bank of America, DuPont, Sony, FedEx and Ford were successful at reaching management performance. Six Sigma includes different management processes, such as MAIC (measure, analysis, improvement, control), DMADV (define, measure, analyze, design, verify) and DMAIC (define, measure, analyze, improve, control). DMAIC is recommended when the cause of the problem is unclear (Snee and Hoerl, 2003). This article then applied DMAIC to reduce burglaries on campus and then promote operation performance of schools. These steps are as follows:

Define: improve the burglary problems.

Measure: take total loss (TL) caused by burglaries as measurement direction and then define sub-index on measurement loss according to the number of average loss and upper specification limit of the number of loss.

Analyze: use cause and effect diagram to draw cause and effect diagram of loss. Figure out the main reason leading to loss and analyze it particularly.

Improvement: use cause and effect matrix to provide advice of management for burglaries on campus according to the main reason of loss analyzed from cause and effect diagram.

Control: build up the mode of loss control and monitor the degree of loss in time with accepting range by setting upper and lower specification limit and control center.

Definition and measurement

In recent years, schools not only have to share resources with the communities, they have to merge with them to form a dynamic system. In the pursuit of “a school-community or community-school”, apart from providing space to the general public, the issues of burglary confronted by schools also cannot be avoided. Losses resulting from these issues have increased administrative difficulties and cost expenditures.

As a result, the first defined problem is to reduce the rate of burglary. Apparently, the purpose of this paper in adopting six sigma is to define the loss of burglaries caused by theft. In general, most schools in current time provide diverse equipment for students and faculties and we divide stolen equipment on campuses into three categories: educational equipment, water and electricity equipment and precision instruments. Each stolen category is attributed to different losses; X_{ij} refers to loss of stolen equipment j of category i and N_i is the total number of stolen equipment of category i where j = 1,…, N_i , i = 1,2,3. 1 refers to educational equipment; 2, water and electricity equipment and 3, precision instruments. We then define the sum of the stolen equipment of category i , TL_i , as:

$$TL_i = \sum_{j=1}^{N_i} X_{ij} \text{ , } i = 1,2,3 \quad (1)$$

The total loss of the school is the sum of the stolen equipment of these three categories shown as follows:

$$TL = TL_1 + TL_2 + TL_3 \quad (2)$$

If the stolen equipment of each category is not certain, the total loss of stolen equipment N_i is a random variable with a Poisson distribution. The probability density function is shown as:

$$P(N_i = n_i) = \frac{\lambda_i^{n_i} e^{-\lambda_i}}{n_i!} \text{ , } N_i = 1,2,..., \ i = 1,2,3 \quad (3)$$

Where parameter λ_i refers to the average number of stolen equipment, $E(N_i) = \lambda_i$. In addition, loss X_{ij} is a continuous random variable caused by shortage of category i in stolen time j. To reduce total average loss, we have to reduce either average number of stolen equipment λ_i or average loss of stolen equipment θ_i, but when burglary occurs, the loss is done. As a result, the key to reduce total average loss is to reduce the average number of stolen equipment λ_i.

To achieve this objective, the maximum burglary U_i is defined by operation objective, school scale, and other factors to examine the maximum tolerance of schools for burglary.

From the categorization of stolen equipment, we found that due to large equipment on campus, it is unlikely to reduce burglary rate within a short period of time. Thus, according to Chen et al. (2009), this paper defined time loss measurement index according to average number of stolen equipment, U_i, and the maximum number of stolen equipment:

$$I_{Li} = \frac{\mu_i}{U_i},\ i = 1,2,3 \tag{4}$$

Where, I_{L1} refers to time loss measurement index of category 1; I_{L2} refers to time loss measurement index of category 2; and I_{L3} refers to time loss measurement index of category 3. From the above formula, when I_{Li} = 1, average number of stolen equipment λ_i equals to maximum number of stolen equipment U_i indicating the tolerance capacity of schools gets to maximum. When I_{Li} > 1, λ_i is larger than U_i indicating schools cannot tolerate the number of stolen equipment. In other words, schools have poor operation management and that results in the average number of stolen equipment exceed maximum tolerance capacity. When I_{Li} < 1, λ_i is smaller than U_i, showing the number of stolen equipment does not exceed tolerance capacity of stolen equipment and there is good operation management. Apparently, time loss measurement index is the decreasing function of λ_i. A smaller value of λ_i shows a smaller average number of stolen equipment on campus, better management efficiency, and larger time loss measurement index.

This study used optimal estimation of I_{Li} time loss measurement index as measuring statistics. Optimal estimation refers to the minimum of unbiased estimation and it is defined as follows:

$$\bar{I}_{Li} = \frac{\overline{N}_i}{U_i} \tag{5}$$

Where, $\overline{N}_i = (\sum_{i=1}^{k_i} N_i)/k_i$ is the result caused by the sampling average from the amount of lost items in the "i" category. It was calculated by adding up the accurate k amount of lost items from a kind of category ($N_1 + N_2 + ... + N_k$), then the "k" category will be divided. Based on this theory, the study has estimated the theoretical mean λ_i from the amount of lost items. With regard to the measuring index and its best estimation, the parameter relations can be understood from Figure 1.

According to the mentioned concept, the expected value and variance of the best estimated formula $\overline{I}_{Li}$ can be anticipated and its process is as follows:

$$E(\bar{I}_{Li}) = E(\frac{\overline{N}_i}{U_i}) \tag{6}$$

$$= \frac{1}{U_i} E(\overline{N}_i)$$

$$= \frac{1}{U_i} E(\frac{\sum_{i=1}^{k_i} N_i}{k_i})$$

$$= \frac{1}{k_i U_i} E(\sum_{i=1}^{k_i} N_i)$$

$$= \frac{1}{k_i U_i} E(N_1 + N_2 + ... + N_k)$$

$$= \frac{1}{k_i U_i} [E(N_1) + E(N_2) + ... + E(N_k)]$$

$$= \frac{1}{k_i U_i} [\lambda_i + \lambda_i + ... + \lambda_i]$$

$$= \frac{1}{k_i U_i} (\lambda_i k_i)$$

$$= \frac{\lambda_i}{U_i} = I_{Li}$$

$$Var(\bar{I}_{Li}) = Var(\frac{\overline{N}_i}{U_i}) \tag{7}$$

$$= \frac{1}{U_i^2} Var(\overline{N}_i)$$

$$= \frac{1}{U^2} Var(\frac{\sum_{i=1}^{k_i} N_i}{k_i})$$

$$= \frac{1}{k_i^2 U_i^2} Var(\sum_{i=1}^{k_i} N_i)$$

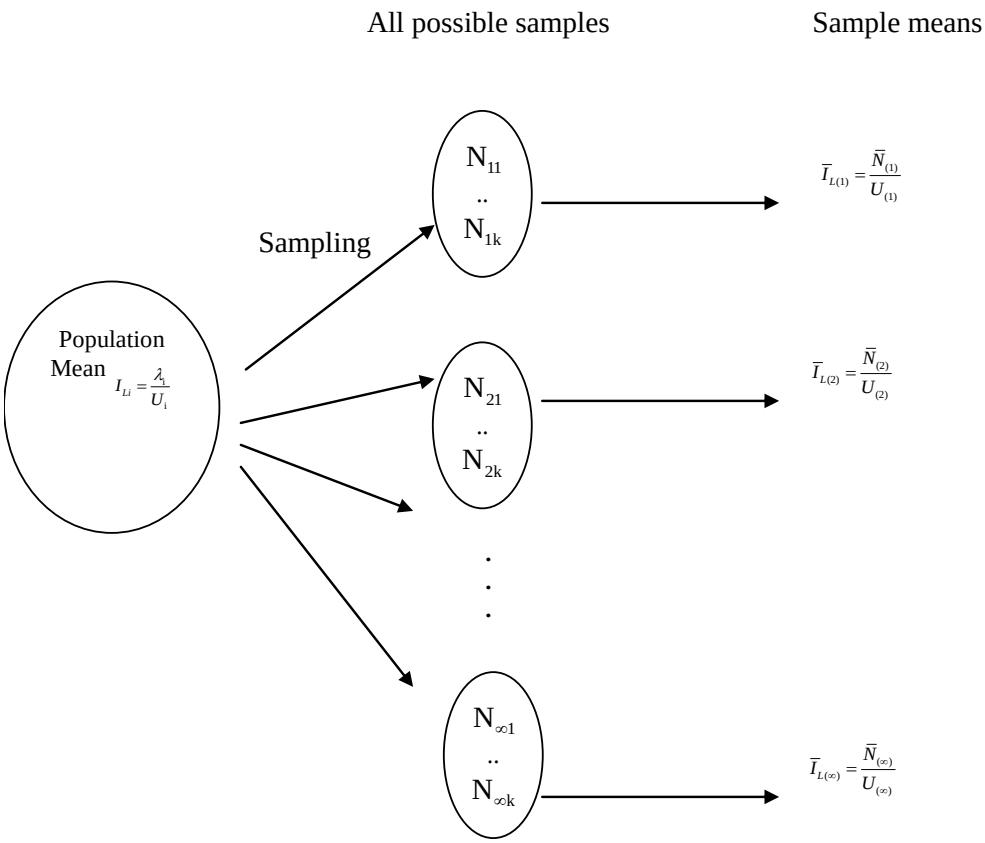

Figure 1. The sampling distribution of sample means.

$$= \frac{1}{k_i^2 U_i^2} Var(N_1 + N_2 + ... + N_k)$$

$$= \frac{1}{k_i^2 U_i^2} [Var(N_1) + Var(N_2) + ... + Var(N_k)]$$

$$= \frac{1}{k_i^2 U_i^2} [\lambda_i + \lambda_i + ... + \lambda_i]$$

$$= \frac{1}{k_i^2 U_i^2} (\lambda_i k_i)$$

$$= \frac{\lambda_i}{k_i U_i^2} = \frac{1}{k_i U_i} \times \frac{\lambda_i}{U_i} = \frac{I_{Li}}{k_i U_i}$$

The mentioned calculation pointed out that $E(\bar{I}_{Li}) = I_{Li}$, and $Var(\bar{I}_{Li}) = \frac{I_{Li}}{k_i U_i}$, if the test value $= \frac{\bar{I}_{Li} - I_{Li}}{\sqrt{\frac{I_{Li}}{k_i U_i}}}$. If k_i value is larger, the test value will be similar to the standard normal distribution Z followed by the Central Limit Theorem.

$$P(-Z_{\alpha/2} \le \frac{\bar{I}_{Li} - I_{Li}}{\sqrt{\frac{I_{Li}}{k_i U_i}}} \le Z_{\alpha/2}) = 1-\alpha_i \quad (8)$$

$$\Rightarrow P(-Z_{\alpha/2} \le \frac{\sqrt{k_i U_i}(\bar{I}_{Li} - I_{Li})}{\sqrt{I_{Li}}} \le Z_{\alpha/2}) = 1-\alpha_i$$

$$\Rightarrow P(-Z_{\alpha/2}\sqrt{\frac{I_{Li}}{k_i U_i}} \le \bar{I}_{Li} - I_{Li} \le Z_{\alpha/2}\sqrt{\frac{I_{Li}}{k_i U_i}}) = 1-\alpha_i$$

$$\Rightarrow P(\bar{I}_{Li} - Z_{\alpha/2}\sqrt{\frac{I_{Li}}{k_i U_i}} \le I_{Li} \le \bar{I}_{Li} + Z_{\alpha/2}\sqrt{\frac{I_{Li}}{k_i U_i}}) = 1-\alpha_i$$

Confidence interval of $1-\alpha_i$ of I_{Li} is shown as bellow:

$$[LCL, UCL] = [\bar{I}_{Li} - Z_{\alpha/2}\sqrt{\frac{I_{Li}}{k_i U_i}}, \bar{I}_{Li} + Z_{\alpha/2}\sqrt{\frac{I_{Li}}{k_i U_i}}] \quad (9)$$

According to confidence interval of said index I_{Li}, we are able to clearly understand estimated interval value of time loss measurement index. Chen et al. (2009) suggested

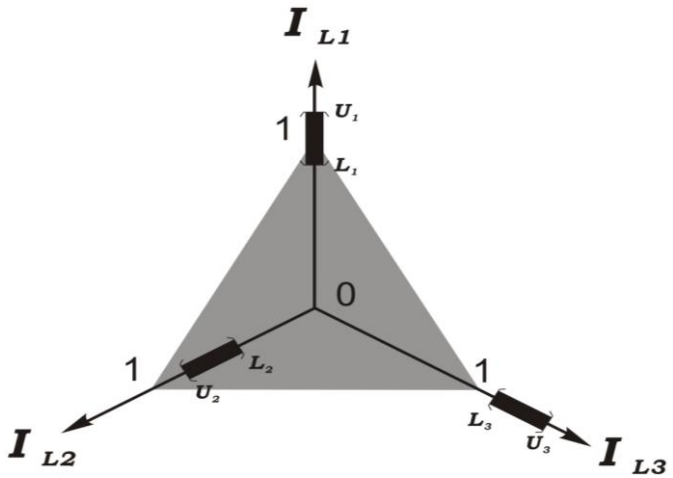

Figure 2. Radar analysis diagram.

Table 1. Index value and up-low limit.

Category	Index value	LCL,UCL
Educational equipment	I_{L1}	[L_1 , U_1]
Water and electricity equipment	I_{L2}	[L_2 , U_2]
precision instruments	I_{L3}	[L_3 , U_3]

that radar analysis diagram is a good tool to analyze tolerance capacity. This study also used radar analysis diagram according to indexes of three categories and their confidence intervals. Gray zone in Figure 2 shows a tri-angle of three time loss measurement indexes at value 1, the tolerance area of stolen equipment of three categories on campus. This paper used three different intervals of three categories as examples for description shown in Figure 2.

When I_{L1} interval is within tolerance area, schools reaches the maximum tolerance area and when I_{L2} interval is within tolerance area, the number of stolen equipment does not exceed the maximum tolerance of school and there is functional operational management. When I_{L3} interval is outside the tolerance area, the number of stolen equipment exceeds the maximum tolerance of schools, indicating high level of stolen equipment resulting from poor management. Thus, radar analysis diagram helps us to understand burglary problems of three categories on campus and that will serve as reference for future improvement in schools. To facilitate management of schools, this study proposed the following measurement procedures:

Step 1: Record stolen equipment in three categories of educational equipment, water and electricity equipment, and precision instruments after inventory checking including quantity number and amount of stolen equipment. Then calculate the average respectively.

Step 2: Calculate the actual time loss measurement indexes of the said three average numbers according to defined indexes and fill them in Table 1.

Step 3: According to the actual time loss measurement indexes acquired in Step 2, we define their up and down bounding with Equation (9) and fill them in Table 1.

Step 4: Mark confidence interval of LCL,UCL according to Table 1 and estimate based on the following principles:

A. When $1 \in [LCL,UCL]$, the tolerance capacity of schools for the number of stolen equipment has reached the up bounding and it requires tighter control.

B. If 1< L_i, schools cannot tolerate the number of stolen equipment and there should be improvement strategies for high level of stolen equipment resulting from poor management.

C. If 1> U_i, the number of stolen equipment does not exceed the tolerance capacity of schools and there is functioning operational management.

Analysis

As described earlier, this paper adopts six sigma to improve main defined problem of school management efficiency, that is, to reduce burglary rate on campus. In addition to estimated values of time loss measurement indexes and radar analysis diagram, this study provides an estimation model and enacts a set of measurement steps. Through those steps, if result is found to be outside gray area, then schools cannot tolerate the number of stolen equipment. Poor management results in high level of burglary. They need to examine and analyze the factors that contribute to burglary loss. In another words, the main purpose of analysis stage is to identify reason and time for burglary occurrence during operating process. In fact, many analysis methods and tools are available and for many businesses. They concern more of convenience of use while promoting service quality. Cause and effect diagram is a good tool to identify and analyze questions from different dimensions. Chen et al. (2009) also suggested that through the application of cause and effect diagram, manufacturing qualify has been improved. This paper, therefore, uses cause and effect diagram as the tool to analyze reason of burglary on campus. Figure 3 shows the cause and effect diagram of burglary occurrence on campus from four dimensions: environment, personnel, procedure and management system, described as follows.

Personnel

1. Moral Values: With changes in the society and the rise of living standards, the values held by people are also changing. Values held by school faculty members also

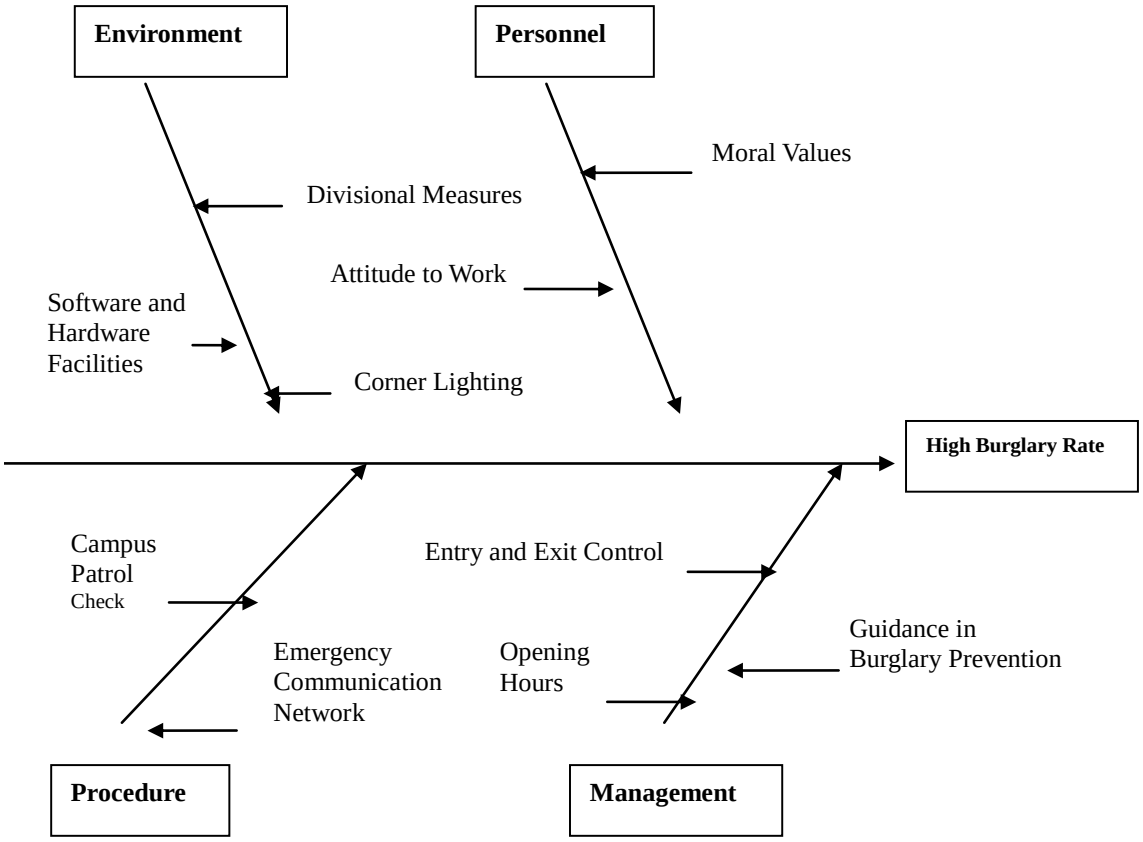

Figure 3. Cause and effect of burglary on campus.

have an indirect influence on their moral values. Knowing how to nurture and instill moral values in school faculties through education is a problem the school administrators must confront.

2. Attitude to Work: A professional attitude to work is a necessity for any type of profession. The conscientious attitude of the school faculty to work also has a certain effect on burglary. A vigilant attitude (not laissez-faire) toward suspicious individuals, together with a sense of responsibility in protecting school property, can indirectly reduce the rate of burglary in schools.

Environment

1. Divisional Measures: Schools are open spaces with different areas designed for specific purposes. In order to increase the efficiency of school administration, administrators must separate the premises into open and prohibited areas, education and dormitory areas, passage ways and other important areas.

2. Software and Hardware Facilities: On-campus security software and hardware facilities include electronic labels, closed circuit cameras, security alarms and patrol boxes, etc. This equipment can monitor or manage activities within the campus and at the same time check for unlawful behaviors. Furthermore, regular maintenance of older electronic security equipment or security alarm systems must be done in order to prevent malfunction when the need for them arises.

3. Corner Lighting: Lighting on campus has a definite effect on security and safety. Dimly lit corners and areas with poor lighting often become blind-spots on campus. And school buildings with years of disrepair due to lack of management are usually dangerous places that give thieves the opportunity to strike.

Management system

1. Guidance in Burglary Prevention: Whether it is a burglary prevention explanation or burglary prevention management, both can be a topic in educational training. The more importance school administrators give to the training of faculty members in burglary prevention, the higher the level of rapid immediate response and the more active the prevention.

2. Entry and Exit Control: The entry and exit control plays a significant role in a school's operation. Proper entry control must be enforced by security personnel.

Table 2. Relevance matrix analysis.

	Office of general affairs	Campus security	Office of academic affairs	Office of student affairs
Personnel	◎	◎	◎	◎
Environment	◎	◎	◎	◎
Management System	◎	○	○	○
Procedure	◎	◎	○	○

◎refers to direct relevance;○ refers to indirect relevance.

Moreover, entry control regulations must be set by each department and followed strictly by each member. Furthermore, other people from outside and construction workers should register and exchange IDs at the security office before entering the campus. Through these regulations, the rate of burglary caused by the entry and exit of outsiders or members present outside their authorized time on campus can be reduced.

3. Opening Hours: The campus opening hours should be clearly stated, and campus opening measures must also be drafted at the same time. For example, the campus is not open to the public for leisure activities during office hours. The operation of elevators in the campus buildings should also be regulated in accordance with different hours of the day on working days and holidays.

Procedure

1. Emergency Communication Network: Schools should enable an emergency notification system for local police precincts or community watch programs in order to reinforce the patrols of schools. If the need arises in an emergency, help can be requested immediately.

2. Campus Patrol: Campus security personnel should follow a stipulated patrol protocol. Schools must set up patrol boxes around the campus and various locations in each building patrolled by security personnel on-location at regular and irregular intervals. The number of security personnel, equipment, and security locations should be designated in accordance with campus size and funds.

Improvement

As mentioned above, this paper uses cause and effect diagram from the perspectives of four dimensions, personnel, environment, management system and procedure to identify reasons of burglary occurrence and then we analyze four questions to identify four factors of relevant matrix analysis as vertical dimension and the organization structure of school as horizontal dimension to propose improvement strategy via relevance analysis shown as in Table 2.

As shown in relevance matrix analysis, personnel have direct relationship with all departments. When lifting the moral values of staff members, school administrators should stipulate the work-related standards and authorities. At the same time, ethics-related seminars can be held to improve guidance. Regarding the members' attitude toward work, each department administrator should instill keen and responsible attitudes in their staff. Placing expensive educational equipment in tight security storage rooms, spraying paint, embossing or sticking detailed logs on all equipment purchased will make the disposal of stolen equipment by burglars more difficult. This way, thieves are also afraid to send the equipment for repair in case of malfunction. Everyone must make their own contribution toward campus safety by keeping an eye out for suspicious individuals and activities.

Environment can be examined from analysis of three factors: divisional measures, software and hardware facili-ties, corner lighting. According to Planning Advice Note 46 of Scottish Government in 1994, the principle of environment planning for avoiding crime includes natural surveillance, privacy, definition of boundaries, landscaping, lighting, access and parking. In addition, the CPTED (Crime Prevention through Environmental Design) rationale suggests that through the proper design and use of the built environment, it is possible both to reduce the actual incidence of criminal activity and to mitigate fear of crime (Parnaby, 2006). As shown in relevance matrix analysis, divisional measures, software and hardware facilities and corner lighting have direct relationship with all departments. When setting up divisional measures, the spaces in each department should be distinctly separated. For example, open and closed-off areas must be clearly separated. To decrease the chance of burglary, outsiders should be made to stay as far from campus computer rooms and important belongings as possible. Regarding corner lighting, bare treatment could be given to enclosed walls, parapets or other security blind spots so as to increase transparency and eliminate them. Dimly lit areas should be well-lit. With respect to software and hardware facilities, closed circuit cameras must be mounted and other protective installations set up at building exits and stairwells. Furthermore, each department on campus should also have its own internal emergency system (such as alarm bells, warning lights, infrared alarms, and air sirens) and simple and clear signals, allowing on-duty and off-duty personnel to take immediate action when the need arises.

Of course, school administrators can also integrate technology with policies when operating appropriate software to oversee campus security.

Three factors of management system, guidance in burglary prevention, entry and exit control, and opening hours are analyzed. Regarding guidance in burglary prevention, the school's General Affairs Office can invite specialists to teach staff members about anti-burglary management on a regular basis and encourage joint effort by everyone to prevent burglary and increase awareness. Regarding entry and exit control, the General Affairs Office should request each department to set entry control regulations that must be followed by staff members. Doors must be closed following entry during holidays and after hours to prevent unlawful entries. Janitor's rooms and reception rooms can also help filter people without fixed duties. Cars will only be allowed to enter the campus by means of parking permits. Temporary permits will be provided to temporary staff and construction vehicles upon registration at the security office. Regarding opening hours, the General Affairs Office must exercise strict control over the operation of elevators in the campus buildings and set opening hours for holidays and working days to help facilitate security control.

Procedure can be explained by two factors, campus patrols and the emergency communications network. As shown in relevance matrix analysis, procedure has direct relationship with The General Affairs Office and The Campus Security Office. The General Affairs Office must create an efficient plan for security personnel to take charge of campus patrols and inspection in different areas, campus vehicle control, and campus entry control. The Campus Security Office must establish patrol boxes in various locations around and within the campus that should be patrolled by security personnel on-location at regular and irregular intervals. Night-time and blind spot patrols must be reinforced, and alertness to suspicious individuals must be raised. Regarding the emergency communication network, the General Affairs Office should plan to complete a security agreement with the local police precinct so as to facilitate the reporting of emergencies and accidents. At the same time, the emergency communications network should enable the campus security team to contact relevant personnel and deal with campus burglary in the shortest time possible.

Control

This paper also proposes anti-burglary management model built on DMAIC of six sigma suggested by Michael (2006) to effectively control burglary rate on campus. As a result, this paper develops the control model of anti burglary on campus to avoid burglary occurrence and monitor the control of burglary rate at the same time. Under the guidance of this model, school administrators are able to know control result of burglary rate and adopt real-time improvement to improve management efficiency. In accordance with Equation (8),

$$P(-3 \le Z \le 3) = P\left(-3 \le \frac{(\bar{I}_{Li} - I_{Li})}{\sqrt{\frac{I_{Li}}{k_i U_i}}} \le 3\right) = 99.74\%$$

$$P(I_{Li} - 3\sigma_i \le \bar{I}_{Li} \le I_{Li} + 3\sigma_i = 99.73\% \quad (10)$$

Where $\sigma_i = \sqrt{\frac{I_{Li}}{k_i U_i}}$

According to Equation (10), we acquire up and down bounding and central line of $\bar{I}_{Li}$ shown below:

$$\text{UCL} = I_{Li} + 3\sqrt{\frac{I_{Li}}{k_i U_i}} \quad (11)$$

$$\text{CL} = I_{Li} \quad (12)$$

$$\text{LCL} = I_{Li} - 3\sqrt{\frac{I_{Li}}{k_i U_i}} \quad (13)$$

Actually, I_{Li} is unknown. We take the average of group m of sample $\bar{I}_{Li}$ to replace I_{Li} and then we get UCL, CL and LCL as follows:

From the above acquisition, we use average loss measurement index $\bar{\bar{I}}_{L_i}$ to estimate actual I_{Li} and revise equation (11), (12), and (13) as follows:

$$\text{UCL} = \bar{\bar{I}}_{L_i} + 3\sqrt{\frac{\bar{\bar{I}}_{L_i}}{k_i U_i}} \quad (14)$$

$$\text{CL} = \bar{\bar{I}}_{L_i} \quad (15)$$

$$\text{LCL} = \bar{\bar{I}}_{L_i} - 3\sqrt{\frac{\bar{\bar{I}}_{L_i}}{k_i U_i}} \quad (16)$$

$$\text{Where } \bar{\bar{I}}_{L_i} = \frac{1}{m} \times \sum_{i=1}^{m} \bar{I}_{L_i} \quad (17)$$

Obviously, according to above up and low control limit and control center, we are able to adopt control principle and method to conduct real-time monitoring on burglary rate on campus.

Conclusion

With campuses introducing Information Technology (IT) equipment to assist education, schools have become

high risk areas for burglary. Relevant researches also showed that burglary is a serious problem on campus. School administrators, therefore, are inevitable to face high burglary rate. How to effectively reduce burglary rate becomes a concern of school administrators.

Few in the previous literature discussed procedure and model that help to improve and control burglary rate on campus; therefore, this paper adopts DMAIC model of six sigma proposed by Michael (2006). Because that model systematically defines five stages of definition, measurement, analysis, and control as the step of execution and through measurement, we quantify stolen equipment. Improvement strategy is further proposed via the result acquired from tool analysis. The coordination with control model helps to solve and improve problems in time; and it helps to monitor and keep efficiency result within required area. With DMAIC model, this paper found that burglary rate is cut down through the use of six sigma.

In terms of measurement, this paper uses total loss (TL) of stolen equipment for measurement and defines time loss measurement index according to the up bounding of average number and total number of stolen equipment. Interval values are then acquired to compile radar analysis diagram. In the stage of analysis and improvement, we construct cause and effect diagram of stolen equipment on campus and identify the main reasons in four dimensions of environment, personnel, procedure, and management system and we propose four suggestions for improvement. In the end, anti burglary control model is built according to up and down bounding and central center to monitor burglary problem and push it down to allowable scale.

In terms of methodology, demonstration with a practical case or real life data would attach a greater credibility to the work. We, therefore, planned to study the issue about burglary on campus with two phases. First phase is to introduce our ideas with sound theories and proper methodology as we studied here. In the second phase, we are going to collect real life data with a practical case to demonstrate our frame in the near future.

This paper found that burglary rate is cut down through the use of DMAIC model of six sigma. School administrators should continue training their employees and improving hardware and software facilities and they should also conduct more effective contacts and communication with each department. With all those measures, they are able to improve management efficiency in the future.

REFERENCE

Chen KS, Shyu CS, Kuo MT (2009). An application of six sigma methodology to reduce shoplifting in bookstores. Quality and Quantity. Online first version(published online: 18 July 2009).

Parnaby PF (2006). Crime Prevention through Environmental Design: Discourses of Risk, Social Control, and a Neo-liberal Context. Canadian J. Criminol. Criminal Just. 48(1):1-29.

Snee RD, Hoerl RW (2003). Leading Six Sigma: A Step by Step Guide Based on Experience with GE and Other Six Sigma Companies. Prentice-Hall, New York.

Taipei Teachers Association (2005). Taipei Teachers Association press release. Available at: http://www.fhjh.tp.edu.tw/teacher/latestnews.html (accessed 31 July 2010)

Technological and Vocational Education Department (1995). A manual of Campus security management in university, Technological and Vocational Education Department, Taipei.

The University of Arizona Police Department (2007). Campus Crime Statistics. Available at: http://www.uapd.arizona.edu/campus%20crime%20stats.htm(accessed 31 July 2010).

Michael LG (2006). Lean Six Sigma for Services. McGrawHil, New York.

U.S. Department of Education (2006). Summary Campus Crime and Security Statistics 2002-2004. Available at: http://www.ncjrs.gov/spotlight/school_safety/publications.html (accessed 31 July 2010).

Wang ZB (2005). Taipei Councilor press release. Available at: http://www.tta.tp.edu.tw/1_news/upload/ (accessed 31 July 2010).