

THEFT AND VANDALISM ON INDUSTRIAL AND ROOFING CONSTRUCTION
PROJECTS

By

PETER DONKOR

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To my family.

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I thank my entire family for supporting me in all endeavors. I also thank Dr. Hinze for giving me the idea for this study and also for his direction and support throughout the period of undertaking the study.

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Abstract of Thesis Presented to the Graduate School
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Peter Donkor

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Theft and vandalism can compromise the successful performance of any construction project. To avoid or minimize such events, appropriate countermeasures must often be implemented. This study was conducted to determine the extent of theft and vandalism incidents on industrial and roofing construction project sites and also to identify methods that construction firms have employed to help curb the problem. A survey was sent out to both industrial contractors and roofing contractors to determine the types of experiences that they had had with theft and vandalism and also to identify measures that they had adopted to curb such incidents of theft and vandalism on their project sites. The analysis of the responses resulted in the following conclusions:

- Theft and vandalism are not unique to any particular type of firm.
- Theft and vandalism are a greater problem in industrial construction than in roofing construction.
- Tools are the highest valued items stolen from both industrial and roofing contractors.
- The implementation of a good jobsite security plan can be helpful in reducing the incidents of theft and vandalism on project sites.

CHAPTER 1 INTRODUCTION

According to the National Insurance Crime Bureau, approximately \$1 billion is lost nationwide on an annual basis due to the theft of construction equipment and tools (LoJack 2003). Other estimates put the loss between 1 and 2 billion dollars annually. These figures do not include the losses incurred as a result of theft and vandalism of construction materials. The wide range of the estimates is due to a lack of accurate data on construction jobsite theft and vandalism incidents. For instance, the Federal Bureau of Investigation (FBI) in its annual uniform crime report does not distinguish between construction equipment theft and the theft of other types of vehicles. This makes it difficult to know the percentage of vehicle or equipment thefts that are construction related. Theft and vandalism problems exemplify the lax security that is in place on most construction sites. Some of the losses to individual construction firms as a result of theft and vandalism can lead to the failure of a project.

This research was undertaken to determine the types of experiences that construction firms have had with theft and vandalism and also to identify measures that firms have adopted to curb the incidents of theft and vandalism on their projects. Although jobsite theft and vandalism is considered a major problem in the construction industry, little research has been conducted in the area. The objective of this research was that findings of this study would increase the understanding of the magnitude of the problem of jobsite theft and vandalism and thereby help contractors appreciate the importance of jobsite security.

The results would be helpful to contractors when developing jobsite security plans for their projects. The study would also identify those practices that have proven to be successful for

some contractors in tackling the issue of theft and vandalism on their project sites which would in turn help other contractors reduce the losses that are attributed to theft and vandalism.

CHAPTER 2 LITERATURE REVIEW

According to the National Insurance Crime Bureau, approximately \$1 billion a year is lost nationwide due to the theft of construction equipment and tools (LoJack 2003). According to the National Association of Home Builders (NAHB), the theft of backhoes and other heavy equipment, tools, building materials, and appliances costs the home building industry \$4 billion a year and inflates the cost of the average new home by 1.5 percent, or more than \$4,000 (O'Malley 2005). The Surveying and Mapping Society, based in Tallahassee, Florida, has recorded the theft of 150 surveying instruments which amounts to more than \$1.3 million at an average cost of \$12,400 per incident (Tudor 2007). These figures clearly indicate the widespread nature of the theft and vandalism problem in all the different sectors of the construction industry. Prior studies have targeted some sectors of the construction industry but there are some sectors that have not been researched. This means theft and vandalism losses within some sectors of the construction industry are unknown.

Incidents of theft and vandalism on construction jobsites are not limited to the U.S. alone. Over 24,000 pieces of equipment were estimated stolen in the U.K. in 1997 alone. The stolen pieces of equipment were estimated to cost well over £66 million. This figure is based on the depreciated value of the equipment (Smith and Walmsley 1999). Between the years 2000 and 2007, more than £216 million of stolen equipment was reported to The National Plant and Equipment Register (TER) in the U.K. (TER, 2007). According to TER, plant and equipment theft is endemic across the UK with Home Office estimates running at £1 million of equipment being stolen every week and more than £200 million of stolen equipment in circulation. In Canada, conservative estimates put the loss due to theft on construction sites at 200 million Canadian dollars annually but others peg the loss at 1 billion Canadian dollars (CBC News 2003).

Previous studies in the U.S. has shown that many construction firms do not report the theft of items that are valued less than the company's insurance deductible amount. This has made it very difficult to know the magnitude of theft and vandalism in the construction industry. Since the value of construction equipment is high, such losses are reported to the police and therefore there are more accurate of statistics on equipment losses as compared to material losses. According to LoJack, a firm that specializes in vehicle tracking systems, from January through December 2006, police recovered over 18 million dollars worth of stolen construction equipment that were outfitted with a LoJack device. Since the year 2000, more than \$69.7 million worth of stolen assets has been recovered as a direct result of LoJack (LoJack 2006). According to LoJack, the equipment recovery data illustrated the most popular types of equipment targeted by thieves. The following is the order in which the recovered equipment were ranked:

- Backhoe Loaders / Skip Loaders / Wheel Loaders
- Skid Steers
- Generators / Air Compressors / Welders (Towable)
- Forklifts and Scissor Lifts
- Light Towers
- Light Utility / Work Trucks and Trailers

California, Florida, Texas, Arizona, Georgia, Nevada, New Jersey, Maryland, Illinois, and Louisiana were the top ten states with the highest number of construction equipment theft incidents in 2006, respectively, based on LoJack's recovery data. In 98% of the cases, the stolen equipment was recovered in the same state where the theft was reported. It was either in storage or in use on a local jobsite (LoJack 2006). A study conducted by the National Equipment

Registry (NER), an equipment recovery database, concluded that as little as 10% of the stolen equipment is recovered and the types of equipment recovered closely mirror the types most often stolen (NER 2005). In a study conducted by the NER, it was realized that the theft of heavy equipment is seen as a lucrative business because the rewards far outweigh the risks. The report noted that heavy equipment which is often valuable and easy to sell is on sites with very little or no security. The rate of recovery of stolen equipment was also noted as being low and this was attributed to the following factors;

- The delay in theft discovery and reporting
- Inaccurate or non-existent owner records
- The lack of pre-purchase checks in the used equipment market
- Limited resources that law enforcement can dedicate to equipment theft investigations
- The difficulty of conducting equipment investigations due to the complexities in equipment numbering systems
- The lack of information available to law enforcement

There is no mandated registration system for heavy construction equipment and this compounds the problem of equipment recovery.

The National Insurance Crime Bureau (NICB) acknowledges that heavy equipment theft is a growing problem throughout North America and that organized crime rings are the primary driving force behind the thefts. The NICB also states that many of these organized criminal rings transport stolen construction equipment to the nearest port for shipping to other countries or across the border prior to its being reported as stolen. To help combat the problem of equipment theft, equipment manufacturers adopted a standard worldwide 17-digit product identification number (PIN) system beginning with the year 2000 models. This format is intended to help

international law enforcement computer systems to better check, verify, and track equipment that is reported stolen.

The concern about theft is not restricted to heavy equipment. In 2002, Zachry Construction Corp., a general contractor reported that it lost \$2 million dollars in tools out of an inventory of \$35 million (Tudor 2003). Since tools are very difficult to track, their loss is not easily detected and it is often very difficult to estimate accurately the dollar value of such losses. The theft of materials is also not well documented by contractors. This makes it difficult to estimate the value of those losses. Contractors may be concerned about losses that are small, but when losses are less than their insurance deductible amounts, they generally remain unreported. This is one of the reasons why the theft of materials and tools are not well documented since their value is generally less than the firms' deductible amount.

There have been suggestions as to how to prevent or curtail jobsite theft and vandalism. One general suggestion is the development and implementation of a jobsite security plan before actual construction begins. This plan, it is suggested, should be documented. It has also been suggested that the execution of the plan should be supervised by a management level employee. Keeping an up-to-date inventory of materials, tools and equipment is vital in making a jobsite security plan a success. Various organizations or associations provide their members with information on how to prevent incidents of theft and vandalism on their sites. Such information may differ from organization to organization or even differ within the same organization as a result of geographical location. According to the Problem-Oriented Guides for Police Problem-Specific Guides Series Guide No. 43, which was published in August 2006, the factors that contribute to theft are high construction materials costs and lax builder practices. The publication also stated that burglaries are committed by amateur thieves, professional thieves and insiders

(construction workers). The following were described in the publication as ways of reducing theft and vandalism on single-family house construction sites:

Improving Builder Practices

- In order to provide meaningful supervision of construction sites, builders should limit the number of sites for which each supervisor is responsible. This will afford supervisors a better opportunity to monitor materials, workers, and deliveries.
- Coordinate the delivery of materials and appliances so that they are installed shortly after delivery. When materials are installed, they are more secured and the house will soon be occupied, further reducing the exposure to theft.
- Whenever possible, builders should screen prospective employees and subcontractors, by conducting both criminal and financial background checks. Through training sessions, builders should clarify, emphasize, and enforce rules that prohibit the taking of construction tools, materials, and property that have been delivered onsite.
- Builders are encouraged to maintain a consistent workforce that is familiar with the company rules, practices, and attitudes towards the misappropriation of property. Builders who use subcontractors who in turn hire subcontractors are likely to be victims of theft.
- Contractors are encouraged to maintain a system for tracking tools. There are various tool tracking systems that can be used to reduce theft opportunities. Some builders designate one person to track the use of tools, which can help instill a sense of accountability in workers and reinforce the perception that management is monitoring tool inventory.

- Large builders especially are encouraged to retain the services of professional loss prevention specialists who have expertise in preventing and solving burglaries and who can work closely with police and other builders to control burglary.
- The construction industry leaders regard the use of security patrols as one of the most effective means of reducing and preventing construction site crime. Security patrols are a visible, proactive burglary deterrent.
- Many individual builders and builder associations have established hotlines that allow callers to report crimes anonymously.
- Construction site workers who are tempted to steal are likely to be deterred by the threat of being fired.

Making Construction Sites a Difficult Target for Thieves

- Proper lighting can deter burglars both by illuminating security measures in place at the construction site and by increasing the ability of passersby and police to observe suspicious activity at the site.
- Closed circuit television (CCTV) has been shown to be effective in deterring property crime. Evaluations of CCTV reveal that it is effective where an adequate number of cameras cover a particular area as well as on sites with limited and controlled access points.
- Alarm systems can be a cost effective deterrent in high risk areas. There are a number of different alarms available, including wireless systems that can be adapted to the environment (for example, for use in onsite storage containers). Some wireless alarms can be installed at any stage of the construction, without the need for pre-wiring or other electrical work.

- Properly secured storage units should be used for materials that are kept at construction sites overnight. These units should be equipped with wireless audible alarms and locks that cannot be accessed with conventional bolt cutters.
- Properly constructed and secured fences can control access to construction sites. Temporary wire fencing may be the most appropriate and cost effective measure for larger construction sites.
- Marking property with identification markings helps control burglary in three ways: it warns burglars that owners are monitoring their property, it discourages potential buyers of stolen property, and it increases the probability that recovered property will be returned to its rightful owner.
- Global positioning satellite (GPS) locator chips can be used to track and recover high-end appliances and equipment. If the property is stolen, the chip allows the builder or the police to monitor its movement by computer.
- Prominently and strategically displayed signage can inform potential burglars that builders and police are working to reduce thefts on construction sites.

The NICB offers the following as ways to prevent heavy equipment theft:

- Render equipment immobile or difficult to move during after hours or on weekends by:
 - Not leaving equipment, such as backhoes, on lowboys when unattended;
 - Clustering equipment in a "wagon circle" with more easily transported equipment, such as compressors, in the middle, surrounded by larger pieces of equipment.
- Maintain a log that lists all equipment by serial or product identification numbers in a central location. If possible, include photos and other identifying information.

- Use hydro locks to fix articulated equipment in a curved position, preventing them from traveling in a straight line.
- Use sleeve locks to fix backhoe pads in an extended position, keeping wheels off the ground.
- Install a system that disables the equipment's electrical or ignition system when universal keys are used.
- Install a tracking transmitter system in each unit designed for construction and heavy duty equipment.

A construction site cannot be said to be a hundred percent immune from theft and vandalism. Solving theft and vandalism incidents is made more difficult when these crimes are perpetuated by employees of the affected firm. From the literature reviewed, it is clear that taking jobsite security seriously on project sites can help reduce the losses incurred as a result of the activities of professional thieves and vandals. In combating equipment theft, joint initiatives between equipment manufacturers, rental companies, contractors and the police will be highly beneficial. By combining better manufacturer fitted security equipment, with increased operator awareness and better police cooperation, the number of equipment thefts can be significantly decreased.

CHAPTER 3 METHODOLOGY

The primary objective of this research was to determine the magnitude of theft and vandalism losses on construction sites and also to identify methods that contractors have used to curb incidents of theft and vandalism on their project sites. Two similar studies were done in 2003 but those focused on residential construction and commercial construction. As part of the recommendations of those studies, it was suggested that other studies be done with a focus on specific types of construction, hence the focus on industrial contractors and roofing contractors. To conduct the study, surveys were mailed to targeted firms. The survey used was a modified version of one that had been developed by Dr. Jimmie Hinze of the M.E. Rinker, Sr. School of Building Construction to conduct the studies that concentrated on residential and commercial construction. Modifications were made to help capture information unique to the types of construction that were being studied. The final version of the questionnaires (see appendix A and B) and a copy of the cover letter to be sent out with the questionnaires were approved by the University of Florida Institutional Review Board (IRB).

The final questionnaires were handed out to approximately 100 industrial contractors that were in attendance at a safety forum sponsored by Southern Company. The forum was held at Callaway Gardens, Pine Mountain, Georgia from September 26 to 27, 2007. Surveys were also faxed to about 850 roofing contractors who were members of the Florida Roofing Sheet Metal and Air Conditioning Contractors Association, Inc. (FRSCA). Most of the firms were located in the southeast of the U.S. The roofing contractors were faxed through the FRSCA. The survey was structured to obtain information on the magnitude of theft and vandalism on construction sites of the surveyed firms and also find out how the firms had been able to curb incidents of theft and vandalism on their construction sites.

A sample size of 164 was determined to be the minimum desired sample size to meet the requirements of the research objective (see table in Appendix D). A total of 71 questionnaires were completed and returned for the study focused on the industrial constructors and 35 questionnaires were returned for the study focused on roofing contractors.

The data gathered were analyzed using the Statistical Package for Social Sciences software. Correlations that were found to be statistically significant are noted.

CHAPTER 4
RESULTS

Roofing Contractors

Thirty-five questionnaires were completed and returned by the roofing contractors. The data received were analyzed by calculating the frequencies of specific responses. Responses to open-ended questions were analyzed separately. The results include a summary of the theft and vandalism incidents experienced by the firms in the past three years, the dollar losses incurred as a result of the thefts and vandalism, and an analysis of measures firms have adopted to curb the incidents of theft and vandalism on their project sites.

Thirty-four firms provided information on their approximate annual dollar volume of work performed (Figure 4-1). Of these firms, four (12%) had an approximate annual dollar volume of work between \$400,000 and \$700,000, eight (24%) had annual dollar volumes of work between \$701,000 and \$1,400,000, five (15%) between \$1,401,000 and \$2,800,000, ten (29%) between \$2,801,000 and \$6,000,000, and seven (20%) firms reported an annual dollar volume of work in excess of \$6,000,000.

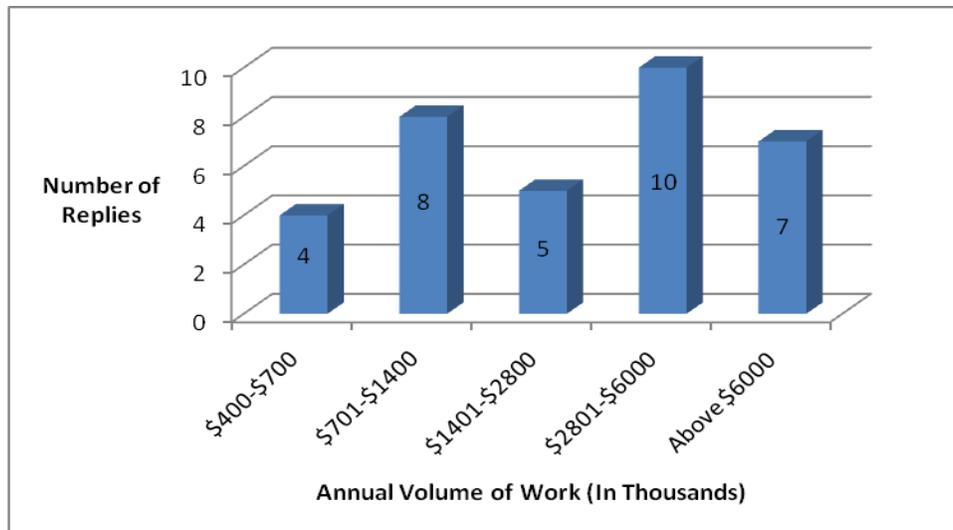


Figure 4-1: Approximate annual dollar volume of work performed (N=34)

The percentage of work typically subcontracted by the firms was broken down into five categories. Fourteen (41%) respondents did not subcontract any work. Eighteen firms (53%) subcontracted between one and twenty five percent of their work. One (3%) respondent subcontracted 100% of its work (see Figure 4-2).

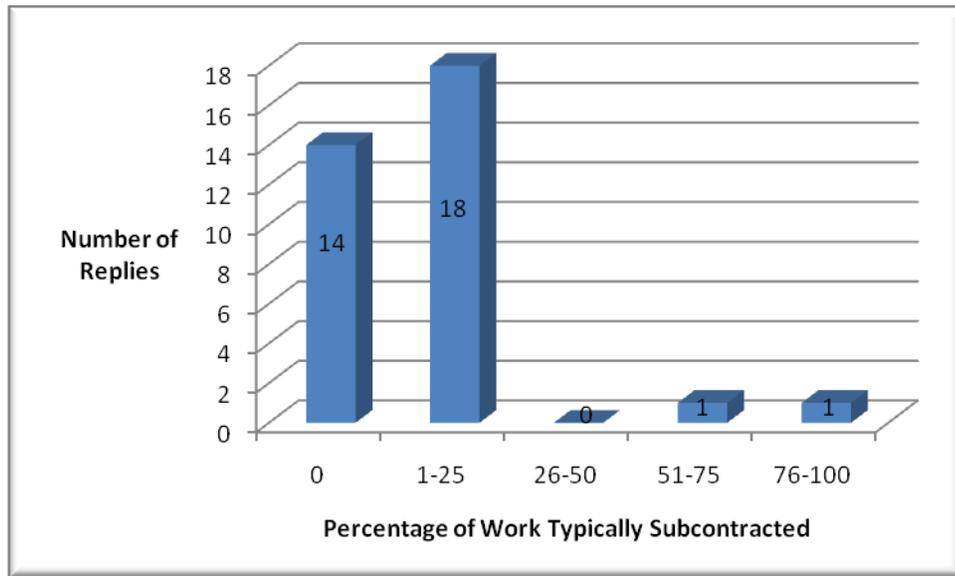


Figure 4-2:Percentage of work typically subcontracted (N=34)

Theft

This section presents information on the types of theft experienced by responding contractors along with approaches they have adopted to curb the number of theft incidents on their project sites.

Thirty-two firms provided information on the number of theft incidents they had experienced in the past three years (Figure 4-3). Six (19%) contractors reported that they had experienced no theft incidents within the last three years. Five (16%) firms reported that they had experienced only one theft incident within the last three years. Fifteen respondents (47%) reported having between two and five theft incidents within the past three years. Two (6%) firms reported that they had experienced twenty theft incidents within the last three years. The mean

number of theft incidents experienced within the past three years by the responding firms was four with the median being three .

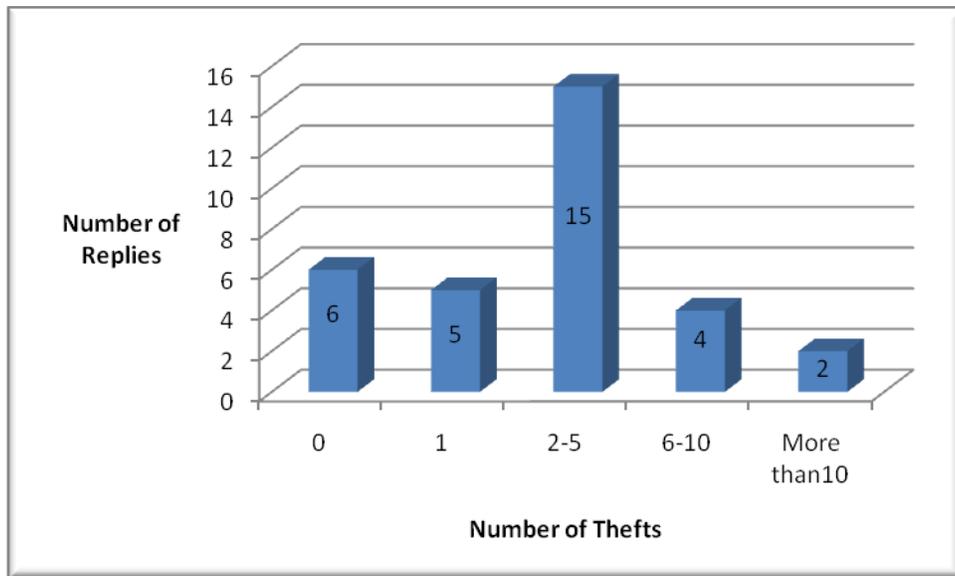


Figure 4-3: Number of theft incidents experienced in the past three (3) years (N=32)

Thirty-one responding firms provided information on the total estimated cost of the theft incidents they had experienced within the past three years (Figure 4-4). Of the thirty one responses, six (19%) reported losses between \$100 and \$2,000. Nine firms (29%) reported losses between \$2001 and \$5000. Six firms (19%) reported losses between \$5,001 and \$10,000. Two (6%) firms reported losses between \$10,001 and \$20,000. Three (10%) firms reported of losses of over \$20,000. The mean of the estimated cost of the losses reported by the thirty-one firms was approximately \$7000. This value was made higher as a result of a \$40,000 dollar loss experienced by one firm. The median was \$4,500.

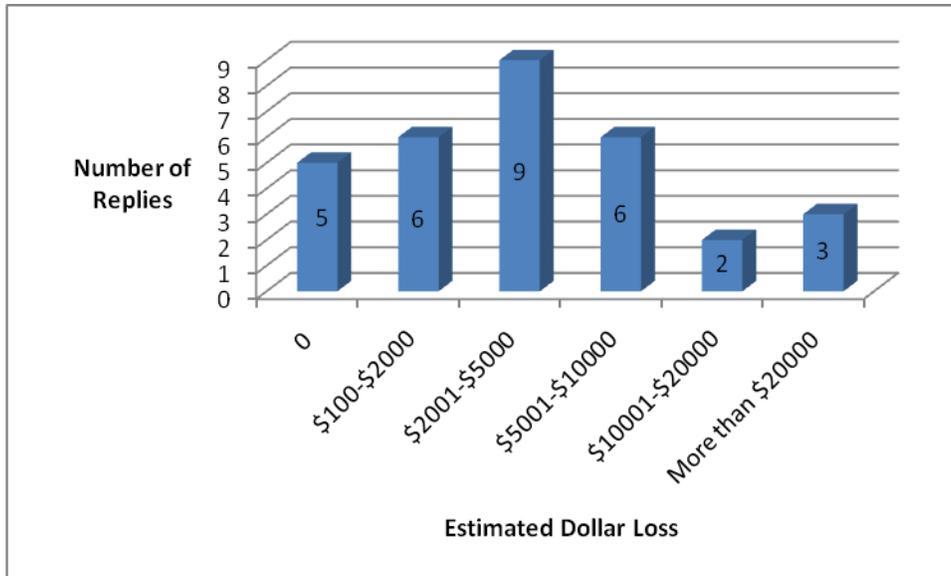


Figure 4-4: Estimated dollar loss resulting from theft incidents in the past three years (N=31)

The cost of theft losses per \$1,000 of work performed was also calculated from the responses provided (Figure 4-5). Twelve firms (50%) had losses between \$0.01 and \$1.0 per \$1,000 of work performed. Six firms (25%) had losses of between \$1.1 and \$2.0 per \$1,000 of work performed. Three firms (13%) experienced losses of between \$2.1 and \$3.0 per \$1,000 of work performed. Two firms (8%) experienced losses greater than \$4.0 per \$1,000 of work performed. The mean was \$1.56 with the median being \$1.23.



Figure 4-5: Cost of theft losses per \$1000 dollars of work done (N=24)

Twenty-eight firms indicated the number of theft incidents reported to the police. Nine (32%) of these firms did not report any of their losses to the police. Eight (29%) firms reported one or two theft incidents to the police. Seven (25%) firms reported between three and five theft incidents to the police while four (14%) firms reported between six and twenty theft incidents to the police (Figure 4-6).

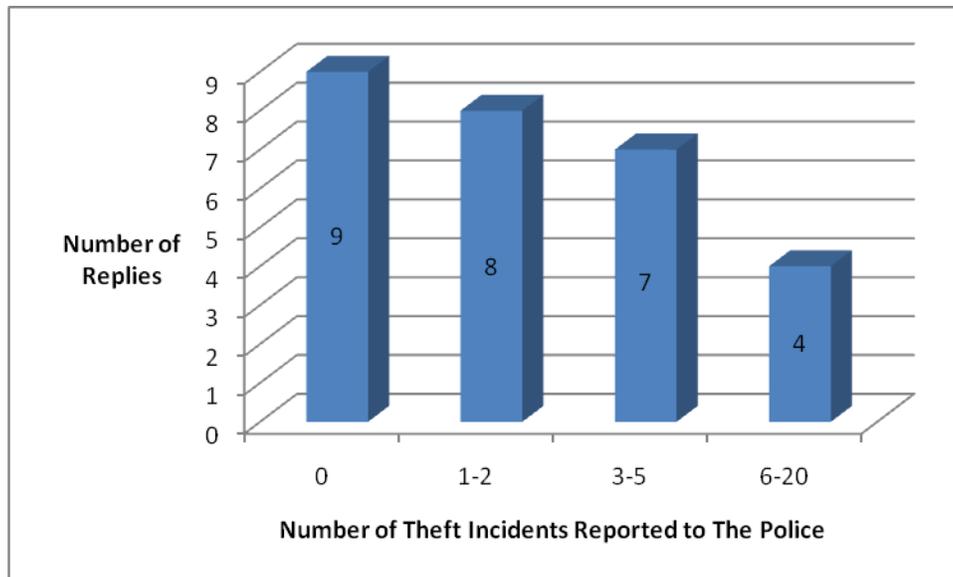


Figure 4-6: Number of theft incidents reported to the police (N=28)

Builders risk insurance covers a builder's property and the facility being constructed during construction. Benefits of such an insurance includes coverage for building materials, property of both prime and subcontractors that would be integrated into the building fabric, materials and supplies stored on the building site and those in transit to the building site. The coverage includes theft and vandalism, damage or destruction of property for which the insured has an insurable interest. The limit of insurance in some cases may be equal to the full value of the project. There are instances where coverage is made available for a loss limit. The deductible amount on such an insurance policy is the value stated in the policy that exempts the insurer from paying an initial specified amount in the event that the insured sustains a loss.

The deductible amount for the responding firms ranged from \$100 to \$10,000 (Figure 4-7).

The mean was approximately \$3,200 and the median \$2,000.

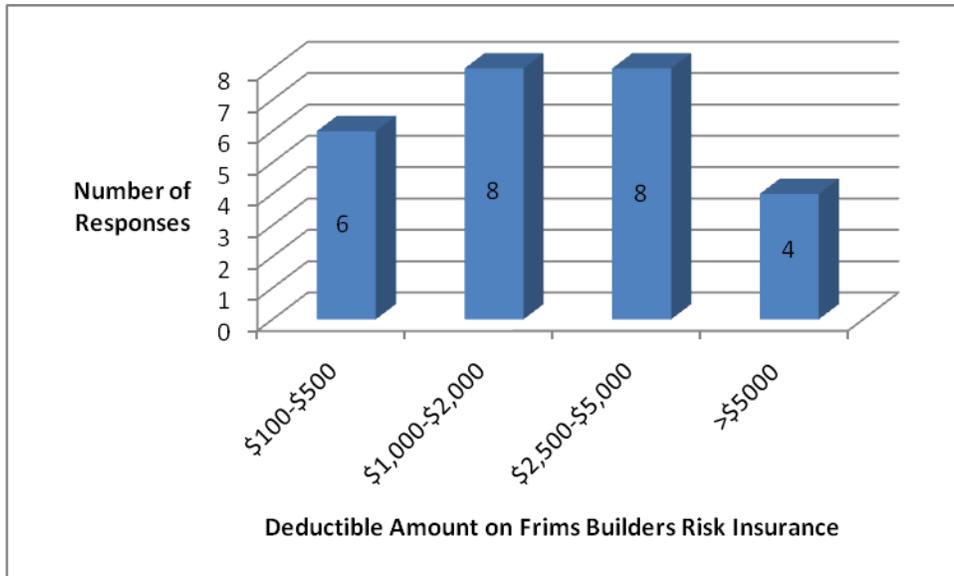


Figure 4-7: Deductible amount on the builders risk insurance policy (N=26)

Most of the items stolen were never recovered. From the twenty nine respondents to the question, twenty four (83%) reported that none of their stolen items had been recovered. Two (3%) firms reported that they had recovered 50% of the items stolen (Figure 4-8).

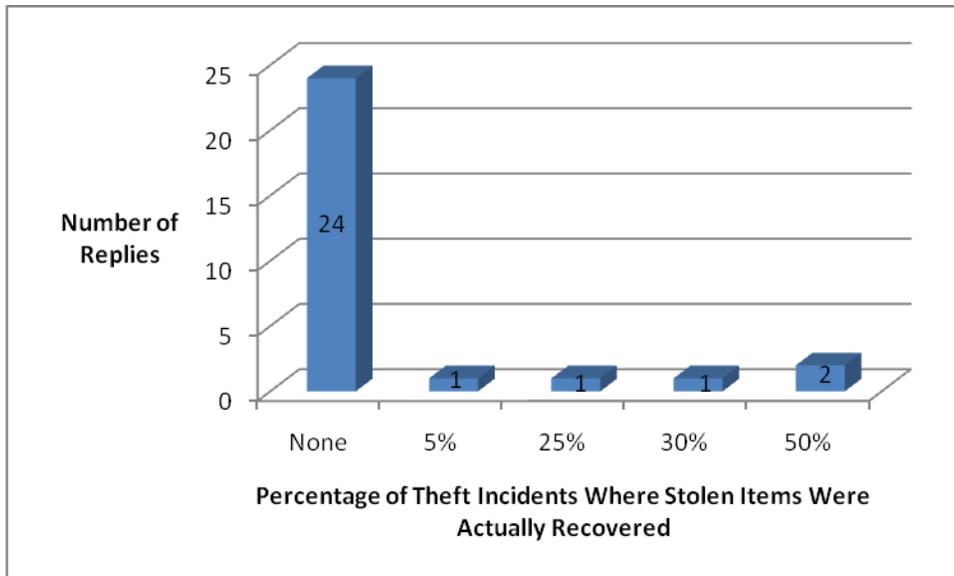


Figure 4-8: Percentage of theft incidents where stolen items were actually recovered (N=29)

The survey asked respondents to speculate on the percentage of thefts carried out by current or former employees. Thirteen (48%) of the twenty seven respondents to this question thought none of their current or former employees were responsible for the thefts. Three (11%) thought that between 1% and 25% of the thefts they had experienced were carried out by current or former employees, eight (30%) thought that between 30% and 75% of thefts they had experienced were carried out by current or former employees and three (11%) thought that all of the thefts they had experienced were carried out by either their current or former employees (Figure 4-9).

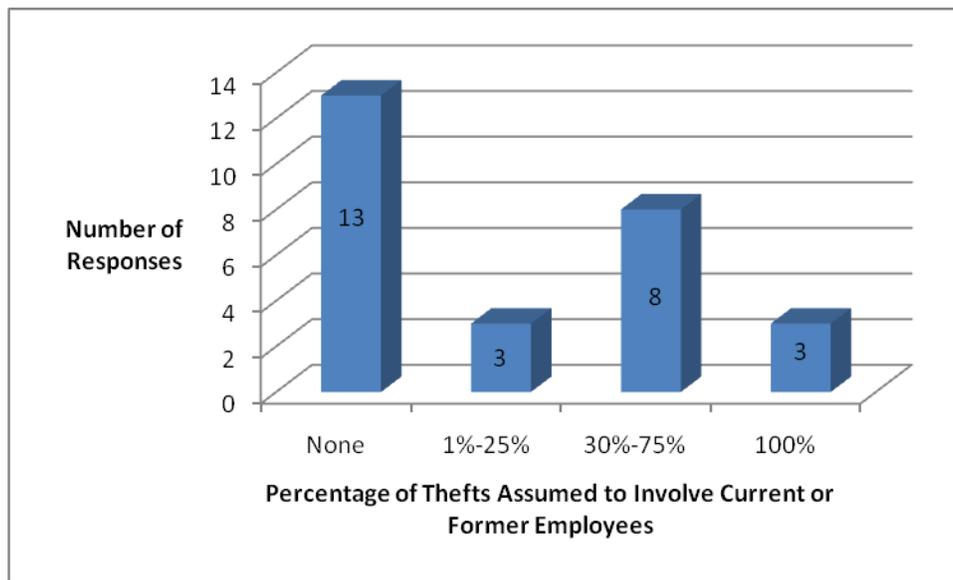


Figure 4-9: Percentage of theft incidents assumed to involve current or former employees (N=27)

The survey had a question on measures used to ensure jobsite security on construction sites. Respondents were given a list of measures available for use by construction firms and asked to check those they employed on their project sites. The results are summarized in Table 4-1.

Table 4-1 Measures commonly used to ensure security on the construction sites (percentages out of thirty five (35) responses)

71%	Removal of unused equipment from site
68%	Use of lockbox for tools/small equipment
51%	Strategic parking of large equipment
23%	Posting of warning signs
20%	Gated entrance
17%	Use of exterior lighting on the site
14%	Security fencing
9%	Use worker badge system
9%	Use of night security guard on site
9%	Use of police patrols
6%	Guard stationed at entry gate
3%	Neighborhood watch
3%	Use of security cameras
0%	Use of an alarm system

Some respondents provided information on other techniques they had used to reduce the number of theft incidents on their projects. These responses were:

- Store materials behind houses or on roof tops with ladders taken away.
- Removing roof top access from the jobsite and leaving any tools and materials on the blind side of the roof
- Keep materials in a central well lighted location for storing in full crates and pallets as much as possible
- Using a just-in-time delivery system
- Using a locked cargo trailer which is taken off the site at the end of the work day

As to the specific measures the surveyed firms had employed to prevent theft of tools on their project sites, Table 4-2 provides a percentage breakdown of the answers provided.

Table 4-2 Measures commonly used to prevent the theft of tools on construction sites
(percentages out of thirty-five responses)

71%	Minimizing tools left on site
66%	Maintaining tool inventory
63%	Maintaining a secure storage area
63%	Marking tools
57%	Making workers responsible for tools
49%	Workers providing their own tools

A question was asked to determine the measures commonly used to prevent the theft of equipment on construction sites. The responses are shown in Table 4-3.

Table 4-3 Measures commonly used to prevent the theft of equipment on construction sites
(percentages out of thirty five responses)

77%	Parking equipment inside a fenced area
71%	Securing equipment with chains and locks
69%	Parking equipment in a well-lighted area at night
31%	Parking equipment at a central location/specific formation at the end of each day
23%	Including additional identification on the equipment
14%	Modifying ignition or fuel lines to make it difficult for others to start engine
14%	Installing tracking devices on equipment
11%	Using a distinctive color for equipment

Vandalism

Vandalism is generally defined as the willful wanton and malicious destruction of the property of others. The study examined the experiences that firms had had with regards to vandalism on their project sites.

Thirty-two firms provided information on the number of vandalism incidents they had experienced in the past three years. Fourteen (44%) reported that they had not experienced any incidents of vandalism on their project sites within the past three years. Six (19%) firms reported

that they had experienced one vandalism incident while five (16%) firms reported that they had experienced two incidents of vandalism within the past three years. Five (16%) firms had experienced three vandalism incidents and two (6%) firms had experienced between seven and ten vandalism incidents within the last three years (Figure 4-10).

Thirty-two firms provided information on the estimated dollar losses resulting from the vandalism incidents they had experienced. Of the thirty-two firms, fifteen experienced losses that were less than \$500. The mean of the losses was \$2,197 while the median was \$500 (see Figure 4-11).

The cost of the losses experienced as a result of vandalism per \$1,000 dollars of work performed was computed from the data provided. The mean was \$0.423 and the median 0.10 per \$1,000 of work performed (see Figure 4-12). The firm with the highest loss as a result of vandalism lost \$2.40 per \$1000 of work performed.

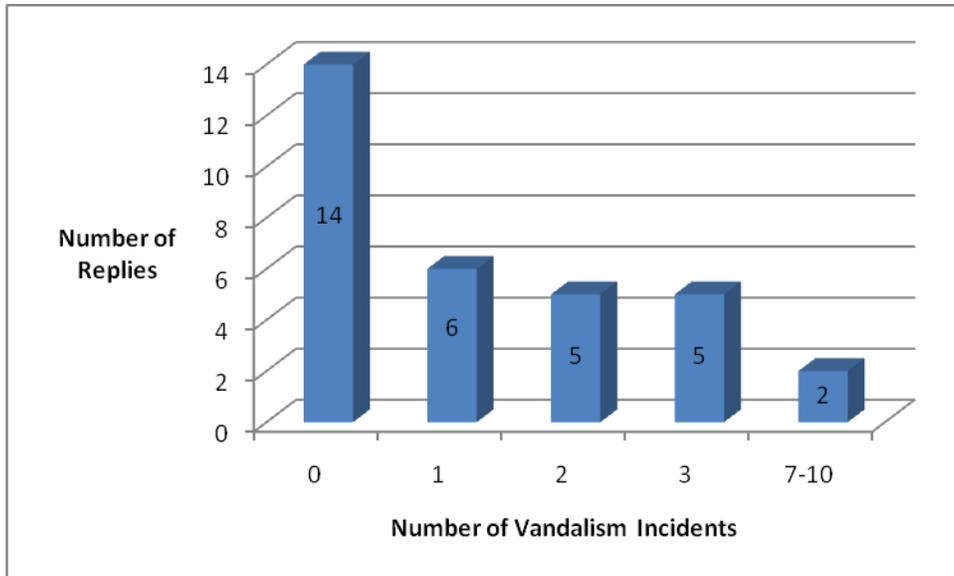


Figure 4-10: Number of vandalism incidents experienced in the past three years (N=32)

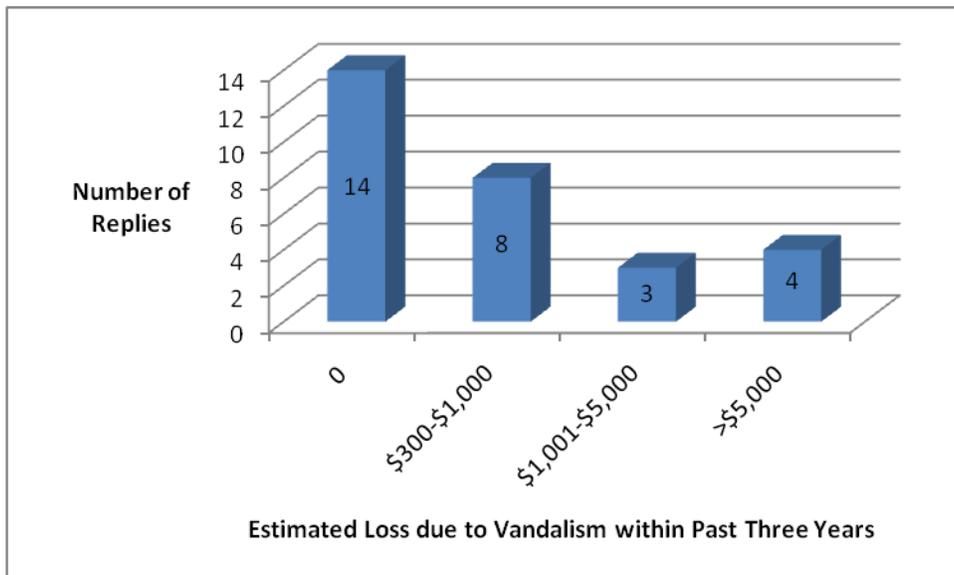


Figure 4-11: Estimated dollar loss due to vandalism experienced in the past three years (N=32)

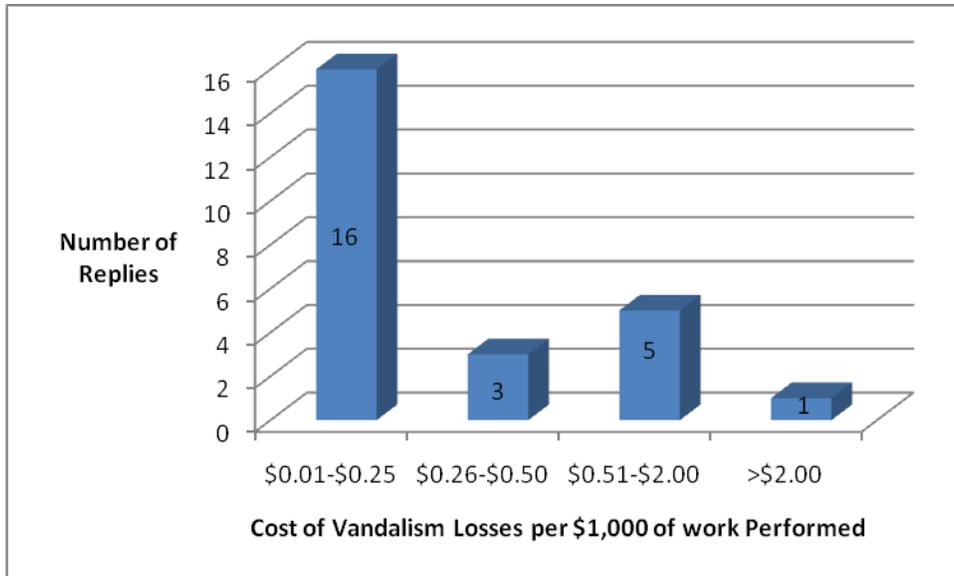


Figure 4-12: Estimated dollar loss per \$1,000 of work performed due to vandalism in the past three years

As to who the respondents thought the vandals were, five (28%) thought the vandals were persons who had been on the site for some reason, four (22%) thought the vandals were neighborhood kids, four (22%) thought the vandals were strangers, three (17%) thought the vandals were disgruntled workers and one (5%) thought the vandals were fired workers (see Figure 4-13).

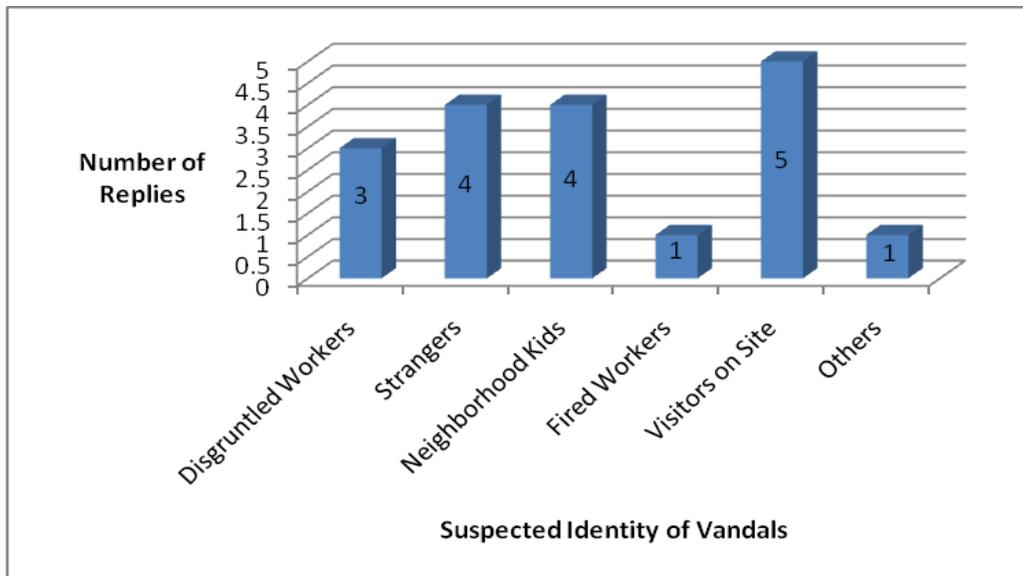


Figure 4-13: Suspected identity of vandalism

The correlation between the annual volume of work performed and other variables were examined. The number of theft incidents were positively correlated with the annual volume of work performed. The estimated cost of theft incidents also increased as the annual volume of work performed increased. The number of vandalism incidents experienced also went up as the annual volume of work increased (see Table 4-4).

Table 4-4 Correlation between annual volume of work performed, number of theft incidents, estimated cost of theft incidents, number of vandalism incidents, and number of stolen items recovered

	Number of theft incidents	Estimated cost of theft incidents	Number of vandalism incidents	Number of stolen items recovered
Annual volume of work performed	0.717**	0.389*	0.780**	0.616*

Pearson correlation

** Correlation is significant at the .01 level (1-tailed).

* Correlation is significant at the .05 level (1-tailed).

The correlation between the insurance deductible amount, the number of vandalism incidents, the estimated cost of theft incidents, the theft losses per \$1,000 of work performed and the percentage of thefts assumed to be by the contractors own or former employees were also examined. The insurance deductible amount was positively correlated with the number of vandalism incidents. The estimated cost of theft incidents also increased as the insurance deductible amount increased. The percentage of thefts assumed to be by employees or former employees also increased as the insurance deductible amount increased. The cost of theft losses per \$1,000 of work done also had a positive correlation with the insurance deductible amount (see Table 4-5).

Table 4-5 Correlation between insurance deductible amount, estimated cost of theft incidents, number of vandalism incidents, percentage of thefts assumed to be by current or former employees, and cost of theft losses per \$1,000 of work done.

	Number of vandalism incidents	Estimated cost of theft incidents	Percentage of thefts assumed to be by current or former employees	Cost of theft losses per \$1,000 of work done
Insurance deductible amount	0.625**	0.428*	0.780**	0.616*

Pearson correlation

** Correlation is significant at the .01 level (1-tailed).

* Correlation is significant at the .05 level (1-tailed).

Industrial Contractors

Seventy-one questionnaires were completed and returned by the contractors. The data received were analyzed by calculating the frequencies of specific responses. Responses to open-ended questions were analyzed separately. The results include a summary of the theft and vandalism incidents experienced by the firms in the past three years, the dollar losses incurred as a result of the thefts and vandalism, and an analysis of measures firms have adopted to curb the incidents of theft and vandalism on their project sites.

Fifty-five firms provided information on their approximate annual dollar volume of work performed (Figure 4-14). The companies were then classified into two categories namely, small to medium sized and large companies. The small to medium sized companies were those with an annual volume of work less than \$100 million and the large companies were those with an annual volume of work performed greater than \$100 million.

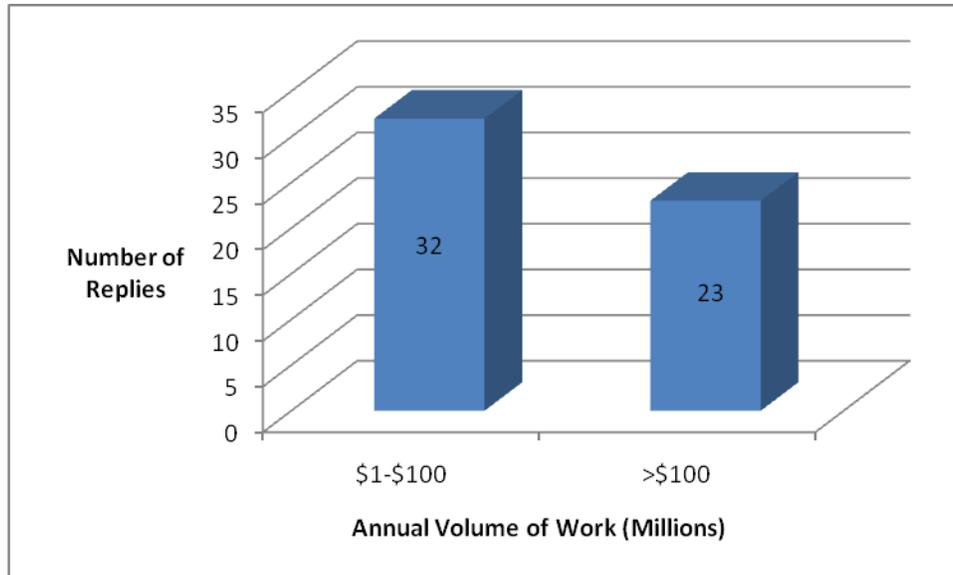


Figure 4-14 Approximate annual dollar volume of work performed (N=55)

The firms were classified according to the type of construction they perform. Thirty-one firms (51%) specialized in industrial projects, twenty three (36%) specialized in utility projects, and five (8%) firms specialized in commercial projects. The three firms left specialized in either residential construction, highway construction, public buildings or other types of construction. The other types were made up of mainly health care projects (Figure 4-15).

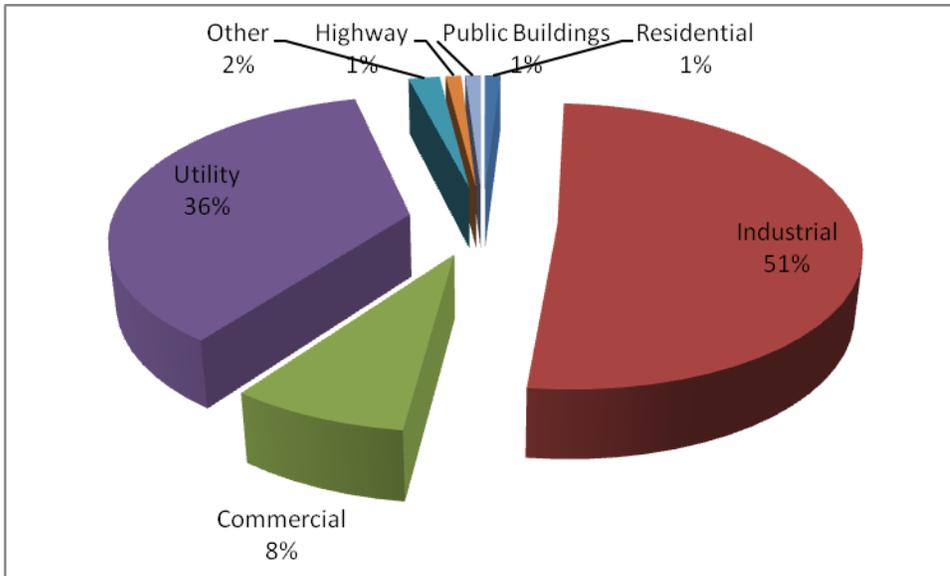


Figure 4-15: Types of projects undertaken (N=62)

The respondents were grouped according to the type of firm, namely general contractor, subcontractor, or client/owner. Out of the sixty-seven firms that responded, thirty-two (48%) were general contractors, twelve (18%) were subcontractors and twenty-three (34%) were owners or clients (Figure 1-16)

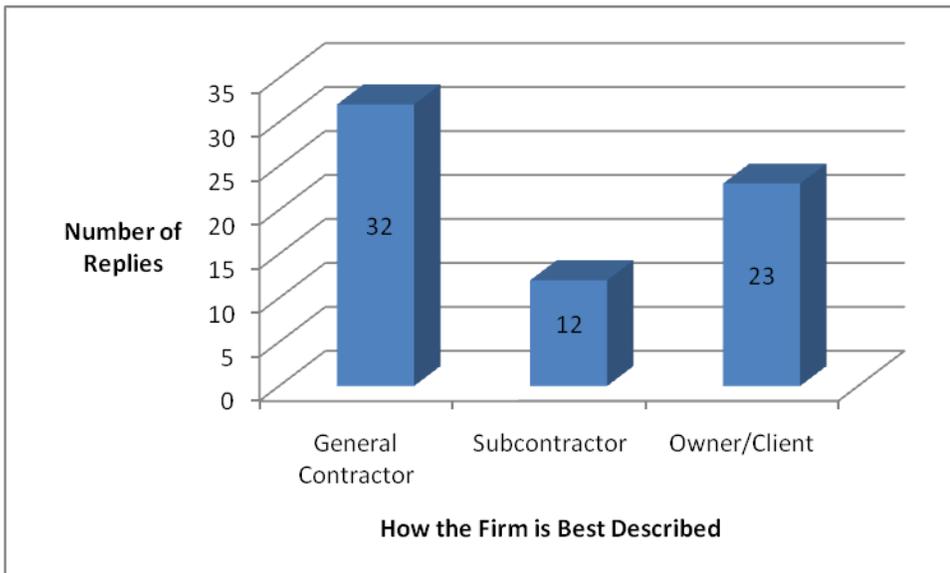


Figure 4-16: How the firm is best described (N=67)

The percentage of work typically subcontracted by the firms was broken down into five categories. Ten (16%) respondents did not subcontract any work. Thirty-seven firms (59%) subcontracted between one and twenty five percent of their work. Six (9%) respondents subcontracted between twenty six and fifty percent of their work. Two respondents (3%) subcontracted between fifty one and seventy five percent of their work and eight (13%) subcontracted between seventy six and hundred percent of their work (see Figure 4-17).

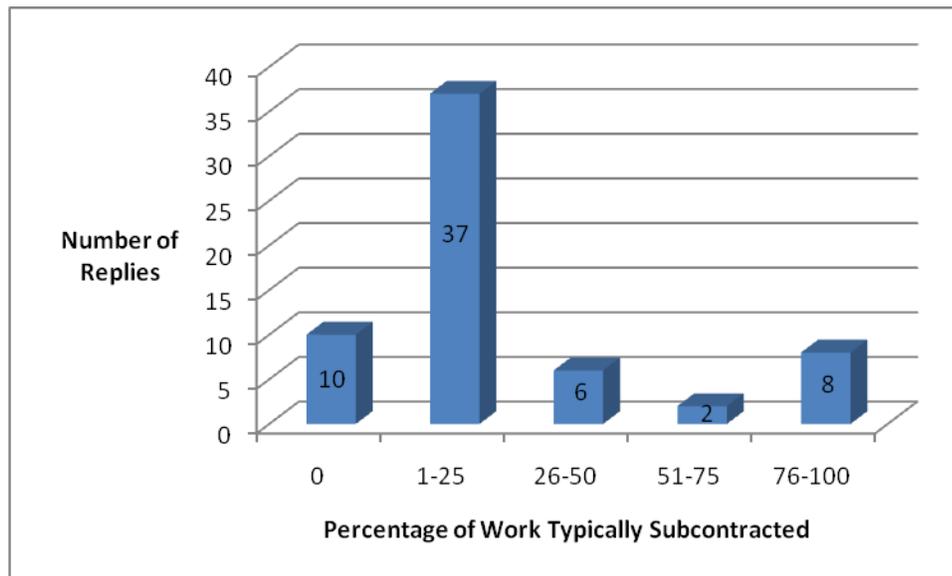


Figure 4-17: Percentage of work typically subcontracted (N=63)

Theft

This section presents information on the types of theft experienced by responding contractors along with approaches they have adopted to curb the number of theft incidents on their project sites.

Forty-one firms provided information on the number of theft incidents they had experienced in the past three years (Figure 4-18). Four (10%) contractors reported that they had experienced no theft incidents within the last three years. Twenty-one (51%) firms also reported that they had experienced between one and five theft incidents within the last three years. Seven

respondents (17%) reported of between six and ten theft incidents within the past three years. Two (5%) firms reported that they had experienced between eleven and fifteen theft incidents within the last three years. Five (12%) firms experienced between twenty and a hundred theft incidents while two firms (5%) experienced over a hundred theft incidents within the past three years. The mean number of theft incidents experienced within the past three years by the responding firms was twenty six with the median being four. The mean was made higher as a result of two firms that had experienced four hundred and one hundred and fifty theft incidents within the past three years respectively.

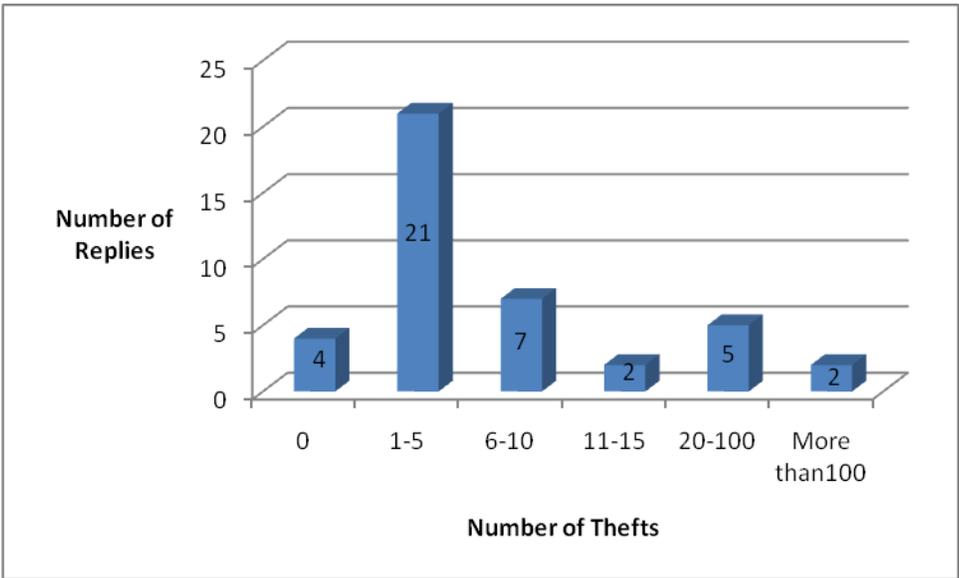


Figure 4-18: Number of theft incidents experienced in the past three (3) years (N=41)

Forty responding firms provided information on the total estimated cost of the theft incidents they had experienced within the past three years (Figure 4-19). Sixteen (40%) reported of losses between \$500 and \$40,000. Eight firms (20%) reported of losses between \$40,001 and \$80,000. Four firms (10%) reported of losses between \$80,001 and \$120,000. Four (10%) firms reported of losses between \$120,001 and \$200,000 and three (7.5%) firms reported of losses of

over \$200,000. The mean of the total estimated cost of the losses reported by the forty firms was approximately \$86,000. The median was \$35,000.

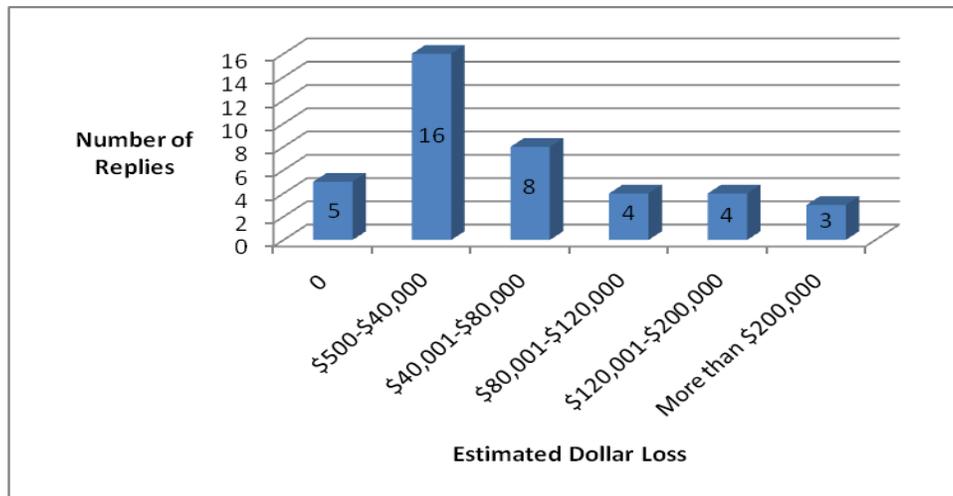


Figure 4-19: Estimated dollar loss resulting from theft incidents in the past three years (N=40)

The average value of tools lost by the respondents within the three year period was \$71,720 which represented the highest value (Figure 4-20). The second was equipment, which had an average value of \$20,357. Construction materials losses amounted to an average value of \$10,056. The average value of licensed vehicles stolen was \$7,500 while computers, fax machines, printers and copiers had an average value of \$4,733.

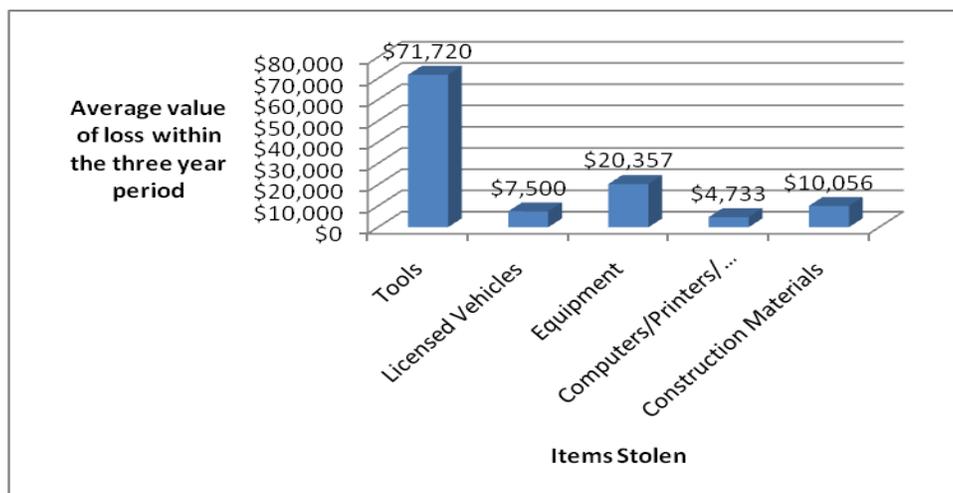


Figure 4-20: Average value of loss suffered by respondents within the three year period

The cost of losses per \$1,000 of work performed was also calculated from the responses provided (Figure 4-21). Twenty-one firms (70%) had losses between \$0.01 and \$1.0 per \$1,000 of work performed. Five firms (17%) had losses of between \$1.1 and \$5.0 per \$1,000 of work performed. Three firms (10%) experienced losses of between \$5.1 and \$25.0 per \$1,000 of work performed. One firm (3%) experienced a loss of \$60.0 per \$1,000 of work performed. The mean was \$3.94 with the median being \$0.32.



Figure 4-21: Cost of theft losses per \$1,000 dollars of work done (N=30)

Forty firms indicated the number of theft incidents reported to the police. Thirteen (33%) of these firms did not report any of their losses to the police. Ten (25%) firms reported one or two theft incidents to the police. Eleven (27%) firms reported between three and five theft incidents to the police while five (13%) firms reported between six and ten theft incidents to the police. One firm (2%) reported all the four hundred theft incidents it had experienced to the police (Figure 4-22).

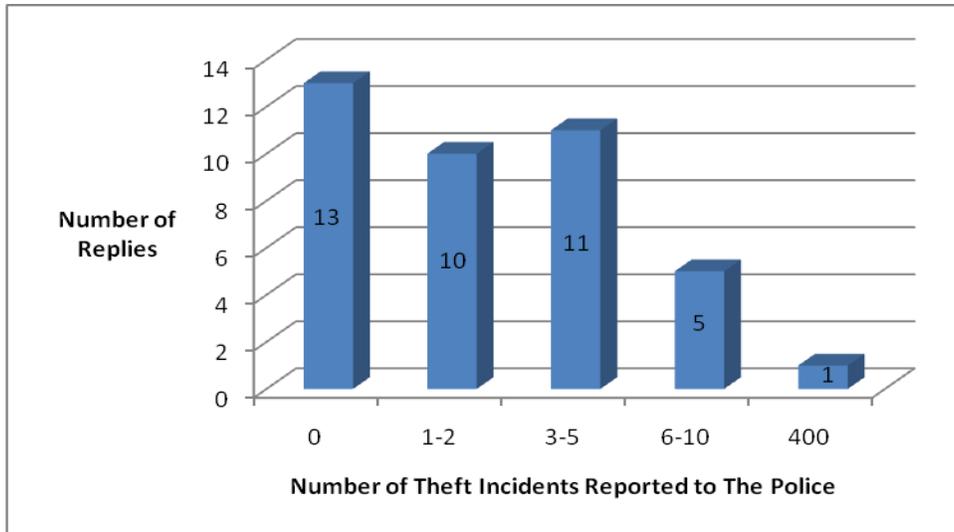


Figure 4-22: Number of theft incidents reported to the police (N=40)

The insurance deductible amount for the responding firms ranged from \$1,000 to \$500,000 (Figure 4-23). Six (43%) firms had an insurance deductible amount between \$1,000 and \$10,000. Three (21%) firms had a deductible amount of between \$20,000 and \$50,000. Two firms had a deductible amount of between \$51,000 and \$200,000 while three (21%) firms had an insurance deductible amount greater than \$200,000. The mean was approximately \$70,318 and the median \$5,000.

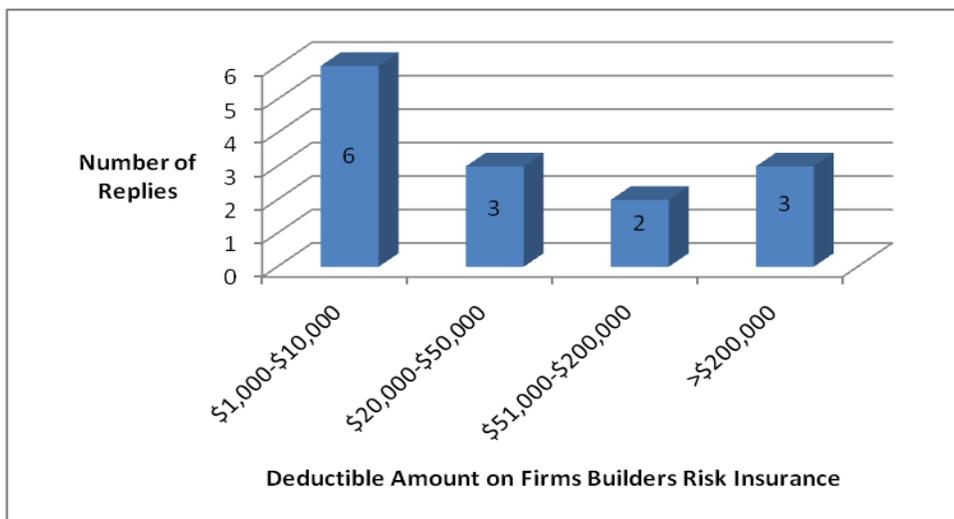


Figure 4-23: Deductible amount on the builders risk insurance policy (N=14)

Most of the items stolen were never recovered. From the thirty-eight respondents to the question, twenty-three (59%) reported that none of their stolen items had been recovered. One firm (3%) firm reported that it had recovered only one percent of the items stolen (Figure 4-24). Six (16%) firms reported that they had recovered five percent of the items stolen. Six (16%) firms again reported that they had recovered ten percent of the items stolen. One firm (3%) firm reported that it had recovered twenty five percent of the items stolen while another firm reported that it had recovered thirty three percent of the items stolen.

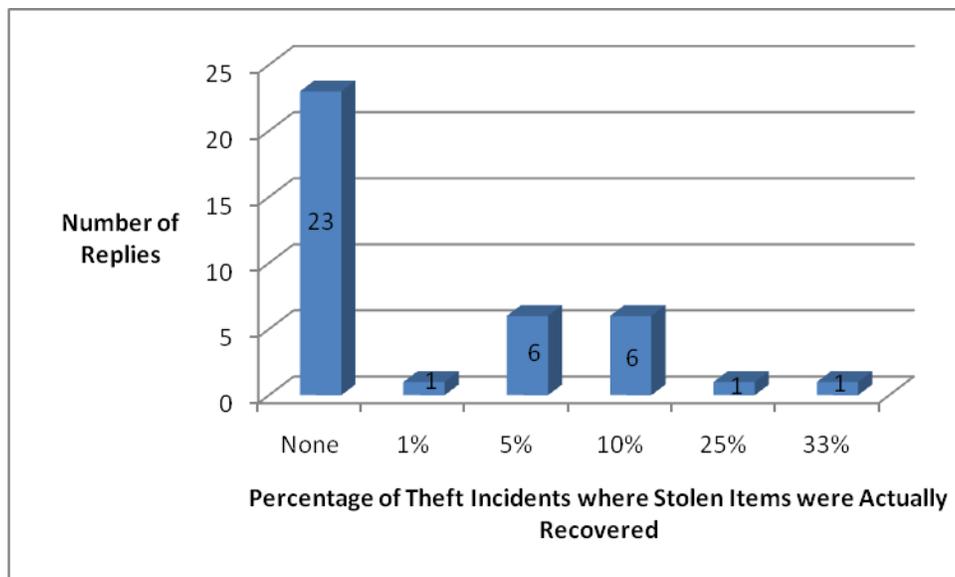


Figure 4-24: Percentage of theft incidents where stolen items were actually recovered (N=38)

The survey asked respondents to speculate on the percentage of thefts carried out by current or former employees. Five (11%) of the forty four respondents thought none of their current or former employees were responsible for the thefts. Six (14%) thought that between 5% and 25% of the thefts they had experienced was carried out by current or former employees, three (7%) thought that between 26% and 50% of thefts they had experienced were carried out by current or former employees and five (11%) thought that between 51% and 75% of thefts they had experienced was carried out by current or former employees. Twenty five (57%) respondents

thought that between 76% and 100% of thefts they had experienced were carried out by current or former employees (Figure 4-25).

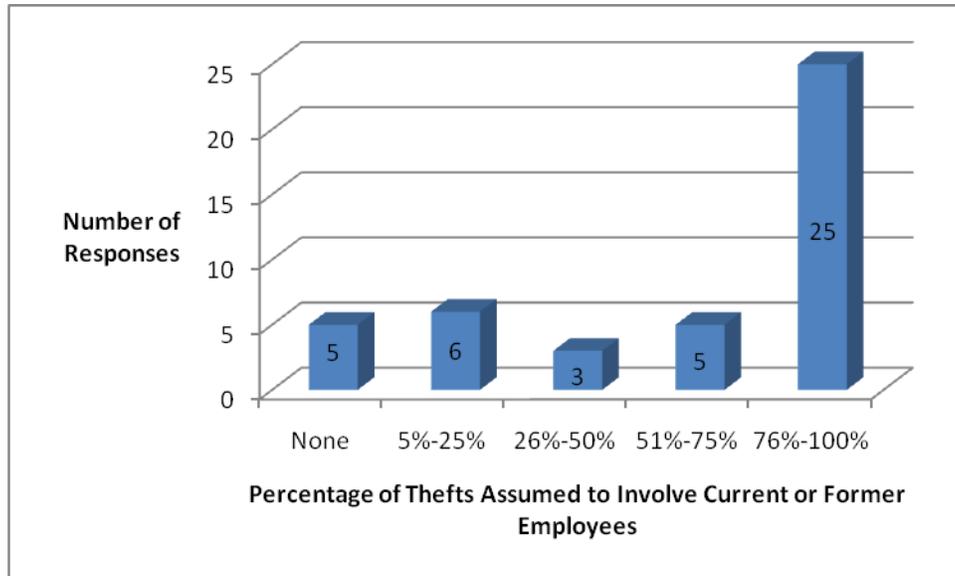


Figure 4-25: Percentage of theft incidents assumed to involve current or former employees (N=44)

The survey had a question on measures used to ensure jobsite security on construction sites. Respondents were given a list of measures available for use by construction firms and asked to check those they employed on their project sites. The results are summarized in Table 4-6.

Table 4-6 Measures commonly used to ensure security on the construction sites (percentages out of sixty-seven responses)

94%	Use of lockbox for tools/small equipment
85%	Gated entrance
76%	Security fencing
75%	Use worker badge system
69%	Guard stationed at entry gate
63%	Use of exterior lighting on the site
61%	Use of night security guard on site
52%	Posting of warning signs
49%	Use of security cameras
40%	Removal of unused equipment from site
40%	Strategic parking of large equipment
18%	Use of an alarm system
13%	Use of police patrols
3%	Neighborhood watch

Some respondents provided information on other techniques they had used to reduce the number of theft incidents on their projects. These responses were:

- Locate tool and equipment storage and issue points centrally, and provide only one way in and out.
- Use of electronic badges, security walk through, and limit drive through access.

As to the specific measures the surveyed firms had employed to prevent theft of tools on their project sites, Table 4-7 provides a percentage breakdown of the answers provided.

Table 4-7 Measures commonly used to prevent the theft of tools on construction sites (percentages out of sixty-two responses)

89%	Marking tools
84%	Maintaining tool inventory
84%	Maintaining a secure storage area
56%	Making workers responsible for tools
50%	Minimizing tools left on site
29%	Workers providing their own tools

Some respondents provided information on other techniques they had used to prevent the theft of tools on their projects. These responses were:

- Using a manned tool room

- Picking up tools at the end of each shift
- Random gate inspection of lunch boxes
- Using a tool tracker with tool person to record tools handed out

A question was asked to determine the measures commonly used to prevent the theft of equipment on construction sites. The responses are shown in Table 4-8.

Table 4-8 Measures commonly used to prevent the theft of equipment on construction sites (percentages out of fifty-seven responses)

68%	Parking equipment inside a fenced area
63%	Parking equipment in a well-lighted area at night
49%	Including additional identification on the equipment
35%	Parking equipment at a central location/specific formation at the end of each day
32%	Securing equipment with chains and locks
28%	Using a distinctive color for equipment
7%	Installing tracking devices on equipment
5%	Modifying ignition or fuel lines to make it difficult for others to start engine

Out of fifty-nine respondents, one (2%) firm had none of its projects with a gated entrance. Two (3%) firms had between one and twenty five percent of their projects with gated entrances. Six firms (10%) had between twenty six and fifty percent of their projects with gated entrances while another six firms (10%) had between fifty one and seventy five percent of their projects with gated entrances. Forty four (75%) firms had between seventy six and a hundred percent of their projects with gated entrances. The results are shown in figure 4-26.

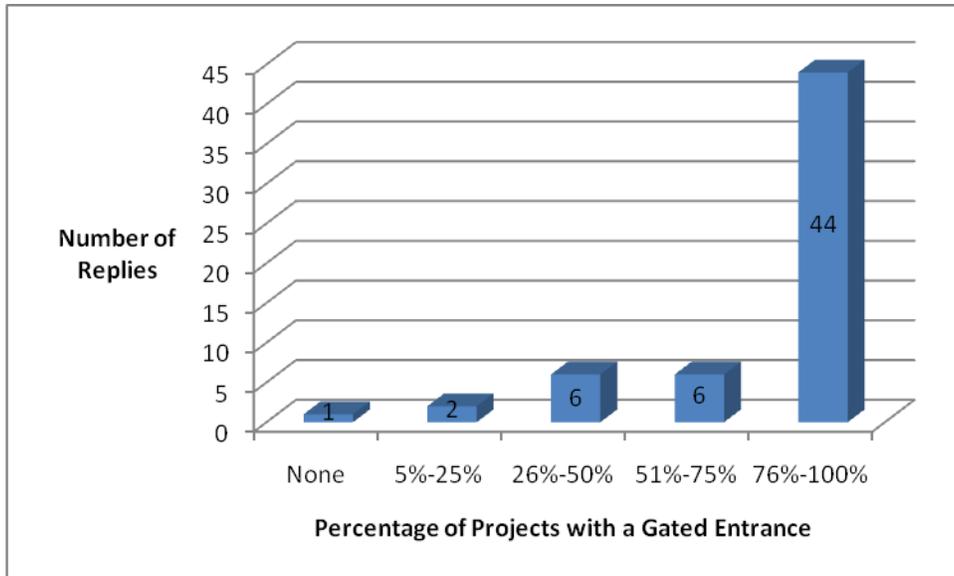


Figure 4-26: Percentage of firms projects with a gated entrance (N=59)

Out of thirty-six respondents, five (14%) firms reported of no theft incident on any of their gated projects. Ten (28%) firms reported of between one and twenty five percent of theft incidents they had experienced on gated projects. Six firms (17%) had experienced between twenty six and fifty percent of their theft incidents on gated projects whiles two firms (5%) had between fifty one and seventy five percent of their theft incidents on gated projects. Thirteen (36%) firms experienced between seventy six and a hundred percent of their theft incidents on projects with gated entrances. The results are shown in Figure 4-27.

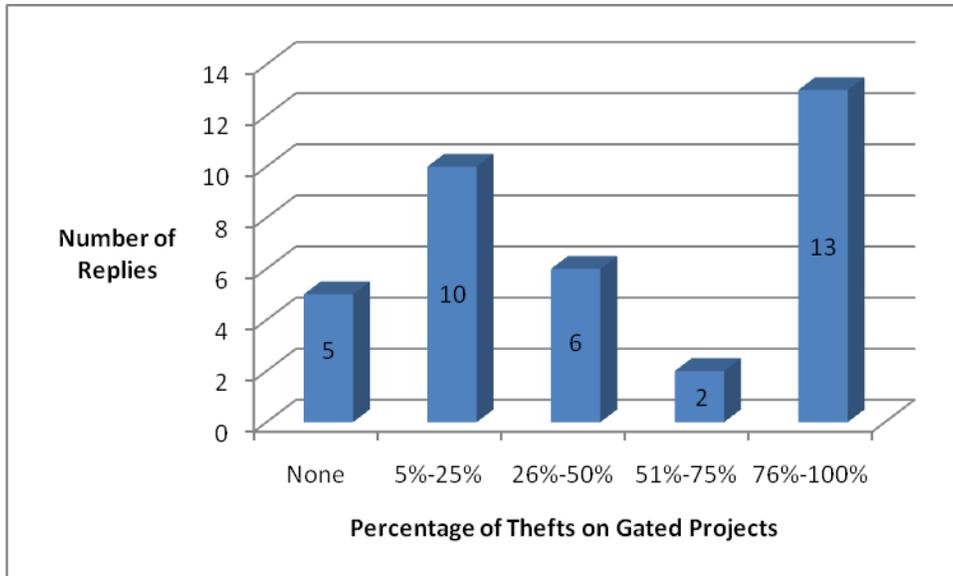


Figure 4-27: Percentage of thefts on gated projects (N=36)

The survey asked respondents to speculate on the percentage of thefts on their gated projects that they presumed had been carried out by subcontractor employees. Five (16%) out of the thirty-one respondents thought none of the theft incidents on their gated projects were carried out by subcontractor employees. Seven (23%) thought that between 5% and 25% of the thefts they had experienced on their gated projects were carried out by subcontractor employees, ten (32%) thought that between 26% and 50% of thefts they had experienced was carried out subcontractor employees and two (6%) thought between 51% and 75% of thefts they had experienced was carried out by subcontractor employees. Seven (23%) respondents thought that between 76% and 100% of thefts they had experienced was carried out by subcontractor employees (Figure 4-28).

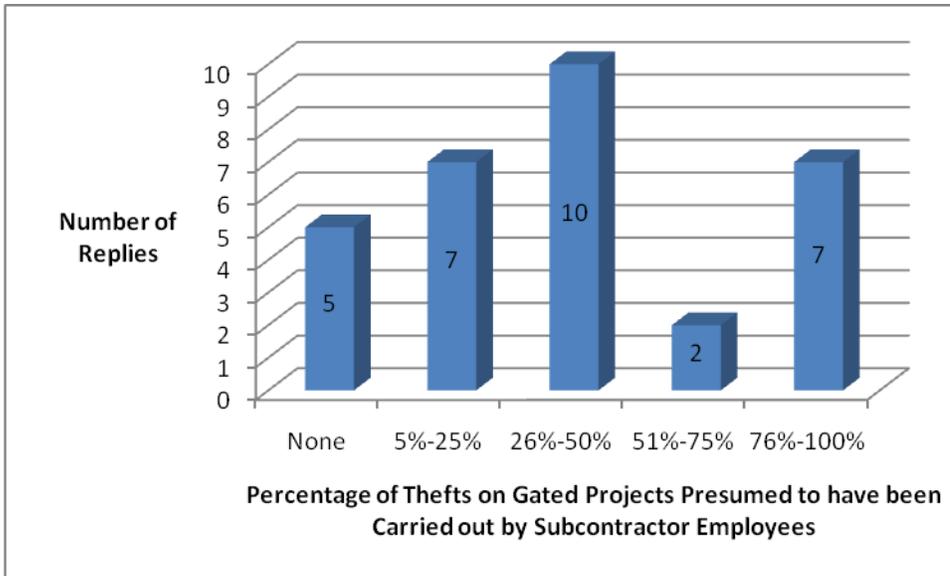


Figure 4-28: Percentage of thefts on gated projects presumed to have been carried out by subcontractor employees (N=31)

Respondents were again asked to speculate on the percentage of thefts on their gated projects that they presumed had been carried out by their own employees. Four (13%) out of the thirty one respondents thought none of the theft incidents on their gated projects were carried out by their own employees. Six (19%) thought that between 5% and 25% of the thefts they had experienced on their gated projects was carried out by their own employees, twelve (39%) thought that between 26% and 50% of thefts they had experienced was carried out by their own employees and one (3%) firm thought that between 51% and 75% of thefts it had experienced was carried out by its own employees. Eight (26%) respondents thought that between 76% and 100% of thefts they had experienced was carried out by their own employees (Figure 4-29).

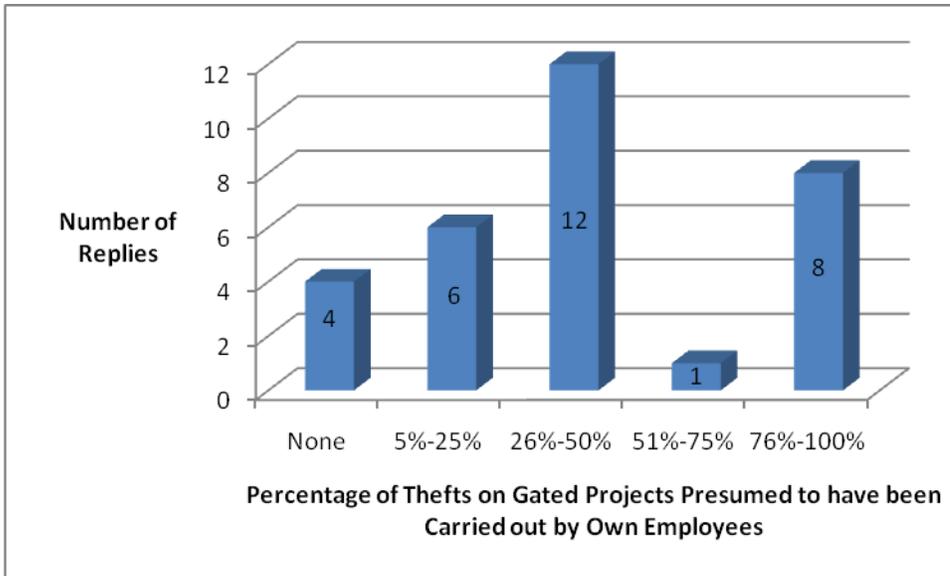


Figure 4-29: Percentage of thefts on gated projects presumed to have been carried out by own employees (N=31)

Vandalism

Fifty-one firms provided information on the number of vandalism incidents they had experienced in the past three years. Fourteen (27%) reported that they had not experienced any incidents of vandalism on their project sites within the past three years. Thirty three (65%) responding firms reported that they had experienced between one and twenty five vandalism incidents. Two (4%) firms reported that they had experienced between twenty six and fifty incidents of vandalism. One firm (2%) experienced hundred incidents of vandalism while another firm experienced one hundred and fifty incidents of vandalism within the last three years (see Figure 4-30).

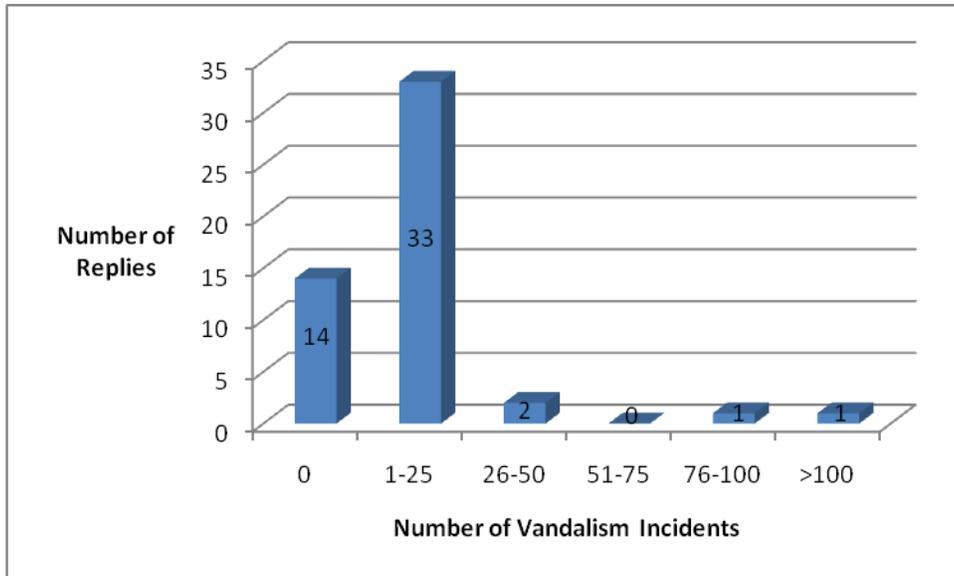


Figure 4-30: Number of vandalism incidents experienced in the past three years. (N=51)

Forty-five firms provided information on the estimated dollar losses resulting from the vandalism incidents they had experienced. Of the forty-five firms, two (4%) firms experienced losses between \$500 and \$1,000. Twelve (27%) firms experienced losses between \$1,001 and \$10,000. Thirteen (29%) firms experienced losses between \$10,001 and \$100,000. Two (4%) firms experienced losses between \$100,001 and \$500,000 while another two (4%) firms experienced losses greater than \$500,000. The mean of the losses was \$600,000 while the median was \$5000 (see Figure 4-31).

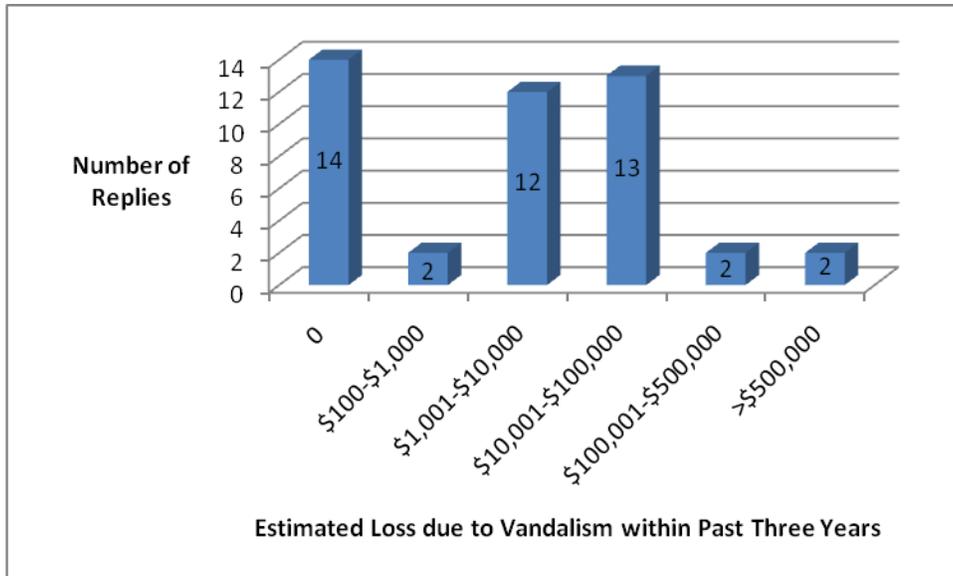


Figure 4-31: Estimated dollar loss due to vandalism experienced in the past three years (N=45)

The cost of the losses experienced as a result of vandalism per \$1,000 dollars of work performed was computed from the data provided. The mean value was \$3.45 and the median \$0.042 per \$1,000 of work performed (see Figure 4-32). Thirty firms (81%) had losses between \$0.01 and \$1.0 per \$1,000 of work performed. Three firms (8%) had losses of between \$1.1 and \$5.0 per \$1,000 of work performed. Two firms (5%) experienced losses of between \$5.1 and \$20.0 per \$1,000 of work performed. Two firms (5%) experienced losses greater than \$20.0 per \$1,000 of work performed.

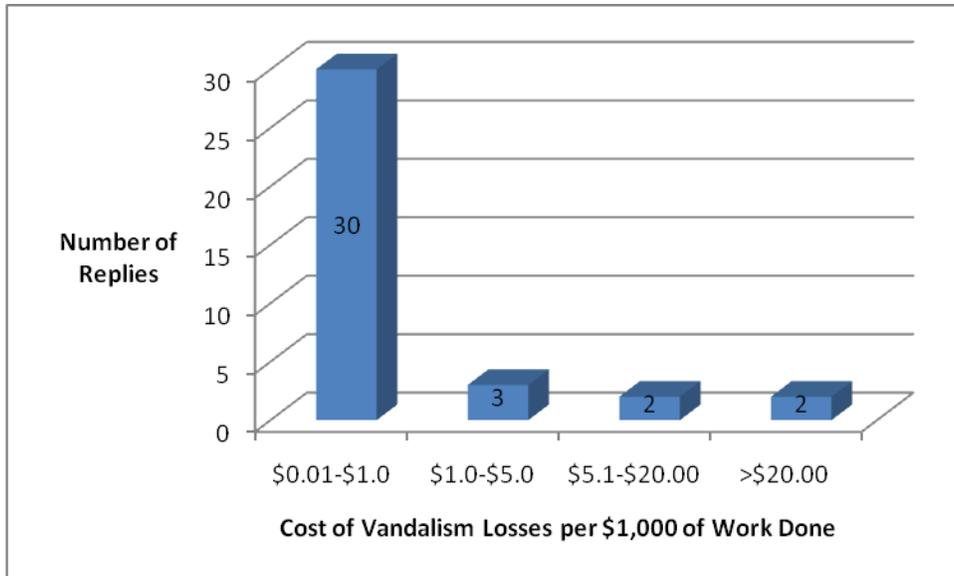


Figure 4-32: Estimated dollar loss per \$1,000 of work performed due to vandalism in the past three years

As to who the respondents thought the vandals were, nine (18%) thought the vandals were persons who had been on the site for some reason, six (12%) thought the vandals were neighborhood kids, eight (16%) thought the vandals were strangers, twenty one (40%) thought the vandals were disgruntled workers, four (8%) thought the vandals were fired workers and three (6%) thought others were responsible for the vandalism they experienced (see Figure 4-33). They however did not give an explanation of who others were.

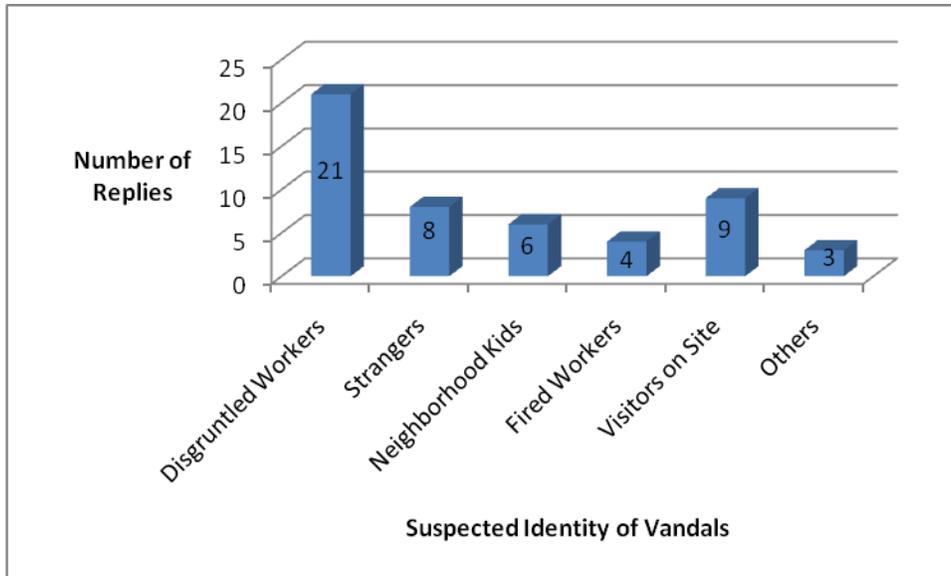


Figure 4-33: Suspected identity of vandals (N=51)

The correlation between the annual volume of work performed and other variables were examined. The number of theft incidents were positively correlated with the annual volume of work performed. The estimated value of computers, photocopiers, printers, etc stolen increased as the annual volume of work performed increased. The number of vandalism incidents experienced also went up as the annual volume of work increased (see Table 4-9).

Table 4-9 Correlation between annual volume of work performed, number of vandalism incidents, value of computers, photocopiers, printers, etc stolen, and whether equipment is secured with chains

	Number of vandalism incidents	Value of computers, copiers, etc, stolen	Securing equipment with chains
Annual volume of work performed	0.345**	0.713**	-0.257*

Pearson correlation

** Correlation is significant at the .01 level (1-tailed)

* Correlation is significant at the .05 level (1-tailed).

The correlation between the insurance deductible amount, the number of vandalism incidents, the estimated cost of theft incidents, and the percentage of thefts assumed to be by the contractors own or former employees were examined. The insurance deductible amount had a positive correlation with the number of vandalism incidents. The estimated cost of theft incidents increased as the insurance deductible amount increased. The percentage of thefts assumed to be by employees or former employees was positively correlated with the insurance deductible amount (see Table 4-10).

Table 4-10 Correlation between insurance deductible amount, value of vehicles stolen, value of equipment stolen, minimum value of theft reported to the police, and whether or not tracking devices are installed on equipment.

	Value of vehicles stolen	Value of equipment stolen	Minimum value of theft reported to the police	Tracking devices installed on equipment
Insurance deductible amount	1.00**	0.864**	0.583**	0.386*

Pearson correlation

** Correlation is significant at the .01 level (1-tailed).

* Correlation is significant at the .05 level (1-tailed).

The correlation between the between the percentage of firms projects with a gated entrance and the identity of the vandals was also examined. The number of vandalism incidents presumed to have been carried out by disgruntled workers and neighborhood kids had a positive correlation with the percentage of the firms' projects with a gated entrance. The number of vandalism incidents presumed to have been carried out by strangers however had a negative correlation with the percentage of the firms' projects with a gated entrance (see Table 4-11).

Table 4-11 Correlation between the percentage of firms projects with a gated entrance and the identity of the vandals.

	Disgruntled workers	Strangers	Neighborhood kids
Percentage of firms projects with a gated entrance	0.366*	-0.425**	0.366*

Pearson correlation

** Correlation is significant at the .01 level (1-tailed).

* Correlation is significant at the .05 level (1-tailed).

The correlation between the between the percentage of firms projects with a gated entrance, the percentage of theft incidents presumed to be by current or former employees, the percentage of thefts on gated projects presumed to be by current and former employees, the use of tracking devices on equipment, and the percentage of thefts on gated projects was examined. The percentage of theft incidents presumed to have been carried out by current or former employees had a positive correlation with the percentage of the firms' projects with a gated entrance. The percentage of theft incidents on gated projects presumed to have been carried out by current or former employees also had a positive correlation with the percentage of the firms' projects with a gated entrance. There was a negative correlation between the installation of tracking devices on equipment and the percentage of the firms' projects with a gated entrance (see Table 4-12).

Table 4-12 Correlation between the percentage of firm’s projects with a gated entrance, the percentage of theft incidents presumed to be by current or former employees, the percentage of thefts on gated projects presumed to be by current and former employees, the use of tracking devices on equipment, and the percentage of thefts on gated projects.

	Percentage of thefts presumed to be by current or former employees	Percentage of thefts on gated projects	Percentage of thefts on gated projects presumed to be by current or former employees	Tracking devices installed on equipment
Percentage of firms projects with a gated entrance	0.509**	0.490**	0.420*	-0.386*

Pearson correlation

** Correlation is significant at the .01 level (1-tailed).

* Correlation is significant at the .05 level (1-tailed).

The correlation between the percentage of thefts on gated projects presumed to be by subcontractors’ employees, type of responding firms, percentage of work that is subcontracted, and the strategic parking of large equipment was examined. There was a positive correlation between the percentage of thefts on gated projects presumed to be by subcontractor employees, type of responding firms and percentage of work that is subcontracted. There was however a negative correlation between the percentages of thefts on gated projects presumed to be by subcontractors’ employees and the strategic parking of equipment (Table 4-13).

Table 4-13 Correlation between the percentage of thefts on gated projects presumed to be by subcontractors employees, type of responding firms, percentage of work that is subcontracted, and the strategic parking of large equipment.

	Type of firm responding	Percentage of work that is typically subcontracted	Strategic parking of equipment
Percentage of thefts on gated projects presumed to be by subcontractor employees	0.422*	0.334*	-0.379*

Pearson correlation

** Correlation is significant at the .01 level (1-tailed).

* Correlation is significant at the .05 level (1-tailed).

CHAPTER 5 CONCLUSIONS AND RECOMENDATIONS

Conclusions

The results obtained in this study show the extent to which theft and vandalism is a problem on construction sites. It is clear from the study that theft is greater a problem than vandalism on roofing construction project sites. The losses suffered by the industrial contractors as a result of theft on their project sites were not substantially different from the losses they suffered as a result of vandalism. The conclusions drawn are based on the responses from thirty five (35) roofing contractors and seventy one (71) industrial contractors. Findings that were found to be unique to each of these groups of contractors shall be treated separately.

The direct losses experienced by the roofing contractors as a result of theft are estimated to be \$1,560 per one million dollars of construction work performed (0.156% of construction put in place). The value of tools lost by the roofing contractors made up about 35% of the total theft losses with the losses due to the theft of construction materials making up about 32%. Removal of unused equipment from construction sites was the most common measure used by the roofing contractors to ensure security on their construction sites. Minimizing the number of tools left on the jobsite was the most common means used by the roofing contractors to prevent tool theft. Parking equipment inside a fenced area was also used by most roofing contractors to prevent equipment theft. The direct losses from vandalism experienced by the roofing contractors are estimated to be \$423 per million dollars of construction work performed (0.0423% of construction put in place).

The number of theft incidents and the estimated costs of those theft incidents experienced by the roofing contractors increased as the annual volume of work performed increased. The

roofing contractors also experienced a higher number of vandalism incidents as their annual volume of work performed increased.

The direct losses from theft experienced by the industrial contractors are estimated to be \$3,940 per one million dollars of construction work performed (0.3940% of construction put in place). The value of tools lost by the industrial contractors made up about 63% of the total losses experienced by them with the loss of construction equipment making up about 18%. The use of lockboxes for tools/small equipment was the most common measure used by the industrial contractors to ensure security on their construction sites. Marking tools was the most common method used by the industrial contractors to prevent tool theft on their project sites. Parking equipment inside a fenced area was also used by most industrial contractors to prevent equipment theft. The direct losses from vandalism experienced by the industrial contractors were estimated to be \$3,450 per million dollars of construction work performed (0.3450% of construction put in place).

Thefts on the gated projects of the industrial contractors were mostly presumed to be perpetuated by their current or former employees. The industrial contractors also experienced a higher number of vandalism incidents as their annual volume of work performed increased. The value of computers, photocopiers, printers, etc stolen increased as the annual volume of work performed by the industrial contractors increased.

Recommendations

Results of this study show that a good jobsite security system will lead to a reduction of the vulnerability of a construction site to theft and vandalism. In undertaking this research, it became obvious that there is a lack of adequate research in the area of theft and vandalism on construction project sites. There was commendable data on construction equipment theft and this

was primarily based on construction equipment theft recoveries or reports by NER and LoJack. Further research will have to be conducted to better understand the problem and to find ways to curb it.

The responses obtained from both surveys give an indication of the extent of theft and vandalism on construction project sites and ways contractors have sought to curb the problem. Further research conducted on a national scale would give a better overall picture of the situation. The results of such a study would lead to greater understanding of the depth of the problem and also help in the formulation of policies to address the problem nationwide. Theft and vandalism could be looked at separately in future research. Theft could again be broken down into equipment theft, tool theft and material theft to provide greater detail of the effects of theft in each of these categories. Another area of research would be to look at the true costs of theft to the construction industry. For example, equipment theft incidents will result in added costs such as that for leasing or purchasing replacement equipment increased insurance premiums, loss of business and reduction in productivity. These true costs could be estimated with greater accuracy.

In order to curtail incidents of theft and vandalism on construction project sites, the concerted effort of a variety of groups will be need. Contractors need to be preemptive when setting out jobsite security plans. Construction activities undertaken onsite sometimes conflict with security requirements onsite. This makes it important to develop a jobsite security plan during the planning stages of a project. Although this might add to the overall cost of a project, the potential savings that could be made as a result of such a plan could be enormous. In coming up with a jobsite security plan, issues such as the location of the project, type of equipment to be used on the project, make and age of equipment, number of subcontractors to be employed on the

project, etc. will all have to be considered. Contacting contractors who had previously worked in the area and getting to know their experiences would also be very helpful. Contractors should not hesitate to change job site security measures to meet security needs during the construction phase of a project. The use of perimeter fencing, secured gates, close circuit television, security guards, lockboxes and careful parking of equipment to block access to easily-moved or high-risk equipment when not in use are all means that can be adopted by contractors to improve security on their projects.

With regards to equipment, the security of small equipment should not be ignored since they can be easily moved. Contractors will also have to keep good records of equipment and should also designate specific individuals to be responsible for equipment use. For example, making equipment to be available to any of the workforce, on the basis of need makes it difficult to have keys held by single users. This need not be the case, however, if working procedures are developed with equipment security in mind. The police can help to curtail the theft of equipment through their comprehensive database and by helping to educate contractors on the awareness of high risk equipment. Insurance companies can also drive change by mandating some security requirements on construction equipment.

APPENDIX A
QUESTIONNAIRE COVER LETTER

To: Potential Study Participants

Subject: Contractor Experiences with Jobsite Theft and Vandalism

Dear Contractor,

We, the M.E. Rinker, Sr. School of Building Construction at the University of Florida, are conducting a study in the United States concerning theft on construction sites. The focus of the study is to examine the past experiences and to understand the practices that are being employed by contractors to address theft and vandalism on construction sites.

The study will be conducted through a survey in which a variety of questions will be asked about your firm's background and your experience with theft and vandalism on construction projects. There are no risks associated with participating in this study and the survey can be completed in about five minutes. A copy of the results summary will be provided to any interested participants. Naturally, you are asked to answer only those questions that you feel comfortable answering.

Your individual responses will be kept strictly confidential to the extent provided by law. Research data will be summarized so that the identity of individual participants will be concealed. No compensation will be provided for your participation. You have our sincere thanks for participating in the valuable study.

Sincerely,

Peter Donkor

Building Construction Graduate Student

Phone: (352) 871-6344

Fax: (352) 392-4537

Email: donpiero@ufl.edu

Dr. Jimmie Hinze

Professor, Director of the Center for Construction Safety and Loss Control

M.E. Rinker, Sr. School of Building Construction

University of Florida

Phone: (352) 273-1167

Fax: (352) 392-4537

Email: hinze@ufl.edu

P.S. For information about participant rights, please contact the University of Florida Institutional Review Board at (352) 392-0433 or Email: IRB2@ufl.edu.

APPENDIX B
JOBSITE SECURITY QUESTIONNAIRE (ROOFING CONTRACTORS)

Information about the size and type of company:

How is the firm is best described?

- General contractor Subcontractor Vendor/supplier

What is the approximate annual dollar volume of work performed by the company? \$

_____.

How does the dollar volume of work performed by the company breakdown by project type?

_____ % Commercial _____ % Residential

_____ % Public buildings

_____ % Other (please describe): _____

How many pieces of rubber-tired or track equipment are used on a typical construction project?

What percent of the work is typically subcontracted? _____ % subbed

What measures are commonly used to ensure security on the construction sites? (Check all that apply)

- | | |
|--|---|
| <input type="checkbox"/> Lockbox for tools/small equipment | <input type="checkbox"/> Strategic parking of large equipment |
| <input type="checkbox"/> Neighborhood watch | <input type="checkbox"/> Alarm system |
| <input type="checkbox"/> Gated entrance | <input type="checkbox"/> Security cameras |
| <input type="checkbox"/> Warning signs posted | <input type="checkbox"/> Remove unused equipment from site |
| <input type="checkbox"/> Security fence | <input type="checkbox"/> Exterior lighting on the site |
| <input type="checkbox"/> Use worker badge system | <input type="checkbox"/> Station a guard at entry gate |
| <input type="checkbox"/> Night security guard on site | <input type="checkbox"/> Police patrols |
| <input type="checkbox"/> Other, describe: _____ | |

Vandalism

The following questions pertain to the company's experience with vandalism:

How many vandalism incidents has the company experienced in the past 3 years? _____

What was the total estimated cost of these vandalism incidents? \$ _____

How many of these vandalism incidents were reported to the police? _____

In how many of these instances of vandalism were the vandals actually caught? _____

How many of the following types of vandalism has the firm experienced in the past 3 years?

_____ Graffiti

_____ Broken glass

_____ Destruction of in-place materials, fixtures, or appliances

_____ Damage to licensed vehicles

_____ Damage to construction equipment

_____ Other: _____

If known, who were the vandals? (Check all that apply)

- | | |
|--|---|
| <input type="checkbox"/> Disgruntled workers | <input type="checkbox"/> Workers who had been fired |
| <input type="checkbox"/> Strangers | <input type="checkbox"/> Persons who had been on the site for some reason |
| <input type="checkbox"/> Neighborhood kids | <input type="checkbox"/> Other: _____ |

What steps, if any, does your firm take to curtail vandalism?

Theft

The following questions pertain to the company's experience with incidents of theft:

Approximately how many theft incidents occurred in the past 3 years? _____

What was the total estimated cost of these thefts: \$ _____

How many of the theft incidents were reported to the police? _____

How many of the following types of theft incidents were experienced in the past 3 years?

____ Tools (hand tools and power tools), Value of Loss = \$ _____

____ Licensed vehicles, Value of Loss = \$ _____

____ Equipment, Value of Loss = \$ _____

____ Computers, printers, copiers, etc., Value of Loss = \$ _____

____ Construction materials, Value of Loss = \$ _____

What has been the value of any copper stolen from your projects in the past 3 years?

\$ _____

If applicable, give an example of a jobsite layout decision that has been used to discourage theft.

What is the minimum value of a theft loss that is reported to the police? \$ _____

What is the deductible amount on the firm's builder's risk insurance policy? \$ _____

What percent of the theft incidents have the stolen items actually been recovered? _____ %

What percent of jobsite thefts on your projects are assumed to involve employees or former employees? _____ %

What measures are commonly used to prevent theft of tools? (✓ all that apply)

Maintain tool inventory

Mark tools

Maintain secure storage area

Make workers responsible for tools

Minimize tools left on site

Workers provide their own tools

Other, describe: _____

What measures does the firm take to prevent theft of machinery and equipment? (✓ all that apply)

Park equipment in well-lighted areas at night

Modify ignition or fuel lines to make it difficult for others to start the engine

Include additional identification on the equipment

Use a distinctive color for the equipment

Park equipment at a central location/specific formation at end of each day

Install tracking devices on equipment.

Secure equipment with chains and locks

Park equipment inside a fenced area

Other, describe: _____

What company projects are of greatest concern in regards to theft?

What has been the most effective way used by company to reduce jobsite theft?

_____.

Optional:

A summary of this research study will be prepared. If you would like to receive a copy of the summary report, please include your name and address below and one will be provided to you as soon as it is available. Note that your firm's identity will not be used in any way other than to get a report to you. Thank you for your participation in this research study..

Name: _____

Firm: _____

Street Address: _____

City: _____ State: _____ Zip: _____

APPENDIX C
 JOBSITE SECURITY QUESTIONNAIRE (INDUSTRIAL CONTRACTORS)

Information about the size and type of company:

How is the firm is best described?

- General contractor Subcontractor Vendor/supplier

What is the approximate annual dollar volume of work performed by the company? \$

_____.

How does the dollar volume of work performed by the company breakdown by project type?

_____ % Commercial _____ % Highway/roadwork

_____ % Utility _____ % Residential

_____ % Industrial _____ % Public buildings

_____ % Other (please describe): _____

How many pieces of rubber-tired or track equipment are used on a typical construction project?

If a general contractor, what percent of the work is typically subcontracted? _____ % subbed

What measures are commonly used to ensure security on the construction sites? (Check all that apply)

- | | |
|--|---|
| <input type="checkbox"/> Lockbox for tools/small equipment | <input type="checkbox"/> Strategic parking of large equipment |
| <input type="checkbox"/> Neighborhood watch | <input type="checkbox"/> Alarm system |
| <input type="checkbox"/> Gated entrance | <input type="checkbox"/> Security cameras |
| <input type="checkbox"/> Warning signs posted | <input type="checkbox"/> Remove unused equipment from site |
| <input type="checkbox"/> Security fence | <input type="checkbox"/> Exterior lighting on the site |
| <input type="checkbox"/> Use worker badge system | <input type="checkbox"/> Station a guard at entry gate |
| <input type="checkbox"/> Night security guard on site | <input type="checkbox"/> Police patrols |
| <input type="checkbox"/> Other, describe: _____ | |

Vandalism

The following questions pertain to the company's experience with vandalism:

How many vandalism incidents has the company experienced in the past 3 years? _____

What was the total estimated cost of these vandalism incidents? \$ _____

How many of these vandalism incidents were reported to the police? _____

In how many of these instances of vandalism were the vandals actually caught? _____

How many of the following types of vandalism has the firm experienced in the past 3 years?

_____ Graffiti

_____ Broken glass

_____ Destruction of in-place materials, fixtures, or appliances

_____ Damage to licensed vehicles

_____ Damage to construction equipment

_____ Other: _____

If known, who were the vandals? (Check all that apply)

- | | |
|--|---|
| <input type="checkbox"/> Disgruntled workers | <input type="checkbox"/> Workers who had been fired |
| <input type="checkbox"/> Strangers | <input type="checkbox"/> Persons who had been on the site for some reason |
| <input type="checkbox"/> Neighborhood kids | <input type="checkbox"/> Other: _____ |

What steps, if any, does your firm take to curtail vandalism?

—

Theft

The following questions pertain to the company's experience with incidents of theft:

Approximately how many theft incidents occurred in the past 3 years? _____

What was the total estimated cost of these thefts: \$ _____

How many of the theft incidents were reported to the police? _____

How many of the following types of theft incidents were experienced in the past 3 years?

____ Tools (hand tools and power tools), Value of Loss = \$ _____

____ Licensed vehicles, Value of Loss = \$ _____

____ Equipment, Value of Loss = \$ _____

____ Computers, printers, copiers, etc., Value of Loss = \$ _____

____ Construction materials, Value of Loss = \$ _____

What has been the value of any copper stolen from your projects in the past 3 years?

\$ _____

If applicable, give an example of a jobsite layout decision that has been used to discourage theft.

What is the minimum value of a theft loss that is reported to the police? \$ _____

What is the deductible amount on the firm's builder's risk insurance policy? \$ _____

What percent of the theft incidents have the stolen items actually been recovered? _____ %

What percent of jobsite thefts on your projects are assumed to involve employees or former employees? _____ %

What measures are commonly used to prevent theft of tools? (✓ all that apply)

- | | |
|---|---|
| <input type="checkbox"/> Maintain tool inventory | <input type="checkbox"/> Mark tools |
| <input type="checkbox"/> Maintain secure storage area | <input type="checkbox"/> Make workers responsible for tools |
| <input type="checkbox"/> Minimize tools left on site | <input type="checkbox"/> Workers provide their own tools |
| <input type="checkbox"/> Other, describe: _____ | |

What measures does the firm take to prevent theft of machinery and equipment? (✓ all that apply)

- Park equipment in well-lighted areas at night
- Modify ignition or fuel lines to make it difficult for others to start the engine
- Include additional identification on the equipment
- Use a distinctive color for the equipment
- Park equipment at a central location/specific formation at end of each day
- Install tracking devices on equipment.
- Secure equipment with chains and locks
- Park equipment inside a fenced area
- Other, describe: _____

Describe the extent that your firm tries to protect the property of the facility owner?

- We protect it as if it was our property We try to protect the owner's property
 We have insurance for the owner's property It is not a concern of our firm

What has been the most effective way used by company to reduce jobsite theft?

Optional:

A summary of this research study will be prepared. If you would like to receive a copy of the summary report, please include your name and address below and one will be provided to you as soon as it is available. Note that your firm's identity will not be used in any way other than to get a report to you. Thank you for your participation in this research study..

Name: _____

Firm: _____

Street Address: _____

City: _____ State: _____ Zip: _____

APPENDIX D
SAMPLE SIZE ESTIMATION TABLE

Confidence level	80%	90%	95%	99%	
Z value	1.28	1.64	1.96	2.59	
Estimate interval (Delta)	0.01	0.01	0.01	0.01	
(p)	(q)	Sample size			
0.5	0.5	4096	6724	9604	16770
0.4	0.6	3932	6455	9220	16099
0.3	0.7	3441	5648	8067	14087
0.2	0.8	2621	4303	6147	10733
0.1	0.9	1475	2421	3457	6037

Confidence level	80%	90%	95%	99%	
Z value	1.28	1.64	1.96	2.59	
Estimate interval (Delta)	0.02	0.02	0.02	0.02	
(p)	(q)	Sample size			
0.5	0.5	1024	1681	2401	4193
0.4	0.6	983	1614	2305	4025
0.3	0.7	860	1412	2017	3522
0.2	0.8	655	1076	1537	2683
0.1	0.9	369	605	864	1509

Confidence level	80%	90%	95%	99%	
Z value	1.28	1.64	1.96	2.59	
Estimate interval (Delta)	0.03	0.03	0.03	0.03	
(p)	(q)	Sample size			
0.5	0.5	455	747	1067	1863
0.4	0.6	437	717	1024	1789
0.3	0.7	382	628	896	1565
0.2	0.8	291	478	683	1193
0.1	0.9	164	269	384	671

Confidence level	80%	90%	95%	99%
Z value	1.28	1.64	1.96	2.59
Estimate interval (Delta)	0.04	0.04	0.04	0.04
(p)	(q)	Sample size		
0.5	0.5	256	420	600
0.4	0.6	246	403	576
0.3	0.7	215	353	504
0.2	0.8	164	269	384
0.1	0.9	92	151	216

Confidence level	80%	90%	95%	99%
Z value	1.28	1.64	1.96	2.59
Estimate interval (Delta)	0.05	0.05	0.05	0.05
(p)	(q)	Sample size		
0.5	0.5	164	269	384
0.4	0.6	157	258	369
0.3	0.7	138	226	323
0.2	0.8	105	172	246
0.1	0.9	59	97	138

Ref: Ostle & Malone (1988) Statistics in Research, Chapter 17.4 & 17.12

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BIOGRAPHICAL SKETCH

Peter Donkor was born and raised in Accra, Ghana. He received his Bachelor of Science degree in building technology at the Kwame Nkrumah University of Science and Technology. Upon receiving his undergraduate degree, Peter worked for a year as a quantity surveyor at the Greater Accra Regional Coordinating Council, Ghana.

After receiving his master's degree in building construction, Peter intends to work in the heavy industrial construction industry.