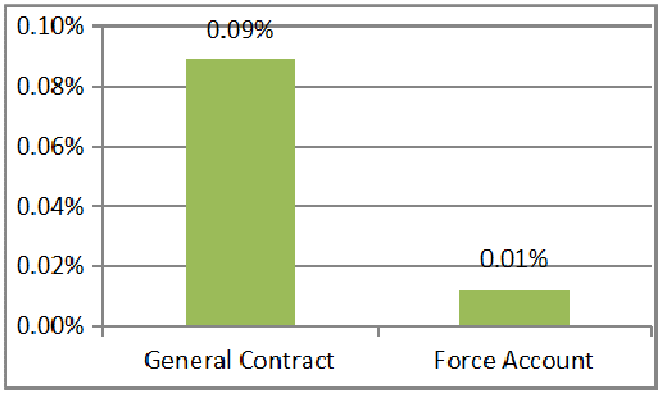

Fig. 11 The average percentage of vandalism losses to the total project cost

Figures 10 and 11 above indicated that vandalism occurred more frequently in the general contract project. Although the percentage of occurrence differs by 20% between the general contract projects and the force account projects, the value of the loss of general contract projects is nine times higher than force account projects.

The result of this research indicates that the force account projects are particularly vulnerable to extortion case, and the general contract projects are vulnerable to theft and vandalism cases. But the force account projects have a higher potential loss from security issues.

Theft, extortion, and vandalism that occurred did not influence the project implementation schedule. Because in general the material theft is limited to construction materials, work equipment, and electrical goods which are small in number and can be found easily on the market. Likewise, extortion only involved the owner of the project or the top level of the management, so that workers can work freely without disturbance.

Project security should be kept in mind as theft and extortion can also occur at the start of the project. Based on this research, the work of the substructure is the most vulnerable stage for the act of theft.

In general, it can be seen that security affects the project cost. The costs incurred to protect against theft, extortion, and vandalism of the project are higher than the cost of protection against these. Contractors rarely include the cost of security in the budget of their bid proposal.

Therefore, by lowering the percentage of security cost against the project overhead cost, the contractors will undoubtedly get a more significant profit. Maximizing the protection system is a critical element in ensuring the security of the project over the whole time of the project.

Similarly, force account projects must implement security management. A force account project is still vulnerable to theft and extortion because of the lack of safety fences and security personnel. The more frequent theft and extortion that occur on force account projects will increase the project cost.

B. Mechanism of protection

Vulnerability to these three security issues is related to the protection employed by the projects. Most of the suspected perpetrators in force account projects are people who work in the project, including the builders. In contrast, perpetrators of theft in contractor controlled projects are less likely to be workers on the project but from outside.

In the case of theft, the most frequently stolen items are construction materials and tools that are easy to carry. Figure 12 shows the types of materials and construction equipment that are the most frequently stolen in force account projects.

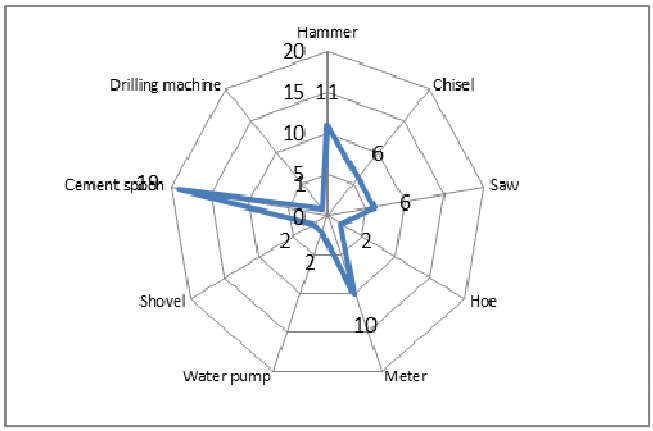

Fig. 12 The construction tools that are frequently stolen in force account project

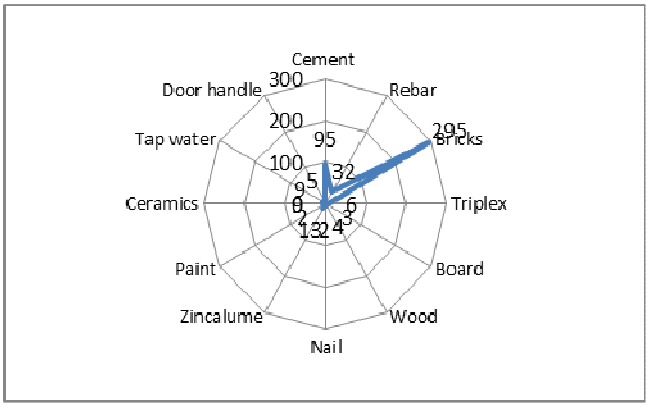

Fig. 13 The construction materials that are frequently stolen in force account project

The type of construction materials stolen on general contract projects is quite similar to the force account project. But the types of construction tools and the number of stolen items are much reduced on the general contract projects. It is noted that contractors only experienced theft on tools such as cement spoon, hammer, and measuring tape.

The reason for the minimum occurrence of theft in contractor managed is that the contractors have better security measures. The contractors have site office and warehouse in the area that minimizes access for the opportunist theft. The contractors also have better logistics management. The amount of stock left on sites should be kept to an absolute minimum. Unattended materials present an opportunity for thieves and vandals.

A countermeasure is developed to mitigate the threat and the resulting vulnerability that was discovered in the assessment. A countermeasure can be one or a combination of the following: intrusion detection systems, security officers, access control, perimeter controls, CCTV, and security lighting [7].

The protection against theft, which is carried out by the contractors, is depicted in Figure 14.

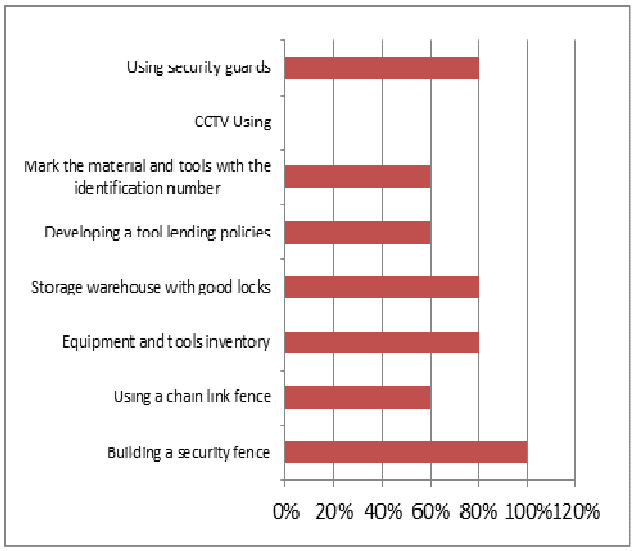

Fig.14 The percentage of a protection mechanism for the theft case

General Contractors used many methods of protection mechanism to maintain security. All of the general contract projects use security fence. To improve security at project sites, general contractors need to use CCTV and security lighting at night. The contractor on the project site does not use these two methods.

Not all of these methods of protection can be applied for the force account projects. Most force account projects are for residential buildings. They do not build security fences around the project sites and do not use the services of security personnel. However, other methods are minimally applied to force account projects in overcoming the act of theft, including off-site.

Assembling of construction materials, for instance, steel reinforcement, also may be used to the construction site, which is not too far from the location of depository [21]. Besides to reduce the cost of transport, using material assembly can increase the safety of the construction site.

Best-practice stock logistics from general contract projects can help force account projects. Just-in-time delivery scheduling could be employed, delivery times could alternate, and there should always be someone trustworthy to accept the delivery. If materials have to be ordered in bulk, these should be stored in a security compound or an area where theft will be noticed quickly.

The frequent occurrence of extortion and the extent of losses incurred on force account projects in Padang City need to be noted. The majority of losses comes from the retribution that is demanded by local youth (gangs) to the project owner. The requirement of employing people from the surrounding communities also happens to the project undertaken by contractors. Also, there are still unreasonable charges for unloading material and bringing heavy equipment out.

Therefore, by strengthening the project site security personnel and improving the relationship with the community and local youth leaders, it is expected that extortion can be minimized. Strengthening and implementing the protection system, as shown in Figure 14 above, will also help avoid vandalism against the project site. Moreover, as incidences of theft, vandalism, and extortion are rarely reported to the police officer, contractors and owners should consider informing police when such events occur.

Automatic identification of construction safety issues using Building Information Models can be used as a proactive method to secure the construction site [22]. The contractors can estimate the cost of project security equipment at the beginning of the project. Although the initial data is not fully available, the contractor can use the Neural method to estimate the security costs of the project [23]. In the future, the contractor can select the most effective security measures within budget constraints and the use of economic indicators as a tool in decision analysis [24, 25].

IV. CONCLUSION

Problems of theft and vandalism are paramount issues related to building sites. In Padang city, extortion also commonly occurs and is a known problem. The literature review revealed that these losses had been identified in previous studies n United State of America and Australia. There has been little research in Indonesia that examines the impact of project costs due to criminal activity at a construction site.

Based on five general contract projects and 34 force account projects, it can be shown that construction projects in Padang city are subject to theft, extortion, and vandalism during their construction process. A good project management form is required so that extortion, which is the most common security problem, does not have a significant impact on the cost and schedule of the project.

If both contractor and force account project owners can prioritize effective communication with stakeholders who are either directly or indirectly involved, then this should lead to fewer instances of theft, extortion, and vandalism. This will include giving information about the project to the community leaders, the local youth leaders, and the residents around the project (neighborhood watch).

Theft, extortion, and vandalism are the risk that should be identified at the beginning of the project. Maximizing the protection system is the key to ensuring the security of the project by running it from the beginning of the project, and continued up to the lower and upper structure.

The lack of initiating to identify the risk of the project will affect to project itself. Some barrier and project constraint is becoming a risk at this point that does not recognize at risk for the entire project without a systematical method [26].

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