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Factors affecting the enforcement of environmental regulation: the case of erosion and sediment control plan

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Abstract. Construction activities significantly increase the amount of sediment loss from sites due to erosion. Hence, governments are implementing environmental regulations, including the Erosion and Sediment Control Plan (ESCP), to reduce the construction industry's impact on the environment. Prior studies suggest that effective enforcement by government bodies is crucial to ensure proper ESCP implementation. Therefore, this study aims to identify the success factors and challenges of enforcing ESCP in practice. To achieve that objective, this study employs a qualitative research technique that compares ESCP guidelines between countries. The significant results include: (a) the challenges are in the aspect of the hierarchy of authorities, lack of information in the guidelines, and enforcement that are lenient; and (b) the success factors include the elements of having detailed information in guidelines, a suitable period is given to all parties, and frequent inspections. These findings can assist researchers and government bodies to develop strategies to enforce ESCP better. The development of better strategies would help improve the success of ESCP implementation. This paper contributes to the body of knowledge in analyzing enforcement strategies in existing guidelines and standards for ESCP.

1. Introduction

Erosion and Sediment Control Plan (ESCP) is a plan that can be used for every construction project to control soil erosion. Soil erosion and sediment will bring a negative impact on construction and community. It can be differentiated into two types of effects, which are on-site impact and off-site impact. Hence, ESCP should be implemented and enforced by authorities to make sure that the soil erosion can be controlled to minimize the impact on construction and community. For the enforcement of ESCP, it is done by the Department of Irrigation and Drainage (DID) and Department of Environment (DoE). Construction players are required to submit ESCP before the construction activities started. It is hard to identify whether the enforcement of ESCP is functioning successfully. However, with some news and tragedies that happened in construction projects due to erosion and sedimentation, it can be said that ESCP did not operate efficiently in Malaysia. After the spot check, the authority found out that at least 85% of contractors do not comply with ESCP. In 2017, 77 construction sites violated ESCP, while in 2019, 55 out of 66 sites did not comply with ESCP. A tragedy happened at a construction site in Bukit Kukus in 2016, which caused nine (9) deaths and four (4) injuries. After the investigation, the authority found out that the contractor failed to fulfill the guideline of ESCP. These results show that there are some problems with the enforcement of ESCP in construction projects.

Research related to the degree of erosion and sediment control meets the required standards and regulations [1]. From 85 construction sites and 147 sediment ponds and traps, 62% of sediment ponds



and traps are installed incorrectly. Another research shows that one-third of the respondents mentioned that enforcement is the biggest challenge in implementing erosion and sediment control [2]. Besides, in another case study, most respondents perceived that environmental laws and policies inadequately implemented due to a lack of enforcement and effective mechanisms to ensure compliance [3]. A study also suggests that stormwater violations by public agencies and lack of permits in Minnesota are caused by a lack of best management practices (BMPs) [4]. Hence, the enforcement of ESCP should be investigated to ensure it is suitable for every party involved. This study aims to identify the factors affecting the enforcement of ESCP in Malaysia. The factors are including challenges and success factors in enforcing ESCP in construction projects. The problems and success reasons affect the enforcement of ESCP, including human factors, environmental issues, and weather conditions. Government authorities can act based on the list, including eliminating the challenges and improving the success factors that already have in the enforcement.

2. Methodology

This research is done by using a qualitative research technique with the document analysis method. Document analysis is one of the qualitative research methods involving the interpretation of meaning from documents. The method reviews documents to give meaning to the recorded words without altering the original context [5]. There are three types of suitable materials and will be used in document analysis, including public records, personal documents, and physical evidence [6]. Qualitative comparative analysis is another method that was used in this research. The qualitative comparative analysis is the method that can be used when the study is related to the phenomenon in the formation of two or more countries [7]. From the analysis, it can compare the similarities and differences between countries. It helps in generate better understanding and awareness by comparing it with different countries. It also helps in explaining some complex and changes in some cases but not others. The number of sample sizes is not defined specifically. However, according to the research done by other researchers, the guidelines from Malaysia with the guidelines from other countries which including Australia, Britain, and the United States of America (USA), are compared [8]. Hence, at least three documents from other countries are needed to consider as sufficient sources. In this research, seven (7) guidelines are collected and compared. The guidelines are: The text of your paper should be formatted as follows:

- Guidelines for Erosion and Sediment Control in Malaysia (2010) - Malaysia
- Erosion and Sediment Control Guidelines for Urban Construction (2006) - Canada
- The Standard for Soil Erosion and Sediment Control in New Jersey (2014) - New Jersey (USA)
- Erosion Prevention and Sediment Control Manual (2011) - Oregon (USA)
- 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control (2011) - Maryland (USA)
- Erosion and Sediment Control Guidelines for Land Disturbing Activities (2010) - New Zealand
- Manual for Erosion and Sediment Control in Georgia (2016) – Georgia (USA)

3. Results and discussion

This research found that there are thirteen (13) factors that will affect the enforcement of ESCP. Table 1 shows the scoring of comparable items between the guidelines of each country. The details will be discussed in the upcoming subsections.

3.1. Inspection report

The inspection report is the report that is used to record the inspection details for site conditions. It is an essential material for every party involved in construction projects. It can provide evidence that soil erosion and sediment control devices are inspected and can be used effectively. The guidelines for erosion and sediment control in Malaysia provide a sample of guidelines that clearly describe the condition of devices required by authorities. The information to be recorded in the inspection check

sheet includes project name, developer name, inspection date, time and weather, inspection type, and construction stage. Meanwhile, in the guideline from Canada, New Jersey, and Oregon, the inspection checklist is not provided in detail. They only offer some examples of questions in guidelines for construction projects, and no checklist is provided. It means that there are no examples of inspection checklist provided in the guidelines, resulting in decision-makers not following the authorities' requirements. The detailed description of the inspection checklist might improve and benefit the enforcement of ESCP in Malaysia. It is because the comprehensive inspection checklist provides more information from authority to construction management. Besides, the inspection checklist can be a reminder for contractors [9]. The contractor can review the critical items to be done in the checklist and recheck it once the work is done. It can be made as a record for reference in the future. It also can be used in some legal actions in the future.

Table 1. Scoring of comparable items

Guideline/ Item	Malaysia	Canada	New Jersey (USA)	Oregon (USA)	Maryland (USA)	New Zealand	Georgia (USA)
Inspection report	√	√	√	√			√
Site inspection period	√	√		√			√
Time for maintenance after inspection	√			√			√
Time for keeping inspection records	√	√					
ESCP checklist	√	√	√	√	√	√	√
Submission time	√	√	√	√	√	√	√
Approval from authority	√	√	√	√	√	√	√
Valid time	√		√				
Wet weather plan requirement	√	√	√	√	√		√
Project size requirement	√	√		√		√	
Number of rules referred	√	√	√	√	√	√	√
Figures and examples of the plan	√	√	√	√	√	√	√
Submission process	√	√	√	√	√		√

3.2. Site inspection period

Site Inspection is an activity that needs to be done when there is a new construction product, activities, and any event that will cause devices damaged. To make the inspection effective, the authority needs to identify a specified period for every construction project. For erosion and sediment control guidelines in Malaysia, the site inspection should be done periodically as a schedule planned by developers or contractors. The inspection should be done after every storm event to ensure that the devices can function efficiently. The site inspection should also be done for the installation and removal of BMPs. This is also to make sure that the devices still can function well after installing and removing.

For guidelines in Canada, there are least accurately describing the period of the site inspection. In the guideline, it is only mentioned that the inspection should be done periodically with schedules. It does not indicate any inspection under a condition, which means the inspection will only be done by

following the schedule. Meanwhile, in Oregon, the guideline shows a different site inspection period with others where the site inspection will be obtained once a week for active sites and once every two weeks for inactive sites. Besides, the inspection also needs to be done within 24 hours after the event of rain. For Georgia, the guideline mentioned that the site inspection should be done periodically with schedules. However, the inspection also can be done randomly to have a spot check for the construction project.

The scheduled inspection will bring benefits to enforcement in construction projects in Malaysia. When the inspection period is scheduled, a specified target needs to be inspected, and it is notified to contractors beforehand. This can lead to contractors, or the person in charge will have plenty of time to prepare [10]. However, a random inspection provides a more “real” result for erosion and sediment control devices because it is an immediate checking for the construction site. The contractors and person in charge might not have enough time to repair and prepare devices for inspection; hence, it will be a usual situation. Some enforcement will benefit Malaysia’s guidelines where the inspection would need to be done after every storm event. It is a safer action for every construction project to check their devices’ condition after the event of a storm.

3.3. Time for maintenance after inspection

There are some maintenances needed for erosion and sediment control devices to ensure that it can function properly to reduce any impact on the environment. The inspection should be done after the maintenance of the devices. Hence, the maintenance time after inspection should be determined and enforced to ensure that the devices can be fixed in a short time and minimize the impact and effect on the environment. For guidelines in Malaysia, the time for maintenance after inspection should be 48 hours after the storm event. It means that within 48 hours after a storm event, the inspection and maintenance need to be done to ensure the requirement from authority can be achieved. The authority might aim to minimize the impact on the environment. Besides, guidelines for Malaysia also mentioned that the maintenance should be done regularly. It is to make sure the devices can maintain in good condition from time to time. In Oregon’s guideline, there are no times mentioned to maintenance after inspection. It is only indicating that the devices need to be fixed immediately after damage. There are no specific times provided for contractors to undergo maintenance. However, the other countries’ guidelines do not mention the maintenance after inspection. Georgia's guidelines in the year 2016 require contractors to execute the maintenance after inspection within 24 hours after a storm event. By comparing the time for maintenance after inspection between Malaysia, Oregon, and Georgia, Georgia has a shorter time for maintenance after inspection than Oregon and Malaysia. The frequency of maintenance is constant for every week. It can be adopted by Malaysia to improve the quality of enforcement. The shorter time for maintenance can minimize any environmental impact, and weekly maintenance can provide a better quality of erosion and sediment control devices.

3.4. Time for keeping records of inspection

The inspection will be done by authority and project management on sites and erosion and sediment control devices. The inspector will record the state of devices and sites in the inspection form as evidence for future legal purposes. According to the Guideline for Erosion and Sediment Control in Malaysia, the period to keep records of inspection should be at least three years by developer or owner. Besides, other relevant documents and records for incidents should also be kept for maintenance and better quality of BMPs. For the guideline in other countries, Canada's only guideline shows that the document for inspection and maintenance should be kept at least one year after the development is completed. By comparing the time to keep records after inspection between Malaysia and other countries, Malaysia provides a specific time, at least three years, and detailed descriptions are given while other countries are not providing it. Compared with Canada, which is at least one year, Malaysia is enforcing a longer time than Canada, which may benefit Malaysia. More prolonged periods for keeping the records will protect the liability of construction. The period for retaining records should be the period of liability for the claim, plus one year [11].

3.5. ESCP checklist

ESCP is a plan that detailed the measures that control the impact of erosion and sediment. Different devices were obtained in ESCP, including sediment basins, sediment traps, and temporary stormwater diversion. Besides, the minimum requirement of ESCP in the checklist will also be necessary for the enforcement.

In Malaysia, the ESCP checklists are described in detail and grouped into categories that include a general requirement, site plans minimum requirement, erosion and sediment control, final erosion and sediment control plans, and minimum requirements. The checklist for ESCP also provided a detailed description of the required part, which helps the management and contractors to follow the checklist. For guidelines in Canada, the checklist of ESCP does not group as Malaysia's guideline, where it only provides a simple description of the items required in ESCP. However, a detailed description of erosion and sediment control required by authority is provided in the appendix part together with pictures and details. Comparing the ESCP checklist condition of Malaysia and other countries shows a benefit and advantages to the success of enforcement of ESCP in Malaysia. With the detailed checklist for construction management, the management shall make things organized to make sure there is no process skipped and forgot [12]. The checklist can be a to-do list for the management to follow up on what they have done and what they have not done. It is a quick and easier review for the management, and it helps to improve productivity. Hence, when there is an ESCP checklist in Malaysia, and other countries do not obtain the checklist in their guideline, Malaysia will have a bigger advantage than the others. For the information in the checklist, it should be in detail to ensure that the contractors clearly understand authority requirements. Hence, Malaysia is having a more detailed checklist when compared with Canada and Oregon.

3.6. Submission time

In Malaysia, the submission of ESCP to local authority should be at least two months or more extended periods or according to the local authority requirement. Malaysia provides more time for the authority to review and evaluate ESCP from the developer and owner to ensure that the plan is suitable and valid to be used. The periods of 2 months' submission times should be counted before the beginning of construction activity. For guidelines in Canada and Georgia show no specific time for the submission of ESCP but mentioned during the construction project's planning phases. For New Jersey, the guideline mentioned that the authority needs 30 days for approval, and the district has the right to have 30 additional days for review. This means the construction project would also need to submit their plan at least 60 days, which is approximately two months before the construction activities begin so that the progress can be continued smoothly. For Oregon, Maryland, and New Zealand, no specific time is shown in the guideline. The submission of the plan should be made for months before the beginning of construction projects. This can increase the period of evaluation for the plan to make sure that it can work efficiently. By comparing guidelines in Malaysia and other countries, Malaysia obtains the most extended and fastest submission period. Besides, Malaysia's guidelines also clearly defined the specific time for submission, while others do not mention submission time. For guidelines in New Jersey, authority remains the right to extend an extra 30 days for the approval period, which shows uncertainty to management. Hence, with a specific time and longest submission time, Malaysia shows a better advantage to others.

3.7. Approval from authorities

The party involved as the authority is the local authority for each area in Malaysia. The permit given by local authorities should be at least 14 days before the construction activities begin. For guidelines in other countries, more parties are involved as the authority—however, no specific time is provided to approve the plan before the construction activities begin. For the authority involved in the approval process, more parties involved will have a better quality of plan because there will be more opinions from different experts in different fields. The subcommittee of Maryland with various parties' members shows good practice in evaluating the plan. It is a cross-functional team collaboration that

helps create better insight for the team [13]. This can be adopted by Malaysia to improve the enforcement of ESCP since more aspects will be taking care of to make sure the plan can be completed.

3.8. ESCP valid time

The guideline for Erosion and Sediment Control in Malaysia states that the valid time for ESCP should be two years from the date of acceptance by authorities. After a valid time, the plan should be re-review and re-acceptance by the authorities, as stated in the guideline. The plan will be a review based on the current condition to ensure the plan is suitable to be used. For guidelines in New Jersey, the plan will be valid for the duration of initial project approval granted. This means that the plan will always be used for the whole project. This can benefit developers and contractors where the plan will no need to be revised and changed anything which will increase their work. For guidelines in other countries, the valid time for the plan is not mentioned in it. It should be stated and enforced for a valid time to ensure that the plan can be updated to fit with the current situation. Hence, by comparing Malaysia's guideline with other countries, Malaysia shows advantages since its guideline states a valid time for plans clearly. In contrast, others do not mention it. When compared with guidelines in New Jersey, the plan will be valid for the duration of projects. In other words, the plan will not be re-reviewed unless some problems occur. With this, Malaysia obtained a valid two-year time for the plan to ensure that the plan is suitable for the construction through the review process. This action is more beneficial to the enforcement of authority to ESCP where the plan must be re-reviewed in a certain time; otherwise, the construction activities cannot be continued.

3.9. Wet weather plan requirement

All seven guidelines do not require wet weather plans, except Oregon. Oregon's wet weather plan provides a checklist to ensure the erosion and sediment control plan can sustain wet weather. To do that, the wet weather plan requires the establishment of native vegetation, temporary vegetation, slope stabilization, and permanent ground cover. In a nutshell, the amount of rain in Malaysia (79 inches/year) is higher than Oregon (43 inches/year) [14]. Therefore, Malaysia should also consider developing a wet weather plan requirement for its erosion and sedimentation control plan. It is always an excellent action to prepare for a backup plan during wet weather, minimizing any environmental impact when problems occurred. It is found that the non-linear effect of high-intensity storms on runoff and erosion processes. Hence, it can be concluded that high intensity and short duration storms lead to higher soil losses [15]. With this, a wet weather plan will be needed to ensure that all devices can function well while minimizing the environmental impact by applying a wet weather plan. This can be adopted by Malaysia so that the enforcement of ESCP can be improved since 79 inches of rains are obtained annually, which is more than Oregon.

3.10. Project size requirement

For guidelines in Malaysia and Canada, the management should submit ESCP when the size of projects greater than 1 hectare. However, in Oregon, all construction projects should submit ESCP, including the project, which less than 1 hectare. This means that all construction will need to install BMPs to ensure that any environmental impact can be minimized. The enforcement in Oregon where all size of construction project needs to submit ESCP should be adopted by Malaysia to improve on the enforcement of ESCP. It helps minimize the impact of erosion and sediment on the environment and prevents any party from violating the rules.

3.11. Number of rules referred

Thirty-two legislations, eight municipal rules, and six guidelines are referred in a guideline from Malaysia to come out with the guidelines of erosion and sediment control. The regulations and legislation are listed out which including Water Act, Land Conservation Act, Sewerage Services Act. The legislation also included the enactment and ordinance in Sabah and Sarawak. Besides, for local

rules, Earthworks By-Laws, Refuse Collection, Removal, and Disposal By-Laws are referred. Urban Stormwater Management Manual for Malaysia first and second edition have been referred to as a guideline.

In Canada's guideline, ten regulations and Acts have been used. Besides, the Federal Fisheries Act and the Canadian Environmental Assessment Act (CEAA) are also being used by Canada's guideline. The guideline only refers to one act in New Jersey: the Soil Erosion and Sediment Control Act. For Oregon, same with New Jersey, only one act is referred to, the Clean Water Act. For Maryland, the Code of Maryland Regulations (COMAR) and State & local regulations are referred by the authority to make guidelines for erosion and sediment control. In New Zealand, the guideline applies to the Resource Management Act (RMA), Regional Water and Land Plan Rules, and Bay of Plenty Regional Air Plan Rules, which is also integrated. Lastly, in Georgia, the guideline does not mention the rules and regulations used, but state and local laws, ordinances, rules, and regulations are used.

More rules and regulations are used can make the completeness of guidelines where all aspects can be considered. Hence, by comparing the number of rules and regulations used in Malaysia and other countries, guidelines in Malaysia referred to 46 legislation, rules, and guideline, which is an advantage in the enforcement of ESCP. It is more than other countries, which included New Jersey, Oregon. It helps to integrate the guideline, and this can be a successful reason for the enforcement.

3.12. Figures and examples of the plan

There are typical drawings for erosion and sediment control facilities in Appendix D of Malaysia's guideline. It described the details of the facilities with the proper and precise figure provided. Besides, brief notes are written in the appendix for every facility. This helps the users to fully understand the details of facilities so that no error will occur when implementing it. For guidelines in other countries, all provided figures and examples of plans in their appendix section. This can be a benefit for the enforcement of ESCP because the authority gives clear information. With the complete figure and example of a plan, the guideline can be completed by providing more information. Users shall follow the figure and example to construct the erosion and sediment facilities. It can be a success factor for Malaysia to enforce ESCP.

3.13. Submission process

There is no clear and specific submission process stated in Malaysia and other countries' guidelines. No detailed description of the submission process in the guideline. However, there is a detailed description of Maryland's submission process to guide users for submitting the plan. The mind map briefly explains the submission process and states the sequence from planning phases to submitting plans. In Georgia, only a simple description of the submission process in the guideline. By comparing the guideline in Malaysia and other countries, the submission process should be included in guidelines and adopted by Malaysia to improve the enforcement of ESCP. The submission process in guideline helps the management have clear information on the submission process and save more time for authority and construction management. It is because the error occurs due to misunderstanding on the submission process can be reduced. This helps the progress of construction activities can proceed as planned.

4. Conclusion

This research contributes to the existing body of knowledge with a list of factors affecting the enforcement of ESCP in construction projects by comparing seven (7) guidelines from different countries. Five (5) challenges and eight (8) success factors have been found from the comparison. The five (5) challenges are:

- Enforcing a longer time for maintenance after inspection and storm events than other countries.
- Fewer parties involved in the hierarchy of authority, which cause fewer experts in the different fields, are included in the evaluation process.

- Lack of Wet Weather Plan requirement in guidelines when Malaysia has more amount of rains annually.
- All sizes of projects should require submitting ESCP.
- No submission process in the guideline for the users.

While the eight (8) success factors are:

- An integrated inspection report with a detailed description to assist guideline users and inspectors.
- The frequent site inspection period for a better quality of BMPs.
- Longer time for keeping inspection records.
- Integrated ESCP Checklist.
- Fast submission time which assists in providing sufficient evaluation time for authority.
- Suitable ESCP valid time for the authority to re-review the plan.
- Refer to a more significant number of rules for completing guidelines.
- Complete and detailed figures and examples of plans are provided in guidelines for users to follow during implementation.

The list of factors affecting the enforcement of ESCP in construction projects can help government authorities integrate guidelines for better enforcement of ESCP. By comparing the guidelines from other countries, better enforcement actions can improve the current enforcement. Besides, it can help to solve the challenges faced by authorities and make improvements in enforcing ESCP.

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